PROJECT PERIODIC REPORT

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Periodic report: **1st X** **2nd ☐** **3rd ☐** **4th ☐**

Period covered: **from 1 September 2015 to 28 February 2017**

Project website address: **http://www.europlanet-2020-ri.eu/**

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Project Summary

1. Background

The Europlanet identity has emerged from collaborations established between European scientists involved in the Cassini-Huygens mission, developing the European Space Agency (ESA) Huygens probe to explore the atmosphere of Titan, Saturn's largest moon, and land on its surface - the farthest ever landing of a man-made machine. This pioneering mission announced Europe's 'coming of age' as an independent space exploration power, subsequently confirmed by ESA's missions to Mars and the highly successful Rosetta mission to rendezvous and land on a comet and to explore the onset and evolution of its activity. ESA is also supporting the implementation of two new European-led space missions. BepiColombo, due to be launched 2018 and JUICE (JUpiter ICy moon Explorer) due for launch in 2022. BepiColombo aims to explore the formation and evolution of Mercury, the smallest of the terrestrial planets. JUICE aims to explore the space environment of the planet Jupiter, particularly the Jovian moon, Ganymede. Many Europlanet scientists are playing prominent investigator roles on BepiColombo and JUICE.

Europe now hosts one of the largest international communities of planetary scientists, with over 800 tenured academics and around 3000-4000 young researchers in more than 200 research groups/institutions, spread across nearly all Europe's national states. Since Europlanet's foundation in 2004, a considerable degree of cohesion and unity of purpose amongst European planetary scientists has been forged through successive Europlanet projects, funded through EU Framework programmes (FPs). The European Planetology Network (EuroPlaNet*),* supported by a 2 million Euro FP6 Coordination Action from 2005 to 2008, allowed the planetary science community to develop networks and launch an annual meeting, the European Planetary Science Congress (EPSC) , which now regularly attracts 800-1000 researchers from both Europe and the rest of the world.

The Europlanet Research Infrastructure (RI), funded by a 6 million Euro grant under FP7 from 2009 to 2012, consolidated this community and established a distributed research infrastructure of laboratory facilities, field sites and virtual access tools. These two projects have led to the establishment in 2013 of a Europlanet Consortium that now includes a membership of 89 research institutions and companies related to planetary science, linked by a Memorandum of Understanding (MoU). The Europlanet Consortium promotes cooperation within the planetary science community, provides a hub for forming consortia for funding bids and acts as the parent body for EPSC, which is now a self-sustaining meeting that attracts leading researchers from the international community.

2. Europlanet 2020 Research Infrastructure

The current **Europlanet 2020 Research Infrastructure (EPN2020-RI)** builds on this strong heritage to provide a pan-European infrastructure for world leading planetary science. EPN2020-RI has a focus on inclusiveness, to build a bigger, stronger and more collaborative European planetary community and engage a wide range of stakeholders (including policy makers, industry, amateur astronomers and the general public) with the achievements, ambition and opportunities of European planetary research. EPN2020-RI is coordinated by the Open University, UK, and has 33 beneficiary institutions from 19 European countries and includes more than 150 participating individuals.

EPN2020-RI is organised around four types of activity: **Transnational Access (TA)** to field sites and laboratories; **Virtual Access (VA)** to diverse planetary datasets and tools; **Joint Research Activities (JRA)** to develop new field sites and facilities; and a set of **Networking Activities (NA)** to expand

Europlanet's networks, both within the planetary science community and with external audiences, in order to promote the services offered by EPN2020-RI and disseminate the project's achievements. EPN2020-RI is structured in 12 work packages (WP), including the management and co-ordination of the EPN2020-RI project (WP1). A series of Boards oversee daily management of the project, and provide democratic discussion, accountability and feedback on EPN2020-RI and its services.

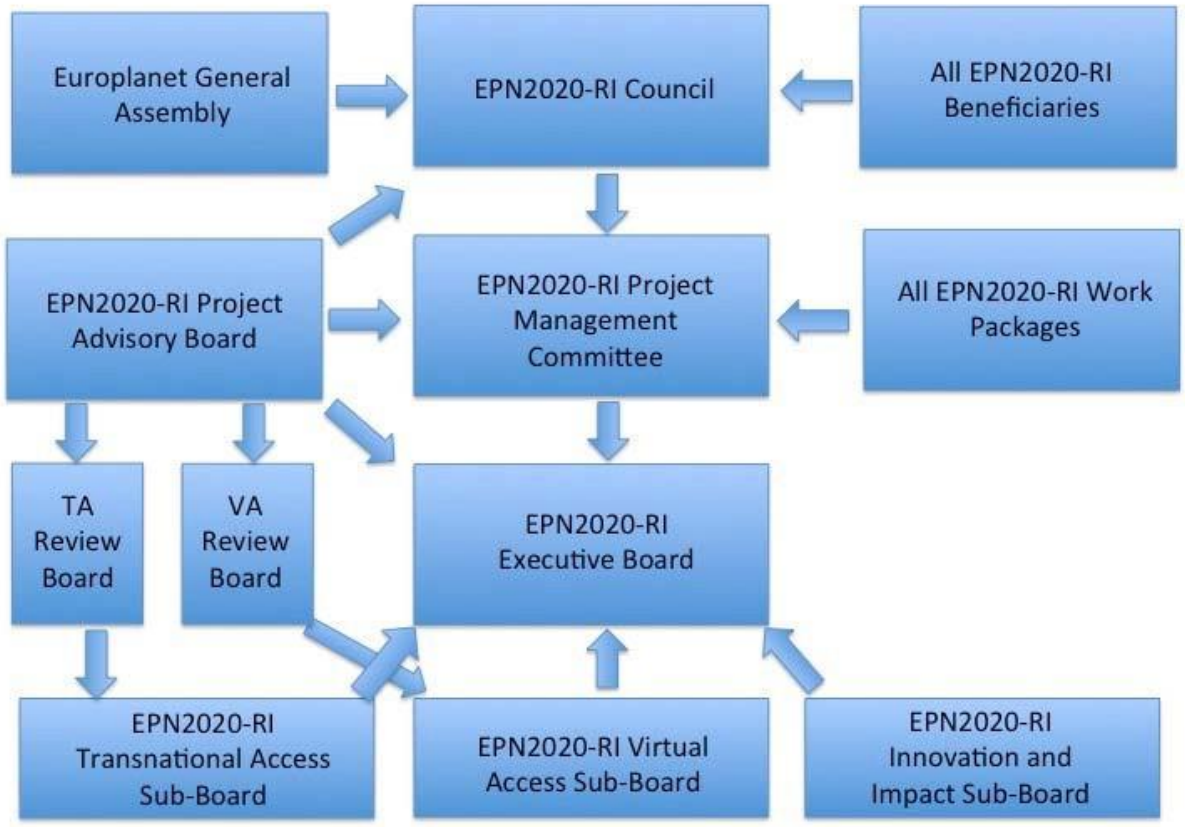

Figure 1 - Management Structure of the Europlanet Research Infrastructure here

The TA programme is central to EPN2020-RI, offering free access to a comprehensive set of laboratory facilities and field sites tailored to the needs of planetary research and with a particular emphasis on analogues for targets for current and planned planetary missions. The TAs support travel and local accommodation costs for researchers to visit a facility for an approved period of time to conduct their own research programme. Calls and independent peer review of applications are managed by the European Science Foundation (ESF). The TA programme is organised in three themes:

- **TA1 (WP2): The Planetary Field Analogues (PFA)** currently offers access to 3 well-characterised terrestrial field sites (Rio Tinto (Spain), Ibn Battuta (Morocco) and Iceland) that provide realistic analogues of surfaces of Mars, Europa and Titan, so that scientists can perform high quality scientific research and test instrumentation for space missions.
- **TA2 (WP3): The Distributed Planetary Simulation Facility (DPSF)** provides access to seven laboratory facilities (Planetary Emissivity Laboratory, Interactive Microbiome Research Facility, Planetary Environment Facilities, Cold Surfaces Spectroscopy, High Pressure/High-Temperature Laboratory, Large Mars Chamber Facility, and Petrology-Mineralogy Characterisation Facility). This suite of laboratories enable the simulation of conditions found in atmospheres and on surfaces of planetary objects; characterisation of the texture and

mineral composition of samples; or detection and characterisation of samples related to astrobiological studies.

- **TA3 (WP4): The Distributed Sample Analysis Facility (DSAF)** provides access to four of the world's leading analytical laboratories for the analysis of meteoritic and sample returns through stable and radiogenic isotopic systems.

The TA programme will be significantly enhanced in the second half of EPN2020-RI through the work carried out by the JRA programme in Years 1 and 2:

- **JRA1 (WP7): Characterisation Lake Tirez and Danakil planetary field analogues.** JRA1 is delivering two new field sites to the PFA: Lake Tirez system in Spain as a Martian analogue and Dallol in the Danakil depression in Ethiopia as an analogue of Venus and the early Earth.
- **JRA2 (WP8): Implementation of New Spectroscopic and Simulator capabilities.** JRA2 is providing upgrades to three of the DPSF facilities: the installation of a new high-speed particle imaging system, a cooling system and a UV solar simulator at the Planetary Environment Facilities in Aarhus; the extension of spectral coverage for high temperature measurements typical of Venus surface temperatures the Planetary Emissivity Laboratory at DLR, and the development of a novel micro spectro-gonio radiometer for small and dark materials at low temperatures at IPAG-CNRS.
- **JRA3 (WP9)**: **Optimal planetary sample handling, investigation and analysis.** JRA3 is developing methodologies for the optimal handling, investigation and analysis of rare or unique samples (e.g. from sample return missions), determining possibilities for characterisation using no preparation, developing novel preparation techniques to lower sample loss, and developing mass spectrometry techniques to optimise isotopic analysis of small samples.

EPN2020-RI also supports two ground breaking **VAs:**

- **VA1 (WP5): Planetary Space Weather Service (PSWS)** provides toolkits for tracking planetary or solar events through the Solar System to assist researchers and industry planning for space missions.
- **VA2 (WP6): Virtual European Solar and Planetary Access (VESPA)** is a virtual observatory for planetary science, offering diverse datasets drawing on the demands and requirements of the community through VESPA Open Calls and visualisation and analysis/modelling tools needed for comparing and understanding planetary environments in the Solar System and beyond.

The VAs are supported by two further, dedicated JRAs:

- **JRA4 (WP10): Planetary Space Weather Service** is reviewing, testing, improving and adapting methods and tools available within EPN2020-RI partner institutes to prototype the planetary space weather services available through VA1-PSWS.
- **JRA 5 (WP11): Virtual European Solar and Planetary Access** is adapting and developing new data visualisation and analysis tools and services for VA2-VESPA, as well as setting up new data services for integration into VESPA and integrating plotting tools (e.g. GIS) into the data-mining capabilities of the VA.

All these TA, VA and JRA programmes are underpinned by two networking activities:

- **NA1 (WP12): Innovation through Science Networking**. NA1 is responsible for dissemination of EPN2020-RI's activities to the science community, as well as organising meetings,

workshops and personnel exchanges to strengthen the community, developing industry-academic collaboration, discussing latest scientific results, and setting the strategy and goals for planetary science in Europe for decades to come.

- **NA2 (WP13): Impact through Outreach and Education.** NA2 engages the international media and Europe's citizens, teachers, students and policy makers with cutting-edge planetary science and exploration, and provides tools, training, funding and best practice workshops to support outreach and education related to planetary science.

3. Impact to date

EPN2020-RI has issued three TA calls to date, attracting 181 applications. As of February 28, 2017 (the end of the reporting period), 31 TA visits have taken place. The research supported by the TA programme has been extraordinarily diverse and has already led to several publications and conference presentations. Examples of TA projects funded by EPN2020-RI include:

- Collection and analysis of oxidized mineral samples from the Rio Tinto Mars analogue site to study how oxidized aerosols could affect the Martian climate.
- A field investigation of a planetary analogue site for studying sinkholes and lava tube collapses.
- Identification and characterisation of Icelandic lava field sites as new analogues of rover field sites on Mars.
- A study of microbial flora in the three modules in which the Mars500 simulation of a 520-day manned flight to Mars took place.
- A study of how volcanic dust is remobilised through wind erosion, with implications both for comparative planetology and for risk assessments on threats to life and infrastructure during and after the course of an explosive volcanic eruption on Earth.
- A comparison of water flows in Martian and terrestrial atmospheric conditions to help understand the role liquid water might play on the surface of Mars in the present day.
- Identification and characterisation of meteorite inclusions that contain samples of the first solids to condense in the protoplanetary disk, giving insights into the role of supernova input influenced the formation of the Solar System.
- Analysis of a core sample from the South-Atlantic to study the change in mineral deposits over time and the implications for changing ocean currents and climate since the last glacial maximum (and potentially for understanding variability of climatic conditions on other planets, e.g. early Mars)
- Analysis of igneous 'pebbles' within the Barwell meteorite that provide evidence to challenge the canonical view that the solar system formed "bottom up" from dust to progressively larger objects until finally the planets formed.

Three further TA calls are planned and EPN2020-RI thus expects to support some 200 research projects involving more than 400 researchers (applicants and hosts). This initiative has thus become a significant resource for the European Planetary Science community and is expected to foster many high quality publications. The Aarhus Planetary Environment Facility (APEF) has already proved particularly attractive, with considerably more applications than anticipated, including several from industry partners. Two TA visits to the APEF have already utilized the new capabilities installed by JRA2.

The first paper from JRA3 has been published (Timmerman et al, 2017) and this was also the subject of an EPN2020-RI press release. Based on the success of the 10^{13} Ohm amplifiers developed for JRA3, the Rare Gas Instruments Group at the VU Amsterdam (not directly part of the EPN2020-RI team) decided to invest in the new technology and are expecting to make major break-throughs in the

precision with which they can determine the age of rock formation on Earth and in samples returned from missions. JRA3 is also demonstrating impact beyond the field of planetary science. A researcher from the School of Archaeology at the University of Oxford has received funding to apply analytical techniques developed through JRA3 to museum artefacts to determine their place of origin. Two studies concerning climate change were published at the end of 2016 that also made use of the newly developed techniques for JRA3.

Logistical arrangements associated with EPN2020-RI TA1 proposals for the Ibn Battuta have led to the development of new facilities at the site – at no cost to the EPN2020-RI project – including two large workshops, a storage room, offices, recreational rooms and a kitchen. The Dallol site characterised through JRA1 has already attracted considerable interest from the science community, as well as significant media coverage, including features in the New York Times and on BBC World Service.

The VA1-PSWS portal (http://planetaryspaceweather-europlanet.irap.omp.eu/) gives access to an initial presentation of PSWS activities and has already attracted more than 5,000 visitors since its launch. PSWS has also built contacts with ESA and other key stakeholders in the Space weather community including other space weather projects funded by H2020 programmes.

Of the 12 services that will ultimately be delivered through VA1-PSWS, four are already operational (1D MagnetoHydrodynamic Solar Wind Prediction Tool, the Propagation Tool, Lunar impacts, Giant planet fireballs) and will be publicly released in June 2017. The Transplanet tool is operational for Earth, Mars, Jupiter and will be extended for Venus and Saturn through ongoing work in JRA4. The prototype of the Meteor showers tool is available for internal testing. Development of the remaining six tools (Cometary tail crossings, Cometary tails, Mars radiation environment, Giant planet magnetodiscs, Jupiter's thermosphere and Alerts) is being progressed through JRA4.

As an example of the services now available, the giant planet fireball detection software tool (http://pvol2.ehu.eus/psws/jovian_impacts/) is helping users to detect visible fireballs in amateur or professional video observations of giant planets. This work has been developed by the Universidad del País Vasco (UPV/EHU) in collaboration with the worldwide amateur astronomer community. VA1-PSWS, supported by an NA1 workshop, has made significant progress in building a network of amateur astronomers who will use the software tool to analyse many thousands of hours of their video observations of Jupiter to identify fireball impacts.

Significant progress has also been made towards VA1-VESPA's goal to increase the accessibility of planetary data. Some 50 data services are expected to be provided by the end of the program and VESPA currently has 32 online tools 21 of which have been developed during the first 18 months of EPN2020-RI (http://www.europlanet-vespa.eu/tools.shtml). These tools will be increased and enhanced throughout EPN2020-RI. A further 10 services are currently being designed or are at test level.

Importantly, ESA has implemented a test of the table access protocols (TAP) within the Planetary Science Archive (PSA). The PSA includes 8 million files from 30 years of planetary science missions in Europe, thus will give very large visibility to the VESPA activity.

In 2016, an application was also made to the NASA "Planetary Data Archiving, Restoration and Tools" (PDS4) programme to implement EPN-TAP on its services. A node defines a theme; there are 5 or 6 and each of them handles different kind of data from space missions. Although this proposal was not funded, interfacing EPN-TAP with PDS4 archives is still an important goal for the coming years. Other collaborations with the Japanese and Indian space agencies, JAXA and ISRO, are being explored and opportunities are being actively promoted in conferences forums e.g. the Chinese Space Agency and

National Astronomy Observatory of China (NAOC) at the Asia Oceania Geosciences Society (AOGS) 2016 conference.

An extensive training programme has been organised by the VESPA Team for users and existing/potential service providers. Concerning the large SSHADE spectroscopy service, six meetings to train and support 10 of the data providers have been hosted to date. In addition, two VESPA tutorials were held at the Joint DPS-EPSC Meeting 2016 in Pasadena, USA and at the European Geosciences Union General Assembly 2017 in Vienna. Annual calls to the community for the inclusion of new services into VA2-VESPA are being issued with the goal of not only increasing the content of the planetary science virtual observatory, but also to support teams in developing tools and services for future inclusion in VESPA. Several publications related to VESPA tools and data services have been prepared and documentation on VESPA standards published. VESPA is also organising a Special issue of Planetary Space Sciences to be published in 2017.

As part of its Inclusiveness programme, EPN2020-RI has made specific efforts to engage with European amateur astronomers, a community that can provide valuable data for planetary research. These skilled enthusiasts now have access to high-quality equipment, and are able to produce standardised data that complement those generated by professional observatories and fill gaps in coverage that inevitably result from the competitive scheduling of large telescopes that cover the whole spectrum of astronomy and cosmology. In addition to the input to the giant planet fireball detection tool in VA1-PSWS, VA2-VESPA is providing a forum for incorporating such data into a portal accessible to the wider research community: the Planetary Virtual Observatory and Laboratory (PVOL) service (http://pvol2.ehu.eus), covering the field of planetary imaging by amateurs, is entirely operational and accepts new submissions; RadioJOVE, covering radio monitoring of Jupiter, is installed and currently includes a limited dataset for test purposes

EPN2020-RI's NA1 activity has hosted or co-hosted 11 scientific and industrial foresight workshops and a further 19 are planned for 2017-19. In September 2016, EPN2020-RI held the first European meeting dedicated to asteroid mining (co-hosted with Luxembourg Ministry of Science and Technology), bringing together academics, industry and government members to explore the technical, commercial and legal challenges to mining of asteroids.

To prepare for expanded efforts to engage with industry, the EPN2020-RI Industry Officer is compiling a matrix detailing SME participation in planetary exploration across the EU Member States, with particular focus on Inclusiveness Countries. At present, 284 companies from 10 countries have been included in the database, with an emphasis on smaller and emerging space nations. Once all 26 countries have been completed, the database can be expected to comprise around 800 companies

A major aspiration of EPN2020-RI is to widen participation in planetary science to researchers in less represented parts of the EU particularly central and Eastern Europe and the Baltic States. In September 2017, EPSC 2017 will take place in Riga, Latvia, with special workshops, activities and exhibition opportunities aimed at researchers from Baltic nations, entrepreneurs and policy makers from the region, as well as events and exhibitions for the general public and schools.

EPN2020 RI's outreach activities have also placed a particular emphasis on Inclusiveness countries: the first best practice and science communication training workshops were held in Athens in July 2016 and were attended by participants from Greece, Lithuania, Romania, Slovakia, Portugal, as well as France, Germany and the UK. The next workshops will be hosted by the University of Vilnius in the summer of 2017, and will be followed up by outreach sessions, meetings and training workshops at EPSC 2017 in Riga.

EPN2020-RI is building a more politically aware community of researchers and has provided a forum for coordinated feedback into consultation processes by policy makers e.g. Framework 9 and the EU Space Strategy. EPN2020-RI has already held one dinner debate and an exhibition in the European Parliament, and has held one-to-one briefings with more than 20 Members of the European Parliament (MEPs) and their representatives. This policy activity has been focused to date on the ITRE Committee and Sky and Space Intergroup, and has led to Europlanet becoming a recognised source of information for MEPs.

The results of EPN2020-RI's activities have been successfully disseminated through the Europlanet Media Centre and the Europlanet social media channels. The Europlanet Media Centre has issued 33 press releases to date, and has also assisted partner institutions to reach a wider audience by translating their press releases into English and by posting on the Europlanet website and to media lists and services reaching 5000+ journalists worldwide. One of the major contributions that Europlanet makes to EPSC is through provision of the conference press office. The significant media attendance at EPSC and media coverage resulting from this press office investment has assisted in raising the profile of EPSC internationally and the impact of the science presented at the meeting e.g. Nature agreed to postpone publication of a paper on Rosetta results to coincide with EPSC 2015, where a press conference was held on the results and press release issued in collaboration with ESA.

Press releases issued through the Europlanet Media Centre have been covered by many of the world's leading and most trusted media outlets around the world, including the BBC, the Associated Press, CNET, National Geographic, Discovery News, Le Monde, Le Figaro, Der Spiegel, Nature, Time, El Mundo, New Scientist, Lietuvos Rytas.

Europlanet 2020 RI has produced two animated videos, already viewed by at least 75,000 people, that aim to engage, inform and educate and entertain young people and members of the public with planetary science. A series of these videos will be complete by Month 30 of the Europlanet 2020 RI project, after which they will be promoted through TV channels and educational networks.

EPN2020-RI has also been active in programmes to inspire the next generation of scientists and engineers. NA2 is identifying and reviewing high-quality collections of educational resources and has already published an EPN2020-RI-branded collection on the IAU astroEDU portal for educators, with three more collections in preparation. Through close collaboration with the Horizon 2020-funded Space Awareness educational project, EPN2020-RI is producing careers information and helped initiate, coordinate and promote a retrospective longitudinal careers survey to find out how background, experiences and choices have led the scientists and engineers working in Europe's planetary science community down their own career paths.

4. Collaborations with other EU projects

Europlanet 2020 RI has developed strong links with several other H2020 projects funded within the H2020 Leadership in Enabling and Industrial Technologies - Space programme from PROTEC and COMPET calls including:

- EURO-CARES - European Curation of Astromaterials Returned from the Exploration of Space
- MIARD - Multi-instrument analysis of Rosetta data – Establishing a new paradigm for cometary activity
- NEOShield-2 - Science and Technology for Near-Earth Object Impact Prevention
- PPOSS - Planetary Protection of Outer Solar System
- PTAL - Planetary Terrestrial Analogues Library

- REGOLITE - Sintering Regolith with Solar Light
- SBNAF - Small Bodies: Near and Far
- UPWARDS - Understanding Planet Mars With Advanced Remote-sensing Datasets and Synergistic Studies

and two education based projects

- EUSPACE-AWE - EU SPACE AWARENESS
- ODYSSEUS II - Youth for Space Challenge

within the Infrastructure programme Europlanet has engaged with ASTERICS - Astronomy ESFRI and Research Infrastructure Cluster which started at same time as Europlanet in 2015 and the Renewed OPTICON - Optical Infrared Coordination Network for Astronomy and RadioNet Advanced Radio Astronomy in Europe Advanced Research Infrastructures launched in January 2017.Europlanet is also developing links with JUMPING JIVE ("Joining up Users for Maximising the Profile, the Innovation and the Necessary Globalisation of JIVE") building on the JIVE -Joint Institute for Very Long Baseline Interferometry consortium.

In 2016 many of these projects collaborated with Europlanet in an exhibition at the European Science Open Forum (ESOF 2016) held in Manchester July 23 to 27, 2016.

5. Future Plans and Sustainability

In order to secure the legacy and exploit the success of pan European collaboration in planetary science engendered by EPN2020-RI, the Europlanet consortium has developed a sustainability plan. This is focused around a 'distributed' management structure where Europlanet offices may be hosted within several institutions across the European Research Area (ERA). Europlanet will continue to represent all nations in the European geographic area and not just those who are full members of the European Union.

The Europlanet Board will review the opportunity for forming a European Research Infrastructure Consortium (ERIC): https://ec.europa.eu/research/infrastructures/pdf/eric_en.pdf. Such a structure would allow Europlanet to become a legal entity with its own PIC number for future FP bids. Europlanet must also seek, through its members, to secure additional funding sources to support its research and related activities. EPN2020-RI Management, WPs, Advisory Boards and the Europlanet consortium have already identified forthcoming H2020 (and related pan-European) calls to which the Europlanet Consortium should apply, with partner funding used to complement and support current Europlanet activities.

Europlanet has established a worldwide reach through its communication channels and an active and effective programme of engagement with policy makers. The ongoing operation and maintenance of these channels beyond the RI project are also core parts of the Europlanet sustainability plan for ensuring that there will be a substantive legacy for future generations involved in planetary science.

6. Conclusion

In the first 18 months of the project, all four EPN2020-RI activities (a Transnational Access (TA) programme; a Virtual Access (VA) programme; Joint Research Activities (JRA) and a set of Networking Activities (NA)) have become fully operational and are now delivering services to the community,

taking advantage at the same time of the strong heritage from previous FPs. Through its TA programmes to field sites and laboratories, EPN2020-RI has directly supported the research of over 140 scientists to date, while its novel Virtual Access facilities have already engaged several thousand online users. Workshops, meetings and conferences under the auspices of EPN2020-RI have engaged more than 3000 researchers, whilst many thousands more members of the public have been engaged through the EPN2020-RI outreach and dissemination programme, and millions worldwide through media coverage of planetary activities related to Europlanet. EPN2020-RI is thus providing the advanced infrastructure that the European planetary sciences community needs to retain its position as a global leader in space exploration.

A summary of progress toward the thirteen Work Packages (WPs) is provided in the following chapters.

1. WP1: Management

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

The Europlanet 2020 Research Infrastructure (EPN2020-RI) is a large and complex project involving 33 beneficiaries plus 22 partners from 17 European Union member states, including six Inclusiveness Member States (IMS) and two associated countries (Iceland and Switzerland). EPN2020-RI consists of a nested set of programmes that provide Transnational Access (TA) to eleven laboratory facilities and five field sites, as well as Virtual Access (VA) to two large-scale services: a pioneering new space weather service for spacecraft traveling beyond Earth's orbit; and the Virtual European Solar and Planetary Access (VESPA) virtual observatory, which comprising the largest set of planetary data and online data tools available today. EPN2020-RI's Joint Research Activities (JRAs) are further developing these facilities by upgrading existing laboratory capabilities, opening two new field sites (Dallol in Ethiopia and Lake Tirez in Spain), and developing new online services and visualisation techniques.

A major objective of EPN2020-RI is to provide a platform for the European planetary science community to meet, discuss and disseminate results, imagine and propose future scientific programmes, and, in general, address technological and organisational challenges facing the community in developing a European planetary science programme. To achieve this, EPN2020-RI has two Networking programmes (NA): NA1, dedicated to developing the scientific programme through conferences and technology foresight workshops; and NA2, dedicated to outreach and dissemination with a range of external stakeholders including students, the general public and policy makers. The annual European Planetary Science Congress (EPSC) is a major focus for EPN2020-RI, providing a venue for management meetings and a platform for dissemination and dialogue with the wider planetary science community.

The success of EPN2020-RI therefore depends crucially on the effective management and integration of all the above diverse elements. The primary objective of WP1 is therefore to provide the necessary management structure and skills to operate EPN2020-RI, ensuring that the project delivers excellence, inclusiveness, interoperability, interactivity, responsiveness, transparency, timeliness, accountability, sustainability and impact. In the project we have 47 female and 112 male participants (including those whose salary and expenses related to the project are partly or fully paid by the received H2020 funding).

1.2 Explanation of the work

EPN2020-RI Boards and Committees

The Management structure is based around a number of different structural bodies, each with well-defined remits and responsibilities; these are defined as 'Executive' with responsibility for the delivery of project deliverables and 'consultative' which are aimed at developing community engagement with the RI. Full details are given in Section 3.2 of the DoA which can be downloaded from the private area of the website.

<u>Executive Boards:</u>

1. The EPN2020-RI Council
2. The Project Management Committee (PMC)
3. The Executive Board (EB)

Consultative Boards:
1. The General Assembly (GA)
2. The Project Advisory Board (PAB)

These Boards are supported by a project management team based at the coordinating institution (The Open University) that comprises the Coordinator; The Project Manager; a financial officer and an Administrative Secretary. The project also has appointed 'thematic officers' including: an Inclusiveness officer; an Impact and Innovation officer; an Industry officer; a Communication officer and a Policy officer.

Detailed description of work

Task 1.1 - Management structure and tools

Executive bodies- members

1. The Europlanet 2020 RI Council is composed of one representative per beneficiary of the consortium, as follows

Table 1 - Members of Europlanet RI 2020 council

Beneficiary	**Name**
#1 OU	Nigel Mason
#2: OBSP	Athena Coustenis
#3: UCL	Nicholas Achilleos
#4: CNRS	Nicolas André
#5: INTA	Felipe Gómez
#6: VUA	Gareth Davies
#7: SO	Mariana Barrosa
#8, OeAW Graz	Günter Kargl
#9, IRSPS	Gian Gabriele Ori
#10: FMI	Ari Matti Harri
#11, DLR	Jorn Helbert
#12, ABER	Manuel Grande
#13, MPS	Norbert Krupp
#14, NHM	Sara Russell
#15, jacobUni	Angelo Pio Rossi
#16, INAF	Maria Teresa Capria
#17, AU	Jon Merrison
#18, Wigner RCP	Karoly Szego
#19, IAP	Ondrej Santolik
#20, MATIS	Viggó Þór Marteinsson
#21, WWU	Thorsten Kleine
#22, ESF	Nicolas Walter
#23, GFI	Daniel Popescu
#25, MUG	Christine Moissl-Eichinger
#26, IASB-BIRA	Ann C Vandaele
#27, LU	Amara Graps
#28, UPV/EUH	Ricardo Hueso
#29, IGS PAS	Joanna Gurgurewicz

#30, VU	Grazina Tautvaisiene
#31, IASA	Ioannis Daglis
#32, U Leiden	Pedro Russo
#33, SRC PAS	Lukasz Tomasik
#34, ISSI*	Michel Blanc

*- Stiftung International Space Science Institute: this is an associate country and does not receive any funding from the project

2. The Europlanet 2020 RI Executive Board (EB) is the 'engine room' of the project, with the following members

Table 2 - Members of Europlanet 2020 RI executive board

Role	**Name**
Coordinator	Nigel Mason
Deputy Coordinator	Athena Coustenis
Project Managers	Barbara Pizzileo; Louise Thomas
Impact and Innovation Officer	Steve Miller until 13/01/17 (now retired, and currently replaced by the communication, industry and policy officers until a new election from the council will be done)
Virtual access officer	Stéphane Erard
Transnational access officer	Gareth Davies

3. Project Management Committee (PMC) is made up of the Executive Board (see above), Thematic Officers (see above), and Leaders (and their deputies) of each Work Package as follows.

Table 3 - Members of Europlanet 2020RI Project Management Committee (*- also member of the Executive Board)

WP	**Main contact (Deputy)**
WP1- MGMT	Nigel Mason* (Athena Coustenis *; Barbara Pizzileo*; Louise Thomas*)
WP2 - TA1	Felipe Gomez (Gian Gabriele Ori)
WP3- TA2	Jörn Helbert (Jonathan Merrison)
WP4- TA3	Gareth Davies* (Albert Galy)
WP5- PSWS	Nicolas André (Manuel Grande)
WP6- VESPA	Stéphane Erard* (Angelo Pio Rossi; Baptiste Cecconi ; Christiane Adam ; Aurélie Kasprzak)
WP7- JRA1	Felipe Gomez (Gian Gabriele Ori)
WP8- JRA2	Jörn Helbert (Jonathan Merrison)
WP9- JRA3	Gareth Davies* (Sara Russell)
WP10- JRA4	Nicolas André (Manuel Grande)
WP11- JRA5	Stéphane Erard* (Maria Teresa Capria)
WP12- NA1	Ari-Matti Harri (Karoly Szego)
WP13- NA2	Mariana Barrosa (Anita Heward)
Key role – TAs Independent evaluators	Nicolas Walter

Key role- Previous Europlanet manager	Christelle Feugeade
Key role - EPSC	Manuel Grande
Key role – Impact officer's delegate	Nick Achilleos

4. Thematic Officers:

    - The Inclusiveness Officer (Karoly Szego) has the duty of reviewing how all aspects of the RI work plan can benefit Inclusiveness Member States (IMS) partners and acts as a spokesperson and liaison with institutions and individuals in these states. IMS states are defined those states joining The EU from 2004 onwards, also known as EU13 (Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia) plus Portugal and Luxembourg.

    - Industry officer- Two people have been appointed to foster the academic –industry contacts and develop the related RI's industry strategy: Helene Boithias (Airbus), who is also a representative of 'Eurospace', Europe's space industry trade association, and Marcell Tessenyi from Blue Skies Space Ltd who was appointed to allow the RI to engage with the ME community. In the original DoA, Thales, together with Airbus, was to be one of the two industry partners with Joel Poncy as delegate. Unfortunately Joel Poncy died unexpectedly before the start of the project. His support during the bidding phase was invaluable and highly appreciated.

    - Communication officer - Anita Heward. EPN2020-RI places great emphasis on dissemination and outreach and ensuring that the RI and the wider planetary science community engage with stakeholder groups. The Communications Officer will oversee and develop effective engagement and dissemination with key audiences, including policy makers, the media, educators, schools and the general public.

    - Policy officer- Europlanet community has consistently engaged with major stakeholders such as ESA, the EC and European Parliament (see NA2 report). This post was held by Veronika Raszler from September 2015 to December 2016 and is now being held by Livia Giacomini INAF-IAPS.

Consultative boards

1. The Europlanet General Assembly (GA) is made up of one representative from each of the institutions that have signed the Europlanet 2020 Memorandum of Understanding (MoU). The current MoU has been signed by 89 Institutions across Europe with a further 45 in the process of signing. The current list can be seen on the Europlanet website.

1. The Project Advisory Board (PAB) has two sub-boards made up of its members - the TA Review Board and the VA Review Board. These provide an independent scrutiny of the TA and VA programmes respectively. The Project Advisory Board has been formed as detailed in Deliverable D1.1, with some changes. The following represents an updated roster of membership:

Table 4 - Members of Europlanet 2020 RI advisory board (*- Member of the full Project Advisory Board)

TAs	Klaus Mezger* (Male/ University of Bern/from Germany but living in CH)	-Head of isotope and Professor for Geochemistry. -University of Bern | Institute of Geological Sciences | Baltzerstrasse 1+3 | CH-3012 Bern |
	Vishnu Reddy* (Male/DPS)	-Former E/PO officer of the Division for Planetary Sciences Committee of the American Astronomical Society. - Lunar and Planetary Lab University of Arizona 1629 E *University* Blvd. Tucson, *AZ* 85721-0092 USA
	Prof David Field* (Male/Aarhus/ Denmark)	-He has a lot of synchrotron experience and refereed for us last time. Now retired he won't have conflict of interest -Department of Physics and Astronomy Ny Munkegade 120 building 1520, 429 8000 Aarhus C, Denmark
	Prof Dr. Wolf Dietrich Geppert * (Male/ University of Stockholm/Sweden)	-He organised field trips to Iceland (also familiar with Big labs DESIREE storage ring) and will be leader in Astrobiology RI. -Department of Molecular Physics Stockholm University Sweden astrobiology;
	Dr Carol. R. Stoker (Female/ NASA Ames Research/ Center /USA)	-FOR TA1 and TA2 - Staff planetary scientist - NASA Ames Research Center; Moffett Field, CA 94035, USA
	Scot C. R. Rafkin (Male/Planetary Atmospheres and Surfaces/ USA)	-TA2. -Assistant Director -Southwest Research Institute Boulder, Colorado, 80302.
	Murthy S Gudipati, (Male/ Jet Propulsion Laboratory/Indian-US)	-TA2. -Principal scientist -Jet Propulsion Laboratory; Pasadena, CA 91109, USA
VESPA	Santa Martinez (Female, ESA / ESAC, Spain)	-Archive scientist at PSA. ESA/ESAC, D/SRE-O -Directorate of Science and Robotic Exploration Science Operations Department

	Joseph Mafi (Male, UCLA, US)	-Archive Production Coordinator with PDS plasma node -Office: 6859 Slichter Hall Address: Los Angeles, CA 90095-1567 http://www.igpp.ucla.edu/people/jmafi.html
	Thomas Stein (Male, WUSTL, US)	-System manager at PDS geoscience node; current chair of IPDA -Washington University Campus Box 1169 1 Brookings Dr Saint Louis MO 63130-4899
	Andrea Nass (Female, DLR / Potsdam)	-Post Doc - Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR) Rutherfordstraße 2 | 12489 Berlin
	Sandrine Guerlet (Female, LMD / Paris)	-Researcher at LMD -Laboratoire de Météorologie Dynamique Université Paris 6, Tour 45-55, 3ème ét. Case Postale 94, Place Jussieu F 75252 Paris Cedex 05
PSWS	Mark Lester * (Male / Univ. Leicester, UK)	-He will help us connecting with ESA/SSA and space weather-related FP7 projects. -University of Leicester University Road Leicester, Leicester LE1 7RH United Kingdom
	Apostolos Christou (Male, Armagh Observatory, Ireland)	-He will helps us connecting with the amateur community -Armagh Observatory, College Hill, Armagh BT61 9DG, Northern Ireland.
	Angelica Sicard-Piet (Female, ONERA, France)	-She will help us connecting with industries / space agencies. -ONERA/DESP, 2 avenue E. Belin 31400 Toulouse France
	Kirsti Kauristie (Female / FMI, Finland).	-She will help us connecting with COSPAR and their space weather roadmap. -Finnish Meteorological Institute, P.O. Box 503 FIN-00101 Helsinki, Finland
NA1	Helmut Rucker * (Male/ Commission for Astronomy /Austria)	Professor emeritus -Austrian Academy of Sciences Schmiedlstraße 6 A-8042 Graz, Austria

	Esa Kallio (Male, Aalto University, Finland)	-Professor -Aalto University School of Electrical Engineering Department of Radio Science and Engineering Street address: Otakaari 5 A, room C110, 02150 ESPOO, FINLAND postal address: Aalto University School of Electrical Engineering PO Box 13000 FI-00076 AALTO, FINLAND
	Prof. Emer. Sandor Szalai (Male/ SGF Technology Associated/ Hungary)	-Director SGF Technology Associated Co. Ltd. -1-5/20 street Pipiske 1121 Budapest
NA2	Brian Trench * (Male, Dublin City University, Ireland)	-Brian Trench is a senior lecturer in the School of Communications. He teaches modules in Science and Media, Science and Society and Research Methods. He is the president of the Public Communication of Science and Technology (PCST) Network. -School of Communications Dublin City University, Glasnevin, Dublin 9
	Britta Thomsen * (Female, Copenhagen Business School, Denmark)	-Britta Thomsen was a Member of the European Parliament (2004-2014) and a member of the EP's Committee on Industry, Research and Energy, the Committee on Women's Rights and Gender Equality, and the Sky and Space Intergroup. Adjunct Professor Copenhagen -Business School Department of IT Management Howitzvej 60, 2000 Frederiksberg Denmark

WP1 meetings

A specific duty of task 1 was to organise the kick-off meeting. The EPN2020-RI kick-off meeting took place on 15/09/15 in Milton Keynes, UK. On this occasion the EPN2020-RI council has formally approved the formation of the Executive Board. Minutes can be found in the private area of the website. Consequent meetings all are reported under task 2 below.

Europlanet RI 2020 Website

A specific deliverable under task 1 was to create and launch the project website. A first version of the project website was launched on September 2014, but after feedback and consultations amongst

consortium and the wider community the website was updated and relaunched as a new enhanced version and design on 15/02/17. The website has a private area where beneficiaries can download all relevant materials (submitted deliverables, including those not for public dissemination, dissemination activity reports, main documents –e.g. DoA, minutes from meetings, minutes from PMC telecons, Newsletters, Templates –e.g. for deliverables, TAs access reports). In order to reduce attempts of hacking, the login fields to access the private area are not immediately visible to everyone. Thus one needs to copy to the browser a specific url. Public Deliverables can be downloaded from the website at the following url. Links to publicly disseminated deliverables have been added throughout this report.

Figure 2 - Screenshot from the website (launched on 15/2/17) - home page

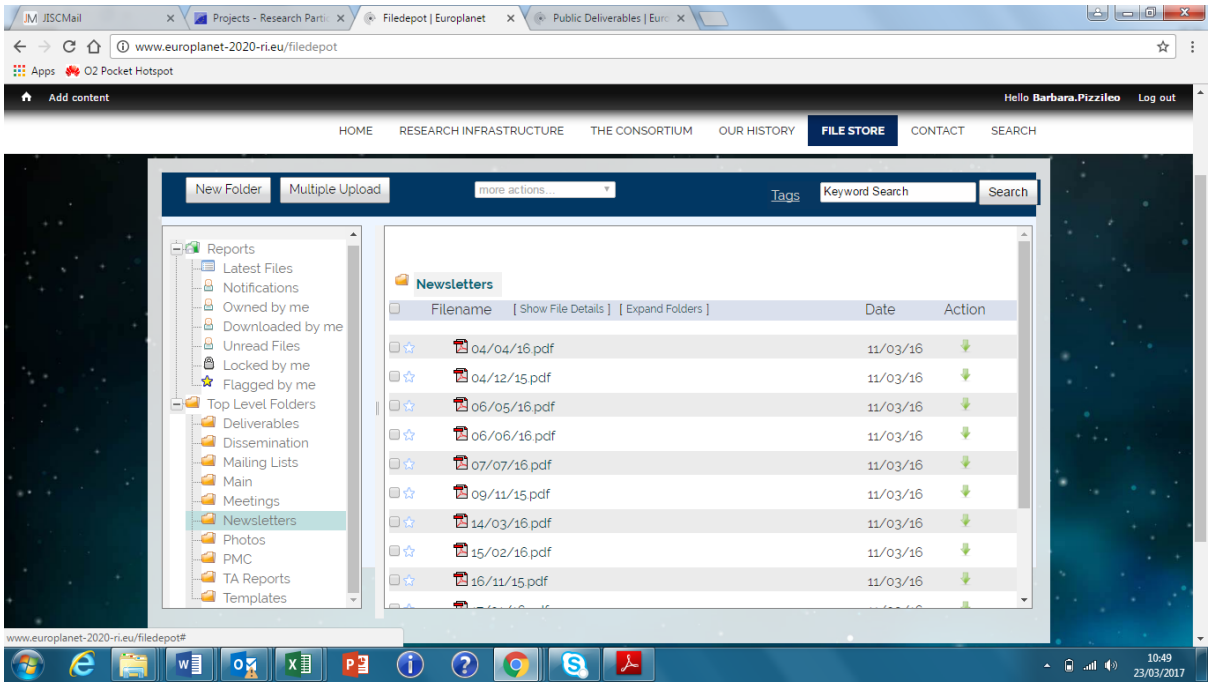

Figure 3 - Screenshot from the website private area

Analytics were extrapolated for the new enhanced website launched on 15/2/17.

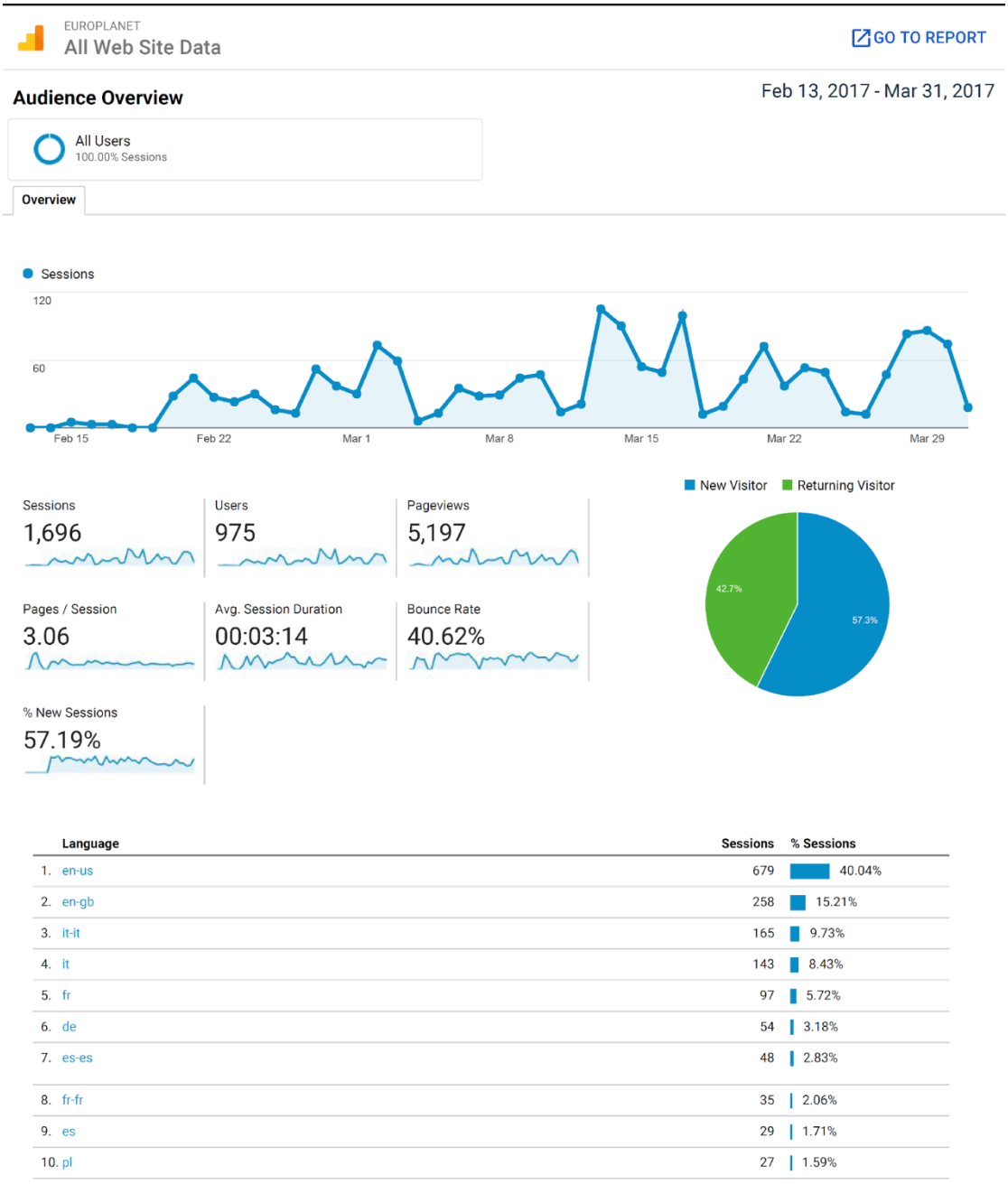

Figure 4 - Screenshot showing the increased viewing figures for the new website since the launch in February 2017

EPN2020-RI members were requested to include an acknowledgment in their websites for the funding received by the EU via EPN2020-RI: “Europlanet 2020 RI has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654208”. Their websites also contain a link to the main website to improve visibility of the project.

Table 5 - Acknowledgments in EPN2020-RI beneficiaries' websites

Beneficiaries	url
#1 OU	http://stem.open.ac.uk/research/eu-funding/europlanet-2020-research-infrastructure-epn2020-ri
#2: OBSP	https://www.obspm.fr/-international-.html
#3: UCL	https://www.ucl.ac.uk/cps/cps-news-publication/europlanet2020
#4: CNRS	http://ipag.obs.ujf-grenoble.fr/hosted-websites/ http://geops.geol.u-psud.fr/spip.php?article511 http://www.crpg.cnrs-nancy.fr/spip.php?rubrique78 http://cdsweb.u-strasbg.fr/
#5: INTA	https://auditore.cab.inta-csic.es/europlanet/
#6: VUA	http://www.falw.vu.nl/en/research/earth-sciences/cluster-geology-and-geochemistry/research/EUROPLANET-2020-RI/index.aspx
#7: SO	http://www.scienceoffice.org/projects/europlanet/
#8, OeAW Graz	http://www.iwf.oeaw.ac.at/en/research/exo-planetary-physics/planetary-surfaces/projects/europlanet-2020-ri/
#9, IRSPS	http://www.irsps.it/
#10: FMI	http://en.ilmatieteenlaitos.fi/earth-observation
#11, DLR	http://www.dlr.de/pf/desktopdefault.aspx/tabid-10866/19013_read-44266/; http://www.dlr.de/pf/desktopdefault.aspx/tabid-10866/19013_read-44267/
#12, ABER	https://www.aber.ac.uk/en/phys/research/solar/
#13, MPS	http://www.mps.mpg.de/planetary-science/europlanet-2020
#14, NHM	http://www.nhm.ac.uk/our-science/our-work/origins-evolution-and-futures/europlanet.html
#15, jacobUni	https://www.jacobs-university.de/directory/arossi
#16, INAF	http://www.inaf.it/it/sedi/sede-centrale-nuova/direzione-scientifica/relazioni-internazionali/epn2020-ri
#17, AU	http://phys.au.dk/en/research/facilities/planetary-environment-facilities/
#18, Wigner RCP	http://wigner.mta.hu/hu/elnyert-palyazatok
#19, IAP	http://www.ufa.cas.cz/vyzkum/projekty.html?lang=en
#20, MATIS	http://www.matis.is/english/projects/nr/4531
#21, WWU	http://www.uni-muenster.de/Planetology/ifp/research/Kosmochemie.html
#22, ESF	http://www.esf.org/our-services/project-management/ec-contracts/europlanet/
#25, MUG	http://www.medunigraz.at/center-for-microbiome-research/ag-moissl-eichinger/projekte/europlanet/
#26, IASB-BIRA	http://planetary.aeronomie.be/en/projects.htm#proj_vespa
#27, LU	www.lu.lv/astr (to be moved to http://www.lu.lv/eng/faculties/fges/)
#28, UPV/EHU	http://www.ajax.ehu.es/research.en.html
#29, IGS PAS	http://www.ing.pan.pl/1Bad3_Granty_E.htm
#30, VU	http://www.tfai.vu.lt/europlanet
#31, IASA	http://www.iasa.gr/activities/Projects.html#EPN2020-RI
#32, U Leiden	https://www.universiteitleiden.nl/en/science/astronomy/pubout
#33, SRC PAS	http://www.cbk.waw.pl/index.php?option=com_content&view=arti

	cle&id=736:europlanet-2020-ri&catid=81:projekty&Itemid=256;
#34, ISSI	http://www.issibern.ch/spotlight.html

EPN2020-RI mailing lists; the project management team has established several mailing lists to facilitate communication. Details are listed below.

Table 6 - Europlanet Mailing lists

Mailing list	**Description**
Europlanet2020PMC@jiscmail.ac.uk	The project management committee
Europlanet2020leaders@jiscmail.ac.uk	WP leaders and deputies
Europlanet2020beneficiaries@jiscmail.ac.uk	Beneficiaries working on the project
Europlanet2020team@jiscmail.ac.uk	Other project members who do not appear in the portal
Europlanet2020ga@jiscmail.ac.uk	General assembly
Europlanet2020news@jiscmail.ac.uk	Bigger list (about 1520 subscribers) including external people to disseminate news and events

The project management team communicates all relevant news to the project consortium via newsletters, which can be downloaded from the private area of the website as described above. Details on the date of submission of the 20 newsletters are listed below

Table 7 - Lists of the Europlanet RI newsletters

Newsletter #	**Date**
1	30/10/15
2	09/11/15
3	16/11/15
4	20/11/15
5	04/12/15
6	18/12/15
7	17/01/16
8	31/01/16
9	15/02/16
10	29/02/16
11	14/03/16
12	04/04/16
13	06/05/16
14	24/05/16
15	06/06/16
16	21/06/16
17	07/07/16
18	11/08/16
19	30/09/16
20	17/12/16
21	31/01/17

Task 1.2 - Regular operations of the management structure

- EB and PMC

On 15/09/15, at the Open University, Milton Keynes (UK) the Executive Board established the Project Management Committee. Minutes are kept in the private area of the website as described above.

The PMC and EB meets every month, mainly via telecon or on the occasion of major events, and all minutes are kept in the private area of the website.

Table 8 - Lists of the management board's meetings (*- relevant for Reporting period 2)

#PMC	**Date, location**
1	26/09/15, Nantes
2	27/11/15, telecon
3	18/12/15
4	26/1/16
5	26/2/16
6	6/4/16
7	6/5/16
8	7/6/16
9	20/7/16
10	8/9/16
11	10/10/16
12	22/11/16 (During the Council mtg)
13	30/1/17
14*	2/3/17
15*	31/3/17

- Europlanet 2020 RI Council

The Council met for the first time on 15/09/15 at the OU in Milton Keynes. The project kicked off on 26/09/15. It met for a second time shortly after, on 27/09/15 in Nantes, on the occasion of the EPSC 2015. It then met on 23/11/16 in Milton Keynes (UK). A fourth meeting has been planned on 3/05/17, Windsor (UK). Minutes of the first three council meetings can be found in the private area of the website

- The Europlanet General Assembly

The first General Assembly of MoU signatories was held at the Europlanet General Assembly during EPSC 2015, on Wednesday 30th September, in Nantes (France). The second one would normally have occurred at EPSC 2016 but in 2016 EPSC was held jointly with the 48th Meeting of the Division for Planetary Science (DPS) in Pasadena USA and travel costs prevented any GA from being quorate. The next GA will thus be held at EPSC 2017 in Riga, Latvia.

- Project Advisory Board

The PAB sub-board for the TAs have not yet met face to face, as until recently only a few of the TA missions were completed. However the next EPSC meeting (Riga, Latvia) will provide a good opportunity for the PAB-TA Board to meet and provide feedback on TA visits held from Calls 1 and 2.

The PAB sub-board for the VAs-VESPA has not met in person but has interacted via email as described in D6.2. Individual discussions with members of the PAB sub-board for the VAs-PSWS took place during

the last ESWW conference. The PAB sub-board for the VAs-PSWS will meet in November 2017 in order to review all operational PSWS services.

The PAB sub-board for the NA1 activities has participated in some progress meetings but never met face to face in a separate location.

The PAB sub-board for the NA2 activities met during the I&I meeting on 07/09/16 in Milton Keynes, UK. Minutes of the first two can be found in the private area of the website

Task 1.3 - Reporting

Annual reports from each WP were submitted as deliverables and can all be found here.
During the Council meeting on 23rd November 2016 particular attention was devoted to an analysis of the spending patterns for each beneficiary and each WP. These discussions have been continued further and on 3rd May 2017 a new Council meeting will be held to decide the financial changes or evolution (here included in Section 2.2) necessary for the most effective implementation of project goals in the latter part of the RI.

A risk assessment has been described in detail under the continuous reporting in the EU portal. In **Table 33** at the end of this document we report only on those risks that have arisen.

Task 1.4 - Call for proposals, evaluation and validation of TA visits

The competitive call management and scientific assessment of research proposals submitted in response to the Transnational Access programme had the following objectives:

- To offer access to well-characterized terrestrial field sites that have been identified as providing the most realistic analogues of surfaces of Mars, Europa, Titan and other bodies to which planetary missions have been sent or are planned;
- To make available laboratory facilities capable of simulating the wide range of environments encountered on planetary bodies;
- To provide a comprehensive capability to determine isotopic and elemental compositions of planetary samples, including analyses at high spatial resolution, high precision and high sensitivity;
- To act as a model of a widely distributed Research Infrastructure;
- To help position Europe at the forefront of planetary science internationally.

In order to contribute to these objectives, the European Science Foundation (ESF) has:

i) Set up an efficient online platform geared towards applicants to Transnational Access, research facilities/analogue site operators and evaluators;
ii) Identified high-level independent international experts to participate in the Peer Review Panel; and
iii) Convened the review panel and reported on the outcome of the assessment.

Two calls have been completed during the first reporting period (and one additional call has been initiated in January 2017).

INFORMATION ON COMPETITIVE CALL PROCESS

Two competitive calls for Transnational Access to facilities and analogue sites were opened in 2016; altogether these calls attracted 103 applications (46 for the first call and 57 for the second), of which 95 were eligible (43 for the first call and 52 for the second).

A third call was opened on 26 January 2017 (closed 30 March 2017). It attracted 78 applications showing a further increase in applications per call.
Table 9 provides a summary of the outputs of the first TA competitive calls.

CALL PROCESS
To coordinate and manage the first two TA calls the following procedure was implemented (a process that is currently also being followed for the third call).

Defining the content of the call text
The call texts were formulated in cooperation between the ESF, the Open University and the TA WPs teams (WP2, 3, 4) These call texts precisely laid down the general conditions of the calls, their objectives, eligibility criteria and timeline. The text of the two first calls were provided in deliverables D1.5 and D1.6. Eligibility criteria, rules for participation, technical feasibility, evaluation and reporting requirements all of which can be found on the project website.

Setting-up and maintaining an online call management platform
All TA applications were submitted online, and ESF set up an online platform intended to be used for all the EPN2020-RI TA calls. This online platform has the following functionalities:

- Proposal Submission: the TA applicants have to submit their application online in two steps:
  - Filling in an online form gathering the following information: project title, TNA applied for, abstract, scientific discipline, keywords, site(s) selected, visit duration, contact details of the applicants, planned number of participants to the visit.
  - Uploading the .pdf detailing their project, following the provided template.

- Technical feasibility check: once submitted, all applications relevant to a given site or facility are forwarded (anonymously) to its identified operator contact. The operator has to validate the technical feasibility of the proposed work. If they consider that the proposal is not feasible, they have to argue the case and this is then validated by the Transnational Access Sub-board, communication with which is managed by the 'corporate' Europlanet Office.

- Online evaluation: Review panel members have access to all applications submitted through the online platform. This platform also provides them access to the assessment forms for their assigned proposals and to all document and information relevant to the call.

Setting up a pool of expert reviewers
Based on the description of the field sites, facilities and laboratories as well as the scope of potential scientific activities to be performed, the ESF identified experts who could potentially serve as reviewers for applications submitted in the frame of the TA calls. This pool of reviewers is to be maintained and complemented for the duration of the project. For reasons of objectivity, no EPN2020-RI beneficiary / active representative (WP or task leader, member of the General Assembly) can be part of this pool of reviewers.

Through the first two calls, a total of 129 potential reviewers were identified and integrated in the pool of expert reviewers.

Reviewers were eventually invited to join the peer review panel based on their scientific background and the content of the applications submitted. The aim was to have a good match between the disciplinary profiles of the panel and the applications. One review panel member was appointed chair of the panel.

Table 9 - First two TA calls outcome

	Call 1	Call 2	Total
Call Open	15 Oct. 2015	15 Mar. 2016	
Call Closed	30 Nov. 2015	29 Apr. 2016	
Total number of applications submitted	46	57	**103**
Total number of eligible applications submitted	43	52	**95**
CALL ELEMENTS AND SITE			
TA1: Planetary Field Analogues (PFA)	**9**	**9**	**18**
Ibn Battuta Centre	5	4	**9**
The glacial and volcanically active areas of Iceland	3	3	**6**
Rio Tinto Field Site	1	2	**3**
TA2: The Distributed Planetary Simulation Facility (DPSF)	**20**	**25**	**45**
Planetary Environment Facilities at Aarhus University	10	2	**12**
Petrology-Mineralogy Characterisation Facility (PMCF), Mineral and Planetary Sciences Division, Natural History Museum, London, UK.	2	7	**9**
Centre for microbial life detection at Medical University Graz, Austria	4	4	**8**
Planetary Emissivity Laboratory	2	5	**7**
Open University Mars Chamber	2	3	**5**
Cold Surfaces spectroscopy, Institut de Planétologie et Astrophysique de Grenoble (IPAG)		3	**3**
High-pressure laboratory at VUA		1	**1**
TA3: Distributed Sample Analysis Facility (DSAF)	**14**	**18**	**32**
Radiogenic, non-traditional stable & rare gas isotopes. Le Centre de Recherches Pétrographiques et Géochimiques (CRPG), Nancy, France	4	11	**15**
NanoSIMS 50L Secondary Ion Mass Spectrometer - The Open University	5	4	**9**
Radiogenic & non-traditional stable isotopes: Institute for Planetology (IfP); University of Münster, Münster, Germany	2	1	**3**
Radiogenic and non-traditional stable isotope facility: Geology and geochemistry, Faculty of Earth and Life Sciences, VU University, Amsterdam, NL	2	1	**3**
Stable Isotope Analytical Facilities - The Open University	1	1	**2**

GEOGRAPHICAL DISTRIBUTION (LEAD INVESTIGATORS)			
Italy	11	11	**22**
Germany	9	7	**16**
UK	6	7	**13**
France	5	5	**10**
US	3	6	**9**
Spain	2	3	**5**
NL	2	1	**3**
Greece		3	**3**
Hungary	1	1	**2**
Ireland		2	**2**
Belgium	2		**2**
Switzerland	1	1	**2**
Denmark	1		**1**
Australia		1	**1**
Bolivia		1	**1**
Poland		1	**1**
Portugal		1	**1**
Sweden		1	**1**

Scientific assessment and review panel meetings

Two rapporteurs (one lead and one secondary) were assigned to each application; these rapporteurs had the task of providing a set of marks (and comments) for each of the evaluation criteria as follows:

- ***Criterion 1 -*** Innovative nature of the proposal (originality of the research proposed and/or of the methodology to be applied)
- ***Criterion 2 -*** Science and Technology excellence (Soundness of concept, and quality of objectives)
- ***Criterion 3 -*** Implementation (quality, effectiveness and feasibility of the methodology and associated work, relevance of the facility/site, strategy for utilisation and publication of the new data)
- ***Criterion 4 -*** Scientific impact (how do the objectives and expected results contribute to advancing the state of the art; relevance for European and/or international planetary scientific community and/or past or future missions)

Each criterion is rated on a 0 to 5 scale with an equal weight (total maximum score 20). The table below provides a guideline illustrating the value and meaning of individual marks.

Table 10 - Evaluation Criteria scoring guidelines

Numeric score	**Corresponding wording**	**Definition**
5	Excellent	The application successfully addresses all relevant aspects of the criterion in question. Any shortcomings are minor.
4	Very good	The application addresses the criterion very well, although certain improvements are still

		possible.
3	Good	The application addresses the criterion well, although improvements would be necessary.
2	Fair	While the application broadly addresses the criterion, there are significant weaknesses.
1	Poor	The criterion is addressed in an inadequate manner, or there are serious inherent weaknesses.
0	-	The application fails to address the criterion under examination or cannot be judged due to missing or incomplete information.

Once both rapporteurs have provided their preliminary assessment, these reports become available to all panel members. They are requested to read them before the panel meetings.

Review panel meetings were held via web conferencing platform (WebEx) and the ESF staff provided the secretariat to the panel.

The panel meetings were structured as follows:

- each TA call was discussed separately (TA1, TA2, TA3)
- for each application the lead rapporteur presented the project and his/her assessment
- the secondary rapporteur presented his/her assessment
- the panel discussed the application and agreed on a set of marks
- once all the applications of a given TA call were discussed, the panel reviewed the outcome of the evaluation (the ranked list) for a final coherency/consistency check.

The panel prepared a short statement for each project, with specific recommendations for proposals that were considered to not have met the funding criteria. For example, areas where the proposal was not well explained in terms of scientific aims; lacked detail on the nature of the samples; had unclear rationale for the choice of methodology etc. These comments were forwarded to the applicant. The comments were often accompanied with a recommendation that they contact the TA host facility for advice on a practical solution to any technical shortcomings or for help with clarifying the goals of the proposal.

First call review panel meeting (24 and 27 June 2016)

For the first call, nine experts joined the review panel. Three from the US, two from France, one each from Germany, Italy, Morocco and Canada. The panel comprised seven men and two women.

All reviewers provided their pre-assessments by 22 January 2016.

Second call review panel meeting (8 and 15 February 2016)

For the second call, ten experts joined the review panel. Five from the US, one each from Czech Republic, Italy, Morocco, the Netherlands, United Kingdom. The panel comprised eight men and two women.

All panel members except one provided their assessments (one mark per criterion and comments) by 22 June 2016, these were made available to the panel members before the meetings. The missing assessments were provided and made available before the second meeting on 27 June 2016.

The number of applications for the first TA call was lower than expected. Informal contacts were undertaken within the e-mail forums and on a one-to-one basis to understand why applications did not occur after initial expressions of interest. The feedback given was that although the application process was relatively simple and only required short scientific proposals, preparation time was long. Some potential applicants stated that ~6 months was required to ensure the viability of the proposed research and the practical implementation. This is because relatively short periods of time are funded for a TA visit. The community was also taken a little by surprise at the speed of initiation of EPN2020-RI. The community was expecting lengthy delays between confirmation of project funding and project implementation. The decision was therefore made to build on the momentum and publicity of Call 1 and launch Call 2 seven months early. This strategy proved a success with a total of 95 of 105 applications eligible.

Review of the overall TA process includes a satisfaction survey conducted by ESF. This on-going procedure is designed to provide advice on how to optimise the practical aspect of TA visits. The survey includes questions on the actual TA-supported visit (e.g. length, previous collaboration with the site, feedback on technical facility and laboratory environment) and on the experiments performed and their results (e.g. data collected, unforeseen results, publication plan). The preliminary survey results -out of 19 answers- are gratifyingly positive as 11 respondents qualified the visit 'excellent' and 6 'very good'. This preliminary feedback validates that EPN2020-RI has learned from previous experience and organises efficient TA visits. The scientific support in the interpretation of results obtained during the TA visits was pointed out as particularly appreciated by TA users. To date only 31 TA visits have been completed and ESF is actively soliciting feedback before providing detailed feed-back to the Transnational Access Sub-board (continuous, from Month 24).

A third call opened during RP1 and closed in RP2 (30th March 2017). A graph showing the received applications for the three calls has here been included in Figure 4. Numbers on the applications from the last call have been added to this report to highlight the positive trend.

Table 11 - Number of applications from the first TA calls

Call #	Total number of applications	Number of eligible applications
1	46	43
2	57	52
3	78	75

Table 12 - Access to TAs facilities

Participation number	Organization short name	Infrastructure short name	Installation number	Installation short name	Unit of access	Minimum quantity of access	Access claimed in RP1	Access provided/granted in calls 1 and 2 (unit of access)	Applications received in call 3
6*	VUA	DAFS TA3	1	GGIF	day	180	15	40	4
25	MUG	DPSF TA2	2	IMRF BioLab	day	150	28	40	7
21	WWU	DAFS TA3	7	RNTSI	day	140	20	30	3
14*	NHM	DPSF TA2	7	PMCF	day	110	25	65	3
11	DLR	DPSF TA2	1	PEL	day	110	25	60	10
6*	VUA	DPSF TA2	5	HPHT	day	80	0	0	0
4	CNRS	DPSF TA2	4	CSS	day	90***	20	40	6
1*	OU	DAFS TA3	4	HS50L	day	80	16	41	2
4*	CNRS	DAFS TA3	3	SRIF	day	70	7	72	6
1*	OU	DPSF TA2	6	LMC	day	120	70	110	4
1	OU	DAFS TA3	6	CSSIA	day	50	0	0	1
4	CNRS	DAFS TA3	2	HNIF	day	40	0	0	0
1	OU	DAFS TA3	5	LFS	day	32	0	0	0
5	INTA	PFA TA1	1	Rio Tinto	week	32	1	4	0

4	CNRS	DAFS TA3	8	IPF	day	60	31	31	0
17*	AU	DPSF TA2	3	PEF	day	75	35	60	7
20	MATIS OHF	PFA TA1	3	Iceland	week	16	1	3	7
4***	UJF	DPSF TA2	4 (8)	CSS - 3rd party	day	13	0	0	0
9	IRSPS	PFA TA1	2	Ibn Battuta	week	16	6	15	7
5	INTA	PFA TA1	4	Tirez Lake	week	8	Not open		3
9	IRSPS	PFA TA1	5	Danakil	week	8	Not open		8

*- These facilities will be subject to JRA updates so we can expect more access in RP2

**- not open for access in RP1

***- An update has been requested in the next amendment to allocate these 13 units of access to facility 4 CNRS DPSF TA2, which therefore has 90 unit of access rather than 77 (UJF is only providing staffing support, not access).

Task 1.5 - Sustainability

The first sustainability report has been submitted as a deliverable: D1.13 - First Sustainability report. Although further reports will be delivered in the next reporting periods, an update to the above is provided below.

The Europlanet Consortium. The Europlanet Consortium has been established to act as a forum (and voice) for the European planetary science community, independent of nations, government and funding agencies. It is a counter part of ESA and other space councils, being a 'bottom-up' organisation whose objective is to support and represent planetary space sciences in Europe. Europlanet will engage in strategic fora and provide input to and commentary on Space initiatives in Europe (and, when invited, in collaboration with non-EU partners beyond). Thus Europlanet has engaged in discussion of the recent EC Space Strategy, the space programme of H2020 and will feed into discussions of role and content of space in the forthcoming FP9 programme. Europlanet predominantly provides a pan-European perspective and does not aim to engage in national dialogues except when it is appropriate to be invited to do so.

The Europlanet Consortium will be organised through a 'Consortium Board' composed of members drawn from the Institutions that have signed the MoU. Chaired by Prof N J Mason with Prof Athena Coustenis as Deputy (roles they also hold in Europlanet-2020-RI), the Board will be responsible for the long-term sustainability of Europlanet. The board shall comply with Europlanet's aim to be fully inclusive with a balanced gender membership and representatives from 'Inclusiveness' countries as well as academia and industry. The Board can also co-opt representatives from other European space policy units (e.g. European Space Sciences Committee of ESF and Eurospace, representing Europe's space industry). The Board will meet as required but not less than twice a year; and the Board is expected to meet face to face at the Europlanet annual scientific meeting (EPSC).

Future Structures. Europlanet is Developing 'distributed' management structure where its 'offices' may be hosted within several institutions across the European Research Area (ERA). Europlanet will represent all nations in the European geographic area and not just those full members of the European Union.

Currently the HQ and operational office of Europlanet Consortium and EPN2020-RI is located at The Open University, in Milton Keynes in the UK. This will continue to be the main HQ until at least September 2019. However, as part of this sustainability plan we aim to establish an office(s) in another European state(s). Ongoing discussions have identified Strasbourg as a potential site for the second office. The office would be located in the offices of the European Science Foundation (ESF). The co-location of Europlanet with secretariat and administration of the European Space Sciences Committee of ESF, together with ESF experience in bidding for and co-ordinating EU FP/H2020 projects is seen to be mutually beneficial to Europlanet and ESF. ESF's re-launch as ESF-Science Connect with its mission to: foster partnerships providing Project Management services; hosting and supporting European Expert Boards and Committees; providing peer review and evaluation services are complementary to those of the Europlanet Consortium within the context of support for the European planetary science community.

Collaboration between ESF and the International Space University (ISU), also based in Strasbourg, provides further opportunities for hosting larger scale meetings including Europlanet General Assembly and Europlanet's planned annual Early Career Group meeting (a one week school). Should Europlanet decide to become an individual membership organisation (aka the USA DPS), then a 'membership office' responsible for membership communications and subscriptions may also be

hosted in Strasbourg within an ESF-ISU collaboration.

Strasbourg is also home to the European Parliament with which Europlanet has, throughout its history, developed strong links in particular relation to the STOA and ITER committees, which discuss topics of relevance to space and planetary science. To date these activities (dinner debates, exhibitions) have taken place in Brussels but could be held in Strasbourg, when MEPs and their office staff may have more time for consultation, than when the Parliament is scheduled to meet in Brussels.

It should also be noted that the University of Strasbourg has several groups whose research is relevant to Europlanet Science programmes.

Another Europlanet initiative is based on supporting the next generation of European planetary scientists, to ensure a sustainable research community.

An early-career network will be launched at the EPSC conference 2017 in Riga. The Europlanet Early-Career network (EPEC) welcomes all space-related interested early-career scientists and space professionals from Europe. The planned structure consists of three levels, with the entire community at the bottom, from which enthusiastic individuals and representatives of different European space-related networks and institutes will make up the Early-Career Group (equivalent of the Europlanet Consortium) which will represent the interests of the early career community and collaborate in different work groups. The Early Career Group will elect an EPEC Council every two years, which will consist of a council representative - establishing the communication with the Europlanet board - and the work group leaders. The work groups include for example organization of early-career events at the annual EPSC conference (e.g. an early-career forum and short courses), outreach activities, organization of an annual training school, surveys, and science policy training and activities.

Financial Plan. It is recognised that the activities of Europlanet require a longer term secure financial basis. To date, Europlanet activities have been based on Framework programme funding and this should not be regarded as a guaranteed source of funding. Therefore the Europlanet consortium will explore mechanisms for supporting its central activities that lower the risk of 'single funding'.
The Europlanet Board will review the opportunity for forming a European Research Infrastructure Consortium (ERIC). See the following URL for further detail : https://ec.europa.eu/research/infrastructures/pdf/eric_en.pdf.
Recent changes in the legal protocols may allow this formation to be developed more easily than in the past with the example of the JIVE (Joint Institute for VLBI, Very Long Base Line Interferometry) ERIC https://www.jive.nl/. Such a structure will allow Europlanet to become its own legal entity, securing its own PIC number for future FP bids. ERIC Institutional 'Membership fees' may provide some support for administration of Europlanet office(s) and support for Board / Assembly meetings.

Europlanet must also seek, through its members, to secure research project funding to support its research and related activities. Management and work package Boards and the Europlanet Consortium have already identified relevant forthcoming H2020 (and related pan- European) calls for the purposes of applying with partner funding, such bids being aimed at complementing and supporting current Europlanet activities. As stated above, the opportunity to continue to support TA and VA activities in FP9 (providing a service to EU community that cannot be secured from national funding) should be encouraged as part of Europlanet's engagement with FP9.

European Planetary Science Congress
The European Planetary Space Congress (EPSC) is the largest annual planetary science meeting in Europe and hosts the main management meetings for both EPN2020-RI and the Europlanet Consortium. EPSC was launched in 2006 under the EuroPlaNet FP6 project and has developed into a

self-sustaining (fee based) conference. The Europlanet Consortium is the parent body of EPSC and the EPSC Executive Committee is drawn from its membership. EPN2020-RI currently contributes to EPSC through (1) flat rate subsidies for Early Career Researchers and amateur astronomers to attend and (2) the provision of support for the EPSC press office.

EPSC will remain an integral part of the future Europlanet structure (e.g. (e.g. venue for annual General Assembly, members being eligible for a lower EPSC fee). EPSC is also expected to be the vehicle for many of Europlanet's community activities thus acting as a communication forum in a manner similar to the Division for Planetary Sciences (DPS) Annual meeting in the USA.

Task 1.6 - Data management (OU, OBSPARIS, UCL, VUA)

A first DMP has been submitted as a deliverable: D1.16 - First data Management Plan. This deliverable is listed as confidential and can be downloaded from the private area of the website or the EU portal

This will be updated as required in following Reporting periods.

WP1 (Management)-Deliverables

D1.1 - Project advisory board. This deliverable is listed as confidential, please refer to the EU portal or the private area of the website.

D1.5: 1st call for TA Facilities. Planned and submitted on Month 3 with 2 days of delay.

D14.1: NEC - Requirement No. 4. Planned at month 3. Delayed until M24, as approved by the project officer Keji Adunmo.
D14.4: NEC - Requirement No. 5. Planned at month 3. Delayed until M24, as approved by the project officer Keji Adunmo.
D1.9: 1st call, Evaluated proposals and approved access to Facilities. Planned and submitted on Month 6. For a full version of the deliverable (with sensitive information) please refer to the EU portal or the private area of the website.

D14.2: POPD - Requirement No. 2. Planned at month 6. Delayed until M24, as approved by the project officer Keji Adunmo.
D14.3: POPD - Requirement No. 3. Planned at month 6. Delayed until M24, as approved by the project officer Keji Adunmo.

D1.6: 2nd call for TA Facilities. Planned on Month 13. Submitted on Month 11.

D1.10: 2nd call, Evaluation proposals and approved access to TA Facilities. Planned on Month 15. Submitted on Month 11. For a full version of the deliverable (with sensitive information) please refer to the EU portal or the private area of the website.

D1.5 and D1.6 provided the information for the first two Transnational Access calls, as conveyed to the community on the EPN2020-RI website. They also provided the screenshots of the proposal submission forms as well as the proposal template.

D1.9 and D1.10 included lists which are ordered by TA call element and contain the following information:

- IdProp – Original reference number
- ProjectNumber – ESF reference number
- Title
- Keywords
- Call element applied for (TA1-TA3)
- Site applied for
- Project leader name and contact details

D1.13 - First Sustainability report. Planned and submitted on month 15

D1.16 - First data Management Plan. This deliverable is listed as confidential, please refer to the EU portal or the private area of the website.

WP1 (Management)-Milestones

- MS1: Kick off meeting. Planned on month 1. Achieved on 15/09/15
- MS11: Project Advisory Board/General Assembly created. Planned on month 1. Achieved on 15/09/15
- MS2: Establishment of project management structures (including web page). Planned on month 3. Achieved on 15/09/15
- MS15: Issue of 1st call for access to the TA facilities. Common with WP 2, 3, 4. Planned on month 3. Achieved on 15/10/15
- MS23: 1st Data management plan review. Planned on month 5. Achieved on 08/12/15
- MS3: 1st EPN 2020-RI council meeting. Planned on month 6. Achieved on 15/09/15
- MS4: council meeting and annual report from all work packages. Planned on month 12. Achieved on 27/09/15
- MS12: 1st Project Advisory Board/General Assembly meeting. Planned on month 12. Achieved on 30/09/15
- MS16: Issue of 2nd call for access to the TA facilities. Common with WP 2, 3, 4. Planned on month 13. Achieved on 15 Mar. 2016
- MS19 1st Sustainability review for the TA. Common with WP 2, 3, 4. Planned on Month 14. Achieved on 23/11/16
- MS27 Completion and review of first round of TA Projects. Common with WP 2, 3, 4. Planned on Month 15. Not yet achieved.
- MS5: 3rd EPN 2020-RI council meeting (6 monthly basis). Planned on month 18. Will be achieved on 23/11/16
- MS17: Issue of 3rd call for access to the TA facilities. Common with WP 2, 3, 4. Planned on month 25. Achieved on 26th Jan. 2017

1.3 Impact

The 50 publications arising from the project can be downloaded from the EU portal and will be uploaded in the website.

Europlanet 2020 RI places a big emphasis on the importance of the impact, so much so as to have an entire dedicated WP, “WP13-NA2 Impact through Outreach and Engagement”. The details contained in this section are at support and clarification of the information added in the tab “Dissemination” into the EU portal.

At the end of this document, **Table 32** summarises all dissemination activities, which, along with the information below, shows the great effort that has been done in terms of time and money (note, all values are in euros).

Table 13 - Summary of dissemination activities and costs per WP

WP1 (MGMT)			
OU	WP1	Travel to Europlanet Parliamentary Exhibition and dinner, Brussels, ESTEC, Outreach meetings, Eurospace, ESF and ISU strategy and sustainability meetings, ISSI, Space Information day in Lisbon, Coordinators day, and DG12 Space day in Brussels,. Travel for the I&I meeting for attendees and panel. European Science Open Forum conference 2016 Publications, flyers and posters for numerous meetings including the above. Production of videos to advertise Europlanet and the facilities available Article on Europlanet UK Parliamentary magazine Space issue	**27317**
UCL		Travel to relevant meetings and events by Prof. S. Miller (Europlanet Parliamentary Exhibition, Brussels; Eurospace meeting, Paris; Europlanet Impact Board meetings chair)	682.45
OBSParis		Presentation and advertisement of EPN at the Space Science Week in Washington (A. Coustenis, 29-31 April 2016 & 28-30 April 2017)	No charge
		Presentation and advertisement of EPN at the Space Studies Board of the National Academy of Sciences by A. Coustenis and N. Walter, Washington, DC, (25-27 April 2016), Irvine, CA (1-2 Nov. 2016)	No charge
		Presentation including EPN to the ESA DG at the Paris HQ (20/1/2016 and 20/2/2017) : A. Coustenis and N. Walter	No charge
		ESSC Plenary Meetings (with ESA and EC representatives): A. Coustenis and N. Walter (Rome, 17-19 May 2016; Strasbourg, 14-16 Nov. 2016)	No charge
		Presentation to the Paris Science Letters (PSL) University (Paris, May 2016)	No charge
		Presentation at the EUROSPACE Meeting, 22 Jan. 2016 (N. Mason, A. Coustenis, S. Miller)	No charge
		Presentation at the DPS-EPSC joint meeting, 16-22/10/2016 by M. Grande	No charge
WP5 (PSWS) and WP10 (PSWS-JRA)			
CNRS	WP5	Presentation, Space weather at Titan, ESWW13, Oostend, 25/11/2015, by J. Lilensten	No charge for PSWS
		Presentation, The Planeterrella: an Analog Model for Teaching About the Invisible Electromagnetic Processes Driving Space Weather, AGU, 17/12/2015, by J. Lilensten	No charge for PSWS
		Presentation, Planetary Space Weather Services for the	No

		Europlanet 2020 Research Infrastructure, PNST, 15/03/2016, by N. André	charge for PSWS
		Presentation, Planetary Space Weather Services for the Europlanet 2020 Research Infrastructure, EGU, 19/04/2016, by N. André	No charge for PSWS
		Participation to a workshop, Juno Ground-Based Support from Amateurs: Science and Public Impact workshop, Nice, 12-13/05/2016, by J. McKeon (amateur for CNRS, cost for mission)	476.32
		Participation to a workshop, Giant Planet Fireball Detection, Meeting at IRAP, 11-12/01/2017, by E. Kraaikamp (amateur for CNRS, cost for mission)	477.79
		Participation to a workshop, Giant Planet Fireball Detection, Meeting at IRAP, 11-12/01/2017, by M. Delcroix (amateur for CNRS)	No charge for PSWS
		Publication, Les aurores polaires, un chapitre dans « La lumière en lumière », Coordonné par Benoit Boulanger, Saïda Guellati-Khelifa, Daniel Hennequin et Marc Stehle, 978-2-7598-1829-7, EDPS Ed., January 2016, by J. Lilensten	No charge for PSWS
	WP10	Website, Planetary Space Weather Services, http://planetaryspaceweather-europlanet.irap.omp.eu/, by A. Goutenoir	No charge for PSWS
		Website, Transplanet, http://transplanet.irap.omp.eu/, by A. Goutenoir	No charge for PSWS
		Presentation, Planetary plasma data analysis and 3D visualisation at the French Plasma Physics Data Centre, DPS-EPSC 2016, Pasadena, 18/10/2016, by M. Gangloff	No charge for PSWS
		Organization of a workshop, PSWS Kick-Off Meeting, IRAP Toulouse, 21-23/03/2016, by N. André (cost for missions for Baptiste Cecconi, Jan Soucek, Daniel Matthiae, Benjamin Grison, Ricardo Hueso, Manuel Grande, André Opitz)	5122.03
		Organization of a workshop, PSWS Kick-Off Meeting, IRAP Toulouse, 22-23/03 2016, by N. André (cost for subsistence)	1146.50
		Organization of a workshop, PSWS meeting on giant planet magnetodisc and VOEvent, IRAP Toulouse, 23-24/02/2017, by N. André (cost for subsistence)	916.22
		Organization of a workshop, PSWS Giant Planet Fireball Detection meeting, IRAP Toulouse , 11-12/01/2017, by N. André (cost for subsistence)	306.88
		Participation to Europlanet PMC, Milton Keynes, November 2016, by N. André (cost for mission)	387.56
UCL	WP5	Presentation, Comets' Interactions with the Solar Wind, ESWW13, Oostend, 25/11/2015, by G. Jones	No charge for PSWS
UPV/EHU	WP5	Participation to a workshop, Giant Planet Fireball Detection, Meeting at IRAP, 11-12/01/2017, by R. Hueso and J. Juaristi	No charge for PSWS

		Press release, http://www.europlanet-eu.org/jupiter-blasted-by-6-5-fireball-impacts-per-year-on-average/, by R. Hueso	No charge for PSWS
ABER	WP5	Presentation, Planetary Space Weather Services for the Europlanet 2020 Research Infrastructure, EPSC, Nantes, 28/09/2015, by M. Grande (for N. André)	2561.53
	WP10	Organization of a workshop, SMW2.6 Planetary Space Weather Services, http://www.stce.be/esww13/program/wm.php?nr=12, ESWW13, Oostend, 19/11/2016, by M. Grande	
		Participation to a conference, Comparative Science and Space Weather Around the Heliosphere, DPS-EPSC, 28/10/2016, by M. Grande	
		Participation to a conference Planetary Space Weather Service: Part of the the Europlanet 2020 Research Infrastructure, COSPAR 2016, by M. Grande, cancelled	
		Participation to a workshop, Planetary Space Weather Services, Royal Astronomical Society Weather on Other Planets, London, 09/10/2015	
WIGNER	WP5	Communication campaign, Women in Science" presentation for secondary school pupils, Budapest, 30/01/2016, by A. Opitz	No charge for PSWS
		Communication campaign, Invited guest at the talk show "Ridikül" in television (Duna TV), http://www.mediaklikk.hu/2016/05/24/ridikul-tudos-nok/#, Budapest, 25/05/2016, by A. Opitz	No charge for PSWS
		Presentation, Space weather conditions at the induced magnetospheres of Venus, Mars and the Comet CG, ESWW13, Oostend, 25/11/2015, by A. Opitz	No charge for PSWS
		Presentation, Planetary Space Weather Services for the Europlanet 2020 Research Infrastructure, ESWW13, Oostend, 25/11/2015, by A. Opitz (for N. André)	No charge for PSWS
		Presentation, Planetary Space Weather Services for the Europlanet 2020 Research Infrastructure - invited e-poster, Oostend, 26/11/2015, by A. opitz (for N. André)	No charge for PSWS
		Presentation, Improvement of background solar wind predictions, EGU 2016, Vienna, 19/04/2016, by A. Opitz	No charge for PSWS
	WP10	Presentation, Validity of space weather prediction to Venus and Mars, ESWW13, Oostend, 25/11/2015, by A. Opitz	No charge for PSWS
OBSPARIS	WP10	Presentation, Developing an Efficient Planetary Space Weather Alert Service using Virtual Observatory Standards, EGU 2016, 19/04/2016, by B. Cecconi	No charge for PSWS
		Presentation, Developing an Efficient Planetary Space Weather Alert Service using Virtual Observatory Standards, EPSC 2015, Nantes, 29/09/2015, by B. Cecconi	No charge for PSWS
WP6 (VESPA) and WP11 (VESPA-JRA)			
IAPS/INAF	WP6	Implementation workshop in Toulouse, 2016	693.31

	WP11	IAU Astroinformatics meeting Oct 2016	1010.75
Jacobs U.		EPSC	784.16
	WP6	VESPA Implementation workshop Toulouse 2016	1232.59
	WP6	VESPA Hand's on Tutorial splinter, EGU 2016, Vienna, Austria	No charge
		Travel for student doing data processing toJacobsUni (from Uzbekistan, i.e. student residence)	485
IAP		travel to 2016 VESPA workshop.	1925.05
UPV/EHU		Juno Ground-Based Support from Amateurs: Science and Public Impact, Nice, 12-13 May 2016 Europlanet workshop organized by Europlanet NA1 Main organizer: R. Hueso http://www.ajax.ehu.es/Juno_amateur_workshop/ Presentations related to VESPA and PSWS were given.	1052.45 (Agustín Sánchez Lavega) 873.49 (Ricardo Hueso)
ObsParis	WP6	AGU conference 2015 (STEPHANE ERARD) Planetary Science VO session. San Francisco, 12-21/12/2015	3811.70
		ESLAB Conference / comets – Rosetta ground support archive poster (Erard) Leyden, 14-18/03/2016	(no charge on VESPA)
		French Planetary Science VO workshop & VESPA implementation workshop (Erard, Le Sidaner, Cecconi, Savalle, Chauvin, Zi Yin) Toulouse, 03-08/04/2016	4404.32
		EUROPLANET/ EGU 2016, hands-on session for users (Le Sidaner, Chauvin) Vienna, 18-20/04/2016	2465.78
		SF2A meeting 2016: presentation of Europlanet and VESPA infrastructure (Erard) Lyon, 13-15/6/2016	(no charge on VESPA)
		AOGS conference - VESPA presentations in Planet Sc archive session + forum on international collaboration (Erard, invited) Beijin 30/07 - 07/08/2016	4283.82
		Planetary Science VO workshop (CalTech) + VESPA hands on session at DPS-EPSC joint meeting (Erard, Chauvin, Cecconni, Le Sidaner) Pasadena / 14 au 23/10/2016	15504.72
		AGU conference 2016 (Erard), Planetary Science data session. San Francisco, 10-18/12/2016	4634.31
	WP11	• EPN20 et EPSC 2015 (Cecconi) Nantes / 26/09 au 04/10/2015	1432.70
		ASOV meeting 2015: presentation of VESPA infrastructure (Le Sidaner) Paris, 14-15/3/2016	no charge on

			VESPA
		IVOA Interop meeting (Erard) Cap Town, 08-15/05/2016	2723.77
OEWF	WP6	EPSC Nantes 2015 (M Scherf):	1924.41
		Travel costs of Tarek Al-Ubaidi to VESPA Implementation Workshop, Toulouse	1033.93
		Travel costs of Manuel Scherf to VESPA Implementation Workshop, Toulouse	1004.27
		EGU 2016 (M Scherf)	no charge on VESPA
		DPS-EPSC (M Scherf)	no charge on VESPA
		Juno Amateur Workshop in Nice, 2016 (M Scherf)	no charge on VESPA
		Planetary Radio Emissions Conference in Seggau (M Scherf)	no charge on VESPA
		Exoplanets Summer School in Vilnius 2016.	no charge on VESPA
CNRS/IPAG	WP6	SSHADE Training, Grenoble & Bern	7576.26
		Participation to a conference (EPSC)	2368.10
		VO Planeto workshop, Toulouse 2015	265.54
CNRS/IRAP		Organisation of VESPA Workshop Toulouse April 2016	6335.32
		Tutorial Session EPSC-DPS Octobre 2016 , Pasadena	3656.46
UCL	WP6	VESPA Workshop attendance in Toulouse by N. Achilleos and P. Guio	1022.13
IASB/BIRA		Participation of Loic TROMPET to VESPA Workshop, Toulouse (France), 04/04/2016 - 08/04/2016, 1 person	1074.76
WP12 (NA1)			
OEAW	WP12	Participation of Manuel Scherf at EPSC Nantes 2015 (dissemination amateur session, leading to Juno Workshop):	1924.71
		Participation of Manuel Scherf at NA1 Juno Amateur Workshop, Nice, France, May 2016 (presentation of Europlanet, NA1 and VESPA)	720.81
		Participation of Manuel Scherf at NA1 Exoplanets Summerschool , Moletai, Lithuania, August 2016 (presentation of Europlanet, NA1 and VESPA)	831.67
		Participation of Günter Kargl at NA1 Rosetta Workshop, Seggauberg, Austria (presentation of Europlanet and NA1)	200.66

		M. Scherf presented Europlanet NA1 at the Planetary Radio Emissions conference in Seggauberg in October 2016.	No charge
FMI	WP12	W. Scmidt & A.-M. Harri represented NAI activity at the EuroPlanet open planning Meeting (during EPSC), *at the La Cité des Congrès, Nantes, 28.9.2015.*	1194,75
		Ari-Matti Harri: EuroPlanet NA2 Impact kick-off, London 10.-12.11.15:	1398
		A-M. Harri, NA1 meeting and information, Vienna (EGU) 16.-23.4.16	No charge
		M. Genzer, EuroPlanet NA1 meeting, Vienna (EGU) 16.-23.4.16	865
		H. Haukka, NA1 meeting and information, Vienna (EGU) 16.-23.4.16	No Charge
		Ari-Matti Harri, NA1 workshop information dissemination and EPS/DPS meeting, Pasadena 15.-24.10.16 (recruiting 2 key note speakers for NA1 workshop)	1971
		H. Haukka, representing NA1 at the Asteroid workshop ASIME2016, Luxembourg 20.-23.9.16	930
		A-M. Harri, representing NA1 at the Horizon-2061 forum Bern, 12.-16.9.16.	1677
MPG		N. Krupp, NA1 meeting and information, Vienna (EGU) 16.-23.4.16	No Charge
		N. Krupp represented NA1 at the Eurospace Meeting, Lausanne, April 2016.	No Charge
		N. Krupp psrticipated at the EuroPlanet open planning Meeting (during EPSC), and represented the Task-4 *at the La Cité des Congrès, Nantes, 28.9.2015.*	No Charge
		N. Krupp, representing the Task 2 of the NA1 at the Horizon-2061 forum Bern, 12.-16.9.16.	No Charge
WIGNER		K. Szego represented NA1/Task-2 at the NA1 meeting and dissiminated information, Vienna (EGU) 16.-23.4.16	No Charge
		K. Szego, representing NA1 at the Horizon-2061 forum Bern, 12.-16.9.16.	No Charge
In addition extensive work has been done in prepapration of each workshop, as listed in Table 32			
WP13 (NA2)			
ObsParis	NA2	Travel	2700
		2016 Europlanet Prize for Public Engagement with Planetary Science	4000
		Europlanet Public Engagement Funding Scheme	7500
Vilnius University		travel costs to Athens - science communication best practice workshop	682.47
Leiden University		NUCLIO Subcontracting / [Organisation of a workshop]	5700
		astroEDU associated cost with activities publication and development [Non-scientific and non-peer reviewed publications (popularised publications)]	448
		renting and food costs for workshop in Athens, 4th and 5th July 2016, by Coral Hotel: [Organisation of a workshop]	675

Athens University		organization of the outreach workshop in Athens 4th and 5th July (travel and subsistence expenses for participants, facility rental, coffee breaks, light lunch)	3509.01
		EPSC Conference Fee Bursaries - Oct15 (France) & DPS/EPSC Conference Fee Bursaries - Oct16 (USA)	18628.93
Science Office		travel to conferences, meetings, workshops	14804
		equipment for production of outreach content	8910
		Other goods and services like initial cost of setting up the Europlanet Outreach website and subscriptions to media and social media services, catering and printing costs with the Dinner Debate (Deliverable 13.3) and cost with the European Parliament Exhibition (Deliverable 13.4)	13934

2. Deviations from Annex 1

2.1 Amendment (approved in March 2016)

Loss of beneficiary CORIOLYS. The beneficiary #24, Coriolys, asked to be terminated as it was declared bankrupted. The budget has been transferred to CNRS-IPAG (Beneficiary #4).

Under WP12, there was a typo w.r.t. the PMs of the Beneficiary VU (#30), which should have been 11 rather than 1, with a consequent increase of 10 PMs from the original ones. This will not create any problem in the delivery of milestones and deliverables as it mainly refers to the management-related effort (to organise meetings, activities, etc). The total requested contribution will stay unvaried. Annex 1 will be changed accordingly.

Changes to VESPA (VA) programme. ESA adopted the OBSPARIS' protocol EPN-TAP, to provide access to its Planetary Science Archive (PSA) of space-borne observations only after the submission of the proposal. This will give very large visibility to the VESPA activity, but is also the source of new constraints and responsibilities to be studied in detail. Since the PSA is willing to use a GIS-oriented interface this also impacts the VO-GIS activities of VESPA, as well as the study of workflows, which will provide the user with extra functions on the retrieved data. The EPN-TAP protocol also needs to be upgraded to v.2, but this is expected to be completed in the first 6 months of the program. Thus OBSPARIS's proposal was

• To maintain the current deliverables with the same time line.
• To add extra deliverables for the same budget. This only required extending the JRA a little longer so as to maintain the active status of this WG.

Extra deliverables:

a) VESPA main user interface upgrade. This will include handling of answers from several services together. Prototype expected at PM 36, delivery at PM 40. Lead beneficiary: ObsParis. No additional effort in comparison with the original DoA.
b) VO-GIS interface adaptation to ESA's PSA content for planetary images. Prototype expected at PM 36, delivery at PM 40. Lead beneficiary: Jacobs Univ. No additional effort in comparison with the original DoA.
c) Workflow studies + application to the Magnetospheres science theme and new services in VA and PSA. PM 40. Lead beneficiary: ObsParis. Other beneficiaries involved: CNRS/IRAP, Prague. No additional effort in comparison with the original DoA.

Budget transfer. A budget transfer of 24,000 EUR from Beneficiary # 27 (LU) to Beneficiary #7 (SO) was agreed. This corresponded to the money to be paid toward a subcontractor, which has to be moved to a different beneficiary in order to avoid complying with Latvia's procurement rules, which would cause a delay of 8-9 months in the payment.

2.2 Future changes

These changes will be included in the next amendment, to be triggered immediately after the mid-review with the Commission on 11th May 2017.

2.2.1 Already approved by the Project Officer

This section lists those changes that already have been approved by the Project Officers, Keji Adunmo and Andrea de Candido, via email. Due to their nature, they did not require an amendment. However they will all be included in the next agreement as a matter of record, which will be started soon after the review with the Commission on 11th May 2017.

-Earlier opening of the first TA call

As early as the grant negotiation phase, it was agreed that the first call for TA access needed to be open and publicised as soon as possible. Although the original plan was to have it open on 1st December 2015, the call was open 1.5 months in advance, on 15 October 2015.

-Earlier second call for TA access

Following the outcome of the first call and in order to build up on the momentum gained, WP2,3 & 4 team and the Project Office agreed to bring forward the second call for Transnational access. This second call, originally planned for 1st October 2016 was open on 15 March 2016. This allowed to 'keep the ball rolling' and to maintain the communication and outreach effort of the project. 24% more proposals were submitted to the second call when compared to the first and more than 100 applications were submitted to the TA scheme within less than a year.

-Postponing four deliverables until M24.

D14.1- NEC (National Ethics Council) – Requirement No. 4. It was due at month 3
D14.4 NEC – Requirement No. 5. It was due at month 3
D14.2 POPD (Protection of Personal Data) – Requirement No. 2. It was due at month 6
D14.2 POPD– Requirement No. 1. It was due at month 6

The above ethics requirements became deliverables through the new update of the Sygma ethics module, thus the delayed discovery (only in March 2016) of them being pending. The PO suggested to extract relevant text from the Data Management Plan deliverables, to be submitted with an update in month 24. Approved via email on 7/4/16.

-D5.1: 1st PSWS VA Review Board Report was submitted on month 16 rather than 13. A delayed delivery in month 16 was considered more appropriate since the advisory board was available to attend a coordination meeting hosted during ESWW week in Ostende mid-November. Approved via email on 17/8/16.

-D6.2: 1st VESPA VA Review Board suffered some delay and was submitted on month 14 rather than 13. Because one member has dropped out of the board, the panel suffered of some delay in arranging a suitable time to talk and meet. Approved via email on 10/10/16.

-D9.1: because of a death in the family of the leading beneficiary, the deliverable "Road map on preparation protocols" was submitted on month 19 rather than 18. Approved via email on 16/1/17.

-Developments for services C2 Mars radiation environment at ABER, C3 Giant planet magnetodiscs at UCL, and C4 Jupiter thermosphere at UCL have not yet started.
A 6-month extension has been requested by ABER for the C2 service due to some delays in hiring personnel with appropriate skills. CNRS is proposing to help ABER and UCL integrate their models by PM30 and PM42, respectively, into the architecture developed for the C1 Transplanet – Earth, Mars (Venus), Jupiter (Saturn) service operational at http://transplanet.cdpp.eu.
This requested extension has impacts on the delivery date of two PSWS JRA4 deliverables:

- D10.2, PSWS Software Development, Public, from month 24 to month 30
- D10.3, PSWS prototype, Public, from month 36 to month 42

Approved via email on 13/2/17.

-MS51: Regional geological map; Tirez lake. Change leader from CNRS to INTA. It was a typo. Approved via email on 17/8/16.

-D3.6: 2nd Annual Report of TA2 Access. Change leader from ESF to DLR. It was a typo. Approved via email on 17/8/16.

-Updates on DoA (part A and B):

Three deliverables were associated with the periodic reporting. These should be deleted as the periodic reports are contractual obligations rather than deliverables. Approved via email on 6/4/17.

D1.2, Report & Budget -1st EC reporting period - OU Report Public 18
D1.3 Report & Budget - 2nd EC reporting period - OU Report Public 36
D1.4 Report & Budget - Final EC reporting period - OU Report Public 48

-All the effort under the VAs should be amended because of a misunderstanding during the Grant Preparation Phase. The coordinator was also told not quote the person months under the participation per partner tables in each work package in Annex 1, as they are listed in the Virtual Access Excel sheets, but to include these costs under the separate personnel costs and indirect costs. This was later clarified with the PO Andrea de Candido via email on 4/4/17 and agreed to be included in an amendment.

2.2.2 Additional proposed changes

This section lists those changes that have not yet been approved. They will all be included in the next amendment, which will be started soon after the review with the Commission on 11th May 2017. Some of them will need to be submitted for approval during the Council meeting on 3rd May.

By beneficiary

Beneficiary #1 Open University (OU) and #3 University College London (UCL)- The leader at UCL, Steve Miller, retired in January 2017. Although Nick Achilleos, already working at the project, has been appointed now as a new leader at UCL, the task associated with the management of bursaries should now be transferred to the project management office at the OU. This has been agreed with UCL and will require a budget transfer.

Beneficiary #4 CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS)- allocate 13 units of access from facility 4 UJF DPSF TA2 to facility 4 CNRS DPSF TA2, which therefore has 90 unit of access rather than 77 (UJF is only providing staffing support, not access).

Beneficiary #7 –Science Office (**SO)** and **#16-Istituto Nazionale di Astrofisica (INAF):** In SO's budget, 60K plus overheads were originally allocated to fund the policy officer, Veronika Raszler, who assured this position from project month 1 to 16. 20K plus overheads have been spent to date on Veronika Raszler's salary. The new Policy officer, Livia Giacomini, works at INAF, Rome. Thus we suggest to move (from the remaining 40k plus overheads) 20K plus overheads from SO to INAF and to reallocate 20K plus overheads within SO's budget. Source from the re-allocation will be determined on the occasion of the Council meeting on 3rd May 2017. This will leave SO with 20K plus overheads additional funds to be moved from personnel to other direct costs, to contribute towards the growing needs of WP13 in terms of printing/meetings/funding travel/Brussels meetings etc.

Beneficiary #12- ABERYSTWYTH UNIVERSITY (Aber): Transfer two months effort from other direct to personnel (to provide admin support for meeting arrangement and logistics; this task has proved more labour intensive than originally envisaged).

Beneficiary #12- ABERYSTWYTH UNIVERSITY (Aber) and **Beneficiary #4- CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS):** Transfer 16.25 keuro (3 person months, including overheads) from Aber to Toulouse to pay for the web-based implementation of Aber Moon and Mars software.

Beneficiary #19 -USTAV FYZIKY ATMOSFERY AV CR (**IAP)**: increasing the effort under WP 10 from 12 to 13.5 PM

Beneficiary #22- FONDATION EUROPEENNE DE LA SCIENCE (ESF): All resources at ESF have been used according to the original plan. Efficient call and call infrastructure management is necessary to support the implementation of a fifth and sixth calls. All the TA infrastructure hosts have committed resources, in kind, to support the Call and review process. Some money should be re-allocated to enable the opening of extra calls, with a reallocation toward ESF of about 25000 EUR.

Beneficiary #32- University of Leiden (UL): After the development of the training session materials and resources in Year #1, UL would prefer to use resources for travel of the training team to the training session in events like the upcoming summer schools and EPSCs. Thus we propose to move 5000 EUR of the direct personnel costs to other direct costs. The 5000 EUR will cover the travel costs for four training sessions in Europe.

By WP

WP2 (TA1), 3 (TA2), 4 (TA3): Following the completion of the currently open TA call 3, a detailed review will be undertaken by the Transnational Access sub-board and the 'corporate' Europlanet office of a proposal made to the PMC for the re-allocation of funds within TA programme (TA1, 2 ,3) to the facilities that are proving to be the most in demand. Once agreed, a request for a re-allocation of resources within the individual TAs will be forwarded to the Commission to reflect the variability in demand of individual facilities.

Given the access to the date (refer to **Table 12**) we propose the following:

TA1

1. Rio Tinto Field Site, Spain
2. Ibn Battuta Centre, Morocco
3. The glacial and volcanically active areas of Iceland, Iceland

4. *Danakil Depression, Ethiopia (available from early 2017)*
5. *Tírez Lake, Spain (available from early 2017)*

On budget: Iceland; Tirez Lake.
Moving money to: Ibn Battuta; Danakil depression.
Moving money from: Rio Tinto. Possibly now out of fashion as this facility was one of the most popular in previous projects.

TA2

1. Planetary Emissivity Laboratory, Germany
2. Planetary Environment Facilities at Aarhus University, Denmark
3. Open University Mars Chamber, UK
4. High-pressure laboratory at VUA, NL
5. Cold Surfaces spectroscopy, Institut de Planétologie et d'Astrophysique de Grenoble (IPAG), France
6. Center for microbial life detection at Medical University Graz, Austria
7. Petrology-Mineralogy Characterisation Facility (PMCF), Mineral and Planetary Sciences Division, Natural History Museum, London, UK

On budget: Planetary Emissivity Laboratory; Center for microbial life detection at Medical University.
Moving money to: Planetary Environment Facilities; OU Mars Chamber
Moving money from: Petrology-Mineralogy Characterisation Facility (PMCF); High-pressure laboratory; Cold Surfaces spectroscopy, Institut de Planétologie et d'Astrophysique now picked up but may still fall short without extra calls

TA3

1. Radiogenic and non-traditional stable isotope facility: Geology and geochemistry, Faculty of Earth and Life Sciences, VU University, Amsterdam, NL
2. Radiogenic, non-traditional stable & rare gas isotopes. Le Centre de Recherches Pétrographiques et Géochimiques (CRPG), Nancy, France
3. Stable Isotope Analytical Facilities - The Open University, UK
4. NanoSIMS 50L Secondary Ion Mass Spectrometer - The Open University, UK
5. Radiogenic & non-traditional stable isotopes: Institute for Planetology (IfP); University of Münster, Münster, Germany

On budget: Radiogenic, non-traditional stable & rare gas isotopes (CRPG); NanoSIMS 50L Secondary Ion Mass Spectrometer

Moving money internally at CRPG so more SIMS time access is covered
Moving money i from Stable Isotope Analytical Facilities, some to the NanoSIMS at OU ;
Moving money from Radiogenic and non-traditional stable isotope facility (Ifp):

WP5 (PSWS): Developments for the service A4. Cometary tail crossings (UCL) and B1. Lunar impacts (ABER) will request some support from IRAP/CNRS in order to post online the software developed by UCL and ABER.

This will translate in a transfer of 16,25 keuro (3 person months, including overheads) from Aber to CNRS to pay for the web-based implementation of Aber Moon and Mars software.

WP8 (JRA2): in task 8.4 (Development of a micro spectro-gonio radiometer for small and dark

materials at low temperatures), the amortisation of the equipment bought for the project is currently low due to careful material selection, ordering and delivery. On the other hand we needed more manpower to perform properly all the tests to insure optimal selection of materials, to develop the control/acquisition software and perform the future tests and calibrations of the whole setup. We hired an engineer for this aim. So a shift of 20,920 Euros from equipment to manpower is to be expected at the end of program.

WP11 (JRA5):

IPAG/CNRS

Following the failure of industrial partner Coriolys just after the start of the contract, Philippe Bollard (from Coriolys) was hired directly at IPAG. His contract could only be started in mid-December 2015. The situation was then secured, but the activity slightly shifted in time. It now appears that the development time was correctly estimated but with no margin, so that the initial administrative delay could never be compensated for.

An extension of JRA/VESPA at IPAG is requested until January 31, 2018 (end of P. Bollard's contract on SSHADE).

--D11.8 SSHADE final infrastructure from M24 to M28. A draft version will be released mid-September for a presentation at the next EPSC meeting. The extension will also allow P. Bollard to react to the first user comments, and work on a first update if needed.

WP12 (NA1)

D12.6 1st ISSI WS Book- ISSI Other Public. From month 24 to month 40.
D12.7 2nd ISSI WS Book- ISSI Other Public. From month 38 to month 48
D12.8 3rd ISSI Book- The workshop results will be compiled within the EPN2020 final report, the book will be published and delivered few months later.

Mercury science (in support of the BepiColombo mission) was selected in 2015 as the topic for the first ISSI workshop and book. However, it later transpired that NASA and the MESSENGER team are planning a book on MESSENGER/Mercury results. Thus, this topic would involve conflicts and duplication and so was deemed unsuitable. Although topics for all three workshops have now been confirmed, the change of topic at late stage caused delays in the organisation of the first workshop and this has also had a knock-on effect for the second and third workshops.

The production of an ISSI book takes approximately two years to complete following the initial workshop. Thus, an extension is requested for the deliverable dates for the 1st and 2nd ISSI WS Books and to delete the 3rd book as a deliverable, since this will now be published well after the end of EPN2020-RI.

WP13 (NA2): The opportunity to hold an Exhibition in the European Parliament (D13.8, due M36) arose one year earlier (M15) than anticipated in the proposal. This deliverable is now completed. However, as a result, the second Dinner Debate in the European Parliament (D 13.7, due M24) will instead take place in Year 3 of the project (estimated to be delivered M27).

-D13.7 2nd European Parliament Dinner Debate move from M24 to M27

<u>Others</u>

Industry officer: change from Thales (Joel Poncy) to Blue Skies Space Ltd (Marcell Tessenyi).

Unfortunately Joel Poncy died unexpectedly before the start of the project. His support during the bidding phase was invaluable and highly appreciated.

In the EU portal, Beneficiary #7 - Science Office (SO) appears not to be a SME. Despite a recent validation, the portal still doesn't pick this up and the IT suggested this should be changed by the coordinator, probably in phase of an amendment. The opposite case arose for Beneficiary #34-Stiftung International Space science institute (ISSI).

GFI is mistakenly listed in Part B of the DoA as an SME. Again this is related to a problem with the validation.

3. Financial reports

Table 14 below details the maximum grant awarded and the requested contribution this reporting period with a % requested as a total of the maximum allowed. The RP1 period is for first 18 of the 48 months of the project. On a pro-rata basis spending would be 37.5% the overall budget requested; for RP1 the total spend is currently 36% of the total of the project and over half of the institutions requests are within 10% of the 37.5% M18/M48. In the Table we have highlighted where beneficiaries have spent significantly more or less than the pro-rata 37.5% of their budget with an explanation for why spending is more/less than pro-rata.

Table 14 - Costs under RP1 for each beneficiary

Number	Beneficiary	Maximum Grant amount	Requested contribution	% of funding requested	Reason for requesting less or more than 37.5%
1 *	OU	€ 1,189,282.19	€406,925.58	34%	JRAs due to finish in years 1 and 2. Lower than expected access to some TA labs **
2 *	OBSPARIS	€ 933,500.00	€ 371,449.15	40%	
3 *	UCL	€ 469,004.06	€ 81,454.55	17%	JRA extension request. Less bursaries due to Pasadena meeting and Evaluation task planned for the 2nd half of project
4 *	CNRS	€ 1,501,035.25	€ 791,487.96	53%	4 JRAs due to finish in years 1 and 2. Lower than expected access to some TA labs** Includes 4 third parties
5 *	INTA	€ 500,447.00	€ 110,538.95	22%	Lower than expected access to Rio Tinto **

6 *	VUA	€ 494,032.00	€ 70,818.56	15%	Lower than expected access to TA labs ** & ESR salary in year 2
7	SO	€ 477,335.00	€ 208,597.50	44%	
8	OEAW	€ 461,500.00	€ 154,718.28	34%	
9 *	IRSPS	€ 421,079.00	€ 185,307.32	44%	JRA costs focussed in first 2 years **
10	FMI	€ 365,000.00	€ 85,698.44	23%	NA1 Workshops to be held in years 2, 3 and 4
11 *	DLR	€ 281,285.00	€ 148,584.61	53%	JRA costs focussed in first 2 years
12 *	ABER	€ 257,550.00	€ 84,496.74	33%	
13	MPG	€ 253,750.00	€ 35,680.80	14%	NA1 Workshops to be held in years 2,3 and 4
14 *	NHM	€ 204,350.00	€ 65,038.78	32%	
15 *	JacobsUni	€ 206,250.00	€ 110,244.05	53%	JRA costs were focused in the first 2 years
16 *	INAF	€ 207,000.00	€ 56,603.75	27%	
17 *	AU	€ 195,625.00	€ 143,883.06	74%	** Higher than expected access to TA labs and JRA costs in 1st 2 years
18	Wigner RCP	€ 195,000.00	€ 28,836.29	15%	NA1 Workshops to be held years 2, 3, 4
19 *	IAP	€ 176,250.00	€ 44,421.14	25%	JRA related staffing delays
20*	MATIS OHF	€ 147,226.00	€ 9,291.62	6%	Lower than expected access to TA field locations – These are season related with TAs to Iceland from calls 1and 2 to be held in Summer 2017
21 *	WWU	€ 141,323.00	€ 19,327.98	14%	Lower than expected access to TA labs
22	ESF	€ 124,012.50	€ 54,335.60	44%	

23 *	GFI INFORMATIQUE SA	€ 113,750.00	€ 113,750.00	100%	Industrial partner – all JRA tasked work done in year 1
25	MUG	€ 130,125.00	€ 27,949.74	21%	Lower than expected access to TA labs
26 *	IASB - BIRA	€ 85,000.00	€ 15,996.81	19%	Workshop for which they are responsible is planned in period 2.
27	LU	€ 73,900.00	€ 23,100.84	31%	
28 *	UPV/EHU	€ 68,000.00	€ 53,191.49	78%	Major JRA costs in years 1 and 2
29 *	IGS PAS	€ 61,750.00	€ 36,195.40	59%	All JRA tasked work done in year 1
30	VU	€ 61,000.00	€ 17,116.10	28%	
31	IASA	€ 50,000.00	€ 14,134.96	28%	
32	U LEIDEN	€ 50,000.00	€ 35,023.25	70%	Hosted a major workshop in first 12 months
33 *	SRC PAS	€ 50,000.00	€ 21,347.10	43%	
34	ISSI	Does not need to complete a form C as they are directly funded by the Swiss government			
TOTAL		€9,945,361.00	€ 3,620,924.34	36%	
24	CORIOLYS budget reallocated to CNRS as the beneficiary was terminated	0.00 €			

* These beneficiaries have significant JRA costs which since JRAs are focussed on first 24 months of the project may lead a higher spend pattern by these beneficiaries in years 1 and 2.

** for these Beneficiaries JRAs are developing TA facilities, which may lead to lower TA access until the JRA is complete. The exception is AU where their TA visits have been incredibly popular with both academia and Industry and the JRA will only increase this popularity.

(b) OBSParis has donated some effort as indicated in the table below

	Direct costs claimed				Direct costs effectively encountered			
	PM	Personnel	Others	Total costs	PM	Personnel	Others	Total costs
WP6-VESPA	22.7	118,230.94	32,519.06	150,750	30.11	156,870.3	32,519.06	189,389.36
WP11-JRA	11.9	86,053.98	16,996.02	103,050	12.52	90,622.51	16,996.02	107,618.53

(c) Some details from CNRS

WP	DR/Lab	Staff's name	PM	Cost	Contract type	Position/main activities
WP3 TA2 DPSF	DR11/IPAG	Bernard Schmitt	1.14	11,920.30	Permanent	Researcher/TA2 Task leader-Scientific support
WP3 TA2 DPSF	DR11/IPAG	Olivier Brissaud	0.97	6,032.13	Permanent	Engineer / Technical support
			2.11	*17,952.43*		
WP3 TA2 DPSF	TP / UGA	Pierre Beck	0.67	4,376.96	Permanent	Researcher / Scientific support
			0.67	*4,376.96*		

WP	DR/Lab	Cost Type	Description	Cost
WP3 TA2 DPSF	DR11/IPAG	Travel & subsistence	Users costs: 2 weeks TA (O. Poch, Z. Yoldi, B. Jost) Oct 2016, 2 weeks TA (F. Tosi, S. de Angelis) Nov 2016 (partly)	4,238.84
				4,238.84

2. WP2 - TA 1: Planetary Field Analogues (PFA)

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

The main objective of Trans National Activity 1 (TA1) is to provide external users with access to a set of well-characterized planetary analogue field sites. Three planetary field analogues – Rio Tinto (Spain), Ibn Battuta (Morocco) and cold and hot environments in Iceland – were selected to provide transnational access during the first two years of the project. The selected sites provide the most realistic terrestrial analogues of the surface and near surface geological/geomorphological environments of several planetary objects of astrobiological importance like Mars, Europa and Titan.

EPN2020-RI´s planetary analogues field sites provide researchers from a board spectrum of disciplines the capability to undertake the comprehensive multi-disciplinary research strategies needed to support planetary missions. External users during the first period were interested mainly in the complex (bio) geo-chemical feed-back processes that control planetary evolution so that researchers can develop quantified models to explain observations made of planets in our Solar System. Other TA visits enabled through EPN2020-RI focussed on the study of the processes that influence the survival of life under extreme conditions and the detection of records of past or present biological activity. Some of the characterised habitats are similar to where life is thought most likely to have evolved on Earth and, consequently, are a valuable resource for Earth and life scientists and have important

astrobiological implications. Finally, TA1 applicants were interested in testing instrumentation under development by industry for future planetary space missions, as well as evaluating analytical-operational-management concepts in fully operational settings.

JRA 1 is characterising two new sites that will become available for access in late 2017 offering additional and analogues. Hence increased usage of TA 1 is expected in the second half of the project.

1.2 Explanation of the work

Detailed description of work

Task 2.1-Rio Tinto (INTA)

Table 15 - Completed external users visits during first periodic report to Rio Tinto facility

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-012	Constraining optical properties of Martian aerosols by using Rio Tinto regolith analogs at increasing oxidation state	LATMOS	France	June 2016

Case study: Project No. 15-EPN-012. Site visited: June 2016 (access 2 person weeks)

Title: Constraining optical properties of Martian aerosols by using Rio Tinto regolith analogs at increasing oxidation state
Applicant: Dr. Lisset Gavilan, Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS), France

The mineralogy of Martian dust is constrained by in-situ Mars Exploration rovers, showing the dominant presence of ferric oxides and perchlorate salts. The oxidation of basaltic dust is thought to be the result of chemical weathering in the atmosphere, and this is why Martian dust has become a target of atmospheric studies. The effect of aerosol weathering via oxidation, nucleation, and/or ultraviolet irradiation in the atmosphere of Mars is less well constrained. Winds can suspend soil dust into aerosols, and aerosol surfaces can favour nucleation and oxidation by radicals. These can in turn modify the optical properties of aerosols, having a yet unknown impact on Mars climate. For the manned missions to Mars, this information will be critical for astronauts' safety.

EPN2020-RI TA1 enabled researchers from LATMOS to visit the Rio Tinto Transnational Access facility in collaboration with Dr. Felipe Gómez of the Centro de Astrobiologia in Madrid. The central goal of the project was to use minerals from Mars analogue sites with increasing oxidation state to explore how oxidized aerosols could affect Mars climate. This project involves a sequential program utilizing tools from geochemistry, spectroscopy, and modeling taking advantage of the transnational access facilities of the Europlanet consortia. Mineral samples were collected from visits to different sites along Rio Tinto's banks ("Berrocal", "Minas", and "El Origen"). These included wet and dry samples of natural iron oxides (jarosite, pyrite) and sulfates, selected for their potential to provide very fine regolith and a high potential for volatilisation, since these minerals will be used as Martian aerosol analogues.

Ten samples were selected from the field that seemed to be the most interesting candidates to study volatility. The colour of the minerals ranges from bright yellow to dark brown, and is expected to provide oxides with increasing degrees of oxidation. Centro de Astrobiología dried, ground and filtered these samples. XRD measurements will be performed to identify the dominant minerals of sizes inferior to 40 microns. A fraction of the dry powder samples will in future be studied on another TA facility, the Planetary Emissivity Laboratory in Berlin, in order to constrain the spectral properties of this regolith from the UV to the IR and to compare to current rover and orbiter data of Martian aerosols already published in scientific journals.

A few examples are shown in the figure below.

Figure 5 - Ten samples were selected from the field that seemed to be the most interesting candidates to study volatility. The colour of the minerals ranges from bright yellow to dark brown, and is expected to provide oxides at increasing degree of oxidation

Figure 6 - Diversity of materials and minerals recovered at Rio Tinto.

Based on the initial studies the research team has been broadened to include a collaboration with the Ecole Normale Superieure (ENS) de Geologie in Paris. This group has extensive experience in dealing with hydrated sulphur bearing minerals and are advising on optimal storage and analytical strategies.

Figure 7 - Rio Tinto sampling site selected for material and minerals recovering and sampling.

Task 2.2-Ibn Battuta Centre (IRSPS)

Table 16 - Completed external user visits during first periodic report to Ibn Battuta Facility

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-036	Mars analogue drills and laboratory analysis at dry, salty terrains to support ExoMars rover's activity, workflow optimization and later interpretation	Research Centre for Astronomy and Earth Sciences (MTA CSFK)	Hungary	September 2016
15-EPN-046	Meteorological Signatures of Vertical Convective Vortices	Westfälische Wilhelms-Universität	Germany	May 2016
16-EPN2-007	Testing The Impact Of Wind On The Collection Efficiency Of Precipitation Gauges	Italian Institute of Speleology	Italy	October 2016
16-EPN2-024	Astrobiological potential of microbial biogeomorphology in arid, evaporite-dominated environments: an aid to the use of image spectrometers in future landed missions on Mars	Università di Bologna	Italy	November 2016

Case study: Project No. 15-EPN-046. Site visited: 4-18 May 2016 (access 4 person weeks)

Title: Meteorological Signatures of Vertical Convective Vortices

Applicant: Dr. Dennis Reiss from Institut für Planetologie, Westfälische Wilhelms-Universität, Münster, Germany and Jan Raack, Department of Physical Sciences, The Open University, Milton Keynes, UK

EPN2020-RI TA1 enabled a team from the Institut für Planetologie and The Open Universities to spend two weeks in the area of Merzuga (Erfoud, Tafilalt) to obtain a comprehensive dataset of signatures of convective vortices that will help to interpret data obtained by past lander/rover mission, the upcoming ExoMars and InSight landing missions as well as future missions on Mars. They used an improved version of their array of meteorological sensors for the identification and monitoring of dust devils, which will enable the detection of smaller dust devils and comparison with data from future missions such as InSight. In addition to sensors for horizontal wind speed, vertical wind speed, wind direction, pressure, temperature, solar irradiation, magnetic field, and sound level, the team added a sensor for measuring the atmospheric electric field. In addition, six active dust devils were sampled collecting vertical grain size distributions within dust devils up to a height of 5 m.

Observed dust devil frequencies near Merzouga during the TA visit were very high compared to other regions where the researchers had previously conducted dust devil field work. Meteorological signatures of about 50 dust devils in the diameter range of 1 – 30 m were measured, which passed

directly over, between or close to one of the five logger stations.

Case study: Project No. 10586. Site visited: 15-21 September 2016 (access 4 person weeks).
Title: Mars analogue drills and laboratory analysis at dry, salty terrains to support ExoMars rover's activity, workflow optimization and later interpretation.
Applicants: Dr. Akos Kereszturi and Dr. Gabor Ujvari from Research Centre for Astronomy and Earth Sciences (MTA CSFK), Csatkai, Hungary.

EPN2020-RI TA1 enabled a Hungarian team to undertake 7-days field work organized by the Ibn Battuta Centre in Morocco. They visited 65 potentially interesting sites (most of them imaged only) along a route from Marrakesh to Ouarzazate, Erfoud, Zagora and back to Ouarzazate and Marrakesh. Altogether 572 images were taken, two thirds of them for correlation analysis with GoogleMaps-based data aimed at improving site evaluation by comparing remote sensing and in-situ information. Samples were collected at five sites, including sampling after drilling at four sites. At these sites borehole walls were imaged by a probe and nearby open air outcrops were imaged using a commercially available camera. The acquired samples are to be investigated using an optical microscope, FTIR and Raman spectrometers at the Hungarian home institute. Establishing such complex datasets is aimed at providing suggestions for targeting and interpreting ExoMars rovers' drilling and laboratory analysis activities, especially for identifying and discriminating fluvial and aeolian transport modes on Mars.

Case study: Project No. 16-EPN2-007. Site visited: 2-9 October 2016 (access 2 person weeks)
Title: The Azrou Plateau (Middle Atlas, Morocco): a perfect terrestrial analogue for studying both karst and lava tube collapses with remote sensing techniques and field geology.
Applicants: Prof. Jo De Waele from Italian Institute of Speleology, Universita' di Bologna, Italy and Dr. Maria Teresa Melis from Dipartimento di Sciense Chimiche e Geologiche, Universita' di Cagliari, Italy.

EPN2020-RI TA1 enabled a team from Cagliari and Bologna universities to visit several collapsed features that are linked to a complex system of lava tubes in a basalt plateau in the Middle Atlas area near Azroou. This area provides a perfect terrestrial analogue for studying both karst and lava tube collapses with remote sensing techniques and field geology. In preparation for the field trip to Morocco, the area was mapped using geo-referenced Google Earth images and geological data derived from Landsat and Sentinel-2 imagery, and over 300 sinkhole features identified. During the field work, almost 150 of these giant collapses were visited. Maximum and minimum diameters were measured with an optical range finder and clinometer. These data were then compared with the remote sensing data, which enabled a more detailed redefinition of the geological limits and the dimensions of the mapped sinkholes. Three main morphological types of caprock sinkholes were identified: bowl-shaped with a concave or a flat bottom, asymmetric sinkholes, and funnel-shaped sinkholes with vertical walls. Both collapse and sagging sinkholes were found to be present, including spectacular collapse sinkholes that reach diameters of more than 200 m and depths up to 67 m.

Case study: Project No. 16-EPN2-024. Site visited: 1-15 February 2017 (access 4 person weeks).
Title: Astrobiological potential of microbial biogeomorphology in arid, evaporite-dominated environments: an aid to the use of image spectrometers in future landed missions on Mars
Applicants: Prof. Roberto Barbieri and Dr. Barbara Cavalazzi from Dipartimento Scienze Biologiche, Geologiche e Ambientali dell' Universita' di Bologna, Italy.

EPN2020-RI TA1 enabled researchers from the University of Bologna University to investigate, from an astrobiological perspective, surface morphologies produced during on-going, mixed sulphate-

carbonate mineral precipitations in the Sabkha Oum Dba of the Western Sahara, approximately 45 km north of the city of Laayoune. This study of microbial biogeomorphology in an arid, evaporite-dominated environment will support the use of image spectrometers in future lander missions on Mars. Thanks to a relatively easy access, the field observation and samplings were optimally performed throughout the entire period. Following field observations, description of the environmental contexts, and physical measurements, samples were taken of both fresh (i.e. living) and fossil (carbonates and evaporite deposits) materials. Samples were safely transported to the laboratory in Bologna for further analysis.

Task 2.3- The glacial and volcanically active areas of Iceland, Iceland (MATIS)

Three successful applications were made in the first call to access the TA1: Planetary Field Analogue Site "The glacial and volcanically active areas of Iceland", and one in the second call (Table 12). The third call is currently ongoing and as for the previous calls, the Icelandic TA site representatives are in contact with multiple potential applicants to assist them with their proposals in regard to site accessibility and logistics.

Table 17 - Completed external users visits during first periodic report to the Icelandic TA-RI site.

ESF Project No.	**Title**	**Applicant organisation**	**Country**	**Site visit**
15-EPN-039	Field Exploration and Life Detection Sampling for Planetary and Astrobiology Research (FELDSPAR)	Cranfield University	U.K.	6-15 July 2016

Case study: Project No. 15- EPN-039. Site visited: 6-15 July 2016 (4 person weeks)
Title: Field Exploration and Life Detection Sampling for Planetary and Astrobiology Research (FELDSPAR
Applicant: David Cullen Cranfield University, UK.

The "Field Exploration and Life Detection Sampling for Planetary and Astrobiology Research" (FELDSPAR) project is an on-going multi-year collaboration between various international groups to exploit Icelandic lava field sites as analogues of rover field sites on Mars. The core objective of the study is to use a cascade of analytical techniques to simulate those used during rover operations and comprising (i) non-contact observations – e.g. Mars orbital and rover based remote sensing, (ii) rover contact instruments with ability to analyse only a small number of samples and (iii) selection of samples for caching for Earth return and post-return analysis.

EPN2020-RI TA1 enabled researchers from Cranfield University and Stockholm University, Sweden to participate in the 2016 FELDSPAR field campaign and explore new lava field sites in north-east Iceland for inclusion in future FELDSPAR field campaigns. A variety of field sites in north-east Iceland – specifically Holuhraun (Nornahraun) and Krafla lava field, Dyngjusandur sand field, Hverfjall and Ludentarskáli explosion craters – were explored and sampled.

During the campaign, a range of sites were surveyed using quadcopter drone collected imagery, a portable UV-visible spectrometer, in field assessment of biomarkers (ATP using bioluminescence ATP assay kits) and samples were collected for post-campaign analysis in institutional laboratories.

Post field campaign activities will include collating the various analytical datasets, identification of appropriate samples for bio-signature analysis, planning of future campaigns and the down-selection of the expanded set of potential field sites. Results from the 2016 FELDSPAR campaign will be included in both conference presentations and peer-reviewed publications.

Task 2.4-Tirez Lake (INTA)

Access not open in RP1

Task 2.5-Danakil Depression, Ethiopia (IRSPS)

Access not open in RP1

WP2 (TA 1: Planetary Field Analogues)-Deliverables

D2.1 and D2.4 provide additional details on Transnational Access to Planetary Field Analogue Sites provided by EPN2020-RI through the TA1 calls

D2.1 1st call for TA1 Facilities. Planned and submitted at Month 3

D2.2 1st call Proposals evaluated and access approved for the TA Facilities. Planned and submitted at Month 6. For a full version of the deliverable (with sensitive information) please refer to the EU portal (or the private area of the website) and see below.

D2.3 Annual Report of TA1 Access. Planned and submitted at Month 12

D2.4 2nd call for TA1 Facilities. Planned at Month 13 and submitted at Month 11

D2.5 2nd call Proposals evaluated and access approved for the TA1 Facilities. Planned at Month 15 and submitted at Month 11. For a full version of the deliverable (with sensitive information) please refer to the EU portal or the private area of the website.

D2.2 and D2.5 included lists, ordered by mark given by the panel and contain the following information:

- IdProp – Original reference number
- ProjectNumber – ESF reference number
- Title
- Project leader name and contact details
- Ranking
- Final Score

See section 1.2 and EU portal (or the private area of the website) for full details.

WP2 (TA 1: Planetary Field Analogues)-Milestones

MS15 Issue of 1st call for access to the TA facilities. See WP1

MS16 Issue of 2nd call for access to the TA facilities. See WP1

MS19 1st Sustainability review for the TA. See WP1

MS27 Completion and review of first round of TA Projects. See WP1

MS17 Issue of 3rd call for access to the TA facilities. See WP1

1.3 Impact

1.3.1 Dissemination

A web page devoted to TA1 activities has been set up, which is now online and accessible to the community.
Results are being published for the benefit of the science and general public communities e.g. a paper by Lisset Gavilan on the use of minerals from Mars analogue sites at increasing oxidation state to explore how oxidized aerosols could affect Mars climate is being prepared for publication. Other communication campaigns are also planned to present results at workshops and congresses.

A full list of dissemination activities can be found in **Table 32**.

Ongoing Studies and Upgrades to the Rio Tinto Facility

Regular studies on the physical-chemical parameters of the Rio Tinto water are carried out seasonally. At the same time, new sites of astrobiological interest are being located in order to provide the external users new opportunities for their own science.

Upgrades to the Ibn Battuta Field Facility

Some of the TA proposals have involved some complex, operational activities with a large impact on local logistics. In order to support these needs and hence improve the impact of Europlanet on the community, a field facility has been prepared at no cost to the EPN2020-RI project. The use of this facility will be will be within the estimated cost of single access.

In a parallel effort, IRSPS has built, along with the Hotel Kasbah Xaluca, a facility consisting of two large workshops, storage room, offices, recreational rooms and kitchen. A satellite connection provides WIFI Internet. An area for download and upload of trucks was established next to a large parking area and connected by a cement pathway to the workshop and helipad.

Figure 8 - The Ibn Battuta Field Facility

The facility has already been used for large and complex operation for the simulation of the landing system for both 2016 (no longer available) and 2020 Exomars missions and other activities. The facility, created with an independent budget will be available for Europlanet activities and will be particularly suitable for industrial applications.

Identification and analysis of further sites

It is important that EPN2020-RI can provide potential users with new planetary analogue sites to increase the scientific possibilities and improve the scope of Ibn Battuta's capability to represent scientific and technological analogues. Hence during TA visits, the research centre team has explored the area of Zagora and identified several scientific targets for both astrobiological and geological purposes. In addition, some sites large-scale simulations and operations have been identified. The area north of Tata has features (Precambrian conglomerates) that may mimic catastrophic flooding similar to the cataclysmic flows that formed outflow channels on Mars. Other new sites include the lava tubes of the Azrou area and coastal deposits and paleovalleys along the coast of the Atlantic Ocean South of Sidi Ifni. The identification of new sites is on-going. The continued development of additional facilities and the recognition of new environments analogous to extra-terrestrial conditions is part of the strategy to ensure that the facilities continue to be extensively utilised after the completion of Europlanet 2020-RI.

3. WP3 - TA 2: Distributed Planetary Simulation Facility - DPSF

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

The main goal of TA2 (Distributed Planetary Simulation Facility – DPSF) is to give European and international scientists access to seven world-leading laboratory facilities for planetary studies. The urgent requirement for access to these facilities is that Europe is operating, preparing and planning a fleet of spacecraft to investigate – amongst others - the surface and atmospheric environments and compositions of Mercury, Venus, comets, Mars, Jupiter, Saturn and their icy moons Titan, Enceladus, Ganymede and Europa; i.e., related to the extremely successful Cassini mission that is about to complete its study of the Saturn system, the JUICE mission to the Jupiter system and BepiColombo mission to Mercury scheduled for launch in 2018. These disparate bodies are made up of remarkably diverse environments, many totally incomparable to terrestrial conditions. The expanding planetary exploration programme is generating an increasing demand for simulation facilities from European scientific and industrial communities to aid with key mission goals, instrument design, validation of instrument performance, as well as to obtain a better understanding of the physical-geological processes that formed specific planetary environments and the biogeochemical processes that control the likelihood that life could evolve or survive. To address this demand DPSF has retained the three laboratories most in demand in previous Europlanet-RI (The Planetary Spectroscopy Laboratory (PSL), DLR, Germany; the Planetary Environment Facility (PEF) , Arhus, Denmark; and The Large Mars Chamber Facility (LMC), Open University, UK), all of which have introduced new infrastructure and expanded their methodologies since 2008. Four new laboratories have been added, extending the capabilities to include spectroscopy in low temperature environments, life detection techniques, high temperature and pressure petrology and petrology-geochemical characterisation techniques. The three laboratories that were part of the previous Europlanet-RI allow visitors to measure samples under analogue conditions of Mercury, Venus, Mars, the Moon and near-Earth asteroids. The new low temperature spectroscopy laboratory (Cold Surface Spectroscopy, IPAG, France) have extended capabilities to comets and the icy moons of the outer planets. The added life detection techniques (Interactive Microbiome Research Facility, Graz, Austria) support the study of terrestrial extremophiles educating us about the range of potential habitable environments in the Solar System. The new high temperature and pressure petrology laboratory (High pressure Facility, Amsterdam, Netherlands) extends studies from the planetary surface to the workings of planetary interiors and ultimately to the evolution of planets. Finally the computer tomography facility (Natural History Museum, London, UK) provides high quality geochemical imaging data of samples returned from space and allow detailed comparisons with analogue studies. DPSF provides major synergies between the laboratories, allows the use of multi-disciplinary approaches and gives the European scientific community access to a wide range of world leading technologies and in many cases unique methodologies.

The main aim of the WP3 facilities is to guarantee that TA access is organised and implemented efficiently. The overall goal is to provide the facilities and technical support to generate new data that ultimately results in high quality publications in peer reviewed journals. In addition the wider implications of the research will be widely disseminated to the general public and policy makers.

JRA 2 is introducing new capabilities at 3 TA 2 facilities: the Planetary Spectroscopy Laboratory (DLR), Cold Surfaces spectroscopy facility (IPAG) and Planetary Environment Facilities at Aarhus University. The new capabilities are already partly available and will become fully available for access in late 2017. Hence increased usage of these TA 2 facilities is expected in the second half of the project.

1.2 Explanation of the work

Detailed description of work

The seven TA host institutions all actively contributed to generating publicity about the calls for access to the TA facilities. This was achieved by distributing flyers at international conferences and e-mail forums dedicated to planetary science. Details of the application procedure for the TA facilities that allows for a rigorous appraisal of the scientific impact is detailed in previous sections. So far 45 proposals have been approved, with 20 in the first call and 25 in the second call. All seven facilities have at least one application and 6 had approved proposals. Apart from the High Pressure Facility all facilities already have hosted several visitors and more visits are arranged over the next 6 months. Work common to all facilities has included support for visitors in the form of organising accommodation arranging re-imbursement of expenses.

Full details of the individual calls completed can be found at the Europlanet2020 RI website (http://www.europlanet-2020-ri.eu/research-infrastructure/public-deliverables) along with reports submitted and approved at the completion of the individual visit, which have been stored in a private part of the website. The amount of data and the wide range of research performed at the seven facilities cannot be fully displayed in this summary report. For the sake of brevity, we will highlight here only some examples of research undertaken at each Facility.

Task 3.1: Planetary Spectroscopy Laboratory, Institute for Planetary Research, DLR, Berlin, Germany

Table 18 - Completed visits from the first and second TA call at the Planetary Spectroscopy Laboratory

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-027	Thermal alteration of CI and CM chondrites: links to primitive C-type asteroid surfaces	Natural History Museum	UK	2016/06/06 - 10
16-EPN2-063	Spectroscopy of primitive meteorites and the nature of dark asteroids	Institut de Planétologie et d'Astrophysique de Grenoble	France	2017/01/09-20
15-EPN-022	Spectroscopy of epithermal ore minerals: clues for the detection of past and present shallow depth hydrothermal activity on Mars.	University of Padova	Italy	2017/01/23-27
15-EPN2-044	Modelling of reflectance spectra of asteroids	University of Edinburgh	UK	2016/11/21-25

Case study: Project No. 15-EPN-027. Site visited 6-10 June 2016 (access 5 person days)
Title: Thermal alteration of CI and CM chondrites: links to primitive C-type asteroid surfaces
Applicant: Ashley King, Natural History Museum, UK

Carbonaceous chondrite meteorites are thought to derive from primitive, carbon-rich carbonaceous (C-type) asteroids that inhabit the outer edges of the asteroid belt. As the surfaces of many C-type asteroids are the focus of several current and future space missions (e.g. Dawn, Hayabusa-2 and OSIRIS-REx), it has become important to systematically characterise the spectral properties to understand the processes that formed them and to help interpret in-situ mission observations.

EPN2020 RI has enabled researchers from the Natural History Museum, London, UK, to use the

Planetary Emissivity Laboratory at the Institute of Planetary Research, German Aerospace Center (DLR) to analyse the reflectance spectra of heated powders derived from 16 carbonaceous chondrite meteorites (CI and CM). The aim is to relate spectral features visible, near- and mid-infrared to the known properties (e.g. H_2O content etc.) and inferred alteration history of the meteorites. Previous studies had shown that the carbonaceous chondrites sampled had experienced low temperature (<150°C) aqueous alteration followed by thermal metamorphism (300 - 1000°C). Spectra for each meteorite powder were obtained at phase angles expected to mimic observations by the Hayabusa-2 and OSIRIS-REx spacecraft.

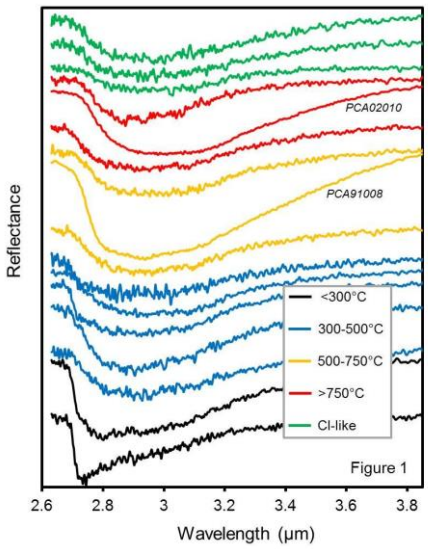

Figure 9 - Thermal metamorphism dehydrates phyllosilicates – here shown is the depth of the 3 µm band, resulting from -OH/H_2O, decreasing with peak metamorphic temperature. Figure produced during the site visit

Initial processing of the spectra has focused on the visible and near-infrared as this is the region in which asteroids are typically observed. Preliminary findings have given insights into the effects of metamorphic temperature on iron oxidation states and hydration in phyllosilicates. The next step is to examine in detail the mid-IR spectra, which should allow observing the effects of phyllosilicate dehydration and recrystallization of silicates.

Task 3.2: Interactive Microbiome Research Facility (IMRF) Medical University Graz (MUG), Centre for Medical Research (ZMF), Graz, Austria.

Table 19 - Completed visits from the first and second TA call at the IMRF

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-004	Studying the effect of abraded silicates on the survival of clean room isolates	Aarhus University	Denmark	2016/06/05 - 20
15-EPN-011	Microbial diversity under extreme conditions: A case study in the salt and sulphur springs of the Dallol, Danakil Depression, Ethiopia	Università di Bologna	Italy	2016/06/27 - 2016/07/01

15-EPN-029	The microbial diversity of the astrobiological significant Santa Cesarea Caves in Apulia, Italy	DLR	Germany	2016/05/23 - 2016/05/27
15-EPN-044	MICHAmolecular – bacterial and archaeal inventory in a confined spacecraft mock-up during the MARS 500 project	DLR	Germany	2016/08/08–12

Case Study: Project No. 15-EPN-044. Site visited: 8-12 August 2016 (access 5 person days)
Title: MICHAmolecular – bacterial and archaeal inventory in a confined spacecraft mock-up during the MARS 500 project
Applicant: Petra Schwendner, DLR, Germany

MARS 500 is the first full duration simulation of a manned flight to Mars with international crews of women and men. The third stage of the mission was accomplished from June of 2010 to November of 2011 (www.mars500.imbp.ru) with a crew of six men. One of the scientific experiments MICHAm (MIcrobial ecology of Confined Habitats and humAn health, modified) conducted during this project aimed to survey the cultivable microbial flora in three modules (EU-100, EU-150 and EU-250) of the MARS 500 facility from the start to the end of the simulation study, and to investigate the impact of confinement. As only 1 % of all microorganisms is cultivable, in this project the whole microbial community structure was investigated to provide a more realistic and comprehensive estimation of the microbial species present in manned habitats. A mapping file which provides per-sample metadata containing environmental data like CO_2, O_2, temperature and humidity as well as data obtained from the cultivation e.g. average Colony Forming Units (CFU) of bioburden and vegetatives from surface samples per module as well as average CFU of vegetative cell count from air samples per module. The study of the microbiome in a confined habitat, where exchange with the exterior is completely prevented, presented a unique opportunity to unveil bacterial behaviour, proliferation, and survivability over a long time of isolation.

EPN2020-RI TA2 enabled researchers from DLR to investigate swab and DNA samples from the MARS 500 modules at the Interactive Microbiome Research Facility (IMRF) Medical University Graz. The swab and DNA samples were delivered to the Medical University of Graz in a frozen state and, prior to the TA visit, DNA was successfully extracted from the swabs.

Both bacterial and archaeal gene signatures were detected. Looking at the overall phylogenetic data of all samples on phylum level, a similar pattern was obtained for all samples from the different modules over the whole period of confinement. In addition, significant differences that were module-specific were identified. This project obtained insights in the microorganisms' origin, the microbial community structure of their routes and frequencies and thus will facilitate making risk assessments for human's health in confined habitats.

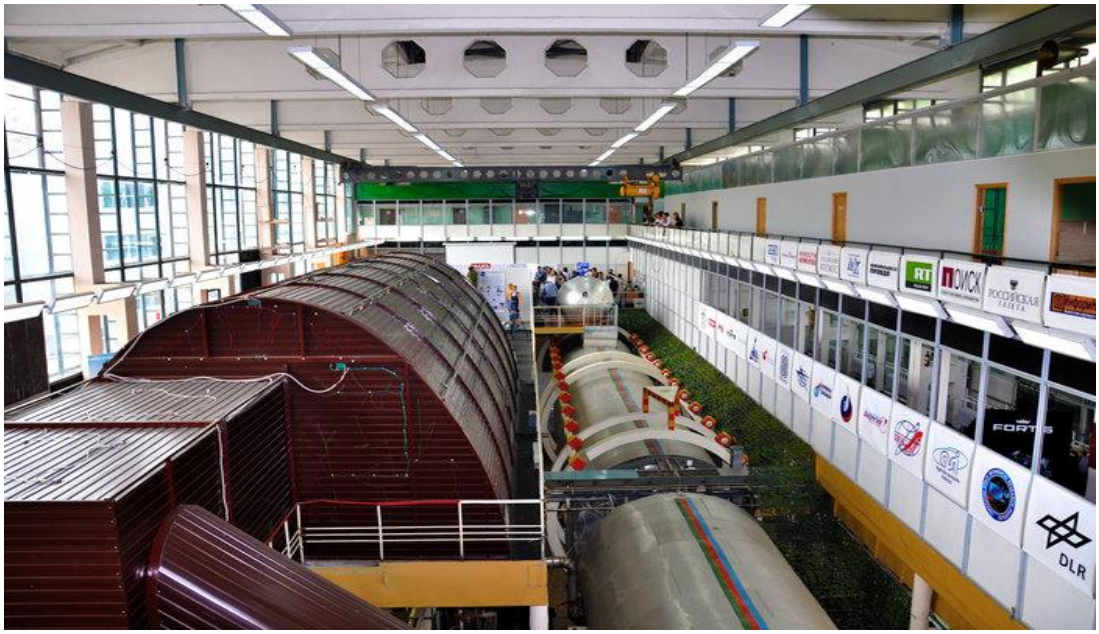

Figure 10 - An exterior view of the isolation facility at the Russian Institute of Biomedical Problems in Moscow where the Mars 500 simulation took place. Credit: ESA

Task 3.3: Planetary Environment Facilities at Aarhus University, Denmark

Table 20 - Completed visits from the first and second TA call at the Planetary Environment Facilities

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-003	High-speed imaging of gas-particle and particle-particle interactions in lab-sized volcanic jets/plumes	Istituto Nazionale di Geofisica e Vulcanologia	Italy	2016/06/20-24
15-EPN-008	Passive Acoustic Planetary Anemometer (PAPA)	Johns Hopkins Applied Physics Laboratory	USA	2016/09/26 - 30
15-EPN-023	DREXS: DReams EXperiment Simulation in Martian like environment	INAF-Osservatorio Astronomico di Capodimonte	Italy	2016/06/26 - 2016/07/02
15-EPN-026	Properties of CO2 slab ice: filling the gaps in understanding of Martian polar regions	Physikalisches Institut der Universität Bern	Switzerland	2016/06/05 - 11
15-EPN-016	3-D spherical thermal anemometer for Mars surface	Universidad Politécnica de Cataluña (UPC)	Spain	2016/11/21 - 2016/12/02
15-EPN-005	Experimental analysis of high-speed free jets at low Reynolds number	Technische Universität Berlin	Germany	2017/01/09 - 13

Case Study: Project No. 15-EPN-003. Site visited: 20-24 June 2016 (access 5 person days)
Title: High-speed imaging of gas-particle and particle-particle interactions in lab-sized volcanic jets/plumes
Applicant: Jacopo Taddeucci, Istituto Nazionale di Geofisica e Vulcanologia, Italy

The remobilization of volcanic ash from the ground is one of the many problems posing threat to life and infrastructures during and after the course of an explosive volcanic eruption. A proper management of the risks connected to this problem requires a thorough understanding of the factors that influence and promote the dispersal of particles over large distances.

EPN2020-RI TA2 enabled a series of experiments with state-of-the art high-speed imaging equipment from INGV in the environmental wind tunnel facility at Aarhus University to define processes controlling the remobilization threshold of ash particles by wind erosion. The experiments captured at unparalleled temporal and spatial resolution the removal dynamics of ash-sized (0.5 mm to micrometre-sized) particles.

A homogenous layer of particles was set up on a plate placed downwind from a boundary layer setup. Resuspension processes were filmed at 2000 frames per second and 50 micrometre pixel resolution, and the plate weighed pre and post-experiment. The experiments investigated the effects of wind speeds, boundary layer structure, the size, chemical and textural features of grains, temperature and humidity, by conducting experiments either at ambient conditions or with a heated sample. Grains included basalt and trachyte samples from Campi Flegrei (Pomici Principali eruption 10,000 years ago) and Eyjafjallajökull (May 2010) eruptions.

It was found that the grain size distribution exerts a strong control on the fundamental dynamics of gas-particle coupling. Particles larger than 90 micrometres detach from the particles layer individually, also entering the gas flow individually. Conversely, particles smaller than 63 micrometres are removed in clumps of aggregates. These clumps, once taken in charge by the gas flow, are frequently disaggregated and dispersed rapidly (order of few milliseconds). Preliminary results show that, for a given size distribution, the boundary between the two dynamics may shift greatly as a function of ambient humidity.

Task 3.4: Cold Surfaces spectroscopy, Institut de Planétologie et Astrophysique de Grenoble (IPAG) Grenoble France

Table 21- Completed visits from the first and second TA call at the Cold Surfaces Spectroscopy Facility

ESF Project No.	**Title**	**Applicant organisation**	**Country**	**Site visit**
16-EPN2-026	Near- and mid- infrared spectroscopy of icy planetary/cometary analogue matter	University of Bern	Switzerland	2016/10/17-28
16-EPN2-028	Characterization of Hydrated Na-Carbonates at Cold Planetary Conditions	INAF-IAPS	Italy	2016/11/14 - 18

Case Study: Project No. 16-EPN2-026. Site visited: 17-28 October 2016 (access 10 person days)
Title: Near- and mid-infrared spectroscopy of icy planetary/cometary analogue matter
Applicant: Oliver Poch, University of Bern

Well-characterized samples of water ice/dust mixtures with different dust-to-water mass ratios provide very valuable data for the interpretation of the observations of past, current and future space missions exploring icy/dust objects such as the Rosetta mission to 67P/Churyumov-Gerasimenko and the JUpiter Icy moons Explorer (JUICE) mission to Jupiter's system and in particular its icy moons. These data also provide useful references to test radiative transfer models.

EPN2020-RI enabled researchers to use the Cold Surfaces Spectroscopy Facility at IPAG to measure the reflectance spectra of surface samples of water ice and dust particles produced with the SPIPA machines (Setups for the Preparation of Icy Planetary Analogues) developed at the University of Bern. The SPIPA machines were transported from Bern to Grenoble in order to prepare well-characterized samples in reproducible ways.

Mixtures were prepared with different dust-to-water mass ratios (0.01 and 0.1) and using different methods to mix the ice and the dust (intra- and inter- mixtures). Anthracite dust was mixed with the water ice because this material has a nearly featureless spectrum over the range of wavelengths studied (0.7 to 4 µm), enabling precise characterisation of how the dust affects the water ice spectral features in the visible and infrared ranges (Figure 13). About 30 spectra of 10 different samples (at 173K) have been obtained including pure water ice particles of different size distributions, and their mixtures with anthracite dust (Table 18).

Table 22 - Samples whose reflectance spectra were measured during this TNA visit

N°	Sample description	Size distribution		Temperature
		water ice	anthracite dust	
1	Pure water ice particles	4.5 ± 2.5 µm	N.A.	173 K
2	Pure water ice particles	67 ± 32 µm	N.A.	173 K
3	Pure water ice particles	67 ± 32 µm	N.A.	223 K
4	Pure water ice particles	5-100 µm*	N.A.	173 K
5	Pure anthracite	N.A.	< 25 µm	173 K
6	Intra-mixture of water and 1% anthracite	67 ± 32 µm	< 25 µm	173 K
7	Intra-mixture of water and 10% anthracite	67 ± 32 µm	< 25 µm	173 K
8	Inter-mixture of water and 1% anthracite	67 ± 32 µm	< 25 µm	173 K
9	Inter-mixture of water and 10% anthracite	67 ± 32 µm	< 25 µm	173 K
10	Inter-mixture of water and 1% anthracite	4.5 ± 2.5 µm	< 25 µm	173 K

Results revealed that the shape, depth, brightness and amplitude of reflectance spectra are influenced by both different particle size distributions in the pure water ice samples and by different concentrations and mixing of water and dust. For instance, there is a peak at 3.7 micrometres in the pure water ice spectra where micrometre-sized particles are present but no peak where there are only larger particles.

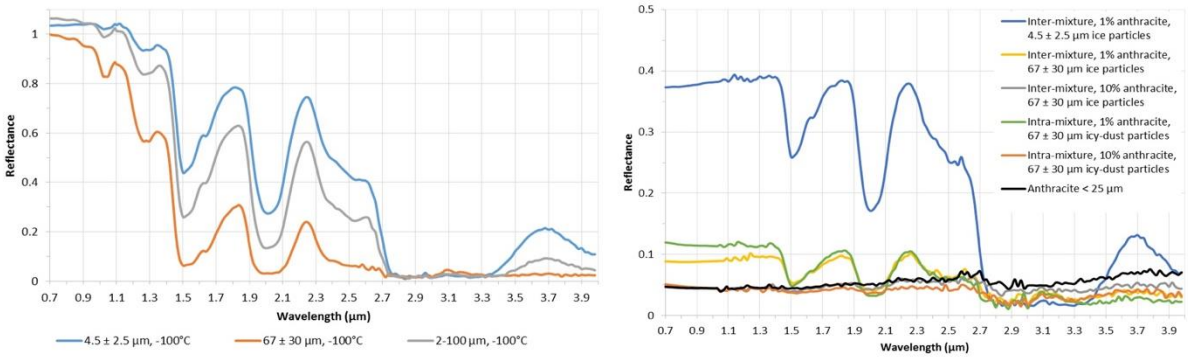

Figure 11 - Left: Reflectance spectra of pure water ice particles with different size distribution. Right: Reflectance spectra of surfaces mixtures of water ice and anthracite particles

Based on the success of this visit and the need of such laboratory reference measurements for the community, a future campaign of measurements on this facility is planned. This new campaign would complete the systematic study started in this visit and characterise the evolution of these icy-dust samples during sublimation of the ice, especially with a dust composition closer to a cometary one, in order to help the interpretation of Rosetta OSIRIS/VIRTIS data.

Task 3.5: High-Pressure, High-Temperature Laboratory (HPHTL), Geology and Geochemistry, VU University Amsterdam.

During the reporting period this facility had only one application which was not funded. We believe this was due to lack of visibility of the unique capabilities offered by this facility and additional efforts are being made to make applicants aware of this opportunity and to induce future applications.

Task 3.6: Large Mars Chamber Facility (LMCF), Open University, Milton Keynes, United Kingdom

Table 23 - Completed visits from the first and second TA call at the LMCF

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-019	The Role Of Transient Liquid Water In Present-Day Landscape Evolution On Mars	University of Paris-Sud	France	2016-09-22- to 2016-12-23
15-EPN-020	Laboratory Investigation Of Downslope Sediment Transport On Mars And The Influence Of Boiling	University of Nantes	France	2016-06-05 to 2016-07-06

Case Study: Project No. 15-EPN-019. Site visited: 22/09/2016 - 23/12/2016 (access 5 person days)
Title: The Role Of Transient Liquid Water In Present-Day Landscape Evolution On Mars
Applicant: Clémence Herny, University of Paris-Sud, France

Many of the present-day processes that trigger seasonal changes in surface morphology on Mars could involve the presence of transient liquid water at or near the surface. The potential presence of liquid

water on the Martian surface in the present-day has implications for the habitability of Mars. To understand if liquid water is involved in present-day activity on Mars surface, it is essential to perform experiments to study the behaviour of meta-stable water under low atmospheric pressure and its impact on surface topography.

EPN2020-RI TA2 enabled researchers to perform water flow experiments at low atmospheric pressure (7mb) in the Mars Chamber at The Open University, Milton Keynes, UK and at Earth atmospheric pressure in the Cold Chamber at the Paris-Sud University, Orsay, France.

The influence of (1) liquid water to sediment ratio on the behaviour of meta-stable water flows on Mars and (2) the atmospheric pressure on the behaviour of water-sediment flows were compared in each environment. A reservoir which contained a known sediment-water mixture was positioned at the top of a 20° slope (representing a permafrost sub-surface) containing a 1-2 mm thick layer of dry sand.

For the 80 experiments completed, flow velocity was monitored on video using one internal and two external cameras. Right after each experiment, the chamber was returned to atmospheric pressure, while pictures and measurements were taken manually of the morphologic features (runout length and the length of the alcove, channel, and deposits). The videos and photos have been used to analyse qualitatively the behaviour of the flow.

First results show that:

- Morphological flows at low atmospheric pressures show differences with experiments performed under Earth atmospheric pressure. Under Martian atmospheric pressure, (1) a liquid flow composed of an alcove, a channel and a debris apron and (2) several linear flows with no alcove, a long and linear channel and a sand bloc on the debris apron, were observed. This last type of morphology has never been reproduced under Earth atmospheric conditions.
- The width of the flow decreased and then increased with the increase of water volume involved.
- The number of linear gullies and their length increased with the water volume (under Martian atmospheric conditions).
- The length and width of the flows are similar under terrestrial and Martian atmospheric pressure.
- The water volume has more influence than the sand volume on the flow morphology.

These exciting data will be presented at the forthcoming EPSC meeting and are expected to lead to a publication is in preparation.

Task 3.7: Petrology-Mineralogy Characterisation Facility (PMCF), Mineral and Planetary Sciences Division, Natural History Museum, London, UK

Table 24 - Completed visits from the first and second TA call at the PMCF

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-041	Solar System forensics: Possible supernovae fingerprints in the earliest solids	University of Münster	Germany	2016/08/22-26
16-EPN2-057	Characterisation of extraterrestrial component (ETC) carrier phases in Archean spherule layer material from the Barberton Greenstone Belt, South Africa, by means of high-resolution FE-SEM/EDX.	Museum für Naturkunde Berlin	Germany	2016/11/09-23

Case Study: Project No. 15-EPN-041. Site visited: 22-26 August 2016 (access 5 person days)
Title: Solar System forensics: Possible supernovae fingerprints in the earliest solids
Applicant: Gregory Brennecka, University of Münster, Germany

Calcium-aluminium-rich inclusions (CAIs) were the first solids to condense in the protoplanetary disk. CAIs in carbonaceous chondrite meteorites provide us with a glimpse of the earliest reservoir(s) present in the Solar System and an opportunity to better understand their origin and evolution.

EPN2020-RI TA2 enabled researchers from the University of Münster to access the PCMF at the Natural History Museum, London, to carry out petrological characterization of four CAIs from four different carbonaceous chondrites, as well as locating CAIs in a further (CM2) chondrite, and to combine with previously obtained isotopic data of CAIs. Combining the petrologic and isotopic information of all analysed CAI samples should give insights into the earliest epoch of our Solar System and potentially reveal the degree of isotopic homogenization of the CAI-forming region, how material was transported/mixed, and if supernova input influenced the formation of our Solar System.

Secondary and backscatter electron images of the four CAI samples were taken and high-resolution elemental maps were produced, enabling the calculation of bulk chemical compositions and identification of individual minerals in these CAIs.

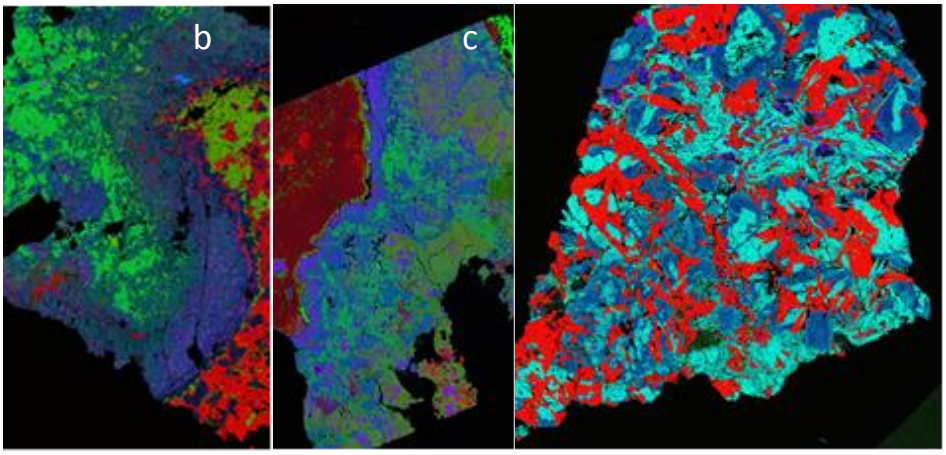

Figure 12 - X-ray elemental maps of the analysed samples (red = Mg, green = Ca, blue = Al). Typical minerals in the (a) Type C and (b) Type B CAIs include spinel, anorthite, and melilite. The Al-rich chondrule (c) is mostly composed of olivine and two different plagioclase phases (An_{25} and An_{90}) but also contains grossular and spinel.

Large area elemental mapping of several slices of the CM2 chondrite, Jbilet Winselwan, led to the identification of at least 50 objects of interest with high calcium and aluminium concentrations. The elemental maps will be used to drill out and isotopically analyse these presumed CAIs to establish a representative suite of isotopic compositions for CAIs from CM chondrites.

Petrologic data combined with isotopic data from samples (CV3 and CK3 inclusions) are currently being written up for publication and will be submitted to an international journal in the cosmochemistry community and presented at international meetings (e.g. LPSC 2017). Furthermore, petrologic and isotopic data of the analysed CAIs will be used to constrain links to their host meteorites and present these findings as well. An abstract and publication in an international journal will also arise for the CM CAIs once they have been micro-drilled and analysed at the home institution for isotopic studies

WP3 (TA 2: Distributed Planetary Simulation Facility)-Deliverables

D3.1 and D3.4 provide additional details on Transnational Access to Planetary Simulation Facilities provided by EPN2020-RI through the TA2 calls.

D3.1 - First call for TA2 facilities. Planned and submitted on month 3

D3.2 - 1st call: Proposals evaluated and access approved for the TA2 facilities. Planned and submitted on month 6. For a full version of the deliverable (with sensitive information) please refer to the EU portal (or the private area of the website) and see below for more details.

D3.3 - First Annual report of TA2 access. Planned and submitted on month 12

D3.4- Second call for TA2 facilities. Planned on month 13 and submitted on month 11

D3.5 - 2nd call: Proposals evaluated and access approved for the TA2 facilities. Planned on month 15 and submitted on month 11. For a full version of the deliverable (with sensitive information) please refer to the EU portal or the private area of the website.

D3.2 and D3.5 included lists are ordered by mark given by the panel and contain the following information:

- IdProp – Original reference number
- ProjectNumber – ESF reference number
- Title
- Project leader name and contact details
- Ranking
- Final Score

See section 1.2 and EU portal or the private area of the website for full details.

WP3 (TA 2: Distributed Planetary Simulation Facility)-Milestones

MS15 Issue of 1st call for access to the TA facilities. See WP1

MS16 Issue of 2nd call for access to the TA facilities. See WP1

MS19 1st Sustainability review for the TA. See WP1

MS27 Completion and review of first round of TA Projects. See WP1

MS17 Issue of 3rd call for access to the TA facilities. See WP1

1.3 Impact

The TA visits completed to date have already resulted in presentations at conferences, workshops and seminars (please refer to **Table 32**). Many more presentations are already scheduled for the next 6 months; e.g., forthcoming 48th Lunar and Planetary Science Conference (Houston, end March, 2017) and European Geoscience Union General Assembly (Vienna, end April, 2017). Results have also been presented at team meetings for the ESA Rosetta mission, ExoMars mission as well as the JAXA Hayabusa 2 mission. The first peer reviewed papers have been published (See **Table 32**) and several more are expected to be submitted in the next 6 months and published in early 2018. That date will mark the stage where there will be a major dissemination of the results to the broad scientific communities as well as public outreach.

4. WP4 - TA 3: Distributed Sample Analysis Facility (DSAF)

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

TA 3 (WP4) is designed to provide European and a limited number of international users, with access to four internationally renowned centres of excellence to enable state-of-the-art isotope geochemical analysis. “The Distributed Sample Analysis Facility (DSAF)” comprises national

facilities in France (CRPG), Germany (Münster), United Kingdom (OU) and the Netherlands (VUA) and offers the broad range of instrumentation required to quantify the complex (bio)geochemical cycles that control the formation and evolution of planetary bodies. Isotopic and geochemical analyses require sophisticated infrastructure and extensive academic and technical support. The combined infrastructure available within DSAF includes a past investment of ~ €40 M (excluding buildings) mainly sourced from national funding agencies. The entire distributed facility was assembled to provide the comprehensive capability to determine:

- isotopic and elemental analyses at high spatial resolution, down to ~3 nm,
- high precision (down to 5 ppm)
- high sensitivity (sub ng sample sizes).

The broad range of scientific disciplines included in Planetary Science requires that DSAF has the capability to support diverse research. DASAF therefore contains large national facilities with a reputation for multi-disciplinary research and hence the capability to support a wide range of research topics related to fundamental processes that led to the formation of the planetary bodies in the Solar System (e.g., accretion & differentiation processes), to atmospheric and hydrological process at the surface. The understanding of the latter is required to support researchers studying planetary analogues in field studies in their quest to understand habitability on Earth and potentially on other planets.

JRA 3 is introducing new capabilities for improved sample handling techniques (minimally destructive) and smaller sample size. The work will have impact on facilities at VU, OU, NHM (TA 2), and CRPG. The new capabilities are already partly available and will become fully available for access in late 2017. Hence increased usage of these TA 2 facilities is expected in the second half of the project.

The main goal of the facilities that comprises WP4 is to ensure that the visits by TA users are organised and implemented efficiently and that results obtained ultimately appear in peer reviewed journals so that the wider implications of the research are disseminated widely to policy makers.

1.2 Explanation of the work carried

The four TA hosts institutions have all contributed to the publicity associated with the calls for access to TA facilities. This was achieved at international conferences and through dedicated planetary science and geochemical e-mail forums. Details of the application procedure for the TA facilities that allows rigorous appraisal of the scientific impact is detailed in previous sections.

To date 31 proposals have been approved. Seven TA visits have been complete and reports delivered. One started visit requires a further visit due to a problem with an instrument. More than 20 visits are planned for the forthcoming 6-9 months.

Each of the TA 3 facilities has hosted at least one TA visit and arranged for several more to be conducted over the near future. The secretarial staff at the host institutions have helped to arrange accommodation for the visitors and re-imbursement expenses. The technical and academic staff have committed their time to training the TA users in sample preparation, instrument operation, detailed data interpretation and data storage protocols. An important additional activity of the TA host facilities is to advise the visitors in the preparation of a TA report and approve the final report. All reports are stored on the EPN2020-RI site where access is limited to the TA sub-board. Data will be made open access after 1 year of the report being filed unless the data contains commercially sensitive information. Exceptions will also be made where a PhD thesis is being prepared.

Full details of the individual calls completed can be found at the Europlanet2020 RI website (http://www.europlanet-2020-ri.eu/research-infrastructure/public-deliverables) along with reports submitted and approved at the completion of the individual visit, which have been stored in a private part of the website. Even to date, the amount of data produced and the breadth of subjects covered is too wide to attempt to present comprehensive coverage. This report therefore briefly summarises the tables available on the Europlanet 2020 RI website and highlights a case study one project undertaken at each of the four host facilities.

Detailed description of work

Task 4.1: Radiogenic and Non-Traditional Stable Isotope Facility: Geology and geochemistry, Faculty of Earth and Life Sciences, VU University, Amsterdam, NL

Table 25 - Completed visits from the first and second TA call at the Radiogenic and Non-Traditional Stable Isotope Facility, VU Amsterdam

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-015	COATS : Carbon Ocean Atmosphere Transfer in the Southern ocean	Laboratoire d'Océanologie et de Géosciences, Lille	France	May & June 2016

Case Study: Project No. 15-EPN-013. Site visited May & June 2016 (access 15 person days)
Title: COATS: Carbon Ocean Atmosphere Transfer in the Southern Ocean
Applicants: Mr François Beny (PhD student) and Dr Viviane Bout, Laboratoire d'Océanologie et de Géosciences, Lille, France

A better understanding of feed-back mechanisms between climate-erosion-chemical weathering and atmospheric CO_2 levels would improve the understanding of how quickly the atmosphere-ocean system responds to major changes in atmospheric CO_2 levels. This would provide input for predicting future conditions on Earth, as well as potentially gaining a better understanding of climatic conditions on other planets, e.g. early Mars and may potentially have implications for the runaway greenhouse conditions on Venus.

EPN2020-RI TA3 enabled researchers from the Laboratoire d'Océanologie et de Géosciences, Lille, France to access the Radiogenic and Non-Traditional Stable Isotope Facility at VU Amsterdam to analyse a sediment core obtained from the central Atlantic by the research vessel *Marion Dufresne* and sampled over a time period that covers the last interglacial maximum (LGM) until recently (approximately 25,000 years). The main objective was to reconstruct past atmosphere-ocean carbon exchange processes in the Southern ocean under contrasting climatic conditions by focusing on the role and fate of fine highly-reactive clay particles that are transported by ocean currents.

The distribution of clays on the different continental masses that bound the Atlantic and Antarctic Oceans (Figure 13) suggest that the different clays provenance will be found during the LGM compared to current ocean circulation. Specific sedimentary inputs have distinct radiogenic isotope compositions and clay mineralogy. The Nd-Sr-Pb isotopic systems were used in order to characterize the provenance of clay particles and to quantify the respective contribution of distinct sources. The models for how ocean circulation is thought to differ between today and the last glacial maximum are shown in **Figure 13** and **Figure 14**, along with the sampling site.

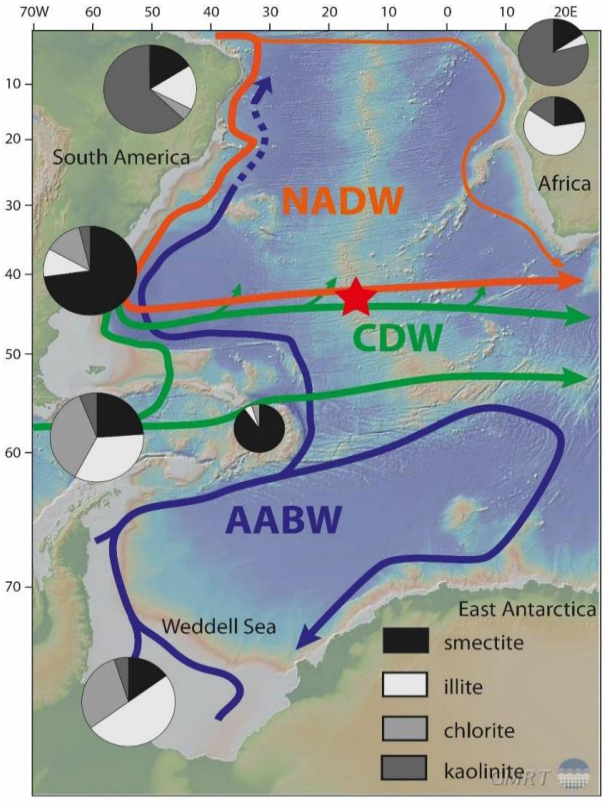

Figure 13 - Simplified sketch of modern deep ocean water circulation and clay mineral compositions. Sampling site shown by red star. North Atlantic Deep Water (NADW), Circumpolar Deep Water (CDW), Antarctic Bottom Water (AABW). Figure provided by Viviane Bout, University of Lille, PI of the TA application.

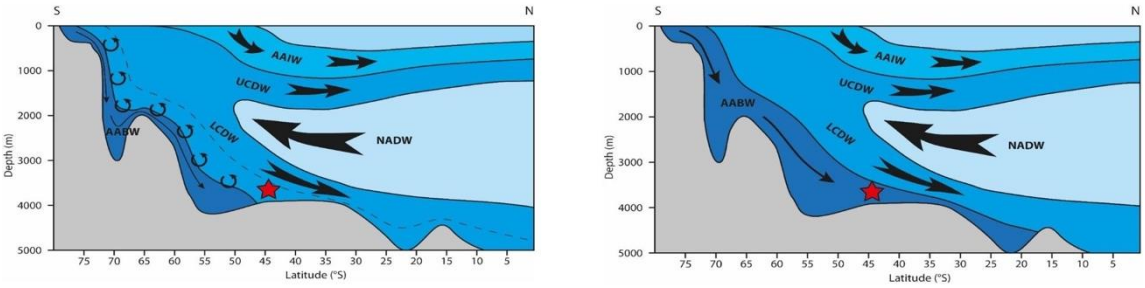

Figure 14 - (Left) Modern oceanic circulation showing the major mixing of the Antarctic Bottom Water (AABW) and Lower Circumpolar Deep Water (LCDW). Sampling site shown by red star. Upper Circumpolar Deep Water (UCDW). Antarctic Intermediate Water (AAIW); (Right) Possible oceanic circulation during the last glacial maximum. Figure provided by Viviane Bout, University of Lille, PI of the TA application.

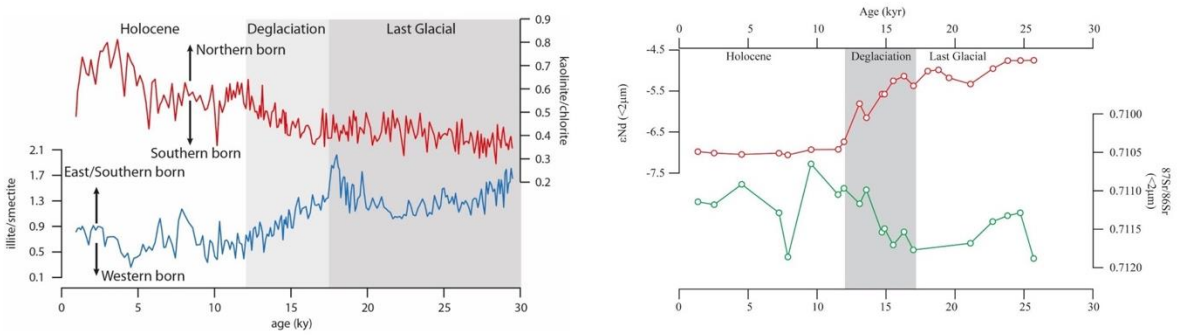

Figure 15 - (Left) Summary of clay changes over time in core MD07-3076. Note that from Figure 1 illite is expected to be derived from the East and South, Smectite, derived from weathered igneous rocks in the West. Chlorite is derived only from high latitudes whereas Kaolinite forms nearer the tropics. (Right) Temporal variations in Sr and Nd isotope variations recorded in core MD07-3076. Note Sr scale is reversed as the lower $^{87}Sr/^{86}Sr$ is correlated with increased smectite content. Figure provided by Viviane Bout, University of Lille, PI of the TA application.

Changes in the illite/smectite ratio reflect changes in east-west water mass movement over time (a decrease in illite from the East and South and increase in smectite, derived from weathered igneous rocks in the West, in the present day compared to LGM). Changes in the kaolinite/chlorite ratio reflect increased northerly water mass input to the region in the present day compared to LGM. The preliminary isotope data shows a marked change in clay provenance during deglaciation (Figure 18). Nd isotope ratios increase and Sr isotope ratios decrease, indicating more input from younger geological regions, such as the Scotia Sea-South Sandwich Islands. Future work plans to characterise the changes in different sediment size fractions to allow an assessment of changing water mass flow velocities (faster currents transport material further but more importantly larger grain grains).

The success of the first TA visit has already led to a series presentations at national and international conferences. Future TA applications are anticipated to document the sedimentary record in other parts of the South Atlantic to refine the location of changes in water mass mixing over time (see **Table 32**).

Task 4.2: Radiogenic, non-traditional stable & rare gas isotopes. Le Centre de Recherches Pétrographiques et Géochimiques (CRPG), Nancy, France

Table 26 - Completed visits from the first and second TA call at the Radiogenic, Non-Traditional Stable & Rare Gas Isotopes Facility, CRPG

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-002	O and Mg isotopic constraints in relict olivines: for a better understanding of their origin and the initial 26Al variability in the solar protoplanetary disk	University of Bristol	UK	Nov-2016

15-EPN-015	Coupled C-N isotope analysis of dated diamond growth zones: implications for Earth's plate tectonic- and carbon-cycle.	VU Amsterdam	Netherlands	Sept 2016
15-EPN-017	Carbon isotope evolution of the deep Earth from coupled C-O isotope SIMS measurement of carbonates in kimberlites	University of Melbourne	Australia	Nov-2016 & Jan 2017

Case Study: Project No. 15-EPN-015. Site visited: Sept 2016 (access 10 person days)
Title: Coupled C-N isotope analysis of dated diamond growth zones: implications for Earth's plate tectonic- and carbon-cycle.
Applicant: Mr Michael Gress (PhD student), and Gareth Davies, VU Amsterdam, Netherlands

Assessing the behaviour and changes in carbon fluxes from the Earth interior over time and the possible recycling from the surface provides information about how our planet, and the life it hosts, has evolved. Importantly it may also help in developing better long-term climate models if the role of the deep carbon cycle is better understood (i.e. whether it is a net carbon sink or source). Understanding of the processes that control the deep carbon cycle on Earth has direct relevance to predicting how carbon cycles may operate on other planets in the Solar System and beyond (exoplanets).

The Great Oxidation Event (GOE) around 2.3 billion years ago was a huge change in the oxidation state of the Earth's atmosphere. It was associated with a fundamental change in the nature of life on Earth, Earth's atmosphere, and subsequently the nature of material subducted into the mantle due to plate tectonics. How the Earth's volatile cycles have evolved overtime is of great importance for understanding not only how the carbon cycle influenced the evolution of life on Earth but also the feed-back mechanisms between the Earth's surface and interior. These fundamental questions can potentially aid in assessing how other planetary bodies have evolved over time. Diamond and encapsulated inclusions are one of few unaltered records from Earth's interior, providing insights into the evolution of Earth's mantle back at least 3.2 billion years (i.e. pre- and post-GOE).

EPN2020-RI TA3 enabled researchers from VU Amsterdam to access the Radiogenic, Non-traditional Stable & Rare Gas Isotopes Facility at CRPG, Nancy, France. Based on the ages of diamond growth, the goal of the TA visit was to determine the spatial variation of nitrogen contents and coupled carbon- and nitrogen-isotope ratios within and between well-characterised diamond growth zones of different ages. Analysis of isotopic variations of distinct diamond growth features at micrometre-scale spatial resolution will help constrain processes controlling diamond precipitation (e.g. oxidation, reduction, change in pH), temporal evolution of carbon sources and the impact on Earth's mantle carbon cycle (carbon fluxes and carbon reservoirs). These data also have important implications for the changing (plate-tectonic) evolution of Earth.

Cathodoluminescence (CL) images the growth and resorption history of a diamond (**Figure 16**). Fourier Transform Infrared Spectroscopy (FTIR) records the varying N-concentrations of the diamond growth zones and by implication the supercritical melt medium from which they formed. (**Figure 16**) below is an image of a polished plate cut from the centre of diamonds and shows clear growth zones from a central nucleation point in the centre of the right side of the diamond. A clinopyroxene mineral inclusion is marked as cpx.

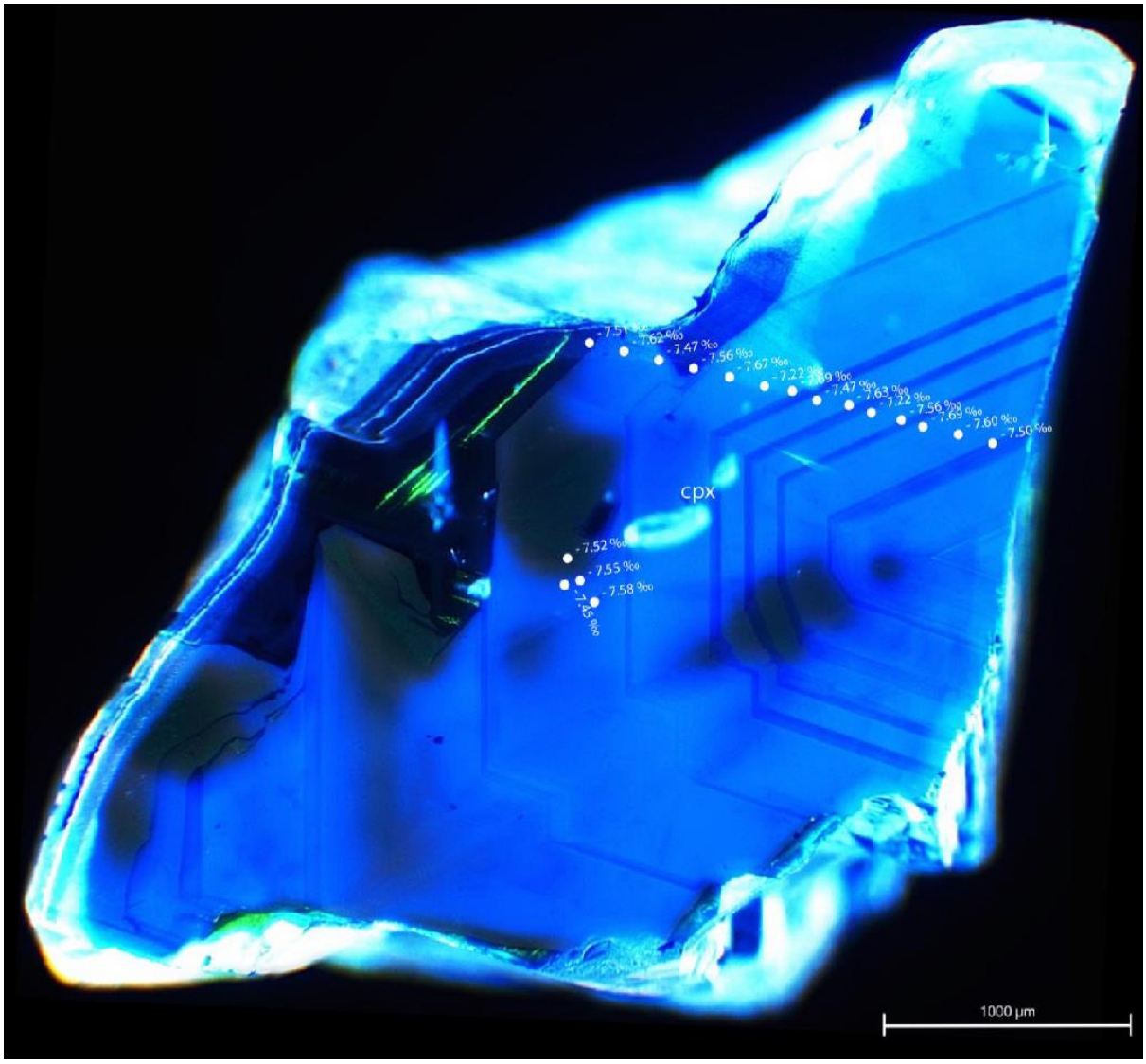

Figure 16 - Polished laser cut plate from broken diamond LK241 showing regular growth zones around a core located on the left side (centre) of the plate. SIMS C isotope analyses are marked by white circles.

The initial results of the work were presented at an international workshop (Deep Carbon Observatory meeting, St Andrews Scotland) in March, the EGU meeting in Vienna (April) and will be presented at the International Kimberlite Conference in Botswana in October 2017. The next stage of the project will be to extract and date the mineral inclusions within the diamond plates. This will provide the temporal constraints required to establish if there were changes with time in the C-N isotope compositions in the mantle allowing implications to be made about the interior workings of the Earth. The data will form part of a PhD thesis and be included in peer reviewed publications.

Task 4.3: Radiogenic & stable isotopes. Open University, Milton Keynes, United Kingdom

Table 27 - Completed visits from the first and second TA call at the Radiogenic & Stable Isotopes Facility, OU

ESF Project No.	Title	Applicant organisation	Country	Site visit
15-EPN-001	NanoSIMS Measurements of Carbon rich areas in Archaen Cherts	Università di Bologna	Italy	July-2016
15-EPN-010	Carbon and Nitrogen isotopic compositions of the carbonaceous matter in a series of Antarctic micrometeorites	Université Grenoble Alpes	France	Sept 2016
15-EPN-033	Determination of the origin of micrometeorites from the Antarctic Sør Rondane Mountains using NanoSIMS	Vrije Universiteit Brussel	Belgium	Oct-2016

Case Study: Project No. 15-EPN-033. Site visited: October 2016 (access 10 person days)
Title: Determination of the origin of micrometeorites from the Antarctic Sør Rondane Mountains using NanoSIMS.
Applicant: Dr Steven Goderis (VU Brussel)

Background: Each year, the Earth is bombarded by 40,000 tons of extraterrestrial material derived predominantly from asteroidal, cometary, and planetary debris. Micrometeorites (less than 2 mm large) form the largest fraction of this extra-terrestrial flux to Earth. Their petrographic and chemical characteristics differ significantly from meteorites, and their origin continues to be a topic of much debate. Oxygen isotopic analysis forms one of the most powerful tools in cosmochemistry to discriminate between the origin of planetary materials, and can easily be applied to micrometeorites, as the modifications of the isotopic composition during atmospheric entry are relatively well-understood. However, bulk rock methods such as laser fluorination require more than 50 micrograms of silicate material, necessitating the application of NanoSIMS oxygen isotope determination on the rarest and smallest micrometeorite samples.

EPN2020-RI TA3 enabled Dr Steven Goderis (VU Brussel) to access the OU Nanoscale Secondary Ion Mass Spectrometer (NanoSIMS) to analyse rare samples of micrometeorites collected between December 2012 and January 2013, during a field campaign in the Sør Rondane Mountains, Antarctica.

During a week-long research visit, the NanoSIMS was applied to: (i) relict olivine grains within partially melted micrometeorites, and (ii) a set of glassy cosmic spherules previously characterized by a combination of analytical techniques, for which not enough material (<40 micrograms) remained for the application of the laser fluorination method. The NanoSIMS instrument was also applied to (iii) fusion crust materials of particular meteorite types to compare these to the oxygen-isotopic composition of previously defined groups of cosmic spherules.

The oxygen isotope compositions were used to identify the potential parent bodies of these extraterrestrial materials. The results indicate that micrometeorites sample diverse Solar System source reservoirs, which is consistent with the results from previous micrometeorite studies. These results will be presented at forthcoming international meetings and submitted for publication to a high impact factor journal (e.g., Geochimica et Cosmochimica Acta, Meteoritics and Planetary

Sciences, Earth and Planetary Science Letters or Chemical Geology), acknowledging the EPN2020-RI support.

Task 4.4: Radiogenic & non-traditional stable isotopes: Institute for Planetology; University of Münster, Münster, Germany

Table 28 - Completed visits from the first and second TA call at the Radiogenic & Non-Traditional Stable Isotopes Facility, IFP

ESF Project No.	**Title**	**Applicant organisation**	**Country**	**Site visit**
15-EPN-034	Investigating the settings of nebular condensation using Mo isotopes in fine- and coarse-grained CAIs.	Massachusetts Institute of Technology	USA	Aug & Sept 2016
15-EPN-042	Hf-W measurements of Barwell "basaltic pebbles": Dating early differentiation in the Solar System	Natural History Museum	UK	Jan & Feb-2017

Case Study: Project No. 15-EPN-042. Site visited: January-February 2017 (access 20 person days)

Title: Hf-W measurements of Barwell "Pebbles": Dating early differentiation in the Solar System.
Applicant: Ms Natasha Almeida (PhD student) and Prof Sara Russell, Natural History Museum, UK

The fundamental question of how planets formed from a dusty accretion disk has gained more relevance due to the new generation of space telescopes that can image stars in this period of development. Information from meteorites that date from the pre-planetary times is critical in unravelling the history of our Solar System. In addition, recent and upcoming sample return missions to asteroids (Hayabusa, Osiris Rex and Hayabusa-2) have strengthened the need to better understand the asteroids we have within meteorite collections.

The canonical theory states that parent bodies of the ordinary chondrites accreted from millimetre-sized solids in the pre-planetary stage of the Solar System, prior to the formation of larger bodies. However, the presence of "pebbles" – igneous objects found within ordinary chondrites – supports a paradigm of an early generation of differentiated planetesimals and indicates that the accretion of planets was not a simple pathway from small objects to progressively larger ones

The Barwell meteorite is an ordinary (L5) chondrite that fell on Leicestershire in England in 1965. The Barwell "Pebble" refers to an object found within the meteorite that carries the isotopic signature matching H-group (iron-rich) chondrites while exhibiting the texture, mineralogy and trace element concentrations of an igneous rock. EPN2020-RI TA3 access to the Radiogenic & non-traditional stable isotopes facility in Münster enabled age dating of both the igneous clast and the host meteorite.

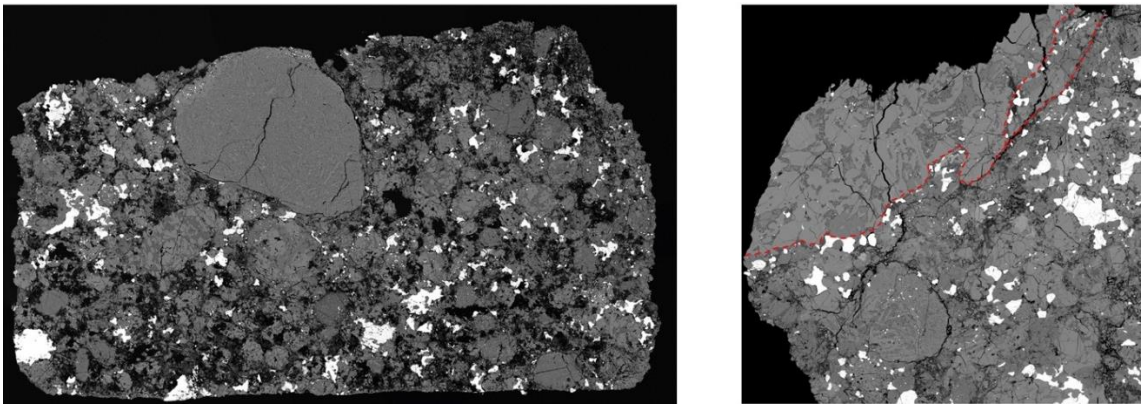

Figure 17 - Left: Backscatter image of a section cut from the Barwell L5 meteorite: Field of view 2 cm. Right: Backscatter image of a section cut from the Barwell L5 meteorite clearly showing sub-rounded chondrules and a "pebble" above the red dashed line. Field of view 8 mm. Images provided by the British Museum staff who conducted the TA visit.

The study undertaken at Münster involved the first time use of the hafnium-tungsten (Hf-W) isotopic system on igneous clasts in Barwell. The short-lived ^{182}Hf-^{182}W system (half-life of 9 million years) makes the isotopic system ideal to study the early evolution of the solar system. Data from 3 Barwell "pebbles", combined with an inclusion from another L chondrite and bulk L chondrite isotope data plotted on an isochron diagram indicate that that the Barwell inclusions formed within 2 million years of the initial condensation of calcium–aluminium-rich inclusions (CAI), thought to be the first material to condense from the solar nebular. This suggests that these inclusions were formed by melting and associated Hf/W fractionation (metal loss) from a L chondrite precursor. However, there are two inclusions that plot off the isochron. These inclusions have negative two stage model ages, indicating a more complex, multi-stage evolution. These data provide further evidence to challenge the canonical view that the solar system formed "bottom up" from dust to progressively larger objects until finally the planets formed.

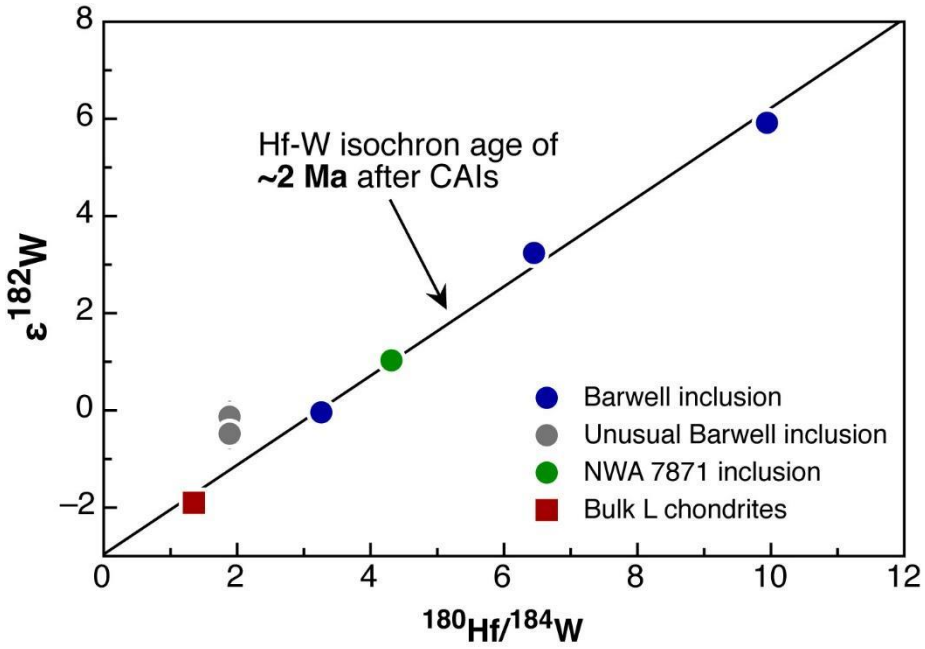

Figure 18 - Hf-W isochron diagram indicating that the Barwell inclusions formed within 2 Myr of the initial condensation of calcium–aluminium-rich inclusions (CAI). Data taken from the TA report.

WP4 (TA 3: Distributed Sample Analysis Facility)-Deliverables

D4.1 and D4.4 provide additional details on Transnational Access to Sample Analysis Facilities provided by EPN2020-RI through the TA3 calls.

D4.1 - First call for TA3 facilities. Planned and submitted on month 3

D4.2 - 1st call: Proposals evaluated and access approved for the TA3 facilities. Planned and submitted on month 6. For a full version of the deliverable (with sensitive information) please refer to the EU portal (or the private area of the website) and see below for more details.

D4.3 - First Annual report of TA3 access. Planned and submitted on month 12

D4.4- Second call for TA3 facilities. Planned on month 13 and submitted on month 11

D4.5 - 2nd call: Proposals evaluated and access approved for the TA3 facilities. Planned on month 15 and submitted on month 11. For a full version of the deliverable (with sensitive information) please refer to the EU portal or the private area of the website.

D4.2 and D4.5 included lists are ordered by mark given by the panel and contain the following information:

- IdProp – Original reference number
- ProjectNumber – ESF reference number
- Title
- Project leader name and contact details
- Ranking
- Final Score

See section 1.2 and EU portal or the private area of the website for full details

WP4 (TA3: Distributed Sample Analysis Facility)-Milestones

MS15 Issue of 1st call for access to the TA facilities. See WP1

MS16 Issue of 2nd call for access to the TA facilities. See WP1

MS19 1st Sustainability review for the TA. See WP1

MS27 Completion and review of first round of TA Projects. See WP1

MS17 Issue of 3rd call for access to the TA facilities. See WP1

1.3 Impact

The limited number of TA visits completed to date and the complex nature of the data produced means that so far peer reviewed publications are limited. TA visits have led to several presentations at conferences, including the 48th Lunar and Planetary Science Conference (Houston, end March), European Geoscience Union General Assembly (Vienna, end April), workshops and seminars (**Table 32**). Importantly however, many more presentations are already scheduled for the next 6 months, e.g. the forthcoming Geochemical Society's Goldschmidt meeting (Paris, August) and the quadrennial International Kimberlite Conference (Botswana, October). Geochemical and isotopic analysis do not lend themselves to immediate dissemination to the public and press nor immediate publication. Data need to be processed and duplicated before they can be fully interpreted and papers prepared. Peer reviewed papers are expected to be submitted in the next 6 months and published from early 2018 onwards. At that stage it is expected that there will be major dissemination of the results to the broad

scientific communities as well as public outreach in the form of articles to popular press.

2. Deviations from Annex 1

2.1 Use of resources

As explained above the number of TA applications to call 1 was lower than predicted such that the second call was brought forward. The number of TA visits in TA3 is approximately on schedule given that the introduction of the new capabilities from the JRA work is expected to lead to more applications later in the project. The high number of applications to the third TA call underlies this conclusion. Some re-distribution of resources between the facilities may be warranted after a review of the third TA3 call has been conducted.

General notes WP 2-4 (TA 1-3)

The overall strategy of the TA facilities is for the JRA activities to introduce innovative new capabilities at the start of year three. These new capabilities, in some cases world firsts, were expected to lead to a greater demand for access in the second part of the project. Resource utilisation of the TA's was therefore predicted to be significantly below 50% at the middle of the project. The increased number of applications in the third TA call substantiates this assumption and greater numbers of TA visits in the second half of the project seem assured.

TA applications are peer-reviewed anonymously by a committee of independent scientists assembled by ESF. The committee has approved a series of TA proposals that have requested on average longer access times than predicted in the original EPN2020 RI proposal. The net effect is that fewer individual TA accesses have been granted but for greater periods of time. This has led to a change in the way resources are allocated but this change has been led purely on the basis of the scientific assessments. The justification of the longer access periods is that more complex science can be undertaken. This change is expected to lead to scientific publications with greater impact, i.e. higher impact journals. Going forward, therefore, it is expected that there will be less individual TA access but for longer periods i.e. the number of person weeks will be as budgeted but the number of individual access will be lower than predicted.

5. WP5- VA1: PSWS (Planetary Space Weather Service)

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

Space Weather – the monitoring and prediction of disturbances in our near-space environment and how they are controlled by the Sun - is now recognised as an important aspect of understanding our Earth and protecting vital assets such as orbiting satellites and power grids. EPN2020-RI aims to transform the science of space weather by including an entirely new Virtual Access Service, the "Planetary Space Weather Services" (PSWS) to be developed under the auspices of WP10 JRA4 and delivered to the community through WP5.

PSWS will make five entirely new 'toolkits' accessible to the research community and to industrial partners planning for space missions: a general planetary space weather toolkit, as well as three toolkits dedicated to the following key planetary environments: Mars (in support of the on-going ExoMars), comets (building on the Rosetta mission) and outer planets (in preparation for the ESA JUICE mission to be launched in 2022). This will give the European planetary science community new methods, interfaces, functionalities and/or plug-ins dedicated to planetary space weather in the tools and models available within the partner institutes. It will also create a novel event-diary toolkit aiming at predicting and detecting planetary events like meteor showers and impacts. The PSWS portal (http://planetaryspaceweather-europlanet.irap.omp.eu/) gives access to an initial presentation of PSWS activities.

1.2 Explanation of the work

The Planetary Space Weather Service (PSWS) will provide 12 tools distributed over four different service domains: A) Prediction; B) Detection, C) Modelling and D) Alerts. These are sub-divided as follows:

A1. 1D MHD Solar Wind Prediction Tool (See JRA4)
A2. Propagation Tool (Task 5.2)
A3. Meteor showers (See JRA4)
A4. Cometary tail crossings (Task 5.3)
B1. Lunar impacts (Task 5.3)
B2. Giant planet fireballs (Task 5.3)
B3. Cometary tails (Task 5.3)
C1. Transplanet – Earth, Mars, Jupiter (See JRA4 for Venus and Saturn)
C2. Mars radiation environment (See JRA4)
C3. Giant planet magnetodiscs (See JRA4)
C4. Jupiter's thermosphere (See JRA4)
D. Alerts (See JRA4)

Detailed description of work

Since PSWS is a new facility, tools will be added to the VA throughout EPN2020-RI with the aim of delivering all tools by Project Month 40. The work done for each task during the first reporting period 1 September 2015 to 28 February 2017 is reported below.

Task 5.1 Coordination (CNRS, ABER)

The task is led by Nicolas Andre of CNRS with support from Manuel Grande of the University of Aberystwyth. A series of meetings have been held by the PSWS coordination team to prepare the PSWS VA facility for presentation to User community:

- A meeting was held on the development of the PSWS Propagation Tool at IRAP/CNRS (with IRAP/CNRS, GFI Informatique) on 22 September 2015
- The formal PSWS Kick-off meeting was held at IRAP/CNRS (with IRAP/CNRS, UCL, ABER, GFI Informatique), 21-22 March 2016
- A Giant Planet Fireball meeting was held during the NA1 workshop on Juno Ground-Based Support from Amateurs: Science and Public Impact (with UPV/EHU), Nice, 12-13 May 2016
- A Coordination and Liaisons meeting was held as part of the European Space Weather Week (ESWW) in Oostende (with ABER, CNRS, SRC PAS), 14-18 November 2016
- A second Giant Planet Fireball meeting was held at IRAP/CNRS (with IRAP/CNRS, UPV/EHU), 11-12 January 2017
- A meeting on Giant planet magnetodiscs and Jupiter's thermosphere was held at IRAP/CNRS (with CNRS/IRAP, UCL), 23-24 February 2017

Minutes from the meetings can be downloaded from the private area of the project website.

Task 5.2 Implementation (UCL, ABER, CNRS, SRC PAS, GFI Informatique)

The following subsections reports the successful implementation of PSWS VA services now operational and open to users through the PSWS portal (http://planetaryspaceweather-europlanet.irap.omp.eu/). For discussion of tools in more developmental phase please read report on WP10 –JRA4.

A2. Extensions of the CDPP Propagation Tool (CNRS, GFI Informatique)

GFI Informatique (GFI) is extending the Propagation Tool available from CDPP (http://propagationtool.cdpp.eu) for application to comets, giant planet auroral emissions, and catalogues of solar wind disturbances. They are providing new plug-ins including selection of comets as targets, visualization of their trajectories, projection onto solar maps, projection onto J-maps, and estimates of solar wind disturbance arrival times; they will enable the user to use a catalogue of solar wind disturbances in order to identify those that have impacted the planetary environments.

Status:

The following PSWS Propagation Tools are operational:

- Comets;
- Giant planet auroral emissions;
- Service for ingestion of catalogues of solar wind disturbances.

Achievements:

- A new plug-in has been defined, developed, and made available for comets in the propagation tool including selection of comet as targets, visualization of their trajectories, projection onto solar maps, projection onto J-maps, and estimates of solar wind disturbance arrival times;
- Connection to the APIS database specified and plug-in has been developed;
- Catalogues of events specified (outputs from the FP7 HELCATS programme, https://www.helcats-fp7.eu/) and ingested in the tool through a dedicated plug-in.

Task 5.3 Detection of tail crossings (UPV/EHU, UCL, ABER)

A4. Cometary tail crossings (UCL) The Mullard Space Science Laboratory (MSSL) within University College London (UCL) is developing a software tool that will enable users to predict comet ion tail crossings by any interplanetary spacecraft including for future missions such as Solar Orbiter. Tail crossings cannot simply be searched for by looking for times when comets pass between the Sun and spacecraft. The ion tails are carried with the solar wind, and it takes a finite amount of time for the ions to travel from the comet to the detecting instruments. Tail crossings are dependent on the solar wind flow direction, which is not always directly away from the Sun, and on the speed of the solar wind carrying the tail to the spacecraft.

Status:

- Development of the tool has started based on strong heritage but requires streamlining for efficiency and robustness.

Achievements:

- A list of all known comets has been compiled.
- Trajectories of spacecraft cruising in the interplanetary medium have been identified.
- The tool for search technique is largely complete but still requires refinement before commissioning.

B1. Lunar impacts (ABER) Aberystwyth University (ABER) is upgrading and converting its lunar impact software (https://www.britastro.org/lunar/tlp.htm) and has posted it online in order to enable users to detect visible flashes in lunar amateur or professional images of lunar impacts.

Status:

- A VA Service is now operational with a prototype software version downloadable by users.

Achievements:

- A PDF instruction manual, the Video frame size BMP header files, and the C source code for the software has been delivered to IRAP/CNRS by ABER.

B2. Giant planet fireballs (UPV/EHU). The Universidad del Pais Vasco (UPV/EHU) has upgraded and converted its giant planet fireball detection software (http://pvol2.ehu.eus/psws/jovian_impacts/) and posted it online in order to enable users to detect visible fireballs in giant planet amateur or professional images. This work has been done in collaboration with the amateur community and in particular with help from a French amateur astronomer, Marc Delcroix, based in Toulouse. In order to detect fireball impacts in Jupiter, thousands of hours of video observations need to be analysed. This will be achieved by the dissemination of a software tool through a network of amateur astronomers who will analyse their video observations of the planet.

Status:

- The Giant planet fireball service has been developed. The service is operational but requires improvements towards a larger community of collaborators.

Achievements:

- An algorithm to find impacts in video observations of the planets has been developed and implemented in a software tool for Windows with a complete Graphical User Interface. As of 28 February 2016 the software is being tested at UPV/EHU and further developed to implement robustness.
- A network of users have been created within the amateur community. The users are currently employing a preliminary version of the algorithm. This preliminary version does not have a Graphic User Interface. This software (available on day one) produces statistical log files containing statistical information that can be analysed to determine relevant parameters for the estimation of impact rates at Jupiter.

- We have developed a visualization tool of statistical log files from the ensembles of log files supplied by the users. This tool is written in IDL and maintained at UPV/EHU and allows to explore how efficiently Jupiter is being observed by the users looking for impacts on the planet.

B3. Cometary tails (UCL). The Mullard Space Science Laboratory (MSSL) within University College London (UCL) is upgrading and converting its comet tail analysis software and has posted it online, with the aim of providing it as an interactive suite. The software will be readily accessible to any users (professional or amateur) who work with comet images and wish to obtain an estimate for the solar wind speed at the comet, derived from their observations.

Status:

- A preliminary version of the software has been developed but is currently in a non user-friendly form that requires improvements to be made

Achievements;

- The design and methodology of the cometary tails toolkit, software and platform has been developed and a preliminary version produced.

Task 5.4 Liaisons (CNRS, SRC PAS)

SRC PAS is illustrating how other programmes can benefit from PSWS outputs by implementing PSWS Alerts in the Polish SSA project HelgeoSSA, which is monitoring Earth's ionosphere and magnetosphere for civilian GPS and radio users (http://helgeossa.cbk.waw.pl/helgeossa/MAIN.html).

Status

The HelgeoSSA system has been developed in a Matlab (Matrix Laboratory) environment, the large databases are held as the Matlab workspace in MAT-Files, the VOEvent document generators also will be created in Matlab software (compatible with open source Octave).

Achievements;

- A topical issue in Journal of Space Weather and Space Climate has been agreed with Jean Lilensten (IPAG/CNRS - JSWC editor) and will follow PSWS-related sessions at the European Planetary Science Congress 2017 and European Space Weather Week 2017.
- The SRC PAS team has prepared some JSON format test, because of ESA program:

"P2-SWE-I activity - Space Weather Expert Service Centres Definitions and Development" where JSON (RFC 462) was chosen as the server-to-server communication protocol.

- Procedures to import/export RWC daily messages have been tested:
  Creating Matlab .mat file with messages
  Inserting data into sample JSON format (used for internet communication, transitional format to XML)
  Inserting data into sample XML format

WP5 (VA1: Planetary Space Weather Service)-Deliverables

The following deliverables have been completed during the time period 01/09/2015-28/02/2017 for PSWS VA1 WP5:

D5.1 PSWS VA Review board Report. Planned at month 13 and submitted at month 16 as approved by

the Project officer Keji Adunmo.

D5.5 PSWS Annual report. Planned and submitted at month 12

WP5 (VA1: Planetary Space Weather Service)-Milestones

MS31 PSWS Kick-off meeting. Planned at month 3. Achieved on 21-22/03/2016

MS32 External Review Board. Planned at month 6. Achieved on 30/11/2015

MS33 PSWS Website. Planned at month 6. Achieved on 26/01/2016

MS34 PSWS Coordination meeting. Planned at month 12. Achieved on 17/11/2016

1.3 Impact

A full list of current and past activities can be found in **Table 32**. They demonstrate that PSWS has established a prominent position in Europe and internationally for providing products for prediction, detection and analysis of space weather related events, as well as raising awareness of planetary space weather within the planetary community.

EPN2020-RI's VA1-PSWS has built contacts with ESA and other key stakeholders in the Space weather community including other space weather projects funded by H2020 programmes. The PSWS portal will be demonstrated at the forthcoming European Space Weather Week in Oostende, 27 November-01 December 2017. A dedicated workshop on the Sun's influence on planets will be hosted (jointly by EPN2020-RI's VA-PSWS and NA1) in the autumn of 2017 where relevant PSWS services will be tested by scientists. The PSWS portal will also be demonstrated at the forthcoming EPSC in Riga, September 19 to 23, 2017. Dedicated amateur campaign observations of Jupiter and the Moon will be coordinated by PSWS members in order to present and test some of the PSWS services. A dedicated workshop on amateur observations of planetary bodies will be organized in the autumn of 2017 by EPN2020-RI's VA1-PSWS and NA1.

1.4 Statistics

The PSWS portal (website) http://planetaryspaceweather-europlanet.irap.omp.eu/ that has been **5371 visitors from 1st September 2015 to the end of the** first reporting period.
These numbers are expected to increase significantly when all the services become operational at the end of the JRA (the number of users is already increasing fast: a further 1620 unique visitors have accessed the site between 28th February and the submission date of 25th April (currently 6991 unique visitors).

Statistics for the PSWS tools that have been developed during the first year of the project can be found at the following webpages:

- CDPP/AMDA tool (total number of connections, http://amda.cdpp.eu/): http://cdpp1.cesr.fr/AMDA/depotUTILS/stats.html
  6575 connections since 01/09/2015
- Details on geographical distribution etc. can be found at CDPP/AMDA awstats: http://amda.cesr.fr/awstats/awstats.pl
- Access to CDPP/PROPTOOL (http://propagationtool.cdpp.eu/) http://storms-st.irap.omp.eu/awstats/awstats.pl
- Access to CDPP/AMDA datasets: http://cdpp1.cesr.fr/AMDA/depotUTILS/amda_data_stats.html including access to datasets

used by the PSWS service A1. 1D MHD Prediction Tool in development

2. Update of the plan for exploitation and dissemination of results

Dedicated 'Planetary Space Weather Services' sessions will be held at the European Planetary Science Congress, Riga, 17-22 September 2017 and at the European Space Weather Week 14, Oostende, 27 November-01 December 2017 have been proposed and selected by the respective Science Organizing Committees. The session will be dedicated to a presentation of operational services and welcomes papers on all aspects of planetary space weather related to the above service domains. A topical issue in Journal of Space Weather and Space Climate has been agreed with Jean Lilensten (IPAG/CNRS - JSWC editor).

3. Update of the data management plan

The PSWS Data Management Plan was delivered in February 2016 and will be updated when PSWS JRA4 WP10 is completed. PSWS plans to follow wherever possible the VESPA Data Management Plan in order to ensure that PSWS datasets are compliant with the Virtual Observatory. Consequently, PSWS datasets will be made accessible and usable through VESPA tools (EPN-TAP, SAMP, VOEvent) as summarized below.

Table 29 - Table showing connections between PSWS services and VO tools/protocols

PSWS Services	Type of developments	Use of EPN-TAP	Use of SAMP	Use of VOEvent
1D MHD Solar Wind Prediction Tool	Website+Database+Alerts	yes	yes	yes
Propagation Tool	Software+Database+Alerts	yes	yes	yes
Meteor showers	Website+Alerts	no	no	yes
Cometary tail crossings	Software+Alerts	no	no	yes
Lunar impacts	Software+Database+Alerts	yes	yes	yes
Giant planet fireballs	Software+Database+Alerts	yes	yes	yes
Cometary tails	Software+Database	yes	yes	no
Transplanet	Runs on request+Database	yes	yes	no
Mars Radiation Environment	Runs on request+Database	yes	yes	no
Giant planet magnetodiscs	Runs on request+Database	yes	yes	no
Jupiter's thermosphere/ionosphere	Runs on request+Database	yes	yes	no
Alerts	Database+Alerts	yes	no	yes

4. Deviations from Annex 1

D5.1: 1st PSWS VA Review Board Report was submitted on month 16 rather than 13

6. WP6 - VA2: VESPA (Virtual European Solar and Planetary Access)

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

Under FP7, Europlanet developed the first dedicated Virtual Access facility for the European Planetary Science community in the form of the "Integrated and Distributed Information Service" (IDIS). WP6 VA2 "Virtual European Solar and Planetary Access" (VESPA) builds on the FP7 IDIS system to create a Solar System and Planetary Sciences Virtual Observatory (VO). This fulfils two different functions:

- at one level VESPA provides a web-based portal giving access to remotely distributed data resources using online forms with scientific parameters;
- at another, it incorporates a series of standards and interoperable tools that enable users to share data transparently and visualise planetary datasets, derived from different instruments, missions and models, simultaneously, to create a multi-dimensional view of the "planetscapes" under study.

The development of VESPA is being carried out in coordination with existing standards ensuring project sustainability. This vision allows users to tremendously increase the science return of the shared datasets. In the proposed infrastructure the shared datasets will be reachable either by using the VESPA web-portal, or through existing visualisation tools in use in the science community but optimised for planetary sciences.

In developing VESPA, Europlanet's key objectives and current achievements include:

- Integration and networking with science users through science sessions and practical hands-on sessions describing the Planetary Science Virtual Observatory, organised during major conferences such as EGU and EPSC. In addition there will be an annual selection of new data services through an annual open call. This is intended to create a community of users and data providers in Europe and beyond. The VESPA Planetary Surface workshop to be held in April 2017 is also intended to advertise the use of VO techniques associated with GIS in this particular community.

- Creation of a "virtual observatory" for planetary science: In the VA, this consists of implementing new data services that are publicly accessible. These include high-level data that are searchable through criteria related to science themes, and readily visualized. 11 pre-existing services were upgraded to the EPN-TAP v2 protocol (see JRA5), 21 new data services were implemented during RP1, 10 other services are being studied or tested. Access to data from space missions is handled through collaborative work with space agencies (ESA, NASA/PDS, and contacts with JAXA and ISRO through the IPDA). All data services are reachable through the VESPA user interface (http: http://vespa.obspm.fr). The Implementation workshops related to the calls for new services are an efficient way to spread the VESPA standards in the community.

- To act as an exemplar of a widely distributed Research Infrastructure: This is a principle of the Virtual Observatory – data services are located where the scientific expertise is, and are connected with standards used to describe and search their content.

- To help to position Europe at the forefront of planetary science internationally: VESPA already represents the widest community-based integrated system of data services in Planetary Science. Direct international contacts reinforce the visibility of the data distribution system. VESPA will provide additional and handy search capacities to ESA's Planetary Science Archive, therefore increasing its visibility and usage.

1.2 Explanation of the work

Detailed description of work

The WP has the following Tasks (in parenthesis are the leading institutes for each task):

Task 6.1- Coordination (led by OBSPARIS and Jacobs University with all members of WP attending)
Task 6.2- Internal services (OEAW, OBSPARIS)
Task 6.3- Enlarging VO contents (OBSPARIS, Jacobs University)
Task 6.4- Lining to the Amateur community (OEAW, UVP/EHU)
Task 6.5- Training (CNRS/IRAP, Jacobs University)
Task 6.6- Dissemination & sustainability (OBSPARIS, OEAW)

Below follows a description of the work carried out for each of these Tasks.

Task 6.1. – Coordination

A bi-weekly task telecom is held with members of WP11 –JRA5 attending meetings when appropriate. Complete documentation of VA activity is maintained and available on the VESPA public wiki (https://voparis-confluence.obspm.fr/); a more user-friendly version can be reached on the web site (http://www.europlanet-vespa.eu/)

Task 6.2: Internal services

The VESPA Virtual Access facility currently has 32 online tools as listed in Table 29 below 21 of which have been developed during the first 18 months of Europlanet 2020 RI.

Table 30 - EPN-TAP data services publicly accessible through the VESPA interface and other TAP clients, as of 14/3/2017. External services are highlighted in blue in 1st column

#	New in H2020	Origin	**Name / # of entries**
1	x	ObsParis & IAA/CSIC	abs_cs - Data for numerical modeling of planetary atmospheres : 13 results
2	x	CNRS/IRAP	AMDA - CDPP AMDA DataBase : 900565 results
3		ObsParis	APIS - Auroral Planetary Imaging and Spectroscopy 32316 results
4		ObsParis	BASECOM - The Nançay Cometary Database 15611 results
5		ObsParis	BDIP - Base de Données d'Images Planétaires 16906 results
6	x	IASB-BIRA	BIRA-IASB TAP - Profiles from SPICAV-SOIR/VEx 1612 results
7	x	CNRS/IRAP	CLIMSO - CLIMSO coronagraphs at pic du midi de Bigorre 102568 results
8	x	Jacobs Uni	CRISM - CRISM data from Earth Server 2 2669 results
9	x	ObsParis	DynAstVO - Asteroid orbital database and ephemerides 17265 results
10		ObsParis	ExoPlanet - Extrasolar Planets Encyclopaedia 3578 results
11		ObsParis	HFC1AR - Heliophysics Feature Catalog active regions 948627 results
12		ObsParis	HFC1T3 - Heliophysics Feature Catalog type 3 radio bursts 90845 results
13	x	ObsParis &	Iitate - Iitate HF data 2797 results

		Tohoku	
14		ObsParis	IKS - IR spectroscopy of comet Halley 206 results
15	x	CNRS/IRAP	ILLU67P - Illumination maps of 67P 151200 results
16	x	IWF	IMPEx_EPN20 - IMPEx Simulation Data 1277 results
17		ObsParis	M4AST - M4AST - Modeling for Asteroids 6370 results
18	x	Jacobs Uni	Mars_Craters - Martian Impact Craters 384344 results
19	x	ObsParis & LMD	MCD - EPN-TAP access to the Mars Climate Database 62244 results
20	x	ObsParis & Heidelberg	mpc - Minor Planet Center - Asteroid Orbital Data 728743 results
21		IAPS	nasadustcat - NASA dust catalogue TAP service 4272 results
22		ObsParis	NDA - Jupiter Routine Observations from Nançay 707 results
23	x	ObsParis	planets - Main characteristics of solar system planets 8 results
24	x	ObsParis & Tohoku	pparc_r - IPRT/AMATERAS data 1384 results
25	x	UPV/EHU	PVOL 31126 results
26		ObsParis	RadioJOVE - RadioJOVE Data Archive 12 results
27	x	CNRS/LATMOS	SPICAM - SPICAM Mars Atmospheric Vertical Distribution 1232 results
28		ObsParis	Titan - Vertical Profiles in Titan Middle Atmosphere 1430 results
29	x	ObsParis	tnosarecool - TNOs are Cool 592 results
30	x	Jacobs Uni	USGS_WMS - USGS WMS 55 results
31	x	IWF	VExMag_EPN20 - Venus-Express Magnetometer Data 2278 results
32	x	ObsParis	VVEx - VIRTIS Venus Express nominal mission (demo) 15682 results

Additional tools and services are in preparation and progress is reported in WP11 JRA5.

Task 6.3: Enlarging VO contents

An annual call to the community for the inclusion of new services into the VESPA VA is made with the goal of not only increasing the content of the Planetary Science VO but also to transfer the VO knowledge to teams allowing them to develop their services in accord with the infrastructure of the VESPA VA. The first VESPA call for data services led to two teams being supported to develop their services for interoperability with VESPA, Granada and (MS41 and MS45). The related VESPA implementation workshop took place in 2016 in Toulouse, and also hosted external contributors

(including ESA to interface the complete PSA database).

Task 6.4: Linking to the amateur community

The amateur community provides valuable data for the planetary science community. These skilled enthusiasts now have access to high-quality equipment, and are able to produce standardised data that complement those generated by professional observatories, filling in gaps in coverage that inevitably result from the competitive scheduling of large telescopes that have to cover the whole spectrum of astronomy and cosmology. For the first time VESPA will provide a forum for incorporating such data into a portal accessible to the wider research community. The initial setup of the RadioJOVE service (with limited data) has been completed. The pre-existing Planetary Virtual Observatory and Laboratory (PVOL) service (now in v.2) has been upgraded to a modern VO data service; in addition to its previous submission interface and web site, the new VESPA data service now provides VO access and search functions to amateur images. A prototype service in Graz allows for amateurs to upload description of their facility and equipment. In collaboration with NA1 VESPA arranged a Juno Amateur Workshop in Nice, France, May 2016 to engage with the amateur community, demonstrate the tools developed and present plans for future services.

Task 6.5: Training

An extensive training programme has been organised by VESPA Team for users and for existing and potential service providers. Six meetings to train and support 10 of the SSHADE data providers (AIU Observatory, PGL/IGS-PAS, CML/IGS-PAS, IEM-CSIC, ESRF, IAS, CNRS/IRAP, LPGN, PIIM, WP-Unibe) have been hosted (Figure 28). Independently, VESPA tutorials for users were held during EGU 2016 in Vienna and 2016 EPSC/DPS in Pasadena, USA.

Figure 19 - VESPA implementation workshop, Toulouse 2016

Task 6.6 Dissemination and sustainability

Several publications related to VESPA tools have been prepared and documentation on VESPA standards published. More than 30 presentations and posters were given in conferences. VESPA is also organising a Special issue of Planetary Space Sciences to be published in 2017, to which the VESPA participants have submitted 8 papers.

VESPA has engaged with many stakeholders whose long term engagement is necessary for sustainability of the VESPA portal. This includes discussions with the IVOA (International Virtual Observatory Alliance) and IPDA. VESPA has developed a strong links with policy makers in France (ASOV, SF2A, the PADC service in Paris) and worked with the NASA PDART program to support implementation of EPN-TAP on PDS Small Bodies Node. Although this proposal was not funded,

interfacing EPN-TAP with PDS4 archives is still an important goal for the coming years and will be developed in the frame of the IPDA. VESPA has also developed contacts with the U.S. Geological Survey (USGS) on Geographic Information Systems (GIS). Other contacts exist through IPDA (e.g., with Japanese and Indian space agencies, JAXA and ISRO) or conferences forums (e.g., Chinese space agency NAOC at AOGS 2016).

WP6 (VA2: Virtual European Solar and Planetary Access)-Deliverables

VESPA VA deliverables scheduled in Period 1 were:

D6.1. VESPA website. *Web site connecting all VESPA related information.* Planned and delivered on month 3.

D6.11 First VESPA training Session reports. *A single report is produced annually, covering both EPSC and EGU. First report by IRAP & Jacobs Univ*. Planned and delivered on month 9.

D6.6 Annual Report of VESPA new data services, tools & use cases. Planned and delivered on month 12. The deliverable is confidential, please refer to the EU portal or the private area of the website.

D6.9 First set of standards documentation. Planned and delivered in month 12

D6.2 First VA Review Board Report. *From review board chair Santa Martinez. Recommendations were implemented for the most part in the next two months.* Planned on month 13. Delivered on month 14 (17 days later, due to tight schedule and unavailability of the board members)

WP6 (VA2: Virtual European Solar and Planetary Access)-Milestones

MS40 VESPA kick-off meeting. Organized during EPSC 2015, Nantes + a later telecon with all beneficiaries. Planned in month 3. Was achieved on 20/11/2015

MS41 1st data service AO + selection report. Planned on month 6.

MS45 1st implementation workshop in Toulouse. Planned for month 10.

MS41&45 documents were delivered together by ObsParis and IRAP on 27/6/2016.

MS42 2nd data service AO + selection report. Planned on month 16. Selection achieved on 13/3/2017. Document to be delivered together with Graz workshop report about one month after the workshop

1.3 Impact

The impact of VESPA VA Facility is threefold:

1- Impact on Planetary Science archives (VA)

The main goal of VESPA VA is to increase the accessibility to and standardisation of planetary data. The ultimate goal is to provide some 50 data services by the end of the program and there are already 32 EPN-TAP services open, plus ~10 more being designed / at test level (see **Table 30**).

VESPA implements data services which can be accessed through a single portal allowing planetary data to be searched for easily thanks to their uniform data description and to the preparation of several query interfaces developed in the JRA. VESPA has developed several libraries installed within some VO tools (currently CASSIS, 3Dview and AMDA) to access EPN-TAP services independently from the main interface, so as to prepare sustainability.

New EPN-TAP data services are implemented through several strategies:

- Direct implementation by VESPA participants; this encompasses recent and historical archives, sometimes related to previous EU programs, or containing derived data related to publications.

- Research team contributions, selected through annual calls (Toulouse 2016, then Graz 2017 during RP2). In many situations, this relates to archives produced by a local experiment, or extensive derivations of observational datasets.
- Services from the amateur community. Two such services have been identified based on content quality and potential impact: PVOL and RadioJOVE.
- Direct collaborations with large institutes or consortia. This aspect is most relevant for ESA, who have implemented a test EPN-TAP access on the PSA (8 million files, 30 years of Planetary Science missions in Europe). A partnership was also started with the PDS Small Bodies Node in 2016, with an application to NASA "Planetary Data Archiving, Restoration and Tools" program to implement EPN-TAP on their services. Although this proposal was not funded, interfacing EPN-TAP with PDS4 archives is still an important goal for the coming years. Regular contacts with the Tohoku University, Japan, take place about their radio observations of Jupiter. Other contacts exist through IPDA (e.g., with Japanese and Indian space agencies, JAXA and ISRO) or conferences forums (e.g., Chinese space agency NAOC at AOGS 2016).

2- Impact on Science applications (VA)
Easy access to data archives and reference (lab) data will improve data interpretation. An expected outcome is to speed up the analysis of space borne observations, either archived or on-going.
- An example application is the update of the Martian craters database (revision of Robbins crater DB supported by VO tools developed at GEOPS) with direct application to dating of terrains.
- VESPA now provides easy access to the Mars Climate Database, which will support interpretation of Mars atmospheric observations and has potentially a big impact on current missions (including ExoMars); this was stressed as attractive during the AOGS international collaboration forum
- SSHADE has a similarly large potential for surface research, by providing access to experimental spectroscopy of minerals and ices (see Task 11.3 in WP11).
- Potential for small body studies with many services in development, both dynamical and spectral
- More specific aspects in study with support for coordinated ground based observations

3- Impact on participative science & involvement of the amateur community
The two preselected services (PVOL and RadioJOVE) have been implemented and are expected to foster professional-amateur collaboration and exploit the use of high-quality amateur observations by the science community. PVOL, covering the field of planetary imaging, is entirely operational and accepts new submissions. The PVOL website lists 30 scientific publications that have used amateur data from PVOL in its first version (since 2003) or from the version 2 now developed. RadioJOVE, covering radio monitoring of Jupiter, is installed and currently includes a limited dataset for test purposes.

VESPA is very active on http://openplanetary.co/ and other media, including their own slack: https://vespa-epn.slack.com/

For a full list of dissemination activities, see **Table 32**.

1.4 Statistics
Data services are monitored by awstats, installed on all VESPA data servers. The portal and other web

sites are monitored by piwick.

The figures below provide access statistics by data server during the period of interest. The first services were publicly opened in September 2016. Most accesses are from the participating countries, except in Nov 2016 when a peak access in the US occurred during the joint DPS-EPSC meeting.

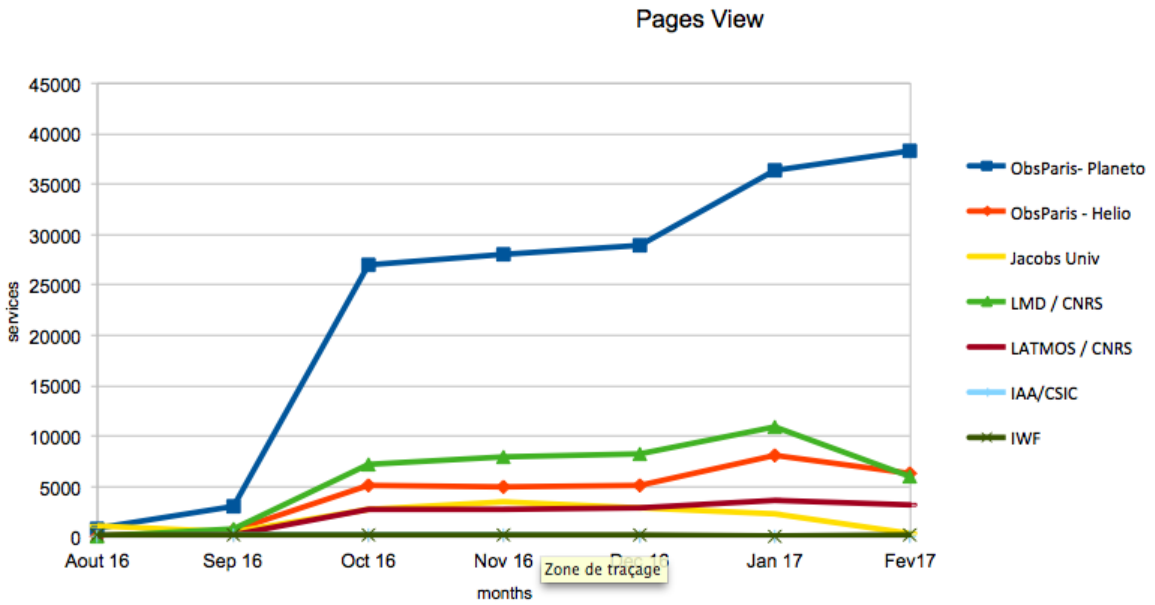

Figure 20 - Monthly pages view grouped by data server, from date of public opening

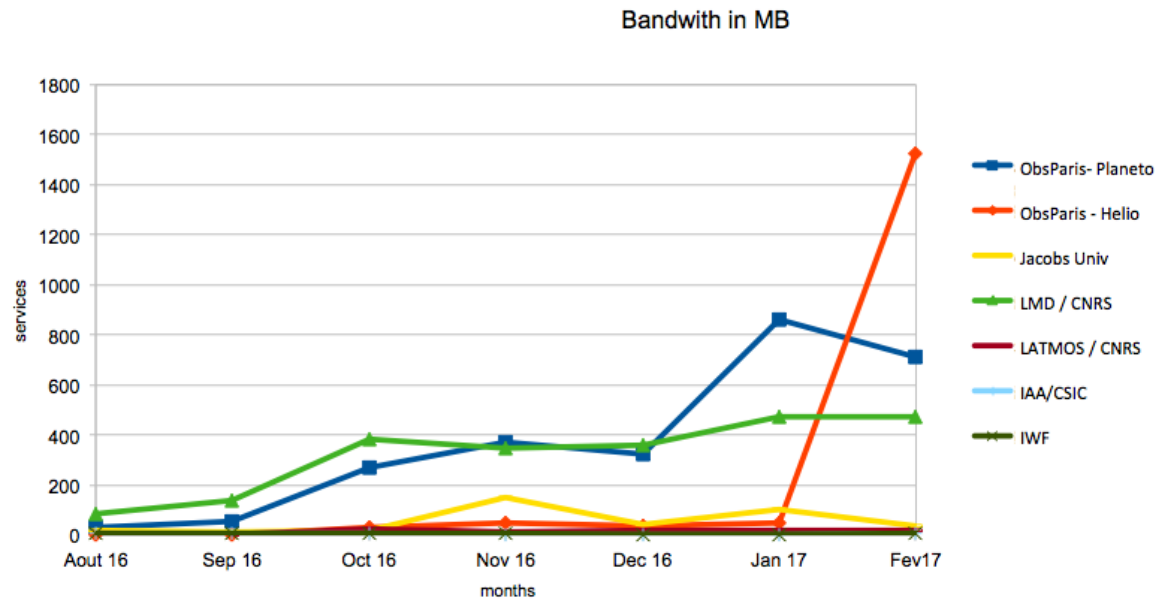

Figure 21 - Data transferred monthly grouped by server, from date of public opening

Access

• The VESPA external review board provides an annual report and performs continuous monitoring through random access to services.

• VESPA VA task2/3 participants perform continuous monitoring through scientific access to services.

• A helpdesk is available on the main portal for users to provide feedback.

3. Update of the data management plan

A VESPA Data Management Plan was issued during RP1 (VESPA-003-PL v1.0, dated 14/2/2016). Data services are public, although a proprietary period can apply. Software related to creation or update of data services is accessible in the VESPA Github. Service access information is stored in IVOA registries. All of the data providers commit to maintain their services beyond the end of RI. Metadata from the services may be mirrored in the Observatory of Paris in the future for extra backup purposes. Publications related to VESPA activity are available from open repositories (e.g. ArXiv or conference sites).

4. Deviations from Annex 1

See the approved amendment

7. WP 7 - JRA1: Characterisation Lake Tirez and Danakil planetary field analogues

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

The main objective of JRA1 was to prepare two new Planetary Field Analogues (PFA) for the TA1

activity in the final two years of the EPN2020-RI project. These additional, well-characterised PFAs will complement the analogue sites offered in Years 1 and 2 of EPN2020-RI and will, in particular, have relevance for future astrobiology targets, e.g. Europa.

Fieldwork is needed to fully characterise the geo-microbiological environment and to determine the feed-back mechanisms between the regional geology, soils, climate and biology and how these mechanisms vary throughout the year. Once all the information is available, we will need to integrate the working model of the system as the last objective.

Characterisation of the Tirez Lake system (PFA1) as an Earth Analogue (Coordination: INTA-CAB; IRSPS)

The Tírez lagoon system is centred on Tírez Lake at 39º 32 N -3º 21´E. This environment provides a good analogue for chloride deposits on Mars, such as the layered deposits discovered at the North Pole. Tirez Lake is a seasonal lake of endorreic origin such that for most of the year it is composed of a sun baked, dry surface of deposited salt (NaCl) overlying sources of underground water. The vivid red colour is due to the high content of ferric iron. Within this extreme arid and saline environment a wide biodiversity exists comprised of photosynthesisers and extreme halophilic bacteria. Three field campaigns have been performed during the first two years of the RI program to thoroughly characterize the locations.

Figure 22 - The Tirez lagoon system field site area

Characterisation of Dallol in the Danakil depression (Ethiopia) as Earth analogue (Coordination: IRSPS Gian Gabriele Ori, Barbara Cavalizzi; INTA-CAB: Felipe Gómez, Nuria Rodríguez González)

The second field site is the volcanic environment of Dallol in the Danakil depression in north-eastern Ethiopia. Dallol is a volcanic edifice with an adjacent plain that stretches from the volcano itself to Lake Assal, close to the Ethiopian border with Eritrea. The plain is one of the most impressive depressions in the entire Afar area and it is one of the most inhospitable areas on Earth. A large number of extreme environments form an intricate complex geological and biological setting constructed by volcanoes, hydrothermalism, salt flat and salt deposition, mineralisation, evaporation, and extreme microbial communities. The volcanic activity started during the Miocene (more than 5 million years ago) and is on-going as volcanoes (for example the Erta Ale nearby) and hydrothermal vents. This leads to an association of salt deposition and dry lakes in one of the hottest places of the Earth and have created one of the most extreme environments. Water ponds with very low pH (about 1), sulphur, iron dioxide, and other “exotic” mineralisation form an unusual base for microbial

colonisation. The area is extremely interesting from the geological and astrobiological point of view.

The matching of geomicrobiology and geology in this unique analogue environment has great potential for advancement in knowledge of astrobiological processes. Moreover, this area is attractive for scientists due to the uniqueness and richness of the environments.

Figure 23 - Left: Expedition to Dallol in April 2016. Centre: Hydrothermal system at the Danakil Depression. Right: Collecting samples from copper-rich pools of water between sulphate deposits. Images from F. Gomez, CAB.

1.2 Explanation of the work carried per WP

Detailed description of work-

Task 7.1: Coordination

The overall JRA action has been coordinated by Dr. Felipe Gómez Gómez of the Centro de Astrobiologia (INTA-CAB) and Gian Gabriele Ori of the International Research School of Planetary Sciences (IRSPS). The Dallol PFA has led to important partnerships with Dr. Miruts Hagos and Tesfamichael Yohannes of Mekelle University and Dr. Barbara Cavalazzi from the University of Bologna.

Monthly science meetings on scientific progress were carried out by Skype and regular communication has been undertaken by email. Scientific results have been included in a paper to be published in international research journal on the field of Earth Analogues.

Tasks 7.2 and 7.3: Characterization of PFA1 and PFA2

Development team leads: F. Gómez Gómez, (INTA-CAB), G.G. Ori. For PFA1: N. Rodríguez González (CAB-INTA), M. Hagos & T.G. Yohannes (Mekelle), B. Cavalazzi & R. Barbieri (Bologna).

Three field campaigns to Tirez Lake have taken place in seasonal field campaigns in January, June and November 2016 (MS50: Tirez Field work and monitoring) and the Dallol site was visited in April 2016 (MS57: First field expedition to Danakil Depression) and January 2017 (MS58 Second field expedition to Danakil Depression).

In the first year, the key planetary analogue sites were analysed and mapped, and a detailed biological survey was conducted using sequencing techniques to catalogue the biology at the different sub-habitats. Year Two was used to produce detailed biological distribution maps (spatial and depth) to obtain a detailed quantitative understanding of the processes that control the interaction between biology and geology of the habitat. The regional geological and hydrological mapping and the characterisation of temporal variation water chemistry at Tirez Lake were all completed ahead of schedule (MS51: Regional geological map, Tirez lake; MS52: Regional hydrological map, Tirez Lake; MS53: Characterisation temporal variation water chemistry).

Laboratory work has focused on bacterial population analysis and understanding the biodiversity of the system through molecular ecology techniques. Samples were cultivated in the laboratory under controlled conditions in order to grow natural populations by classical microbiology techniques. 16 S rDNA genes were amplified by Polymerase Chain Reaction (PCR) from the natural samples and cloned in order to sequence those genes. Phylogeny bioinformatics tools allowed identification of the microorganisms presents in the samples. The integration of knowledge from the geological prospective with the biological analysis supported the development of a working model of the entire system. This knowledge will help external users visiting the site in the last two years of the project to better develop their planned work.

For both field sites the following procedures were followed:

- *Sampling and sample conservation*. A homogeneous mixture of the first centimetres of sediments with the water was retained in the core-sampler, corresponding to a 1-2 cm of the water column (if sampled beneath water).
- *Physico-chemical characterization.* The following physico-chemical parameters were measured *in situ*: temperature and conductivity, pH and redox potential, and dissolved oxygen. Sulfate and carbonate were also determined *in situ*. Other anions and cations were determined in the laboratory.
- *Metabolic assays and isolation of pure cultures*. Sulfate-reducing and methanogenic activities were analysed and sulfide production was qualitatively detected.
- Agar plates were used to isolate pure cultures of sulfate-reducing bacteria (SRB) enrichment cultures and methanogenic cultures.
- *DNA extraction and PCR*. Cells from the homogeneous sediment-water samples were disrupted and DNA was extracted. The 16S rRNA genes from mixed microbial DNA were amplified by PCR.
- *Clone libraries and sequencing*. The amplified 16S rRNA genes were cloned and then transformed into competent *E. coli* cells. Plasmid DNA inserts were extracted by alkaline lysis. Automated DNA sequencing was performed.
- *Sequence analysis*. Sequences were compared with the National Center for Biotechnology Information (NCBI) database to identify the closest sequence.

WP7 (JRA1: Characterisation Lake Tirez and Danakil planetary field analogues)-Deliverables

The deliverables from WP7 are to make two new analogue sites available for access in year 3 of the project and hence the deliverables are not due in RP1. The delivery of the sites (D7.1 and D7.2) is therefore due in EPN2020-RI Project Month 24. However in order to host visits in Year 3 it was necessary to include the two new sites in the third TA call. A total of 15 applications were received for access to the 2 new sites in Third call stressing the communities interest and need for access to additional analogue sites.

WP7 (JRA1: Characterisation Lake Tirez and Danakil planetary field analogues)-Milestones

MS49 Employment of 2 ESR. Planned on Month 3 but achieved with delays, on 03/04/17. INTA started the hiring process right at the beginning of the Europlanet project, but unfortunately, due to complications in the administration system in Spain, the process took 1 year.
As the first two years end next August I suppose we can hire this person till August for helping me with the tremendous work we are developing for Europlanet.
MS57 First field expedition to Danakil Depression. Planned on Month 8. Achieved on 31/03/16
MS50 Tirez Field work and monitoring; Planned on Month 12. Achieved on 25/08/16
MS51 Regional geological map; Tirez lake. Planned on Month 14. Achieved on 25/08/16

MS52 Regional hydrological map; Tirez lake. Planned on Month 14. Achieved on 25/08/16
MS58 Second field expedition to Danakil Depression. Planned on Month 16. Achieved on 28/02/17
MS53 Characterisation temporal variation water chemistry; Tirez Lake. Planned on Month 18. Achieved on 07/12/16
MS59 Regional geological map; Danakil Depression, Planned on Month 18. Achieved on 07/12/16

1.3 Impact

Dallol Ethiopia; The development of the Dallol PFA site offers unique and wide-ranging scientific, cultural, socioeconomic and outreach opportunities, in Ethiopia, Europe and worldwide. In December 2016, Europlanet 2020 RI held a workshop on Ethiopia and the Danakil Depression in Planetary Science as part of its NA1 (WP12) science networking activity and co-sponsored by the International Research School of Planetary Sciences (IRSPS), Italy. The aim of the meeting was to stimulate discussion and planning for future activities around the Danakil field site, consolidate collaborations and encourage new collaborative projects across all Horizon 2020 and other research programmes.

A press release following the first expedition to Dallol in April 2016 led to articles in the worldwide media (see **Table 32** for details of coverage) and the development of ongoing relationships between Dr. Gómez and Dr Cavalazzi with journalists and broadcasters (e.g. from New York Times) that have kept in contact throughout 2016 and published articles on the second field trip in 2017 (e.g. New York Times, 30/01/17: Gazing Into Danakil Depression's Mirror, and Seeing Mars Stare Back). The spectacular nature of the Dallol site makes it very appealing to the wider public, and it has been a central focus of EPN2020-RI outreach activities, including the exhibition in the European Parliament and online webinars. Dr. Gómez used the April 2016 expedition to pilot a Raspberry-Pi based climate sensor as part of the Space Climate Detectors outreach project aimed at schools. In addition, Dr Cavalazzi spent a month working in schools in Ethiopia and EPN2020-RI is now collaborating with the EU Space Awareness project on developing an outreach strategy for engaging local communities and schools in Ethiopia with the Dallol PFA site. Dr Cavalazzi performed a multi-media show at the Oratorio San Filippo theatre in March 2017.

Lake Tirez, Spain; A press release is currently in preparation on publication of a paper on the prokaryotic community of Tirez.

Great effort has also been made in outreach to the science communities. Science papers are ready to be submitted to international research journals for publication. The results from this research will be available to the science community through open access journals. For a full list of dissemination items refer to **Table 32**.

Four external users teams have already been in contact with the coordinator. Those teams are interested in applying for visiting the field facility.

2. Update of the plan for exploitation and dissemination of result

All aspects of the project are expected to be completed within the prescribed 24 months and the newly developed capabilities will be available for future TA calls as planned. EPN2020-RI recognises the importance of providing potential TA applicants with new planetary analogue sites to increase the scope of scientific possibilities and improve capabilities in representing scientific and technological analogues. As per the ongoing upgrades and expansions of the current TA1 facilities at Rio Tinto and Ibn Battuta, we envisage improvement of the two JRA facilities throughout the Europlanet2020-RI

time period and beyond, based on the feedback from the first. Hence the end of the RI will not represent the end of the development work.

JRA 1 has already had a significant impact in disseminating results in the form of presentations at conferences and major coverage in the media. The publications expected following completion of the JRA and subsequent TA visits will lead to peer reviewed publications that again will be linked to articles in the popular press. This strategy is expected to maintain a high level of academic interest for at least the new 5 years and the work will be linked to further articles in the popular press.

8. WP8: JRA2 - Implementation of New Spectroscopic and Simulator capabilities

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

The main objective of JRA2 has been to improve experimental capabilities relevant to the planning and implementation phases of forthcoming missions to Mercury, Mars, asteroids and the icy moons of Jupiter. The expanded capabilities offered in years 3 & 4 of EPN2020-RI will allow more quantitative interpretations of planetary mission observations through better-calibrated analogue experiments and measurements made at more pertinent conditions, as described hereafter.

JRA2 has introduced new high-speed imaging techniques, air cooling system and a UV LED solar simulator to the Aarhus University Planetary Simulator Facility to enable the quantitative study of planetary dust and sand transport processes. These capabilities will enhance studies and models of physical parameters and processes (e.g. role of moisture) controlling the Martian surface and atmosphere and provide a deeper understanding of the physical controls of dust-sand transport. Moreover, these capabilities will be relevant to studies of a wide variety of planetary bodies such as Mars, Venus and gas giants and their satellites (like Titan Europa, Enceladus, etc), as well as contributing to research relative to comparative planetology, volcanology and Earth's upper atmosphere.

For the two spectral facilities offered in TA2 (DLR and CNRS-IPAG), JRA2 has been working to extend the spectral coverage and provide capabilities for measurements under extreme conditions pertinent to planetary surfaces and for measurements small and rare samples.

Spectral observations are core to all planetary missions but interpretation of visible and near infrared spectroscopy data from orbiters requires spectral libraries acquired under conditions matching those on the surfaces being studied. This is particularly true for Venus, which has extreme conditions on the surface: 460°C and 93 bars and a dense, CO_2-rich atmosphere. The permanent cloud cover of Venus prohibits observation of the surface with traditional imaging techniques over most of the visible spectral range. Fortunately, Venus' CO_2 atmosphere is transparent in small spectral windows near 1 μm.

Ground observers have successfully used this spectral range during the flyby of the Galileo mission at Jupiter, and most recently by the VMC and VIRTIS instruments on the ESA Venus Express spacecraft. Observations have revealed compositional variations correlated with geological features. In particular, the spectral region near 1 μm fortuitously permits acquisition of several channels of information where most iron and transition metals in minerals have absorption bands, making interpretations about the redox state and transition metal contents of the surface possible. Such analyses rely on a solid foundation of laboratory data acquired at high temperatures. The extension of the Planetary Spectroscopy Laboratory (PSL) to cover the spectral range from 0.7 to 1.2 μm at Venus surface temperatures, will ensure that this data is available.

Development of a micro spectro-gonio radiometer at CNRS-IPAG for small and dark materials at low temperatures will allow far greater sensitivity and the capability to analyse samples from space, such as meteorites, analogues of cometary and asteroid material, and interplanetary dust particles.

1.2 Explanation of the work

Detailed description of work

Task 8.1: Coordination (DLR; AU; IPAG)

The overall JRA action was coordinated by Dr. Jonathan Morrison, Dr. Jörn Helbert and Dr. Bernard Schmitt, but all team members were involved as the ultimate goal is to provide new capabilities that are highly in demand by the scientific community. Industrial partners also have an important role in the upgrade of each of the facilities. Technical staff from the industrial contractors have visited the JRA host institutions to help install/modify and evaluate new equipment and its performance.

Most communications have been via e-mail but periodic dedicated meetings were held at conferences, e.g., EPSC 2016. The opportunity of PMC meetings held at Milton Keynes was also used to set up dedicated meetings between AU-DLR-IPAG.

Task 8.2: New capabilities for Aarhus Planetary Environment Facility

Development team: J. Merrison, J.J. Iversen (AU), M. Patel, M. Balme (OU), W. Goetz (MPS), W. Van Westrenen (VU), B. Weinzierl (DLR)

The aim of JRA2 Task 8.2 was to design, install and test three large-scale technological improvements into the Aarhus Planetary Environment Facility (APEF) to allow new and improved research capabilities:

Sub-task 8.2.1: Quantification of dust/sand entrainment/suspension

The Particle Image Velocimetry (PIV) system, comprising a high speed camera and laser sheet systems, has been constructed and installed (Milestone MS64: PIV installation). This system has already been used – ahead of schedule – in two TA2 visits (specifically 15-EPN-005, 15-EPN-003) and will be referenced in the presentations and publications relating to this work.

The PIV's high-speed imaging techniques allow identification and tracking of individual suspended/transported particles and quantify their velocity and the nature of entrainment/suspension processes. Major components for the PIV and high speed imaging system were designed, procured and constructed somewhat ahead of schedule allowing the installation to occur in early 2016 and some preliminary testing to be performed. The tests involved both high speed imaging of wind driven dust/sand re-suspension and also dust injection i.e. aerosol jets.

The systems functioned entirely as anticipated. Even at the test stage, interesting phenomena have been observed that had previously not been possible within the facility, including dust aggregates being entrained (lifted), transported and breaking up to generate dust.

Sub-task 8.2.2: Quantification of precipitation (icing) and suspended dust

The air cooling system has been designed, procured, constructed and installed by November 2016 – ahead of schedule. Final installation/testing has been performed and the Milestone is completed (Milestone MS67: Validation report on cooling system). This system has also been used for two of our test campaigns already (ahead of schedule), specifically 15-EPN-016, 15-EPN-023, also with related presentation/publication of this work.

Preliminary tests were performed and technical issues were identified and corrected. The tests involved measuring the air temperature under low pressure conditions (of order 10mbar) while applying liquid nitrogen cooling to the cooling systems. The new air cooling system seems to function entirely as anticipated with a minimum (average) chamber air temperature of less than -50°C while applying wind. Prior to the modifications sub-zero air temperatures had essentially not been possible.

Sub-task 8.2.3: UV irradiation and optical properties of suspended dust

An LED based (far) UV solar simulator has been designed, but construction was delayed due to late delivery of LED components. Final construction and installation was performed in December 2016. (Milestone MS68, Installation solar simulator (APEF); Milestone 69: Validation report Installation solar simulator).

Compromises in uniformity were made for reasons of practicality and affordability, however the initial criteria for lamp operation were in fact exceeded. Installation and testing of the lamp demonstrated a higher overall optical irradiance than specified. The systems functioned entirely as anticipated also at low pressure (10mbar) where stable operation was demonstrated for over 80 minutes. These three systems are now considered functional and available for scientific studies.

Figure 24 - Installation of the Particle Image Velocimetry at the Wind tunnel

Task 8.3: Expansion of spectral range for high temperature measurements

Development team: Alessandro Maturilli, Jörn Helbert (DLR), Thomas Widemann (LESIA), Sabrina Ferrari (University Padua)

The goal of EPN2020-RI JRA2 Task 8.3 was to extend the spectral coverage for high temperature measurements down to 0.7 µm at the Planetary Spectroscopy Laboratory (PSL) at DLR. This extension offers the community – for the first time – access to spectra obtained in emission, covering the spectral range from 0.7 to 1.2 µm (and beyond) and obtained at typical Venus surface temperatures of 460°C.

The unique feature of the PSL is a high-temperature chamber (Figure 25**Error! Reference source not found.**) that allows heating of samples to temperatures up to 1000K under vacuum conditions (medium vacuum - 10-100Pa).

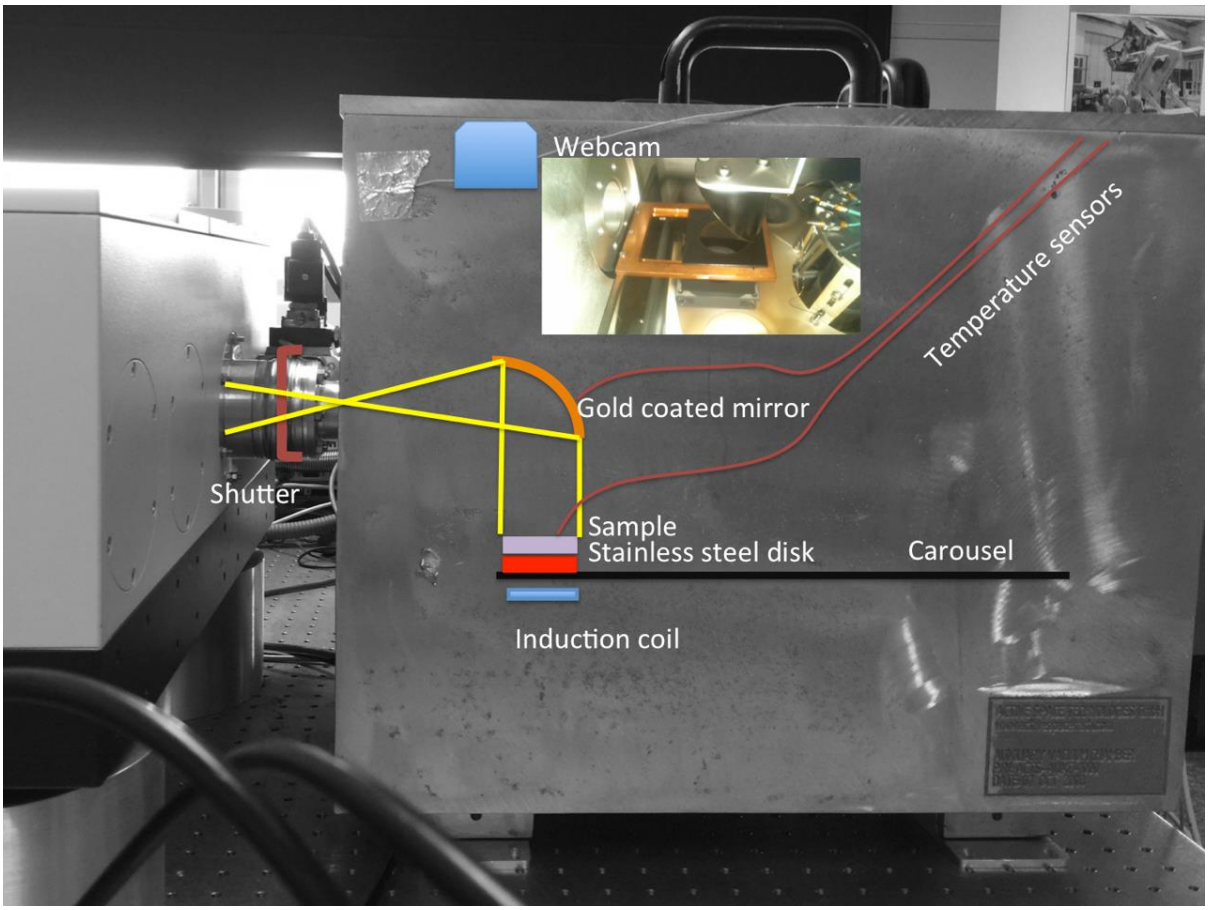

Figure 25 - Configuration and major elements for the external emissivity chamber at the Planetary

Spectroscopy Laboratory (PSL).

Sub-task 8.3.1: Defining measurement requirements, developing measurement protocols and verification procedures.

The teams at DLR and LESIA defined the measurements protocols, including the definition of verification protocols and selection of a set of analogue samples for the first series of test measurements (Milestone MS71: Definition of spectrometer requirements (PEL)).

Sub-task 8.3.2: Designing optical setup, identify necessary components and assessing spectral sensitivity

Upgrading the spectrometer to increase the signal-to-noise ratio below 1µm was a very straightforward task. After discussion with the spectrometer provider and with planning by the optical and detector engineers at LESIA it was decided that an InGaAs detector would offer the best efficiency in the required spectral range. Implementing this detector required an upgrade of the spectrometer electronics as well as the installation of an adapted beamsplitter. All tasks were performed by Bruker together with the DLR laboratory manager.

Sub-task 8.3.2: Implementing changes at PEL

The second task, to upgrade the external chamber to adapt to Venus measurements was more challenging. Steel, when heated to the high temperatures needed to bring the granular sample surface to above 700K, glows strongly and adds a large amount of radiation in the visible spectral range explored. After some tests and discussions with the DLR thermal engineers, a ceramic enclosure was built to embed the steel disk needed to heat the samples, to reduce the disturbing effect coming from the glowing steel.

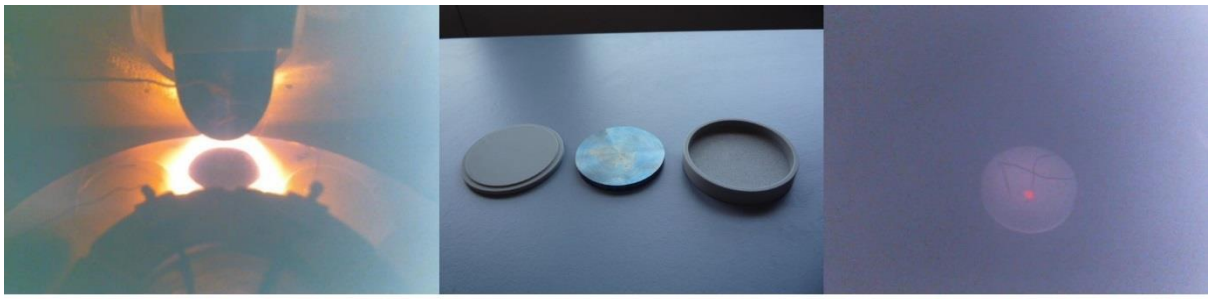

Figure 26 - Left: Webcam picture of steel disk glowing when heated above 700K. Centre: Steel disk and the ceramic enclosure used to mask its glowing in visible spectral range. Right: Webcam picture for the ceramic enclosure heated at 750K. The ceramic enclosure is slightly emitting in the visible spectral range, but much lower than the steel disk used previously.

The final heating system met requirements of as little perturbation as possible coming from the heating itself on the emissivity measurements of Venus analogue slabs in the visible spectral range. The spectrometer system was successfully tested with a range of Venus analogues (Figure 35) and the Milestone completed. (MS72 Spectrometer system design (PEL). Achieved: Project Month 7).

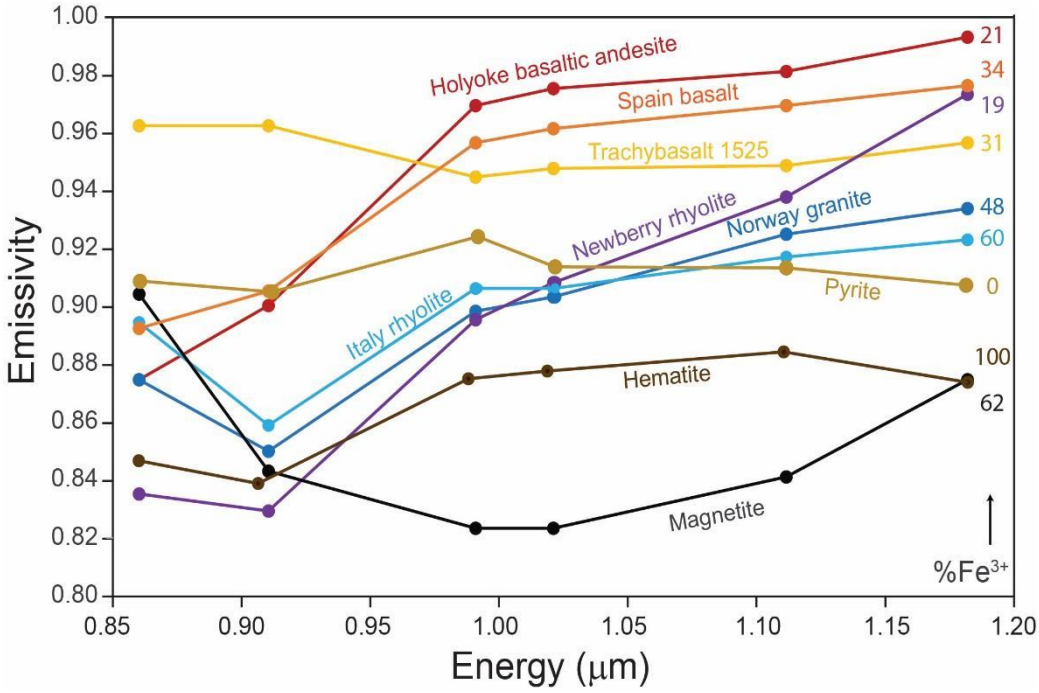

Figure 27 - First set of test measurements for a range of Venus analogues

Task 8.4: Development of a micro spectro-gonio radiometer for small and dark materials at low temperatures

Development team: Bernard Schmitt (IPAG - CNRS), Pierre Beck (IPAG - UGA), Olivier Brissaud (IPAG - CNRS), Sandra Potin (IPAG - CNRS)

The objective of Task 8.4 has been to further expand the spectral range of a new spectro-gonio radiometer with a radical new design. This will allow far greater sensitivity and the capability to analyse small (sub-centimetre) sample sizes at low temperatures, i.e. samples from space such as meteorites, analogues of cometary and asteroid material and interplanetary dust particles.

Sub-task 8.4.1: Defining measurement requirements, developing measurement protocols and calibration procedures

Calculations and tests of preliminary design in the near- to mid-infrared

The micro spectro-gonio radiometer was originally developed for the visible range. Illumination optical calculations were performed with the new design to verify that the design is also adapted to the near- to mid-infrared (NIR-MIR) range and to optimize the NIR-MIR optical transfer of the whole system from the source to the spectrometer.

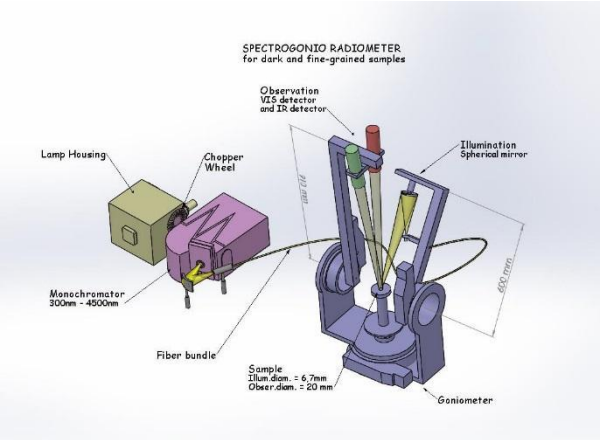

Figure 28 - Schematics of the new design

Experimental determination of the S/N improvement

The prototype of the core of the new illumination design was inserted into the current instrument in order to test the expected performances of the NIR-MIR extension of the new instrument. Tests on various samples and dark reference surfaces to determine the ability of the new design to measure dark (reflectance < 10%) to very dark (reflectance < 2%) surfaces largely exceeded expectations of S/N from the preliminary calculations.

First tests on classical and challenging samples

Two dark synthetic reference surfaces were used to test the ability of the system to accurately measure dark samples: Dark Spectralon 5% (LabSphere), and Metal velvet (Acktar). A VANTABLACK sample was also measured; this is a very challenging material with a reflectance given to be less than 0.05% in the visible, currently the darkest material known on Earth.

The results confirmed that the new design is able to measure samples with reflectance as low as 0.03% in the visible and NIR (< 2.5µm) and 0.2% in the MIR (at least 4.5 µm).

The tests on bidirectional reflectance distribution function measurements over a wide spectral range, high spectral resolution, wide angular range and high angular resolution performed on a CM carbonaceous chondrite (ALH83100) were both effective and fast.

Selection of the NIR spectral range

The question of the NIR-IR spectral range involves a trade-off between the scientific objectives only achievable at high wavelengths (typically in the 3.5-5µm range), the S/N of the measurements over the remaining range, and the cost and complexity of the system.

Diminishing the maximum wavelength reduces the thermal infrared contribution in the background signal and thus the noise of the detector with, as a result, an increase of the S/N over the remaining spectral NIR range of the detector. Cutting the wavelength range below about 4.3 µm would have very significant impact on the science that could be achieved, in particular limitations on the study of minerals, water in minerals and organics and that of the organics themselves. For these reasons, the widest spectral range possible was retained, i.e., up to at least 4.8 µm (as for the current goniometer) or reaching 5 µm with still good S/N using a miniature cryocooled detector. (Milestone: MS76:

optimize spectral range extension. Achieved: Project Month 19).

Selection of challenging samples

Several discussions and meetings occurred in Grenoble, Paris, Wroclaw and Krakow with the members of the expert's consortium (*SRC-PAS; INAF; CNRS-IAS)* to define the set of challenging samples (mostly very dark or precious) and reference samples (well characterized) to be delivered to IPAG for the testing of the prototype, calibration and validation of the final instrument. Some samples have already been delivered, however this testing will be mostly in RP2 once the whole setup has been installed. A general meeting of the consortium is planned in spring 2017 to validate the final instrument requirements and planned performances, the definition of the final calibration procedure will be also discussed.

Sub-task 8.4.2: Introduce Near-IR capabilities, calibrate and validate performance of the micro Spectro-Gonio Radiometer

Selection and tests of the materials for the NIR

- ***Lamp + optics:*** A Quartz Tungsten Halogen (QTH) lamp with a back reflector has been chosen to improve the collection efficiency of its NIR radiation relative to the previous system.
- ***Monochromator:*** The monochromator has been chosen, ordered and delivered with a grating #4 allowing to go well above 5µm.
- ***Optical fibre bundle:*** A specially made fluoride glass infrared fibre optic bundle has been designed and ordered to be manufactured by 'Le Verre Fluoré' company. It has an excellent throughput up to 4.8 µm and still a good one up to 5 µm. It is designed in 2 parts to be able to reduce the polarization induced by the monochromator gratings thanks to various tests on different techniques to depolarize the output of the optic fibre bundle (partly and variably polarized by the gratings at its input).
- ***Cooled Near-infrared detector and its optics:*** An indium antimonide (InSb) detector has been chosen with good detectability value and cooled at 80K with a mini Stirling cryocooler and without long wavelength filter but with a cooled field stop to reduce the solid angle of thermal radiation to the focalization optics. A special collection optics with MgF_2 coated Sapphire and CaF_2 lenses has been designed.
- A test of S/N in the NIR up to 5 µm has been performed on a dark (5% reflectance) calibration target with the prototype system installed on our current spectro-gonio radiometer. It allows to expect a good S/N up to at least 4.7-4.8 µm. The deviation of the signal above 4.8 µm has to be investigated but could be due to the background current. This will be studied during the photometric calibration procedure.
- ***Control and acquisition software:*** The acquisition/calibration/visualization software of the whole instrument is being developed under LabView. The acquisition visualization part of the software is fully ready with all instruments interfaced and all variable parameters implemented in several typical measurements sequences.
- ***Test optical bench:*** An optical bench has been installed in a dedicated room in order to perform all the tests on the material samples before ordering, and then to characterise individually each component, then each function, and finally the whole instrument once mounted. When all the remaining materials are delivered (March-April 2017), they will be tested individually and added to the system in order to start the final verification and calibration phases of the whole system. These results will be reported in the next Milestone M8.15: 'Calibration & Verification' after the delivery of the whole instrument, tested and calibrated (D8.3) on schedule before 1st September 2017.

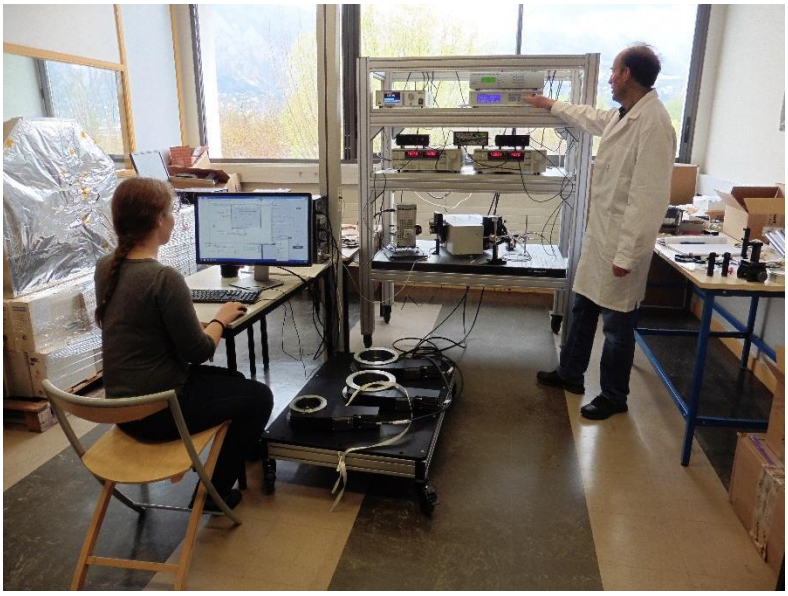

Figure 29 - Overview of the test bench and laboratory with the instrument and all the current delivered materials and instruments under testing and waiting installation on the goniometer (still partly to be delivered in April).

WP8 (JRA2 - Implementation of New Spectroscopic and Simulator capabilities)-Deliverables
No deliverables were due in RP1. The delivery of the three facilities (D8.1, D8.2 and D8.3) is due in EPN2020-RI Project Month 24.

WP8 (JRA2 - Implementation of New Spectroscopic and Simulator capabilities)-Milestones
MS71 Definition of spectrometer requirements (PEL). Planned at month 3. Achieved on 31/01/16
MS72 Spectrometer system design (PEL). Planned at month 6. Achieved on 12/04/16
MS75 Definition of spectrometer requirements (IPAG). Planned at month 6. Achieved on 01/03/16
MS64 PIV installation; Aarhus Planetary Environment Facility (APEF). Planned at month 9. Achieved on 03/05/16
MS68 Installation: solar simulator (APEF). Planned at month 9. Achieved on 11/01/17
MS66 Cooling system completion (APEF). Planned at month 12. Achieved on 04/01/17
MS65 PIV validation report (APEF). Planned at month 15. Achieved on 20/11/16
MS69 Validation report Installation solar simulator (APEF). Planned at month 15. Achieved on 11/01/17
MS67 Validation report on cooling system (APEF). Planned at month 18. Achieved on 04/01/17
MS73 optimize spectral range extension & validate (PEL). Planned at month 18. Achieved on 15/03/17
MS76 optimize spectral range extension (IPAG). Planned at month 18. Achieved on 01/03/17.

1.3 Impact

The new capabilities at the APEF will enhance our understanding of physical parameters and processes controlling the Martian surface and atmosphere and dust-sand transport, as well as providing capabilities which will be relevant to other planetary bodies and comparative planetology, volcanology and Earth's upper atmosphere. This has already been demonstrated by TA visits (e.g. 15-EPN-003 that investigated gas-particle and particle-particle interactions in volcanic eruptions occurring on Earth and in non-terrestrial environments). For industrial testing (e.g. Mars missions and meteorology sensors) these new capabilities are already in urgent demand by users.

Work in progress at the Planetary Emissivity Laboratory is laying the groundwork for a collection of a spectral library for rocks and minerals under Venus conditions. Once acquired these data will be key

in understanding and modelling differences in emissivity between ambient and Venus conditions, potentially enabling calibration transfer between datasets. With the ESA EnVision mission in the ESA M5 selection and at least 3 Venus-related proposals in the New Frontiers selection, the impact of these measurements will be extremely high. The PEL upgrade has been presented at LPSC 2017 and further presentations are planned. A press release is also in preparation.

The new micro Spectro-Gonio Radiometer will allow far greater sensitivity and the capability to analyse analogue comet/asteroid materials or samples from space that are mostly very dark or precious. Publications/presentations are planned (e.g. at EPSC 2017) and efforts will be made to promote access to the facility following delivery in Project Month 24.

For a full list of activities refer to **Table 32**.

2. Update of the plan for exploitation and dissemination of results

All aspects of the project are expected to be completed within the prescribed 24 months. The newly developed capabilities will therefore be available for future TA calls, as planned. We envisage improvement to all three facilities will continue to be developed beyond the end of the Europlanet2020-RI project, based on the feedback from the first users with Europlanet. Hence the end of the RI will not represent the end of the development work. . The new facilities developed in the JRA and to be made available to TA applicants are expected to be used mainly by planetary scientists in an academic context. However, the two spectroscopic and the environmental chamber offer major improvements that are expected to be utilised by industry involved in planetary missions.
The JRA and TA 2 have already had a significant impact in the form of presentations at conferences. The publications of completed studies will lead to peer reviewed publications that will be linked to articles in the popular press.

9. WP9 - JRA3: Optimal planetary sample handling, investigation and analysis

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

The principle objectives of JRA 3 are to improve capabilities for the mineralogical, geochemical and isotopic analysis of rare or unique samples. The specific focus is on the capability to develop optimal handling and characterisation of material from sample return missions and extra-terrestrial material such as meteorites. The focus is therefore to perform characterisation and analysis involving the minimum amount of sample material possible and minimal or zero sample preparation. The JRA has

three overarching aims:

- to determine to what extent samples can be characterised using no preparation at all (e.g. using computed tomography, scanning electron microscopy, electron microprobe etc);
- develop novel preparation techniques that lower sample loss;
- make key developments in mass spectrometry to optimise isotopic analysis of small samples.

By allowing for the analysis of smaller samples, the JRA is expected to open up totally new areas of research providing new quantitative constraints on planetary formation and evolution. Moreover, the methodological developments are expected to have major spin-offs that have direct benefits in diverse scientific and social science disciplines where sample size is limited e.g. archaeology, art history, forensic science, food security etc.

1.2 Explanation of the work carried

Detailed description of work

Task 9.1: Coordination

The overall JRA action was coordinated by Prof. Sara Russell and Prof, Gareth Davies but all team members provided input in how best to achieve the ultimate goal of the analysis of precious and, in most cases, unique material. Industrial partners also have an important role in the development of new technology. There have therefore been working visits to the manufacturers (e.g., OU and CRPG to Cameca in Paris and VU to ThermoFisher in Bremen) as well as regular e-mail contact. Technical staff from the industrial partners have visited the JRA host institutions to help install/modify and evaluate new equipment and its performance.

There has been regular contact between the NHM-OU and CRPG-VU, as well as with team members e.g. Prof. Davies visited CRPG in September 2016 and held planning and implementations meetings with the Secondary Ionisation Mass Spectrometers (SIMS) and Thermal Ionization Mass Spectrometers (TIMS) groups. Most communications have been via e-mail but periodic dedicated meetings were held at conferences, e.g, Goldschmidt 2016. The opportunity of a PMC meeting at Milton Keynes was also used to set up dedicated meetings between NHM-OU-VU.

A road map (D9.1. Road map on preparation protocol) was designed to advise on optimal sample preparation protocols to maximize the potential mineralogical- textural and geochemical data that can be obtained on an individual sample.

Four Early Stage Researchers (ESR) have been employed (MS79: Employment (or allocation of time for) 3 ESR) in addition to the ESR. The starting dates have been staggered more so than envisaged in the proposal. This was a result of the fact that ESRs originally offered relatively short-term positions either accepting permanent or longer term contracts elsewhere and some delays in the delivery of hardware by industry ensued. The ESRs are:

- Dr Epi Vaccaro (male) NHM, Task 9.2/9.3
- Dr Janne Koornneef (female) VUA, Task 9.4
- Xuchao Zhao (male), OU, Task 9.4
- David Madre (male) CRPG SIMS , Task 9.4

Task 9.2: Development of analysis of pristine samples; no sample preparation *(lead* Sara Russell*: NHM; All JRA Team)* and

Task 9.3: Development of sample preparation for analytical geochemistry with minimal mass loss (leads Sara Russell (NHM) and Gareth Davies (VUA); JRA Team: Albert Galy, Etienne Deloule, Laurie Reisberg (CRPG); Ian Franchi (OU))

Tasks 9.2 and 9.3 are intimately linked and in some cases involve iterative approaches to optimise the minimal amount of material used. To avoid repetition, the two tasks are dealt with together. NHM are leading the development of sample characterisation and analysis utilising no or minimal sample preparation but the JRA includes input from all four partners. 3D image data from Computed Tomography (CT) scanning has been evaluated using primitive chondritic meteorites, comparing outputs from the laboratory CT scanner at NHM with information gained from with synchrotron CT scanning at the SPring-8 facility in Japan. 3D data have also been compared with 2D data acquired from electron microscope analyses. Similar comparisons have already been made on more homogeneous materials, mainly in the biological and materials sciences. However, the complexity of chondrites, consisting of silicates combined with significantly lower density amorphous and carbonaceous materials, along with much denser metal and sulphides, make a specific study on these samples necessary.

In parallel, a study of Energy Dispersive X-Ray (EDX) element maps has used scanning electron microscopy (SEM) on conventionally polished and carbon coated samples and quantitatively compared the data with that acquired on unprepared chips. Analyses will enable researchers to use minimally invasive techniques where appropriate, in order to preserve precious extraterrestrial material. Preliminary work was presented at the Hayabusa Symposium in Japan. This was a workshop to bring together researchers on the samples returned from the asteroid 25143 Itokawa by the JAXA Hayabusa mission. Work scheduled for the final 6 months of the JRA will lead to a conference presentation and potentially a peer reviewed article.

Work comparing CT scanning instruments is at a fairly mature stage and has resulted in a conference abstract. It will be written up as a peer reviewed publication. This will include a further two days of instrument time on the SEM to complete comparison of uncoated and coated samples. Work will continue to evaluate the best options for mounting small extraterrestrial materials for CT analysis. This work should be completed within the next two months, well ahead of the deadline for delivery of the new methods for TA access. The outcome of approaches has been discussed intensely with the OU team in respect of future analysis using SIMS and NanoSIMS in future TA calls. This work already undertaken has provided input to the first two TA calls (specifically 15-EPN-041: Solar System forensics: Possible supernovae fingerprints in the earliest solids; and 15-EPN-017: 3D µ-Tomography Analysis of Chondrule Zonation in Carbonaceous Chondrites) and some capabilities have been delivered ahead of the 24-month milestone.

An additional approach was successfully developed by the VU team. An Electron Microprobe technique has been formulated that requires no sample preparation other than carbon coating. Samples are aligned with surfaces perpendicular to the electron beam. Advice on how to validate data quality have also been developed. The first peer reviewed paper applying the methodology to a scientific question, Timmerman et al. 2017, has been published.

Task 9.4: Validation of analytical methodologies for the use of 10^{13}Ohm resistors in state-of-the-art analytical instrumentation *(VUA; CNRS-CRPG; OU; ThermoFisher; CAMECA)*

The VU, OU and CRPG are collaborating in evaluating the performance of newly developed high Ohmic

resistors to conduct isotopic analyse of smaller samples.

The high resistor amplifier systems are in some cases still being developed by industry. One of the collaborating companies (CAMECA) has acquired a UK company (Nu Instruments) who had independently developed high ohmic resistors (10^{12} Ohm). This led to some delay in delivery and installation of the hardware to the (SIMS) instruments. Both CAMECA and Nu systems, however, have now been evaluated in SIMS instruments and development work continues. So far, the precision achieved represents a significant improvement (around a factor of 2) over conventional 10^{11} Ohm amplifiers and offers the ability to avoid the use of secondary electron multipliers that are prone to drift. Further upgrade of the electronics is expected to lead to additional improved precision over the summer in time for application within the TA as part of the next TA call.

To date a number of measurement scenarios have been evaluated in detail by the OU NanoSIMS team. The very high precision sought in this work is a requirement for exploring most planetary types of processes, especially those at high temperature, where the magnitude of isotopic effects are usually very small. Hence it must be stated that although significant improvements are expected to be delivered within the timescale of the JRA, continued collaboration with industrial partners is expected to lead to on-going improvements in analytical precision for the next 3-5 years.

High resistance amplifiers (10^{13} Ohm) have been applied to TIMS at both VUA and CRPG and Multi-Collector Induced Coupled Plasma Mass Spectrometry (MC-ICPMS). The first TA application to use the high resistance amplifiers was approved in the second TA call, ahead of schedule. The TA visit is scheduled in the summer of 2017.

Reproducibility tests were performed on a MC-ICPMS at various signal intensities using a 10^{13} Ohm amplifier on the ^{57}Fe signal (the smallest Fe isotope mass) and were compared to the same tests run on 10^{11} Ohm amplifiers. Tests suggest that 4-2 times better reproducibility can be achieved for the 10^{13} set-up. Installation will be complete before the end of year 2 of the project, in time for inclusion in future TA calls. In fact we anticipate applications in the current TA call and the facility will therefore be offered ahead of schedule.

Presentations about rare gas instrument performance have been made at workshops and at an invited talk at conferences (e.g., Geological Society of America in September 2016; Kuiper et al.) but are not part of the Milestones-Deliverables specified by Europlanet2020-RI. The work has resulted in the first publication (Timmerman et al., 2017) and more manuscripts are expected in the future.

WP9 (JRA3: Optimal planetary sample handling, investigation and analysis)-Deliverables

D9.1. Road map on preparation protocols. Planned for Month 18. Submitted in Month 19 (17 days late).

D9.2: Publications on sample characterisation. Planned and submitted on Month 18. The first publication that utilise no sample preparation was published earlier this year; Timmerman et al. 2017.

D9.3: Submission of publications on the optimization of methodologies for the application of 10^{13} Ohm resistors. Planned on Month 24, but the first publication that applies 10^{13} Ohm resistors has already been published earlier this year; Timmerman et al. 2017.

WP9 (JRA3: Optimal planetary sample handling, investigation and analysis)-Milestones

MS79- Employment (or allocation of time for) 3 ESR. Planned on Month 3. First of several appointments achieved on 01/01/2016.

MS82 Installation functional 10^{13} Ohm resistors in instruments. Planned on Month 6. Achieved on 18/01/2016

MS83 Presentation results of 10^{13} Ohm resistor Performance. Planned on Month 12. Achieved on 28/06/16 (Goldschmidt conference; Yokohama).
MS80 Presentation of zero sample presentation analyses. Planned on Month 18. Achieved on 28/06/16 (Goldschmidt conference; Yokohama)
MS81 Presentation of minimal sample presentation analyses. Planned on Month 18. Achieved on 29/11/2016.

1.3 Impact

There have already been several presentations at workshops, conferences and seminars, and many more contributions are expected within the next 6 months e.g. the 48th Lunar and Planetary Science Conference in Houston in March 2017, the European Geoscience Union General Assembly in Vienna in April 2017, and the Geochemical Society's Goldschmidt meeting in Paris, August 2017 (see **Table 32** for full details; e.g., Vaccaro et al. 2016). The first paper applying the technique was published in a high impact journal (Timmerman et al. 2107) and was the subject of a press release issued by NA2, resulting in media coverage. The paper reported analysis of small mineral inclusions extracted from diamonds. The publication also reported isotopic data (D9.3) highlighting the potential for synergy through combining the different techniques being developed within the JRA.

Additional publications are already in submission to high impact journals (e.g., Koornneef et al., Nature Communications). The success of the development work is being disseminated to the planetary science community through presentations at international meetings, with an emphasis on promoting the new capabilities within the TA. The turnaround times of submission to publication are typically 6-9 months, thus the significant impact from peer reviewed publications is expected over the next 2-3 years.

A TA visit to undertake isotopic analyses using the high ohmic resistors was approved in the second TA call and this is scheduled for the summer of 2017. The fact that this application was made a year in advance of the expected delivery of the JRA facility, stresses both the importance of the developments to the community and the effective way the information is being disseminated.

Installation and presentation of results related to the performance of 10^{13} Ohm resistors (MS82, MS83) has been accomplished, the former in multiple instruments (4 at VU and 1 at CRPG), Currently all aspects of the JRA appear to be on schedule to do so. The success of the methodologies reported by the VUA team has led to the installation of 10^{13} Ohm amplifiers in rare gas instruments at the VUA. The rare gas group led, by Prof Wijbrans and Dr Kuiper, are not directly part of the EPN2020-RI team. Based on the success of the research using other amplifiers, the rare gas team decided to invest in the new technology and are expecting to make major break-throughs in the precision with which they can determine the age of rock formation on Earth and in samples returned from missions (approximately a factor 2). A presentation discussing the possibilities of the imporved precision was made at the end of 2016 in an invited presentation by Dr Klaudia Kuiper.

Perhaps the most gratifying aspects of the success of the development work has been the direct impact on applications outside the direct field of Planetary Science. The application of the new techniques to the study of diamonds for example has had major press coverage (see **Table 32**) and will result in several presentations at conferences (e.g. EGU and the quadrennial International Kimberlite Conference in Botswana, October).

There has also been direct impact outside the traditional disciplines that use analytical scientific methods. The ability to analyse smaller samples has already led to new developments in art (e.g. a poster on new applications of isotopic analysis of small quantities of oil paint will be presented TechNart conference in Bilbao, May) and archaeology (e.g. an application for the provenance of jade

artefacts in the context of changing archaeological trading networks will be presented at the 27th Congress of the International Association for Caribbean Archaeology in St Croix, July the European archaeological association meeting in August/September in Maastricht). See **Table 32** for full details. Dr Joanna Ostapkowicz (Research Associate in Caribbean Archaeology, School of Archaeology, University of Oxford) has obtained a grant from the Arts & Humanities Research Council of the UK ~ 0.4M Euro to work with Professor Davies' team at the VUA to apply micro-analytical techniques to museum quality artefacts to determine their place of origin (provenance).

Overall the activities outlined above and in **Table 32** suggest that the JRA will leave a major mark and a firm legacy felt more broadly than in Planetary Science. This conclusion is supported by the fact that two studies concerning climate change were published at the end of 2016 that made use of the newly developed techniques (Aarons et al., 2016 a&b). Although not directly attributed to Europlanet funding, these proof of concept studies appeared in journals with high impact and stress that the developments may have applications in scientific fields far wider than currently anticipated (Aarons et al., 2016a,b).

1.3.1 References cited above

Koornneef, J.M., Gress, M.U., Chinn, I.L., Jelsma, H.A., Harris, J.W., & Davies, G.R. (2017). Archaean and Proterozoic diamond growth from contrasting styles of large-scale magmatism. Accepted subject to minor revisions; Nature communications.

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Aarons, S.M., Aciego, S.M., Gabrielli, P., Delmonte, B., Koornneef, J.M., Wegnerf, A., Blakowski, M.A. (2016b). The impact of glacier retreat from the Ross Sea on local climate: Characterization of mineral dust in the Taylor Dome ice core, East Antarctica. Earth and Planetary Science Letters, Volume 444, 34–44. http://dx.doi.org/10.1016/j.epsl.2016.03.035.

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Timmerman, S., Koornneef, J.M., Chinn, I.L. & Davies, G.R. (2017). Dated diamond growth zones reveal variable recycling of crustal carbon through time. Earth and Planetary Science Letters, 463, 178-188. http://dx.doi.org/10.1016/j.epsl.2017.02.001.

Vaccaro E., A. Nakato, A. J. King, J. Najorka, K. Uesugi, A. Takeuchi, T. Nakano, J. Matsuno, A. Takayama , A. Tsuchiyama, and S. Russell. (2016). Matrix investigation of primitive meteorite MIL 07687: 2D-3D comparison In: JAXA Hayabusa Symposium 2016

2. Update of the plan for exploitation and dissemination of results

All aspects of the project are expected to be completed within the prescribed 24 months. The newly developed capabilities will therefore be available for future TA calls, as planned. We envisage improvement to the SIMS and NanoSIMS methodologies will continue to be developed beyond the end of the Europlanet2020-RI project, within currently running non-disclosure agreements. Hence the

end of the RI will not represent the end of the development work. The high number of presentations made associated with the initial development work of the JRA and the publications in high impact journals has already made significant impact with dissemination of the results to the popular press. A similar strategy will be followed as the new capabilities become fully available for TA users. In particular the analysis of meteorite material is expected to have a major impact within planetary science. The spin-offs of the work outside the discipline is already evident, with projects funded to study museum grade archaeological artefacts and collaborations with climate scientists and art historians. Potential applications in forensic science are also being explored.

10. WP10- JRA4: PSWS (Planetary Space Weather Service)

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

The Planetary Space Weather Service (PSWS) aims to extend the concept of space weather to other planets in our Solar System and, in particular, to spacecraft that voyage through it. PSWS will give

European planetary scientists, for the first time, new methods, interfaces, functionalities and/or plug-ins dedicated to planetary space weather in the form of tools and models available.

A variety of tools (in the form of web applications, standalone software, or numerical models in various degrees of implementation) are available in EPN2020-RI partner institutes for tracing propagation of planetary or solar events through the Solar System and modelling the response of the planetary environment (surfaces, atmospheres, ionospheres, and magnetospheres) to those events. As these tools were usually not designed for planetary event prediction and space weather applications, additional research and tailoring is required to adapt them for these purposes. The overall objectives of PSWS JRA4 WP10 consists of reviewing, testing, improving, and adapting methods and tools available within the partner institutes in order to make prototype planetary event and space weather services operational in Europe at the end of the programme. In particular the aims are:

- To define a service for planetary events and planetary space weather predictions;
- To develop new methods, interfaces, functionalities and/or plug-ins dedicated to planetary space weather in the tools and models already available within the partner institutes;
- To define planetary proxies and reliability factors for planetary space weather applications;
- To validate, compare and enhance the capability of the existing models and tools in order to predict the impact of solar events in the vicinity of Solar System objects;
- To identify user requirements, develop the means to implement event alerts, and chain those to the 1) planetary event and 2) planetary space weather predictions;
- To facilitate discovery or prediction announcements within the PSWS user community in order to watch or warn against specific planetary and planetary space weather events;
- To set up dedicated amateur and/or professional observation campaigns, diffuse contextual information for science data analysis, and enable safety operations of planet-orbiting spacecraft against the risks of impacts from 1) meteors and 2) solar wind disturbances.

1.2 Explanation of the work

The Planetary Space Weather Service (PSWS) will provide 12 services distributed over four different service domains: A) Prediction; B) Detection, C) Modelling and D) Alerts. These are sub-divided as follows:

A1. 1D MHD Solar Wind Prediction Tool (Task 10.2)
A2. Propagation Tool
A3. Meteor showers (Task 10.3)
A4. Cometary tail crossings
B1. Lunar impacts
B2. Giant planet fireballs
B3. Cometary tails
C1. Transplanet – Earth, Mars (Venus), Jupiter (Saturn) (Task 10.2)
C2. Mars radiation environment (Task 10.4)
C3. Giant planet magnetodiscs (Task 10.2)
C4. Jupiter's thermosphere (Task 10.2)
D. Alerts (Task 10.5)

Detailed description of work

Coordination of the PSWS JRA4 is led by Nicolas André (CNRS-IRAP), with support from Manuel Grande (University of Aberystwyth). Work undertaken in preparing each of the services for delivery to the PSWS VA facility during the first reporting period 1 September 2015 to 28 February 2017 is

summarised in the tasks below.

Task 10.1 Coordination (CNRS, ABER)

- The PSWS kick-off meeting was held at IRAP/CNRS on 21-22 March 2016 (Attending; IRAP/CNRS, ABER, UCL, OBSPARIS, Wigner SRC, IAP, DLR + SRC PAS remotely),
- A PSWS briefing meeting was held at the European Space Weather Week (ESWW) in Oostende 14-18 November, 2016.
- A first PSWS meeting (also related to Task 10.3) on the reliability of solar wind propagation service was held at IRAP/CNRS 23-27 January 2017. The reliability of the services is ensured by defining planetary proxies and reliability factors for planetary space weather applications.
- A meeting (also related to Task 10.5) to define the PSWS Alert system was held at IRAP/CNRS, 22 February 2017
- A meeting (also related to Task 10.2) on the preparation of Giant planet magnetodiscs and Jupiter's thermosphere tool was held at IRAP/CNRS, 23-24 February 2017
- A second PSWS meeting (also related to Task 10.3) on the reliability of solar wind propagation service was held at IRAP/CNRS, 22 February 2017

Task 10.2 Adapting available tools and methods for planetary space weather (UCL, CNRS)

Several of the PSWS tools have been successfully launched and these have been reported in WP5-VA1: PSWS (Planetary Space Weather Service). Below we will discuss progress on other tools as they are developed for the VA.

A1. 1D MHD Solar Wind Prediction Tool: The Centre de Données de Physique des Plasmas (CDPP) within the Institut de Recherche en Astrophysique et Planétologie (IRAP/CNRS) is providing real time and archive access to propagated solar wind parameters at various planetary bodies (Mercury, Venus, Mars, Jupiter, Saturn, etc) and for several spacecraft (Rosetta, Juno, Maven, etc) using a 1D magnetohydrodynamic (MHD) code available through the CDPP/AMDA tool (http://amda.cdpp.eu) initially developed by Chihiro Tao (Tao et al., 2005).

Status:

- The VA Service is already operational through the CDPP/AMDA Tool (http://amda.cdpp.eu).
- WP11 JRA5 is extending the service through a dedicated web-tool currently in development.

Achievements:

- Propagated solar wind datasets based on OMNI inputs as well as on ACE real-time observations have been created and integrated into the CDPP/AMDA Tool.
- The architecture and data products for a dedicated web-tool have been frozen.

C1. Transplanet – Earth, Mars (Venus), Jupiter (Saturn): The Centre de Données de Physique des Plasmas (CDPP) within the Institut de Recherche en Astrophysique et Planétologie (IRAP/CNRS) is developing an online version of the hybrid-fluid TRANSPLANET ionospheric model (Marchaudon and Blelly, 2015) that will enable users to make runs on request for Venus, Earth, Mars, Jupiter, and Saturn.

Status:

- The service is operational for PSWS VA1 WP5 (http://transplanet.cdpp.eu) for Earth, Mars, Jupiter. The extension of the service to the case of Venus and Saturn is being developed and made operational.

Achievements:

- A web-interface for the definition of configuration files has been developed;
- An architecture enabling runs on request has been developed;

- A database of runs on request has been developed.

C3. Giant planet magnetodiscs: University College London (UCL) is adapting the parametric magnetodisc model for Jupiter and Saturn and their space environments in order to take into account realistic, rapid solar wind compressions based on time-dependent predictions of dynamic pressure from the CDPP Propagation Tool and/or observations of the solar wind at Jupiter orbit.

Status:

- Work on this tool has required more time than expected due to complications with respect to the IT architecture, but since it is based on a strong heritage it should be delivered in PM30. A request for delay in the delivery of this Task will be made.

Achievements:

- Requirements for the infrastructure of the UCL 'model service' specified.

A Task1-Task 2 Giant planet magnetodiscs and Jupiter's thermosphere meeting was organized at IRAP/CNRS (CNRS/IRAP, UCL), on February 23-24 2017 in order to discuss the developments of the C3 and C4 services.

C4. Jupiter's thermosphere: UCL will adapt the 2D thermospheric models available for Jupiter and its space environment in order to take into account realistic, rapid solar wind compressions, based on time-dependent predictions of dynamic pressure from the CDPP Propagation Tool and/or observations of the solar wind at Jupiter orbit.

Status:

- Work on this tool also has been delayed due to complications with respect to the IT architecture, but should be delivered in PM30, as it relies on some heritage. A request for delay in the delivery of this Task will be made.

Achievements:

- Requirements for the infrastructure of the UCL 'model service' have been specified.

Task 10.3 Enabling planetary event prediction/ensuring reliability of services (Wigner, OBSPARIS)

A3. Meteor showers; The Observatoire de Paris (OBSPARIS) will link ephemeris of Solar System objects to predictable meteor showers that impact terrestrial planet surfaces or giant planet atmospheres.

Status:

- A prototype service is available internally and under test. In addition WIGNER is testing space weather connections in the Solar System in order to assess and quantify the reliability of some of the services developed (A1 and A2). A database of past events with relevance to planetary space weather and with multi-spacecraft coverage across the heliosphere is being prepared for PSWS and will also be made public via the VESPA interface.

Achievements:

- Required ephemeris data have been defined and prepared;
- Specifications for the online website have been defined;
- Website development has started.
- Test results and definition of reliability factors for solar wind propagation were delivered by Wigner RCP on 15 January 2017

Task 10.4 Testing space weather connections in the Solar System (IAP, DLR, Wigner RCP)
IAP and Wigner RCP coordinated their approach for validating the existing space weather models and tools. Due to the continuous data coverage at Lagrange Point 1 (L1), IAP is testing the propagation of Interplanetary Coronal Mass Ejections (ICMEs) between Mercury and L1 with the existing propagation tool developed by the CDPP within IRAP/CNRS.

Status:
The tests have provided a larger event database, they refined the validity of the tool and they offer a better comprehension of the ICME propagation in the interplanetary medium. Wigner is testing the propagation of ICMEs at Venus, Mars, and comet Churyumov-Gerasimenko.

Achievements:
Two internal PSWS reports on these activities have been submitted by IAP and Wigner RPC:

- *Test results and definition of reliability factors for solar wind propagation*, Wigner, 15 January 2017
- *Testing space weather connections in the inner Solar System*, IAP, 13 January 2017

C2. Mars Radiation Environment; Aberystwyth University (ABER) together with the Institute of Aerospace Medicine (DLR Cologne) will develop a Mars radiation surface environment model, using modelled average conditions available from Planetocosmics at https://www.spenvis.oma.be/help/models/planetocosmics.html.

The Planetocosmics data are synthesised into look-up tables parameterized to variable solar wind conditions at Mars.
Status:

- The programme at DLR has been completed but that at ABER was delayed due to difficulty in appointing staff with appropriate skills. A report on the system architecture and functionalities for the Mars radiation environment was issued, ABER, 20 January 2017

Achievements:

- Propagation of energetic particles through the Martian atmosphere achieved by DLR;
- Convert to dose in silicon, achieved by DLR;

Task 10.5 Alert Service (OBSPARIS, UCL, CNRS, SRC PAS)
The Heliogeophysical Prediction Laboratory in SRC PAS currently hosts three different Space Weather services:

1) RWC Warsaw - Regional Warning Centre of the International Space Environment Services (ISES) Network – responsible for sharing data and forecasts and providing space weather services to users in their regions (http://rwc.cbk.waw.pl).

2) HelgeoSSA - Polish SSA project that is monitoring Earth's ionosphere and magnetosphere for civilian GPS and radio users (http://helgeossa.cbk.waw.pl/helgeossa/MAIN.html).

3) SRC SGIArv (new) - Archive of solar and geomagnetic indices for drag calculation - one of the 39 services developed in the framework of ESA's Space Situation Awareness programme's Space Weather Service Network P2-SWE-I activity "Space Weather Expert Service Centres Definitions and Development". The SRC SGIArv service (http://swe.ssa.esa.int/web/guest/src-federated) is associated with the Ionospheric Weather Expert Service Centre (I-ESC) but dedicated to the Space Surveillance and Tracking (SST) SWE user domain. The deployment targeting this service took place within the

framework of P2-SWE-I, and provides 10 indices used in atmospheric models (http://swe.ssa.esa.int/web/guest/src-federated).

The HelgeoSSA and RWC Warsaw send alerts using the text style messages. Those data are difficult to process via the external automatic software, due to lack of separation of data from the description and lack of delimiters; in addition the common practice within RWC is to prepare these messages manually (each message/alert should be revised by the technician); this practice introduces extra confusion for users interested in getting alerts data from different sources. A common standard like VOEvent will thus provide added value for the space weather community.

In addition, SRC PAS together with the Observatoire de Paris (OBSPARIS) together with University College London (UCL) and the Institut de Recherche en Astrophysique et Planétologie (IRAP/CNRS) are creating an Alert service linked to the planetary meteor shower and planetary space weather predictions based on the use of VOEvent (White et al., 2006). This service is being developed in order to facilitate discovery or make predictions within the PSWS user community, in order to watch or warn against specific events. The ultimate objective is to set up dedicated observation campaigns, distribute contextual information for science data analysis, and enable safety operations of planet-orbiting spacecraft against the risks of impacts from meteors or solar wind disturbances.

Status:

- Deployment of chosen architecture and definition of alert contents in development.

Achievements:

- VOEvent and Comet chosen for Alert systems;
- Architecture defined (see below);
- Prototyped system successfully implemented at IRAP/CNRS and OBSPARIS;

Those templates will be used by a software alert generator and will produce VOEvent alerts easily suited to automatic interpretation.

WP10 (JRA4: Planetary Space Weather Service)-Deliverables

The following deliverables have been provided during the reporting period for PSWS JRA4 WP10:
D10.1 PSWS Database Consolidation Report. Planned and delivered on month 12.
The Database Consolidation phase consisted of reviewing and defining the needs for improvements and adaptation in the already existing tools, as well as ingesting all required input data in those tools.

WP10 (JRA4: Planetary Space Weather Service)-Milestones

No milestones were set during the reporting period.

1.3 Impact

Discussions with the Community Coordinated Modeling Center (CCMC) took place on April 3-7 2017 during the International CCMC-LWS Working Meeting: Assessing Space Weather Understanding and Applications. A presentation on the "Dynamical use of the SPASE/IMPEx datamodel within the Transplanet run-on-request interface: implementation and lessons learnt" was be given by IRAP/CNRS.
A publication reviewing Planetary Space Weather has been published in Journal of Space Weather and Space Climate:

Christina Plainaki, Jean Lilensten, Aikaterini Radioti, Maria Andriopoulou, Anna Milillo, Tom A. Nordheim, Iannis Dandouras, Athena Coustenis, Davide Grassi, Valeria Mangano, Stefano Massetti, Stefano Orsini, Alice Lucchetti, Bridging Space Weather to Planetary Environments, SWSC, 2016, SWSC, DOI: 10.1051/swsc/2016024, 2016

Four publications describing PSWS services and developments have been submitted to the topical issue of Planetary and Space Sciences devoted to Virtual Observatories in Solar and Planetary Sciences, and are currently under review (André et al., Rouillard et al., Génot et al.). They should appear in 2017.

The Europlanet 2020 Research Infrastructure PSWS has built contacts with ESA and other key stakeholders in the Space weather community including other space weather projects funded by H2020 programmes. Two dedicated sessions on PSWS developments will be organized at EPSC in September 2017 and European Space Weather Week (ESWW) in November 2017 where we will illustrate to the community how they can benefit from our services. A topical issue of Journal of Space Weather and Space Climate devoted to PSWS services will follow these sessions. A publication on each of the 12 PSWS services will be submitted to the issue as well as original science results enabled by those services.

For a full list of activities see **Table 32**.

11. WP11 - JRA5: VESPA (Virtual European Solar and Planetary Access)

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

As mentioned in WP6, under FP7, Europlanet developed the first dedicated Virtual Access facility for the European Planetary Science community in the form of the “Integrated and Distributed Information Service” (IDIS). WP6 VA2 “Virtual European Solar and Planetary Access” (VESPA) will build on the FP7

IDIS system to create a Solar System and Planetary Sciences Virtual Observatory (VO). This will fulfil two different functions: at one level VESPA will provide a web-based portal with access to remotely distributed data resources using online forms with scientific parameters; at another, it will incorporate a series of standards and interoperable tools that enable users to share data transparently and visualise planetary datasets, derived from different instruments, missions and models, simultaneously, to create a multi-dimensional view of the "planetscapes" under study. WP11 JRA5 is the mechanism for developing the tools that will form VESPA VA facility.

1.2 Explanation of the work

Detailed description of work

The WP has the following Tasks:

Task 11.1- Coordination (OBSPARIS, INAF)
Task 11.2- Tools and interfaces (OBSPARIS, UCL, CNRS/IRAP)
Task 11.3- Solid Spectroscopy Hosting Architecture of Databases and Expertise - SSHADE (CNRS/IPAG)
Task 11.4- Planetary surfaces (lead: Jacobs Univ, co-lead: CNRS/GEOPS)
Task 11.5- Magnetospheres (CNRS/IRAP, UCL)
Task 11.6- Small Bodies (INAF, OBSPARIS)
Task 11.7 – Atmospheres (IASB-BIRA, CNRS/LATMOS)
Task 11.8 - Exoplanets (OBSPARIS, CNRS)

Progress in each of these tasks is summarised below and in **Table 30**

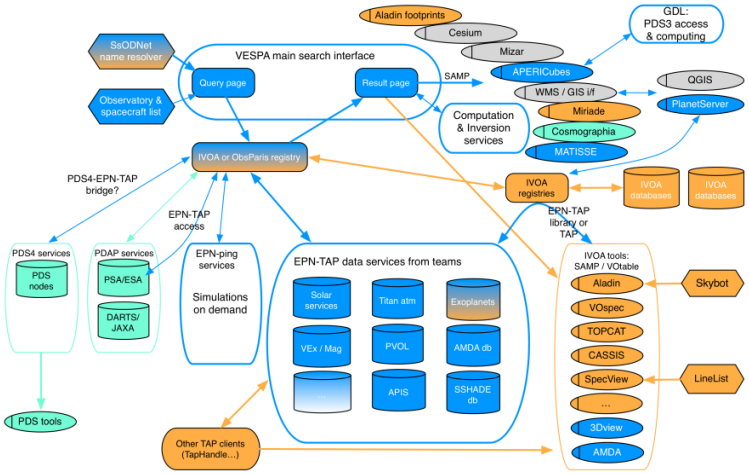

Figure 30 - short-term roadmap for the VESPA system. Colors indicate the main origin of the developments: orange = IVOA, blue = VESPA, light green = PDS / SPICE / IPDA, silver = OGC / GIS-related. Bold arrows are connections already implemented, thin ones are under study or limited in scope.

Task 11.1 Coordination

Bi-weekly telecons have been held often with members of WP6 VESPA VA management team. Complete documentation of JRA activity has been maintained and is available on the VESPA public wiki (https://voparis-confluence.obspm.fr/). A more user-friendly version can be found on the web site http://www.europlanet-vespa.eu.

Task 11.2 Tools and Interfaces

- An upgrade of the EPN-TAP access protocol to v2 + thematic extensions has been completed.
- A main search interface with necessary support tools has been developed together with a

global registry of services. Updated specifications for the DaCHS server and VO tools: a workflow study and on-line visualisation of spectral cubes (APERICubes tool) and specifications to JPL to implement VO interface (SAMP) in WebGeoCalc tool have been made.

- An upgrade of CASSIS for generation of Planetary Science spectra has also been developed.
- 3Dview upgrades: implementation of EPN-TAP library from IRAP; "Cartography" (image projection) interface for APIS.
- Development of the iPECMAN on-line tool for electromagnetic wave polarization analysis; specifications for VO interface and integration with VESPA services.
- Start of Aladin updates to support planetary surfaces and reference frames including the definition of further requirements (Figure 45).

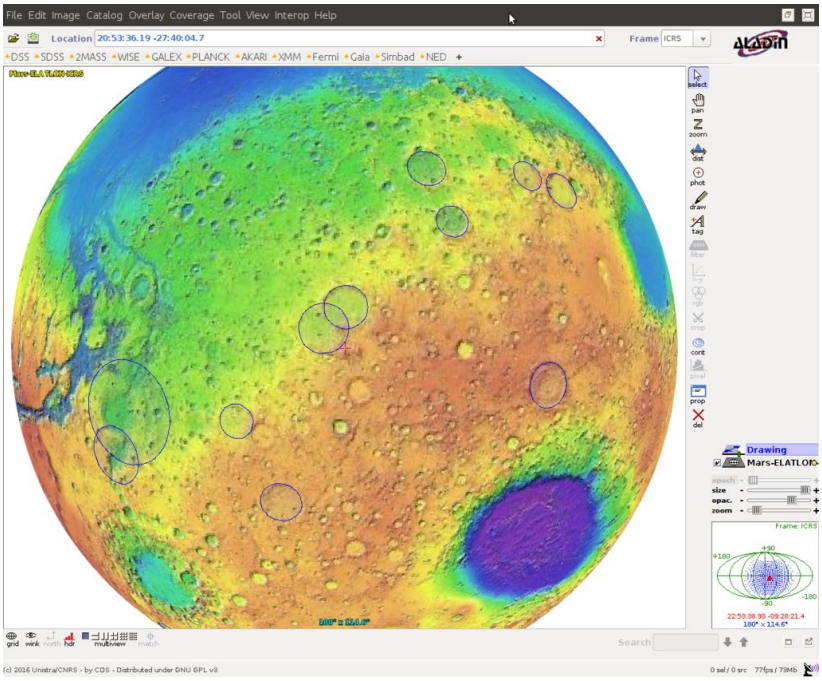

Figure 31 - Mars largest craters from the Robbins database over-plotted on Mars topography in Aladin.

Task 11.3 Solid Spectroscopy Hosting Architecture of Databases and Expertise – SSHADE

SSHADE is a sub-network of 20 European contributors from 8 different countries. It will extend the GhoSST (Grenoble astropHysics and planetOlogy Solid Spectroscopy Thermodynamics) infrastructure defined in FP7 programs Europlanet-RI and VAMDC to a large set of contributors in the field of solid spectroscopy, including the major ones. Implementation in the JRA will be followed by a phase of data documentation and validation in VESPA-VA, to ensure consistency and data quality. The resulting service will not only help improve the spectral databases of ices, minerals and organic material, but will also make the state-of-the-art laboratory data readily available as references to interpret observations of planets and small bodies, in particular from spacecraft.

SSHADE consists of a set of databases on solid spectroscopy (ices and minerals) with:

- A common 'solid spectroscopy' interface
- A common Import/Search/Visualization/Export engine
- A common fundamental database (species, publications, objects, band list, …)

SSHADE will also host all data collected during the EPN2020-RI TA2 programme of visits to the 'Cold

Surfaces Spectroscopy Facility' at IPAG.

The SSHADE databases will cover:
Laboratory, field, airborne as well as simulated and theoretical spectral data with their corresponding spectra and their various types products (ex: transmission, absorbance, absorption coefficient, optical constants, band list) for many different types of solids (ices, snows and molecular solids, minerals, rocks, inorganic solids, natural and synthetics organic and carbonaceous matters, meteorites and other cosmomaterials), with a wide range of measurement technics (transmission, bidirectional reflection, Raman, fluorescence), over a wide range of wavelengths (from X-rays to millimeter wavelengths (can be extended up/down)).

It is based on the Solid Spectrocopy Data Model (SSDM) and the GhoSST database developments developed under the previous FP7 Europlanet RI and FP7 e-infrastructure VAMDC (2009-12) and SUP@VMDC (2013-2014).

WP11- JRA5 is developing the SSDM Data Model by creating a multi-database structure complete with the development of data import tools, interfaces, and templates and various conversion tools. The DM defines units, files, bibtex, etc and Graphical User Interface (GUI) for data producers: import. A prototype service has been completed and delivered to European Commission but is currently under restricted access being opened for the groups of the SSHADE consortium, for data import and training purposes (http://pre-sshade.osug.fr/).

Task 11.4 Planetary surfaces
This activity has developed Geographic Information System (GIS)-VO bridge activities and a QGIS (Free and Open Source GIS) open source application was developed to interface the VO with GIS services in USGS (planetary maps, see http://www.earthserver.eu/node/152 and G*IS-VO for Earth and Planetary Auroral studies User case* by B.Cecconi, S. Erard and P. Le Sidaner, Planetary GIS Workshop at ESAC, Spain, May 2015 funded in previous RI); the Cesium mapping library was extended to support planetary mapping, and a new mapping tool was developed based on it. Review and correction of Robbins' Mars crater database (on-going); study of planetary coordinate systems list and frames description. A surface workshop was held for April 19-21, 2017, Roscoff, France (http://www.europlanet-eu.org/workshop-planetary-mapping-and-virtual-observatory/).

Task 11.5 Magnetospheres
3Dview upgrade: enlarged access to Spice kernels (spacecraft attitude and Field of Views; all space missions are now supported. Internal VESPA meeting on magnetospheres in Toulouse, in February 2017, to discuss this issue, find solutions and coordinate developments (for details see: https://voparis-confluence.obspm.fr/display/VES/VESPA-JRA-T5-Toulouse-Feb-2017).

Task 11.6 Small Bodies
Design of new functions in the MATISSE tool to handle specific datasets from DAWN mission (implementation by ASI); start of study to interface MATISSE with the VO. For memory, the MATISSE web-tool allows access and visualization of planetary data (from raw data to high-level products). DynAstVO service computation system (ephemeris of NEOs). Support to MPC service update in Heidelberg (ephemeris of asteroids from IAU site). Started implementation of observatory horizons to handle object visibility.

Task 11.7 Atmospheres
Support to design of VO interface to the Mars Climate Database at LMD/CNRS, EPN-TAP extension for atmospheric profiles design of ASIMUT service (radiative transfer code). Starting on-line computation

study. Organization of VESPA Atmosphere meeting in LATMOS (near Paris), 20 Feb 2017 to study radiative transfer codes implementation in the VO.

Task 11.8 – Exoplanets
EPN-TAP: design of new atmosphere functions and spectroscopy extension, available on some pages of the Encyclopedia.

WP11 (JRA5: Virtual European Solar and Planetary Access)-Deliverables
D11.1 - VESPA website/GIT. VESPA Git deposit connecting all VESPA codes. Planned and delivered in month 3
D11.4 - Spice kernels in 3D view. Evolution of 3Dview: access to external Spice kernels for spacecraft attitude and instrument FoV. Planned and delivered in month 5
D11.2 - First VESPA incremental report. Annual incremental report of VESPA developments: tool updates & use cases. Planned and delivered in month 12
D11.5 - EPN-TAP client. Evolution of 3Dview tool: data access through the EPN-TAP protocol. Planned and delivered in month 12
D11.6 - SSHADE advanced Prototype. This deliverable is confidential. Please refer to the EU portal or the private area of the website. Planned and delivered in month 12
D11.7 - Cartography i/f in 3Dview. Evolution of 3Dview tool: cartography interface. Planned and delivered in month 18

WP11 (JRA5: Virtual European Solar and Planetary Access)-Milestones
MS89 Internal review of services. Planned for month 12. Achieved on 31/08/16. This was carried out by ObsParis, IRAP, and included in 1st VA annual report (D6.6). This activity is going on continuously for new data services by ObsParis and IRAP and through the helpdesk of VESPA
MS86 1st VESPA JRA meeting, IRAP at PM 14. Planned for month 14. Achieved on 16/10/16. This was organized during Joint DPS/EPSC meeting in Pasadena, Oct 2016

1.3 Impact

The VESPA JRA has had a major impact on Virtual Observatory (VO) standards:
- through attendance at (International Virtual Observatory Alliance) IVOA and International Planetary Data Alliance (IPDA) meetings and contributions to their Working Groups.
- through dedicated sessions in science conferences (e.g. International collaboration forum at Asia Oceania Geosciences Society (AOGS) in August 2016, etc).
- through cross-discipline events, such as the surface workshop held in Roscoff (partly NA1-funded) from 19-21 April 2017. This will focus on the VO-GIS connection (see above).

VESPA has been in pole position for several years in the field of planetary science virtual obsrvatories, and is in practice defining the standards in this field through intense contributions to various consortia:
- IVOA: the new Solar System Interest Group will start activity in May 2017, chaired by B. Cecconi. Extra contributions are provided to WG semantics, applications, registries, etc
- IPDA: participation on the steering committee (Baptiste Cecconi) and Technical Expert Group (Pierre Le Sidaner, Stéphane Erard). Contribution to assessment study of PDS4; study of EPN-TAP as a new IPDA standard.
- IAU: we have issued requests for description systems (coordinate frames, object nomenclature,

observatory list, etc).

The large success of VESPA has led to an enhanced visibility of Planetary Science within the VO and also at the national scale. Stephane Erard's work on VEPSA has directly contributed to ihis appointment as the head of the whole VO service at Paris Observatory, including Astronomy.
For a full list of activities refer to **Table 32**.

2. Update of the plan for exploitation and dissemination of results

Dissemination of VESPA JRA products is being performed through submission of VESPA standards for validation by international consortia. This activity was started during RP1 with IPDA (our EPN-TAP access protocol is a case study at IPDA) and IVAO (proposed extension of various existing standards to handle Planetary Science data, in particular reference frames and field descriptors). This activity will become more and more important with the start of the new Solar System Interest Group in the IVOA, chaired by Baptiste Cecconi.

3. Update of the data management plan

A VESPA Data Management Plan was issued in RP1 (VESPA-003-PL v1.0, dated 14/2/2016). Software developed in VESPA is open source, preferably issued under GPLv3 licence. Documentation is stored in the VESPA wiki and Github sites. Standards validated by international consortia (IVOA, IPDA, IAU) may be published as external documents in the future.

4. Deviations from Annex 1

See the approved amendment

12 WP12: NA1: Innovation through Science Networking

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

NA1 'Innovation through Science Networking' provides the framework to enable EPN2020-RI to build overall capacity in European planetary science and a stronger, bigger community of researchers and industry related to the field. The overarching objectives are:

- to facilitate cooperation between European planetary scientists and engineers;

- to promote innovative techniques in forthcoming planetary science/mission, with commercial and industrial companies including SMEs;
- to integrate scientists from the Inclusiveness States into EPN2020-RI;
- to support the inclusion of amateur communities in European planetary science campaigns;
- to support the activities of EPN2020-RI with exchange of experts;

As an advanced infrastructure, a key objective for EPN2020-RI is widening participation; thus, a main objective of NA1 is to integrate scientists from Inclusiveness States (IS) into EPN2020-RI activities and the wider Europlanet Community.

1.2 Explanation of the work

Detailed description of work

Task 12.1- Coordination (led by FMI; Wigner RCP)

The management structure of the NA1 activity is as follows:

- The **NA1 Coordination Team** is led by Dr Ari-Matti Harri (FMI), together with the Deputy Lead, Dr Karoly Szego (Wigner-RCP). The Coordination Team is responsible for overseeing the overall NA1 programme, coordinating the task leaders, dissemination of activities, and managing the NA1 webpage.

- The **NA1 Executive Team** is made up of the Leaders of the six NA1 Tasks, who are each responsible for defining activities within their tasks. The NA1 Executive Team supports the Coordination team and consists of:
    - Dr. Ari-Matti Harri (FMI), Chair
    - Prof. Karoly Szego (Wigner-RCP)
    - Dr. Norbert Krupp (MPG)
    - Prof. Manuel Grande (U. Aberystwyth)
    - Dr. Gunter Kargl, OEIF.

- The NA1 Management Board provides reviewing functions for the NA1 activity. Proposals for the Expert Exchange Visits and the annual plans of the Tasks are sent to the Management Board for review and approval. The members of the Management Board are:
    - Dr. Maria Teresa Capria (INAF), Chair
    - Dr. Philippe Louarn (CNRS), Deputy Chair
    - Prof. Karoly Szego (Wigner-RCP)
    - Dr. Ari-Matti Harri (FMI), secretary (no voting power)
    - Dr Michel Blanc (ISSI)

The dedicated NA1 webpage http://fmispace.fmi.fi/index.php?id=na1epn2020 (Milestone MS91: NA1 website) is the principal information channel for the activity. Content includes:

- An overall presentation and information regarding the NA1 activities, objectives and results
- The Expert Program electronic application and reporting section
- An Intranet webpage for NA1 task leaders (password protected, distributed on request)
- All workshop information (upcoming and past)
- A “Propose a workshop” webpage where anyone can propose a new workshop for NA1
- The ASIME16 (Asteroid Science Intersections with In-Space Mine Engineering 2016) workshop microsite.

Task 12.1 has organized ten internal NA1 planning meetings during the reporting period. These

meetings were to plan and ramp up the NA1 operations and to facilitate communication among the Task leaders. The meetings were both face-to-face meetings and teleconferences. Minutes of the meetings are available via the NA1 intranet webpage for Task Leaders and others who have access to the intranet.

Task 12.2- Scientific Working Groups (led by MPS, CNRS, UCL)

The Scientific Working Groups Sub-Task is led by Dr. Norbert Krupp (MPG), with support from Dr. Philippe Louarn (CNRS-IRAP). The major objective of this task is to bring together different science teams, especially new teams working on similar science topics and missions, to strengthen links and counter any fragmentation that still exists in the European planetary science community. This Task also aims to build links between the European planetary science communities and amateur associations, commercial bodies and industrial organisations with an interest in planetary science. Three workshops have been organised to date:

- Kick-off Meeting, Göttingen, Germany, 24-25 November 2015 (MS90: NA1 Kick-off meeting)
- Mars 3D visualization, MSSL, Surrey, UK, 7-9 June 2016. This Europlanet training workshop on "3D facilities available at the UK NASA RPIF" introduce 23 early-career scientists to the range of software tools available for the generation of 3D products to visualise planetary surfaces. Website: http://www.i-mars.eu/outreach/workshops/rpif-3d-workshop-jun2016
- Ethiopia and the Danakil Depression in Planetary Science (1-3 December 2016), hosted by the University of Bologna and co-sponsored by the International Research School of Planetary Sciences (IRSPS), Italy. The aim of the meeting was to stimulate discussion and planning for future activities around the Danakil field site, consolidate collaborations and encourage new collaborative projects across all Horizon 2020 and other research programmes. Report: http://www.europlanet-eu.org/ethiopia-workshop-bologna/

In planning for further workshops for 2017-2019, a particular focus has been given to currently active and future ESA/NASA. Topics currently under consideration include:

- Active moons in the solar system (support of JUICE, Cassini, Europa Clipper), covering interiors, surfaces, atmospheres and plasma environment for Europa, Io, Enceladus etc.)
- Comparative planetology and our Solar System bodies astemplates for exoplanets
- Asteroids and Kuiper belt objects (support of DAWN, Hew Horizons)
- Trans-Neptunan Objects and Asteroid mining
- Eroding atmospheres
- Cometary science (Rosetta)
- Mercury science (BepiColombo).
- Mars science (from Curiosity and MAVEN via Exomars to Mars 2020). 3D visualization of Mars
- Giant planets science. Galileo/Cassini/Juno/ links with Hinode (auroral physics at giant planets and related processes). High-latitude plasma physics at Jupiter and Saturn
- Astrobiology, life in extreme environments (related to ExoMars and habitability with JUICE). Modelling in laboratory. Sun's influence on planets
- Future instruments and methods in planetology (related to the Planetary Exploration: Horizon 2061 roadmapping exercise (see Task 12.3 below).
- Future mission concepts to outer planets: Why do we need to (re)visit Uranus and Neptune.
- From planets to exoplanets (diversity of planets and diverse interactions with their stars).
- Future observational capabilities.
- Preparing for sample return missions and their analysis (including meteorite analysis).

Task 12.3- Knowledge consolidation and strategic planning (ISSI, Wigner RCP)

The Knowledge Consolidation and Strategic Planning task is led by Dr Michel Blanc (ISSI) and Dr Karoly Szego (Wigner-RCP).

Sub-task 3.1 Cross-disciplinary ISSI workshops
NA1 is holding three one-week workshops on key cross-disciplinary topics at the International Space Science Institute (ISSI). A total of eight topics were suggested through a Europlanet community consultation at the start of the EPN2020-RI project. The following three workshops have been selected by the ISSI Science Committee for 2017-2019:

- Role of Sample Return Missions in the Exploration of the Inner Solar System. Chief organiser Mahesh Anand, Open University.
- Comparative study of the atmospheres of planets and exoplanets. Chief organiser Oleg Korablev, Space Research Institute, Moscow
- Reading terrestrial planet evolution (Venus, Earth, Mars, Titan) in isotope and noble gas measurements. Chief Organiser Helmut Lammer, OeWF.

Organisation of the first workshop is currently underway.

Sub-task 3.2 Planetary Science Strategy Workshops
The first ISSI-Europlanet forum was held in 13-15 September 2016, a foresight exercise initiated by the Air and Space Academy (Toulouse, France) and jointly implemented by EPN2020-RI and ISSI. The objective of this exercise was to produce a community vision for planetary exploration over the next 50 years (Planetary Exploration: Horizon 2061). The forum at ISSI brought together 33 leading experts in Solar System planetary science and ten experts in space mission technologies with the following objectives:

- To identify the outstanding open questions about Solar System objects, their origin, formation and evolution, their processes and their system aspects, and their potential habitability;
- To identify representative ambitious space missions that could potentially address these outstanding questions over the coming 50 years;
- To address these objectives in the context of the rapidly-expanding science of exoplanetary systems;
- To propose a short list of workshops addressing some of these outstanding science questions, with the aim of understanding the science issues and in the elaboration of the corresponding representative space missions.

The “Planetary Exploration, Horizon 2061” process will now involve further consultations with industry and the public (see Task 4 below), with the intention of presenting the roadmap at the EuroScience Open Forum (ESOF) 2018 in Toulouse.

Sub-Task 3.3: Inclusiveness Programme
Dr. Karoly Szego (Wigner-RCP) leads the Inclusiveness Programme. The list of all Inclusiveness States is very broad: Bosnia-Herzegovina, Bulgaria, Cyprus, Czech Republic, Estonia, Croatia, Greece, Hungary, Lithuania, Latvia, Luxembourg, Malta, Montenegro, Poland, Portugal, Romania, Slovenia, Slovakia, the former Yugoslav Republic of Macedonia, Republic of Serbia and Turkey. The diversity of these countries means that it is not possible to take a homogeneous approach: engagement needs to be tailored to account both for their socioeconomic challenges and for their level of involvement in planetary science.

Engagement with Inclusiveness States has been focused around the following EPN2020-RI services:

- Expert exchanges (short-term visits);
- Transnational Access programmes;
- Access to the ESA summer school in Alpbach (NA1 is offering grants for students from the inclusiveness countries to participate in the Summer School). The aim is that both the space

science community and the emerging space industry of these countries can benefit from the high level contacts this summer school is offering.

The following work plan has been established for the programme of engagement with Inclusiveness countries:

1. Get in touch with as many Inclusiveness scientists (and engineers) as possible.
2. Identify their problems and their needs
3. Find out how to help them in a sustainable way
4. Advertise the methods, the available opportunities and the success stories of EPN2020-RI

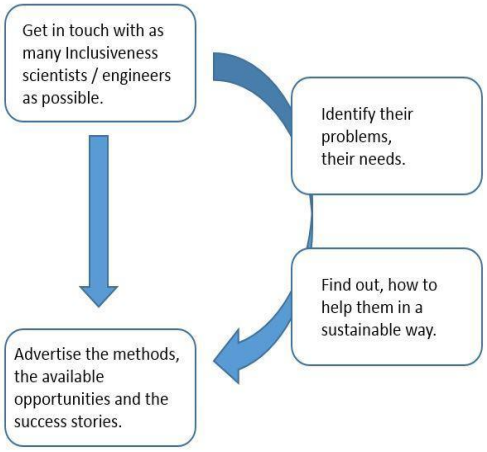

Figure 32 - A scheme to promote EuroPlanet and European planetary science cooperation among the scientists and science organizations in inclusiveness countries

The first step is a potential barrier: the methods and the time needed to successfully build up a network of connections can be very different from country to country. Probably because the Inclusiveness Programme has been managed from Hungary, the best contacts and networks have been established in neighbouring countries (Slovakia and Czech Republic).

NA1 has disseminated information at both an institutional level (contacting institutions that appear to have interests in space research activity) and at a personal level (contacting colleagues).
First, a database was built up containing all the research institutes and universities where astronomical or geophysical research is carried out (which may or may not turn out to be relevant to planetary science). Group leaders or heads of units were contacted. The response rate was around 10%, which seems quite low, but it is very possible that at least half of those contacted are not really target groups (do not actually have planetary-related activities).
Personal contacts, to discuss challenges and needs of researchers, were achieved with only a very few scientists, mainly during conferences or personal visits. Thus, to date, the second and fourth steps (by necessity) have involved small circles of people. The third step – coming up with positive steps for how scientists and institutes could be helped sustainably – is the key to success in this process, although it can prove to be very difficult to accomplish.

The most common response from the consultations to date has been to highlight the need for money. The short-term nature of some of the services offered by EPN2020-RI, such as TA access and expert exchanges, caused some concern (e.g. “Short term visit? Too many conditions, only one week to gain…”) but were also seen as good opportunities (e.g. “I want to send a student on a short term visit.

It is hard to justify the expertise"). Some respondents seemed reluctant to engage with a wider community ("We already have our partners") but others were interested support that EPN2020-RI could provide in identifying potential partners ("Great, I do not have partners, will you get me one").

To assist with promotion and communication for this Task, a dedicated Inclusiveness mailing group has been established and scientists contacted have been encouraged to join. Subscribers are informed about open calls and other opportunities. Furthermore, a talk was about opportunities with EPN2020-RI at the H-SPACE conference in Budapest in February, 2017 (3rd International Conference on Research, Technology and Education of Space) and further opportunities to promote EPN2020-RI at conferences in Inclusiveness States are actively being sought.

In countries where Europlanet has not historically had a presence/involvement, NA1 has established contacts with:

- Romania: Department of Geography, Stefan cel Mare University
- Croatia: Hvar Observatory, Faculty of Geodesy, University Zagreb
- Bulgaria: Solar-terrestrial influences laboratory, BAS

EPNS2020-RI's contacts in the Czech Republic have also been expanded to include the Department of Aeronomy, Institute of Atmospheric Physics CAS, Prague.

To date:

- 4 out of 7 successful applicants to the 3 calls of exchange programs came from Inclusiveness Countries
- 4 out of 91 applicants to the first two TA calls were from Inclusiveness Countries.

Suggestions for generating more interest from Inclusiveness researchers include extending the length of visits to 2 weeks to offset the burden of bureaucracy faced by many organisations in Inclusiveness Countries.

<u>Task 12.4- Innovation and Foresight Working Groups (ABER, FMI, Blue Skies Space Ltd)</u>

The NA1 Task 4 is led by Dr Manuel Grande (U. Aberystwyth) and will be supported by the Early Career Researcher, Natalia Alzate, in Task 4 organisation activities. EPN2020-RI's new Industry Officer, Dr Marcell Tessenyi, the Chief Executive of Blue Skies Space Ltd and Helene Boithias, the contact point for EPN2020-RI in Eurospace (the European space industry association, which has offered to assist EPN2020-RI in making links with industry and disseminating information), provide input from an industry viewpoint.

NA1-Task 4 Workshop organisation

Two preliminary consultations were held at EPSC 2015 in Nantes

- In-Situ planetary measurements (EPSC215 Technology Forsight Workshop), Nantes, France, 30 September 2015. Lead organisers: A. Hagermann and G. Kargl. Attended by 12 participants.
- Cartography and GIS Foresight Workshop, Nantes September 2015. Lead organiser: T. Cook. 4 delegates from Europe, USA and Brazil (industry representative). This workshop discussed the current status of cartography/remote sensing in the planetary sciences and what new mapping/GIS techniques/technology is required to answer key science questions. Discussions also covered changing requirements, application of innovative techniques, applications to missions, developments in software/GIS/web interfaces and the timelines for technology becoming available.

In 2016, Europlanet 2020 NA1-Task 4 organised or co-organised the following four workshops:

- ISSI-EPN forum, Bern, Switzerland, 13-15 September (attended by 45 participants). The final session of the ISSI-EPN forum on the "key questions in planetary science for the next 50 years" explicitly addressed the key technologies required.
- Asteroid Mining, Luxembourg, 21-23 September (attended by 79 participants). Asteroid mining addressed the scientific inputs needed to enable this technology and was co-hosted with Luxembourg Ministry of Science and Technology.
- 3rd International Workshop on Instrumentation for Planetary Missions (IWIPM-3), Pasadena, USA, 24-27 October. IWIPM-3 is the bi-annual US technology foresight meeting, arranged this year to coincide with the EPSC-DPS joint meeting in Pasadena. It featured a Europlanet branded panel presentation. The highly successful outcome was that the next meeting, IWIPM4 will take place in Berlin in 2018, co-hosted by EPSC. This will be the first time the meeting will take place outside the USA.
- 14-18 November 2016, Antwerp. Space weather and radiation design (in conjunction with PSWS). A workshop session was held at the European Space Weather week (ESSW), the leading venue for commercial space weather providers in Europe.

Plans for future WP 12.4 workshops:
In 2017-19 Task 4 will arrange 1-2 meetings/workshops per year, as well as at least one workshop per year attached to EPSC.
The following meetings are already in place:

- Future instruments to detect and characterise extrasolar planets (Technology Foresight Session at EPSC 2017), Riga, Latvia, September 2017;
- Towards a Moon Village (Technology Foresight Workshop at EPSC 2017), Riga, Latvia, September 2017;
- Space mission projects and concepts relevant to SMEs/industry (3 minute show & tell workshop at EPSC 2017), Riga, Latvia, September 2017;
- Planetary Exploration: Horizon 2061 – Technology Consultation, Lausanne, Switzerland, 29 January – 1 February 2018. A planning meeting took place in February 2017 to arrange this technology foresight meeting (co organised with EPFL SwissTech).
- 4th International Workshop on Instrumentation for Planetary Missions (IWIPM-4), Berlin, Germany, September 2018

Further meetings on the following topics have been proposed:

- Cryogenic Sample return (in association with Bern University and ISSI)
- Space weather and radiation design (in association with EuroPlanet PSWS)
- New detector technologies
- Planetary Robotics
- Large Planetary Telescopes
- Nuclear generators for power and thermal control
- Low cost systems (cube sats, penetrators)
- Geographic Information System
- Advanced fabrication techniques
- Propulsion techniques (solar sail, RTG, …)
- 2017 Planetary Environment models
- Future instruments and methods in planetology
- Future mission concepts to Outer planets:
- Preparing sample returns and their analysis (including meteorite analysis).

More detailed planning is currently underway for these meetings and opportunities for co-sponsorship are being investigated. Further workshops will also be co-located with EPSC.

Task 12.5- Coordination of ground based observations (OEAW, VU)

Sub-task 12.5.1: Coordination

The Coordination of ground based observations Task is led by Dr. Günter Kargl and Manuel Scherf of OeAW and Dr. Grazina Tautvaisiene of Vilnius University. During the first project period, regular communications between the beneficiaries of NA1-Task 5 took place. This included informal discussion meetings at EPSC 2015 in Nantes, at the NA1 Kick-Off Meeting in Goettingen, at the NA1-Task 5 Summer School in Vilnius in August 2016, and at the Europlanet Council Meeting in Milton Keynes in November 2016. Frequent teleconferences, as well as email communication between Vilnius University and IWF-Graz took place regularly to coordinate the work within NA1-Task 5.

As a first step, NA1-Task 5 established "Guidelines on EPN2020-RI NA1 / Task 5 Coordination Meetings and Workshops". This document details everything that workshop organisers need to know in terms of planning, execution, and post-processing and is sent to all chairs of Scientific Organising Committees (SOC) at the beginning of workshop preparations. The guidelines ensure a common high standard of NA1-Task 5 workshops. Detailed "Reimbursement Rules" for workshop attendees ensure a smooth reimbursement process for the costs of participants funded by NA1-Task 5.

The document can be downloaded at http://tinyurl.com/hh4lgua; the Reimbursement Rules as a stand-alone document are available via http://tinyurl.com/jfkx6g7.

Sub-task 12.5.2: Establishment of contacts to the amateur astronomer community in the inclusiveness countries (including amateur session at EPSC 2017)

Europlanet had some contacts with European amateur astronomers through the Europlanet-RI FP7 project from 2009-2012; however, these contacts were mainly in Western Europe. This sub-task has focused on extending contacts to the Inclusiveness Member States. The effectiveness of this activity (more than 100 amateurs recruited to date, with over 70 from Inclusiveness countries) has significantly benefitted from the fact that one task leader (Dr. Tautvaisiene) is based at the University of Vilnius in Lithuania. Many of these amateurs have already participated in the first amateur training workshop/summer school in Moletai, Lithuania, in August 2016.

To foster and widen the cooperation with the amateur community, NA1 is organising, in close cooperation with engaged amateurs, two dedicated sessions at the upcoming EPSC 2017 in Riga, Latvia. These two sessions are:

- AM1 Amateur collaborations in small bodies, terrestrial, giant and exoplanetary research
- AM2 Juno ground-based support from amateurs

Depending on the number of abstract submissions, these sessions will be split into several sub-sessions. To guarantee a strong participation from the amateur community at EPSC 2017, up to up to 15,000 Euros has been allocated for flat-rate subsidies to support the attendance of amateur astronomers, with priority given to delegates from the Baltic States and Inclusiveness Member States.

Sub-task 12.5.3: *Preparation and discussions on future extensions of the ground-based observatories database*

The NA1-Matrix (see http://iwf.oeaw.ac.at/matrix/) is part of the heritage developed within the Europlanet RI project under FP7. The NA1-Matrix comprises a database on ground-based observatories and gives amateurs the opportunity to include their own observatories and telescopes in an online list.

For EPN2020-RI, the database will be extended in cooperation with the VA2-VESPA virtual observatory. To date, several discussions have taken place on how to integrate the Matrix with VESPA, the technical implementation of the database within VESPA and on how to make it compatible with

EPN-TAP. As a result, a simple data model for the description of ground-based observatories is being developed for implementation via EPN-TAP.

The database will also be extended in such a way that it will give amateurs the opportunity to upload their own data directly into the database and therefore make it available via VA2-VESPA. A test system for the NA1-Matrix has already been established at IWF-Graz. Furthermore, a first prototype of an upload functionality has been developed in close cooperation with VESPA and will be tested and extended during the next period of EPN2020-RI.

Sub-task 12.5.4: *Workshop organisation*

During the first project period of Europlanet 2020 NA1-Task 5 organised and held four workshops, of which one was an amateur training workshop/summer school:

- A workshop on "Ground-based support of Juno by amateur astronomers: Science & Public Impact", May 12-13, 2016, Observatoire de la Côte d'Azur, Nice, France, was attended by 33 participants, among them 22 amateur astronomers. The dedicated workshop website can be found at http://www.ajax.ehu.es/Juno_amateur_workshop/. This also hosts an announcement, agenda, presentations, and participants of the workshop. All talks were filmed and documented; moreover, a team from Discovery Channel also filmed the workshop as part of a Juno documentary, which aired on July 05, 2016, on Discovery Science Channel. Two press releases about the workshop were issued through NA2, and were well covered by the media, including a dedicated article in Sky & Telescope. The workshop ended with a very well attended public talk by a local French amateur astronomer. A detailed report can be found at http://tinyurl.com/zswlzcz. This workshop was supported by NA1 with 10,000 Euros.
- A workshop on "Ground-based Observations of 67p/Churyumov-Gerasimenko", June 20-22, 2016, Hotel Schloss Seggau, Seggauberg near Graz, Austria, was attended by 40 participants, among them 2 amateur astronomers and the representative of the Rosetta amateur ground-based campaign. To facilitate communication between ground-based observers and the Rosetta instrument teams, several representatives from orbiter instruments were invited to give talks on the latest results from the mission. The dedicated workshop website can be found at http://www.rosetta-campaign.net/meetings/2016-seggau. This website also hosts the announcement, agenda, presentations, and participants of the workshop. An interview with a local radio station, ORF Steiermark, was broadcast on June 23, 2016. A press release on the workshop (including an English version for the international audience and a German version for the local Austrian audience) was distributed. A detailed report can be found at http://tinyurl.com/zymulqt. The workshop was supported by NA1 with 20,000 Euros.
- The "Europlanet & European Astrobiology Campus Summer School 2016 on Exoplanets", August 02-12, 2016, Molètai Astronomical Observatory, Molètai, Lithuania, was attended by 45 participants, among them 29 amateurs and students. 27 participants of the summer school came from Inclusiveness countries and 13 of the participants were female. The dedicated workshop website can be found at http://mao.tfai.vu.lt/exoplanets2016. The summer school was accompanied by two well attended public lectures, one of which was about collaborations between amateur astronomers and Europlanet. One press release on the workshop was issued and it was covered on a number of online and Facebook sites that reached more than a thousand viewers. This summer school was supported by NA1 with 10,000 Euros. A follow-up is already in preparation and will again be held at Molètai, Lithuania, in summer 2017 that will be combined with science communication training provided by NA2.
- The"8th International Workshop on Planetary, Solar, and Heliospheric Radio Emissions (PRE 8), October 25-27, 2016, Hotel Schloss Seggau, Seggauberg near Graz, Austria was attended by 50 participants, including 15 students and young scientists that were supported by NA1 Task 5. The dedicated workshop website can be found at http://pre8.oeaw.ac.at. The workshop series Planetary Radio Emissions already has a long tradition and its predecessor PRE 7 was

already supported by Europlanet RI in FP7. The organizers of PRE 8 are currently preparing a proceedings book, which will contain approximately 30 peer-reviewed articles. It will be published in late 2017/early 2018. The workshop was accompanied by one press release and published an abstract book, which can be downloaded from the workshop website. Funding of 2,500 Euros was focused on the support of students and young scientists.

Besides the organisation of these four workshops, NA1 Task 5 has agreed to support the well-known and prestigious Alpbach Summer School, which has taken place annually for the last 41 years in Alpbach, Austria. The focus of the support (with 4,000 Euros per year for 2017-2019) will be on the funding of young scientists and engineers from Inclusiveness countries. This activity is co-sponsored by NA1 Task 2. The 2017 Alpbach Summer School will have 'The Dusty Universe' as its theme and will take place from 18-27 July. For more details, see: https://www.summerschoolalpbach.at/.

NA1 Task 5 has agreed to fund the following workshops, for which organisation is already in progress:

- 14th International Planetary Probe Workshop (IPPW-14) in The Hague, The Netherlands, June 2017 (7,000 Euros to fund attendance of European students and other early-career scientists).
- Europlanet Summer School 2017 "Space Missions: ground-based observations and science communication", July 18-28, 2017, Molètai, Lithuania (10,000 Euros funding). The website of the summer school can be found at: http://mao.tfai.vu.lt/europlanet2017.
- A workshop on "Pic du Midi T1M Planets Observation Campaigns", Pic du Midi, France (3,500 Euros funding from NA1). The workshop will take place between June and September 2017 .
- A workshop on "New Views of Jupiter: Pro-Am Collaborations during and beyond the NASA Juno Mission", May 10-18, 2018, London, UK (10,000 Euros funding from NA1-Task 5).

Plans for 10 new workshops foreseen for the years 2017-2019, supported by NA1-Task 5, include an amateur training workshop in cooperation with VA1-PSWS in 2017, and a potential workshop for the ground-based support of the joint ESA/NASA mission AIDA in 2018.

Sub-task 12.5.5: Feedback survey for workshop participants

Within the first project year NA1-Task 5 developed a feedback survey for workshop participants (web: http://www.q-set.at/q-set.php?sCode=GCWHZFHVMURM). The aim of this survey is to gather feedback from the workshop participants, in order to enhance and facilitate the organisation and execution of future workshops. The survey was received very well by the community and some of its major outcomes so far are:

- Two full workshop days are better than just one and a half. This leaves much more time for guided and open discussions on topics of interests for the respective workshop.
- Amateurs have a great interest in direct interaction and discussions with professionals. This should be considered in future workshop programs.
- Given the available time, there appears to be a conflict of interest between more or longer talks, which has to be addressed individually for each workshop by the SOC.
- Most participants were invited via the SOC and only a few came across the topic by itself. There still seems to be the feeling that such workshops are not accessible enough for the wider community. Promotion to a wider audience will be a focus for the upcoming project years.
- Remote locations may need elaborate organisation, particularly in terms of travel. Participants must be informed about logistics in as much detail as possible by the first announcement.
- Amateurs usually have a day job. Therefore, they need to be notified of the workshop opportunity well in advance. Workshops with a strong amateur participation should ideally be close to or at the weekend.
- Funding rules have to be communicated clearly and early on.
- Organisers should provide an appropriate reserve within the workshop budget to cover unforeseen expenses and to avoid cost overruns. This has been shown as best practice for the

workshops to date.

The feedback survey will be continued over the next project years and has also been extended to cover feedback from the other tasks of NA1.

Sub-task 12.5.6: ***Specific NA1-Task 5 activity promotion and dissemination***
Even before the official EPN2020-RI project started, NA1-Task 5 was presented at the ESO-Workshop on "Ground and space observatories: a joint venture to planetary science", in Santiago de Chile, March 2-5, 2015. Further presentations were given at the University of Graz, the NA1 Juno Workshop, the Exoplanets Summer School and PRE 8. The aims and goals of NA1-Task 5 were additionally also briefly presented at the NA1 Rosetta Workshop.

Task 12.6- Exchange program (FMI)
During reporting period of 1st September 2016 and 28th February 2017, the NA1 Exchange Program (Task 6) opened 3 standard Calls for Expert Exchanges:

- **Call 1** was for visits to be held in the period 1 March – 31 July 2016, with an application deadline of 29 February 2016:
  - 2 applications were received and approved:
    - From CITEUC, Portugal to Jacobs University Bremen. Purpose: Morphology and mineralogy of Martian dunes: towards an integrated data model
    - From CNRS, France, to Open University, UK. Purpose: Publications and Collaboration on experimental flows on Mars
  - Both exchange visits were completed and reports submitted.

- **Call 2** was for visits to be held in the period 1st June – 30th September 2016, with an application deadline 31st May 2016
  - 4 applications were received and approved:
    - From GEOPS University of Paris-Sud, France to Open University, UK. Purpose: Installation of reservoirs for liquid flows on the Mars Chamber
    - From J. Heyrovsky Institute of Physical Chemistry, Czech Republic to Open University, UK (2 visits): Chemistry and Physics of Shock Impact Events, Spectroscopic Investigation of Shock Radical Chemistry
    - From Finnish Meteorological Institute to Aarhus University, Denmark. Purpose: Utilizing European research infrastructure for advancing planetary atmospheric instruments
  - Three exchange visits were completed and reports submitted.

- **Call 3** was for visits to be held in the period 1st October 2016 and 28th February 2017, with an application deadline of 30th September 2016:
  - 1 application was received and approved for Call 3:
    - From Wigner research centre, Hungary to CNRS, France. Purpose: Solar wind propagation and effect on planetary atmospheres
  - Report pending.

In addition to standard calls, a special call to support IPPW-14 workshop participation was opened on 6th February 2017 with application deadline of 31 March 2017. Another special call for science journalists and lecturers in science journalism is in preparation for April, 2017.

WP12 (NA1: Innovation through Science Networking)-Deliverables

D12.1- 1st NA1 Annual Report. Planned and submitted at month 12

D12.5 - Open Access repository. Planned at month 14 and submitted at month 15 (28 days later)

WP12 (NA1: Innovation through Science Networking)--Milestones

MS90: NA1 Kick-off meeting. Planned on month 2. Achieved on 25/11/15

MS91: NA1 website. Planned on month 4. Achieved on 30/10/16

MS92: 1st Annual meeting of NA1. Planned on month 11. Achieved on 31/8/16

MS100: Year 1 NA1 Task 4 Meetings. Planned on month 12. Achieved on 13 -15/9/16 Bern; 21-23/9/16, Luxemburg; 24-27/10/16 Pasadena; 14-18/11/16 Antwerpen.

MS104: Year 1 NA1 Task 5 meetings. Planned on month 12. Achieved on 11-13/5/16; 20-22/6/16; 2-12/8/16; 25-27/10/16

MS96: Year 1 NA1 task 3 meetings. Planned on month 18. Achieved on 8, 15/2/16 and 14/4/16 (telecons)

MS108: 1st ISSI Workshop. Planned on month 18. Not achieved, will take place on 13/12/17

1.3 Impact

WP12 successfully started its operations and has been able ramp-up its activity. Through NA1 meetings and topical workshops, EPN202-RI has been able to make a difference by bringing together European planetary scientists, engineers, and amateurs, as well as successfully approaching several industrial organizations.

Press releases on workshops have led to coverage in the astronomy-specialist press, as well as by regional and worldwide press (for full details of coverage, see Table 32). The NA1 Juno Workshop was covered in a documentary about the Juno mission, which aired on Discovery Channel on June 11, 2016. The Juno Workshop, as well as the Exoplanets Summer School were also accompanied by one or more public talks, which were open to the local public.

A report on the first ISSI-Europlanet workshop was included in NASA's "Planetary Science Vision 2050" workshop, (February 27–March 1, 2017, NASA Headquarters, Washington DC.) This workshop provided a very long-range vision of what planetary science may look like in the future. Slides from this report by Dr Michel Blanc can be found here: https://we.tl/faUHmBmlNb. A second draft presentation is being given at the EGU General Assembly in Vienna during the general meeting of the Planetary sciences division, April 24th 2017. This consultative exercise with the science community will continue throughout 2017, with further sessions at EPSC 2017 in Riga. Following the technical consultation workshop in Lausanne in January-February 2018, there will be a consultation with teachers and members of the public. The final Roadmap 'Planetary Exploration: Horizon 2061' will be presented in July 2018 at the EuroScience Open Forum (ESOF) 2018 in a dedicated conference that will be co-located with ESOF, as well as a session in the main ESOF programme. ESOF was chosen as the focus for dissemination as the event is well attended by journalists, policy makers, scientists and the general public, giving a very broad audience and multiple opportunities for engagement.

During the first project reporting period, NA1 has built up new contacts with well over 100 amateur astronomers, including over 50 amateurs in Lithuania and more than 20 in Poland. NA1 will continue to establish amateur contacts and will further foster cooperation and the participation of the amateur community in relevant training sessions and ground-based observation workshops.

As stated many times in this report, Inclusiveness has been a core focus of EPN2020-RI. Consultations with researchers and institutions as part of the overall goal to build contacts and networks in Inclusive Member States have led to the following recommendations for adoption by EPN2020-RI during the

remainder of the project:

- Support participation in conferences in Inclusiveness Countries (the main way of establishing connections);
- Organise a business lunch at EPSC for inclusiveness laboratories to make joint plans for future activities;
- Support the organisation of conferences in Inclusiveness Countries
- Extend short term visit to 2 weeks to make it more attractive for professionals /make it less bureaucratic for students
- represent EPN2020-RI in Eastern European conferences
- Advertise successful applicants on the web
- Harmonise websites (main EPN2020-RI and websites of activities)
- Establish fellowship programs for Inclusiveness students.

It is the firm objective and conviction of EPN2020-RI that this investment and focus on Inclusiveness Member States will lead for beneficial long-term effects for those countries, the European planetary community and the European Research Area as a whole.

Statistical data on the NA1 impact can be seen in the Table below. For a full list of activities refer to **Table 32**.

Table 31 - Statistical data on the NA1 impact.

Year	from	to	Workshop Title	City	Country	held in inclusiveness target country	Total number of participants	Number of participants of Inclusiveness states	Number of early career scientists	Participants from Industry	Amateur Participants	Participants from outside Europe
2016	7.6.	9.6.	Mars 3D	Dorking	United Kingdom	no	23	5	23	1	0	4
2016	1.12.	3.12.	Ethiopia (Danakil Depression in Planetary Science)	Bologna	Italy	no						
2016	12.9.	13.9.	ISSI forum 1: Solar system exploration	Bern	Switzerland	no	45	1	4	5	0	11
2016	21.1.		Eurospace meeting	Paris	France	no						
2016	26.4.	28.4.	Eurospace meeting	Lausanne	Switzerland	no						
2016	**21.9.**	**22.9.**	**Asteroid mining**	**Luxembourg**	**Luxembourg**	**yes**	**79**	**13**	**19**	**21**	**1**	**16**
2016	24.10.	27.10.	IWIPM-3	Pasadena	USA	no						
2016	14.11.	18.11.	Space weather and radiation design (in conjunction with PSWS).	Oostende	Belgium	no						
2016	11.5.	13.5.	Ground-based observations in support of the JUNO	Nice	France	no	33	4	0	0	22	5

			mission to Jupiter									
2016	20.6.	22.6.	Rosetta ground-based observations	Seggau	Austria	no	40	0	8	0	2	14
2016	**2.8.**	**12.8.**	**Exoplanets**	**Moletai**	**Lithuania**	**yes**	**45**	**31**	**17**	**0**	**13**	**0**
2016	25.10.	27.10.	Planetary Radio Emissions VIII	Seggau	Austria	no	50	5	13	0	0	18
2017	20.3.	24.3.	Dynamics of planetary systems (Alexander von Humboldt Symposium)	Bad Gastein Salzburg	Austria	no						
2017	26.3.	30.3.	Exomars Atmospheric Science and Missions Workshop	Saariselkä	Finland	no	23	1	3	0	0	2

Overall (informed) **338** participants, **60** of them from the inclusiveness countries (*17,8%* of all participants). **87** early career scientist (*25,7%* of all participants), **27** (*8%* of all participants) from the industry and **38** amateurs (*11%* of all participants). **70** participants were outside the EU (*20,7%* of all participants). All togeather there were 14 workshops and/or meetings, 3 of them were organized in inclusiveness countries (*21%* of all workshops).

13. WP 13 – NA2: Impact through Outreach and Engagement

1. Explanation of the work carried out by the beneficiaries and overview of progress

1.1 Objectives

Europlanet 2020 RI's activities have a direct relevance to our understanding of our own planet, its origins, its past and future evolution, the conditions needed for life, and threats from our space environment, such as solar storms or Near-Earth Asteroids. This brings it into regular contact with industrial partners and policy makers, and the wider publics throughout Europe. The exploration of our Solar System has long been recognised as a potential 'hook' for attracting people with many diverse backgrounds and interests into science. This work package ensures that the work of EPN2020-RI and the community it supports is known, understood and used by the widest possible community of stakeholders, and that inputs from external communities are taken into account by the project. The objectives of NA2 are:

- To take the successful Outreach and Engagement activities of Europlanet RI from FP7 to wider audience and a more professional level in Horizon 2020;
- To ensure that planetary science inspires the next generation through collaboration with schools-focussed projects such as astroEDU and Space Awareness, and through the development of new outreach and educational tools, making use of the latest developments in planetary science;
- To develop and disseminate "best practice" through organising meetings and workshops;
- To train planetary scientists to communicate and engage with a variety of audiences;
- To support the outreach, engagement and education communities in planetary science, and provide a forum for new ideas to be developed;
- To provide a fully professional approach to using the mass and social media to make planetary science news and information available to a variety of wider publics;
- To ensure that policy-makers and industrial partners are well informed and engaged with the planetary science community; to ensure the community is aware of relevant industrial and political developments;
- To provide access to research students and early career researchers – particularly from the Inclusiveness Member States – to the key dissemination events for planetary science.

Europlanet's WP13 tasks have used a range of outreach tools and communication channels to target engagement with different audiences, including:

- The public, both through social media (Facebook, Twitter, Instagram, Flickr, YouTube and campaigns e.g. #MercuryTransitSelfie) and through public events (e.g. Juno Arrival Event in Athens on 5th July 2016, sessions, talks and an exhibition stand at ESOF 2016 and BlueDot);
- Teachers: thorough training workshops, and events (e.g. Juno Arrival event in Athens);
- Schools: through webinars, online careers information and interview videos (in partnership with Space Awareness);
- Policy makers: through 1-1 briefings, exhibition and dinner debate in the European Parliament, briefing sheets, written evidence for Parliamentary inquiries, participation in the EU policy survey);
- The media: through press releases, media briefings and interviews;

- Outreach professionals: through best practice meetings, outreach sessions at EPSC and conferences e.g. Ecsite, ESOF).

1.2 Explanation of the work

Detailed description of work

Task 13.1: Coordination

Mariana Barrosa of the Science Office coordinates the 'Impact through Outreach and Engagement' NA2 Work Package with support from Anita Heward and working closely with all NA2 task and sub-task leaders, as well as other EPN2020-RI WP leaders and EPN2020-RI management to ensure that results and activities of EPN2020-RI are communicated effectively to external audiences (the media, general public, educators, policy makers etc).

Since the start of the Europlanet project (under FP6), there has been an outreach website www.europlanet-eu.org that is aimed at the public, media, educators, outreach providers, policy makers etc. This is complementary to the project website (currently www.europlanet-2020-ri.eu), which is aimed at members of the planetary science community and contains more scientific and technical information. At the start of the EPN2020-RI project, the Europlanet outreach website was completely redesigned with a new template appropriate for multi-platform (computers, smartphones, tablets and other mobile devices users). The new website went online in December 2015. A snapshot of the analytics for the website from January 2016-February 2017 can be seen below.

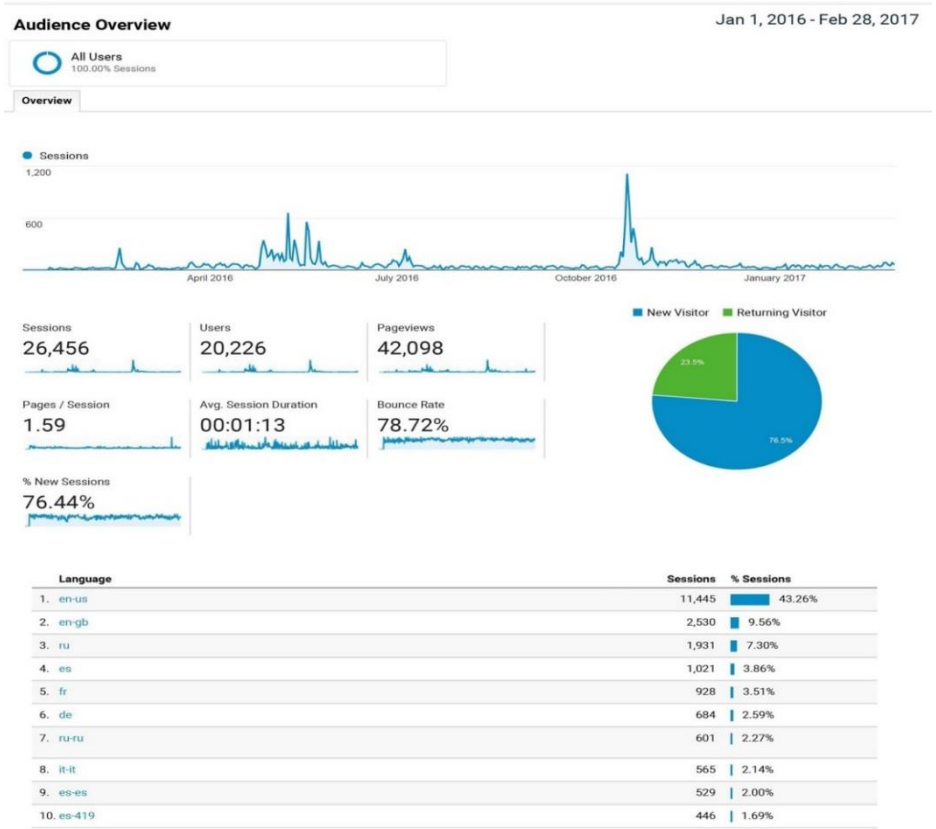

Figure 33 - Visits to the Europlanet Outreach website from 1 January 2016-28 February

Task 13.2: Outreach Services and Community Support

Sub-task 13.2.1. Outreach Services (U Leiden, SO, UCL)

Tibisay Sankatsing Nava of the University of Leiden leads the Outreach Services task, with support from Thilina Heenatigala of Science Office.

With so much information available on the Internet, it can be hard for educators and outreach providers to judge the quality of educational resources and find reliable activities quickly. The IAU's astroEDU (www.iau.org/astroEDU) peer-review method is similar to publishing a scientific paper and allows the authors to improve educational resources according to the comments received from the reviewers (consisting of one educator and one scientist). EPN2020-RI is delivering four collections for the astroEDU platform (D 13.5 astroEDU collections. Due Project Month 24). Two Europlanet-branded collections of educational resources have already been peer-reviewed and published and two further collections are in preparation.

To facilitate communication with the planetary outreach community around Europe, EPN2020-RI launched an outreach newsletter in August 2016 to provide a forum for sharing information on outreach activities and new ideas. The initial distribution list comprised attendees of the Athens best practice and training workshops (see below) and partners in the Europlanet outreach work package. Subscribers have since signed up organically.

Sub-task 13.2.2. Meetings (U Athens, VU)

The Outreach Meetings task is led by Dr Eleni Chatzichristou of Institute of Accelerating Systems and Applications (IASA) and Dr Grazina Tautvaisiene of the University of Vilnius, with support from the team at Science Office and working closely with the University of Leiden team that organises the science communication training (sub-task 13.2.3).

- Seven sessions have been proposed in the Outreach, Education and Policy stream at EPSC 2017 in Riga.
- Two full sessions on outreach were held during the EPSC in September 2015 in Nantes: 'Sharing Best Practice in Planetary Science Outreach & Education' included 6 oral presentations and 5 posters. 'Planetary Science and Exploration through Art' included 6 oral presentations and 3 posters. The oral talks were filmed and posted on the EPSC 2015 YouTube Channel.
- The best practice workshop (Deliverable D13.13: 1st Outreach Best Practice Meeting, Milestone MS114) 'Europlanet Outreach Innovation Day' took place on 4th July at the Coral Hotel in Athens.
    - 24 people attended (12 female and 12 male), including researchers, students, teachers, outreach professionals and journalists, with participants from Greece, France, Germany, Lithuania, Romania, Slovakia, Sri Lanka and the UK.
    - Presentations covered engaging with journalists, the mass media, social media and the public, amateur astronomy, archaeoastronomy, history of astronomy, and astronomy-inspired music. Abstracts and presentations can be found for download here.
    - Interactive sessions discussed (1) direct engagement with the public through face-to-

face or social media and (2) engagement with journalists and the mass media.
    - Outcomes of the workshop include:
        1. A special call for a Europlanet2020-RI Expert Exchange will be launched in April/May 2017 aimed at science journalists/teachers of journalism to visit Europlanet facilities and find out more about the scientific process.
        2. One attendee (Anastasia Kokori, Greece), who is now doing a Master's course in science communication at Dublin City University, is now developing an outreach strategy for Europlanet's Danakil site for her dissertation project.
- The next best practice workshops (Deliverable 13.14: 2nd Outreach Best Practice Meeting) will take place as part of a summer school at Molatei Observatory, Lithuania from 18-28 July 2017.

Subtask 13.2.3. Training (U Leiden, UCL, SO)

Dr. Pedro Russo and Tibisay Sankatsing Nava of the University of Leiden lead the Science Communication Training task, with support from the Science Office team, Dr. Rosa Doran from the NUCLIO Foundation/Galileo Teacher Training Programme and working closely with the team from IASA and VU that organise the outreach meetings (sub-task 13.2.3).

- EPN2020-RI's first Science Communication Training Workshop (Deliverable D13.9: 1st Training Workshop, Milestone MS117) was held at the Coral Hotel in Athens on 5th July. It was led by Rosa Doran of the Galileo Teacher Training Program and Iris Nijman and Wouter Schrier of TEMI.
    - 16 participants (9 female and 7 male), from Greece, Lithuania, Romania, Slovakia and the UK attended.
    - Modules covered Enquiry Based Learning and the TEMI methodology. Practical assignments included to develop activity plans for teachers and students.
- The next science communication training sessions (Deliverable 13.10: 2nd Training workshop) will take place as part of a summer school at Molatei Observatory, Lithuania from 18-28 July 2017. The extended timescale of the summer school will offer a much more extensive training opportunity for engagement with different audiences; thus, modules will cover engagement with the media and policy makers, teachers, the general public and use of social media.

13.2.4 Sub-task Europlanet Prize and Funding Scheme

Dr. Thierry Fouchet of the Observatoire de Paris leads the Europlanet Prize and Funding Scheme, convening the Jury and managing the distribution of funds and prize giving. EPN2020-RI relaunched the annual Europlanet Prize for Public Engagement in Planetary Science and Europlanet Outreach Funding Scheme in October 2015. The Jury that assesses applications for the Funding Scheme and nominations for the Prize is made up of members of the EPN2020-RI outreach team (Thierry Fouchet (Chair), Mariana Barrosa, Anita Heward, Eleni Chatzichristou, Tibisay Sankatsing Nava) and independent external outreach and education experts (Yael Naze (University of Liege), Alain Doressoundiram (Observatoire de Paris), Fiorella Coliolo (ESA/Freelance) and Oana Sandu (ESO)).

- The Europlanet Prize for Public Engagement 2016 (Milestone MS120: 1st Prize and funding awards) was awarded to Stéphane Le Mouélic and François Civet for their development of immersive virtual reality techniques to experience Martian landscapes, including through a

'cave', through Virtual Reality (VR) headsets (Oculus Rift etc) and through mobile phones (Google Cardboard).

- Europlanet outreach funding in 2016 was awarded to Speak Science (http://www.speakscience.it), an Italian not-for-profit, to develop an affordable, self-build version of a 'Science on a Sphere' display system, with plans to be disseminated free via the website. The project is now being developed and progressing as planned, as can be seen in this report and a prototype has been built.
- There were 3 nominations for the prize in both the 2017 (UK, Germany) and 2016 (France, Slovenia and UK) rounds.
- There were 17 applications for the funding scheme in 2017 (France, Greece, Ireland, Italy, Netherlands, Slovenia, Spain, Sweden and UK). There were 15 applications for the funding scheme in 2016 (from Austria, Belgium, Czech Republic, France, Germany, Italy, Latvia, Netherlands, Poland and UK)
- The Jury met to evaluate submissions for the 2017 prize and funding scheme (Milestone MS121: 2nd Prize and funding awards) on 14 March. The results will be announced and funds transferred ahead of schedule (due Project Month 23).

Task 13.3: Dissemination to Stakeholders

Sub-task 13.3.1. European Planetary Media Centre (SO)

The Europlanet Media Centre is coordinated by Anita Heward (SO), working closely with the Social Media Manager, Thilina Heenatigala, as well as task leaders from other EPN2020-RI work packages and EPN2020-RI Management.

- A major contribution of EPN2020-RI to EPSC is provision of press office support (staffing press office, drafting press releases, coordinating press briefings) through the Europlanet Media Centre, which adds to the visibility and impact of EPSC through and leads to significant media attendance at the meeting and worldwide coverage in the media.
- The Europlanet Media Centre has issued 33 press releases relating to the project, including the Joint DPS-EPSC 2016 Meeting and EPSC 2015, which have been covered by leading media outlets worldwide, including the BBC, Forbes, Gizmodo, The Daily Mail, Popular Science, Le Monde, Le Figaro, La Reppublica, Blic.rs, The Guardian, National Geographic, CNN, Yahoo! News, Space.com, Focus, RIA Novosti, La Stampa, ORF, Ciel et Espace, Astronomy Now, Sky at Night, Sky & Telescope, Ma.hu, Přírodovědci. More detailed coverage is available here.
- Press releases have covered activities by the overall EPN2020-RI project (Europlanet 2020 Research Infrastructure launches new era of planetary collaboration in Europe), TA1 (Rainbow-coloured hydrothermal systems show spectrum of extreme life on Earth), NA1 (Amateurs prepare big-picture perspective to support Juno mission, Jupiter blasted by 6.5 fireball impacts per year on average, Scientists come to Schloss Seggau to discuss Rosetta's comet), JRA2 (DREAMS Team Tests ExoMars 2016 Schiaparelli Lander in Aarhus Mars Simulator), JRA3 (Diamond's 2-billion-year growth charts tectonic shift in early Earth's carbon cycle) and further press releases on JRA1, JRA2 and VESPA are currently in preparation. For details of coverage of the press releases, see Table 32 and a more detailed spreadsheet here.
- Europlanet has taken a leading role in coordinating media activities to highlight European

involvement in significant planetary-related events, including:

- The Transit of Mercury in May 2016. A press release gave details of science contacts available for interview about the transit, Mercury and the BepiColombo mission in 10 European countries, as well download details for an animation and infographics produced by SO. This led to wide use by the mass media including the Guardian and Space.com)
- European involvement in the Juno mission (a webpage and press release summarised European involvement and points of contact).

Sub-task 13.3.2. Online and Social Media (SO)

EPN2020-RI's social media presence is managed by Thilina Heenatigala of Science Office. Since December 2015, Europlanet has revamped and/or set up a core base of social media platforms on Facebook, Twitter, Instagram, Flickr and YouTube.

- Information is posted on a regular basis (usually daily, but more frequently during events e.g. EPSC or Europlanet workshops).
- Europlanet's social media following has grown significantly since the start of the project: on Twitter from 612 in September 2015 to 1168 in April 2017 and on Facebook from 180 in September 2015 to 982 in April 2017.
- Social media campaigns e.g. #MercuryTransitSelfie during April/May 2016 (coordinated with The Transit of Mercury microsite, press release issued by the Europlanet Media Centre, webinars and blog posts) have assisted growth in followings.

See Appendix 1 for full details.

Sub-task 13.3.3. Policy-makers and Industry (SO)

Following the departure of Veronika Raszler (SO) in December 2017, role of Policy Officer has been taken on by Livia Giacomini of INAF, who works closely with the EPN2020-RI Coordinator, Nigel Mason (OU), and the Communications Officer, Anita Heward (SO). During the reporting period:

- Europlanet has contacted directly all 134 members and substitutes of the ITRE Committee.
- Europlanet has held one-to-one briefings (see Appendix 4 for full details) with the following MEPs: Clare Moody (UK), Monika Hohlmeier (Germany), Olle Ludvigsson (Sweden), Inés Ayala Sender (Spain), Miloslav Ransdorf (Czech Republic), Cora van Nieuwenhuizen (Netherlands), Marian-Jean Marinescu (Romania), Anneleen Van Bossuyt (Belgium), David Borrelli (Italy), Theresa Griffin (UK), Angelika Niebler (Germany). In addition, it has held one-to-one briefings with representatives of the offices of Jude Kirton-Darling (UK) and Constanze Krehl (Germany).
- Europlanet exhibited in the European Parliament from 14-18 November 2016 (Deliverable 13.8, due Month 36) as part of the 8th European Innovation Summit (EIS) and the STOA Christmas Lecture (theme: Space 4.0 for Industry 4.0). The EIS exhibition was opened by the MEPs Andrey Novakov, Lambert van Nistelrooij and Clare Moody and was attended by at least 300 people during the period, including MEPs, MEP assistants, policy advisors, industry representatives, participants in the 8th EIS and participants in the STOA Annual Lecture. See full report on the Europlanet website. The winner of the 2016 Europlanet Prize for Public Engagement with Planetary Science, an Immersive VR exploration of Mars, was an important part of the Europlanet display.

- The first Europlanet Dinner Debate (Deliverable 13.6) took place on the 27 April 2017, at the European Parliament in Brussels. The title was 'The Impact of the EU on Planetary Science'.
    - The debate was hosted by MEP Clare Moody (UK) and was attended by the MEPs Christian Ehler (Germany), Evžen Tošenovský (Czech Republic), Lucy Anderson (UK), Theresa Griffin (UK), and a representative of MEP Philippe De Backer (Belgium). Oriana Grasso of the European Commission's DG GROW and Frank Moeschler of the UK Representation to the EU attended, alongside representatives of EPN2020-RI WP1 (N. Mason, B. Pizzileo, L. Thomas, B. Bishop), WP12 (M. Grande) and WP13 (A. Heward, V. Raszler), as well as the industry officer/Eurospace representative (H. Boithias) and members of the planetary science community (Tomáš Pajdla of the Czech Technical University, Prague and Luigi Colangeli of the European Space Agency). A total of 23 guests participated in the dinner debate.
- Europlanet submitted recommendations for the EU Space Strategy survey, Europlanet and the Horizon 2020 Space Work Programme 2018-20, as well as encouraging the 90+ member institutions of the Europlanet Consortium to submit individual responses.
- Europlanet has submitted written evidence for three UK Parliamentary inquiries, following consultations with the Europlanet and UK planetary community:
    - The House of Lords Science and Technology Select Committee Inquiry into 'Relationship between EU membership and the effectiveness of UK science'. The Europlanet Consortium Written Evidence was referenced in paragraph 145 (p 47) of the House of Lords Science and Technology Select Committee's report, EU Membership and UK science, published on 20th April 2016.
    - The House of Commons Science and Technology Select Committee Inquiry into 'Satellites and Space'. Europlanet Consortium Written Evidence published 2 February 2016.
    - The UK House of Commons Select Committee Inquiry on Leaving the EU: implications and opportunities for science and research (Europlanet 2020 RI Written Evidence submitted 2nd August 2016).
- Europlanet took part in the Science and the Assembly 2016 event at the Welsh Assembly organised by the Royal Society of Chemistry.
- Europlanet published an article, Europlanet 2020 RI – Creating Space for European Planetary Science to Thrive, in a special edition of The Parliament Magazine on EU Space Policy published on 7th March 2016.

Several other mentions and descriptions of Europlanet and its interest to International scientists were made by EPN H2020 members on occasions such as European Space Agency Advisory Committee, The Space Science Week in Washington, organised by the National Academies of Science, various international Congresses and Workshops at no cost to the Project.

Task 13.4 - Development of Outreach and Educational Tools

Sub-task 13.4.1. Planetary Video Shorts (SO)

The Planetary Video Shorts task is led by Science Office and is managed by Mariana Barrosa with

scripts by Bárbara Ferreira and graphics by the Science Office team of animators.

- EPN2020-RI has released the first two educational videos in a series of animations:
    - "The Transit of Mercury" is a 2-minute animation produced to promote the observation of the transit of Mercury on 9th May 2016 (and the upcoming transit in 2019). The video was a focal point of Europlanet's outreach campaign around the transit in May. Scientific input for the script was provided by Prof David Rothery of the OU.
    - "Jupiter and its Icy Moons" is a 5-minute animation about Jupiter, its multiple moons and what the Juno and JUICE missions expect to discover. Scientific oversight of the script was provided by Prof Steve Miller. A teaser, trailer and posters promoted the animation through social media channels in the run up to Juno's arrival at Jupiter on 4th July. The full animation premiered at a live event in Athens with a link-up via Google Hangout to Juno PI, Scott Bolton at JPL in Pasadena).
- Both videos were shared online through Europlanet's social media platforms and through traditional media and have combined had an estimated 75,000 views (including on other platforms e.g. Space.com).
- The next video, on astrobiology, is currently in production and will be released in May/June. Scientific oversight of the script has been provided by Barbara Cavalazzi and Felipe Gomez. The fourth animation (topic TBD) will be released at EPSC 2017 in September.

Sub-task 13.4.2. Planetary Analogue and Comparative Planetology Outreach and Educational Tools (LU, INTA)

The development of "Space Climate Detectives" outreach tools (Deliverable 13.7, due month 30) is led by Amara Graps of the University of Latvia and Felipe Gomez of CAB-INTA, with support from the Science Office team. A prototype of the Raspberry Pi-based climate detector has been produced and was successfully trialled during the JRA-1 field trip to the Danakil Depression in April 2016; a further test took place at Lake Tirez in March 2017. Work is ongoing to develop the educational package.

Task 13.5. Access to Dissemination Events (UCL)

Prof. Steve Miller of UCL has led the Access to Dissemination Events task and coordinated the announcement, assessment and award of the flat-rate subsidies for young researchers in Years 1 & 2 of EPN2020-RI.

- Europlanet awarded 48 flat-rate contributions for young researchers (23 female/25 male) from 15 countries to attend the European Planetary Science Congress (EPSC) 2105 in Nantes.
- Europlanet coordinated 25 flat-rate subsidies for young researchers (7 female / 18 male) from 10 countries to attend the joint meeting of EPSC and the American Astronomical Society's Division for Planetary Sciences (DPS) in Pasadena in October 2016 (10 of the subsidies for the DPS-EPSC meeting were funded by ESA).

See Appendix 3 for full details of bursaries awarded in 2015 and 2016.

WP13 (NA2: Impact through Outreach and Engagement)-Deliverables

D13.9 - Europlanet IOE Website. Planned and submitted on month 9.

D13.1- 1st NA2 Annual Report. Planned and submitted on month 12.

D13.6- European Parliament Dinner Debate. Planned and submitted on month 12

D13.10 - 1st Training Workshops. Planned and submitted on month 12.

D13.13 - Outreach Professional Mtg. Planned and submitted on month 12.

D13.8 - European Parliament Exhibition. Planned on month 36. Submitted on month 19

WP13 (NA2: Impact through Outreach and Engagement)-Milestones

MS111 Europlanet IOE website re-launch. Planned on Month 9. Achieved on 14/12/15
MS112 1st European Parliament Dinner Debate. Planned on Month 12. Achieved on 27/04/16
MS114 1st Outreach Professional Meeting. Planned on Month 12. Achieved on 04/07/16
MS117 1st Training Workshops. Planned on Month 12. Achieved on 05/07/16
MS120 1st Prize and funding awards. Planned on Month 12. Achieved on 31/07/16

1.3 Impact

1.3.1 Inclusion - engaging European citizens across the EU

In its proposal, Europlanet 2020 RI highlighted the need to address the "information v. interest" gap in science and technology, as highlighted in the European Commission's 2013 Special Eurobarometer 401, which looked at "Responsible Research and Innovation, Science and Technology". This is particularly prevalent in Inclusiveness states, such as Latvia, Estonia and Greece. Europlanet 2020 RI's outreach activities have placed a particular emphasis on these countries - and indeed the task is led by Portuguese SME, Science Office. The Best Practice Meetings Task (2.2) is co-led by IASA in Greece and the University of Vilnius in Lithuania with the aim of attracting researchers from Eastern and Southern Europe to attend workshops. So far, it appears that this approach is proving effective: the first best practice workshop was held in Athens in July 2016 and was attended by participants from Greece, France, Germany, Lithuania, Romania, Slovakia, Portugal and the UK. The next workshop will be hosted by the University of Vilnius in the summer of 2017, and will be followed up by outreach sessions, meetings and training workshops associated with the European Planetary Science Congress (EPSC) 2017 in Riga, Latvia. Plans are already underway for public events and an exhibition at EPSC 2017 to maximise engagement with the local community (including the public, schools, educators, policy makers and industry) in Latvia and neighbouring Baltic countries.

An outcome of the brainstorming session at the Europlanet Outreach Innovation Day in Athens was the need to provide training for both scientists and journalists on their respective priorities and requirements in order to foster better communication. As a result of the workshop, Europlanet is planning a special call for the expert exchange programme aimed at science journalists and teachers of journalism, especially from Inclusiveness Countries.

Bursaries provided by Europlanet have supported young researchers from Bulgaria, the Czech Republic, Poland and Portugal to attend EPSC 2015 and the DPS-EPSC Joint Meeting 2016.

1.3.2 Dissemination of results

The results of Europlanet's activities have been successfully disseminated through the Europlanet Media Centre and Europlanet's social media channels. Europlanet 2020 RI has issued 33 press releases to date on its activities, and has also assisted partner institutions to reach a wider audience by translating their press releases into English and by posting on the Europlanet website and on the AlphaGalileo media service. Europlanet activities have been covered by many of the world's leading and most trusted media outlets around the world, including the BBC, the Associated Press, CNET, National Geographic, Discovery News, Le Monde, Le Figaro, Der Spiegel, Nature, Time, El Mundo, New Scientist, Lietuvos Rytas.

Europlanet had a strong presence at the EuroScience Open Forum (ESOF) 2016 in Manchester. The

'Europe Goes to the Planets' stand, coordinated by the Open University, showcased Europlanet 2020 RI as well as the planetary-related Horizon 2020 projects Upwards, EURO-CARES, NeoShield-2, Space Awareness, ODYSSEUS II, AstRoMap, PPOSS and Small Bodies Near and Far, and the COST Life-ORGINS Action and European Astrobiology Campus. More than 180 booklets summarizing the projects were distributed and several hundred people interacted with by the staff manning the stand. By hosting an interactive round-table session, which featured speakers from the European Space Agency, Google Lunar XPRIZE, universities and citizen science projects, Europlanet engaged participants at ESOF in a dialogue on the changing role in planetary exploration of space agencies, commercial companies, and private individuals; this has since generated coverage in the media e.g. by the Smithsonian. Europlanet is currently working with IRAP to coordinate a session proposal for ESOF 2018 in Toulouse that will present results of the 'Planetary Exploration: Horizon 2061' road-mapping exercise, currently undertaken jointly by Europlanet and the International Space Science Institute (ISSI) in Bern.

1.3.3 Inspiration and education

Europlanet 2020 RI has close links with the Space Awareness project (with whom it shares a number of beneficiaries), and is supporting the project in its objectives to inform children and young adults about current research and issues related to space sciences, as well as the numerous career opportunities offered by space. Europlanet researchers have been interviewed as part of a series of videos to highlight the range of space-related jobs. Europlanet also helped initiate, coordinate and promote a retrospective longitudinal careers survey to find out how background, experiences and choices have led the scientists and engineers working in Europe's planetary science community down their own career paths. 415 responses were gathered from 147 female and 268 male participants. The survey included questions on gender, age, nationality and ethnic background, sources of initial interest in science and space, influencing factors (including resources, experiences, parents and teachers) and priorities for future career choices. An initial top-level analysis of data has been carried out by UCL. Further analysis will be carried out over the next year with a particular emphasis on exploring any differences by gender. The University of Leiden, which leads Space Awareness, provided training on enquiry-based learning for Europlanet researchers at the first Europlanet science communication training workshop, 'Engaging with Teachers', in Athens, and further workshops are planned in Lithuania in the summer of 2017. A public event in Athens on 5th July, organised by Europlanet to celebrate Juno's arrival at Jupiter, was attended by a significant cohort of teachers attending the international Galileo Teacher Training Programme workshop in Marathon the same week.

Google Hangouts provide an opportunity for members of the public and schools to interact directly with researchers and engineers. Europlanet has piloted a programme of Hangouts during 2016 and will implement a regular series from spring 2017 onwards, with a particular emphasis on engaging with teachers and educators.

Europlanet 2020 RI has produced two animated videos, already viewed by at least 75,000 people, that aim to engage, inform and educate and entertain young people and members of the public with planetary science. A series of these videos will be complete by Month 30 of the Europlanet 2020 RI project, after which they will be promoted through TV channels and educational networks.

Since Europlanet's first field trip to the Danakil Depression in April 2016, opportunities have arisen to collaborate with Barbara Cavalazzi at the University of Bologna and colleagues at the University of Mekelle in Ethiopia on outreach activities. Europlanet is strongly committed to following this up, and is looking at opportunities to build links with Ethiopian schools into its 'Space Climate Detectives' project (due for launch in Project Month 30). An outreach strategy for engaging with communities in Ethiopia is being developed in collaboration with Space Awareness and Dublin City University.

1.3.4 Engaging with Policy Makers and Industry

The 33 beneficiaries of Europlanet 2020 RI are a subset of the wider Europlanet Consortium, currently 90+ research institutions, companies and SMEs linked by a Memorandum of Understanding (MoU). Europlanet's policy engagement activities are thus largely undertaken on behalf of this wider community. This has been particularly relevant for Europlanet's UK membership over the past year: Europlanet has responded to three Parliamentary inquiries in recent months and these submissions have aimed both to highlight the importance of EU support and European collaboration for planetary science as a whole, but also to provide an additional platform for planetary science groups in the UK to express their views and concerns in the wake of the Brexit vote.

Although Europlanet had an active programme of engagement with the European Parliament under FP7, the period that elapsed between the end of the previous RI in December 2012 and the launch of Europlanet 2020 RI in September 2015 meant that many of its key contacts were no longer in the Parliament. Thus, even before the official start of the 2020 RI project, Europlanet commenced a new programme of one-to-one briefings with members and substitutes of the ITRE Committee and the Sky and Space Intergroup. More than 20 briefings have been held to date with MEPs and their representatives, and the first year of activities culminated in a successful dinner debate held in April 2016 on the 'Impact of the EU on Planetary Science'.

However, Europlanet's efforts to date have been focused on MEPs that (to some extent) are already engaged with space or science. In Year 2, Europlanet 2020 RI is working to extend its activities to those MEPs that are less aware of planetary science and the potential benefits of the EU's support for space research and exploration. The initial focus of this programme was an exhibition during the week of 14-18th November in the European Parliament in Brussels. The exhibition was part of the 8th European Innovation Summit (EIS) and programmes for the STOA Annual Lecture, and was visited by at least 300 people during the week including MEPs, policy advisors, parliamentary assistants and industry/public visitors associated with the EIS and STOA lecture. Europlanet is now following up on many of these new contacts.

The EPN2020-RI Industry Officer, Dr Marcell Tessenyi (Blue Skies Space Ltd (BSSL)/UCL) is playing an active role in engagement with policy makers and industry, particularly in planning events and an exhibition associated with EPSC in Riga, Latvia in September 2017. Europlanet sees this as a vital opportunity to build links with policy makers and industry in Inclusiveness countries, particularly Latvia, Estonia, Lithuania and other Baltic countries. Dr Tessenyi, with support from colleagues at BSSL, is also producing a matrix detailing SME participation in planetary exploration across the EU Member States, with particular focus on Inclusiveness Countries. The aim of this matrix is to create a comprehensive database of all the upstream (technology provider) space companies in Europe for use by the planetary science community. A decision was made to not include downstream (space services) companies as they mostly deal with Earth Observation data processing/applications.

For each company in the database, contact details, a URL, and a summary of upstream capabilities categorised by ESA's Technology Domains (TDs) have been provided. BSSL has conducted desk research to compile this information from several sources, including: space industry associations' members lists, national space industry catalogues and space clusters' members lists, as well as additional information obtained through Europlanet.

The ultimate aim is to include every upstream space companies from 26 European countries in the database. At present, 284 companies from 10 countries have been included in the database, with an emphasis on smaller and emerging space nations. The number of space upstream companies in each country varies significantly, with an overall an average of 31 companies per country for the countries

fully analysed to date. Therefore, once all 26 countries have been completed, the database can be expected to comprise around 800 companies.

For a full list of activities refer to **Table 32**.

4. Deviations from Annex 1

4.1 Use of resources

A budget transfer of 24,000 EUR from Beneficiary # 27 (LU) to Beneficiary #7 (SO). This corresponds to the money to be paid toward a subcontractor, which has been moved to a different beneficiary in order to avoid complying with Latvia's procurement rules, which would cause a delay of 8-9 months in the payment. Refer to the approved amendment.

Appendices

Appendix 1 - Social Media Report
Appendix 2 - EPSC 2015 Press Office Report
Appendix 3 - Bursaries funded by Europlanet 2020 RI
Appendix 4 - Summary of 1-1 Briefings by Europlanet 2020 RI, Europlanet Policy Briefing Sheets.

Table 32 - List of all dissemination activities

WP	type of activity	title	date	place	type of audience	size of audience	countries addressed
WP1	Flyer	Europlanet Flyer	November 2015 with reissues	International	Scientific community (Higher Education, Research, Industry)	5000	International
WP1	Flyer	Europe Leading International Planetary Science	Jul-16	International	Scientific community (Higher Education, Policy Makers, Research, Industry)	2000	International
WP1	Flyer	Smelly postcards	March 2017	International	Scientific community (Higher Education, Research, Industry), Parliamentary and General public	5000	International
WP1	Films - YouTube	Introduction to the key people in Europlanet	Various	http://www.europlanet-2020-ri.eu/	Scientific community (Higher Education, Research, Industry), Parliamentary and General public	1127 views	International
WP1	New Website	Europlanet main website	September 2014	www.europlanet-2020-ri.eu/	Scientific community (Higher Education, Research, Industry), Parliamentary and General public	Approx. 11,700	International
WP1	Films - YouTube	Lab visit films to advertise the TAs	October 2015	www.europlanet-2020-ri.eu/	Scientific community (Higher Education, Research, Industry),	2032 views	International
WP1	Participation to a Conference	European Space Open Forum 2016	July 2016	Manchester http://manchester2016.esof.eu/en/	General Public, Industry	4500	International
WP1	Participation to a Conference	European Planetary Space Congress	September 2016	Nantes	Scientific community (Higher Education, Research, Industry),	706	International
WP1	Participation to a Conference	DPS/European Planetary Space Congress	October 2016	Pasadena	Scientific community (Higher Education, Research, Industry),	1500	International
WP1	Participation to a Conference	Oral presentations referring to EPN activities at the EPSC 2015 and at the DPS-EPSC joint meetings , by A. Coustenis	27/9-2/10/15 & 16-22/ 10/2016	Nantes, FR and Pasadena, CA, US	Scientific community (Higher Education, Research, Industry)	1500	International
WP1	Participation to a Conference	Oral presentations referring to EPN activities at the 47th Annual DPS 2015 by A. Coustenis	8-13/11/15	Washington, DC	Scientific community (Higher Education, Research, Industry)	1000	International
WP1	Participation to a Conference	Oral presentations referring to EPN activities at the EGU 2015 and 2016 Annual Assemblies, by A. Coustenis	April 2015 and April 2016	Vienna, Austria	Scientific community (Higher Education, Research, Industry)	5000	International

WP1	Participation to a Conference	Oral presentations referring to EPN activities at the EWASS 2016 Meeting by A. Coustenis	4-8 July 2016	Athens, Greece	Scientific community (Higher Education, Research, Industry)	800	International
WP1	Participation to a Conference	Oral presentations referring to EPN activities at the AGU 2016 Meeting by A. Coustenis	12-16/12/16	San Francisco, CA, US	Scientific community (Higher Education, Research, Industry)	5000	International
WP1	Participation to a Conference	Presentation and advertisement of EPN at the Space Science Week in Washington (A. Coustenis, presented the European Space Programme	29-31 April 2016 & 28-30 April 2017)	Washington, DC, US	Scientific community (Higher Education, Research, Industry)	200	International
WP3	Flyer	Apply now to use the Planetary Spectroscopy Laboratory	March 2016	LPSC, Houston, TX, USA	Scientific Community (Higher Education, Research)	3,000	International
WP3	Other	Laboratory tours at "Long night of science"	June 2015	Institute for Planetary Research, DLR, Berlin, Germany	General Public	500	Germany
WP1	Participation in activities organized jointly with other H2020 projects	Workshop on cooperation between Ris with UK involvement (EPN2020-RI, Asterics and Opticon)	21-Feb-17	Royal Astronomical Society, London, UK	Scientific Community	6	UK
WP1	Participation in activities organized jointly with other H2020 projects	Joint H2020 planetary-related project exhibition stand with AstRoMap, Upwards, RegoLight, MiARD, PPOSS, SBNAF, EURO-CARES, NeoShield and Space Awareness "Europe Goes to the Planets"	24-27/07/16	Manchester Central Convention Centre, Manchester, UK	Scientific Community (Higher Education, Research); General Public; Media;	400-600	International
WP1	Participation in activities organized jointly with other H2020 projects	Joint H2020 planetary-related project brocure with AstRoMap, Upwards, RegoLight, MiARD, PPOSS, SBNAF, EURO-CARES, NeoShield and Space Awareness "Europe Leading International Planetary Science"	July 2016 with reissues	Manchester EPOF 2018 and European Parliament Exhibition	Scientific Community (Higher Education, Research); General Public; Policy Makers; Media	2000	International
WP3	Press release	Europlanet 2020: Fokus Weltraumforschung	January 2017	https://www.medunigraz.at/gesundheitsthemen/gesundheitsthemen/detail/news/europlanet-internationale-weltraumforschung/	General Public	5,000	Austria
WP3	Press Release	DPS-EPSC Joint meeting (A. Coustenis)	October	http://www.europlanet-	Media and scientists	1500	US

			2016	eu.org/titan-experiences-dramatic-seasonal-changes			
WP3	Press Release	ESA-EGU on Cassini Grand Finale (A. Coustenis)	April 2017	Athena Coustenis was part of a panel in Vienna, Austria	Media and scientists	50	Austria
WP3	Social media	Astrobiology - The quest for life in the universe	January 2017	http://www.europlanet-eu.org/webinars/	General Public	5,000	International
WP3	Participation to a Conference	VOLCANO: CoV9	November 2016	Puerto Varas, Chile	Scientific Community (Higher Education, Research)	1,000	International
WP3	Participation to a Conference	EGU	April 2016	Vienna, Austria	Scientific Community (Higher Education, Research)	10,000	International
WP3	Participation to a Conference	The Sixth International Conference on Mars Polar Science and Exploration	September 2016	Reykjavik, Iceland	Scientific Community (Higher Education, Research)	1,000	International
WP3	Participation to a Conference	NCCR PlanetS General Assembly	January 2017	Grindelwald, Switzerland	Scientific Community (Higher Education, Research)	200	International
WP3	Participation to a Conference	Reflectance and other related physical properties of icy planetary analogues, Ices in the Solar System ESA/ESAC Workshop	January 2017	Madrid, Spain	Scientific Community (Higher Education, Research)	100	International
WP3	Participation to a Conference	American Geophysical Union Fall Meeting	December 2016	San Francisco, USA	Scientific Community (Higher Education, Research)	24,000	International
WP3	Participation to a Conference	Division of Planetary Science, AAS	October 2016	Pasadena, USA	Scientific Community (Higher Education, Research)	8,000	International
WP3	Participation to a Conference	American Geophysical Union Fall Meeting	December 2015	San Francisco, USA	Scientific Community (Higher Education, Research)	23,000	International
WP3	Participation to an Event other than a Conference or a Workshop	SUPERCAM	November 2016	CNES, Paris	Scientific Community (Higher Education, Research)	50	International
WP4	Participation	Dry limit for life:	19-23.10.16	Lake Stechlin, Germany	Scientific Community (Higher	100	Most of

	to a Conference				Education, Research)		Europe
WP4	Participation to a Conference	Mineralogical and geochemical –Sr, Nd, Pb- tracing of varying northern vs. Southern water-masses contributions in the sub Antarctic Atlantic ocean (MD07-3076) since the last glacial maximum	30.8.2016	Utrecht, Netherlands	Scientific Community (Higher Education, Research)	500	International
WP4	Participation to an Event other than a Conference or a Workshop	The Moon and search of Water	19.09.2016	Nene Vallye Astronomical Society, UK	General Public	50	UK
WP4	Participation to a Conference	Mineralogical and geochemical –Sr, Nd, Pb- tracing of varying northern vs. Southern water-masses contributions in the sub Antarctic Atlantic ocean (MD07-3076) since the last glacial maximum	15.11.2016	Orsay, France	Scientific Community (Higher Education, Research)	150	Predominantly Fr
WP4	Participation to a Conference	Water and other volatiles in the Moon	15.11.2016	Applied Physics Laboratory, USA	Scientific Community (Higher Education, Research)	100	international
WP4	Participation to a Conference	Antarctic micrometeorites vs. carbonaceous chondrites: the organic point of view by	14.02.2017	Sapporo (Japan)	Scientific Community (Higher Education, Research)	50	International
WP4	Participation to a Conference	Antarctic micrometeorites vs. carbonaceous chondrites: th eorganic point of view by	21.02.2017	Villefranche-sur-Mer, France	Scientific Community (Higher Education, Research)	50	International
WP5	Communicati on Campaign	Women in Science" presentation for secondary school pupils	30/01/2016	Budapest	Civil Society	20	Hungary
WP5	Communicati on Campaign	Invited guest at the talk show "Ridikül" in television (Duna TV), http://www.mediaklikk.hu/2016/05/24/ridikul-tudos-nok/#	25/05/2016	Budapest	Media	100,000	Hungary
WP5	Participation to a Conference	Space weather conditions at the induced magnetospheres of Venus, Mars and the Comet CG	25/11/2015	Oostende	Scientific Community (Higher Education, Research)	60	international
WP5	Participation to a Conference	Improvement of background solar wind predictions	19/04/2016	Vienna	Scientific Community (Higher Education, Research)	100	international
WP5	Participation to a	Planetary Space Weather Services for the Europlanet 2020 Research	25/11/2015	Oostende	Scientific Community (Higher Education, Research)	60	international

	Conference	Infrastructure					
WP5	Participation to a Conference	Planetary Space Weather Services for the Europlanet 2020 Research Infrastructure - invited e-poster	26/11/2015	Oostende	Scientific Community (Higher Education, Research)	100	international
WP5	Non-scientific and non-peer-reviewed publication (popularised publication)	Les aurores polaires, un chapitre dans « La lumière en lumière », Coordonné par Benoit Boulanger, Saïda Guellati-Khelifa, Daniel Hennequin et Marc Stehle, 978-2-7598-1829-7, EDPS Ed., January 2016			General Public	10,000	France
WP5	Participation to a Conference	Space weather at Titan	26/1115	Oostende	Scientific Community (Higher Education, Research)	100	international
WP5	Participation to a Conference	The Planeterrella: an Analog Model for Teaching About the Invisible Electromagnetic Processes Driving Space Weather	17/12/2015	San Francisco	Scientific Community (Higher Education, Research)	100	international
WP5	Participation to a Conference	Planetary Space Weather Services for the Europlanet 2020 Research Infrastructure	28/09/2015	Nantes	Scientific Community (Higher Education, Research)	60	international
WP5	Participation to a Conference	Planetary Space Weather Services for the Europlanet 2020 Research Infrastructure	15/03/2016	Hendaye	Scientific Community (Higher Education, Research)	150	France
WP5	Participation in activities organized jointly with other H2020 projects	Planetary Space Weather Services for the Europlanet 2020 Research Infrastructure	19/04/2016	Vienna	Scientific Community (Higher Education, Research)	100	international
WP6	Training	VESPA Hand's on Tutorial splinter, EGU 2016, Vienna, Austria	Apr 18, 2016	Vienna, Austria	Scientific Community (Higher Education, Research)	50+	International
WP6	Training	VESPA Hand's on Tutorial splinter, EGU, Vienna, Austria	Apr 25, 2017	Vienna, Austria	Scientific Community (Higher Education, Research)	50+	International
WP6	Training	VESPA Hand's on Tutorial splinter, EPSC-DPS, Pasadena, CA, USA	Oct 23, 2016	Pasadena, USA	Scientific Community (Higher Education, Research)	50+	International
WP6	Training	VESPA Hand's on Tutorial splinter, EPSC, Nantes, France	Sept 30, 2016	Nantes, France	Scientific Community (Higher Education, Research)	50+	International
WP6	Organisation of a Workshop	Enabling Access to Solar and Planetary Resources through the Virtual Observatory (AGU, San Francisco,	Dec 15, 2015	San Francisco, USA	Scientific Community (Higher Education, Research); Other (Educators/Outreach	40; 10	International

		California, USA, December 2015)			Professionals)		
WP6	Organisation of a Workshop	Open Research Data and Interoperable Science Infrastructures for Earth & Planetary Sciences (JpGU, Tokyo, Japan, May 2016)	May 25, 2016	Tokyo, Japan	Scientific Community (Higher Education, Research)	50+	International
WP6	Organisation of a Workshop	Planetary Science Interoperability (EPSC-DPS, Pasadena, California, USA, October 2016)	Oct 21, 2016	Pasadena, USA	Scientific Community (Higher Education, Research)	100+	International
WP6	Organisation of a Workshop	Enabling Open and Interoperable Access to Planetary Science and Heliophysics Databases and Tools (AGU, San Francisco, California, USA, December 2016)	Dec 15, 2016	San Francisco, USA	Scientific Community (Higher Education, Research)	100+	International
WP6	Organisation of a Workshop	VESPA presentation and demonstration at NASA/Cassini consortium meeting (PSG#71, Monrovia, CA, USA)	2/15/2017	Monrovia, CA, USA	Scientific Community (Higher Education, Research)	50+	International
WP6	Participation in a Workshop	Presentation of VESPA at "Meteorology from atmosphere to space" workshop, in Toulouse, France	Nov 9, 2016	Toulouse, France	Scientific Community (Higher Education, Research); Industry; Civil Society	16; 2; 2	France
WP6	Organisation of a Workshop	VESPA Data Provider's Tutorial at Tohoku University, Sendai, Tokyo	Jul 16 2016	Sendai, Japan	Scientific Community (Higher Education, Research)	10+	Japan
WP6	Organisation of a Workshop	Challenges of Open Science: Research Data Sharing, Infrastructure, and Scientific Communications (JpGU-AGU, Tokyo, Japan, May 2017)	May 23, 2016	Tokyo, Japan	Scientific Community (Higher Education, Research)	1000+	International
WP6	Seminar	VESPA project presentation at IRFU, Uppsala, Sweden	Feb 15, 2016	Uppsala, Sweden	Scientific Community (Higher Education, Research)	10+	Sweden
WP6	Participation in a Workshop	Presentation of VESPA project at PV-2015 Workshop, Darmstadt, Germany	Nov 3, 2015	Darmstadt, Germany	Scientific Community (Higher Education, Research)	100+	International
WP6	Participation in a Workshop	Presentation of VESPA at IPDA-Sterring-Committee annual meeting, ESAC, Madrid, Spain	Jul 28, 2016	Madrid, Spain	Scientific Community (Higher Education, Research)	20+	International
WP6	Flyer	VESPA Flyers at NASA/PDS-IPDA Booth (AGU 2015 , San Francisco, California, USA, December 2015)	15/12/16	San Francisco, USA	Scientific Community (Higher Education, Research); Other (Educators/Outreach Professionals)	800; 200	International
WP6	Flyer	VESPA Flyers at NASA/PDS-IPDA Booth (EPSC-DPS 2016, Pasadena, California, USA, October 2016)	Oct 23 2016	Pasadena, USA	Scientific Community (Higher Education, Research); Other (Educators/Outreach	1000+	International

					Professionals)		
WP6	Participation in a Workshop	Comparision VESPA/PDAP at ASTERICS workshop, Heidelberg, Germany	June 2016	Heidelberg, Germany	Scientific Community (Higher Education, Research)	50+	European
WP6	Training	Planetary Science VO Training Course, Obs Paris, France	Mai 31, 2016	Paris, France	Scientific Community (Higher Education, Research)	10	France
WP6	Training	Planetary Science VO Training Course, Obs Paris, France	Feb 3rd, 2017	Paris, France	Scientific Community (Higher Education, Research)	10	France
WP6	Participation to a Conference	EGU 2016, Vienna, Austria	Mai 25, 2016	Tokyo, Japan	Scientific Community (Higher Education, Research)	50+	International
WP6	Seminar	VESPA project presentation at LASP, Boulder, CO, USA	Mar 9, 2016	Boulder, CO, USA	Scientific Community (Higher Education, Research)	30+	International
WP6	Participation in a Workshop	"Juno Ground Radio Observatoire Support" at Planetary Radio Emissions 8, Graz, Austria	Oct 25, 2016	Graz, Austria	Scientific Community (Higher Education, Research)	150+	International
WP6	Participation in a Workshop	"VESPA for Solar System Plasma" at Programme National relations Soleil-Terre, Hendaye, France	Mar 12, 2016	Hendaye, France	Scientific Community (Higher Education, Research)	50+	France
WP6	Participation in a Workshop	"VO tools for Juno" at French Juno Team Workshop	Oct 14, 2015	Toulouse, France	Scientific Community (Higher Education, Research)	20	France
WP6	Participation in a Workshop	French Planetary VO workshop	April 4, 2016	Toulouse, France	Scientific Community (Higher Education, Research)	20+	France
WP6	Participation to a Conference	EPSC-DPS, Pasadena, CA, USA	Oct 17-21, 2016	Pasadena, USA	Scientific Community (Higher Education, Research)	150+	International
WP6	Training	Organization of a training for partners on the SSHADE database infrastructure	11-13 Mai 2016	Grenoble, France	Scientific Community (Higher Education, Research)	4	International
WP6	Training	Organization of a training for partners on the SSHADE database infrastructure	4 Nov. 2016	Grenoble, France	Scientific Community (Higher Education, Research)	7	International
WP6	Training	Organization of a training for partners on the SSHADE database infrastructure	6-8 Dec. 2016	Grenoble, France	Scientific Community (Higher Education, Research)	5	International
WP6	Training	Organization of a on-site training for Unibe partners on the SSHADE database infrastructure	4-7 Oct 2016	Bern, Swizerland	Scientific Community (Higher Education, Research)	3	International
WP6	Training	Organization of a on-site training for IGS-PAS partners on the SSHADE database infrastructure	12-21 Dec 2016	Wroklaw, Poland	Scientific Community (Higher Education, Research)	5	International
WP6	Website	SSHADE Blog development	30 Sept. 2015	online	Scientific Community (Higher Education, Research)	1000+	International
WP6	Tutorial	Tutorial for partners on data	Dec. 2015 -	online	Scientific Community (Higher	50+	International

		preparation and import in the SSHADE database	May 2016 - Dec. 2016		Education, Research)		
WP6	Organisation of a Workshop	Enabling Access to Solar and Planetary Resources through the Virtual Observatory (EPSC, Nantes, France, September 2015)	10/9 /15	Nantes, France	Scientific Community (Higher Education, Research); Other (Educators/Outreach Professionals)	800;200	International
WP6	Participation in a Workshop	IVOA Interop Meeting Spring 2016, Stellenbosch, South Africa	Mai 9, 2016	Tokyo, Japan	Scientific Community (Higher Education, Research)	50+	International
WP7	Communicati on campaign	Topsy turvy A piece of sea floor, stranded on dry land, may hold clues to life's origin	October, 27th 2016	The Economist	General Public; Policy makers	1,000,000; 1,000	World
WP7	Website	Earth Facilities for Europlanet	April, 1st 2016	Online	Scientific Community (Higher Education, Research); Civil Society; General Public; Policy Makers; Media; Other (Educators/Outreach Professionals)	10,000	International
WP9	Participation to an Event other than a Conference or a Workshop	Geochemistry applied to small samples	23.02.2016	Utrecht University, Netherlands	Scientific Community (Higher Education, Research)	50	mainly NL
WP9	Participation to a Conference	New applications in dating diamonds	29.02.2016	UCLA California	Scientific Community (Higher Education, Research)	40	US, UK,D,Fr, It
WP9	Participation to an Event other than a Conference or a Workshop	Extreme heterogeneity prior to extensive mixing: Sr-Nd-Pb isotope analysis of individual melt inclusions from the Italian Peninsula.	10.03.2016	Vrije Universiteit, Netherlands	Scientific Community (Higher Education, Research)	80	NL, D, It,Fr,B, UK,Sp, etc n> 10
WP9	Participation to a Conference	New applications in dating diamonds	08.04.2016	Veldhoven, Netherlands	Scientific Community (Higher Education, Research)	>400	NL, D,It,Fr,B, UK,Sp, etc n>15
WP9	Participation to an Event other than a Conference or a Workshop	Potential new isotopic applications in Petrology	02.05.2016	Dept Earth Sciences ETH Zurich	Scientific Community (Higher Education, Research)	120	CH, Fr, UK, D, US, It, A etc, n> 15
WP9	Participation	Archaean diamond growth beneath	28.06.2016	Yokohama, Japan	Scientific Community (Higher	>100	international

	to a Conference	Venetia established by Sm-Nd systematics of individual garnet inclusions			Education, Research)		
WP9	Participation to an Event other than a Conference or a Workshop	Isotopic systematics of chondrules	07.02.2017	University of Muenster	Scientific Community (Higher Education, Research)	~40	Germany, UK, Netherlands
WP9	Participation to a Workshop	New applications in dating diamonds	21.07.2016	Northwestern University, Chicago, USA	Scientific Community (Higher Education, Research)	30	US, D, Ca, Mex, Sp
WP9	Participation to a Workshop	New applications in dating diamonds	25.07.2016	Deep Carbon Observatory short course; Yellowstone, USA	Scientific Community (Higher Education, Research)	70	US + n>15
WP9	Participation to a Workshop	Examples of diamond dating	25.07.2016	Deep Carbon Observatory short course; Yellowstone, USA	Scientific Community (Higher Education, Research)	70	US + n>15
WP9	Communicati on Campaign (e.g. Radio, TV)	New Scientist Live	28.09.2016	EXCEL centre, London	General Public	~5000	Mainly UK, but worldwide
WP9	Participation to an Event other than a Conference or a Workshop	Science Uncovered	30.09.2016	NHM, London	General Public	~5000	Mainly UK, but worldwide
WP9	Participation to a Workshop	Matrix investigation of primitive meteorite MIL 07687: 2D-3D comparison	29.11.2016	JAXA, Tokyo, Japan	Scientific Community (Higher Education, Research)	~60	Worldwide
WP10	Website	Planetary Space Weather Services, http://planetaryspaceweather-europlanet.irap.omp.eu/	28/02/2017	Toulouse	General Public	web	international
WP10	Website	Transplanet, http://transplanet.irap.omp.eu/	28/02/2017	Toulouse	General Public	web	international
WP10	Participation to a Conference	Validity of space weather prediction to Venus and Mars	25/11/2015	Oostende	Scientific Community (Higher Education, Research)	60	international
WP10	Participation to a Conference	Developing an Efficient Planetary Space Weather Alert Service using Virtual Observatory Standards	29/09/2015	Nantes	Scientific Community (Higher Education, Research)	100	international

WP10	Participation in activities organized jointly with other H2020 projects	Developing an Efficient Planetary Space Weather Alert Service using Virtual Observatory Standards	19/04/2016	Vienna	Scientific Community (Higher Education, Research)	100	international
WP10	Participation to a Conference	Planetary plasma data analysis and 3D visualisation at the French Plasma Physics Data Centre	18/10/2016	Pasadena	Scientific Community (Higher Education, Research)	100	international
WP10	Organization of a Workshop	Planetary Space Weather Services, http://www.stce.be/esww13/program/wm.php?nr=12	17/11/2016	Oostende	Scientific Community (Higher Education, Research)	60	international
WP10	Participation to a Conference	Comparative Science and Space Weather Around the Heliosphere	18/10/2016	Pasadena	Scientific Community (Higher Education, Research)	100	international
WP11	Website	VESPA GitHub organisation page - https://github.com/epn-vespa	Jan 1, 2016	Online	Scientific Community (Higher Education, Research); Industry	500+	International
WP11	Participation to a Conference	Europlanet Workshop: Juno Ground-Based Support from Amateurs: Science and Public Impact	May, 12, 2016	Nice, France	Scientific Community (Higher Education, Research)	50+	International
WP11	Participation to a Conference	Data mining and visualization from planetary missions: the VESPA-Europlanet2020 activity, in IAU Symposium 325 on Astroinformatics	20 October 2016	Sorrento, Italy	Scientific Community (Higher Education, Research)	150+	International
WP11	Website	Vespa website - http://europlanet-vespa.eu	1/6/2015	Online		1000+	International
WP12	Participation to a Workshop	NA1 progress meeting	21/04/2016	Vienna	Scientific Community (Higher Education, Research)	6	international
WP12	Participation of an event other than Conference or workshop	Eurospace meeting	26/04/2016	Lausanne	Industry	80	international
WP12	Organisation of a workshop	NA1 kickoff meeting	24/11/2015	Göttingen	Scientific Community (Higher Education, Research)	15	international
WP12	Website	NA1 website	14/10/2015	-	Scientific Community (Higher Education, Research); Industry; Civil Society; General Public; Policy	10; 1; 1; 1; 1; 1	International

					Makers; Media		
WP12	Training	Interactive Data Analysis Tools in Planetary and Space Sciences	02/03/2016	Graz, Austria	Scientific Community (Higher Education, Research)	10	Austria
WP12	Participation to a Workshop	Europlanet 2020: Promoting Amateur Collaborations in Planetary Science	11/05/2016	Nice, France	Scientific Community (Higher Education, Research)	33	International
WP12	Participation to a Workshop	Europlanet 2020: Collaboration of Professional and Amateur Astronomers	06/08/2016	Molètai, Lithuania	Scientific Community (Higher Education, Research); General Public	20; 20	International
WP12	Participation to a Workshop	An overview on Europlanet 2020	25/10/2016	Seggauberg, Austria	Scientific Community (Higher Education, Research)	60	international
WP12	Organisation of a workshop	NA1 progress meeting	21/04/2016	Vienna	Scientific Community (Higher Education, Research)	8	international
WP12	Participation to a Workshop	Horizon 2061 Forum	9/12/2016-9/15/2016	Bern	Scientific Community (Higher Education, Research); industry	33; 7	international
WP12	Participation to a Workshop	NA1 progress meeting	8/30/2016-9/1/2016	Helsinki	Scientific Community (Higher Education, Research)	11	international
WP12	Organisation of a workshop	first ISSI-Europlanet forum	13/09/2016	Bern	Scientific Community (Higher Education, Research); Industry	15; 11	international
WP12	Participation to a Workshop	ASIME16 (Asteroid Science Intersections with In-Space Mine Engineering) workshop website	9/20/2016 - 9/22/2016	Luxembourg	Scientific Community (Higher Education, Research); Industry; Civil Society; Policy Makers	40; 15; 5; 5	International
WP12	Website	Planetary Radio Emissions VIII workshop website (http://pre8.oeaw.ac.at/)	01/02/2016	-	Scientific Community (Higher Education, Research); Industry;	60; 20	international
WP12	Press Release	Europlanet 2020 - Neuer Ära der planetaren Forschung in Europa	01/09/2015	-	Scientific Community (Higher Education, Research);	80	international
WP12	Press Release	Scientists come to Schloss Seggau to discuss Rosetta's comet	20/06/2016	-	Scientific Community (Higher Education, Research);	100	international
WP12	Website	Rosetta Workshop Website (http://www.rosetta-campaign.net/meetings/2016-seggau)	01/12/2015	-	Scientific Community (Higher Education, Research);	80	international
WP12	Website	Juno Workshop Website (http://www.ajax.ehu.es/Juno_amateur_workshop/)	01/01/2016	-	Scientific Community (Higher Education, Research); General Public;	40;40	international
WP12	Website	Exoplanets Summer School Website (http://mao.tfai.vu.lt/exoplanets2016/)	01/03/2016	-	Scientific Community (Higher Education, Research);	80	international
WP12	Flyer	Rosetta Workshop flyer	01/04/2016	-	Scientific Community (Higher	60	international

					Education, Research)		
WP12	Flyer	Juno Workshop flyer	01/04/2016	-	Scientific Community (Higher Education, Research)	60	international
WP12	flyer	Exoplanets Workshop poster	01/05/2016	-	Scientific Community (Higher Education, Research)	60	international
WP12	Press Release	Exoplanets Summer School press release (in Lithuanian)	04/08/2016	-	Scientific Community (Higher Education, Research);	80	international
WP12	Video/film	Juno: Close Encounter (documentary by Discovery Channel covering the amateur and professional astronomers Juno WS)	11/07/2016	-	general public	103	international
WP13	Organisation of a Workshop	Impact and Outreach Kick Off Meeting	11-12/11/15	UCL, London	Scientific Community (Higher Education, Research); Other (Educators)	17	International
WP13	Organisation of a Workshop	'Planets Meeting the Public', Outreach Innovation Day	04/07/2016	Coral Hotel, Athens	Scientific Community (Higher Education, Research); Other (Educators)	24	International
WP13	Press Release	EPSC 2015 – 1st Media Invitation	04/09/2015	Online	Media	5000+ Journalists. Coverage includes: Ciel et Espace, Presse Ocean, Breizh-Info, Agences Spatiales, Jet FM 91.2	International
WP13	Press Release	Europlanet 2020 Research Infrastructure launches new era of planetary collaboration in Europe	15/09/2015	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Austrian Press Agency, Yahoo! Notizie, Space Ref, Florida Space Report, Universia Espana	International
WP13	Press Release	EPSC 2015 – 2nd Media Invitation	22/09/2015	Online	Media	5000+ Journalists. Coverage includes: Ciel et	International

						Espace, Presse Ocean, Breizh-Info, Agences Spatiales, Jet FM 91.2	
WP13	Press Release	How Rosetta's comet got its shape	28/09/2015	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Associated Press, BBC, Le Monde, Le Figaro, EuropaPress, El Mundo, La Stampa, Berliner Zeitung, Daily Mail, the Metro	International
WP13	Press Release	Farinella Prize 2015 Awarded to French Comet Researcher Nicolas Biver	28/09/2015	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Physics World, Azo Quantum	International
WP13	Press Release	Mineralogical confirmation for liquid water on present-day Mars	28/09/2015	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Le Monde, New York Times, Vanity Fair, Il Giornale, La Stampa, El Dia, MSNBC, the Guardian, Liberation	International
WP13	Press Release	Dawn teams shares new maps and insights about Ceres	30/09/2015	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes BBC News, Forbes	International

						Magazine, Space.com, Yahoo! News, Universe Today, ABC.net, Daily Mail	
WP13	Press Release	AIDA double mission to divert Didymos asteroid's Didymoon	30/09/2015	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Daily Mail, Express, Metro,	International
WP13	Press Release	First detection of gases at super-Earth show a light-weight, dry atmosphere – with a hint of carbon too?	19/02/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes BBC Online, Nature.com, the Daily Mail, WIRED, the Washington Post, TIME, Yahoo! News, Discovery News, UPI, SPIEGEL Online, Republica.it, Die Standaard, VRT Nieuws.	International
WP13 / WP7	Press Release	Rainbow-coloured hydrothermal systems show spectrum of extreme life on Earth	26/04/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Popular Science, Gizmodo, IFL Science, EarthSky, Tadias, Sputnik International, SciencePost,	International

						Correo, Scientias.nl, RIA Novosti, National Geographic.	
WP13	Press Release	Transit of Mercury – European Events and Media Contacts	26/04/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes the Guardian, Space.com, Telegraph	International
WP13 /WP5/ WP12	Press Release	Jupiter blasted by 6.5 fireball impacts per year on average	18/05/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Space.com, United Press International, Australian News Network, La Razón, RIA Novosti. Yahoo News UK.	International
WP13 /WP1 2	Press Release	Amateurs prepare big-picture perspective to support Juno mission	23/06/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	Coverage includes Sky & Telescope, Astronomy Now, PhysOrg	International
WP13 /WP1 2	Press Release	Scientists come to Schloss Seggau to discuss Rosetta's comet	20/06/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	Coverage includes: APA , ORF.at , bmvit Infothek	International
WP13	Press Release	European involvement in the Juno mission	29/06/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	Coverage includes: Space Daily, SpaceRef, Rodiaki , e Kathimerini , News 247	International
WP13	Press Release	First Media Invitation: DPS-EPSC Joint	16/08/2016	Online	Scientific Community (Higher	5000+	International

		Meeting 2016			Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	Journalists.	
WP13	Press Release	Preliminary press conference program for planetary science meeting	15/09/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists.	International
WP13	Press Release	Final press-conference program for the joint meeting of the AAS Division for Planetary Sciences and European Planetary Science Congress	14/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists.	International
WP13	Press Release	DPS-EPSC 2016: Avalanches, not internal pressure, cause comet nuclei outbursts	17/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes CBC, Space.com, tech.qq.com, 历史趣闻, Cosmos Magazine	International
WP13	Press Release	DPS-EPSC 2016: NASA's MAVEN Mission Gives Unprecedented Ultraviolet View of Mars	17/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes India Today, Sciences et Avenir, www.futura-sciences.com, Universe Today, Space.com, IFL Science, Express, Ukrop News 24, CBS, USA Today, Finacial Express, The Weather Network, Mashable,	International

WP13	Press Release	DPS-EPSC 2016: Astronomers predict possible birthplace of Rosetta-probed comet 67P	17/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes El Mundo, CBC, ABC.es, Space.com, Astronomy Now, Media INAF, IFL Science, Cosmos Magazine, National Geographic	International
WP13	Press Release	DPS-EPSC 2016: Recently active lava flows on the eastern flank of Idunn Mons on Venus	17/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes IFL Science, Astronomy Now, Daily Mail, iTechPost, Endgadget, Space.com, Russia Today, Sputnik News, Sky and Telescope, MSN, Accuweather,	International
WP13	Press Release	DPS-EPSC 2016: New Horizons: Possible clouds on Pluto, next target is reddish	18/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes New Scientist, The Guardian, Times of India, Space.com, CNET, Nature, Media INAF, New York Times, Daily Mail, Discover	International

						Magazine, Scientias.nl, NBC News, Lenta.ru,	
WP13	Press Release	DPS-EPSC 2016: Curious tilt of the Sun traced to undiscovered planet	19/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes ITV, Astronomy.com, Space.com, The Guardian, Gizmodo, Forbes, Telegraph, Daily Mail, WIRED, Huffington Post, Economic Times of India, The Hindu, NY Daily News	International
WP13	Press Release	DPS-EPSC 2016: More evidence for ninth planet roming Solar System's outer fringes	19/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes…	International
WP13	Press Release	Juno Spacecraft in Safe Mode for Latest Jupiter Flyby	19/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Washington Post, Yahoo News, The Guardian, Daily Mail, Popular Mechanics, ArsTechnica, The Sun, Scientific American, Indian Express, NBC News, allesoversterrenkunde.nl/	International

WP13	Press Release	DPS-EPSC 2016: François Civet and Stéphane Le Mouélic Awarded Europlanet Prize for Public Engagement	20/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes University of Nantes, Alphagalileo	International
WP13	Press Release	DPS-EPSC 2016: Long-term, hi-res tracking of eruptions on Jupiter's moon, Io	20/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes New Scientist, Space.com, Popular Mechanics, Taringa!, Gizmodo, ASI.it, Media INAF, MeteoWeb, Daily Galaxy, Staryab.com, NOW.space, technology.org, earthsky.org	International
WP13	Press Release	DPS-EPSC 2016: Titan experiences dramatic seasonal changes	20/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Europa Press, UPI, IFL Science, Daily Mail, The Mirror, Universe Today, Sciences et Avenir, International Business Times, The Tecake.in, Earthsky.org, Inverse	International
WP13	Press Release	DPS-EPSC 2016: Unexpected Discoveries	20/10/2016	Online	Scientific Community (Higher	5000+	International

		on a Metal World			Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	Journalists. Coverage includes Tähdet ja avaruus, scientias.nl, Space.com, Fox News, Universe Today, Science Daily, PhysOrg	
WP13	Press Release	DPS-EPSC 2016: Farinella Prize 2016 awarded to Kleomenis Tsiganis	20/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes Physics World, physics4u.gr, PRO News.gr, www.auth.gr	International
WP13	Press Release	DPS-EPSC 2016: Going Out in a Blaze of Glory: Cassini's Grand Finale	20/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes El Mundo, Liputan6, TECNOXPLORA, Space.com, LA Times, Forbes,	International
WP13 /WP9	Press Release	Diamond's 2-billion-year growth charts tectonic shift in early Earth's carbon cycle	23/02/2017	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	5000+ Journalists. Coverage includes UPI, Science Daily, The London Economic, PhysOrg	International
WP13 /WP1	Non-scientific and non-peer-reviewed publication (popularised publication)	Europlanet 2020 RI – creating space for European planetary science to thrive, The Parliament Magazine	07/03/2016	Online, Print	Policy Makers; Media	100,000+ (70K visits to website, 58K sent digitally, 23K Twitter followers)	International

WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Careers in planetary exploration	15/02/2017	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Europlanet 2016 Highlight Reel	15/12/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Europlanet exhibits in the European Parliament	03/12/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Mars 2020 – stepping up the search for life on Mars	11/11/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	DPS-EPSC 2016: Press tour of JPL	11/11/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Looking Back at a Joint Success – DPS-EPSC 2016	10/11/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication	Farewell Rosetta!	29/09/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach	1000	International

	(popularised publication)				Professionals)		
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Europlanet 2020 RI – First Year Highlights	09/09/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13 /WP8	Non-scientific and non-peer-reviewed publication (popularised publication)	DREAMS Team Tests ExoMars 2016 Schiaparelli Lander in Aarhus Mars Simulator	14/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Spotlight on Outreach: University of Athens Observatory	01/08/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	ESOF 2016 – What do you think a comet smells like?	27/07/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Counting Down to Jupiter	29/06/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Coming soon: Jupiter and its Icy Moons	19/06/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-	Dinner Debate – The Impact of the EU on Planetary Science	28/04/2016	Online	Scientific Community (Higher Education, Research); General	1000	International

	reviewed publication (popularised publication)				Public; Media; Other (Educators/Outreach Professionals)		
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	The Venus Twilight Experiment – what we learned from the last transit of Venus	05/04/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Mercury: the planet, the missions and the transit	02/04/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	EPSC 2015 & Exhibition Organiser Awarded Prize	06/02/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	International
WP13	Non-scientific and non-peer-reviewed publication (popularised publication)	Kick-off Meeting for Europlanet2020 RI Outreach	06/12/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	1000	
WP13	Exhibition	Europe Goes to the Planets	24-27/07/16	Manchester Central Convention Centre, Manchester, UK	Scientific Community (Higher Education, Research); General Public; Media;	400-600	International
WP13	Exhibition	8th European Innovation Summit, European Parliament.	14-17/11/16	European Parliament, Brussels	Scientific Community (Higher Education, Research); Industry; General Public; Policy Makers; Media	300+	International
WP13 /WP1	Flyer	Europlanet 2020 Official leaflet	07/04/2016	International	Scientific Community (Higher Education, Research); Industry; Civil Society; General Public; Policy Makers; Media	N/A	International
WP13	Flyer	Juno Event Invitation	07/04/2016	Coral Hotel, Athens	Scientific Community (Higher	150	International

					Education, Research); Other (Educators/Outreach Professionals)		
WP13	Flyer	Europlanet 2020 briefing sheet - Europlanet Background	Nov-15	European Parliament, Brussels	Policy Makers	150+	International
WP13	Flyer	Europlanet 2020 briefing sheet - Europlanet Key People	Nov-15	European Parliament, Brussels	Policy Makers	150+	International
WP13	Flyer	Europlanet 2020 briefing sheet - Europlanet Participants	Nov-15	European Parliament, Brussels	Policy Makers	150+	International
WP13	Flyer	Europlanet 2020 briefing sheet - Europlanet Project Summary	Nov-15	European Parliament, Brussels	Policy Makers	150+	International
WP13	Flyer	Europlanet 2020 briefing sheet 'Impact of European Union Funding on Planetary Science'	Nov-15	European Parliament, Brussels	Policy Makers	150+	International
WP13	Flyer	Europlanet 2020 briefing sheet - Planetary exploration driving innovation and job creation	Feb-17	European Parliament, Brussels	Policy Makers	150+	International
WP13	Flyer	Europlanet 2020 briefing sheet - Careers in the Space Sector	Feb-17	European Parliament, Brussels	Policy Makers	150+	International
WP13	Flyer	Rosetta Postcards	Jul-15 -	EuroScience Open Forum, European Parliament, Association for Science Education Conference, Slovenian EP Information Office	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	2500	International
WP13	Training	'Engaging with Schools: Training for Researchers'	05/07/2016	Coral Hotel, Athens	Scientific Community (Higher Education, Research); Other (Educators/Outreach Professionals)	12	International
WP13	Social Media	Twitter	01/09/15 -	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	235626	International
WP13	Social Media	Facebook	01/09/15 -	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	324303	International
WP13	Social Media	Flickr	01/09/15 -	Online	Scientific Community (Higher	23347	International

					Education, Research); General Public; Media; Other (Educators/Outreach Professionals)		
WP13	Social Media	Instagram	01/11/16 -	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)		International
WP13	Social Media	Google Hangout on Air: Europlanet Mercury Transit Hangout, Part 1	12/04/2016	Online	Scientific Community (Higher Education, Research); General Public; Other (Educators/Outreach Professionals)	359	International
WP13	Social Media	Google Hangout on Air: Europlanet Mercury Transit Hangout, Part 2	19/04/2016	Online	Scientific Community (Higher Education, Research); General Public; Other (Educators/Outreach Professionals)	207	International
WP13	Social Media	Google Hangout on Air: Europlanet Mercury Transit Hangout, Part 3	09/05/2016	Online	Scientific Community (Higher Education, Research); General Public; Other (Educators/Outreach Professionals)	61	International
WP13	Social Media	Google Hangout on Air: Juno: Countdown to Jupiter - National Astronomy Meeting 2016 Hangout	27/06/2016	Online	Scientific Community (Higher Education, Research); General Public; Other (Educators/Outreach Professionals)	378	International
WP13	Social Media	Europlanet Webinar: ExoMars - Europe's journey to Mars	20/10/2016	Online	Scientific Community (Higher Education, Research); General Public; Other (Educators/Outreach Professionals)	93	International
WP13	Participation to a Conference	EPSC 2015, Nantes	27/09/15 - 02/10/15	Nantes, France	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	706	International
WP13	Participation to a Conference	8th Annual Conference on European space policy	12/02/2016	Brussels, Belgium	Policy Makers	400	International
WP13	Participation to a	Do you want to join my space race? (BlueDot Festival)	23/07/2016	Jodrell Bank, Cheshire	General Public; Media	200	International

	Conference						
WP13	Participation in activities organized jointly with other H2020 projects	Do you want to join my space race? (EuroScience Open Forum (ESOF) Interactive Round Table Session)	26/07/2016	Manchester Central Convention Centre, Manchester, UK	Scientific Community (Higher Education, Research); General Public; Policy Makers; Media	30-40	International
WP13	Participation to a Conference	Joint Meeting of AAS Division of Planetary Sciences (DPS) and European Planetary Science Congress	16-21/10/16	Pasadena, California, USA	Scientific Community (Higher Education, Research); General Public; Policy Makers; Media	1415	International
WP13	Participation in a Workshop	Europlanet outreach resources (Ecsite Space Working Group Pre-Conference Workshop)	08/06/2016	Graz, Austria	Scientific Community (Higher Education, Research); Other (Educators/Outreach Professionals)	45	International
WP13	Participation in a Workshop	CaSE discussion forum on Science, Engineering & Brexit	17/08/2016	Imperial College, London	Scientific Community (Higher Education, Research); Industry	45	UK
WP13	Participation in a Workshop	Europlanet workshop on Danakil Depression	1-3/12/16	U. Bologna, Italy	Scientific Community (Higher Education, Research); Industry; Other (Educators/Outreach Professionals)	20	International
WP13	Participation in a Workshop	Ecsite Space Working Group Meeting	09-09/12/16	ESAC, Cologne, Germany	Scientific Community (Higher Education, Research); Other (Educators/Outreach Professionals)	25	International
WP13	Video/Film	The Transit of Mercury	04/07/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	50 000	International
WP13	Video/Film	Jupiter and Its Icy Moons	07/05/2016	Online	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	25 000	International
WP13	Other (Written evidence for Parliamentary Inquiry)	Evidence for House of Lords Science and Technology Select Committee Inquiry into 'Relationship between EU membership and the effectiveness of UK science'.	Submitted 20/11/2015. Published 04/12/2015	UK	Policy Makers	50+	UK
WP13	Participation	Longitudinal Careers survey with Space	2015-2016	Online	Scientific Community, Industry	415	International

	in activities organized jointly with other H2020 projects	Awareness (Grant Agreement nº 638653)					
WP13	Participation in activities organized jointly with other H2020 projects	Workshop on policy activiteis with Space Awareness (Grant Agreement nº 638653)	27/02/2017	Brussels, Belgium	Scientific Community	9	International
WP13	Other (Written evidence for Parliamentary Inquiry)	Evidence for House of Commons Science and Technology Select Committee Inquiry into 'Satellites and Space'.	Published 02/02/2016	UK	Policy Makers	50+	UK
WP13	Other (Written evidence for Parliamentary Inquiry)	Evidence for House of Commons Science and Technology Select Committee Inquiry into 'Leaving the EU: implications and opportunities for science and research inquiry'	Submitted 02/08/2016	UK	Policy Makers	50+	UK
WP13	Other (Dinner Debate in European Parliament)	Impact of EU on Planetary Science	27/04/2016	European Parliament, Brussels	Scientific Community (Higher Education, Research); Industry; Policy Makers	23	International
WP13	Other (Public Outreach Event)	Celebrating Juno's arrival at Jupiter	05/07/2016	Athens, Greece	Scientific Community (Higher Education, Research); General Public; Media; Other (Educators/Outreach Professionals)	150	International
WP13	9. Website	Europlanet Outreach Website	Nov-16	Online	Scientific Community (Higher Education, Research); Civil Society; General Public; Policy Makers; Media; Other (Educators/Outreach Professionals)	20578	International

Table 33 – Risk assessment (arisen risks only)

Risk number	Description of risk	Mitigation measure	Comments
3	Beneficiary unable to fulfill task due to a change in circumstances	Management team to reassign tasks and duties accordingly	The terminated beneficiary's (Coriolys) staff has moved to a different beneficiary (CNRS)
4	TA facilities not having expected number of high quality applications for visits. Limited applications for access	Use EPN2020-RI's highly effective outreach capabilities to ensure full coverage of planetary science community. Following the mid term review and annual reports, reallocate funding in accordance with facilities which are over subscribed.	A 4th Council has been held on 3rd May 2017 to vote on proposed budget re-allocation. The changes approved by the council has been presented at the mid-term review
12	Broad community participation in TA programme.	Collaborate with Inclusiveness officer to ensure effective communication throughout IMSs.	Inclusiveness countries revealed to have problems in "believing" the free access to facilities. Effort has been made in creating dedicated mailing lists and improving clarity of websites
13	Recruitment of ESR's.	Use set up time to advertise widely and use extensive international networks.	Problems with local administrative arrangements (see MS49) caused delays despite the implementation of mitigation strategies. There are difficulties in appointing very short term contracts (months) to existing staff with needed expertise since they might be employed at the proposed time on another project, requiring alternations in deliverable and milestones for Europlanet 2020 RI.