EPN 2024 RI

EUROPLANET 2024 Research Infrastructure

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Project Co-ordinator: Prof Nigel Mason, University of Kent

Executive Summary / Abstract: We report the developments and services made operational during the first year of the Sun Planetary Interactions Digital Environment on Request (SPIDER) Virtual Activity of the Europlanet 2024 Research Infrastructure. During the first year of the project, four of the six foreseen services have started as planned their developments, with two of them prototyped and two others already operational.

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1.   **Nature:** R = Report, P = Prototype, D = Demonstrator, O = Other

2.   **Dissemination level:**

PU	PP	RE	CO
Public	Restricted to other programme participants (including the Commission Service)	Restricted to a group specified by the consortium (including the Commission Services)	Confidential, only for members of the consortium (excluding the Commission Services)

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Deliverable

1. Explanation of work & Overview of progress

1.1 Objectives

The H2020 Europlanet –2020 Research Infrastructure (RI) programme, which ended on Aug 31st, 2019, included an activity called Planetary Space Weather Services (PSWS), which provided 12 services distributed over four different domains (A. Prediction, B. Detection, C. Modelling, D. Alerts) and accessed through the PSWS portal (http://spider-europlanet.irap.omp.eu/#europlanet):

A1. 1D MHD Solar Wind Prediction Tool – HELIOPROPA,

A2. Propagation Tool,

A3. Meteor showers,

A4. Cometary tail crossings – TAILCATCHER,

B1. Lunar impacts – ALFIE,

B2. Giant planet fireballs – DeTeCt3.1,

B3. Cometary tails – WINDSOCKS,

C1. Earth, Mars, Venus, Jupiter coupling- TRANSPLANET,

C2. Mars radiation environment – RADMAREE,

C3. Giant planet magnetodiscs – MAGNETODISC,

C4. Jupiter's thermosphere,

D. Alerts.

In the framework of the starting Europlanet 2024 RI (EPN 2024 RI) programme, the Virtual Activity (VA) SPIDER (Sun-Planet Interactions Digital Environment on Request) will extend PSWS domain (A. Prediction, C. Modelling, E. Databases) services and give European planetary scientists, space agencies

and industries access to six unique, publicly available and sophisticated services in order to model planetary environments and solar wind interactions through the deployment of a dedicated run on request infrastructure and associated databases.

C5. A service for runs on request of models of Jupiter's moon exospheres as well as the exosphere of Mercury.

C6. A service to connect the open-source Spacecraft-Plasma Interaction Software (SPIS) software with models of space environments in order to compute the effect of spacecraft potential on the scientific performances of charged particle instruments onboard space missions. Pre-configured simulations will be made for Bepi-Colombo and JUICE (JUpiter ICy moon Explorer) missions.

C7. A service for runs on request of particle tracing models in planetary magnetospheres.

E1. A database of the high-energy particle flux proxy at Mars, Venus and comet 67P using background counts observed in the data obtained by the plasma instruments onboard Mars Express (operational from 2003), Venus Express (2006–2014), and Rosetta (2014–2015).

E2. A simulation database for Mercury and Jupiter's moons magnetospheres and link them with prediction of the solar wind parameters from PSWS .

A1. An extension of the PSWS Heliopropa service in order to ingest new observations from Solar missions like the ESA Solar Orbiter or NASA Solar Parker Probe missions and use them as input parameters for solar wind prediction.

The annual report of SPIDER at the end of the first year of the project is described below.

1.2 Explanation of the work carried per WP

SPIDER consists of 4 Tasks and the work performed during the first year of the project for each of them is detailed below:

Task 1. Coordination **(Lead: CNRS, Deputy: WIGNER).**
Task 1 coordinates and manages the overall WP. CNRS reports the status of SPIDER developments and services during monthly telecons with the EPN 2024 RI Project Management Committee (PMC). Since each of the foreseen SPIDER services to be developed are independent, CNRS is directly interacting with each of the responsible institutes by email or telecons. This was the case during the first year in particular with IRF and INAF.

Task 2. Implementation of new space weather services **(Lead: CNRS, Deputy: INAF, Participants: IRF, ONERA, UCL).**
The four services being developed during the first year of the project are C5 (Lead: INAF), E1 (Lead: IRF), E2 (Lead: CNRS), and A1 (Lead: CNRS). The two first services have been prototyped and made operational (see below), and the corresponding deliverables submitted to the European Commission:
* **D5.1 Mercury exosphere run on request service**
* **D5.2 Planetary Plasma Instrument background counts Database & Service**

C5 has been prototyped and is available through a HTPPD interface (Apache 2) that can be reached at http://150.146.134.250 (go to "model" http://150.146.134.250/cgi-bin/modello-input.pl?template=si and then to "full model" http://150.146.134.250/cgi-bin/modello-input.pl?psd=si&td=si&pgr=si&qgr=si&igr=si&info=si&sw=si&map=si&exo=si&term=si&ref=no).
E1 has been prototyped for Mars Express and Venus Express and made accessible in the Automated Multi-Dataset Analysis (AMDA) tool developed by CNRS http://amda.cdpp.eu.

For the E2 service, simulations of Mercury's magnetosphere have been performed, analysed, and submitted in a peer-reviewed publication (Aizawa et al., Cross-comparison of global simulation models applied to Mercury's dayside magnetosphere, accepted for publication in Planetary and Space Science on

January 27, 2021). Now that the paper is accepted the runs will be made accessible in the Automated Multi-Dataset Analysis (AMDA) tool developed by CNRS http://amda.cdpp.eu.

For the A1 service, predictions of the solar wind parameters propagated to BepiColombo, Solar Orbiter and Parker Solar Probe have been added by CNRS to the Heliopropa service http://heliopropa.cdpp.eu and to the Automated Multi-Dataset Analysis (AMDA) tool developed by CNRS http://amda.cdpp.eu.

Task 3. Deployment of consolidated runs on request architecture **(OBSPARIS, CNRS).**

This has been so far driven by VESPA needs but will be adapted and applied in the next years to SPIDER services. A run on request prototype has been implemented at OBSPARIS, using the OPUS framework (https://github.com/ParisAstronomicalDataCentre/OPUS). It is currently used for running the ExPRES code (https://voparis-uws-maser.obspm.fr/client/). The jobs can be submitted via the web interface, or through a command line API (with tokenised authentication). The jobs can be launched on the web portal without authentication (but with fewer capabilities). The server is used by the JUICE mission Science Ground Segment team at ESAC (Madrid) to prepare the JUICE science schedule segmentation. The current plans are twofold: (i) implement an OPUS server at CNRS/IRAP, for managing the jobs of the hosted modelling codes; (ii) use the eduTEAMS-hosted Europlanet VESPA AAI (Authorization and Authentication Infrastructure), provided by GÉANT, to manage the user access authorizations. In a later stage, the implementation of OPUS on EOSC facilities will be studied, in coordination with the ESCAPE H2020 project.

Task 4. Dissemination and Liaisons **(WIGNER RCP, CNRS)**

CNRS has developed a website to promote SPIDER activities, available at http://spider-europlanet.irap.omp.eu/about. CNRS regularly presents SPIDER developments to the BepiColombo and Solar Orbiter communities, in particular the C5, E2, and A1 services. CNRS and WIGNER RCP proposed and organised a session devoted to Planetary Space Weather during the virtual EPSC conference in September 2020. It took place on Thursday, 01 October 2020 10:40-11:00.

The abstract of the **MITM8 session on Planetary Space Weather** was the following:
The emphasis of the session is on all aspects of the conditions in the Sun, solar wind and magnetospheric plasmas that extend the concepts of space weather and space situational awareness to other planets in our Solar System than Earth, and in particular to spacecraft that voyage through it. Abstracts on space- and ground-based data analysis, theoretical modelling and simulations of planetary space weather are welcomed. The description of new services accessible to the research community, space agencies, and industrial partners planning for space missions and addressing the effects of the environment on components and systems are also strongly encouraged. This session will also summarize the planetary space weather services developed during Europlanet RI H2020 as well as introduce the future ones to be developed by the Sun-Planet Interactions Digital Environment (SPIDER) on Request Work Package during EPN RI 2024.

https://meetingorganizer.copernicus.org/EPSC2020/session/38540

The conveners of the session were Nicolas André (CNRS), Sae Aizawa (CNRS) and Andrea Opitz (WIGNER RCP).

There were 8 oral presentations submitted to the session:

https://meetingorganizer.copernicus.org/EPSC2020/oral_presentations_and_abstracts/38540

and 3 posters:

https://meetingorganizer.copernicus.org/EPSC2020/poster_presentations_and_abstracts/38540

SPIDER objectives were introduced by Nicolas André during the session. 28 persons attended the virtual session showcase, with 13 views of the recording and 62 views of presentations in the session.

1.3 Impact

In practice, several actions have been conducted during the first year:
- Continuous involvement, promotion and use of services for current or future planetary missions (BepiColombo, JUICE) as well as heliophysics missions (Solar Orbiter)e.g. a report about synergistic observations with BepiColombo, Solar Orbiter, Parker Solar Probe in the heliosphere in order to track propagation of solar wind disturbances has been submitted to ESA and JAXA, making use of Heliopropa and the AMDA tool.
- Dedicated SPIDER session organised at the virtual EPSC 2020 conference, 28 participants, with 13 views of the recording and 62 views of presentations in the session.
- Preparation of the first Venus flyby in October 2020 and Mercury flyby in 2021, with planned use of SPIDER services C5, E2, and A1.

1.4 Access provisions to Research Infrastructures

Statistics for the SPIDER portal (website) as well as for the C5 service that have been developed during the first year of the project Statistics for the SPIDER services E1 and A1 can be found at the following webpages:

– AMDA tool (total number of connections, http://amda.cdpp.eu/):

http://amda.cdpp.eu/awstats/awstats.pl more than **8224 connections since 01/02/2020**

– Details on geographical distribution etc. can be found at CDPP/AMDA awstats: http://amda.cdpp.eu/awstats/awstats.pl

http://heliopropa.cdpp.eu has received 7649 visits since 2017.

2. Update of exploitation & dissemination plan

No change since the start of the project.

3. Update of data management plan

A first version of the SPIDER DMP section was provided to Management. It will be updated and enlarged each year to cover new services when made operational. The Projects overall DMP can be found in Deliverable D1.3.

4. Follow-up of recommendations & comments from previous review(s)

The report from the VA review board (Deliverable D1.5) was received mid-December 2020, and has been reviewed by the WP management team which has agreed to the following actions :
- The sustainability of PSWS services shall be revised
- The SPIDER website shall be updated and more detail included
- A link to the deliverables shall be added for each service
- A link to the AMDA tool shall be provided.

The following actions have been performed to follow these recommendations:

A SPIDER website has been established, but it is unpopulated.	We have added more information and a page counter.
The SPIDER report states that the existing PSWS site "provided 12 services", but then lists only 11 services, of which only 5 appear to be operational on that site. That is a significant deficit that puts this project at a substantial disadvantage for success.	We have checked all PSWS links and made all of them operational again except one (lunar impact software ALFIE).
A user guessing his way through the site may eventually find a video of the EPSC 2020 presentation, but apart from that there is no information on the site itself about schedules or planned development, or any indication that it is in active development.	We have added information on when the various tools are planned to be made operational.
And while the new home page looks good in a full-sized browser window on a large screen, it does not adapt well to changes in window size.	Corrected.
While it is apparently true that several significant databases have been added to the AMDA database/tool, that tool does not appear to be related to either SPIDER or the prior PSWS in any way. No reference could be found to it by name or link on either the new web site or the legacy PSWS site. Neither is there any reference to either PSWS or SPIDER on the AMDA site.	We will add references to SPIDER directly in the AMDA data tree and in the Heliopropa service.
No mention is made in either the report or the website of the planned Dissemination tasks - specifically special journal issues and dedicated conference sessions.	We have added News and Dissemination on the website.

5. Deviations from Annex 1 (DoA)

5.1 Tasks

The engineer hired at INAF for the development of the C5 service was granted a PhD and left the project to start the PhD, and so is now not fully on the project. INAF is looking for a replacement or other possibilities.

5.2 Use of resources

Patrick Guio (now at University of Tromso with a more permanent position) left UCL during the course of the project but will be employed part-time by UCL (O.2 FTE) d to undertake previously agreed EPN-2024-RI work.

- **5.2.1 Unforeseen subcontracting**
  N/A
- **5.2.2 Unforeseen use of in-kind contributions from a 3rd party against payment or free of charge**
- N/A