EPN 2024 RI

EUROPLANET 2024 Research Infrastructure

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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)

Outline

1. Introduction

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

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 Research Infrastructure programme, the Virtual Activity (VA) SPIDER (Sun-Planet Interactions Digital Environment on Request) will extend PSWS domains (A. Prediction, C. Modelling, E. Databases) services and give the 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 scientific 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 Europlanet 2020 RI PSWS services.

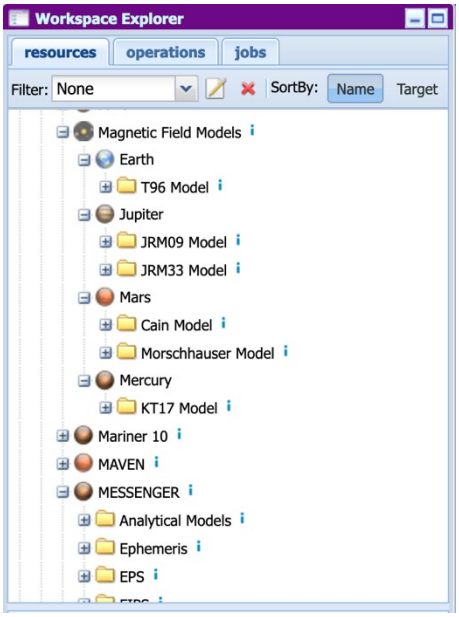
A1. An extension of the Europlanet 2020 RI PSWS HELIOPROPA service in order to ingest new observations from Solar missions like the ESA Solar Orbiter or NASA Solar Parker Probe missions and use them as input parameters for solar wind prediction;

This report describes the run-on-request services made available to the community by SPIDER, as well as their current upgrades.

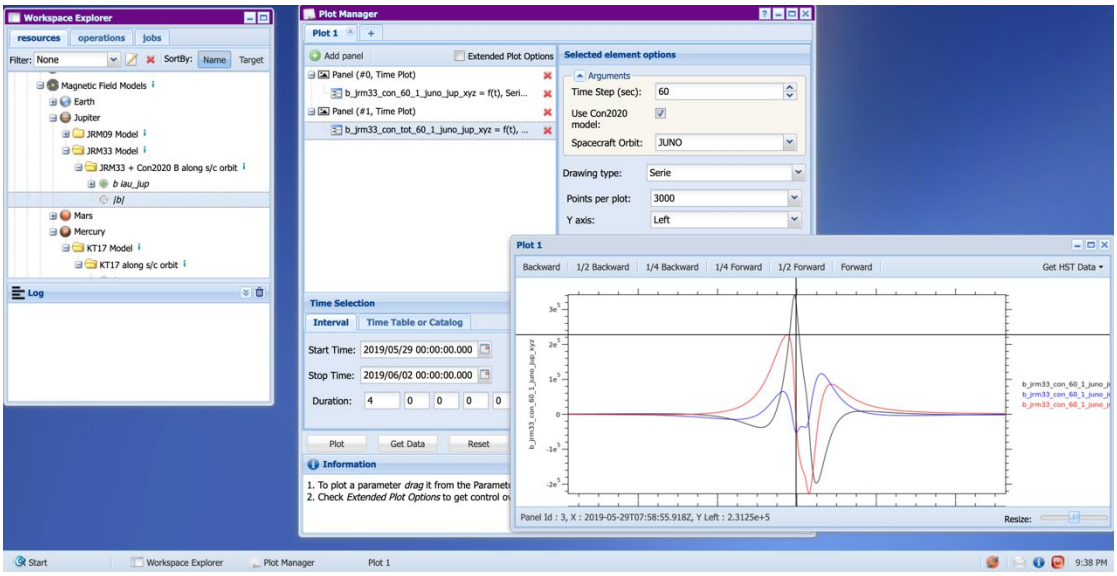
2. Run on request services implemented

2.1. Magnetospheric analytical models

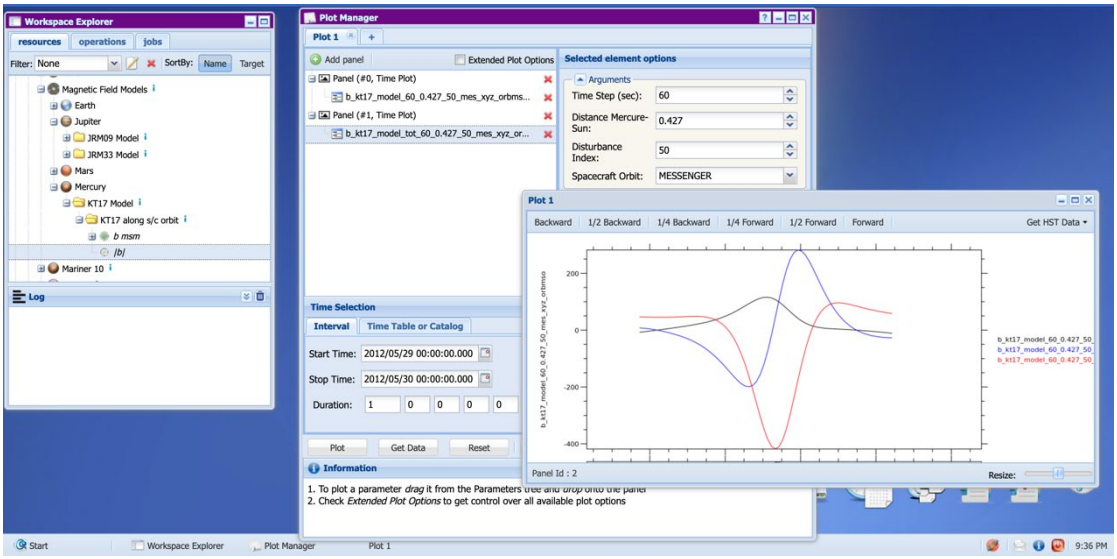
A series of analytical magnetospheric models has been implemented in the AMDA (Automated Multi-Dataset Analysis) tool (http://amda.cdpp.eu) and provided as a service to the community:



For Jupiter: A spherical harmonic model (Connerney et al., 2022) of the magnetic field of Jupiter obtained from vector magnetic field observations acquired by the Juno spacecraft during 32 of its first 33 polar orbits has been implemented in AMDA. The model can be applied to Juno and Galileo as well as predicted JUICE trajectories.



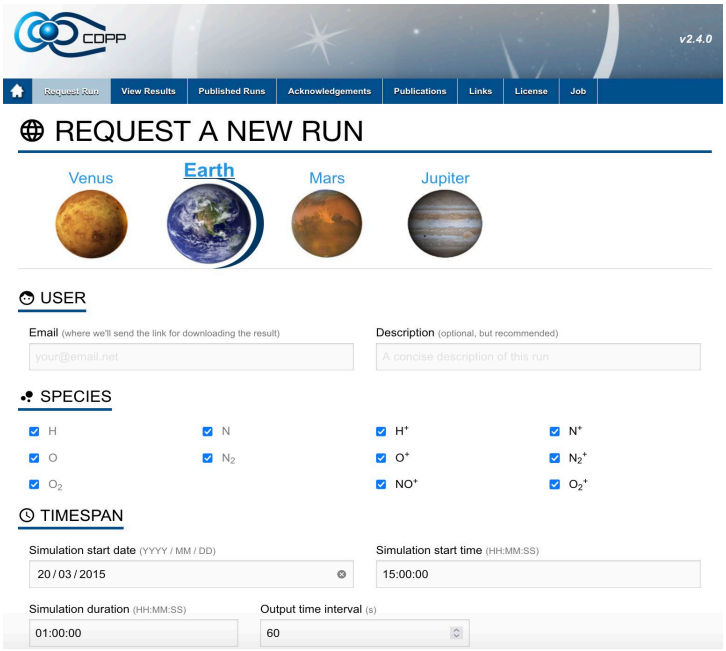
For Mercury: The magnetic field along Mercury's orbit is being calculated in real-time. S/C, sampling time, distance of Mercury from the Sun (AU) and Anderson et al., 2013 disturbance index should be defined by the user. The KT17 magnetic field model (Korth et al., 2017) model is used in the calculations. The model can be applied to Mariner 10, MESSENGER and predicted BepiColombo trajectories.



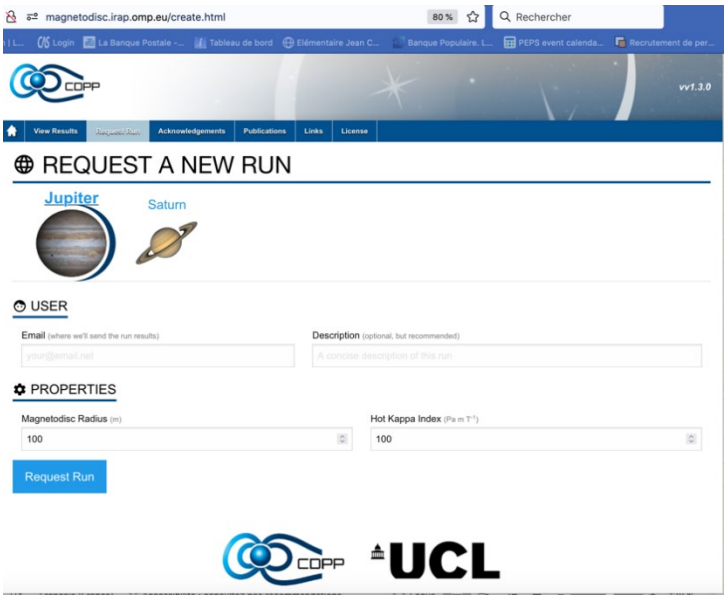
2.2. Planetary environment models

Two run-on-request services were implemented during the Europlanet 2020 RI programme and include a database of archived runs continuously updated during the Europlanet 2024 RI programme:

TRANSPLANET (Blelly et al., 2019, http://transplanet.irap.omp.eu/)



MAGNETODISC (Achilleos et al., 2019, http://magnetodisc.irap.omp.eu/)



3. Current upgrades

The TRANSPLANET and MAGNETODISC services are currently being upgraded in order to be made fully compliant with the Virtual Observatory by using the UWS (Universal Worker Service, https://www.ivoa.net/documents/UWS/) protocol. UWS is an IVOA protocol aiming to create to start and to manage work(s)/job(s). It is especially used in TAP services to execute ADQL queries asynchronously. This library implements the protocol as defined by the IVOA (http://cdsportal.u-strasbg.fr/uwstuto/). These upgrades will be made fully operational at the end of 2023.

4. Conclusions and Perspectives

Simple run-on-request architecture has been implemented during the Europlanet 2024 RI programme in the AMDA tool in order to use analytical magnetospheric models of Jupiter and Mercury along spacecraft trajectories and compare their outputs with observational data. These runs-on-request have been made available to the scientific community involved within the joint ESA/JAXA BepiColombo and ESA JUICE (JUpiter Icy moon Explorer) missions. These services are fully operational.

Sophisticated run-on-request architecture relying on the use of Virtual Observatory protocols are currently being implemented during the Europlanet 2024 RI programme and will replace the existing run-on-request architecture implemented during the Europlanet 2020 RI programme. These services will be fully operational at the end of 2023.

5. References

Achilleos, N., P. Guio, N. André, A. M. Sorba, A magnetodisc model service for planetary space weather studies, Journal of Space Weather and Space Climate, Volume 9, id.A24, doi :10.1051/swsc/2019022, 2019

Blelly, P.L., A. Marchaudon, M. Indurain, O. Witasse, J. Amaya, B. Chide, N. André, V. Génot, A. Goutenoir, M. Bouchemit, Transplanet: A web service dedicated to modeling of planetary ionospheres, Planetary and Space Science, Volume 169, p. 35-44, doi :10.1016/j.pss.2019.02.008, 2019

Connerney, J., Timmins, S., Oliversen, R., Espley, J., Joergensen, J., Kotsiaros, S., et al., (2022). A new model of Jupiter's magnetic field at the completion of Juno's prime mission. Journal of Geophysical Research: Planets, 127(2), e2021JE007055

Korth, H., Johnson, C. L., Philpott, L., Tsyganenko, N. A., Anderson, B. J. (2017). A dynamic model of Mercury's magnetospheric magnetic field. Geophysical Research Letters, 44, 10,147–10,154.