Automated Multi-Dataset Analysis (AMDA): An online database and analysis tool for heliospheric and planetary plasmas

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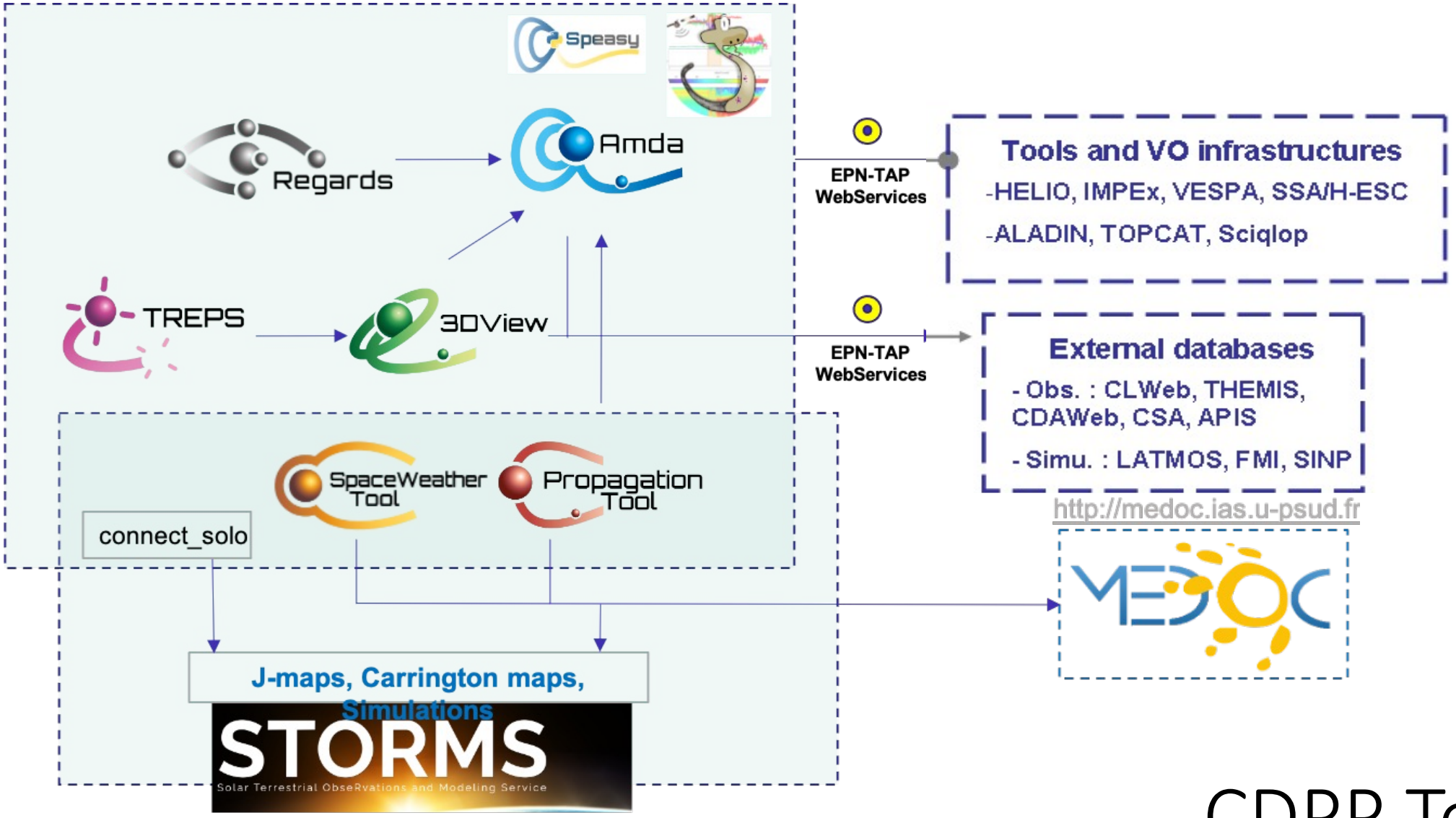
CDPP, the French national data centre for natural plasmas of the solar system

- **https://cdpp.eu**

- Created in 1998 jointly by CNES and INSU, the CDPP assures the long term preservation of data obtained primarily from instruments built using French resources, and renders them readily accessible and exploitable by the international community.

Objectives of CDPP

- **Data:** continue the long-term archiving activity of data obtained by experiments with French participation but also (i) make available recent data on which the community mobilizes and (ii) make them easily usable (extraction in standard formats)
- **Services:** develop attractive Value-Added Services that save users time and energy and promote an increase in the scientific return on data exploitation
- **Interoperability and Virtual Observatories (VO):** continued investment by the CDPP in the development of standards and in future VO projects.


Speasy
Regards
Amda
TREPS
3DView
SpaceWeather Tool
Propagation Tool
connect_solo
J-maps, Carrington maps, Simulations
STORMS
Solar Terrestrial ObseRvations and Modeling Service
EPN-TAP WebServices
Tools and VO infrastructures
-HELIO, IMPEx, VESPA, SSA/H-ESC
-ALADIN, TOPCAT, Sciqlop
EPN-TAP WebServices
External databases
- Obs. : CLWeb, THEMIS, CDAWeb, CSA, APIS
- Simu. : LATMOS, FMI, SINP
http://medoc.ias.u-psud.fr
MEDOC

CDPP Tools

http://amda.cdpp.eu/

- **A data analysis tool in your browser**
  - ***physical parameters not files !***
- **Data are**
  - **replicated from ESA/Cluster Science Archive, NASA/PDS**
  - **or accessed remotely : CDAWeb, simulation and model databases, …**
  - **public or restricted to communities**
  - **can be exported in companion tools (SAMP)**
  - **or uploaded by the user**
  - **can be accessed via web-services (SOAP/REST)**

- **Sessions are saved (*so it's better to register !*)**
  - ***register at amda@irap.omp.eu***

  - **Public access w/o registration also available**

AMDA reference paper

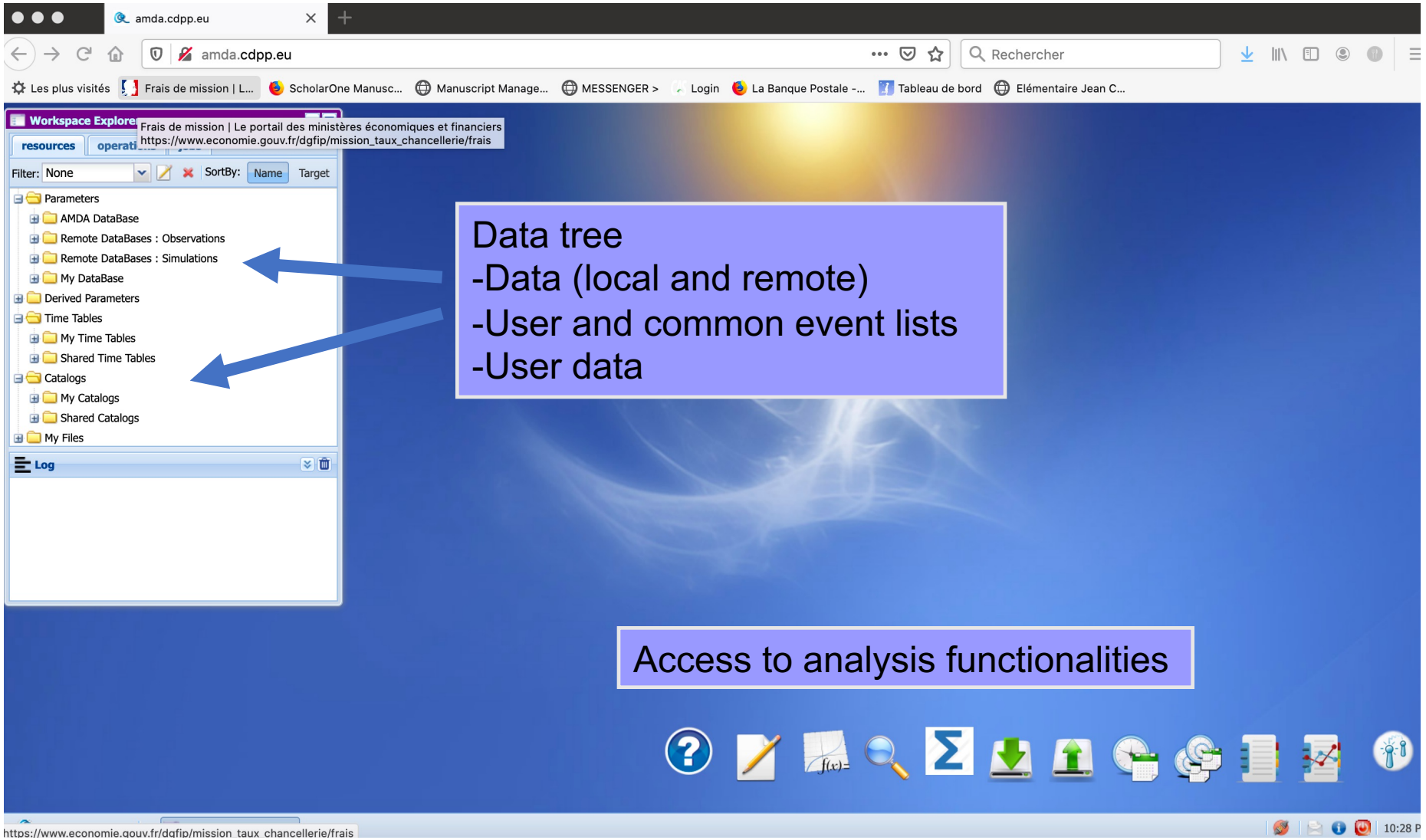
Automated Multi-Dataset Analysis (AMDA): An on-line database and analysis tool for heliospheric and planetary plasma data

Vincent Génot, E. Budnik, C. Jacquey, M. Bouchemit, B. Renard, N. Dufourg, N. André et al.

Planetary and Space Science, Elsevier, 2021, 201, pp.105214.

https://doi.org/10.1016/j.pss.2021.105214

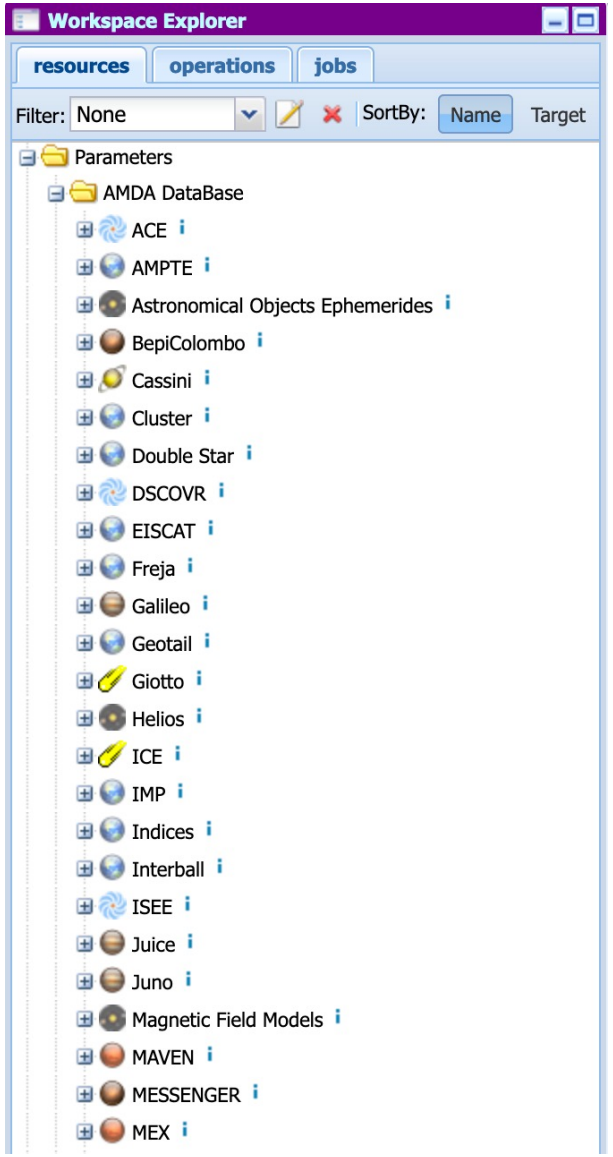
http://amda.cdpp.eu/

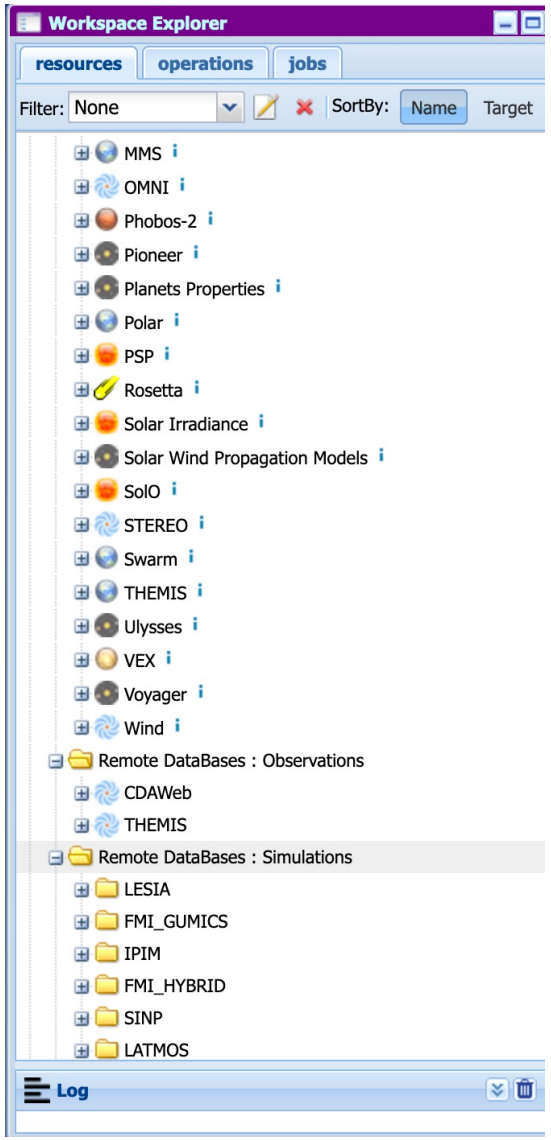


AMDA Database

- More than 80 missions (heliosphere, magentosphere, planets, comets, …) and 800 datasets (electromagnetic fields, plasmas, particles, waves, …)
- **AMDA** has been integrated in the **Space Weather Service Network** of the European Space Agency.
- **AMDA** data can also be accessed through our **HAPI server**.
- **AMDA** data can also be accessed through our **python tool Speasy**.
- **AMDA** data can also be accessed through **EPN-TAP.**

Datasets available in the online tool CDPP/AMDA





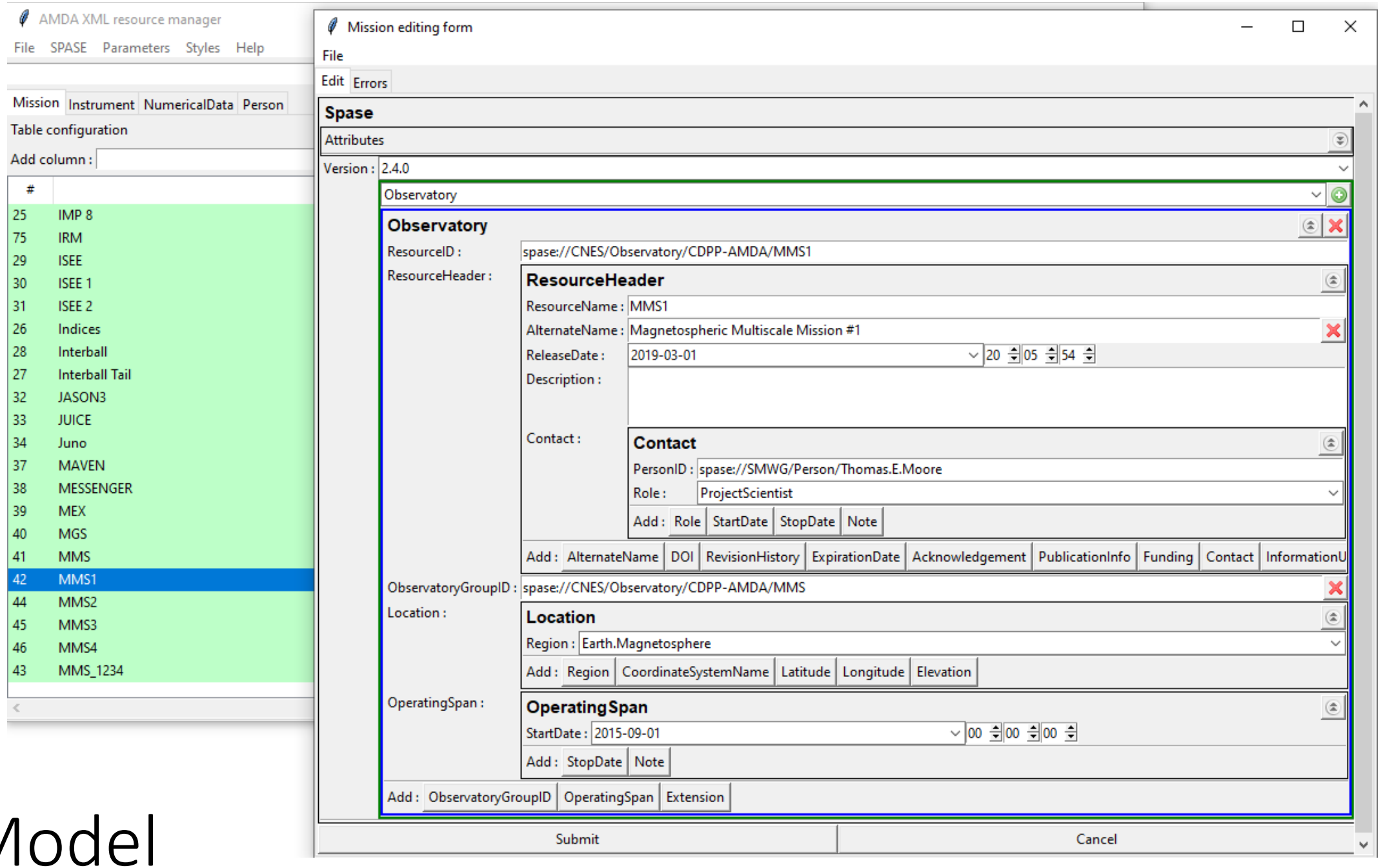
Space missions data

Heliosphere

Planets

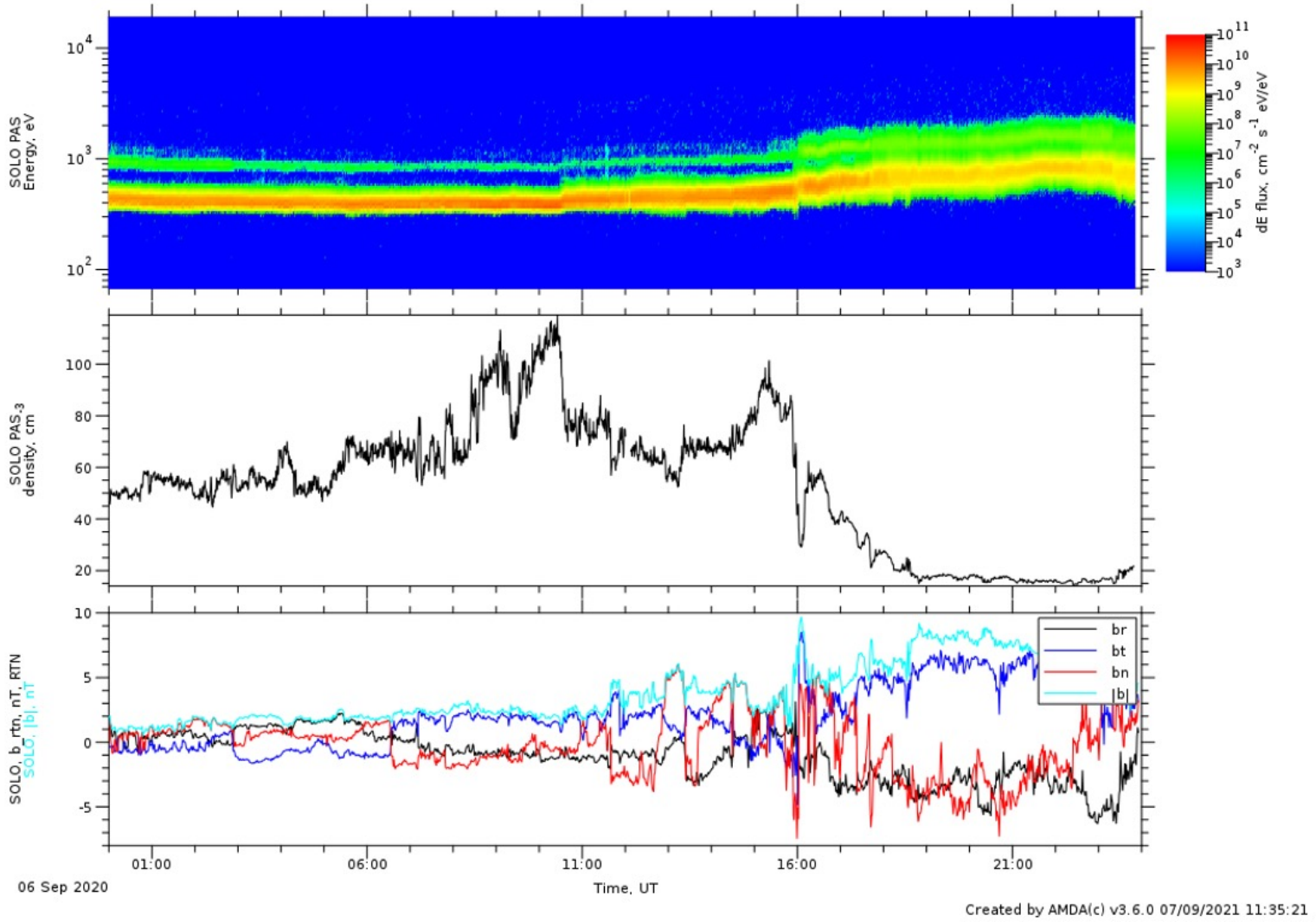
Comets

Earth

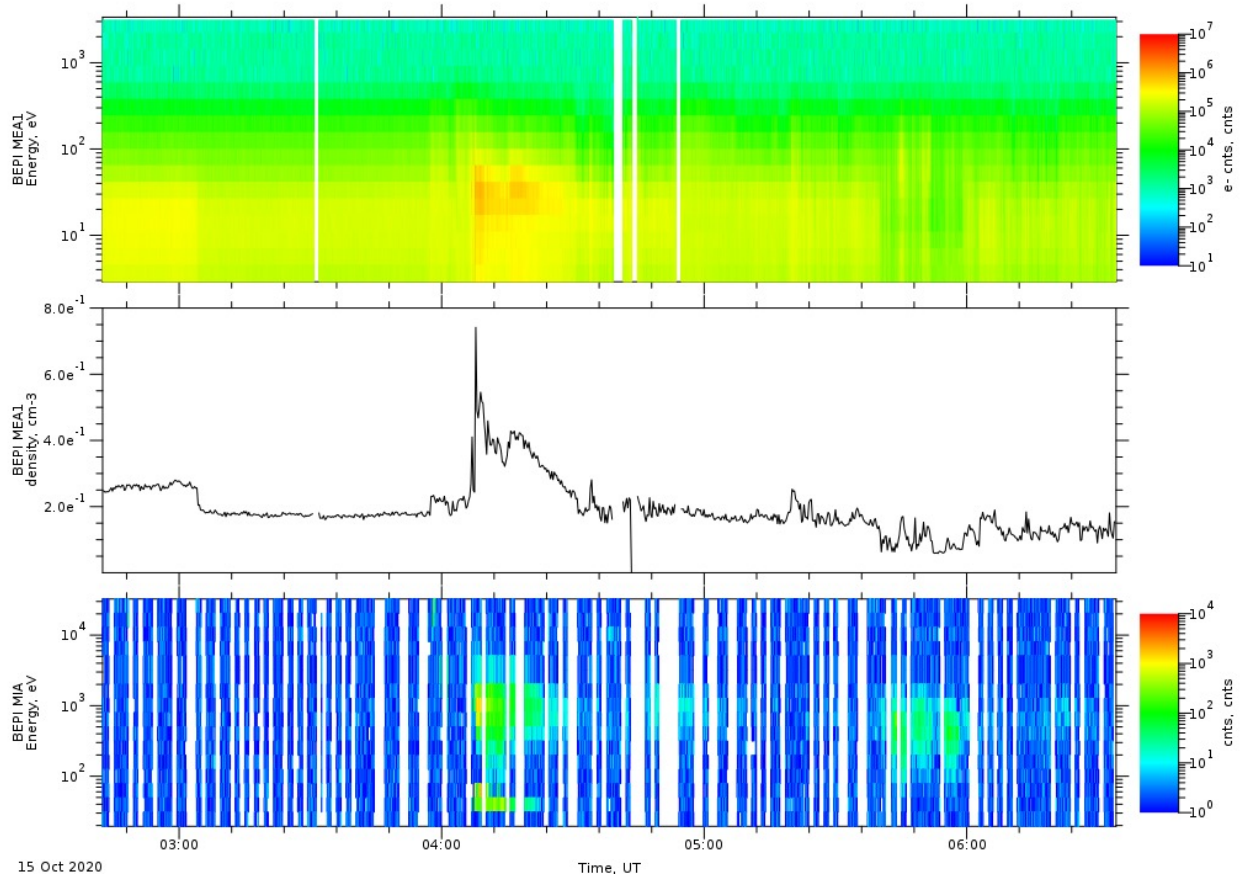


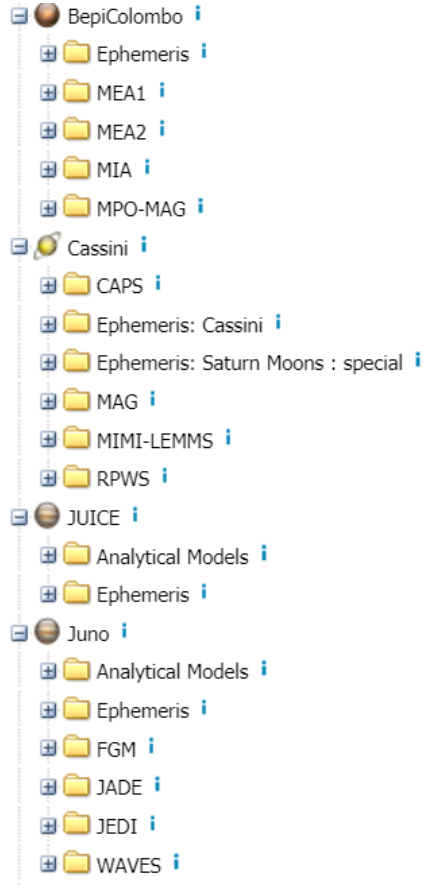
SPASE Data Model

Solar Orbiter (Solar wind)

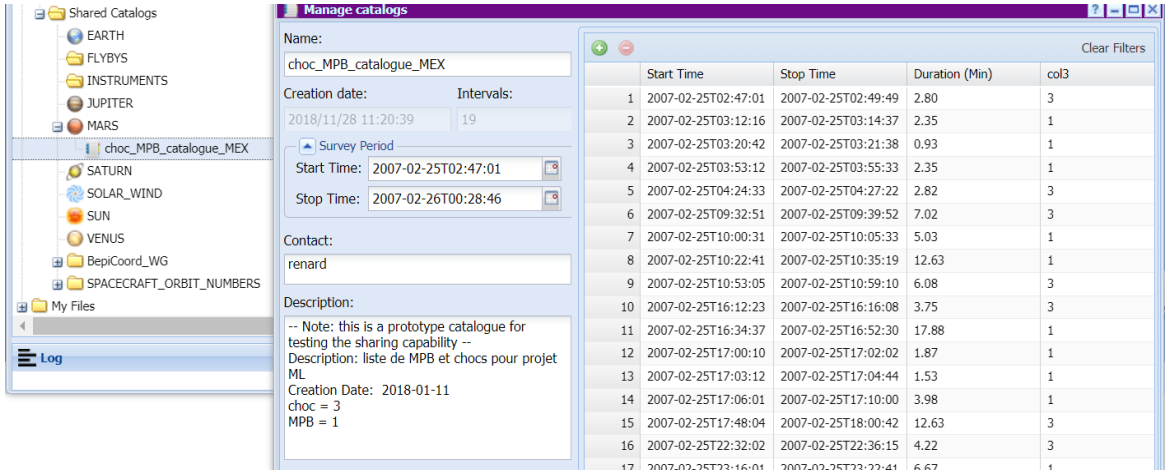


BepiColombo (Venus flyby)

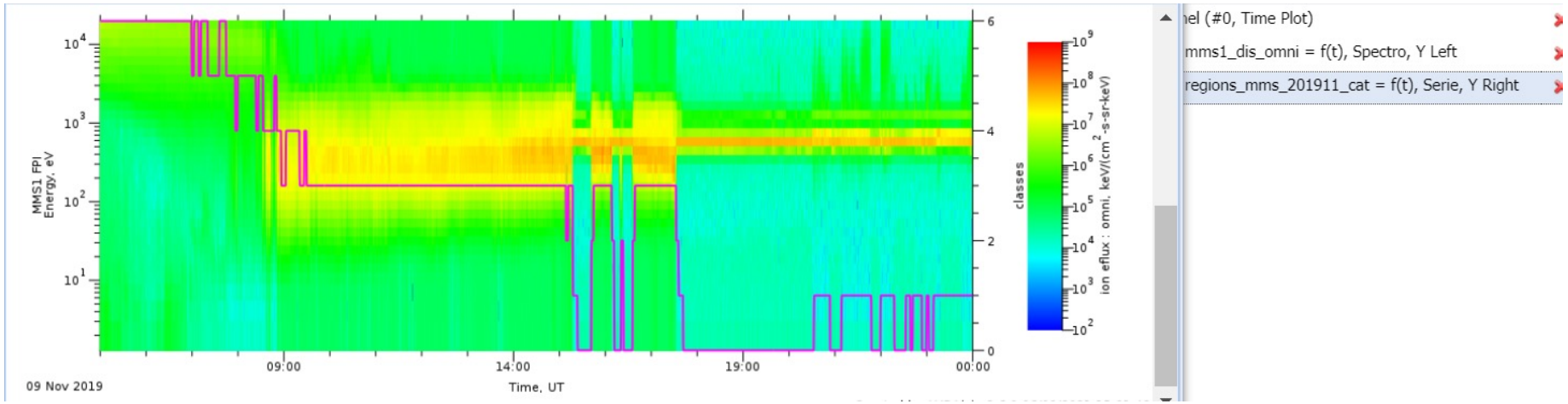




Catalogues



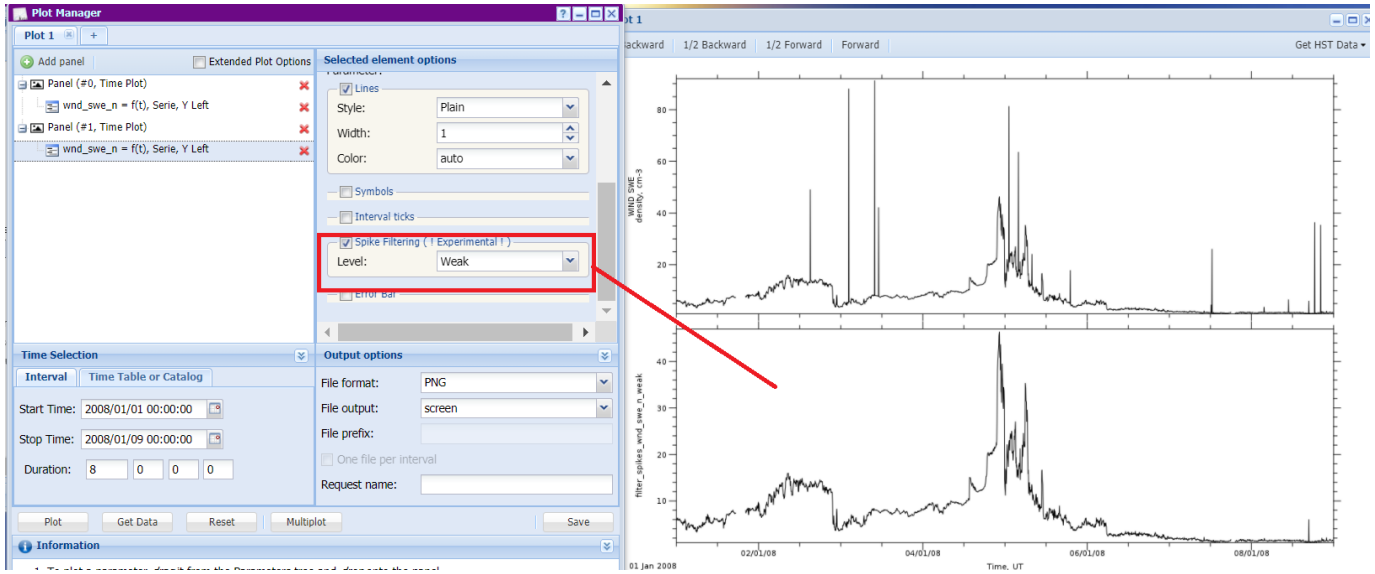
- shared catalogs
- Time formats for ASCII exports



New functionalities

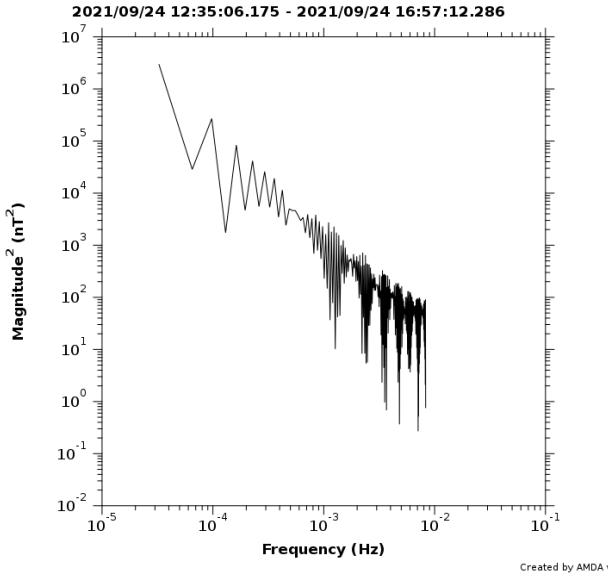
Spike filtering

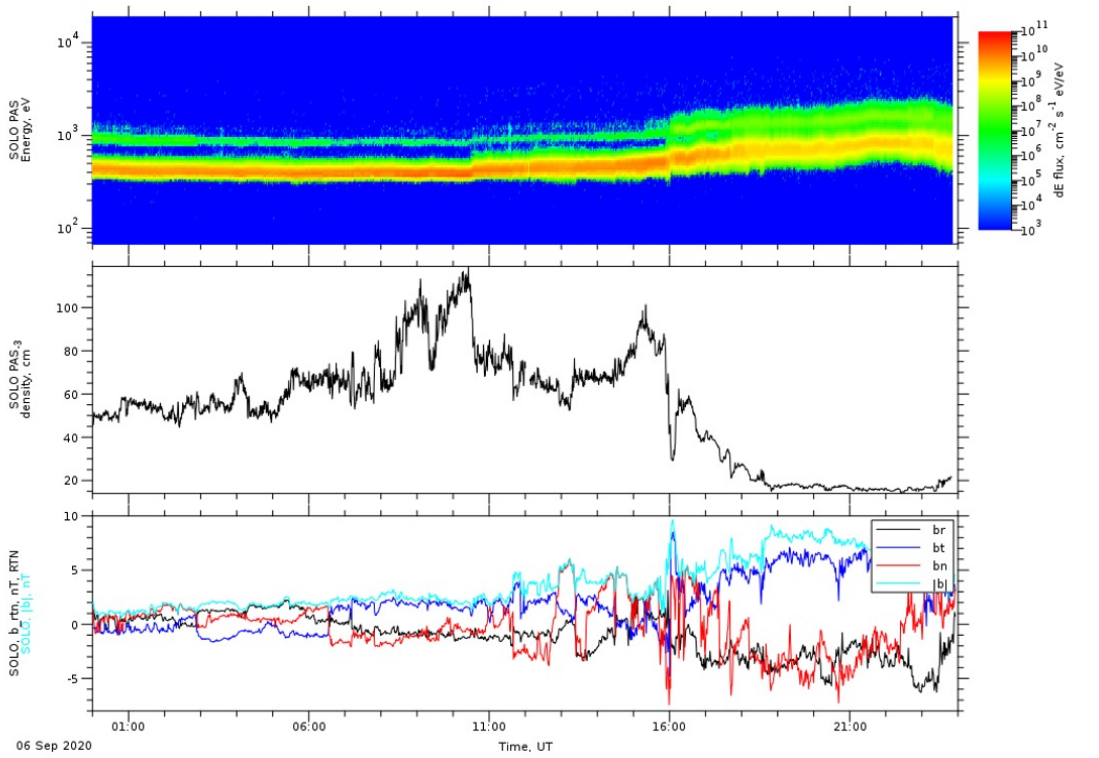
The user can remove spike in time-series data.



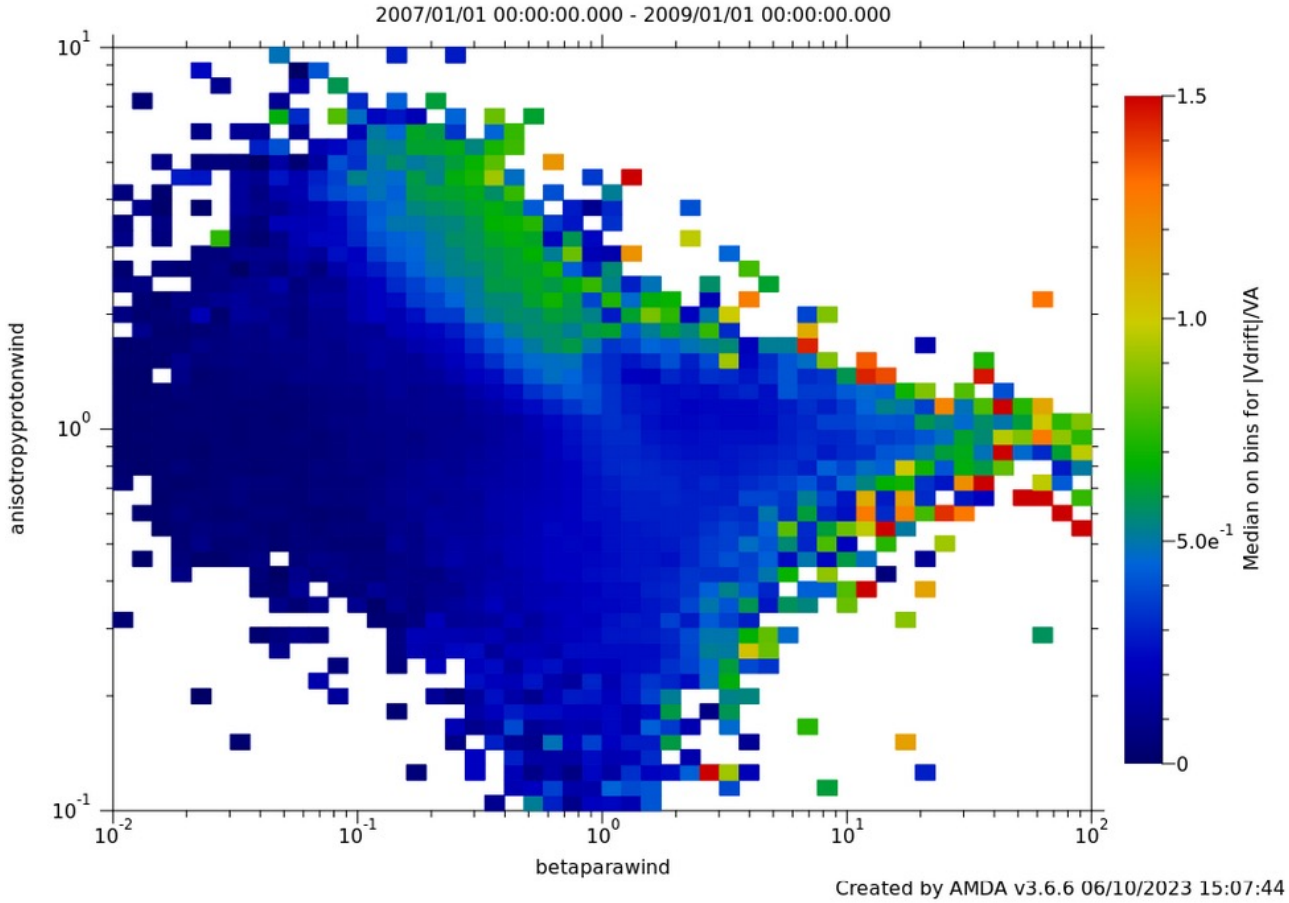
FFT

The user can perform FFT on selected time windows.

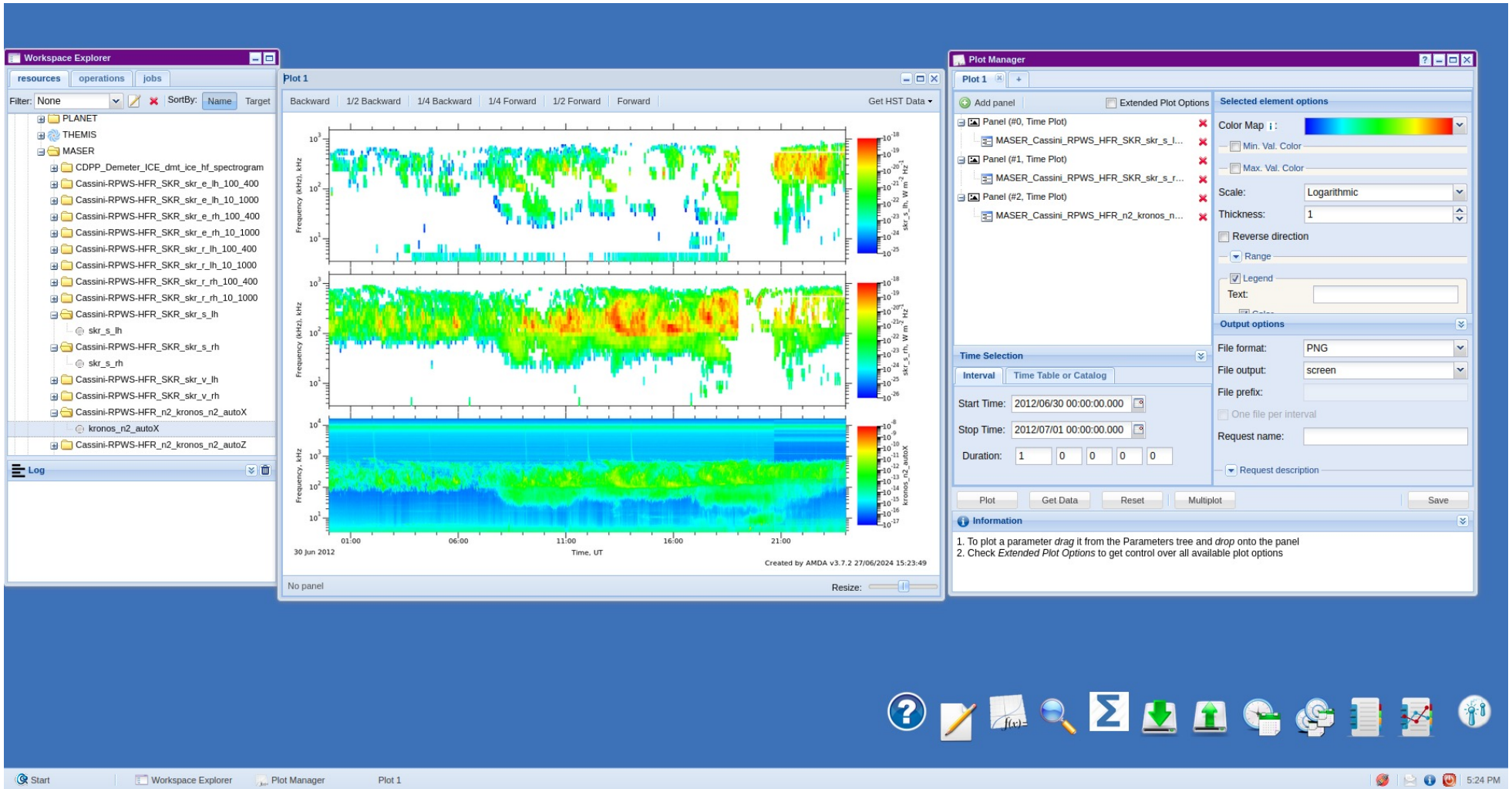




1D/2D Histograms



Connexion AMDA-MASER (radio data)



Hands-on sessions for students

Tools for education in space sciences

•At the Masters Degree level, in summer schools, …

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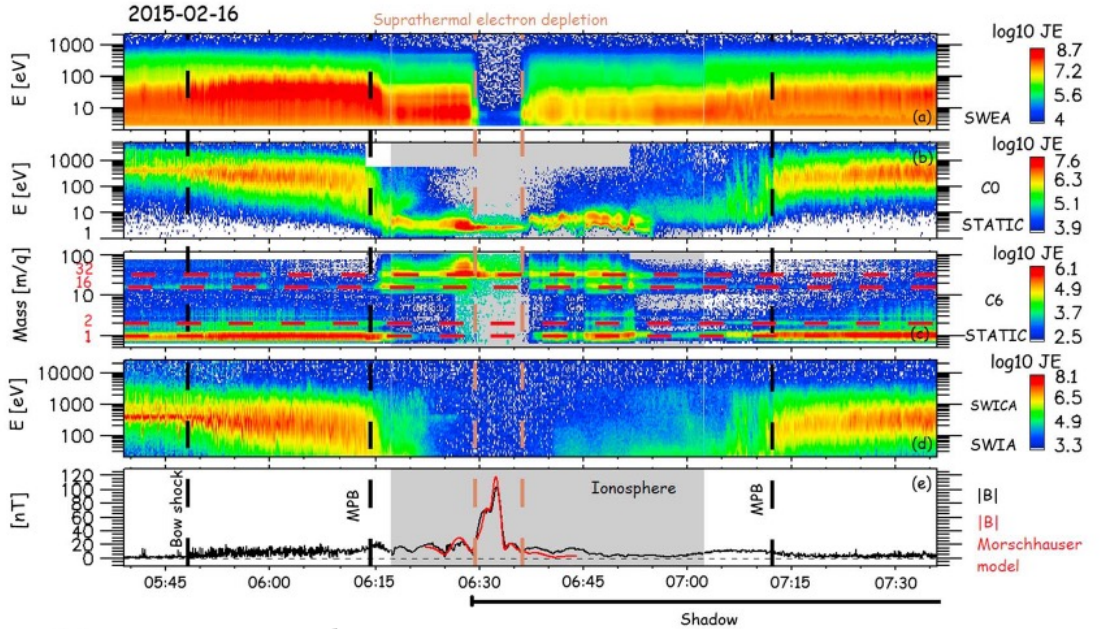
Use of the PDS/MAVEN data from AMDA

Altitude dependence of nightside Martian suprathermal electron depletions as revealed by MAVEN observations, *M. Steckiewicz et al., GRL, 2015*

- MAVEN observes on almost each periapsis in the nightside ionosphere suprathermal electron depletions
- Observed depletions are populated by 6 eV electrons resulting from absorption by CO2 and by 3 eV O2
- The geographical distribution of nightside suprathermal electron depleti…

AMDA was used for data mining (electron depletion) and selection of events



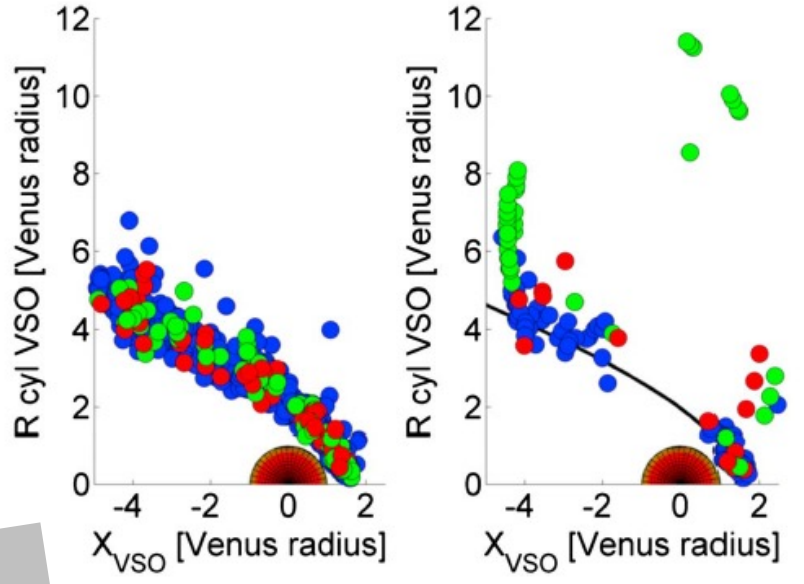
…in its plasma environment observed above a crustal magnetic field anomaly during …ary 2015. (a) SWEA energy-time spectrogram of omnidirectional electron energy flux, (b) STATIC energy-time spectrogram of omnidirectional ion energy flux (C0 mode), (c) STATIC mass-time spectrogram of omnidirectional ion energy flux (C6 mode), (d) SWIA energy-time spectrogram of omnidirectional ion energy flux (SWICA mode), and (e) magnetic field intensity (measured by MAG in black and calculated from the model of *Morschhauser et al.* [2014] in red) versus time. The grey shading highlights the ionosphere. The shadow corresponds to solar zenith angle (SZA) larger than 100°.

Use of Venus Express multi-datasets from AMDA

Space weather effects on the bow shock, the magnetic barrier, and the ion composition boundary at Venus, *Vech et al., JGR, 2015*

- Statistical study of the ICME-Venus interaction
- Analysis of solar wind and magnetic barrier conditions during ICME passages
- Decreased altitude of the nightside ionosphere during ICME passages

AMDA was used to search extreme events in long time series (9 years)



Locations of the bow shock crossing for all the 42 investigated events. The green marks show the bow shock crossings (including the multiple bow shock crossings as well) on the day when the ICME arrived at Venus, the red dots represent the bow shock location during the following day, and the rest of the days are marked with blue dots. (left) Thirty-six cases when the interaction between the magnetic cloud and the induced magnetosphere was not observed and (right) six cases when the signature of the passing magnetic cloud was detected.