



PLANETARY SPACE WEATHER SERVICES

CNRS, Aberystwyth, DLR, GFI Informatique, IAP, OBSPARIS, UCL, UPV/
EHU, SRC, Wigner

N. André, M. Grande,

N. Achilleos, M. Barthélémy, P.-L. Blelly, S. Caussarieu, B. Cecconi, T.
Cook, V. Génot, R. Hueso, G. Jones, J. Liliensten, A. Opitz, F. Pitout, G.
Reitz, A. Rouillard, I. Stanislawska, J. Soucek, , L. Tomasik, J. Vaubaillon

H2020 - A very favorable context

- Before 2016 Smart 1, Rosetta, MEX, MAVEN, VEX, HST, MSL, Dawn
- 2016-2020 Exomars, Juno, HST/JWST, Solar Orbiter
- After 2020 BepiColombo, JUICE, ...

A variety of tools (in the form of web applications, standalone software or numeric models in various degrees of implementation) is available for tracing propagation of Solar events through the solar system and modelling the response of planetary/cometary/asteroid environment to those events. As these tools were usually not designed for planetary space weather applications, additional research and tailoring is required to apply them for this purpose and enable their predictions to be used for virtual solar wind monitors.

N.B.: Solar Orbiter results and new datasets will come right in the middle of H2020

Summary: JRA activities

- The overall objectives of the JRA will therefore be to review, test, improve and adapt 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

Objectives JRA4

- **JRA4-PSWS will set up the infrastructure necessary to transition to a full planetary space weather service within the lifetime of the project.**
- To define a service for planetary event and planetary space weather predictions;
- To develop new methods, interfaces, functionalities and/or plug-ins dedicated to planetary space weather from 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; this will in turn lead to a strengthening of our capabilities for robust prediction in the terrestrial environment.
- To identify user requirements, develop a methodology for issuing event alerts, and link those to the planetary event and space weather predictions;
- To facilitate discovery or prediction announcements within the PSWS user community in order to watch or warn against specific events;
- To set up dedicated professional and/or amateur observation campaigns, disseminate contextual information for science data analysis, and enable safety operations for planet-orbiting spacecraft against the risks of impacts from solar wind disturbances and meteors.

Summary: VA activities

EPN2020-RI will also develop an entirely new Virtual Access service, VA1 “Planetary Space Weather Services” (PSWS). VA1 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 ESA’s ExoMars missions), comets (building on the expected success of the ESA 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 aimed at predicting and detecting planetary events like meteor showers and impacts. This new facility is expected to have an impact beyond the planetary research community, being strongly linked to the wider space community and industry; it will also be relevant to such diverse enterprises as energy and power supply and telecommunications whose commercial activities depend on space weather. VA1 and its associated JRA4 not only have an impact on planetary space missions, but will allow the “hardness” of spacecraft and their components to be evaluated under a variety of known conditions, particularly radiation conditions, extending their known flight-worthiness for terrestrial applications.

Our users:

The scientific community, amateur astronomers, industrial partners, space agencies

Key targets:

support for Exomars, Rosetta, JUICE, BepiColombo missions

Objectives VA1

VA1-PSWS will make five entirely new ‘toolkits’ accessible to the research community and to industrial partners planning for space missions:

1. General planetary space weather toolkit, as well as three toolkits dedicated to the following key planetary environments:
2. Mars (in support of the ESA ExoMars missions to be launched in 2016 and 2018),
3. comets (building on the expected success of the ESA Rosetta mission), and
4. outer planets (in preparation for the ESA JUICE mission to be launched in 2022).
5. Novel “event-diary” toolkit aiming at predicting and detecting planetary events like meteor showers and impacts.

Objectives VA1

To develop the notion of “**planetary space situational awareness**” activities that are ongoing for Earth as an issue and object for research throughout the Solar System. Europlanet will work closely with the winners of the European Commission’s PROTEC-1-2014 “Space Weather” call, which aims to “observe and to predict a range of solar events that may impact the near Earth environment including orbiting satellites and ground based systems”;

To create a step change in “space weather” monitoring and prediction, in particular of disturbances and extreme events, to **include other planets in the Solar System**. This will have the practical impact of being able to predict how space weather events manifest at different planetary environments as the corresponding structures in the plasma outflow from the Sun – the Solar Wind - evolve and propagate outwards through the Solar System;

To extend the prediction and monitoring of meteor showers from encounters with **comet meteoroid streams**, which can also potentially endanger orbiting satellites, throughout the Solar System;

To **test and validate models throughout the Solar System**. By extending of the know-how established at Earth to new environments we will test current understanding in new sets of conditions, and hence strengthen our ability to make such predictions in our own environment. In particular activities and protocols will implement the recommendations of the upcoming COSPAR roadmap on Space Weather;

To lay the basis for allowing **Solar System space missions**, whether they are on a planetary surface, orbiting or travelling, to be protected in the same way that Earth-orbiting and ground-based facilities will be protected by current “space situational awareness” initiatives;

To make demonstrators of prototyped and consolidated services publicly available within the PSWS to **professional planetary scientists, industry, the space agencies and amateur astronomers**;

To make five entirely new ‘toolkits’ accessible

Mars (in support of the **ESA ExoMars** missions to be launched in 2016 and 2018),

comets (building on the expected success of the ESA Rosetta mission), and

outer planets (in preparation for the **ESA JUICE (JUperiter ICy moons Explorer)** mission to be launched in 2022, and as a potential support service for the **JUNO** mission due to arrive at and start orbiting Jupiter in 2016);

it will also inform planning for the **BepiColombo mission due to launch to Mercury in 2017**

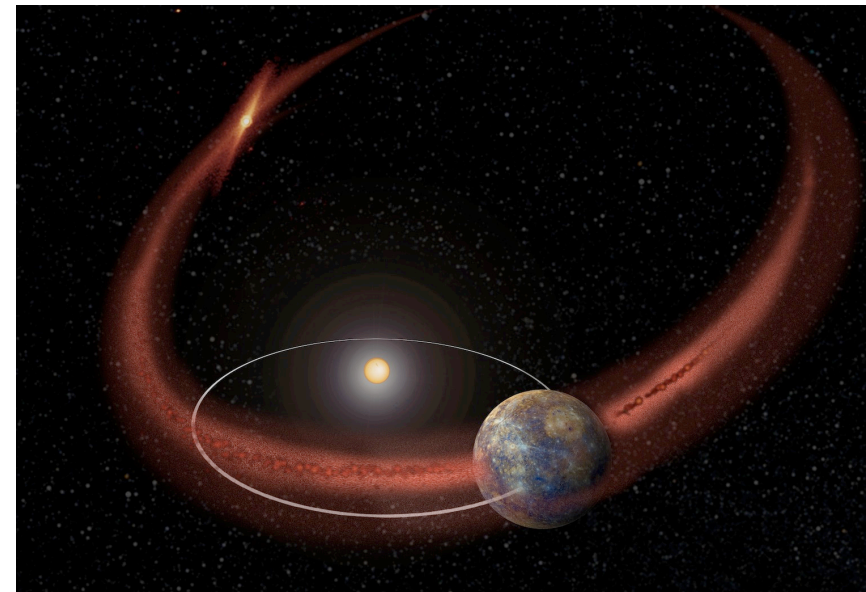
New services well-received, high potential for public outreach



Siding spring comet at Mars
MAVEN, MEX, MSL observations

N.B.: Instruments turned-off for
Safety reasons

Comet Encke causes seasonal
showers of meteor at at Mercury
MESSENGER observations

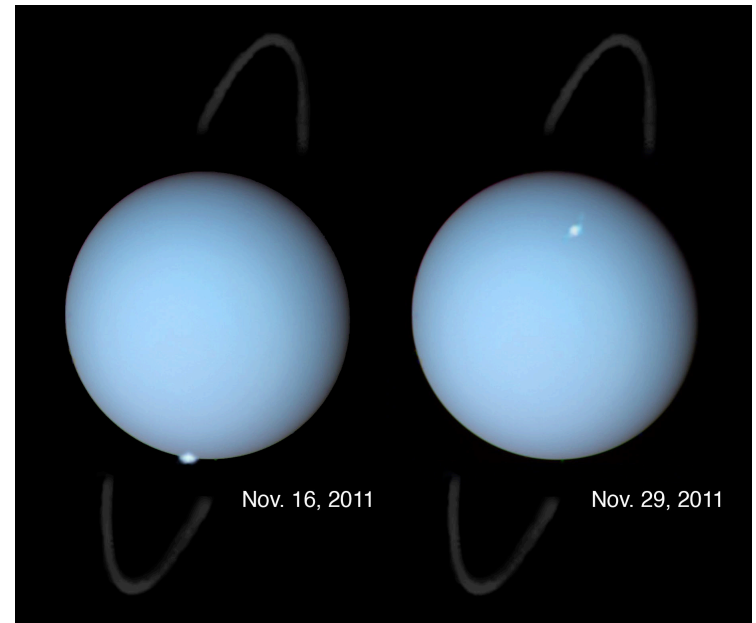


High potential for scientific return and careful planning of new observations



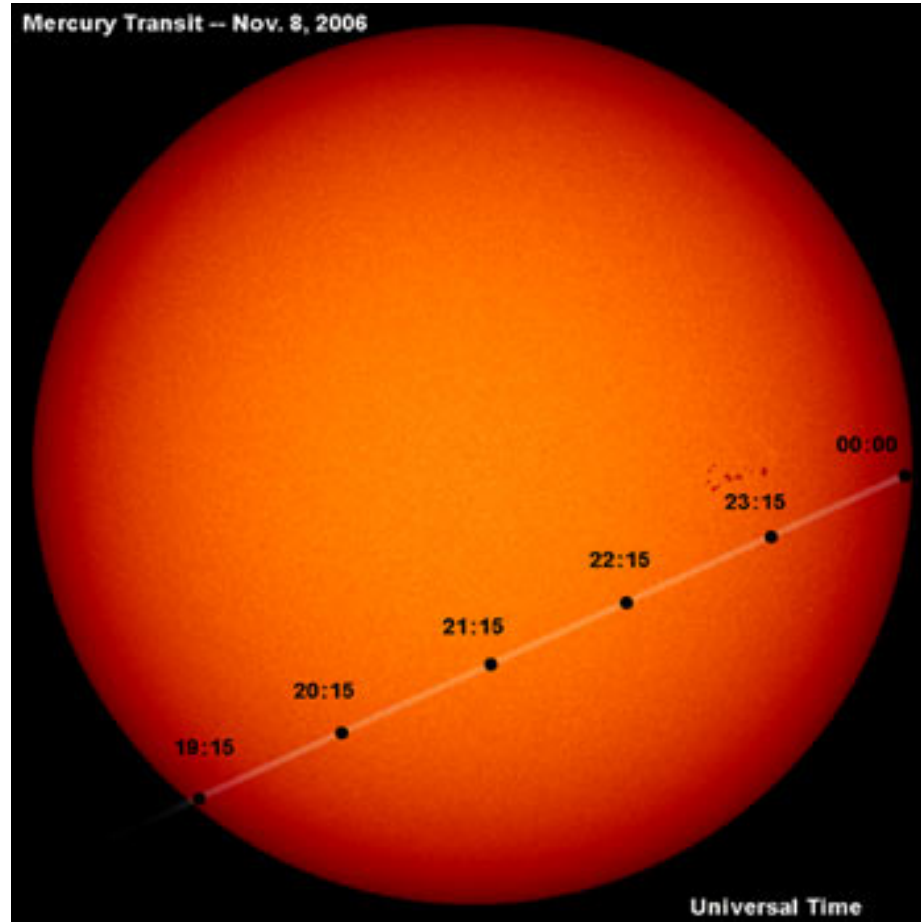
Shoemaker-Levy at Jupiter

Giant planet fireballs at Saturn:
detection and report at EPSC 2012
by amateur astronomer A. Wesley



HST observation of **shock-driven**
auroral emissions at Uranus, by
Lamy et al. (2012)

New Opportunities

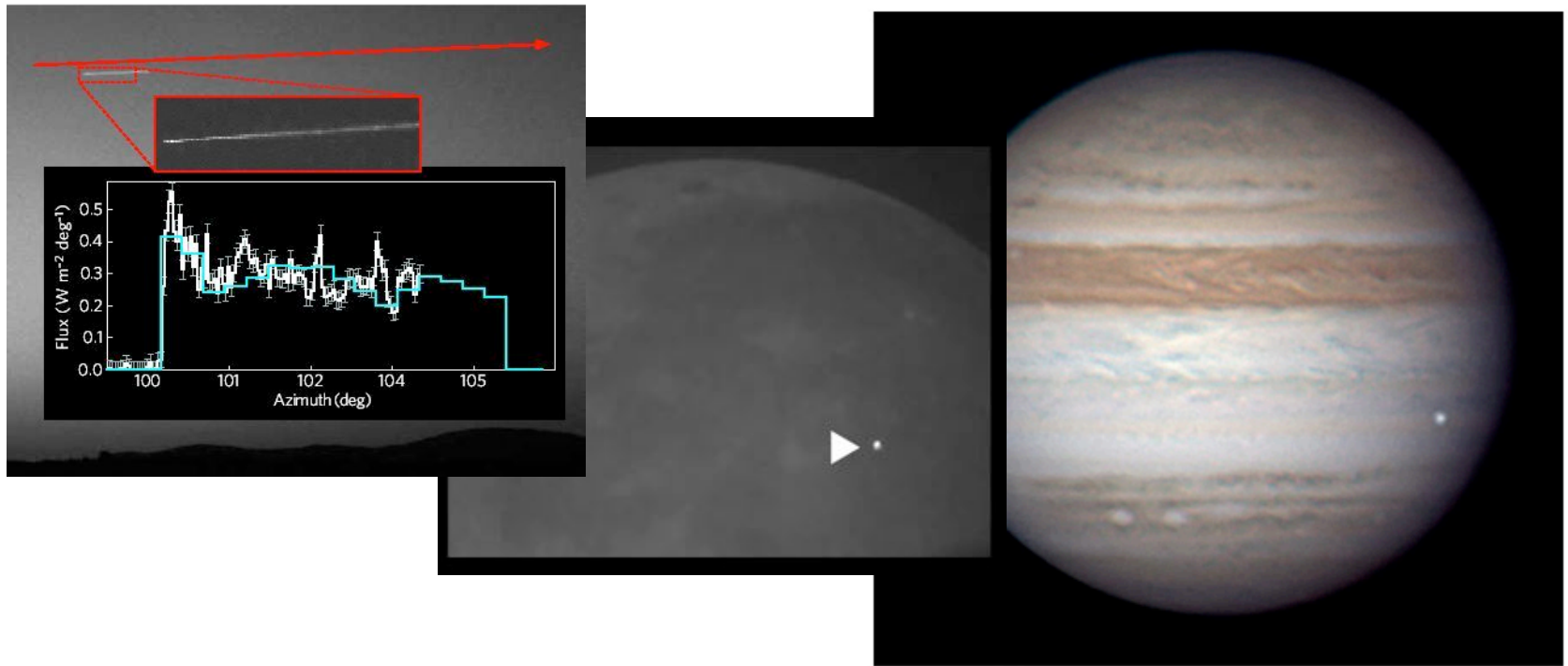


Transit of Mercury 2016

Note also need to communicate PSWS products

Remarkable events in the Solar System and the role of amateur astronomers

- First shooting star seen from Mars (F. Selsis et al., Nature, 2005)



- Amateur astronomers see perseid hits on the Moon
- Fiercest meteor shower on record to hit Mars via comet
- Explosion on Jupiter spotted by amateur astronomers (A. Wesley)

New services well reviewed

- **Referee report:**

‘Another important action is the creation of a planetary space weather service that will be important to spacecraft enroute or operating near or on the surfaces of these bodies’

- **Completely new activity:**

Risk mitigation thanks to other Europlanet activities (outreach, networking, workshops, etc)

-> need to interact strongly with them right at the beginning We need a kick-off meeting

| Beneficiary | Task | Funding (k€) | Overheads (%) | Total (k€) |
|------------------|---------------------------|--------------|---------------|---------------|
| | | | | |
| CNRS-IRAP | JRA4 Task 2 Tools/Methods | 36 | 25 | 45 |
| | JRA4 Task 5 Alerts | 4 | 25 | 5 |
| | VA1 Task 1 Coordination | 10 | 25 | 12.5 |
| | VA1 Task 2 Implementation | 30 | 25 | 37.5 |
| | VA1 Task 3 Detection | 10 | 25 | 12.5 |
| | VA1/JRA4 Meetings | 25 | 25 | 31.25 |
| | | 115 | 25 | 143.75 |
| GFI | VA1 Task 2 Implementation | 46 | 25 | 57.5 |
| | | 46 | 25 | 57.5 |
| AU-IMPACS | JRA4 Task 3 Tests | 10 | 25 | 12.5 |
| | JRA4 Task 4 Prediction | 25 | 25 | 31.25 |
| | VA1 Task 1 Coordination | 10 | 25 | 12.5 |
| | VA1 Task 2 Implementation | 30 | 25 | 37.5 |
| | VA1 Task 3 Detection | 35 | 25 | 43.75 |
| | | 110 | 25 | 137.5 |
| UCL | JRA4 Task 2 Tools/Methods | 30 | 25 | 37.5 |
| | JRA4 Task 5 Alerts | 5 | 25 | 6.25 |
| | VA1 Task 3 Detection | 35 | 25 | 43.75 |
| | | 70 | 25 | 87.5 |
| OBSPARIS | JRA4 Task 4 Prediction | 25 | 25 | 31.25 |
| | JRA4 Task 5 Alerts | 10 | 25 | 12.5 |
| | | 30 | 25 | 43.8 |
| ETSI | VA1 Task 3 Detection | 15 | 25 | 18.75 |
| | | 15 | 25 | 18.75 |
| IAP | JRA4 Task 3 Tests | 50 | 25 | 62.5 |
| | | 50 | 25 | 62.5 |
| DLR | JRA4 Task 3 Tests | 20 | 25 | 25 |
| | | 20 | 25 | 25 |
| CNRS-IPAG | VA1 Task 4 Liaisons | 20 | 25 | 25 |
| | | 20 | 25 | 25 |
| Wigner | JRA4 Task 3 Tests | 20 | 25 | 25 |
| | JRA4 Task 4 Reliability | 20 | 25 | 25 |
| | | 40 | 25 | 50 |
| SRC | JRA4 Task 5 Alerts | 4 | 25 | 5 |
| | VA1 Task 2 Implementation | 16 | 25 | 20 |
| | VA1 Task 4 Liaisons | 20 | 25 | 25 |
| | | 40 | 25 | 50 |

Our Team

700 k€ funding
(7% overall budget)

Participants

- CNRS/IRAP (N. André, V. Génot, A. Rouillard, F. Pitout, P.-L. Blelly)
- CNRS/IPAG (J. Lilensten, M. Barthélémy)
- University of Aberysthwyth (M. Grande, T. Cook)
- University College London (N. Achilleos, G. Jones)
- DLR Cologne (G. Reitz)
- Observatoire de Paris (B. Cecconi, J. Vaubaillon)
- Wigner (A. opitz, K. Szego)
- Polish (Stanislawska)
- University (R. Hueso)

Our Milestones

| Milestone number | Milestone name | Estimated date | Means of verification |
|------------------|--|----------------|-----------------------|
| M7.1/ M12.1 | Kick-Off Meeting | PM 3 | Minutes |
| M7.2 | External Review Board | PM 6 | Minutes |
| M7.3/ M12.2 | PSWD website | PM 6 | D12.1 |
| M7.4 | Public release of prototyped Planetary Space Weather services | PM 18 | D12.2 |
| M7.5 | Public release of prototyped Planetary Diary services | PM 24 | D12.4 |
| M12.3 | Prototyped Alert services | PM 24 | D12.2 |
| M7.6/ M12.4 | Coordination Meeting | PM 27 | Minutes |
| M7.7 | Review Meeting | PM 30 | D12.3 |
| M7.8 | Public release of consolidated Planetary Space Weather services with integrated Alert services | PM 36 | D12.4 |
| M7.9 | Public release of Planetary Diary consolidated services with integrated Alert services | PM 36 | D12.4 |
| M7.10/ M12.5 | Coordination Meeting | PM 42 | Minutes |
| M7.11 | Review Meeting | PM 45 | D12.5 |
| M7.12/ M12.6 | Final Meeting | PM 48 | D12.6 |

Our deliverables

- Reviews by VA board of PAB
 - **Suggestion for external reviewers:**
 - O. Witasse (ESA), JUICE project scientist
 - R. Harrison (RAL), HELCATS FP7 project
 - Kirstie Kauristi (FMI), COSPAR Space Weather roadmap
 - Alexi Glover (ESA) SSA project
 - Detlef Koschny (ESA), lunar impacts
 - Peter Jenniskens (SETI), meteor showers
 - Apostolos Christou (Armagh Obs.), meteor showers
- Annual report
- Validation report

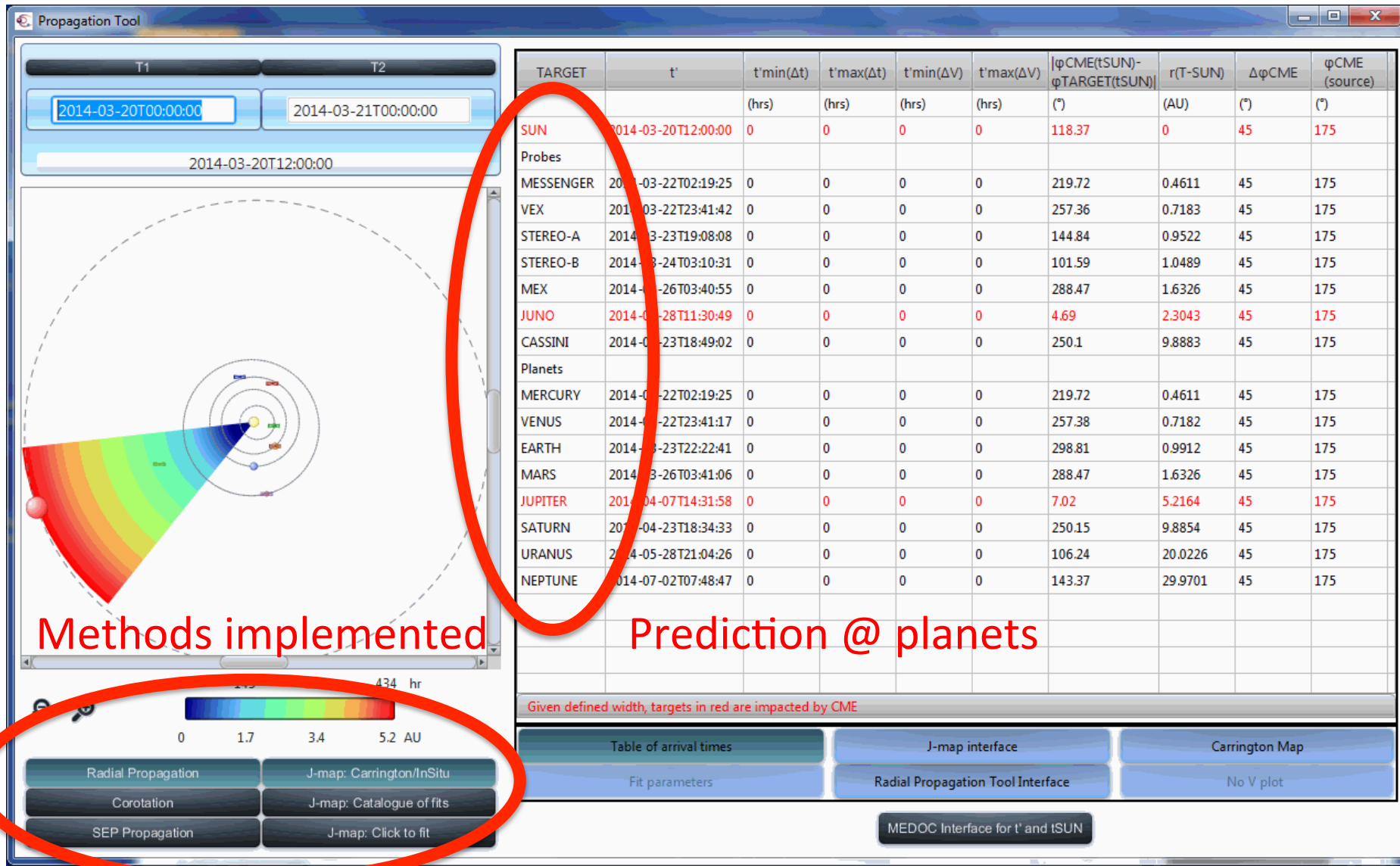
Our toolkits

- General space weather toolkit
 - User-friendly versatile MHD propagation code
 - Extension of propagation and space weather tools from CDPP
- Mars toolkit
 - Radiation environment, from extended atmosphere down to surface
- Comet toolkit
 - Solar Wind-Cometary tail interactions
- Outer planets toolkit
 - Solar Wind/Magnetosphere/Ionosphere/thermosphere connections
 - Meteor showers at planets
- Sustainability toolkit
 - Alert system

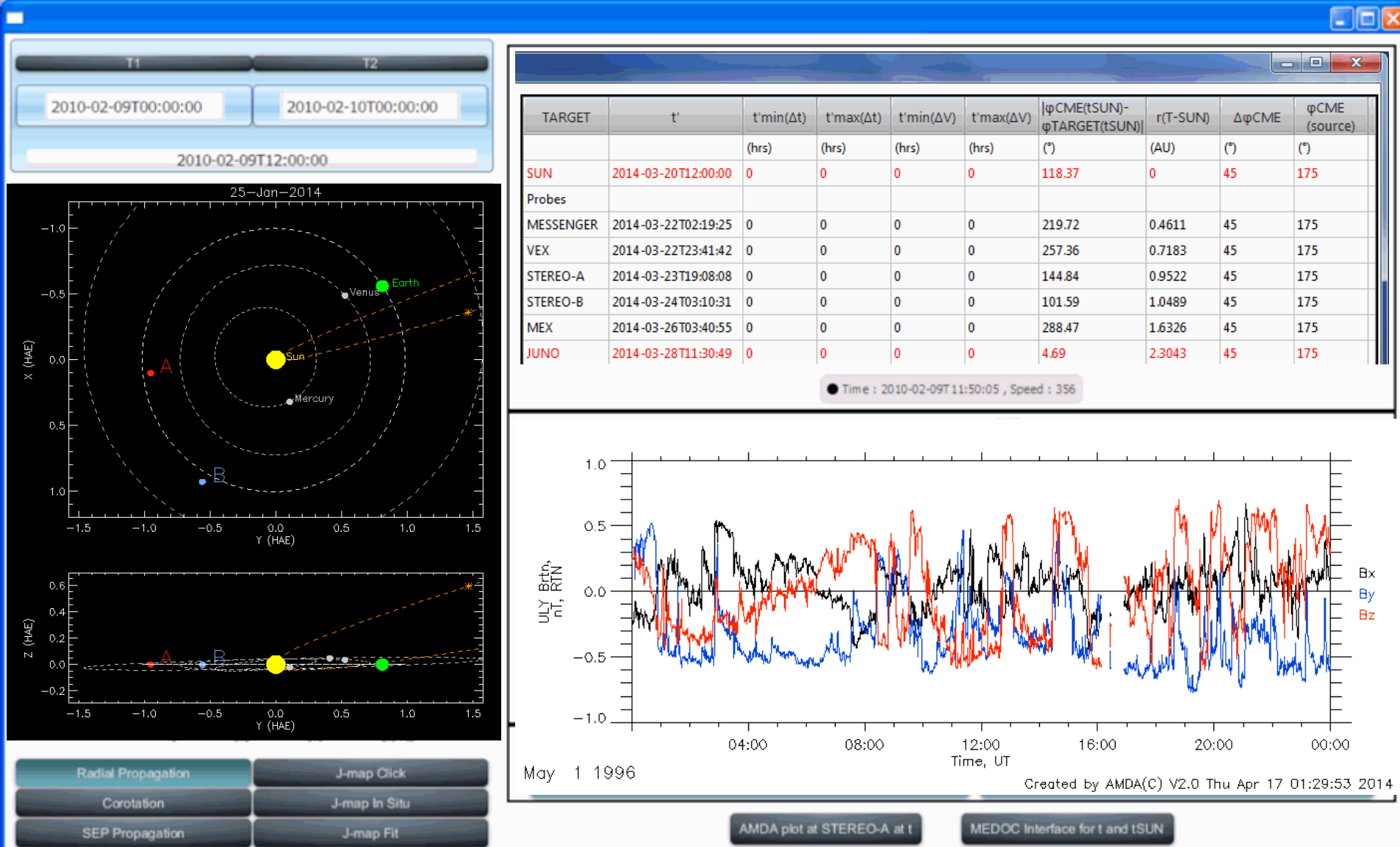
A toolkit consists of

- Database
- Software development
- Prototype
- Alerts

CDPP/Propagation Tool



Predict, SW-Comet Interactions in CDPP/Propagation tool



SOHO's Current Discovery Count is 2,574 Comets!!

Active Comet Zoo

Helioviewer.org – Solar and heliospheric image visualization tool

propagationtool.cdpp.eu Helioviewer.org – Solar and heli... JID_640.jpg (Image JPEG, 640 x ...

helioviewer.ias.u-psud.fr/helioviewer/ Google

Helioviewer.org

Time

Date: 2014/04/16 12 latest
Time: 23:20:28 UTC
Time-step: 1 Day

Images [Add]

AIA 304 2014/04/16 22:33:55

Solar Features & Events

HEK 2014/04/16 23:20:28

- Active Regions (9)
- NOAA SWPC Observer (9)
- Coronal Cavities
- Coronal Dimmings
- Coronal Holes
- Coronal Jets
- CMEs
- Coronal Rains
- Coronal Waves
- Emerging Fluxes
- Eruptions
- Filaments
- Filament Activations
- Filament Eruptions
- Flares
- Loops
- Oscillations

center Link Movie Screenshot Settings

Comet C/2011 L4 (PanSTARRS)
NASA STEREO/SECCHI HI1-B
March 13, 2013 12:49UT

Coronal Mass Ejection

Earth

Earth Scale

STEREO_B HI1
2013-03-12T12:49:47.656

News

Helioviewer API tools for multiple platforms now available
Tue, 04 Mar 2014 16:07:09 UTC

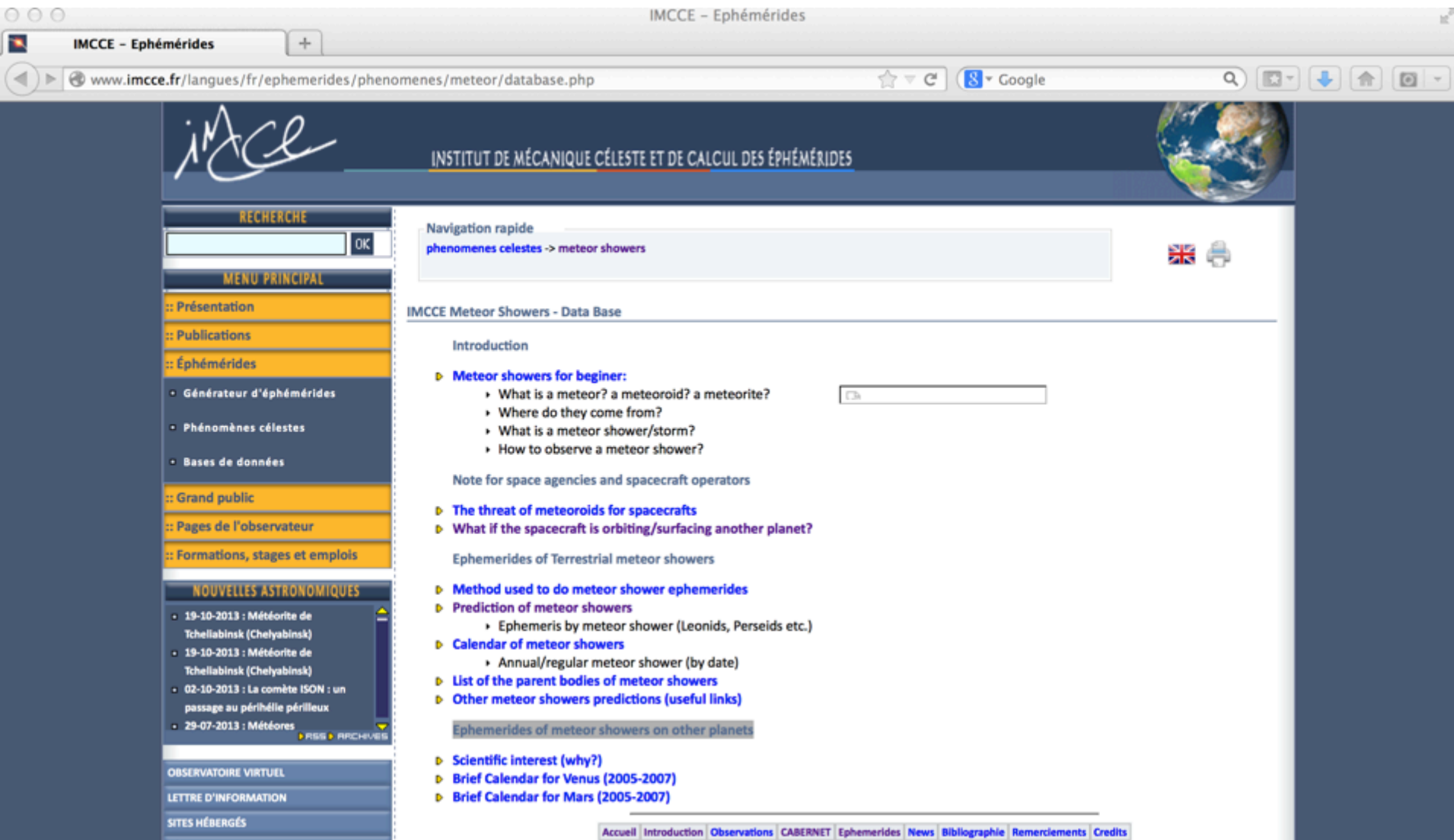
Follow the Helioviewer Project on Twitter
Tue, 28 Jan 2014 15:16:51 UTC

Strong geomagnetic storm expected and a scrubbed launch
Wed, 08 Jan 2014 19:42:57 UTC

YouTube Recently Shared

Predict, e.g. meteor showers at planets (Jérémie Vaubaillon)

Twice as many showers on Mars than on Earth !



The screenshot shows a web browser window with the address bar displaying www.imcce.fr/langues/fr/ephemerides/phenomenes/meteor/database.php. The page title is "IMCCE - Ephémérides". The main content area is titled "IMCCE Meteor Showers - Data Base" and includes a navigation menu on the left and a main text area on the right.

Navigation rapide
phenomenes celestes -> meteor showers

IMCCE Meteor Showers - Data Base

Introduction

- ▶ **Meteor showers for beginner:**
 - ▶ What is a meteor? a meteoroid? a meteorite?
 - ▶ Where do they come from?
 - ▶ What is a meteor shower/storm?
 - ▶ How to observe a meteor shower?

Note for space agencies and spacecraft operators

- ▶ **The threat of meteoroids for spacecrafts**
- ▶ **What if the spacecraft is orbiting/surfacing another planet?**

Ephemerides of Terrestrial meteor showers

- ▶ **Method used to do meteor shower ephemerides**
- ▶ **Prediction of meteor showers**
 - ▶ Ephemeris by meteor shower (Leonids, Perseids etc.)
- ▶ **Calendar of meteor showers**
 - ▶ Annual/regular meteor shower (by date)
- ▶ **List of the parent bodies of meteor showers**
- ▶ **Other meteor showers predictions (useful links)**

Ephemerides of meteor showers on other planets

- ▶ **Scientific interest (why?)**
- ▶ **Brief Calendar for Venus (2005-2007)**
- ▶ **Brief Calendar for Mars (2005-2007)**

Accueil **Introduction** **Observations** **CABERNET** **Ephemerides** **News** **Bibliographie** **Remerciements** **Credits**

Detect, e.g. Jovian Impacts Detection Software (Ricardo Hueso)

02.June2010_Impact_Extract_ChrisGo.avi - Jid - Jupiter Impact Detection

File Parameters View Process Help

Filename: C:\Users\VisualStudio\Videos\02.June2010_Impact_Extract_ChrisGo.avi

Image

Planet's center in frame:
X: 220 Y: 210

Average planet's size:
255 x 243

Histogram

Messages

Min. elements in radius: 3
Found 15 candidates.
Detection Ended.
Clear duplicates
Radius search: 10
Check for duplicates...
Finally detect 1 candidates.

FOUND 1 CANDIDATES

Init fase: Get RESULTS.
End fase: RESULTS.

Frame: 100 Total: 100

NUM

Jid Results

Candidates found: 1 Select: 01-DTC Previous Next

Detected in frame: 50

Position respect planet's center X: 106 Y: -30

Algorithm detection: DTC

Show frame candidate

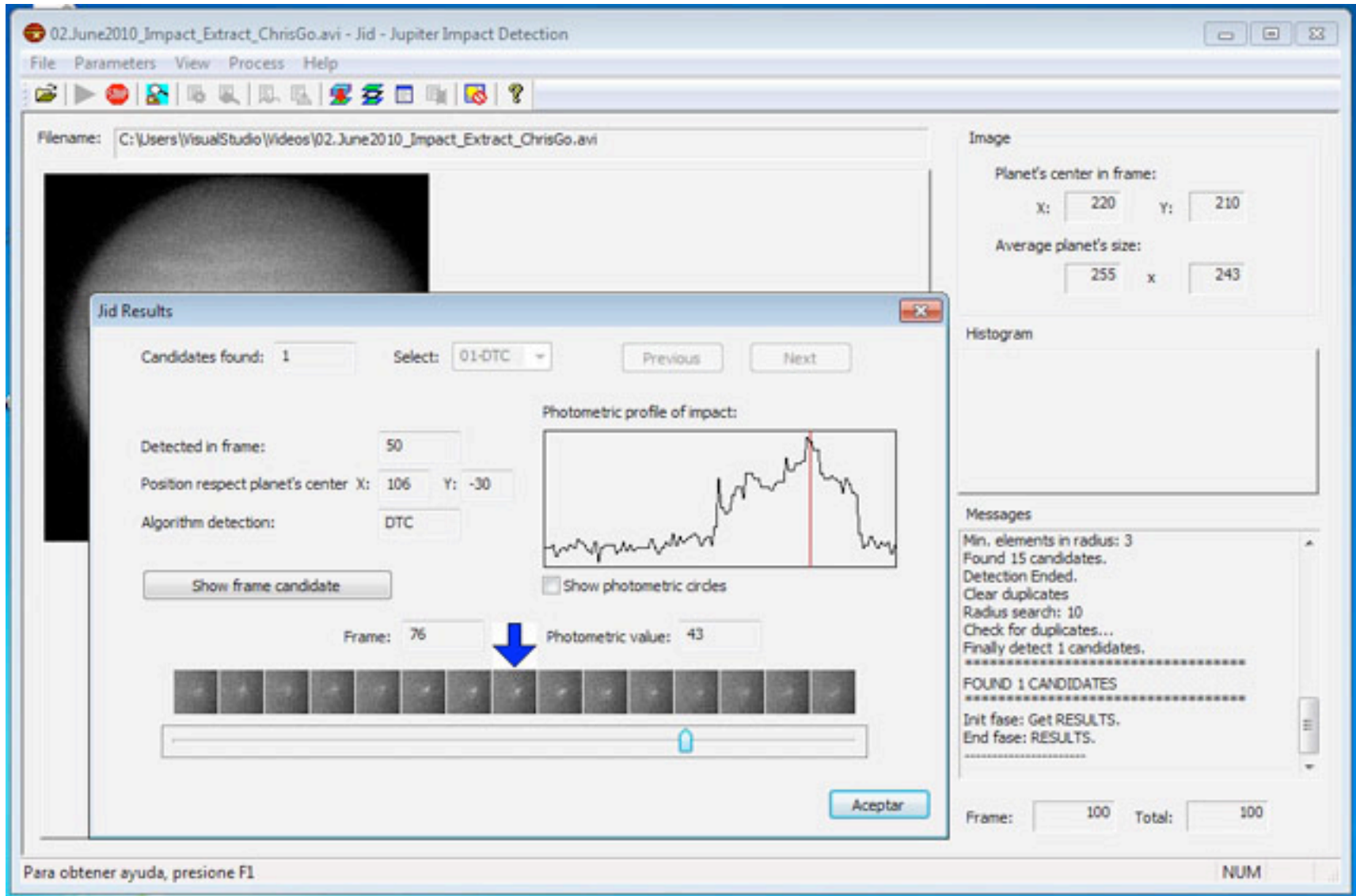
Photometric profile of impact:

Show photometric circles

Frame: 76 Photometric value: 43

Acceptar

Para obtener ayuda, presione F1



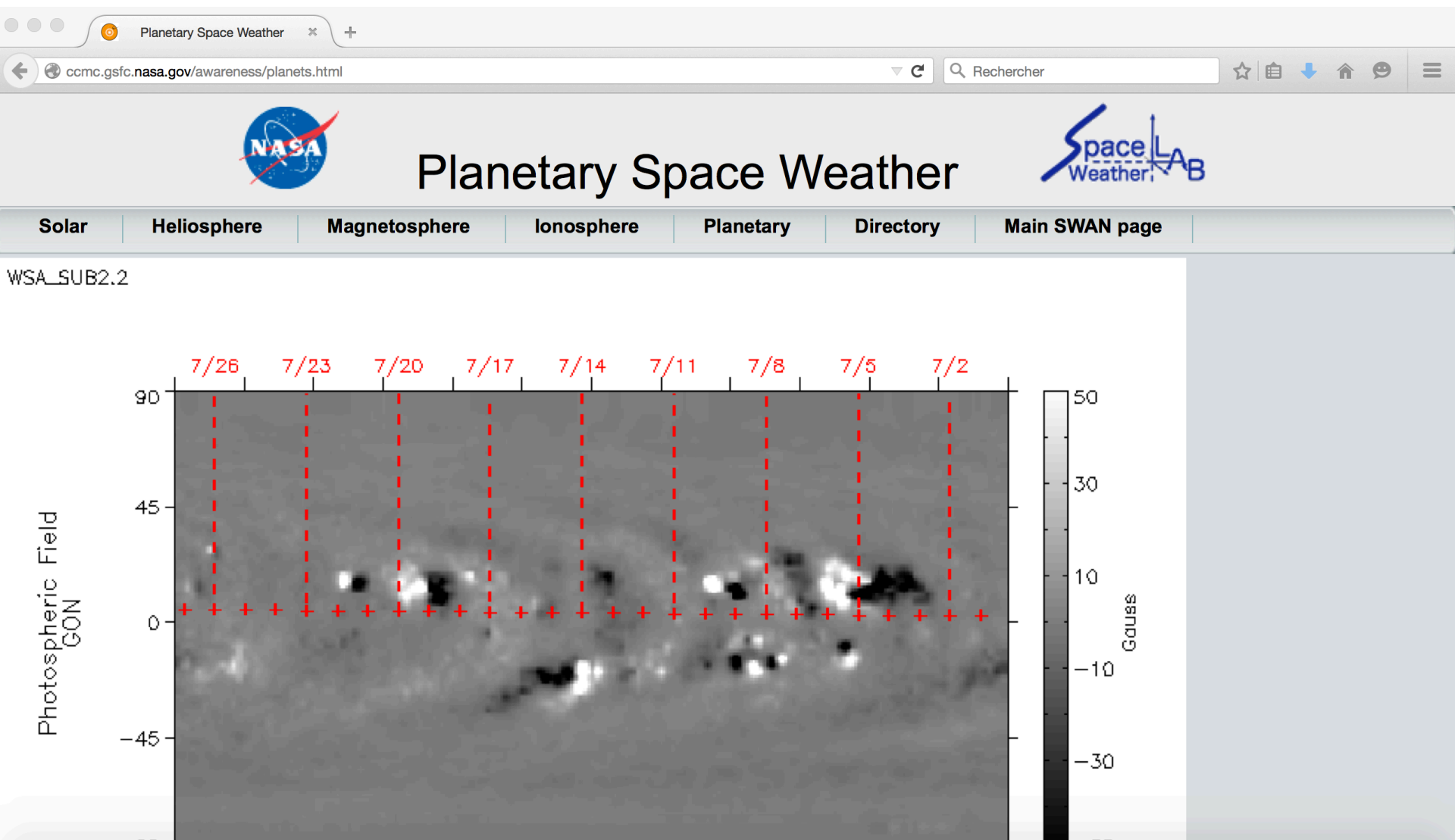
Schedule

- Aims to quickly release first prototypes
 - Comet toolkit (taking advantage of Rosetta)
 - Links with amateur astronomers to be worked on
 - Giant planet toolkit (Juno arriving next year)
 - Propagated solar wind data and auroral campaigns with HST, HISAKI, ground-based observations, etc
 - Mars toolkit (ExoMars 2016)
 - Release of look-up tables for radiation environments (cosmic-rays)



Our users

- Planetary scientists
 - Re-analyzing old datasets
 - Planning new observational campaigns
 - Amateur astronomers
 - Detecting and reporting new cosmic events
 - Space agencies and industries
 - Protecting subsystems including instruments
- + strong outreach potential

Planetary Space Weather @ NASA



NOAA Space Weather Alerts



SPACE WEATHER PREDICTION CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Friday, September 25, 2015 21:57:23 UTC

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CURRENT SPACE WEATHER CONDITIONS on [NOAA Scales](#)

R

S

G

ALERTS, WATCHES AND WARNINGS

Space Weather Message Code: ALTK04
Serial Number: 1816
Issue Time: 2015 Sep 23 1742 UTC

ALERT: Geomagnetic K-index of 4
Threshold Reached: 2015 Sep 23 1740 UTC
Synoptic Period: 1500-1800 UTC

Active Warning: Yes

NOAA Space Weather Scale descriptions can be found at
www.swpc.noaa.gov/noaa-scales-explanation

Potential Impacts: Area of impact primarily poleward of 65 degrees Geomagnetic Latitude.
Induced Currents - Weak power grid fluctuations can occur.
Aurora - Aurora may be visible at high latitudes such as Canada and Alaska.

Space Weather Message Code: WARK04
Serial Number: 2662
Issue Time: 2015 Sep 23 1536 UTC

EXTENDED WARNING: Geomagnetic K-index of 4 expected
Extension to Serial Number: 2661
Valid From: 2015 Sep 23 0905 UTC
Now Valid Until: 2015 Sep 23 2300 UTC
Warning Condition: Onset

European Space Weather portal

Bienvenue | European Spac... x

+

www.spaceweather.eu/fr

Rechercher

☆

↓

🏠

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☰

EUROPEAN SPACE WEATHER PORTAL

Home | Search | Log in

The European gateway to Space Weather resources

Navigation

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SWWT

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Bienvenue

Submitted by Monique Pick on Tue, 03/04/2008 - 13:36.

Bienvenue sur le portail européen de la Météorologie Spatiale, un accès qui centralise les ressources européennes de la Météorologie de l'Espace¹.

Sur la gauche, se trouve le menu (ESWEP¹). Il fournit les liens aux services web et aux « pages jaunes » ainsi que l'accès à des rubriques variées et aux services proposés. Sur votre droite vous avez la possibilité de vous connecter pour vous enregistrer. Les utilisateurs enregistrés bénéficieront de plus de privilèges que les autres. Sur votre droite, vous avez également le choix de la langue.

Upcoming events

Ground-based Solar Observations in the Space Instrumentation Era in Coimbra, Portugal

10/05/2015 - 00:00

AMS-02 Energetic Particle Workshop in Hawaii, USA

10/18/2015 - 00:00

Third Remote Sensing of the Inner Heliosphere and Space Weather Applications Workshop in Morelai, Michoacan (Mexico)

10/19/2015 - 00:00

More...

Plasmasphere

2015-9-25 24.0 UT

SEP event forecast

No SEP event

2015-09-25 21:40:00

[Add your forecast]

Websites

please check:

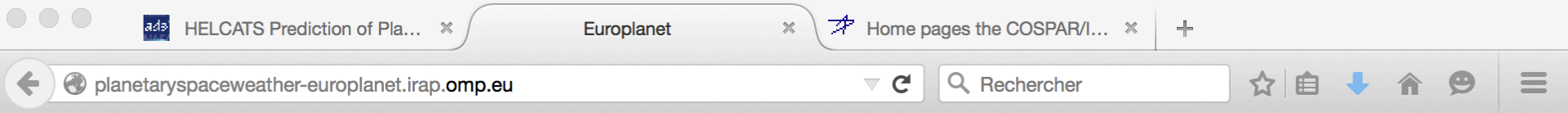
<http://planetaryspaceweather-europlanet.irap.omp.eu/#>

<http://planetaryspaceweather-europlanet.irap.omp.eu/dist/psws.html>

under development

Europlanet-H2020

Planetary Space Weather Services



Planetary Space Weather Services

Europlanet

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. Europlanet 2020-RI aims to transform the science of space weather, by extending its scope throughout the Solar System. An entirely new Virtual Access Service, "Planetary Space Weather Services" (PSWS), has therefore been included in the project submitted to the INFRAIA-1-2014-2015 call of the EU Framework Programme for Research and Innovation. In order to provide "Phase Zero" space weather related resources during the initial stages of the project, a coordinated selection of models and tools related to planetary and solar environments already available or in development can be accessed [here](#).

Service Activities (VA1-PSWS)

VA1-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 ESA ExoMars missions to be launched in 2016 and 2018), comets (building on the expected success of the ESA 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.

Objectives

VA1-PSWS will give the European planetary scientists for the first time new methods, interfaces, functionalities and/or plug-ins dedicated to planetary space weather and diary in the form of tools and models available within the partner institutes, weather services operational in Europe at the end of the programme.

Research Activities (JRA4-PSWS)

JRA4-PSWS will set up the infrastructure necessary to transition to a full planetary space weather service within the lifetime of the project. A variety of tools (in the form of web applications, standalone software, or numerical models in various degrees of implementation) are available 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 originally designed for planetary event prediction or space weather applications, additional development is required for these purposes. The overall objectives of the JRA4-PSWS will be to review, test, improve and adapt methods and tools available within the partner institutes in order to make contribute objective, verification, and space weather services operational.

News

2015-09-15 : Management meeting at Open University, Milton Keynes, UK

2015-09-27 : Kick off meeting in Nantes, France

[Europlanet tools](#)






[Tutorials](#)

[Available on day 1](#)

[Presentations](#)

PSWS - Available on Day 1

PSWS Hosted Models at a Glance

| Domain | Model Name | Developer(s) | Institution | Pre-project | Project-funded | End of project |
|--|-------------------------------------|---------------------|-----------------|---------------------------|--|---------------------------|
|  Heliosphere | Propagation Tool | A. Rouillard et al. | CDPP, France | Publicly available | Extension to comets and giant planet aurorae+catalogue ingestion+development of alerts | Alert Service operational |
| | 1D-MHD propagation software | C. Tao et al. | CDPP, France | Example outputs available | Under development | Publicly available |
| | Space Weather Tool | A. Rouillard et al. | CDPP, France | Under development | | Publicly available |
|  Earth and Moon | TRANSCAR-Earth | P.L. Blelly et al. | IRAP, France | On request | Online service | Publicly available |
| | HelgeoSSA | I. Stanislaw et al. | SRC PAS, Poland | Publicly available | Development of alerts | Alert Service operational |
| | Lunar impact detection software | T. Cook et al. | ABER, UK | On request | Upgrades and conversion | Publicly available |
|  Mars | TRANSCAR-Mars | P.L. Blelly et al. | IRAP, France | On request | Online service | Publicly available |
| | Mars surface environment | M. Grande et al. | ABER, UK | | Under development | Alert Service operational |
|  Giant Planets | Jupiter magnetodisc model outputs | N. Achilleos et al. | UCL, UK | On request | Online service | Publicly available |
| | Jupiter thermospheric model outputs | N. Achilleos et al. | UCL, UK | On request | Online service | Publicly available |
| | TRANSCAR-Jupiter | P.L. Blelly et al. | IRAP, France | Under development | Online service | Publicly available |
| | TRANSCAR-Saturn | P.L. Blelly et al. | IRAP, France | Under development | Online service | Publicly available |
| | Fireball detection software | R. Hueso et al. | UPV/EHU, Spain | Publicly available | Upgrades and conversion | Publicly available |
|  | Cometary tail detection software | G. Jones et al. | UCL, UK | On request | Upgrades and conversion | Publicly available |

Towards an operational planetary space weather alert system: use of VOEvent / the Skyalert experience

