VOEvent in the PSWS
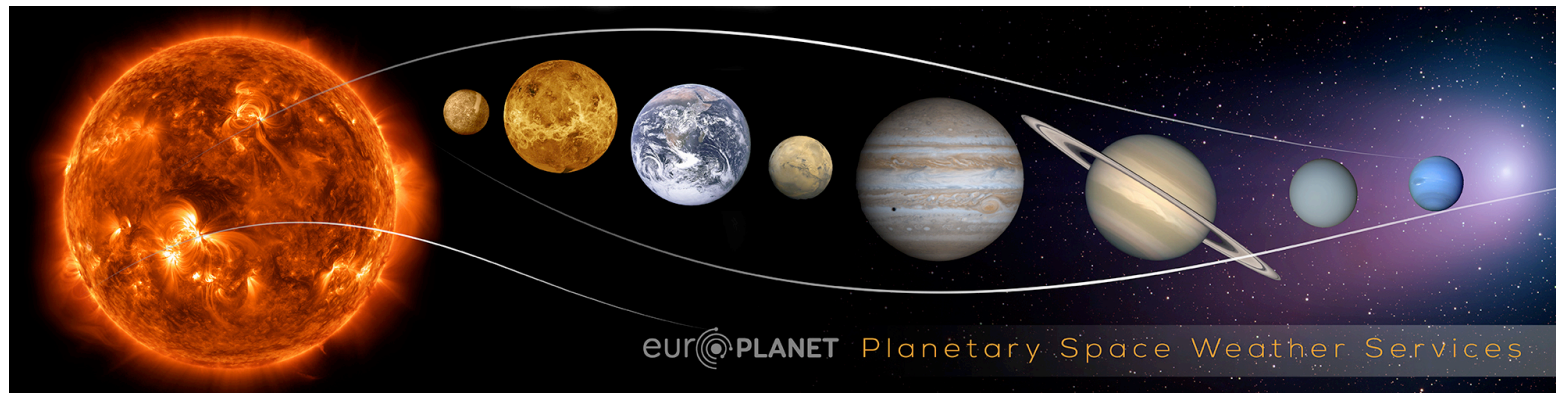# space weather alert architecture

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IVOA Interop, Victoria , May-June 2018

PSWS (*Planetary Space Weather Services*) is one of the Work-Packages of Europlanet-RI
(2015-2019)
in charge of the implementation of alert services

PSWS Alert system Objectives

The *French Plasma physics Data Center* (CDPP, IRAP/CNRS) together with *Observatoire de Paris* (OBSPARIS), *University College of London* (UCL), and the *Space Research Center* (PAS/SRC) created a set of **Alert services linked to the planetary meteor shower and planetary space weather predictions** using **VOEvent** to exchange events.

These services facilitate **discovery or make prediction** in order to **watch or warn against specific events.**

The objectives are to

- set up dedicated observation campaigns,

- distribute contextual information for science data analysis,

- enable safety operations of planet-orbiting spacecraft against impacts from meteors or solar wind disturbances.
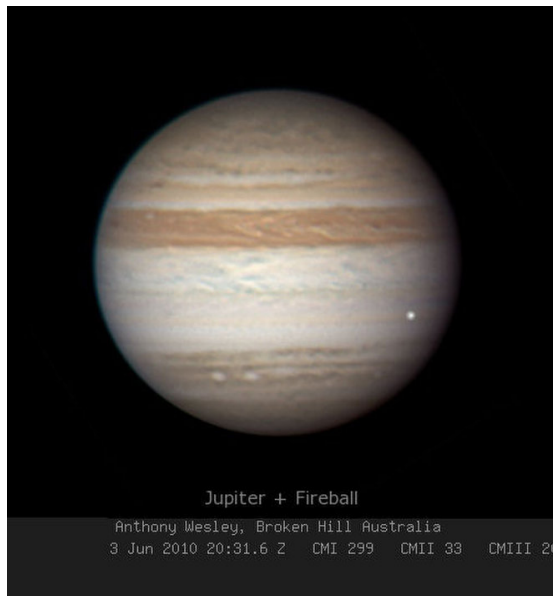
PSWS Alert Network Architecture
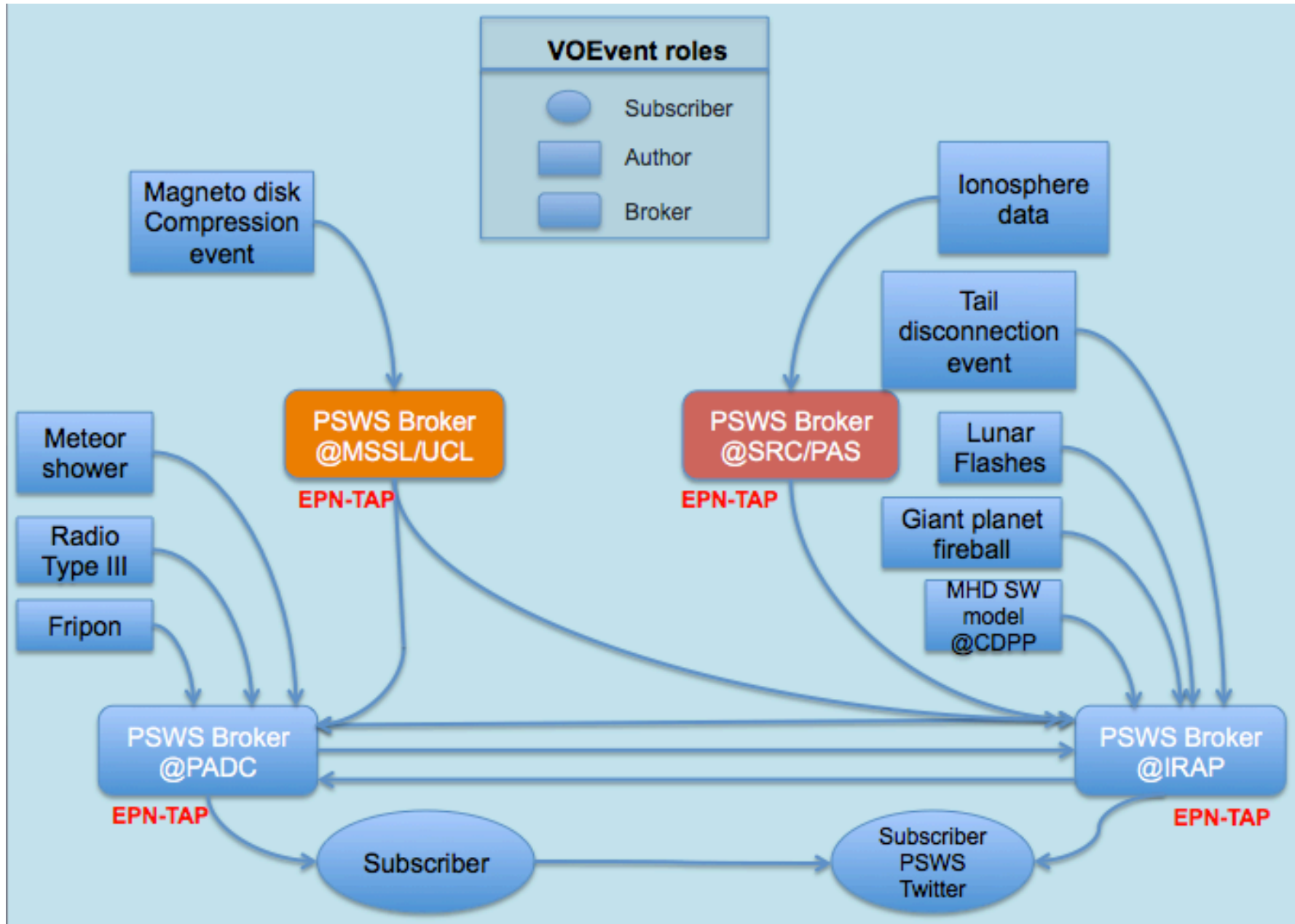
CDPP Alert service

Types of detected events

Three types of events may be the source of VOEvent Alerts generated @by CDPP

Jupiter Fireball

Lunar Flash
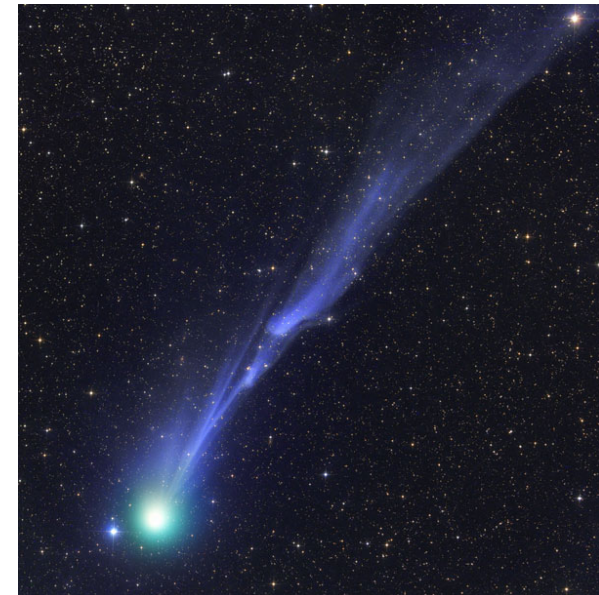
Comet Tail Event

1D MHD Solar Wind Prediction tool

Provides **real time and archive access** to **propagated solar wind parameters** at various planets (Mercury, Venus, Mars, Jupiter, Saturn,…) using a 1D magneto-hydrodynamic(MHD) code available through the AMDA tool (http://amda.cdpp.eu) initially developed by Chihiro Tao (Tao et al., 2005)

Exemple of prediction alert (29 March 18 – 17 April 18)
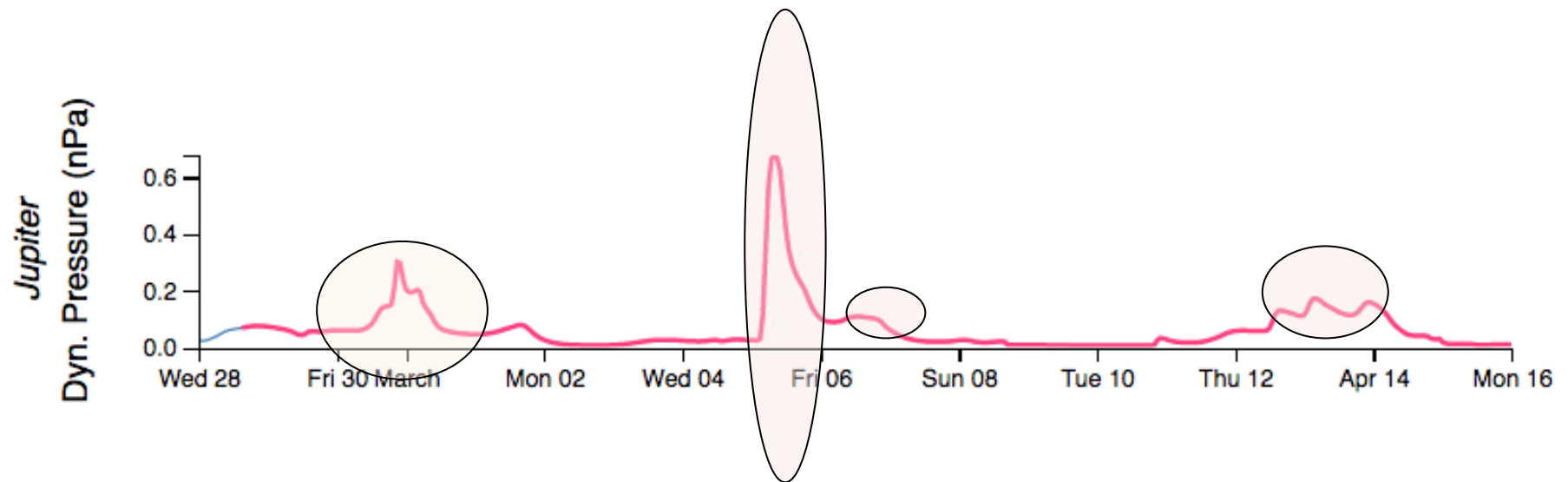
Data set : TAO model at Jupiter with ACE RT as input
Prediction for SW conditions up to about 2 weeks ahead

4 events corresponding to condition :
dynamic pressure at Jupiter > 0.1 nPa   4 VOEvents generated
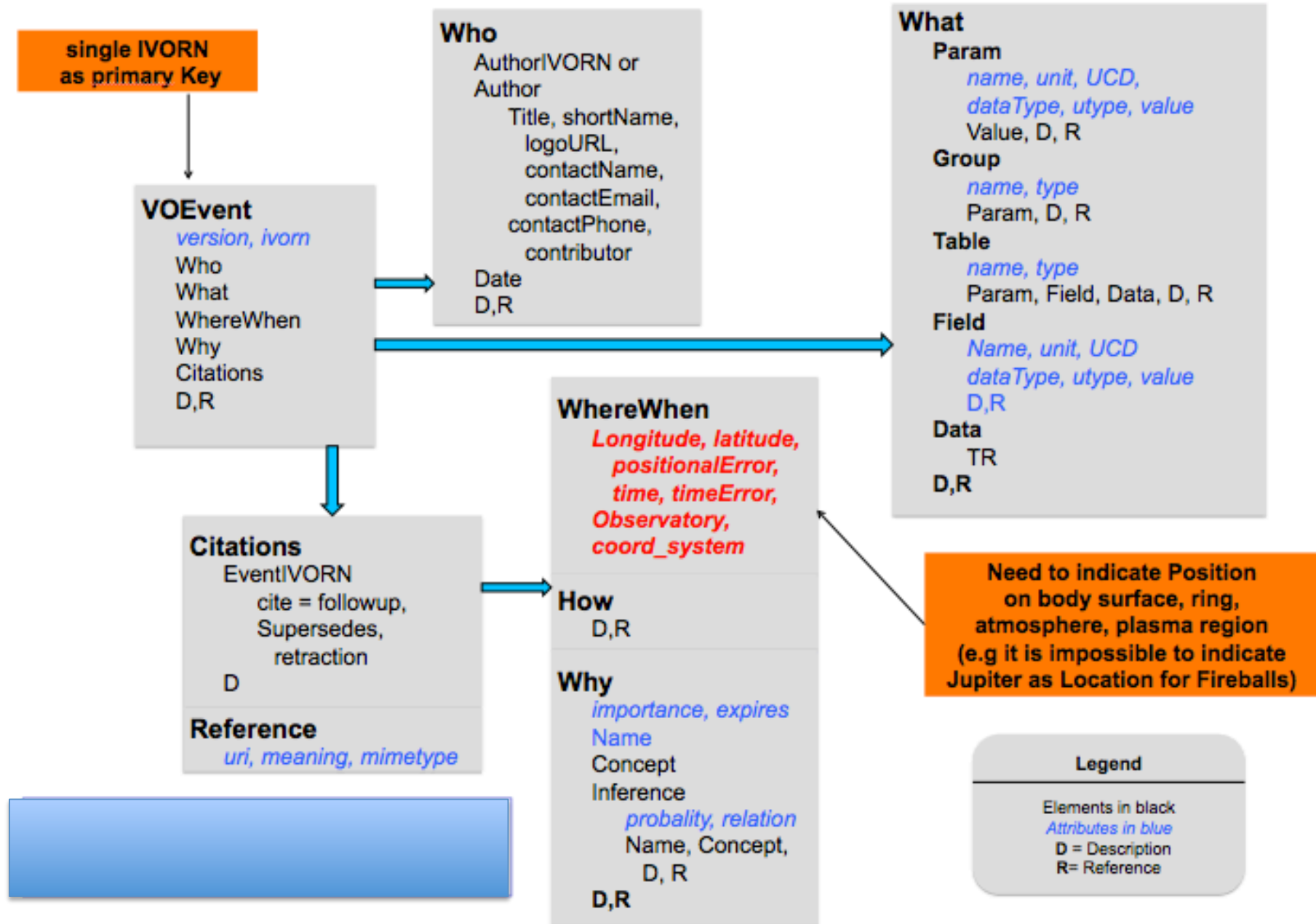   *and sent*

Displayed by Heliopropa (http://heliopropa.irap.omp.eu)

Result : List of time intervals in VOTable

```xml
<?xml version="1.0"?>
<VOTABLE version="1.1">
<DESCRIPTION>
   Time Table generated by PSWS Alerts @ CDPP @IRAP
   Name: PSWS Alert with CDPP Solar Wind Propagation Model
   Description: Search time intervals in which dynamic pressure is greater than a threshold
   Creation date:2018-05-22T05:30:07
</DESCRIPTION>
<RESOURCE>
 <DESCRIPTION>
    PSWS Alerts @CDPP @IRAP
 </DESCRIPTION>
 <PARAM name="threshold" datatype="float" ucd="phys.pressure" value="0.2">
 <PARAM name="body" datatype="char" ucd="meta.id" value="jupiter">
 <TABLE>
   <FIELD datatype="char" name="Start Time" ID="TimeIntervalStart" ucd="time.start">
      <DESCRIPTION>time tag for beginning of interval</DESCRIPTION>
   </FIELD>
   <FIELD datatype="char" name="Stop Time" ID="TimeIntervalStop" ucd="time.stop">
      <DESCRIPTION>time tag for end of interval</DESCRIPTION>
   </FIELD>
   <DATA>
     <TABLEDATA>
      <TR>
        <TD>2018-05-22T06:00:00.000</TD>
        <TD>2018-05-22T09:00:00.000</TD>
      </TR>
     </TABLEDATA>
   </DATA>
 </TABLE>
</RESOURCE>
</VOTABLE>
```

Examples of Enhancements of the VOEvent standard needed for PSWS (in RED)

single IVORN as primary Key

VOEvent
version, ivorn
Who
What
WhereWhen
Why
Citations
D, R

Who
AuthorIVORN or
Author
Title, shortName,
logoURL,
contactName,
contactEmail,
contactPhone,
contributor
Date
D,R

What
Param
name, unit, UCD,
dataType, utype, value
Value, D, R
Group
name, type
Param, D, R
Table
name, type
Param, Field, Data, D, R
Field
Name, unit, UCD
dataType, utype, value
D,R
Data
TR
D,R

WhereWhen
Longitude, latitude,
positionalError,
time, timeError,
Observatory,
coord_system

Citations
EventIVORN
cite = followup,
Supersedes,
retraction
D

Reference
uri, meaning, mimetype

How
D,R

Why
importance, expires
Name
Concept
Inference
probality, relation
Name, Concept,
D, R
D,R

Need to indicate Position on body surface, ring, atmosphere, plasma region (e.g it is impossible to indicate Jupiter as Location for Fireballs)

Legend
Elements in black
Attributes in blue
D = Description
R= Reference

```xml
<?xml version="1.0" encoding="UTF_8"?>
<voe:VOEvent ivorn="ivo://psws.irap/VOEvent/#f536a2a0_4c36_44ee_a8d1_af0e87080c8d"
  role="test" version="2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema_instance"
  xmlns:voe="http://www.ivoa.net/xml/VOEvent/v2.0"
  xsi:schemaLocation="http://www.ivoa.net/xml/VOEvent/v2.0 http://www.ivoa.net/xml/VOEvent/VOEvent-v2.0.xsd">
  <Who>
    <AuthorIVORN>ivo://psws/not_registered_yet</AuthorIVORN>
    <Author>
      <shortName>sys</shortName>
      <contactName>CDPP</contactName>
      <contactPhone></contactPhone>
      <contactEmail>mail</contactEmail>
    </Author>
    <Date>2018_05_22T05:30:07</Date>
  </Who>
  <What>
    <Description>
      1D MHD Model of AMDA..Search with Condition : Dynamic Pressure > threshold
    </Description>
    <Param name="time_end" value="2018_05_22T09:00:00.000" dataType="string" ucd="time.epoch" />
    <Param name="event_type" value="1D MHD Prediction with Solar Wind prediction Model" dataType="string" ucd="meta.flag" />
    <Param name="url" value="localhost/return_files/votable2018_05_22T05:30:07.xml" dataType="string" ucd="meta.ref.url" />
    <Param name="threshold" value="0.2" dataType="string" ucd="phys.pressure" />
    <Param name="event_status" value="onset" dataType="string" ucd="meta.flag" />
    <Param name="time_start" value="2018_05_22T06:00:00.000" dataType="string" ucd="time.epoch" />
    <Group name="target">
      <Param name="target_name" value="jupiter" dataType="string" ucd="meta.id" />
      <Param name="target_class" value="planet" dataType="string" ucd="meta.id" />
      <Param name="target_region" value="Not applicable" dataType="string" ucd="meta.id" />
    </Group>
  </What>
```

```xml
<WhereWhen>
  <ObsDataLocation>
    <ObservatoryLocation>
      <AstroCoordSystem/>
      <AstroCoords/>
    </ObservatoryLocation>
    <ObservationLocation>
      <AstroCoordSystem/>
      <AstroCoords>
        <Time unit="s">
          <TimeInstant>
            <ISOTime>2018-05-22T05:30:07</ISOTime>
          </TimeInstant>
        </Time>
      </AstroCoords>
    </ObservationLocation>
  </ObsDataLocation>
</WhereWhen>
<How>
  <Description/>
</How>
<Why>
  <Concept/>
  <Description>1D MHD Tao Model</Description>
  <Name>jupiter</Name>
</Why>
<Description>
</Description>
</voe:VOEvent>
```

CDPP

Welcome to PSWS Alert Server

The CDPP (Centre de Données de la Physique des Plasmas,(http://cdpp.eu/), the French data center for plasma physics, is engaged for two decades in the archiving and dissemination of plasma data products from space missions and ground observatories.

Under Horizon 2020, the Europlanet Research Infrastructure includes PSWS (Planetary Space Weather Services), a set of new services that extend the concepts of space weather and space situation awareness to other planets of our solar system. One of these services is an **Alert service** associated with solar wind prediction made using the CDPP Heliopropa service (http://heliopropa.irap.omp.eu), detection of meteor shower, lunar flash and cometary tail crossing.

This Alert service, is based on **VOEvent**, an international standard proposed by the IVOA and widely used by the astronomy community. The VOEvent standard provides a means of describing transient celestial events in a machine-readable format.

VOEvent is associated with VTP, the VOEvent Transfer Protocol that defines the system by which VOEvents may be disseminated to the community.

VTP is managed with Comet, a freely available and open source software. Comet is used by PSWS for its Alert service and several partners of PSWS, including the CDPP and Observatoire de Paris.

Register to receive alerts from PSWS

http://alerts-psws.irap.omp.eu/

CDPP   irap   eur PLANET
astrophysique & planétologie

DEPLOYMENT

Comet
(http://arxiv.org/abs/1409.4805)
  Used as Broker to receive and re-send VOEvents
  Used as Author to send VOEvents
  Written in Python 2.7

Docker
  Use of containers facilitates the development
  and deployment
Web server in Python
  Flask (light python framework) & Nginx

Comet broker

container : comet

VTP

**Read
VOevent**

**Write
VOevent**

Shared Volume

Web server (Flask)

container : app