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Joining the yellow hub: Uses of the Simple Application Messaging Protocol in Space Physics analysis tools

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ABSTRACT

The interest for data communication between analysis tools in planetary sciences and space physics is illustrated in this paper via several examples of the uses of SAMP. The Simple Application Messaging Protocol is developed in the frame of the IVOA from an earlier protocol called PLASTIC. SAMP enables easy communication and interoperability between astronomy software, stand-alone and web-based; it is now increasingly adopted by the planetary sciences and space physics community. Its attractiveness is based, on one hand, on the use of common file formats for exchange and, on the other hand, on established messaging models. Examples of uses at the CDPP and elsewhere are presented. The CDPP (Centre de Données de la Physique des Plasmas, http://cdpp.eu/), the French data center for plasma physics, is engaged for more than a decade in the archiving and dissemination of data products from space missions and ground observatories. Besides these activities, the CDPP developed services like AMDA (Automated Multi Dataset Analysis, http://amda.cdpp.eu/) which enables in depth analysis of large amount of data through dedicated functionalities such as: visualization, conditional search and cataloging. Besides AMDA, the 3DView (http://3dview.cdpp.eu/) tool provides immersive visualizations and is further developed to include simulation and observational data. These tools and their interactions with each other, notably via SAMP, are presented via science cases of interest to planetary sciences and space physics communities.

1. Introduction

With the growing amount of data from both observational and modeling origins, data centers are forced to develop and ease data access and scientific exploitation. This goes not only through user friendly data bases but also through the procurement of dedicated tools which are the key to optimal science return. In planetary sciences and space physics the study of a particular object (e.g. planets, moons, comets, solar wind, etc.) is seldom performed using a single dataset; on the contrary it is indeed through the combination of multiple dataset of heterogeneous origins that new insight can be gained. However designing a single analysis tool holding all functionalities to tackle this large variety of data would be unreachable; more reasonably and efficiently, the current trend is to couple or interoperate specifically designed tools. Data communication between these tools or software then remained the key to have such an organization working on a large scale. This is the frame of common protocols to which IVOA (International Virtual Observatory Alliance) has long been committed.

In this paper we show how one of these IVOA protocols, the Simple Application Messaging Protocol or SAMP, has been efficiently used outside its originating community (astronomy) to address

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2213-1337/

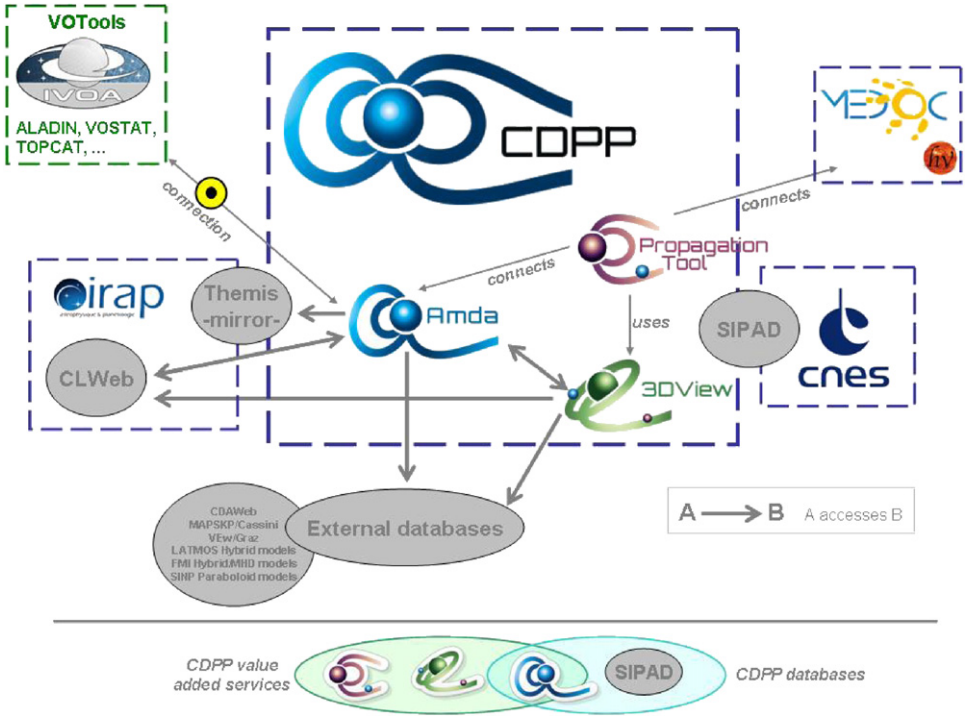

Fig. 1. CDPP is an ensemble of databases and services in interoperable connection with external centers and tools.

science cases applied to space physics. The focus is therefore not on the specificity of the protocol, but rather on its practical use, to show how it enables easy data communication between tools. We take advantage of such uses at the French Plasma Physics Data Centre (CDPP) (Génot et al., 2013a), but also companion tools, to present adequate science cases. Further technical information on SAMP may be obtained directly from IVOA http://www.ivoa.net/documents/SAMP/. The paper starts by shortly presenting the CDPP tools involved, and continues with a short note on SAMP, before proceeding to the science cases.

2. CDPP: a short presentation

2.1. CDPP and interoperability

Since its creation by CNRS and CNES in 1998, the French Plasma Physics Data Centre (CDPP) has a continuous strategy to develop analysis tools for the wider space physics community. If data distribution and scientific tool development are at the core of CDPP activities, they will not reach their goal if they were not entangled in an international web of efforts. Several consortia indeed aim at unifying data description (or data model) and data communication (or protocols) in order to assemble interoperable bricks of services. The main actors are namely: IVOA (http://www.ivoa.net/) in the general astronomy field, IPDA (http://planetarydata.org/) where planetary science issues are discussed between space agency, SPASE (http://www.spase-group.org/) in the space physics field. At the French level ASOV (http://www.france-vo.org/) coordinates the national effort.

In the recent year European FP7 projects have given an important frame for designing and implementing new standard and protocols.

In Europlanet-RI, the CDPP team participated with the VO-Paris team to the development of PSR-DM (Planetary Science Resource Data Model) and EPN-TAP (Europlanet-Table Access Protocol), both based upon IVOA standards. These data model and protocol are now used to share more and more datasets in the domain of planetary sciences (Erard et al., 2014a,b) using IVOA existing standards and infrastructure. At the same time, AMDA has turned SAMP compatible which enabled its connection to external tools such as Aladin, Topcat and query databases such as APIS (http://lesia.obspm.fr/apis/); this is demonstrated here in science cases section. Tutorials (as video or manual) of how this interplay can be performed are also available on the CDPP tutorial page.

In IMPEx (see a detailed project description at http://impex-fp7.oeaw.ac.at/) and (Génot et al., 2013b) the CDPP participated to the development of a simulation data model together with the LATMOS (documents are available at http://impex-fp7.oeaw.ac.at/documentation.html). This model, which is a SPASE extension, enables to describe simulation and analytical model results in a common way which is a prerequisite to build interoperable services on heterogeneous databases.

Fig. 1 presents how CDPP databases and tools are interlinked and connected to the outside world. Some of these value added services and databases are discussed in the next pages.

2.2. Tools at CDPP

Since 2006 and the development of the AMDA tool, CDPP followed its strategy to increase data exploitation. It led to the development of several tools both internally and by the means of close cooperation between CDPP researchers and SME.

AMDA: http://amda.cdpp.eu/

AMDA is developed at CDPP since 2006 (Jacquey et al., 2010; Génot et al., 2010). Its initial aim was to provide visualization capabilities to Earth magnetosphere data. Quickly it was enriched by a data mining tool and the functionality for the user to define its own physical parameters. The central philosophy is that the user manipulates parameters and does not directly manipulate files. The tool therefore acts both as a data base and a tool as its data holding has been progressively increased to include those from a wide variety of heliophysics missions. Recently in the frame of the FP7 IMPEx project access to simulation and model data has been also provided via AMDA.