#### **CAESAR:** Space Weather archive prototype for ASPIS

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**Abstract.** The project CAESAR (Comprehensive spAce wEather Studies for the AS-PIS prototype Realization) is aimed to tackle all the relevant aspects of Space Weather (SWE) and realize the prototype of the scientific data centre for Space Weather of the Italian Space Agency (ASI) called ASPIS (ASI SPace Weather InfraStructure). This contribution is meant to bring attention upon the first steps in the development of the CAESAR prototype for ASPIS and will focus on the activities of the Node 2000 of CAESAR, the set of Work Packages dedicated to the technical design and implementation of the CAESAR ASPIS archive prototype. The product specifications of the intended resources that will form the archive, functional and system requirements gathered as first steps to seed the design of the prototype infrastructure, and evaluation of existing frameworks, tools and standards, will be presented as well as the status of the project in its initial stage.

### 1. Introduction

The Italian Space Agency (ASI) has produced (Plainaki et al. 2020) a Space Weather (SWE) roadmap for a long-term strategy to support the future scientific research of SWE, and the development of a related national scientific data centre for Space Weather, called ASI SPace Weather InfraStructure (ASPIS), while reinforcing the interactions and synergies among the SWE and Planetary Space Weather (PSW) Italian groups, and

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organizing them in a strong collaborative environment. The CAESAR<sup>1</sup> (?) project was selected to reach such goals. CAESAR is coordinated by the National Institute of Astrophysics (INAF) and the project's partners span two more national institutes (INGV & INFN) and seven universities (Tor Vergata – Rome II, Perugia, Genova, L'Aquila, Calabria, Catania, Trento). CAESAR will focus on the whole chain of phenomena from the Sun to the Earth up to planetary environments, selecting a number of well observed *target Space Weather events* for detailed and comprehensive studies in order to showcase the proposed approach.



Figure 1. CAESAR Node 2000 WBS.

The archive prototype itself will be designed and developed by the *Node 2000* (see Fig. 1) group of the CAESAR's Work Packages (WPs), i.e. three high level WPs (they will be described by their *pillar* activities in Sec. 2) that will provide the database, the interfaces on top of it and the metadata it all relies upon.

# 2. ASPIS prototype

The CAESAR ASPIS prototype implementation will be hinged on three main pillars (their interconnection and connection to scientific project's WPs can be seen in Fig. 2):

- **Database** (DB) managed by WP2100, taking care of the design and implementation of the DB as well as the ingestion process;
- **Interface** managed by WP2200, that will define the API sitting on top of the DB as well as a web GUI for basic usage of the archive and a, more advanced, python module (*ASPIS.py*) to consume the archive's content;

<sup>&</sup>lt;sup>1</sup>https://caesar.iaps.inaf.it/



**Metadata** managed by WP2300, that, besides taking care of the documentation, is devoted to collect and map all data, metadata and products contributed to CAESAR by the data providers among its partners.

Figure 2. High Level architecture of the CAESAR ASPIS prototype. Solid lines show access paths; double ones indicate requirements provided by the research community (and double dashed the provided template for product description); dashed lines show collection of documentation.

The ASPIS DB will contain mainly proprietary/co-proprietary products, with their relative data policy in a homogeneous, standardised collection of resources. Other important external data shall be accessed through links to existent archives. A set of 75 main products were identified in the proposal, spanning calibrated data, derived ones, models and tools. Currently collected sample data and descriptions cover about a half of the above, for a, finer grained, current total of more than 100 among data collections, data models and tools. The DB status is in its *pilot* phase, with a relational database structure that has been defined and is about to be populated using sample data and metadata from the collected products. To collect products metadata specifications and sample datasets from the contributed products there was a requirement to have both:

- a way to save product metadata information in a machine useful format;
- a solution that suited scientific researchers without getting lost in technicalities.

For this reason a tool based on JSONForms<sup>2</sup> (see next Sec. 3) has been developed.

# 3. Product Specifications

*ProSpecT* (*Pro*duct *Spec*ification *T*emplate<sup>3</sup>) is a tool that leverages on JSON Schema technology and JSONForms to provide a web interface to describe a "Product" (i.e.

<sup>&</sup>lt;sup>2</sup>https://jsonforms.io/

<sup>&</sup>lt;sup>3</sup>http://prospect-caesar.ssdc.asi.it/

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a *Resource* in general web jargon) and generate a JSON object that contains all the required metadata. The metadata schema (i.e. *template* here) is written in JSON and is used, referenced by JSONForms elements, to generate the web form to be filled in by product providers. The output of the form is the desired JSON metadata instance describing the relevant product. The metadata content has been mimicked from the IVOA VOResource(Plante et al. 2018, and its extensions) standard adapted to the needs and peculiarities of the CAESAR project. The collected JSON descriptions of the about 100 products have already been used to generate wiki-like pages for documentation and to inspect formats and metadata details to be used in setting up the pilot of the database prototype.

### 4. Database, Interfaces, Metadata

The design of the database for the CAESAR prototype, starting from considerations driven by the collected metadata and the requirements to study the chain of phenomena from the Sun to Earth and planetary environments, has to face the (common) metadata and data dis-homogeneity. It also has to include a way to store and manage the interconnections of phenomena, following Space Weather events from the solar starting point through the interplanetary medium, up to Earth, planetary environments and satellites. The pilot database design has already being done and, on top of that, interface solution and user interfaces are under development. Users will have two ways to access the database: through a graphical web interface to rapidly discover, access, visualise and compare data and/or models, or through ASPIS.py, a python module connected to more general heliospheric and solar physics python libraries (e.g. SunPy).

## 5. Where from here

The CAESAR project has about another year of development to provide a final prototype for the ASPIS data infrastructure. In this remaining time span data and metadata ingestion on the pilot prototype will happen, together with interfaces setup. After that, based on feedback on usage and lessons learned, a subsequent refinement of the design will happen, leading to the final data and metadata ingestion and full prototype deployment to be handed back to ASI.

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1, 1 VOA Recommendation 25 June 2010