The Heliophysics Integrated Observatory  
HELIO

Robert Bentley (Project Coordinator)  
and the HELIO Team

http://www.helio-vo.eu

(SWWT, June 2010)

Introduction

• HELIO, the Heliophysics Integrated Observatory, is a Research Infrastructure funded under EC’s FP7 Capacities Specific Programme
  • Started 1 June 2009, duration 36 months  
  • Consortium includes 13 partners from 7 countries

• HELIO will provide the heliophysics research community with an integrated e-Infrastructure that has no equivalent anywhere else
  • HELIO will provide the ability to identify interesting phenomena and access relevant solar and heliospheric data together with related magnetospheric and ionospheric data (for planets with magnetic fields and/or atmospheres)
  • Need for capability driven by desire to study problems that span disciplines
  • Search base on metadata increasingly important as data volumes increase

• HELIO will address its challenges following the Integrated Infrastructure Initiative (I3) activities model of the EC’s Framework Programme:
  • Networking Activities used to involve the community  
  • Service Activities used to implement structure of the virtual observatory  
  • Research Activities used to investigate/develop required capabilities
Context and Communities

- **Heliophysics, an event-driven science**
  - Something is observed and desire is to trace origins or subsequent effects

- **Nature of effect depends on causal phenomenon, type of emission, and the location of the observer**
  - Most effects have origins in emissions from solar activity
    - Some effects related to propagating phenomena resulting from activity
  - Immediate and delayed effects result from the different types of emission
  - Location of observer in relation to the source and with respect to a planet determines what is observed

- **Presence of magnetic field and/or atmosphere influences effect on planetary environment**

Implementation – Service Activities

- **HELIO is based on a Service-Oriented Architecture**
  - Series of search metadata services covering the different domains
    - All types of Event and Feature metadata available
    - Context information helps user to refine selection – images, time series, etc.
  - Services to identify and retrieve observations based on search results
    - Determines whether suitable observations were made at particular time/place
    - Knows which data are stored where and how to access them
  - Enabling services provide other required capabilities
    - Processing, storage, tracking of performance and usage, authentication, etc.

- **High-level service provides enhanced search capability**
  - Facilitates metadata search across domains for interesting events
  - Propagation model available to relate metadata from all part of Solar System
  - HELIO GUI sits on top of the API to this service

- **Services can be used individually or combined through workflow capability**
  - Workflows useful to define standard (canned) or repetitive set of tasks
    - Baseline workflow tool is Taverna – should be possible to use others

- **Semantic-driven approach** used to integrate data from different domains
  - Based on ontology derived from existing data models
SO Architecture

HELIO being implemented with a service oriented architecture

- Identify interesting things
  - Heliophysics Event Catalogue (HEC)
  - Heliophysics Feature Catalogue (HFC)
  - Metadata Evaluation Service (MDES)
  - Context Service (CXS)
  - Auxiliary Information Service (AIS)
  - Propagation, etc. models

- Match to observations
  - Instrument Capabilities Service (ICS)
  - Instrument Location Service (ILS)
  - Observation Coverage Service (OCS)
    - Observation Coverage Table
    - Unified Observing Catalogue

- Locate and retrieve data
  - Data Provider Access Service (DPAS)
    - Provider Access Table

Workflows...

- Within event selection, the user may iterate using several services and tools until they are satisfied. Models help relate things in time and space.

- Other services then help the user go from a list of interesting times and locations to a list of instruments and times to a list of files.

- The user can then retrieve the files they need to address their science problem
Status and Networking

- **Status**
  - HELIO being developed as a series of Releases
  - Working prototypes of several service, etc. already available
    - HEC, ICS & ILS, DPAS and HRS
    - Hand-crafted Workflows executed on Workbench on user’s system
      - Waiting for Taverna Server before they can be “invisible to the user”
    - Simple user interface
  - Lists of metadata and data that could be added

- **Networking**
  - Need to start to implement a series of User Groups
    - Users that will help define Use Cases and system requirements
    - Users that will test and validate the system (over the duration of the project)
  - First CDAW planned for November 2010
    - Will allow us to demonstrate capabilities and get feedback
    - Driving/prioritizing the selection of metadata, data and services
  - Email user_groups@helio-vo.eu if you are interested

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Coordination Action for the integration of Solar System Infrastructures and Science

**CASSIS**

Robert Bentley (Project Coordinator) and the CASSIS Team

[http://www.cassis-vo.eu](http://www.cassis-vo.eu)

(SWWT, June 2010)
CASSIS is a Coordination Action funded under Research Infrastructures within the Capacities programme of FP7
- Started 1 June 2010, duration 36 months

CASSIS intended to facilitate science within the Solar System by improving the interoperability between data and services in all domains

CASSIS brings together three projects that are directly relevant to this issue
- HELIO, EuroPlanet RI and SOTERIA – all funded under FP7
- Relevant partners from each project, plus other key groups

Desire is to engage as many other groups as possible in the discussions, from Europe and the rest of the world

Web site: http://www.cassis-vo.eu

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Background

Solar System Science has traditionally been undertaken within a number of separate disciplines
- Many aspects of the system are inter-related
- Difficult to address them because of the lack of the integrating tools and techniques

Advances in technology means that the intrinsic differences between disciplines are being addressed
- Manifest by differing data formats and other dependencies

Three FP7 projects – HELIO, EuroPlanet RI & SOTERIA.
- Each is making significant improvements to the infrastructure that supports their communities, increasing ability to do science
- Necessary to coordinate the efforts of these and other projects in order to help break down the inter-disciplinary boundaries barriers

CASSIS intended to take things to the next level by cooperating in a number of areas
- Enabling new combinations of interdisciplinary studies
Cooperation & Discussion

- Areas of cooperation include:
  - Investigating ways to improve the interoperability between data and metadata from the domains, and the possibility of sharing services, including metadata resources.
  - Coordinating the use of standard within the projects and reflect any changes that are required to organizations like the IVOA and IPDA.
  - Coordination of the dissemination activities of the projects in order to create a more coherent and comprehensive approach

- Two principle means of discussion:
  - Community Consultation Meeting will be used to gather input from the wider community
  - *Vision for Solar System Science Workshops* are planned to bring key players together in order to lobby the case for solar system science with the decision makers and funding agencies

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Participants in CASSIS

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<thead>
<tr>
<th>Short Name</th>
<th>Organization</th>
<th>Country</th>
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<tbody>
<tr>
<td>UCL</td>
<td>University College London (MSSL and Physics &amp; Astronomy)</td>
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<tr>
<td>KULeuven</td>
<td>Katholieke Universiteit Leuven</td>
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<td>NASA</td>
<td>GSFC Heliophysics Science Division</td>
<td>US</td>
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Participants include groups from the three project – HELIO, Europlanet RI and SOTERIA. Groups from the US were added during the negotiation phase. CASSIS interested in broadening the international aspects of the project by extending invitations to key organisations elsewhere. Whether other disciplines should be included is being considered – e.g. terrestrial climate studies.
HELIO’s perspective of a Generic Problem

- Identify interesting things to study
  - *Search based solely on metadata and derived products*
    - Event lists and feature lists used as primary selection criteria
  - *Search undertaken in 4-Dimensions across several domains*
    - Effects occur as phenomena propagate – whether, where and when to look
    - Follow phenomena through coordinate systems as they evolve

- Review availability of suitable observations
  - Determine whether suitable instruments at the relevant locations
    - Science objectives dictate types of observations required
  - Determine whether instrument was making observations
    - Coverage and quality of observations are additional selection criteria

- Locate, select and retrieve the required observations
  - For all domains, system knows which types of data are held where and handles access no matter how data are stored (access protocols & formats)
  - Optionally process selected observations (extract and calibrate)
  - Optionally return data in different/desired format

- Analysis done with users own software tools (e.g. IDL)
In addition to the services used to identify interesting events and then find and retrieve the data, there are a number of Enabling Services. These provide capabilities such as processing, storage, security, etc.

The HELIO Web pages will provide more information as services are developed: [http://www.helio-vo.eu/](http://www.helio-vo.eu/)

### Defined Services

<table>
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<tr>
<th>Service Name</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>Search Metadata</td>
<td>Maintain and provide access to existing event data from all domains</td>
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<tr>
<td>Heliophysics Event Catalogue (HEC)</td>
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<tr>
<td>Heliophysics Feature Catalogue (HFC)</td>
<td>Maintain and provide access to existing feature data from all domains</td>
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<td>MetaData Evaluation Service (MOES)</td>
<td>Allows the user to create an auxiliary event list based on a newly-derived parameter, etc.</td>
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<td>Context Service (CKS)</td>
<td>Provide context information to help the user make a selection</td>
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### Enabling Services

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<tr>
<td>HELIO Registry Service (HRS)</td>
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<td>Community Interaction Service (CIS)</td>
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<td>Processing Service</td>
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<td>Storage Service</td>
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<td>Coordinate Transformation Service (CTG)</td>
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<td>Semantic Mapping Service (SMS)</td>
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<td>HELIO Monitoring Service (HMS)</td>
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<td>Resource Usage Service (RUS)</td>
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### The HELIO Consortium

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<tr>
<th>Country</th>
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<tbody>
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<td>Int.</td>
<td>European Space Agency (Science Operations Dept., Space Environment &amp; Effects Dept.)</td>
<td>L. Sanchez</td>
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- Several partners have extensive knowledge of the domains of heliophysics and experience in managing and archiving their data
- Others provide expertise in different areas of computer science and also have some familiarity with handling data
Work Packages

- **WP1 – Project Management**
  - General management of the project

- **WP2 – Interoperability of Data and Services**
  - Looking at ways of improving the quality and contents of metadata and data in order to improve interoperability
  - Examining ways of sharing services

- **WP3 – Networking**
  - Talking to the community to determine user requirements, etc.
    - Community should be varied and as international as possible

- **WP4 – Dissemination**
  - Producing various outreach activities at the international level
    - Web Portal, European Solar System Media Centre
    - Vision for Solar System Science Workshops
      - Invite key players and the national, European and international level