International Community Coordination in Space Weather

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Two world-wide initiatives that will benefit from coordination with ISWI

- COSPAR International Space Weather Action Teams (ISWAT)
- International Heliophysics Data Environment Alliance (IHDEA)

COSPAR ISWAT:
A Grass-roots Community-coordinated Initiative

- Establish and coordinate active network of topical focused collaborations*: International Space Weather Action Teams – ISWAT*
- Organize task-oriented community-wide *Campaigns and Working Meetings*.
- Create a dynamic environment that encourages *active participation, emergence of new leads, and innovation*
- ***"Joining forces to advance space weather understanding and capabilities to shield society"***

GLOBAL COMUNITY FORUM

GLOBAL COMMUNITY VOICE

What is an ISWAT Team?

- An *action team* is a building block of the ISWAT initiative.
- Action teams are organized into *ISWAT clusters* (see next slide)
- An *action team* focuses on a specific task relevant to *cluster goals*.
- *Focused tasks* can address different aspects of SWx capabilities:
  - Sharing and utilizing available observations
  - Inputs for future mission planning, instrumentation deployment
  - Assessment of SWx forecasting and analysis capabilities
  - Advancing understanding, theory, and modeling
  - Transitioning research advances to space weather applications
- Team's work is organized by *action team leads/co-leads*.
- ***Team leads* are not appointed, they *emerge***

What is an ISWAT Cluster?

- *ISWAT clusters* group teams by domain (e.g., Sun, Heliosphere, Geospace), phenomenon (e.g., SEP, CME, irradiance), driver (input to heliosphere/geospace), or impact (e.g., GICs).
- Clusters allow existing international teams to participate and build upon established efforts.
- An action team can belong to different clusters (e.g., solar irradiance could join Geospace and Sun clusters).
- *Cluster moderators* coordinate teams' activities, interface with other clusters, organize community-wide campaigns and meetings

S: Space weather origins at the Sun

Solar output
Input to heliosphere and geospace

S1: Long-term solar variability.

S2: Solar magnetic field, heating & spectral irradiance.

S3: Solar eruptions:
(a) flares and enhanced electromagnetic emissions;
(b) high energy particle fluxes;
(c) CMEs

H: Propagation of transient through evolving ambient heliosphere

input to geospace

H1: Evolving ambient heliosphere.

H2. CME structure, evolution and propagation through heliosphere.

H3. SEPs in heliosphere.

G: Coupled magnetosphere Ionosphere-atmosphere (geospace) system

response to solar drivers

G1: Geomagnetic environment.

G2a: Atmosphere variability.

G2b: Ionosphere variability.

G3: Near-Earth plasma and & radiation (b) environment.

Impacts and primary user groups

Climate

Electric power systems, GICs

Satellite/debris drag

Navigation Communications

(Aero)space assets functions

Human exploration

Overarching Activities: EO: Education and Outreach

TE: Testing and Evaluation IA: Information Architecture DU: Optimized Data Utilization

Examples of Near-Term Projects

- **S2, H1:** Ambient corona and solar wind modeling challenge. Assess uncertainty of magnetic connectivity spacecraft mapping. Compare coronal-hole detection schemes.
- **H1, H2:** 3D structure of Coronal Mass Ejections (CME). CME propagation through ambient heliosphere and parameters at L1.
- **G1:** Role of drivers and coupling for GICs. Assess GIC spike modeling capabilities for different stages of geomagnetic storms.
- **G2B:** Traveling ionosphere disturbances & scintillations - assessment of predictive capabilities. Ionospheric activity indices based on user needs.
- **G3:** Design and develop Essential Space Environment Quantities for near-Earth radiation and plasma environment based on user needs.
- **All:** Participate in Whole Heliosphere and Planetary Interactions campaigns

WHPI: A campaign ideal for ISWI participation

- Previous 2 campaigns focused on Sun-solar wind (WSM, 1996) and Sun-solar-wind-geospace (WHI, 2008).
- We are approaching the *end of solar cycle 24*, with an unprecedented range of operating ground- and space-based instruments.
- **Whole Heliosphere and Planetary Interactions (WHPI) campaign broadens the emphasis to include planetary magnetospheres and atmospheres, particularly planetary space weather.**
- **Upcoming campaigns:**
  - "Total Solar Eclipse Campaign" *Jun 29 - Jul 26 2019*, Carrington Rotation 2219
  - "Parker Solar Probe 4th Perihelion Campaign" *Jan 6 - Feb 2 2020*, CR 2226
- Sign up online! https://whpi.hao.ucar.edu/whpi_getinvolved.php

Understanding and predicting space weather is a global challenge

Unite: Join ISWAT!

ISWAT initiative is open to all individuals and groups committed to active participation.

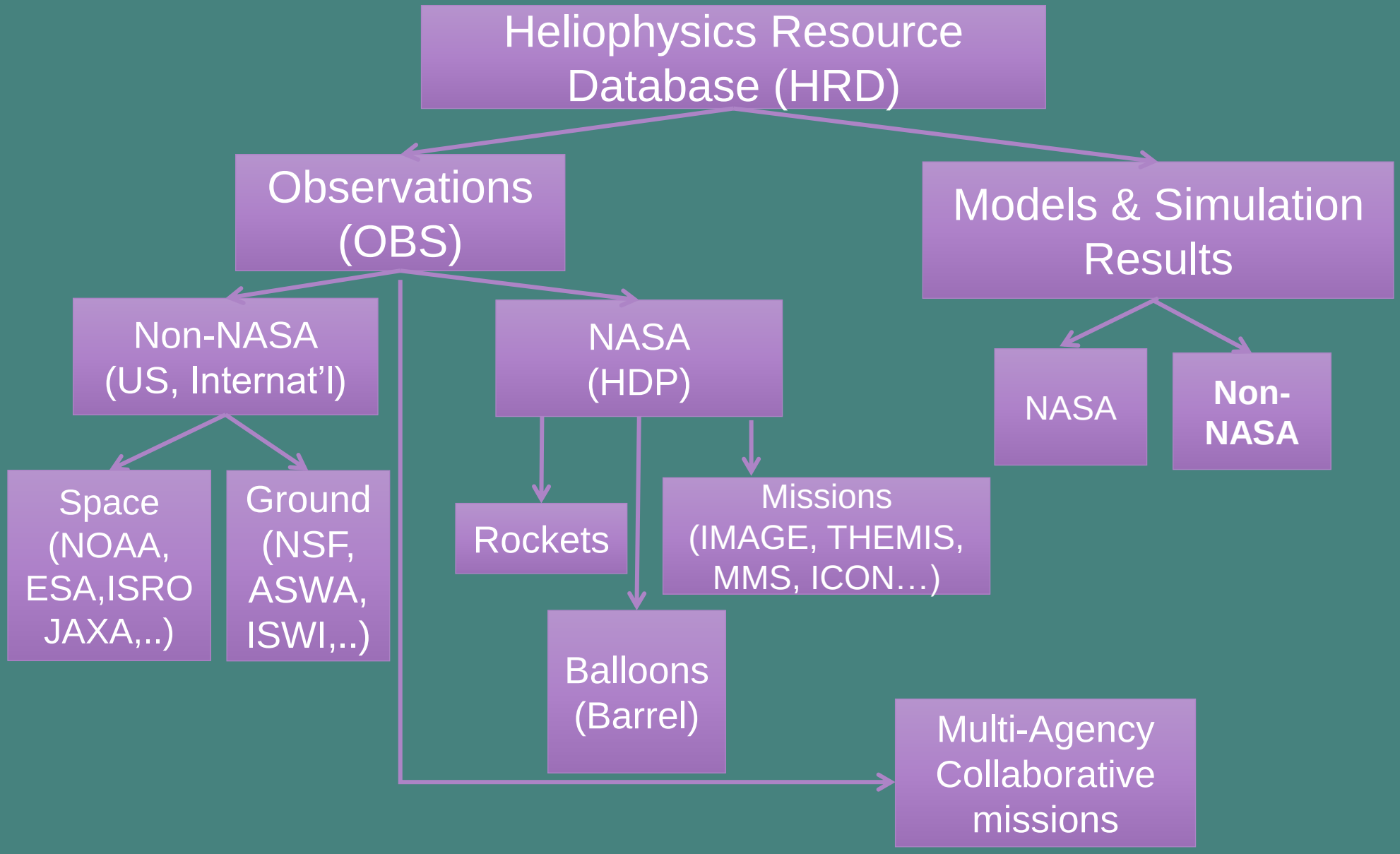
- To join an already registered action team: contact team leads.
- To register a new topical action team: contact topical cluster moderator

GLOBAL COMMUNITY HUB

http://ccmc.gsfc.nasa.gov/iswat

GLOBAL COMMUNITY VOICE

Heliophysics Resource Inventory

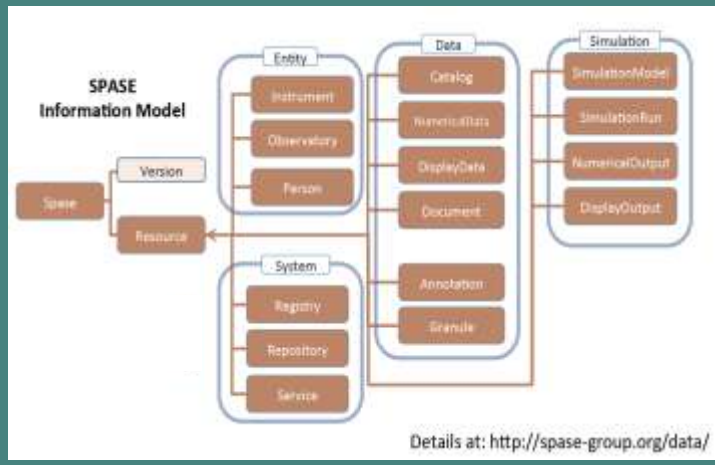


Space Physics Archive Search & Extract (SPASE)

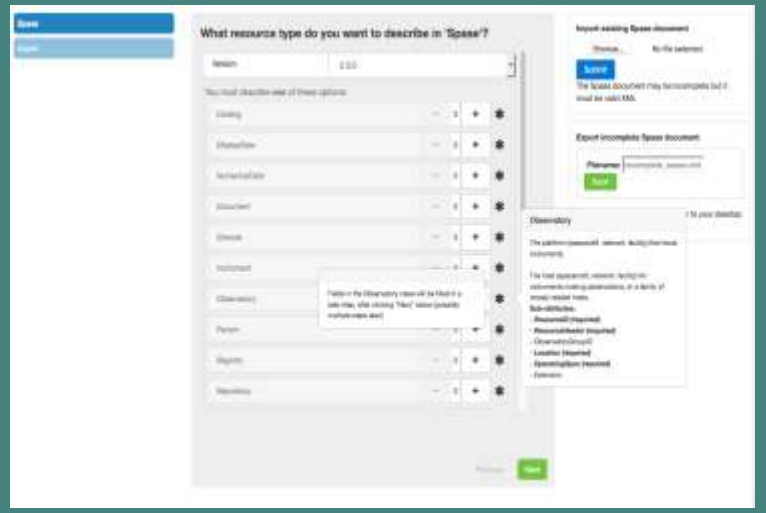
The SPASE consortium is an international community of scientists, specialists, information engineers, and system designers who are endeavouring to create standards and services that enable the open exchange of heliophysics data.

Descriptor Registry

Model Taxonomy



Web-Based Document Editor



SPASE model recently adopted by COSPAR!

The SPASE Metadata Working Team

NASA's effort to describe *all* electronically-accessible heliophysics data products, to track provenance and enable general access.

- Formed in 2016 by NASA Heliophysics Data and Model Consortium
- Supports the Heliophysics Data Environment
- Consists of SPASE Group members, scientists, information technologists, web developers, data archivists, etc.

Tasks:

- Create and maintain heliophysics data inventory (space- and ground-based; model data @ CCMC)
- Generate and register SPASE metadata descriptions
- Maintain a SPASE Registry to support data search and access

New Heliophysics Data Environment

Goal: *To enable efficient and effective data services* to locate, search, access, retrieve, deliver, and use needed heliophysics data

Challenge I: Diverse Data and User types

- Space-, ground-, and model-based
- Distributed data sources (national and international)

Challenge II: "Big Data"

- Instruments are becoming *data-intensive*, e.g.,
  - Solar Dynamics Observatory ~1.4TB/day (science telemetry)
  - MMS ~ 137 GB/day (higher-level science)
  - 100's-1000's ground stations, generating ~ GB/day/station
- Simulation output is also *data-intensive*

International Heliophysics Data Environment Alliance

Science is best served by "instant unfettered access to a wide array of datasets from distributed sources in a uniform, standardized format".*

- Consistent with the ***ISWI* Data Policy** (http://www.iswi-secretariat.org/)

The IHDEA is

- A logical extension of the NASA Heliophysics Data Environment (HPDE; https://hpde.gsfc.nasa.gov/)
- Analogous to other data alliances that pursue data interoperability in planetary, astrophysics, and earth sciences

** 2013-2023 Solar and Space Physics Decadal Survey report*

International Heliophysics Data Environment Alliance

IHDEA's goal: to *encourage the use of common standards and services* to enable data sharing and enhance science.

- **Standards (e.g.,SPASE metadata model and Heliophysics API (HAPI) access protocol) are key technologies that will:**
  - Support a seamless Heliophysics Data Environment
  - Enable the development of a Heliophysics Virtual Observatory
- **Toward this goal, the SPASE Metadata Working Team is:**
  - Compiling an inventory of all heliophysics-relevant data products
  - Generating SPASE metadata and descriptors
  - Maintaining a SPASE Registry to support data search and access

ISWI is an ideal partner in this effort!

Summary

Heliophysics and space weather research will benefit from effective international coordination and collaboration in access to data from space, ground, and models

- Subscribe to open data policies
- Adopt SPASE to describe data products and contribute to SPASE Registry
- Form or join ISWAT teams

- ISWI instruments feed important data to many ISWAT teams
- Data sharing and utilization of standard formats are critical for successful ISWAT collaborations.
- Start coordination/collaboration by joining campaigns such as WHPI.

Main Message

Together, ISWAT, IHDEA, and ISWI can accomplish much more than acting independently.

Coordinate and join forces!

Key websites:

- **ISWAT:** http://ccmc.gsfc.nasa.gov/iswat
- **WHPI**: https://whpi.hao.ucar.edu/whpi_getinvolved.php
- **ISWI data policy**: http://www.iswi-secretariat.org/
- **NASA's HPDE:** https://hpde.gsfc.nasa.gov
- **IHDEA:** www.ihdea.net