STEREO and the Virtual Heliospheric Observatory
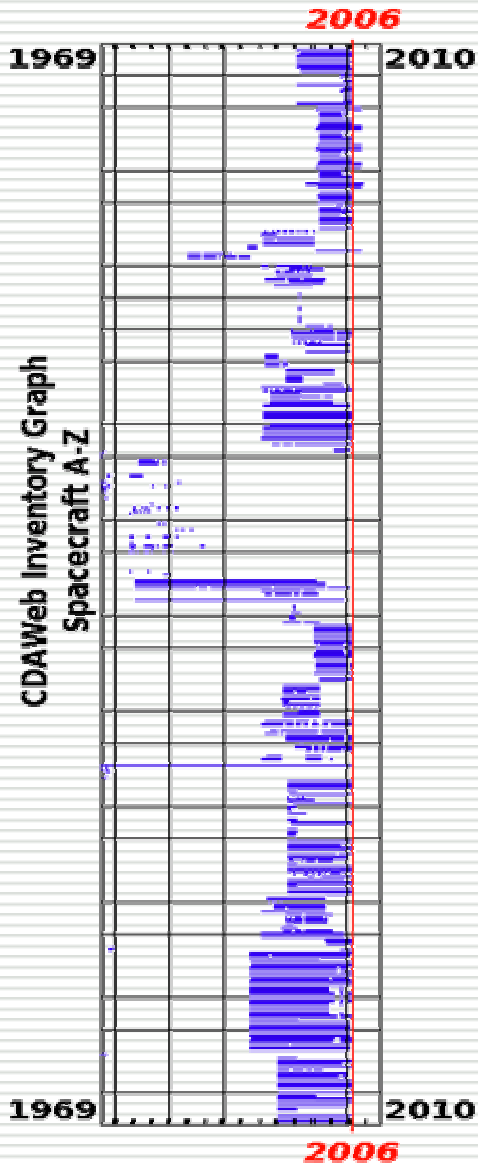
Tom Narock[1,2]   Adam Szabo[1]   Jan Merka[2]

(1) NASA/Goddard Space Flight Center

(2) L3 Communications, GSI

http://vho.nasa.gov

STEREO/Solar B Workshop - November, 2005

Scientific Quest is Changing

2006

1969 2010

CDAWeb Inventory Graph
Spacecraft A-Z

1969 2010

2006

- Past – In-depth single spacecraft studies

- Future – Study multi-spacecraft / multi-instrument local and remote sensing measurements

- STEREO

  - Multi spacecraft platform with remote and in-situ instruments

  - Addresses large-scale heliospheric structures so it would uniquely benefit from other platforms

Battle of WITS

- **W**: Where to find data?
- **I**: Integration of data from various sources is often difficult.
- **T**: Tools are needed to work with the data.
- **S**: Scientific perspective introduces additional questions:
  - Integration of distant heliospheric observations
  - Time-space propagation (what is a match?)
  - Integration of remote and in-situ measurements

Why Virtual Observatories ?

- Many datasets with large volumes

- Data sites distributed worldwide

- Stored in a variety of formats

- Accessible through a wide variety of interfaces
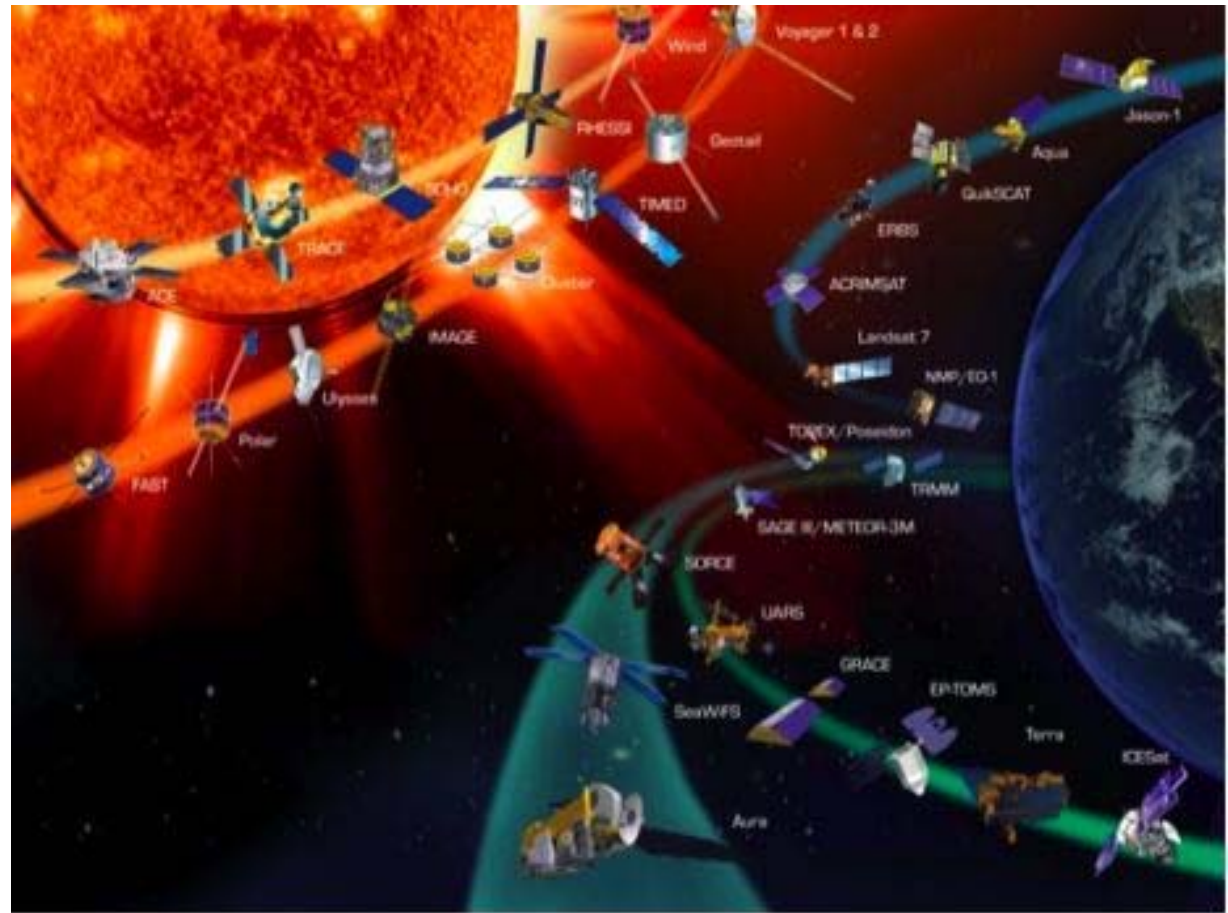
What is the goal of the VHO?

- Science based discovery of heliospheric data

- Unified, yet simple, environment to access all heliospheric data sets and tools

- Provide rapid community access to the highest quality processed data

VHO Design
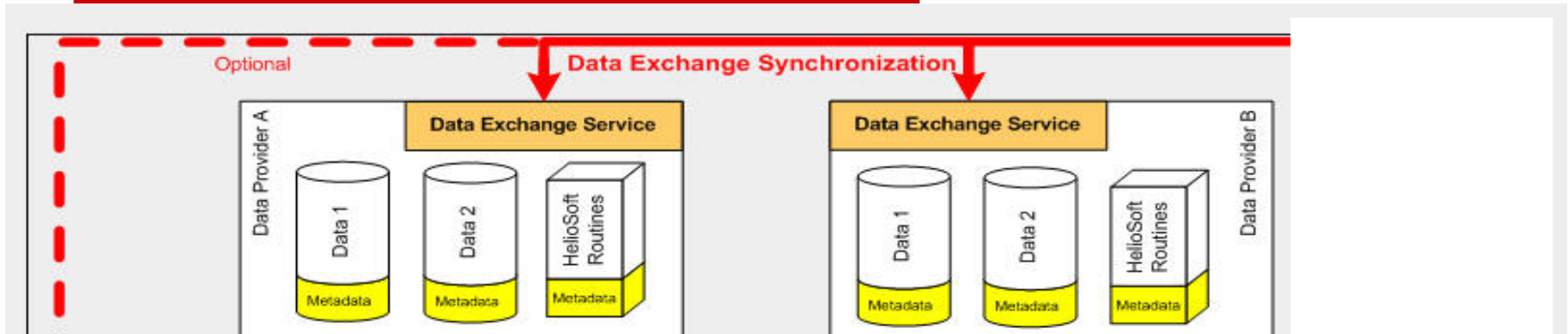
- Existing data providers plus new Metadata descriptions of data and data products
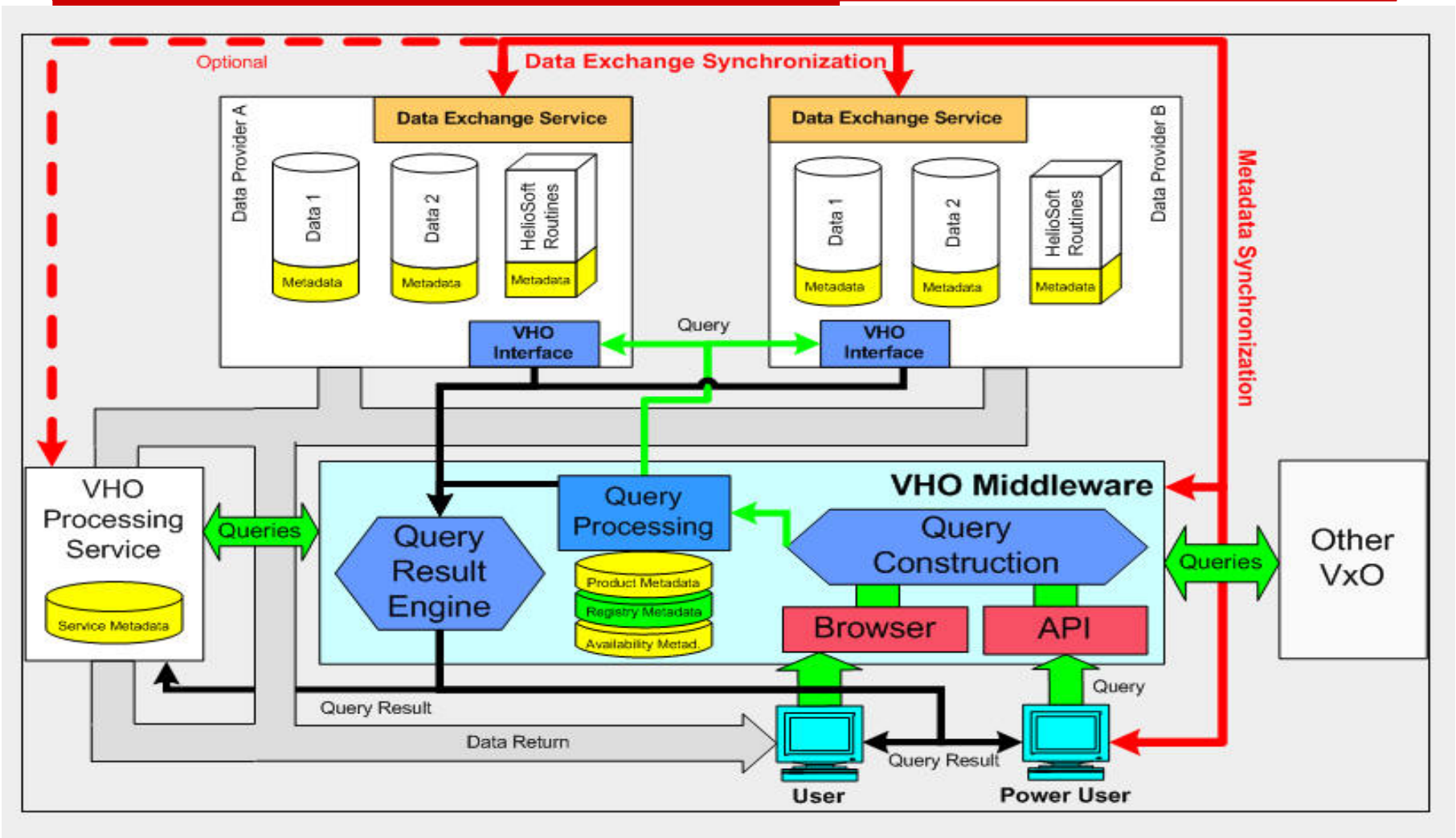
- SPASE dictionary

- Data Synchronization

VHO Design
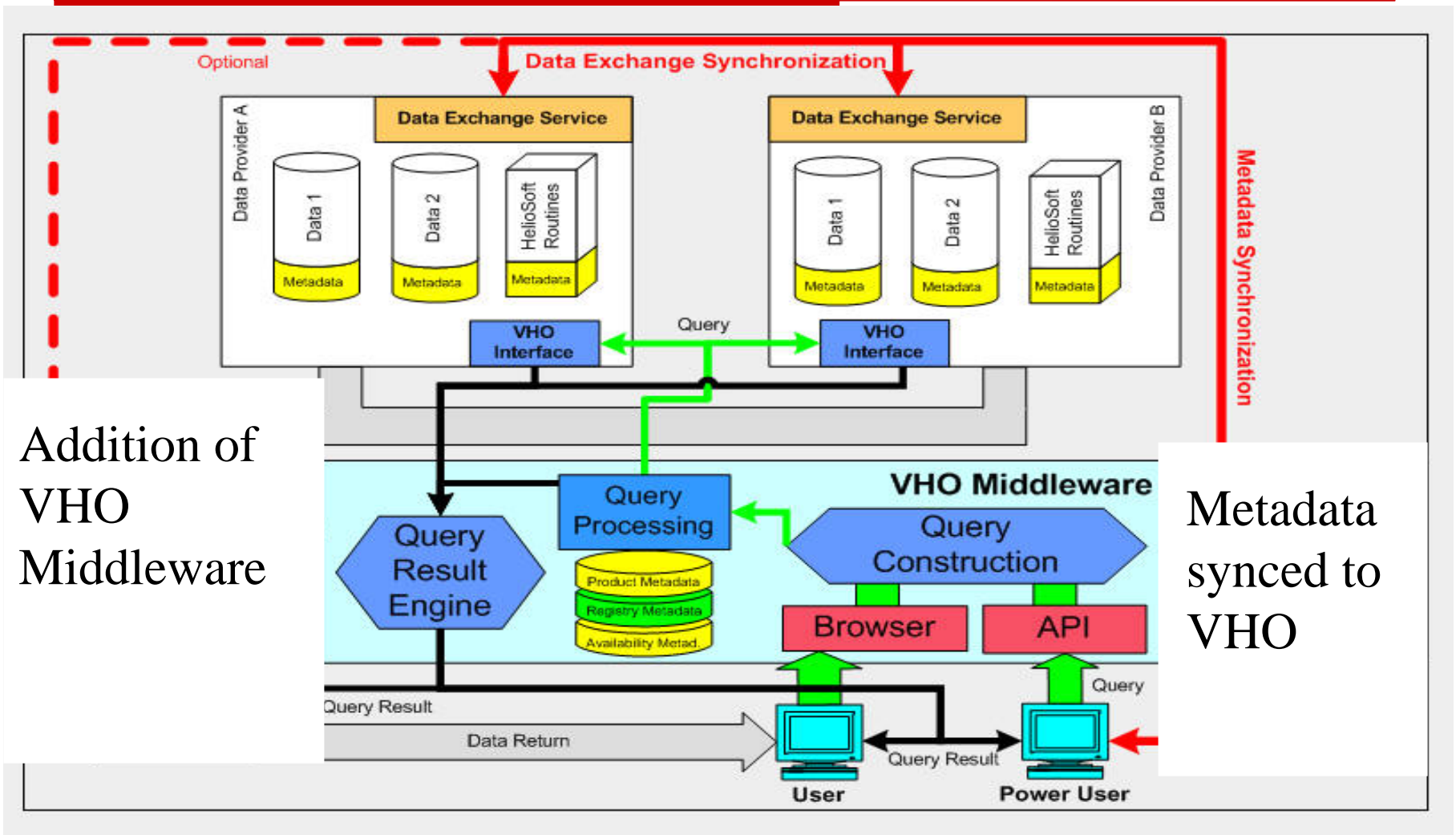
Addition of VHO Middleware
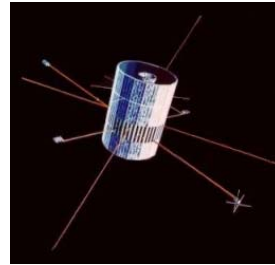
Metadata synced to VHO

VHO Design

Initial VHO Data Participants
8 Spacecraft - 13 Data Sets

ACE

- Magnetometer

- SWEPAM

IMP 8
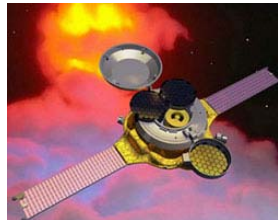
- Magnetometer

Genesis

- Mag. Field Proxy

- 3D Moments

SOHO

- Celias instrument

WIND

- MFI

- SWE

- ELPD

- PLSP

Helios 1 and 2
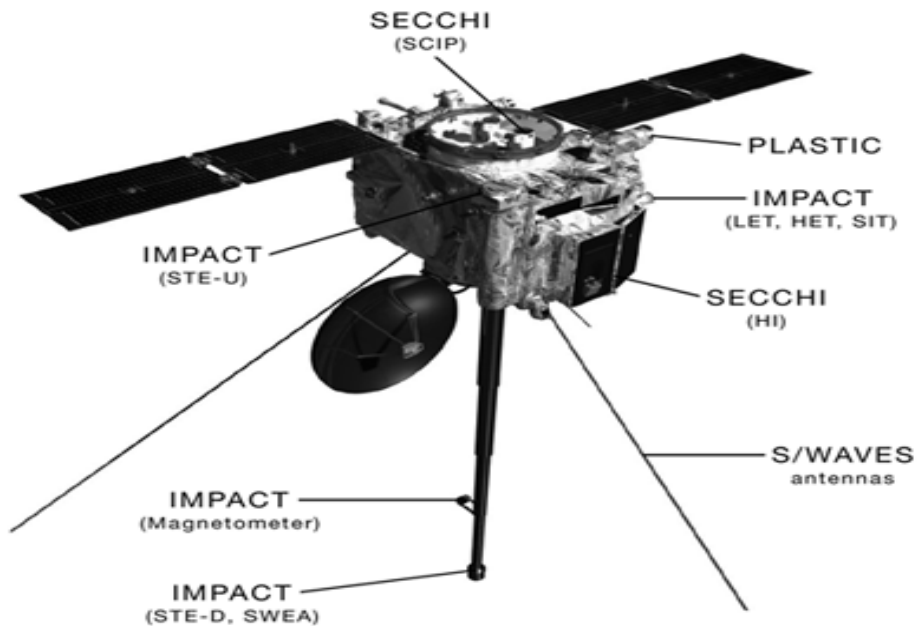
- Magnetometer

- Plasma instrument

Mars Global Surveyor

-Solar Wind Pressure Proxy

Addition of Instruments and Spacecraft
Total: 12 Spacecraft - 30 Data Sets

STEREO

- **IMPACT** - **PLASTIC**

Messenger

- MAG

- EPPS

Ulyssses

- VHM (mag field)

- BAI (ions)

- BAE (electrons)

Voyager

- MAG

Data Synchronization

WIND 3DP ⟷ WIND MFI → CCMC

WIND MFI → CDAWeb

- WIND 3DP processing requires most recent and highest quality MFI data

- Automated synchronization makes archiving requirements easier

VHO Member (red box)   **Data Recipient** (green box)

Current Types of VHO searches

☐   Science driven data searches:

<u>Time</u>	<u>Space</u>	<u>Measurement</u>
1. Date/Time	1. GSE	1. Magnetometers
2. Bartel Rotation	2. GSM	2. SW Plasma
	3. HGI	3. Particles/Moments
	4. Spatial Region	

<u>Other:</u> 1. Event Lists

☐   Spatial Region search allows for keyword search
examples :
Bow Shock to ~60 Re,   L1,   Inner Heliosphere (< 0.8 AU)
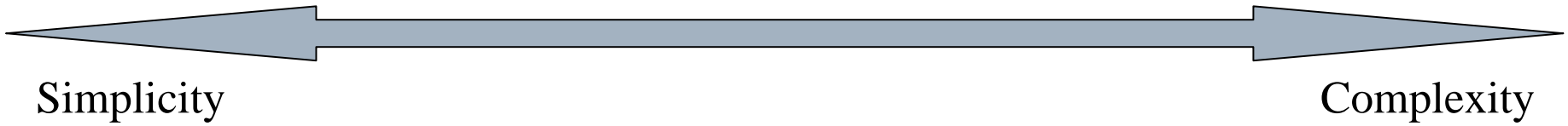Mid Heliosphere (0.8 AU to 5 AU),   Outer Heliosphere (> 5 AU)

Note: solar wind data only, magnetospheric data removed

VHO Searches

- Complex Queries: find data when multiple conditions are true

- Find other heliospheric data sets to use along with STEREO

Ulysses

30 Nov, 2007

STEREO Ahead

ACE

WIND

STEREO Behind

Simplicity   Complexity
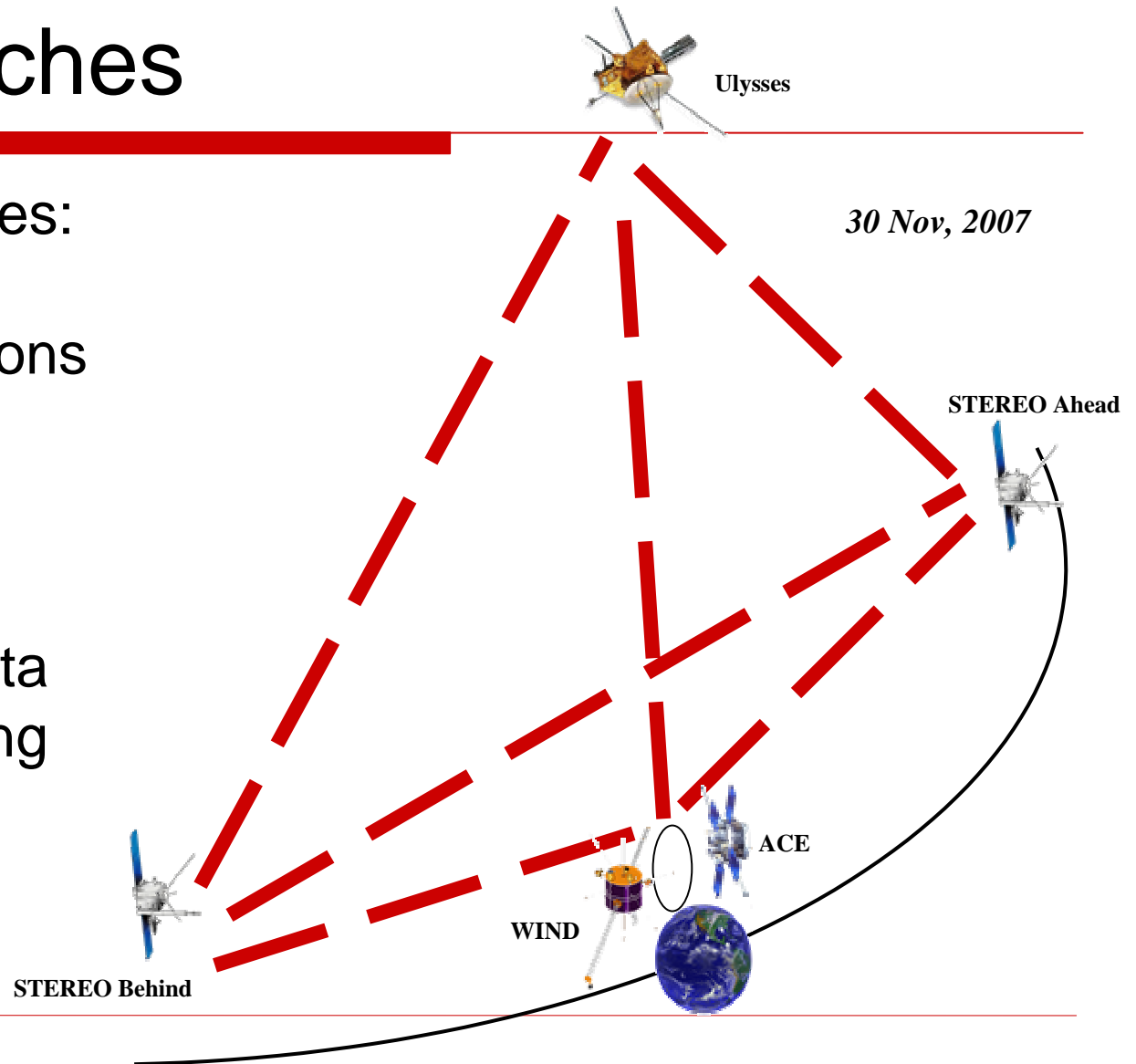
Spectrum of Users

Web Based Interface   Public Tools   **Application Programming Interface (API)**

                              CoSEC, ACE Science Center

• Access all types of searches and services from VHO web page

• CoSEC Client software being written to access VHO

• Access VHO from your own software

▪ Easy access

▪ Fixed Interface

▪ More advanced and community provided

▪ Dependant on tool providers

▪ Complete flexibility

▪ Steep learning curve

Services and Tools

- **Services offer automated data processing:**
1. Coordinate Transformations - 12 coordinate systems
2. Ascii Subsetting - subset a few hours from file
- CoSEC interface offers ability to use services outside of VHO
- Examples of how to use through API/CoSEC
- Example of how to interface with SSCWeb
- Metadata standardization for services

STEREO Related Functionality

- Collaborating with VSO team to set up cross VO queries

- STEREO data users will not have to go to both VSO and VHO to get STEREO data

- Future Services

- Merging multi-spacecraft time series data and solar images into one file

- Backtracing to get solar images

Summary

- Prototype available at http://vho.nasa.gov

- Encourage community input on services and methods used in services
  - SW propagation methods
  - Means of combining in-situ and remote data
- Encourage input regarding models and their integration into virtual observatories