



International Living With a Star - Canadian Update

Presented at the ILWS Working Group Meeting, Nice,
France, April 14, 2003



Contents

- Current Program
- New Developments
- A (Unpaid) Promotion for Heritage Canada

Two Approaches to ILWS

- System integrator (for the polymath)
 - Probes 1, 2, 3 ... in regions A, B, C ... lead to a simultaneously operating fleet for *systematic studies* of the Sun-Earth System
- Modularizeable resources (for the specialist)
 - ILWS also offers the flexibility for the scientist to custom-build investigative tools

A photograph of a modern, multi-story building with a curved facade and large glass windows, illuminated at night. The building is part of the background image on the left side of the slide.

Example: Reconnection

- "Imaging" probes (Sun)
 - Topology; emission spectra; interior dynamics
- "Mechanism" probes (Magnetosphere)
 - Microphysics ("anomalous resistivity"); timing
- "Effect" probes (RB/Ionosphere)
 - Particle acceleration; ionospheric ramifications
- "Context" Probes (Auroral imaging/Ground-Base)
 - Conditioning; energy transport and cascade

The background of the slide features a large, faint, light blue graphic of a satellite or spacecraft orbiting Earth. In the top left corner, there is a photograph of a modern, multi-story building with a curved facade and large windows, illuminated at night.

ILWS Goals in Canada

- In the first instance, build a global magnetospheric context-definition tool and wave profiler:

Canadian Geospace Monitoring

- Also, build an effect probe specializing in how the atmosphere responds: **Enhanced Polar Outflow Probe**
- Also², look towards the future by initiating Phase 0 studies of future ILWS missions (e.g., **RAVENS**)

Context and Wave Profiling

- Waves, in a general sense, are the center of ILWS research for their roles in
 - Formation of structures (coherence)
 - Destruction of structures (instability)
 - Bulk or spectral energy transfer
- Waves are intrinsically hierarchical (nonlinear)
 - A global tool with multiscale capability is essential

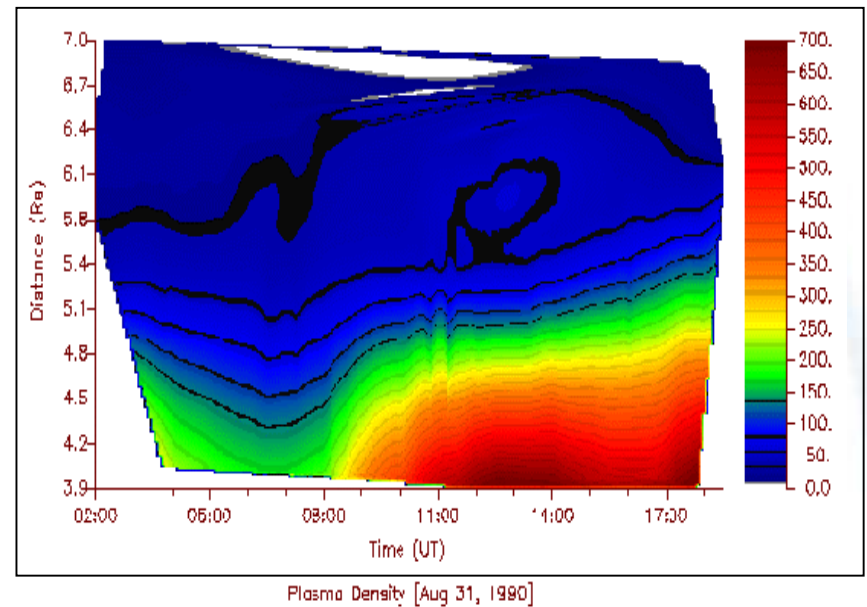
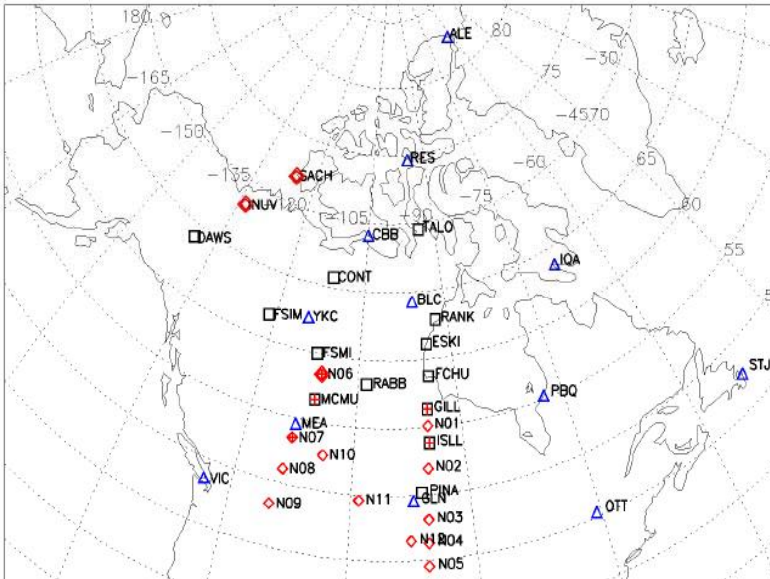


Geospace Monitoring

- Consisting of the following
 - Solar radio monitoring
 - Enhanced (4×) CANOPUS magnetometers
 - NORSTAR auroral imaging array
 - Canadian SuperDARN and CADI
 - Center for Data Assimilation and Modeling
 - Canadian Space Weather Forecast Service

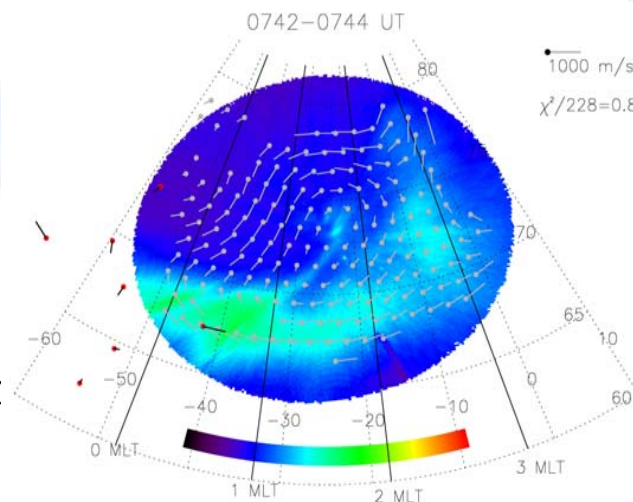
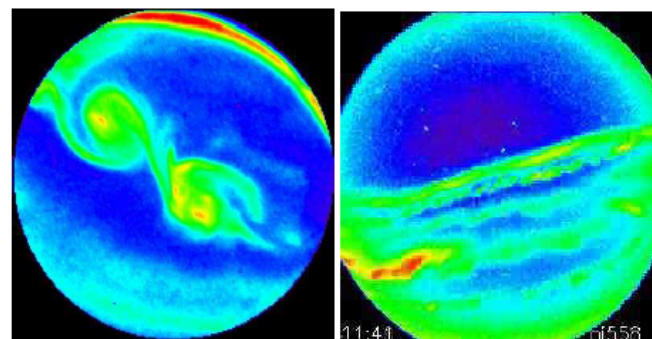
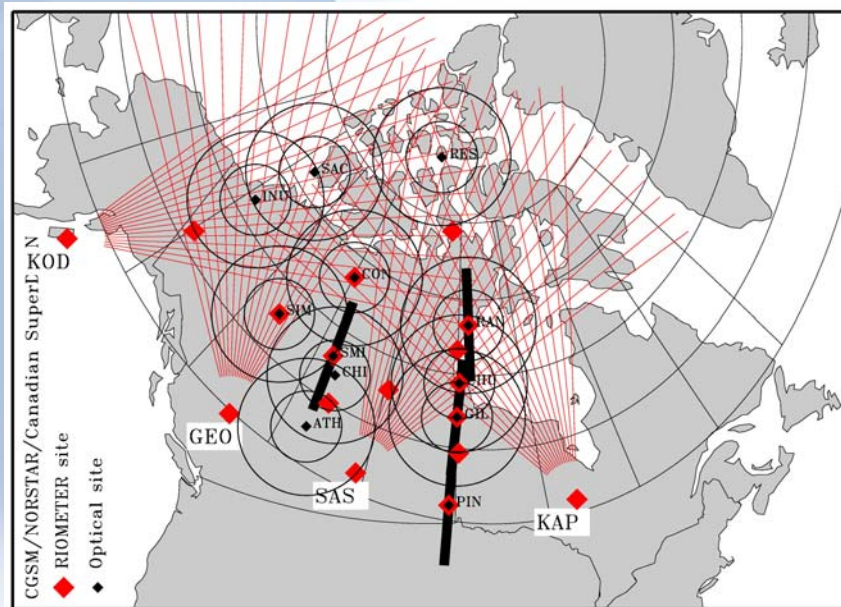
Will contain >70 g.b. instruments for multiscale wave profiling, and context definition

Magnetometer Array



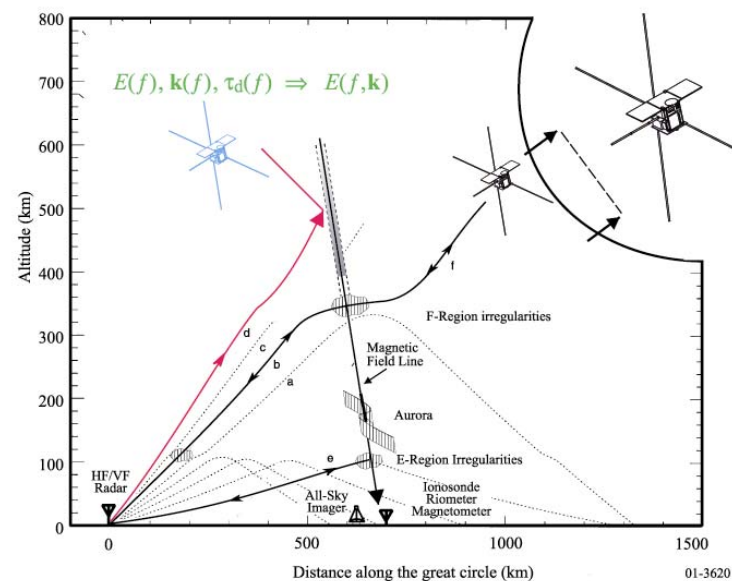
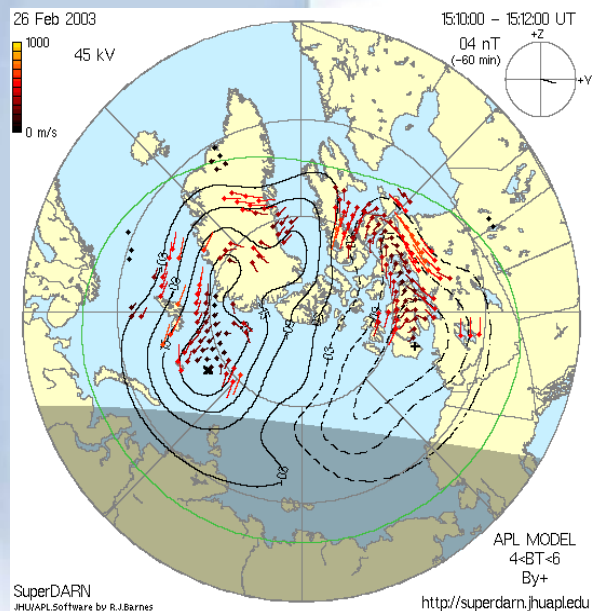
Large-scale magnetometer array gives the distribution of global MHD waves, and analysis of this distribution can further yield the distribution of derivative quantities such as inner magnetospheric density (Courtesy, Ian Mann and Colin Waters)

Optical Imaging Resolves Multiscale Structures (1-1000 km)



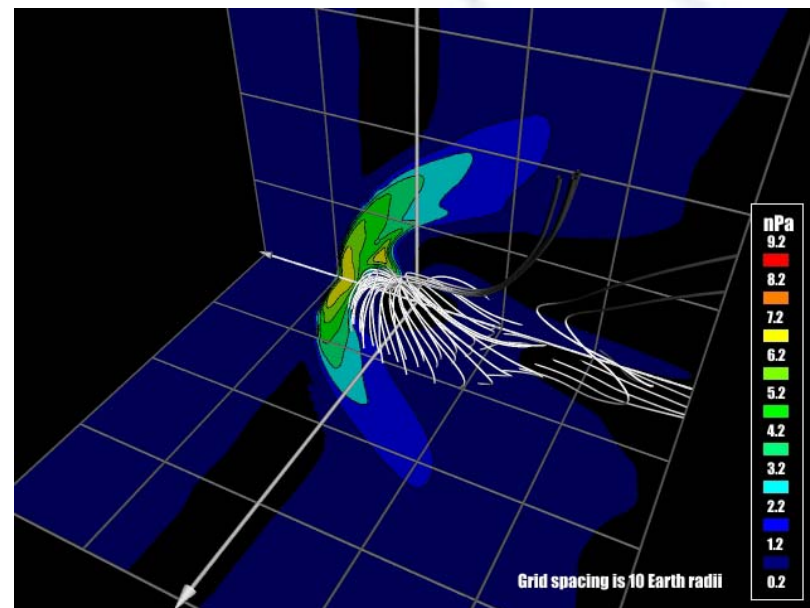
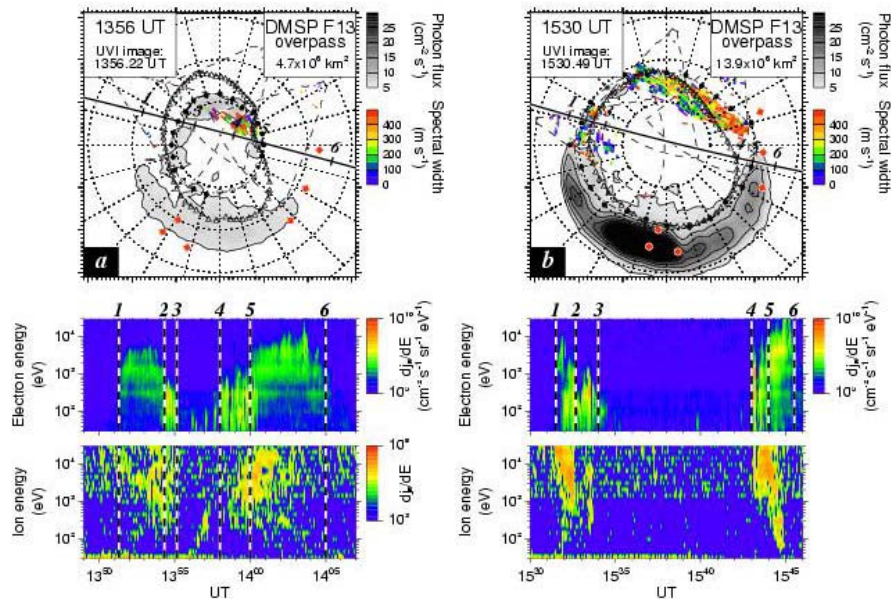
- NORSTAR optical array allows underlying structures of global waves to be seen (courtesy: E. Donovan)

Radio Sounding



(Canadian) SuperDARN adds the energy flow in the system (left) and interacts with ePOP for ionospheric tomography through propagation studies

Putting Things Together Through Theory and Modeling (CDAM)

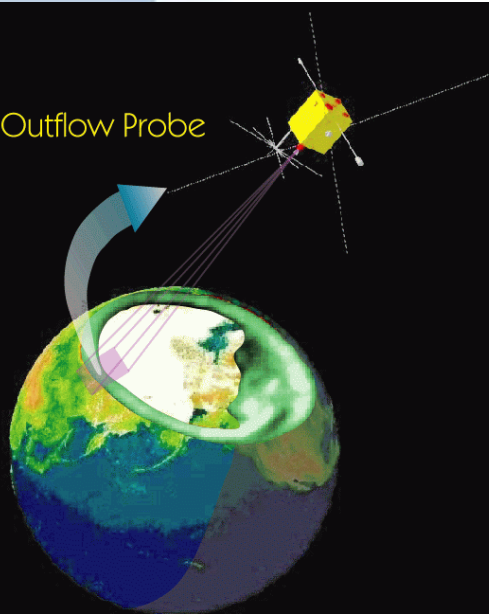




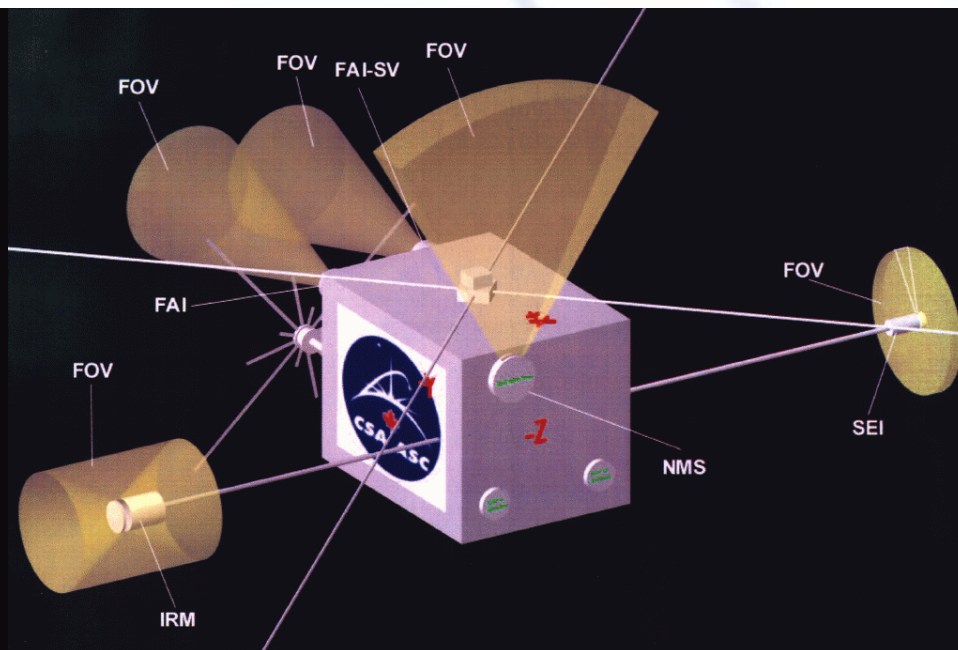
ePOP

e-POP

Enhanced - Polar Outflow Probe



A Canadian Space Environment Satellite



Enhanced Polar Outflow Probe (ePOP) is planned for launch in 2006; eight instruments (3 low-energy particles; 3 radio; 1 magnetometer; 1 auroral imager; 300 by 1500 km, 70 incl)

W. Liu, CSA Program Scientist for Space Environment

Canada

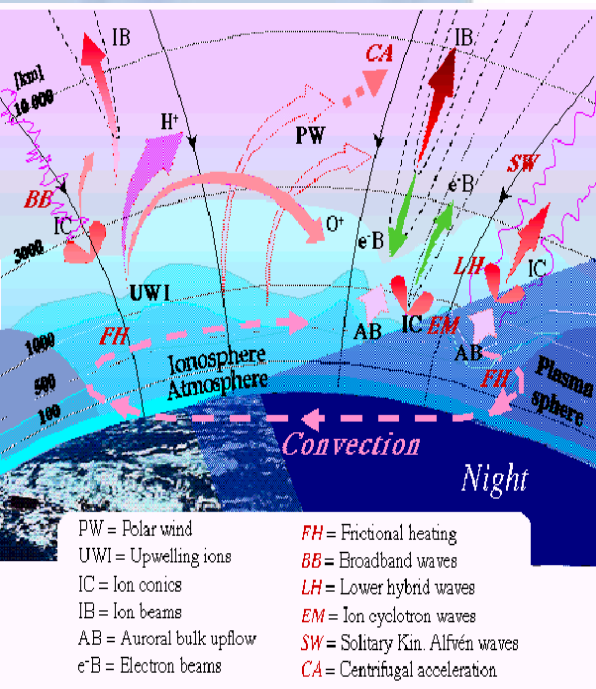
ePOP Science

■ Primary interest

- How various ionospheric outflows are accelerated?
- Do ion outflows have an effect on vertical transport of neutrals?
- Wave-particle interactions

■ Secondary interest

- Ionospheric mapping using HF radars, GPS receivers, and GHz beacons)



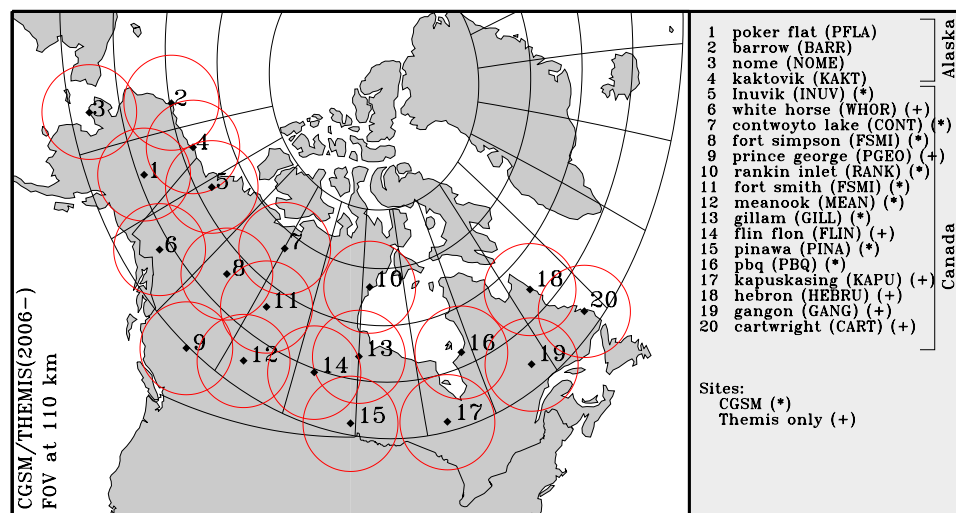
THEMIS

Canadian involvement essential to Themis.

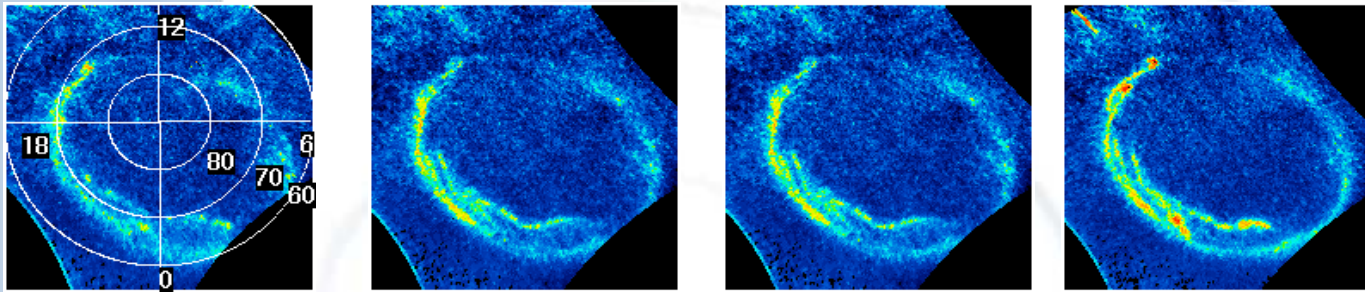
We will deploy and operate and deal with data from a continent wide array of ASIs.

CGSM observations will complete the electrodynamic picture.

Substorm onset mechanism a central theme in CGSM science.



New Missions



Canada has been a leader in auroral imaging from space, starting with ISIS 2 in 72, and best known for Viking UVAI (above). Now an auroral imaging mission concept called RAVENS is being studied in Canada

RAVENS

- The Legend
 - God Odin in the Norse legend has two Ravens, known as Hugin and Munin. They hover around Earth and keep the Boss informed of the goings-on in the world at *all time*
- The Mission (Concept by U. Calgary)
 - **Recurrent Auroral Visualization of Extended Northern Storms**

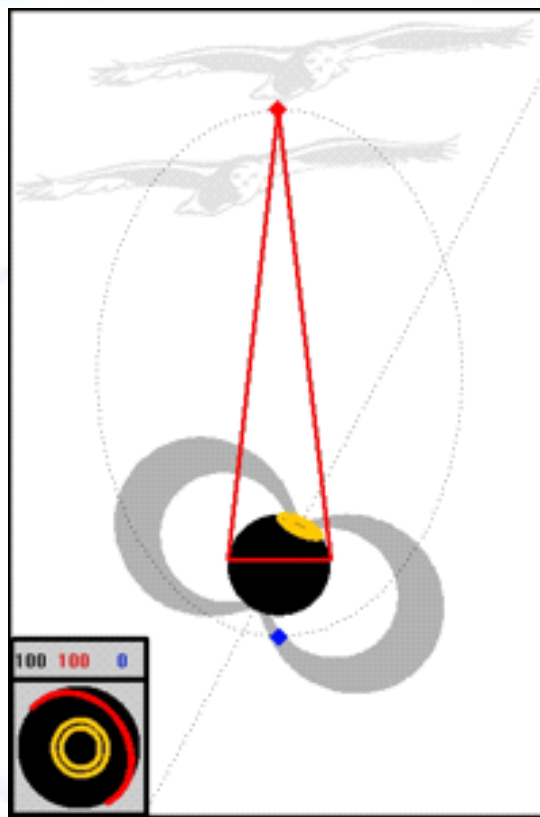
RAVENS

■ The Science

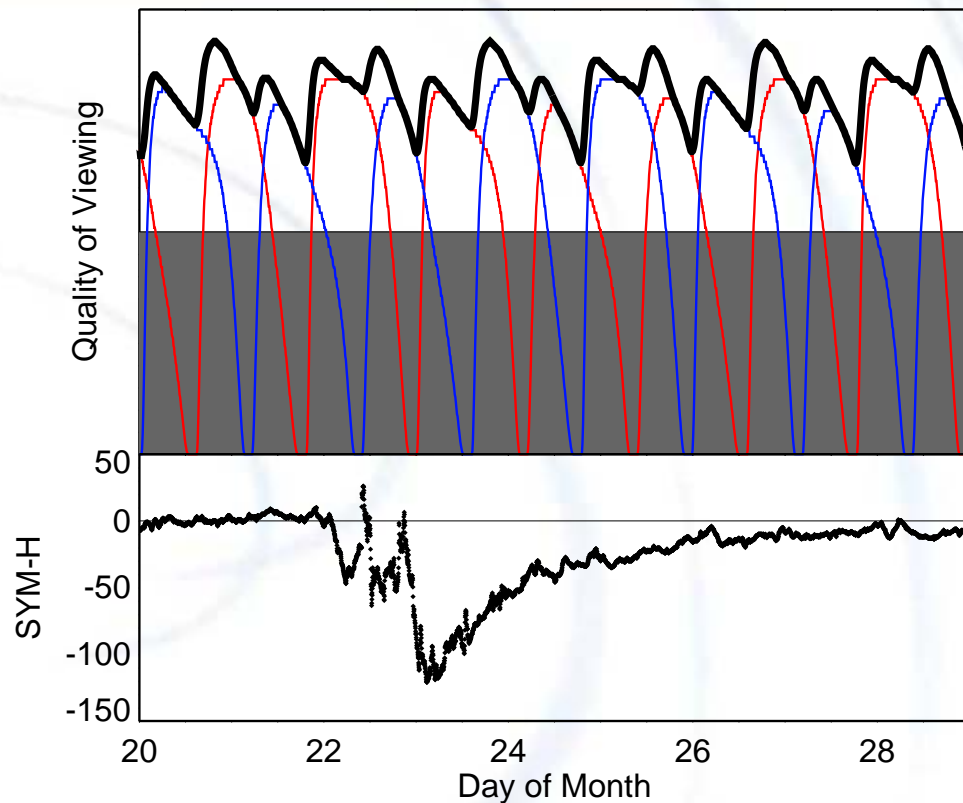
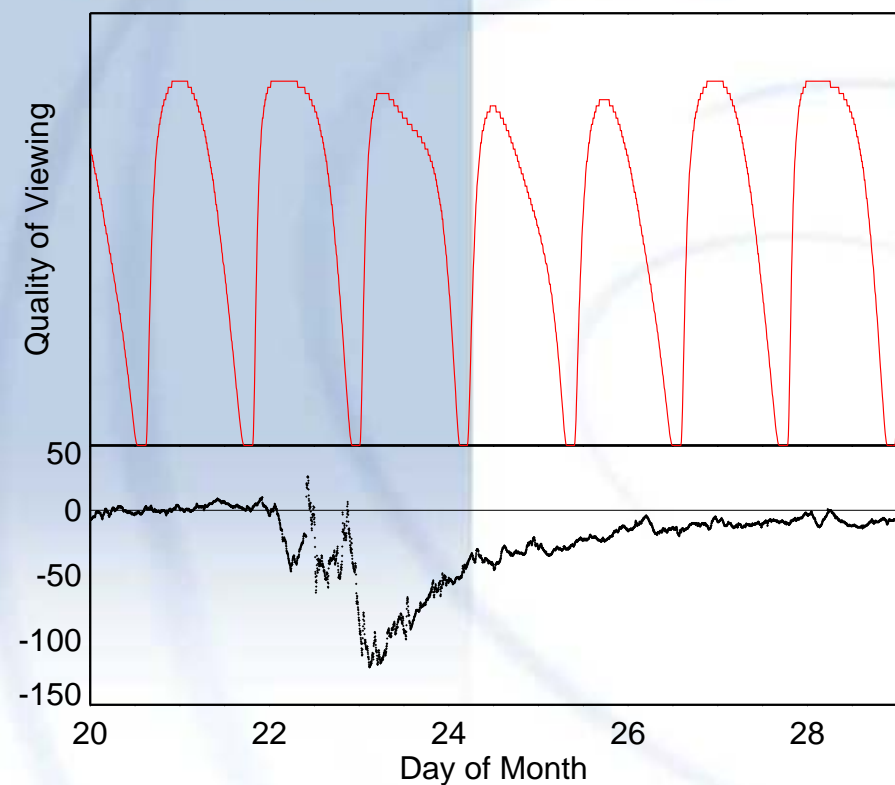
- Storm-substorm relationship has emerged as a major problem in the field
- Continuous, start-to-finish imaging of a magnetic storm (lasting up to a week) is required
- Contraposing 2 s/c in a polar orbit provides unbroken imaging
- Additional benefits include continuous monitoring of the effects of solar rotation on magnetospheric physics



RAVENS



RAVENS



Next Meeting

- CSA kindly invites ILWS colleagues to hold the next WG meeting in Canada
- Suggested venue is Banff, Alberta
- Dates TBD (Summer okay?)
- Will mix serious science discussions with relaxed nature exploration or competitive Kayak racing against Eric Donovan
- Free T-shirts (made this one up)