Special Features of CAWSES Space Weather Theme

- Goal: Collaborative analysis of international sun-to-Earth data sets forcused on space weather understanding & prediction
- Campaign mode (pre-planned or retrospective driven by science questions)
- Testbed for integrated global science analysis tools that require international collaboration (Ex: ULF wave power, gravity waves, hmF2, nmF2, continuous H alpha solar images, etc.)
- Data sharing as a powerful capacity building exercise in underdeveloped nations
- Rolling up into IGY 2007, IHY2007, eGY2007, IPY2007 ….
  - Progressively develop a set of new global data analysis tools
  - Build up an international community familiar with campaign tools & collaborative analysis

CAWSES Space Weather Meeting Sept 11-12, 2004 in Beijing, China

- Discussion Topics:
  - Space Weather Related Science
  - International Collaboration
  - Future Plans
- Immediately preceding IAGA Symposium 226, “Coronal and Stellar Mass Ejections
- Organizing Committee
  - K. Shibata (Co-Chair)
  - N. Gopalswamy (Co-Chair)
  - Y. Yang (LOC-Chair)
  - X. Feng
  - B. Schmieder
  - J. Wang
  - S. T. Wu

Space Weather Panel Structure

CoChairs: Janet U. Kozyra (USA) and Kazunari Shibata (Japan)

Panel Members:

- Santimay Basu (USA)
- Walter Gonzalez (Brazil)
- A. T. Kobea (Ivory Coast)
- Anatoly Petrukovich (Russia)
- Rainer Schwenn (Germany)
- Feng Si Wei (China)
- R. Sridharan (India)
- Exofficio Members --- Subpanel Chairs
  - Nat Gopalswamy (USA), Solar Observations Subpanel
  - Ian Mann (Canada), CAWSES/IAGA/GEM Integrated Global Magnetometer Maps Subpanel (1st derived geophysical parameters: ULF wave index, Magnetospheric thermal density)
  - Anthea Coster (USA), CAWSES Increased-Resolution Global GPS TEC Subpanel

Draft Charge to Space Weather Panel

- To initiate sun-to-earth campaigns or retrospective analysis efforts aimed at answering open questions in space weather understanding & prediction, that may (among other things):
  - Leverage and expand upon already existing worldwide campaigns
  - Collect& preserve comprehensive sets of sun-to-Earth observations
  - Use new CAWSES global science analysis tools (i.e., integrated global maps of geophysical quantities or continuous time series of solar images) in combination with other satellite & ground-based data *to address science questions in ways that were not possible before*.
- To plan new types of global analysis tools & establish the necessary expert subpanels to develop these tools.
- To consider data environments & data distribution methods needed to make this program a success
- To acknowledge, support, coordinate & leverage national CAWSES programs, as much as practical & possible
- To suggest capacity building efforts associated with the CAWSES global analysis tools.
- To discuss & modify this draft charge until it best supports the worldwide goals of CAWSES.

Existing Subpanels

- CAWSES/IAGA/GEM World Magnetometer Maps
  - Chair: Ian Mann, Canada (CANOPUS)
  - Members: Ari Viljanen (IMAGE), Mark Engebretson (MACCS), Jeff Love (USGS), Mark Moldwin (MEASURE), Eftyhia Zesta (SAMBA), Kiyohumi Yumoto (210 MM).
  - First data product: ULF wave power distribution maps
  - Plans:
    - Extend to include other arrays and stations
    - Extend to create other magnetometer data products based on the time-series data.
      - new ULF wave indices
      - ULF magnetospheric density maps
  - Data Host: Space Sciences Data Portal (SSDP), University of Alberta (PI:Robert Rankin)
- Solar Observations
  - Chair: Nat Gopalswamy (USA)
  - Members: TBD
- Enhanced resolution GPS TEC Maps
  - Chair: Anthea Coster (USA)
  - Members: Not populated yet

Draft Charge to Subpanels

- Suggest space weather campaigns or retrospective analysis efforts that utilize the global science analysis tools (& other data) to address cutting edge science questions
- For a given global map or time series decide on:
  - the best parameters to display
  - the needed algorithms to integrate the data from different sites (possibly on the fly)
  - the most useful graphical displays
  - Efficient data access
  - The recruitment of observing sites in critical locations
- Where possible, use recruitment of sites as a capacity building tool
- Suggest changes to this draft charge so that it best supports the subpanel goals

1st CAWSES Campaign

> 40 participating international space & ground-based programs & growing. In collaboration with:

- **ISR World Days, MI-coupling campaign, 29 March - 3 April 2004**
  - Focus:
    - Coupling between the high- and low-latitude ionospheres
    - Coordinated observations by incoherent scatter radars worldwide
      - Sonderstrom, EISCAT, Svalbard, Millstone Hill, Arecibo, Jicamarca, Irkutsk (Russia), and Kharkov (Ukraine)
  - Led by Chao-Song Huang (MIT/Haystack)

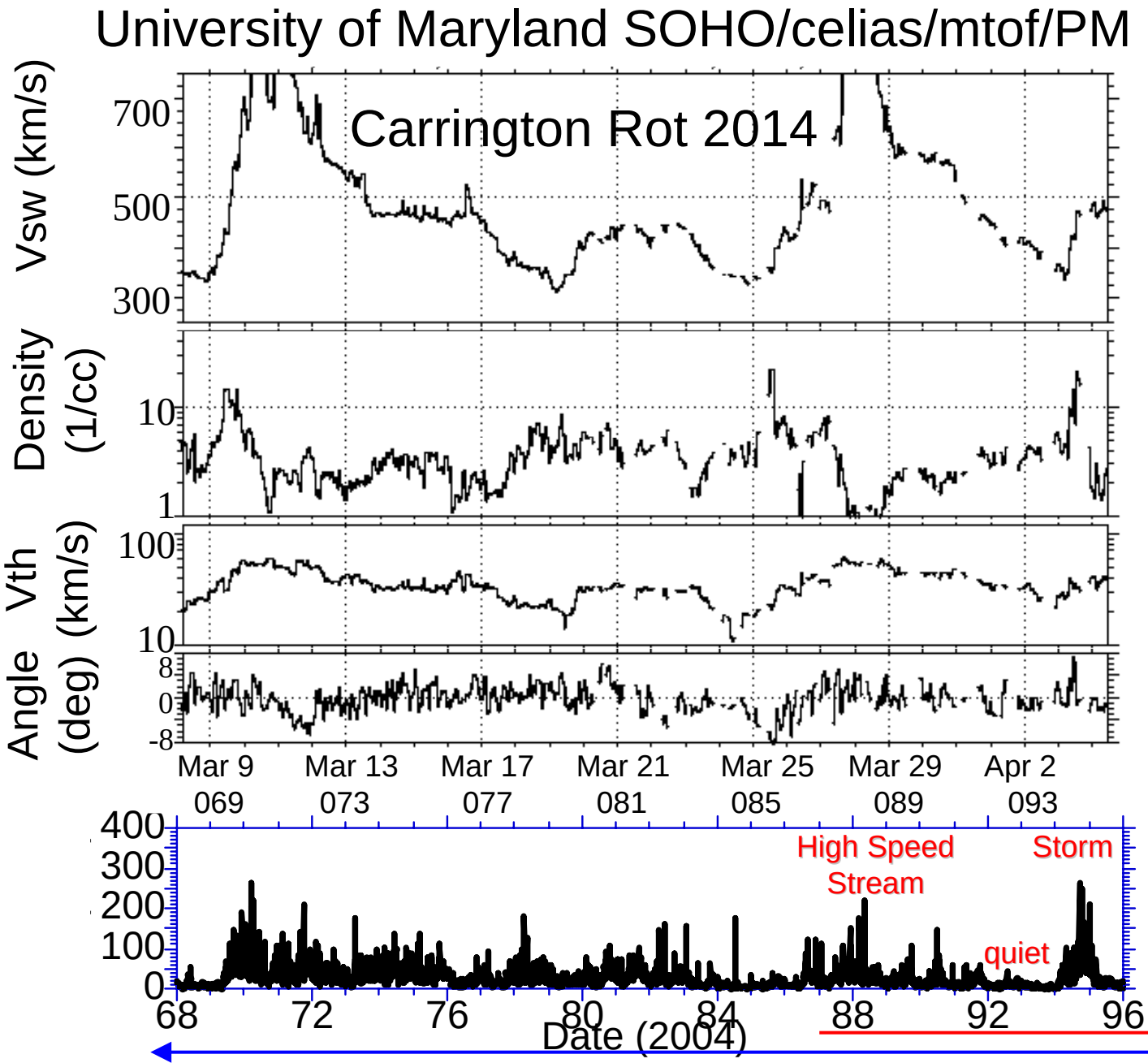
- **CPEA (Coupling Processes in the Equatorial Atmosphere) Campaign, March - April 2004**
  - Focus:
    - Coupling troposphere up through thermosphere
    - strong convective region over Indonesia
  - Led by Prof. Shoichiro Fukao, Dr. Mamoru Yamamoto (Kyoto Univ)

- Pointers to and details of available observations being collected on CAWSES website (www.bu.edu/cawses)

Purpose to investigate:

- **Space Weather Sun-to-Earth (27 March - 6 April 2004)**
  - By collecting a sun-to-Earth data set which dips down into the lower atmosphere
  - By providing the first testbed for a CAWSES/GEM/IAGA effort to combine international magnetometer chains & produce global maps of ULF wave index and magnetospheric density.
- **Equinox State of the Middle Atmosphere & Coupling between Atmospheric Regions (March - April 2004)**
  - By collecting worldwide information on the equinox middle atmosphere.
  - By serving as test bed (where possible) for global integrated maps of middle atmosphere parameters - (i.e., gravity waves, temperature, winds, etc). Looking for gaps to fill.

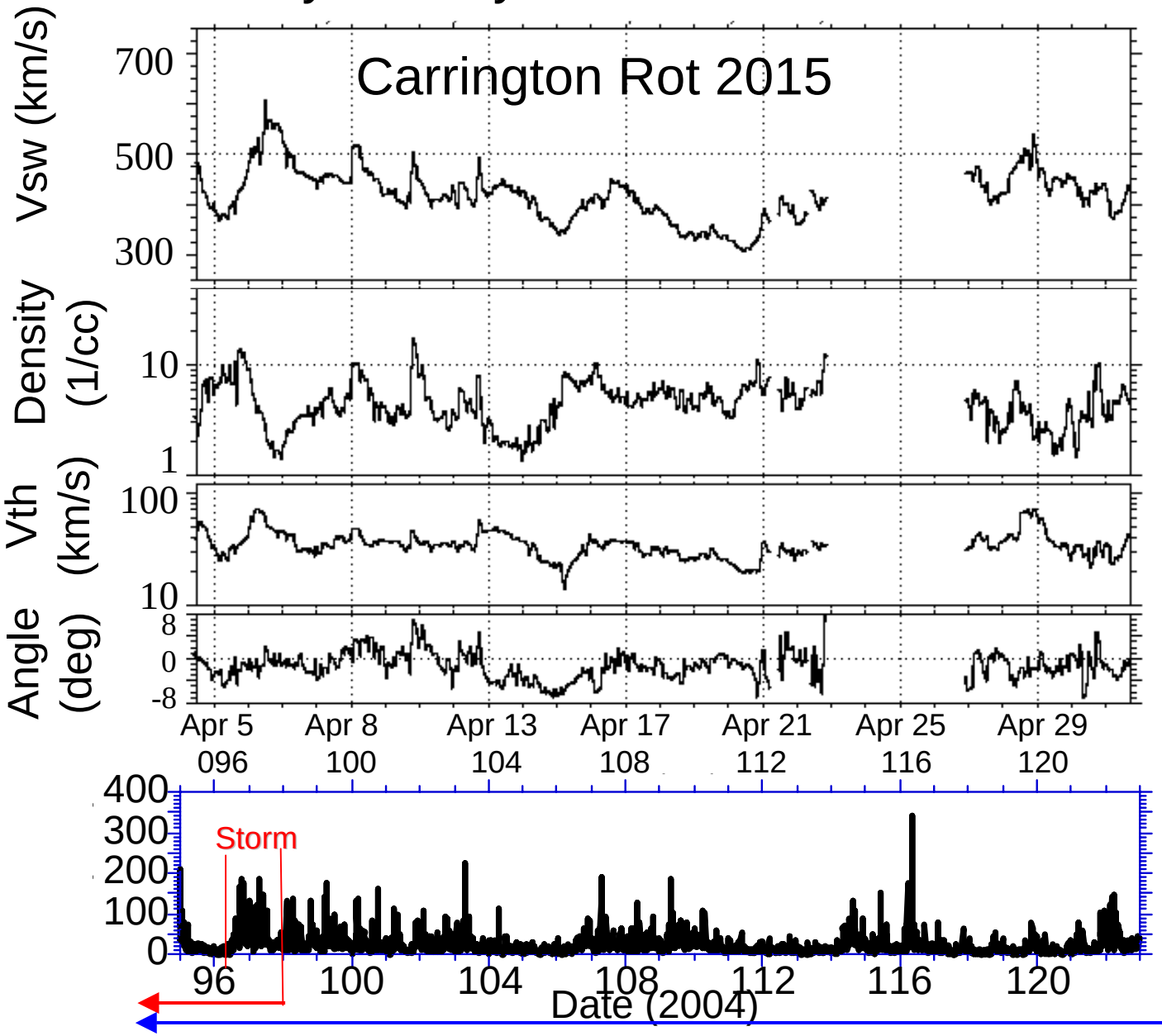
What Happened during the Campaign?



- Strong high speed stream beginning March 25, peaking March 27.
- Electron radiation belt enhanced beginning late March 28
- Supports campaign focus area on ULF waves & electron acceleration
- Storm on 4/3 due to slow CME released 3/31

What Happened during the Campaign?

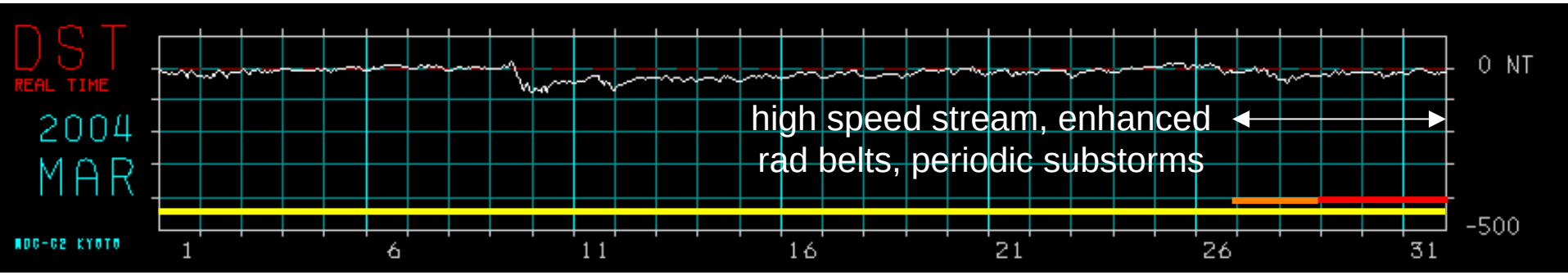
University of Maryland SOHO/celias/mtof/PM

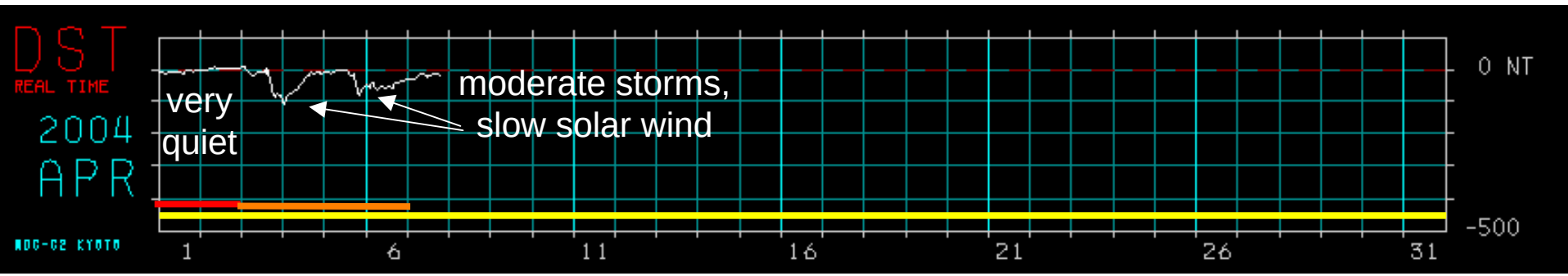


- Strong stream structure has disappeared in April 2004 (CR 2015).
- Weak smaller-scale solar wind streams still generating considerable auroral activity due to fluctuating IMF Bz.
- Storm on 5-6 April at leading edge of a high speed stream

Space Weather
Atmospheric Coupling

Magnetic Activity during the Campaign?



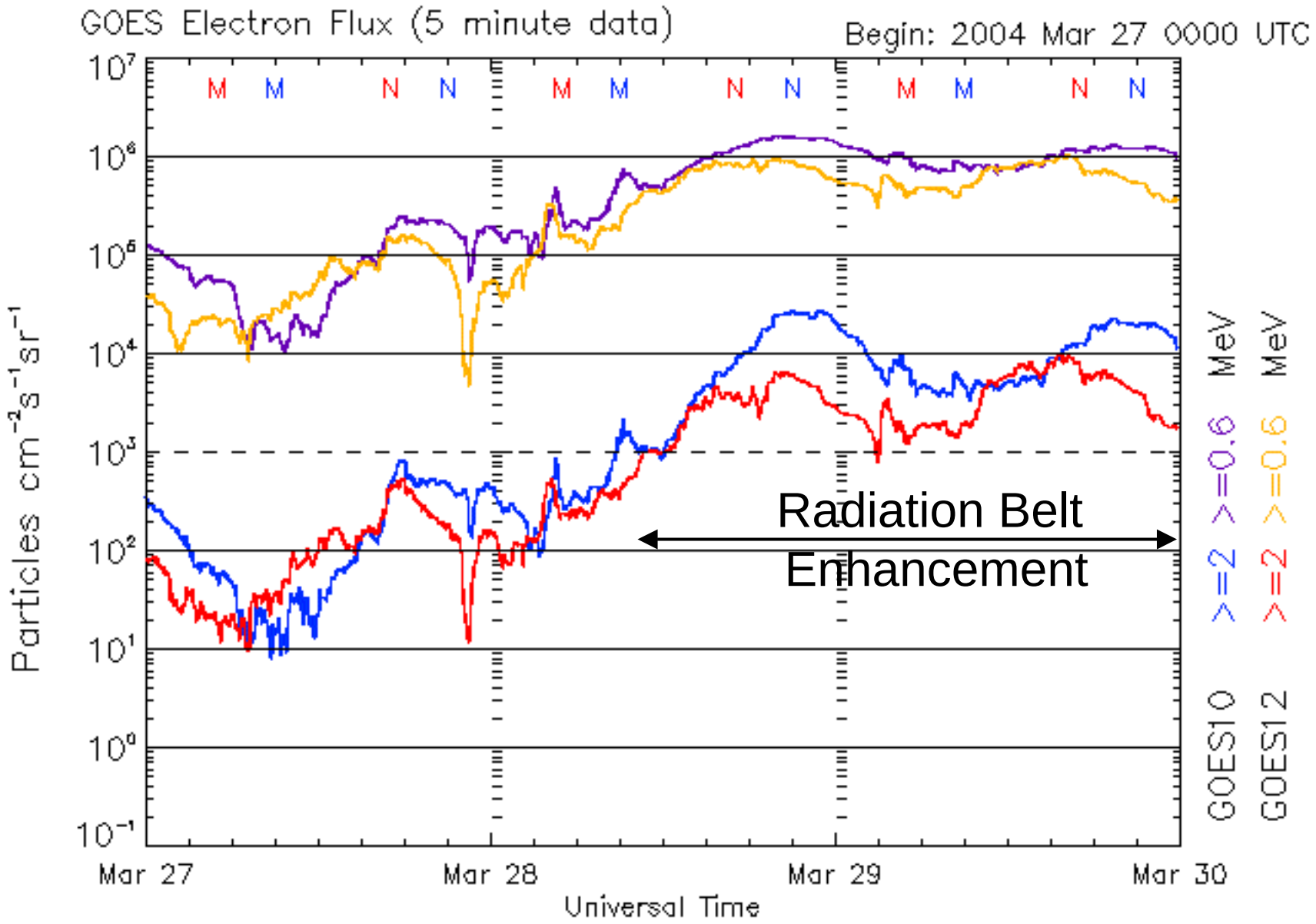


ISR World Days

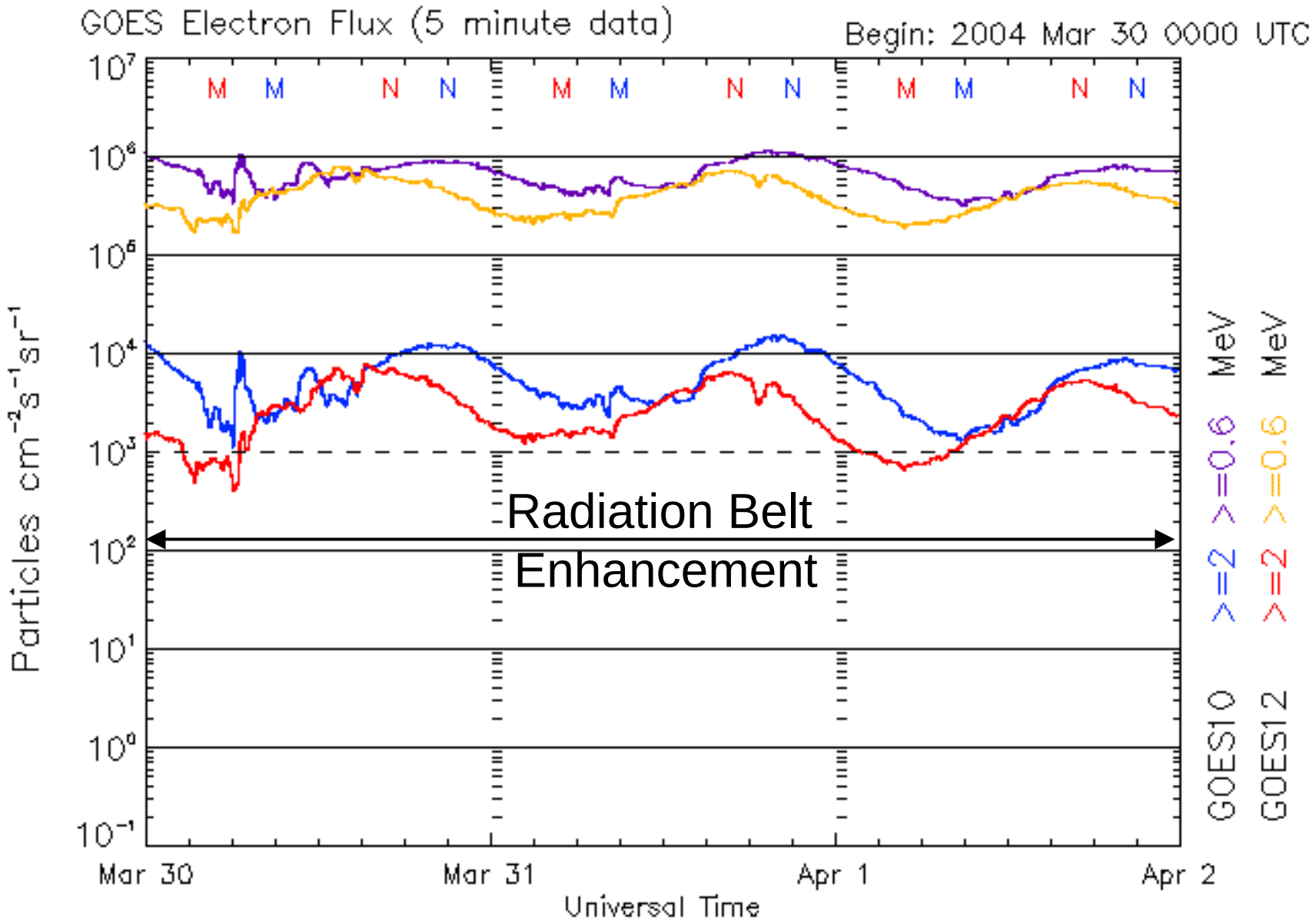
Expanded CAWSES Space Weather Campaign

CAWSES Equinox Atmosphere Campaign, collaboration with CPEA

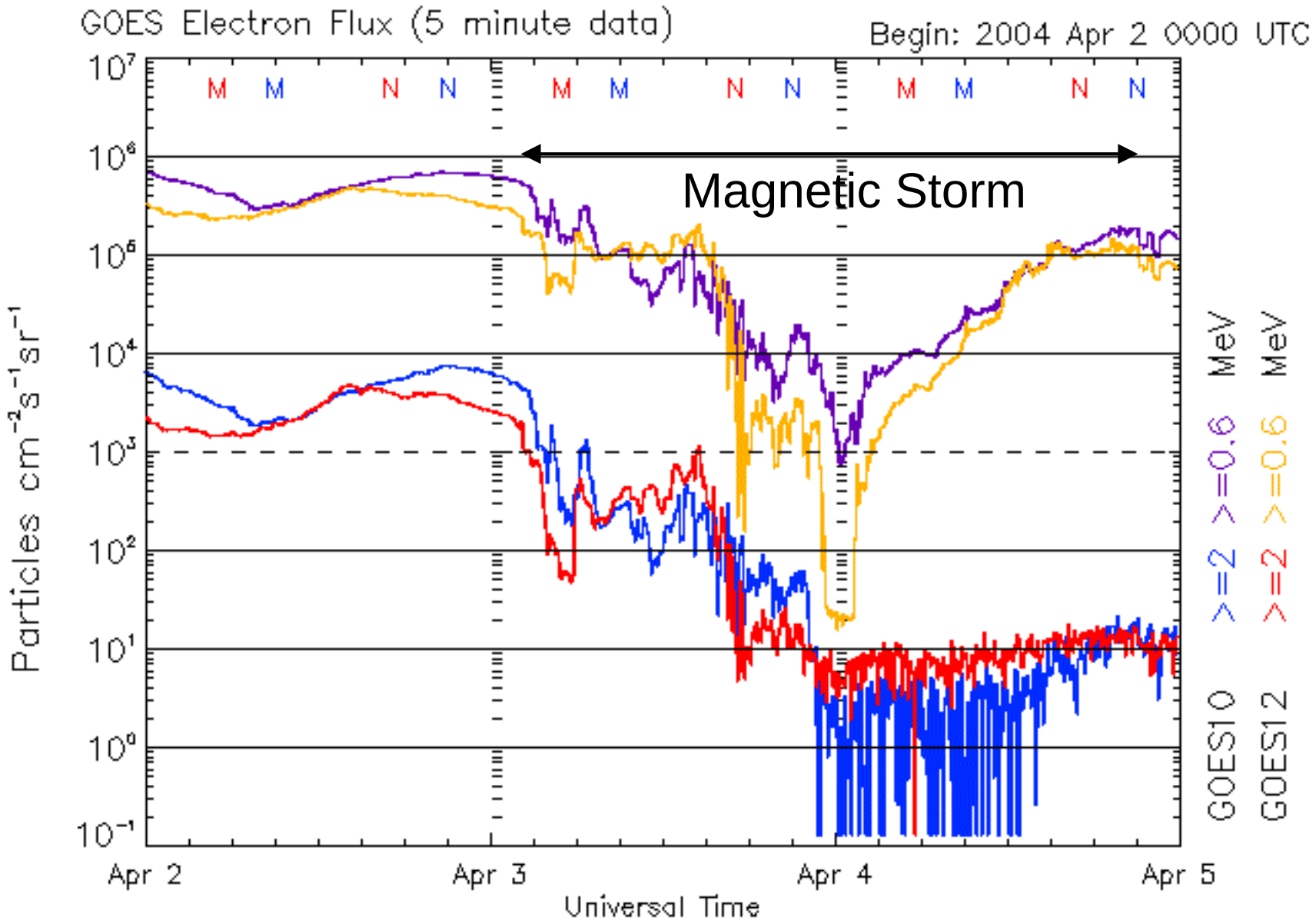
Radiation Belts during the Campaign?



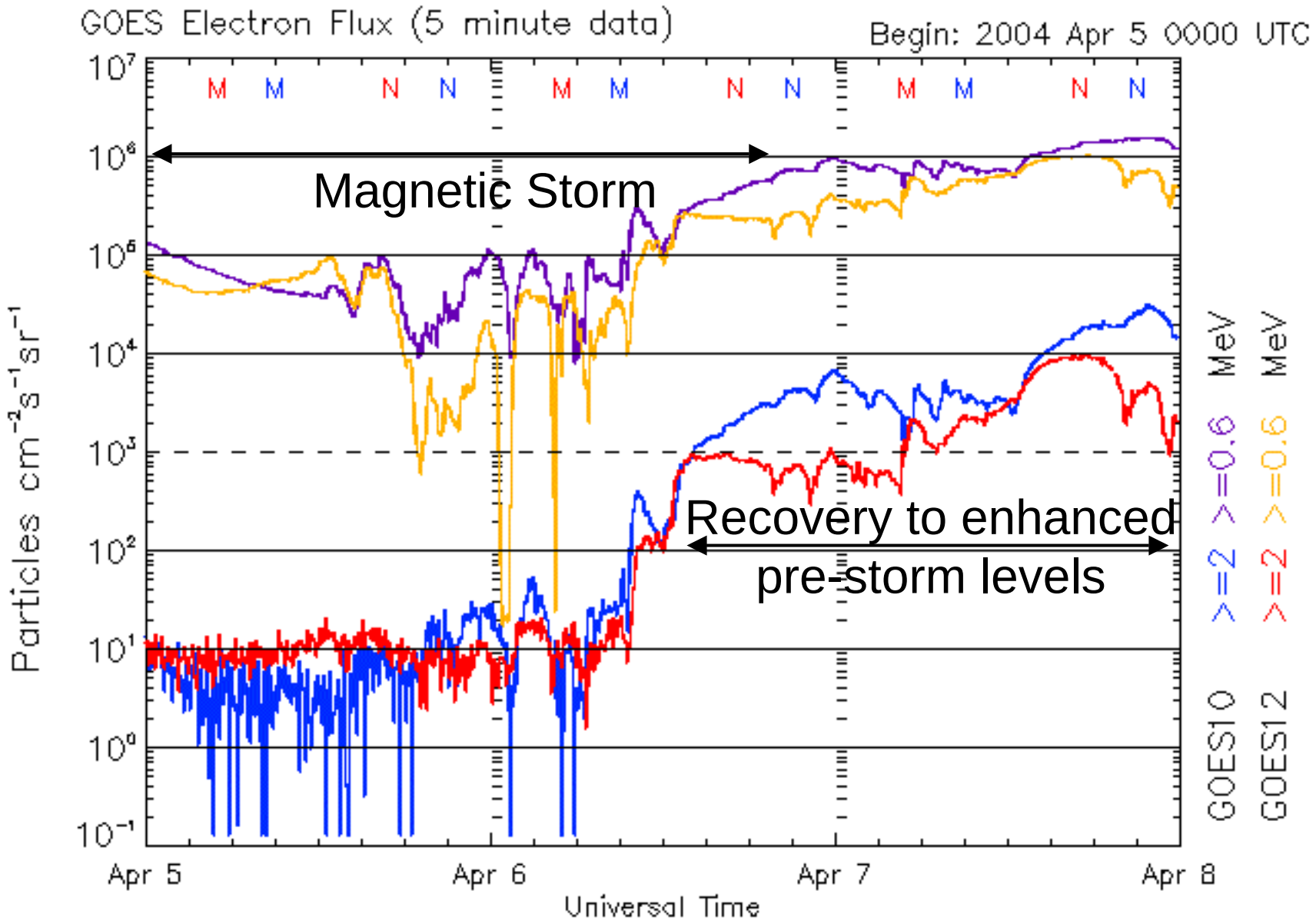
Radiation Belts during the Campaign?



Radiation Belts during the Campaign?



Radiation Belts during the Campaign?



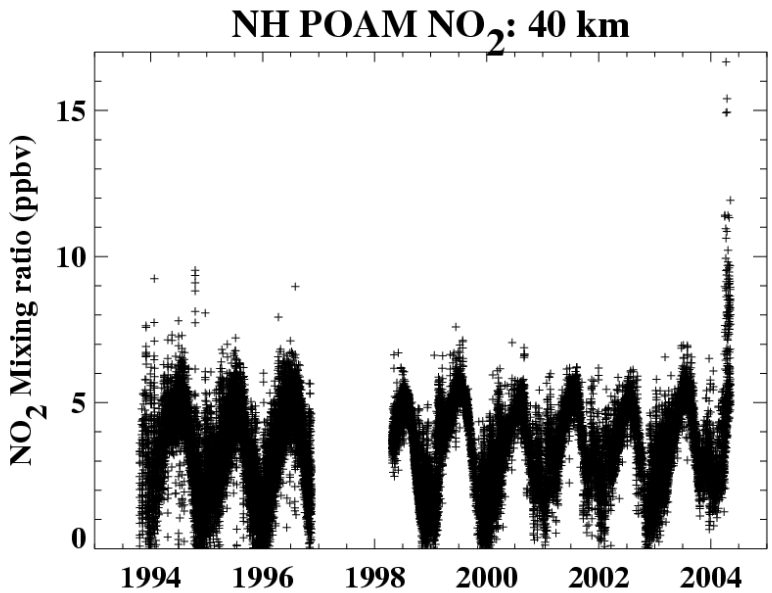
Early Science Highlights

- Superdense cool plasma sheet on 4/3 [Michelle Thompson, LANL GEO]
- Highest levels of odd Nitrogen ever seen by UARS (since 1994) and depletions in Ozone in April 2004 - cause unknown [James Russell].
- Unusual positive storm effects seen at Millstone Hill. Also storm enhanced density plume and subauroral electric field enhancement. [Chaosong Huang, John Foster].
- High speed stream observed
  - Delayed enhancement in the radiation belts.
  - Potential for new scientific discovery: Global maps of ULF wave parameters, satellite observations of solar wind, dayside boundary layers, radiation belts, ULF & VLF wave activity
- 4/3 storm produced by CME released on 3/31. Took ~3 days to get to Earth - reason unknown
- Very magnetically quiet days (4/1-2).
  - Important to specify initial quiet state of the system
  - Starting point for assimilative or first principles modeling
- Ionospheric Data Assimilation - GAIM model [Jan Sojka]
  - Equivalent to a 3D global map of the ionosphere based on ionosondes, TEC and an underlying physics-based model

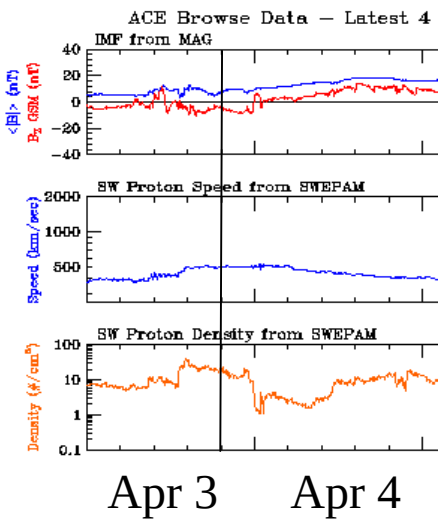
Early Science Highlights

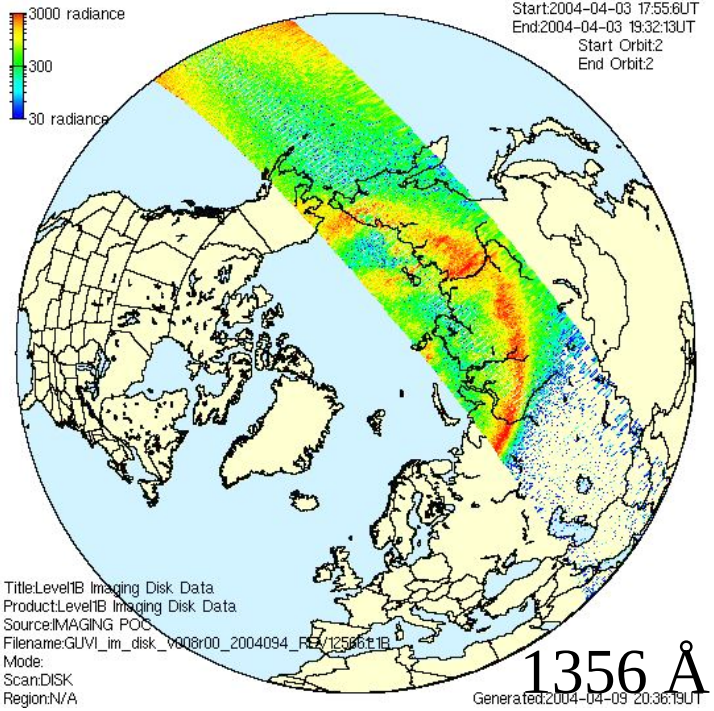
- Ionospheric bubbles [Larry Paxton]
  - Seeding of the equatorial bubbles was occurring during the storm periods seen by TIMED/GUVI
- Auroral Phenomena [Larry Paxton]
  - Undulating auroras containing structured proton precipitation were observed during both the April 3 and April 5 storms? Unusual occurrence in the TIMED/GUVI data
  - Are these related through the global electrodynamics to the trigger for equatorial bubbles occurring near the same time these days?
- Mid-to-low latitude electrodynamics [Dave Anderson]
  - Observed prompt penetration electric fields develop from quiet to active conditions
- Coupling to low altitudes [Larissa Goncharenko]
  - New evidence that SAPs electric fields penetrate to low altitudes (down to 150 km) and produce ion and neutral heating
  - Clear wave signatures in Ti - propagating from below -- seen as high as 160 km on March 30. Produces large changes in Ti

April 2004 Stratospheric NO_2 Enhancement [Jim Russell et al.]

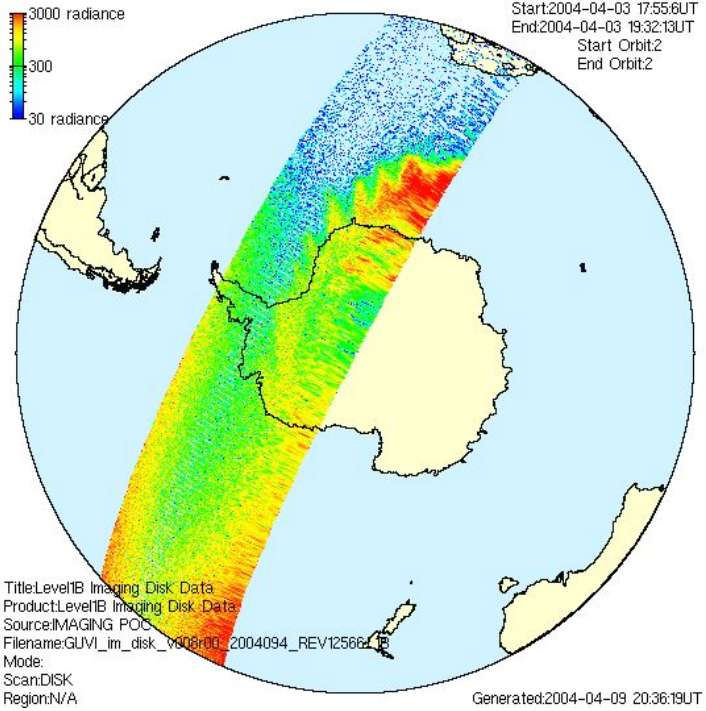


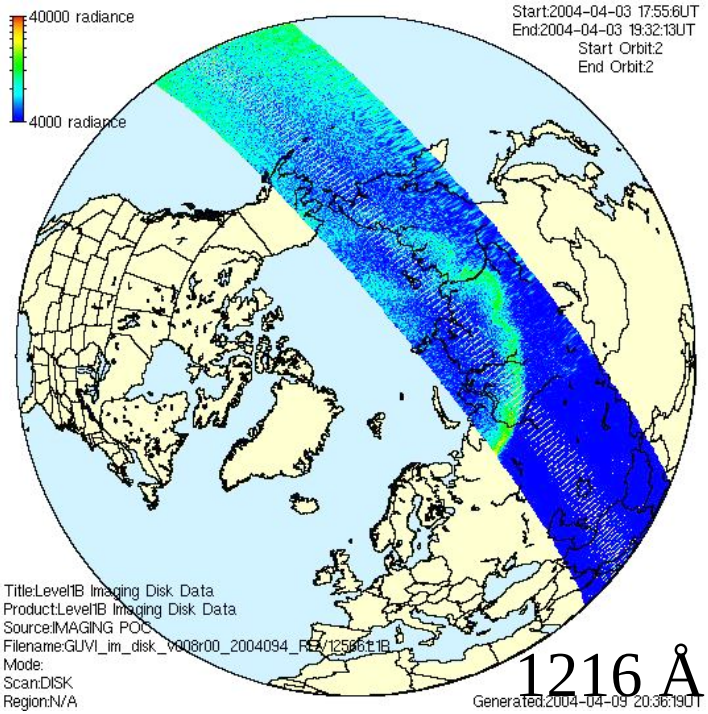
40-km NO_2 enhancements in April 2004 are unprecedented in the UARS/POAM II/III data set (Randall et al., 2004).



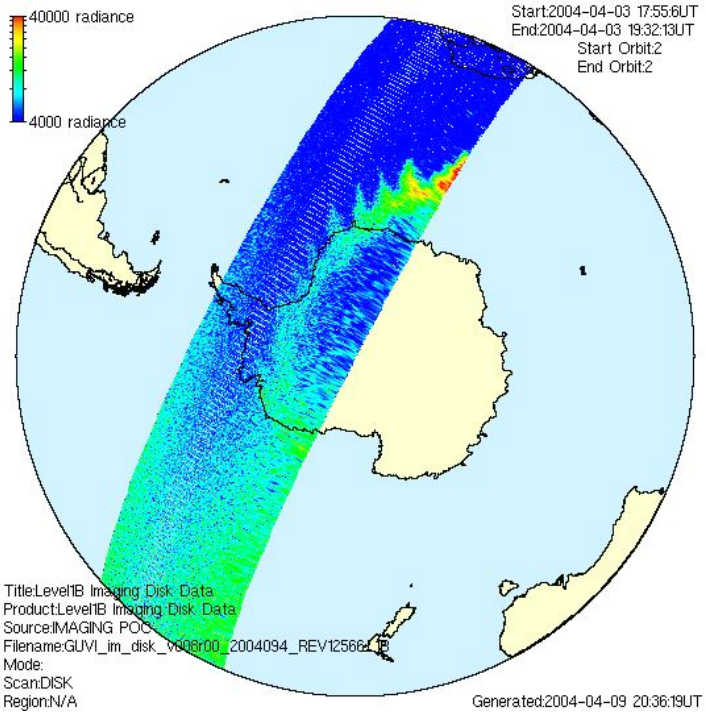


1356 Å

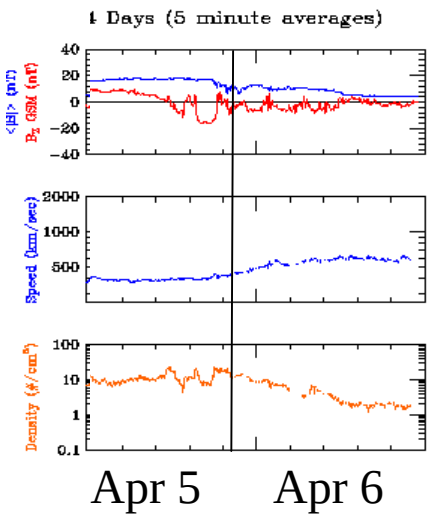


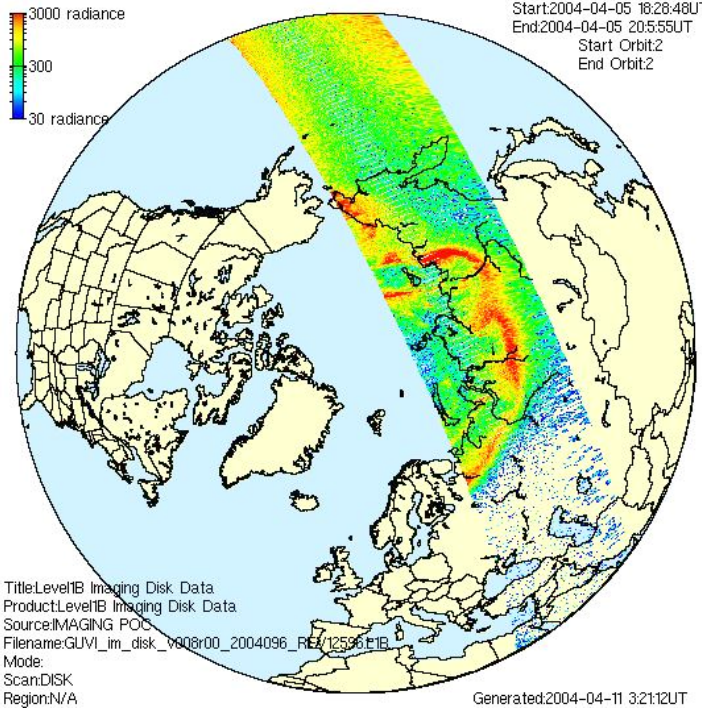


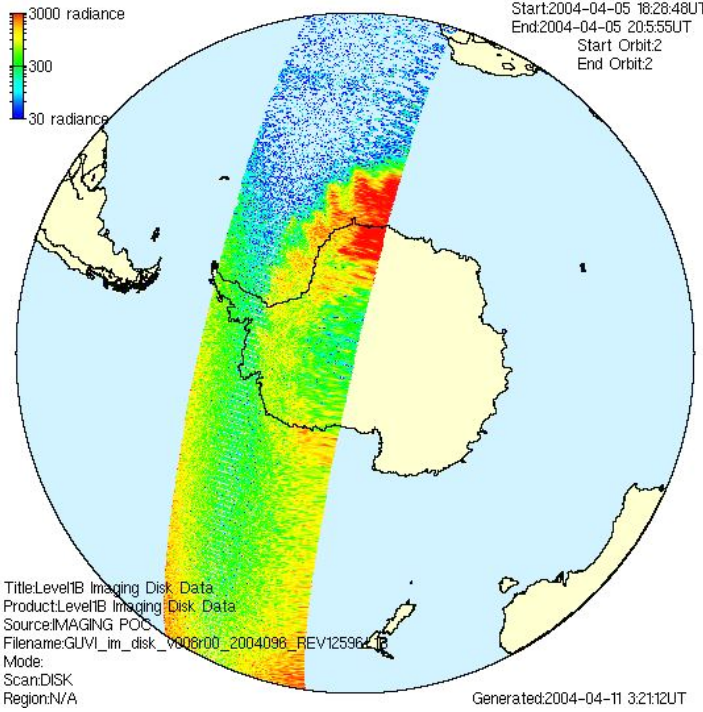
1216 Å

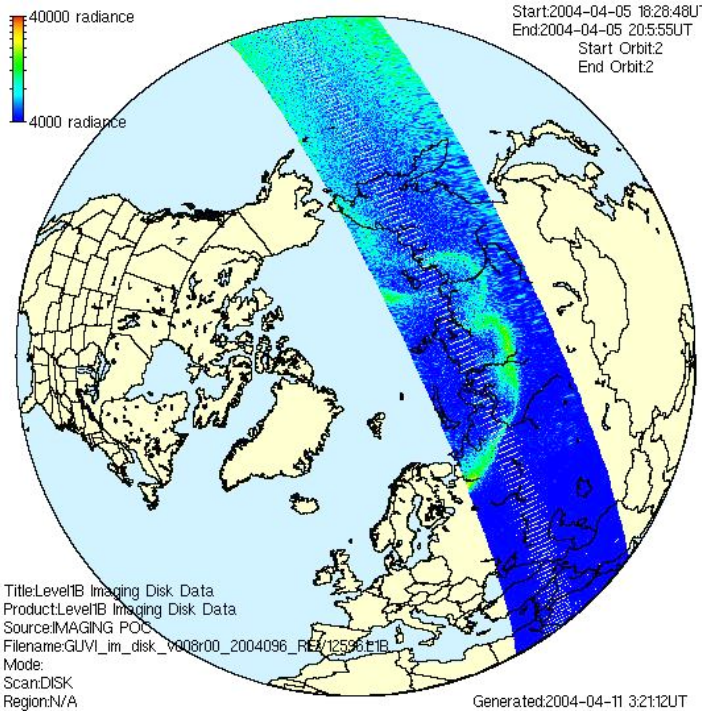


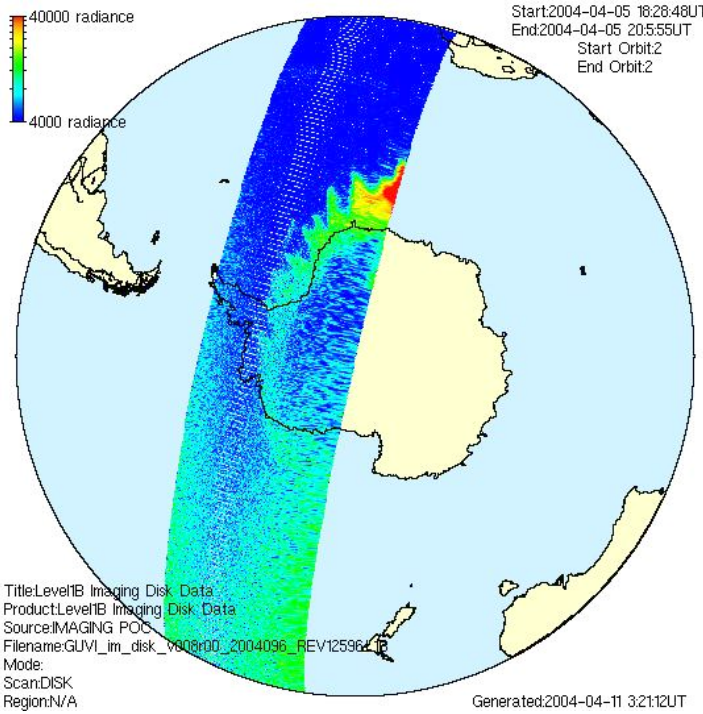
[Courtesy Larry Paxton, TIMED/GUVI]











[Courtesy Larry Paxton, TIMED/GUVI]

Types of Data

- Satellite Data
  - Solar: SOHO, RHESSI
  - Solar Wind: ACE, SMEI
  - Magnetosphere: Cluster, Double Star, Polar, GOES, NOAA/POES, Iridium, LANL GEO, IMAGE
  - Radiation Belt: SAMPEX, GOES particles, HEO, LANL SOPA, GPS
  - Ionosphere: DMSP, FAST, ROCSAT, TIMED
  - Thermosphere/Mesosphere/Stratosphere: TIMED, UARS, CHAMP
- Solar Ground-Based & Satellite Observations
  - Catalog hosted at the CDAW website (http://cdaw.gsfc.nasa.gov)
  - Data Sources: IPS, ISOON, H-alpha, TRACE, SOHO, Metric Radio, Microwave,etc.

Types of Data

- Ground-Based Data
  - Fabry Perot Interferometers
    - Northern Scandinavia at Kiruna, Sweden; Sodankyla, Finland and Longyearbyen, Svalbard
  - Emissions
    - OI (557.7 nm), OI (630.0 nm) at Bear lake Observatory, UT
    - OI (630 nm) High Resolution Imaging Echelle Spectrograph at Boston
    - Optical photometer - Trivendrum
  - Ionosondes & Digisondes
    - International digisonde users group in Center for Atmospheric Research, Lowell's DIDBase
    - Australian Ionosonde Network -- 5 min cadence
    - 3 digital ionosondes in Brazil
    - Vertical ionospheric sounding in Rome
    - Oblique ionospheric sounding between Rome and London
  - Ionospheric Irregularities
    - Scintillations derived from chain of GPS receivers located in the American 70^{o} longitude sector
    - VHF spaced-receiver and GPS instruments (Tirunelveli, India)

Types of Data

- Radars
  - Incoherent Scatter Radars
    - Sonderstrom, EISCAT, Svalbard, Millstone Hill, Arecibo, Jicamarca, Irkutsk (Russia), and Kharkov (Ukraine)
  - SuperDARN
- Magnetometer Data
  - Global ULF wave maps (power, wave index, magnetospheric density)
    - Initial set of magnetometer arrays: IMAGE, MACCS, CANOPUS, USGS, MEASURE, SAMBA, 210 MM
    - Progressively extend to include other arrays, other magnetometer data products
  - ULF wave measurements in Bulgaria, Italy and Antartica
  - Digital magnetometer, Kodaikanal, India
  - SEGMA array in Italy
  - Kharkiv V. Karazin National University magnetometer
  - Trivendrum magnetometer
- TEC
  - IGS Rinex data, World & European maps
  - JPL Maps
  - Chain of GPS receivers located in the American 70^{o} long sector

Types of Data

- Mesosphere Observations
  - MF radar: Neutral winds 80-98 km,
    - equatorial station at Tirunelveli, India
    - Kharkiv V. Karazin National University
    - Network of 35 MF radars spanning high to low latitude (Scott Palo)
  - MST radar at Gadanki, India
  - E-region drifts at 85-105 km at Collm (52N, 15E).
  - All-sky, multi-wavelength gravity wave imager, located at Bear Lake Observatory,UT
  - Medium field (75 deg) Mesospheric Temperature Mapper located at Maiu, Hawaii (20.8 N, 156 W)
  - Raleigh Lidar in Gadanki, India
  - Lower atmosphere radar in Gadanki, India
  - GPS receiver in Gadanki, India
- All Sky Imagers
  - 3 in Brazil
- Equatorial Electrojet
  - Tirunelveli, India
- HF Doppler Radar
  - Kodaikanal, India, Kharkiv V. Karazin National University, & Trivendrum

Types of Data

- Simulation Outputs as Data Sets
  - GAIM - Assimilative model of the Ionosphere - Jan Sojka
  - CSEM MHD Simulation - ULF waves - John Freeman
  - TIEGCM - Geoff Crowley

Data Environment Wish List

Baseline Need: Seamless access sun-to-earth data sets worldwide (including developing nations) -- through Virtual Observatories?

Campaign Needs:

- Analyzed and intepretted data
- On-the-fly generation of integrated data products (world-maps, continuous time series) constructed by networks of worldwide observatories
- Summary data on a common time or spatial axis at vantage points throughout the geospace system
- Mapping between regions
- Tracking of science questions that develop
- Smart data searches (looking for similar features, similar events, statistics in Virtual Observatories)
- Model simulations as data sets
  - viewed along satellite trajectories
  - mapped to ground-based sites
  - Plotted with observations in common format
  - post-processed quantities (i.e., Poynting flux, magnetic field energy, etc.)
- Support for assimilative models
- Secure proprietary data sharing for space weather user community

Extra Slides

Evolving List of Participating Programs

- ISR World Days Campaign (contact: Chaosong Huang <cshuang@haystack.mit.edu>)
  - http://www.haystack.edu/schedules/worldays_2004.html
  - All the incoherent scatter radars worldwide will participate, including Sonderstrom, EISCAT, Svalbard, Millstone Hill, Arecibo, Jicamarca, Irkutsk (Russia), and Kharkov (Ukraine)
  - Measure ionospheric electron density, ion velocity, electron temperature, ion temperature, and electric fields over the F-region. Neutral winds can be derived
  - Focus: to investigate global ionospheric disturbances during magnetic storms and substorms. In particular, how significantly magnetic storms and substorms affect the middle- and low-latitude ionospheric electron density and TEC, how effectively magnetospheric substorm electric fields penetrate to the low-latitude ionosphere, and how the ionospheric electron density and TEC disturbances vary with longitude and latitude
- First CAWSES/GEM/IAGA World Magnetometer Maps (contact: Ian Mann <imann@space.ualberta.ca>)
  - Space weather global data products derived from collaborating ground-based magnetometer arrays
    - First data product will be ULF wave power distribution maps.
    - Testbed arrays: IMAGE (Ari Viljanen), MACCS (Mark Engebretson), CANOPUS (Ian Mann), USGS (Jeff Love), MEASURE (Mark Moldwin), SAMBA (Eftyhia Zesta), 210 MM (Kiyohumi Yumoto).
    - Extend to include other arrays and stations
    - Extend to create other magnetometer data products based on the time-series data. Working toward development of new ULF wave indices and eventually ULF magnetospheric density maps
  - hosted on the Space Sciences Data Portal (SSDP) being developed at the University of Alberta (PI:Robert Rankin)
- Solar Observations Web Page hosted at NASA GSFC (contact: Nat Gopalswamy <gopals@fugee.gsfc.nasa.gov>)
  - Link on the CDAW website at http://cdaw.gsfc.nasa.gov
  - List solar data sources for the CAWSES campaign
  - Link to the data in a usable form for campaign participants
  - Data Sources: IPS, ISOON, H-alpha, TRACE, SOHO, Metric Radio, Microwave,etc.
- SOHO (scientific contact: Joe Gurman <gurman@gsfc.nasa.gov>)
  - SOHO will be in a telemetry "keyhole" between March 20 and April 4. Telemetry will be reduced to ~60%. LASCO coverage of coronal mass ejections will probably still be quite good. EIT data will be unavailable.
- RHESSI (contact: Robert Lin <rlin@ssl.berkeley.edu>)
  - Able to supply information on solar flare emissions and particle acceleration
- Big Bear Solar Observatory (contact: Vasyl Yurchyshyn <vayur@bbso.njit.edu>)
  - 1 min time cadence full disk Halpha images (at BBSO from 1500 to 0000 UT)
  - 1 min time cadence full disk H alpha images from our Global H alpha Network
  - 1 min time cadence hi resolution measurements of the solar magnetic field
- SMEI Contacts: Dave Webb (David.Webb@hanscom.af.mil), Bernie Jackson <bvjackson@ucsd.edu>
  - Try to ensure that SMEI is operating in its normal, all-sky mode during the March-April timeframe.
  - Especially monitor operations during the March 29-April 3 CPEA time period
  - View entire sky beyond ~20 deg from the sun
  - Can see CME's and should be able to detect corotating structures
- ACE (contact: Thomas Zurbuchen <thomasz@umich.edu>)
  - Rapidly analyze and provide level 2 digital files of the upstream solar wind conditions
  - Provide link to analyzed data on the ACE home page

- Cluster (contact: Philippe Escoubet <Philippe.Escoubet@esa.int>)
  - Apogee in front of dayside magnetopause
  - About half- time in the upstream solar wind
  - Crosses the South and North cusp/magnetopause, the auroral region on nightside, the radiation belts and the plasmasphere.
  - View surface waves on the magnetopause
- Double-Star (contacts: Philippe Escoubet, Philippe Escoubet@esa.int; Prof. Z.-X. Liu, liu@center.cssar.ac.cn
- Geotail (Contact: Don Fairfield <Donald.H.Fairfield@nasa.gov>) - NOT CONFIRMED
  - inner magnetosphere current disruption region
  - solar wind upstream of bow shock
- Polar (contact: John Sigwarth <john-sigwarth@uiowa.edu>)
  - Polar perigee at the near-equatorial magnetopause,
  - Science focus: cusp, pressure pulses, triggered aurora, conjugate ovals, dayside O/N2
- GOES magnetic field (contacts: Howard Singer <howard.singer@noaa.gov>, Brian Fraser <Brian.Fraser@newcastle.edu.au>)
  - Magnetic field observations at geo orbit
  - ULF wave signatures
- NOAA/POES (Contact: David S Evans <David.S.Evans@noaa.gov>)
  - Operational data from NOAA-15, -16, 17
  - auroral protons and electrons, ring current and radiation belts, solar particle events
- Iridium magnetic field measurements (contact: Brian Anderson <Brian.Anderson@jhuapl.edu>)
  - Maps of FACs, magnetic perturbations and poynting flux where data quality is sufficient
- Radiation belt particles
  - SAMPEX (Contact: Daniel Baker <daniel.baker@lasp.colorado.edu>)
  - GOES particles (Contact: Terry Onsager <Terry.Onsager@noaa.gov>)
  - HEO (Contact: Joseph Fennell <Joseph.F.Fennell@aero.org>): Electrons >130 keV to >3 MeV; Limited proton coverage at E> 80 keV.
  - GPS and LANL SOPA: NOT CONFIRMED
- IMAGE (in Earth eclipse for much of the campaign - many instruments will have to be shut down.)
  - magnetospheric density profiles - RPI (Contact: Bodo Reinisch , Paul Song <paul.song@uml.edu>). Run as long as possible.
  - ring current populations, substorm populations, outflows (ENA Imager Contacts: HENA, Don Mitchell (Donald.G.Mitchell@jhuapl.edu>; MENA, Craig Pollock <craig.pollock@swri.org>; LENA Tom Moore <Thomas.E. Moore@gsfc.nasa.gov>)
  - plasmaspheric dynamics (Contact: Bill Sandel <sandel@arizona.edu>)
  - Auroral emissions: Partial coverage by WIC due to shut down for sun protection, more complete coverage by SI-12 and SI-13 possible (Contact: Harald Frey <hfrey@ssl.berkeley.edu>)
- LANL GEO plasma (contact: Michelle Thomsen <mthomsen@lanl.gov)
  - satellites at 8, 69, 103, 195, and 322 East Geographic Longitude
  - Routine observations of plasmaspheric drainage plumes, near-Earth plasmasheet
- DMSP and ROCSAT (Contact: Rod Heelis <heelis@utdallas.edu>)
  - charged particle drift, composition and temperature
  - data sets will provide equatorial mid-latitude and high latitude data distributed in latitude, longitude, and LT

- DMSP Particles & Fields (Contact: Fred Rich, Frederick.Rich@hanscom.af.mil)
  - Thermal plasma data, precipitating particle data, fluxgate magnetometer data
- FAST: (Contact: Cynthia Cattell <cattell@belka.space.umn.edu>)
  - pre-noon/dusk (~20 MLT).
  - Taking data to low latitudes (~ 50 deg ILAT).
  - Magnetometer data to help with the field-aligned current/ULF wave physics
  - High-resolution particle measurements 10's eV to 10's keV
- Fabrey-Perot Interferometers in Northern Scandinavia Contact: Anasuya Aruliah <a.aruliah@ucl.ac.uk>
  - FPIs observing the 630nm emission at Kiruna, Sweden; Sodankyla, Finland and Longyearbyen, Svalbard
  - Also operating a narrow field of view spectrograph platform, observing several wavelengths, but looking in particular at proton aurora. Context is provided by co-located video camera, and absolute calibration by co-located photometers.
  - Observations at night pending clear weather during the campaign
- TIMED (Contact: Sam Yee <Sam.Yee@jhuapl.edu>)
  - 10 - 22 LT plane
  - Lower thermosphere and mesosphere observations of chemically active species, neutral temp, particle inputs, neutral composition, auroral emissions, etc. Also solar EUV, XUV emissions
  - Will support the ISR World Days Campaign as well as CPEA
  - Will limit operations that disrupt observations during the entire March-April time interval of the campaign.
- IPS Ionosonde Network in Australia (contact: Phil Wilkinson <phil@ips.gov.au>)
  - 5 min cadence ionograms
- SuperDARN radar network (contact: Ray Greenwald <Ray.Greenwald@jhuapl.edu>)
  - website at APL wil provide the convection patterns and cross polar cap potential as the campaign evolves
- JPL TEC Maps (contact: Tony Mannucci <Tony.Mannucci@jpl.nasa.gov>)
  - Data from ground and space-borne GPS receivers
- TEC generated from IGS RINEX data Contact: Ruth Bamford (McCrea) <R.A.Bamford@rl.ac.uk>
  - supported under the European COST271
  - European maps at http://ionosphere.rcru.rl.ac.uk/index.htm
  - World maps can be produced
- UK Ionosonde facilities (contact: Sarah James <sarah@wdcc1d.stp.rl.ac.uk>)
  - at Chilton, UK and Port Stanley, Falkland Islands
  - 5 min cadence ionograms
  - available online via the World Data Centre for STP, Chilton website at http://www.wdc.rl.ac.uk/ and it will also be included in Center for Atmospheric Research, Lowell's DIDBase
- Ionospheric scintillations & TEC Network (Contact: Cesar Valladares <valladar@maill.bc.edu>)
  - GPS scintillation data, GPS-derived TEC data
  - Chain of GPS receivers located in the American 70 deg longitued sector
- MACCS magnetometer chain Contacts: Jeff Hughes hughes@bu.edu ; Mark Engebretson engebret@augsburg.edu
  - Operate as normal during CAWSES

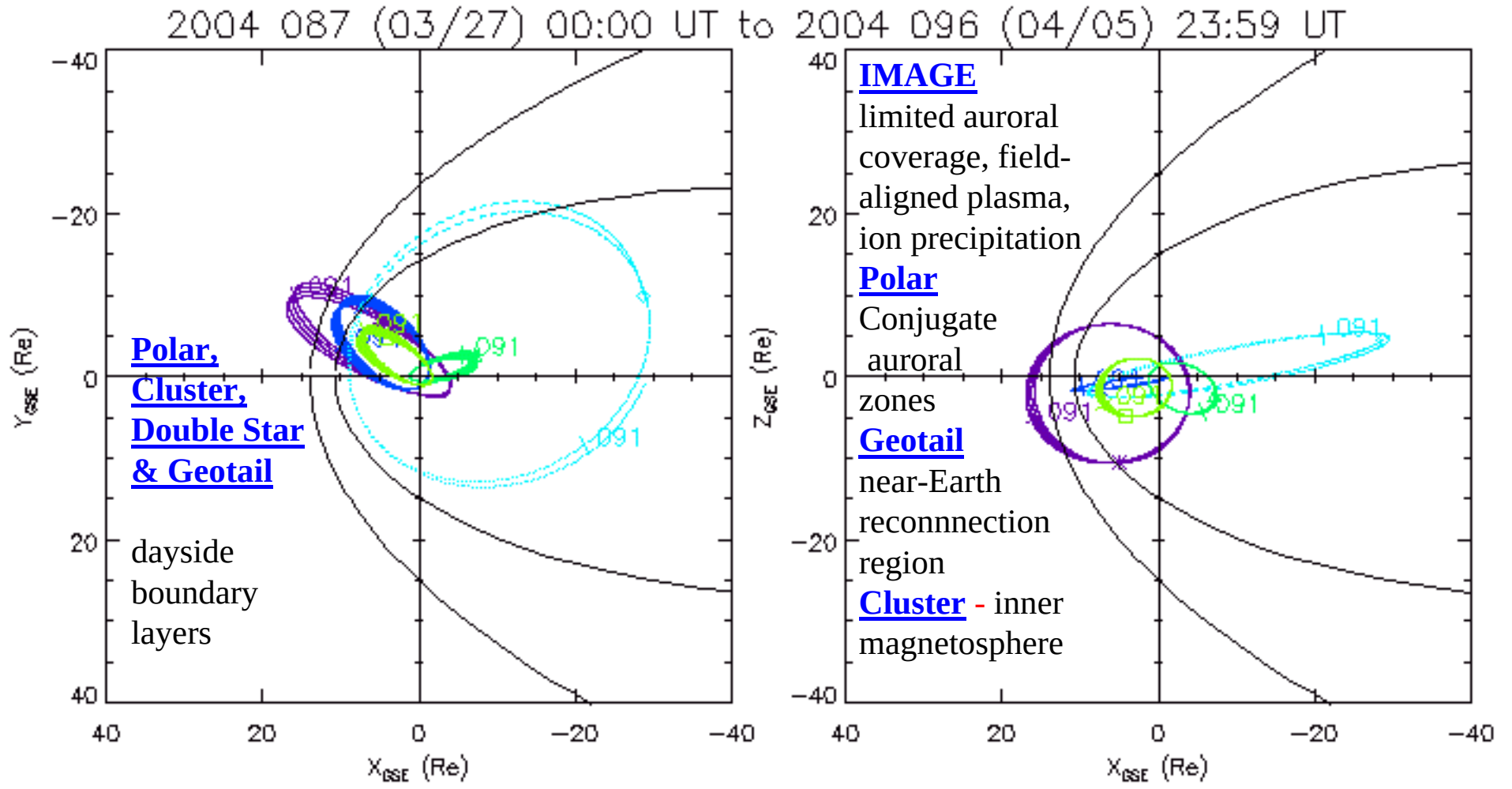
- UARS (Contact: Charles Jackman <jackman@assess.gsfc.nasa.gov>)
  - Very low power situation during ISR world days. It is possible that there will be some measurements by SOLSTICE and SUSIM,but very little else
  - After April 2, the possibility exists to have SOLSTICE, SUSIM, HALOE, and possibly HRDI on with PEM during the daytime part of the orbit.
  - Longer term data set possible for equinox campaign: HALOE is scheduled to make measurements March 1-7 and 16-26. The schedule for April will soon be available.
  - HALOE data is available after it is processed at http://haloedata.larc.nasa.gov/Haloe/noframe_home.html
- Coupling Processes in the Equatorial Atmosphere (CPEA) campaign (contact: Prof Shoichiro Fukao <fukao@kurasc.kyoto-u.ac.jp>
  - Download brochure at http://people.ece.cornell.edu/wes/URSI_ISWG/ CPEA-panf.pdf
  - Runs March and April 2004 in Indonesia
  - Observe coupling processes in the neutral atmosphere from troposphere to thermosphere in a region of strong turbulence.
  - One focus is on the characterization of gravity waves over Indonesia by CPEA from April 10 - May 10, 2004
    - CPEA observations will be placed into the global context by the CAWSES atmospheric observations.
      - Note: The CAWSES objective is to characterize the middle atmosphere using global sets of ground-based observations and satellite data during the equinox interval.
      - It supports and broadens the CPEA objectives
      - CAWSES provides a testbed for producing global maps of important geophysical quantities (i.e., gravity waves, neutral winds, etc.) using international collections of ground-based observations combined with satellite data.
- Indian Institute of Geomagnetism (IIG) Contact: Dr. S. Gurubaran <gurubara@vsnl.com>: Equatorial Station at Tirunelveli
  - Partial reflection MF Radar. Continuously operated. Measurements at 80-98 km
  - Digital fluxgate magnetometer that along with Alibag system provides EEJ strength at high temporal resolution (Contact: Prof. S. Alex)
  - VHF spaced-receiver and GPS instruments are also operated here that can provide a variety of information on the equatorial ionospheric irregularities (contact: Prof. A. Bhattacharyya)
- Mesospheric Gravity Wave & Temperature Measurements (Contact: Mike Taylor <mtaylor@cc.usu.edu>
  - During the new moon period in March (13-28) and April (11-27)
  - All-sky, multi-wavelength gravity wave imager, located at Bear Lake Observatory,UT (41.6 N, 111.6 W). Sequential measures of the NIR OH, O2(0,1) band emissions, and the OI (557.7 nm), OI (630.0 nm) and Na (589.2 nm)line emissons
  - Medium field (75 deg) Mesospheric Temperature Mapper for OH(6,2) and O2(0,1) band emission intensity and rotational temperatures at 3-min resolution and ~2 K precision. Located at Maiu, Hawaii (20.8 N, 156 W)
- Indian Institute of Astrophysics, Solar-Terrestrial Physics Facilities at Kodaikanal Contact: J. H. Sastri <jhs@iiap.res.in>
  - campaign mode now till April 6, 2004
  - ionosonde, HF Doppler radar and digital magnetometer

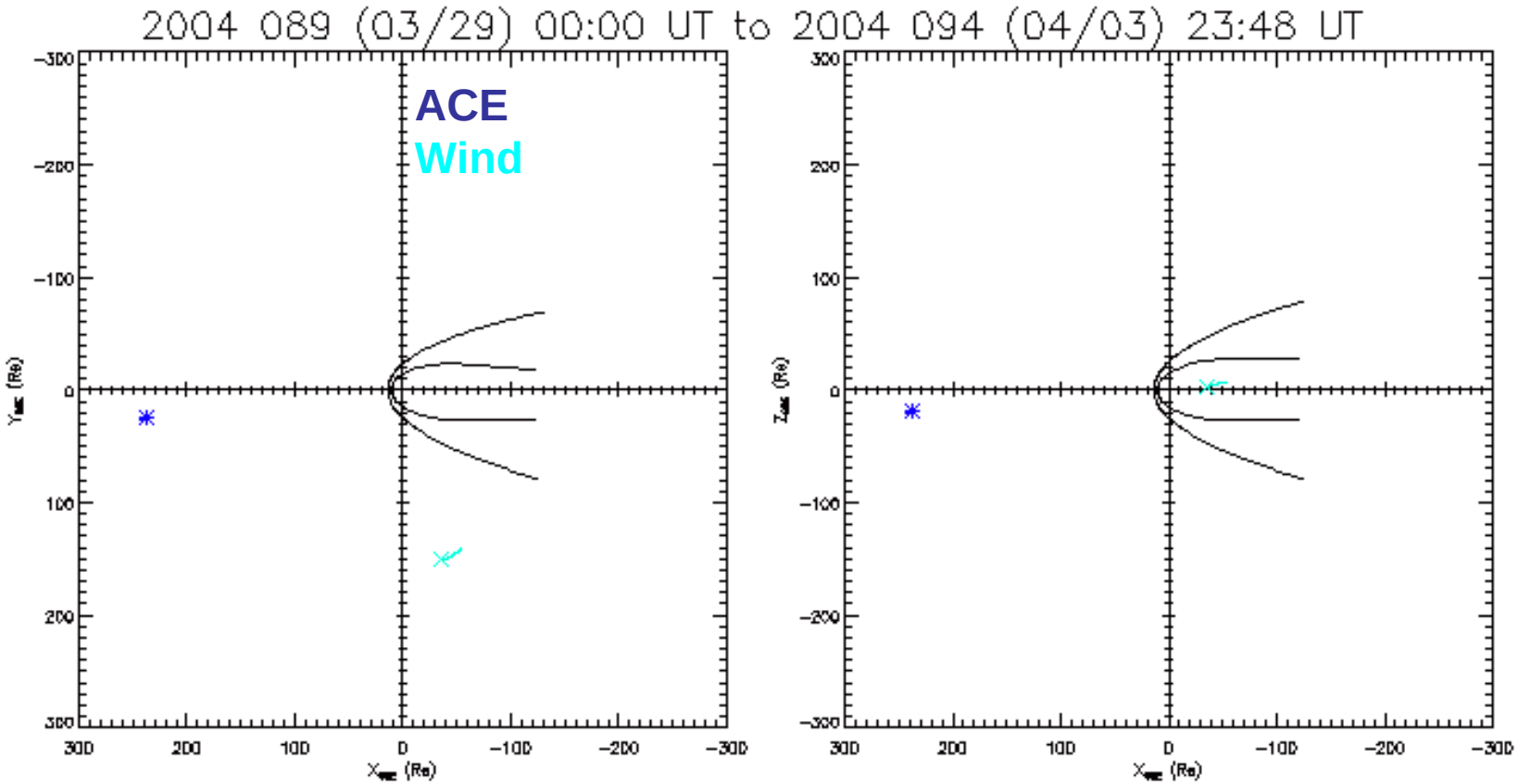
- Brazilian Ionosondes (Contact: Dr. Paulo Fagundes, fagundes@univap.br)
  - 3 digital ionosondes (CADIs)
  - 3 multi-spectral all-sky imaging imaging systems
  - Operational during the proposed period (March 29 to April 03, 2004)
  - Spread from equator to low-latitudes
- Consorzio "Area di Ricerca in Astrogeofisica", L'Aquila (Italy). Person to contact: U. Villante (umberto.villante@aquila.infn.it)
  - SEGMA Magnetometer Array. Person to contact: M. Vellante (massimo.vellante@aquila.infn.it)
  - ULF wave magnetic measurements at Panagyurishte (Bulgaria). Person to contact: M. Vellante (massimo.vellante@aquila.infn.it)
  - ULF wave magnetic measurements at Ottana (Italy). Person to contact: P. Palangio (palangio@ingv.it)
  - ULF wave magnetic measurements at Terra Nova Bay (Antarctica).
    - measurements will be available only after the next summer campaign (December 2004).
    - Person to contact: M. De Lauretis (marcello.delauretis@aquila.infn.it)
  - Absolute magnetic field measurements at the Geomagnetic Observatory of L'Aquila (Italy). Person to contact: P. Palangio (palangio@ingv.it)
  - Absolute magnetic field measurements at the Geomagnetic Observatory of Castello Tesino (Italy). Person to contact: A. De Santis (desantisag@ingv.it)
  - Vertical ionospheric sounding at Rome (Italy) and Gibilmanna (Sicily, Italy). Person to contact: B. Zolesi (zolesi@ingv.it)
  - Oblique ionospheric sounding between Rome and London. Person to contact: B. Zolesi (zolesi@ingv.it)
- "Istituto di Fisica dello Spazio Interplanetario" (IFSI), of the Italian CNR (National Reasearch Council)
  - Kerguelen SuperDARN radar.
  - run by IFSI in cooperation with CNRS, Orleans.
  - radar is crossed with the Japanese radar in Syowa, and provides the vector flow velocity pattern of the ionospheric plasma.
  - radars operate continuously
  - Contacts are provided in the SuperDARN web page http://superdarn.jhuapl.edu/info.html
- PSPT (Precision Solar Photometric Telescope) at the Rome Astronomical Observatory
  - During the first CAWSES campaign "triplets" of CaII K line (393.3 nm, bw 0.25 nm), blue continuum (409.2 nm, bw 0.25 nm) and red continuum (607.1 nm, bw 0.5 nm). images of the solar disk will be acquired within few minutes each hour, during the whole day, weather permitting.
  - The images calibrated for instrumental effects will be available through the OAR web-page at http://www.mporzio.astro.it/solare
- Department of Space Radio Physics at the Kharkiv V. Karazin National University (Contact: Prof. Oleg F. Tyrnov, Oleg.F.Tyrnov@univer.kharkov.ua)
  - magnetometer, the MF radar, the HF radar, and navigation satellite radio beacon receivers (49œ 38'N, 36œ 20')
  - described at http://www radiophys.univer.kharkov.ua/space/
- SCINDA
- C'NOFS team (contact: Odile de La Beaujardiere <Odile.delaBeaujardiere@hanscom.af.mil>)
  - analysis of pre-C'NOFS equatorial data set

- International Digisonde Users Group. Contact: Bodo Reinisch bodo_reinisch@uml.edu
  - 1 ionogram every 5 minutes,
  - calibrated drift operation run 2-4 drift cases following each ionogram.
  - data archived in DIDBase.
- HIRISE (High Resolution Imaging Echelle Spectrograph) Contact: "D. Pallamraju" <raju@cawses.bu.edu>
  - operating from Boston (42.2N, 71.W, mag lat. 48.3)
  - daytime red line (630.0nm) emission measurements
- Network of Mesospheric Radars (Contact: Scott Palo <palo@colorado.edu>
  - Radars run quasi-continuously. Will try to mnimize radar downtime for maintenance in the March-April 2004 time frame.
  - List of ~ 35 network radars spanning high to low latitudes at http://sisko.colorado.edu/TIMED/ . Follow links --> Data: Ground-based Radars --> Sites
- Atmospheric facility at Gadanki, India (Contact: D. Narayana Rao <dnrao_2001@rediffmail.com>)
  - MST Radar, Raleigh Lidar, Lower atmospheric radar, GPS receiver, GPS Sonde and some of the meteorological parameters at ground level
- LF Wind Measurements at Collm (52N, 15E). Contact: Christoph Jacobi, <jacobi@rz.uni-leipzig.de>
  - horizontal E-region drifts at 85-105 km
  - LF reflection heights at oblique incidence on 177 kHz
  - Data coverage is ~12 h for heights and 16 h for winds (both nighttime), resolution is 30 min
  - Measurements are continuous. 20 year data base is available for comparisons
- UPOS_GSE Geoeffectiveness of Solar Events (contact: Charles Deehr cdeehr@gi.alaska.edu)
  - Calculates 4-day and 28-day predictions of solar wind density, velocity, pressure and magnetic field to 2 and 10 AU every hour at http://gse.gi.alaska.edu/recent/
  - "Fearless Forecast" provides email notification of predicted shock arrival times. Subscribe at: http://www.gi.alaska.edu/mailman/listinfo/gse-ff.
- Space Physics Laboratory, VSSC, Trivendrum (Contact: R. Sridharan at r_sridharan@vssc.org
  - HF Radar, Magnetometer, and Optical photometers will be operating.
- GAIM model -- Jan Sojka
  - First results presented at CEDAR meeting 6/27/2004
- Penetration Electric Field -- Dave Anderson
  - Derived from low-latitude magnetometer measurements

Participating Satellites - Orbits

Satellite Observations to Explore ULF wave generation, substorm triggering, & particle acceleration during high speed streams

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Z (Re)
X (Re)
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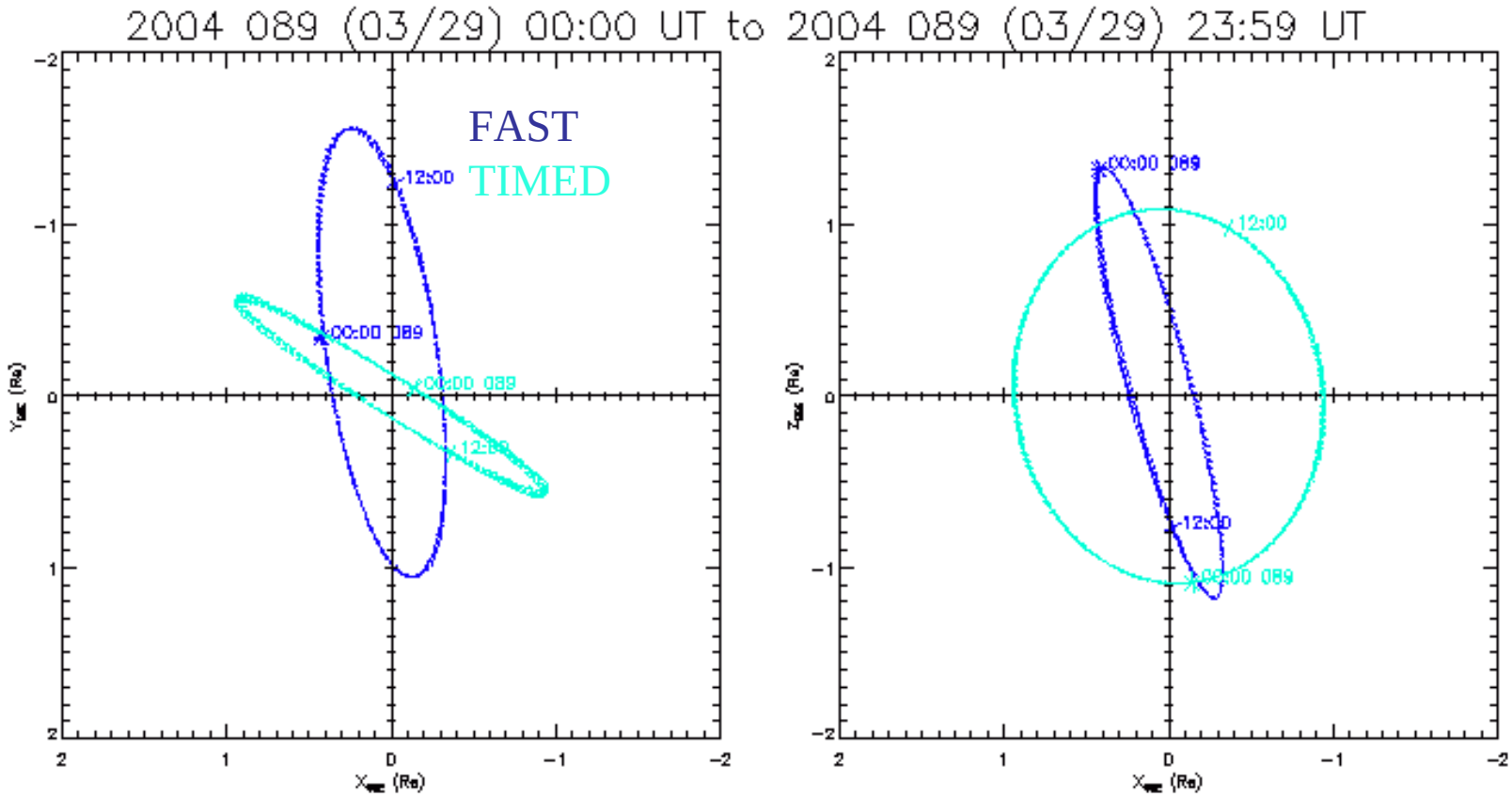
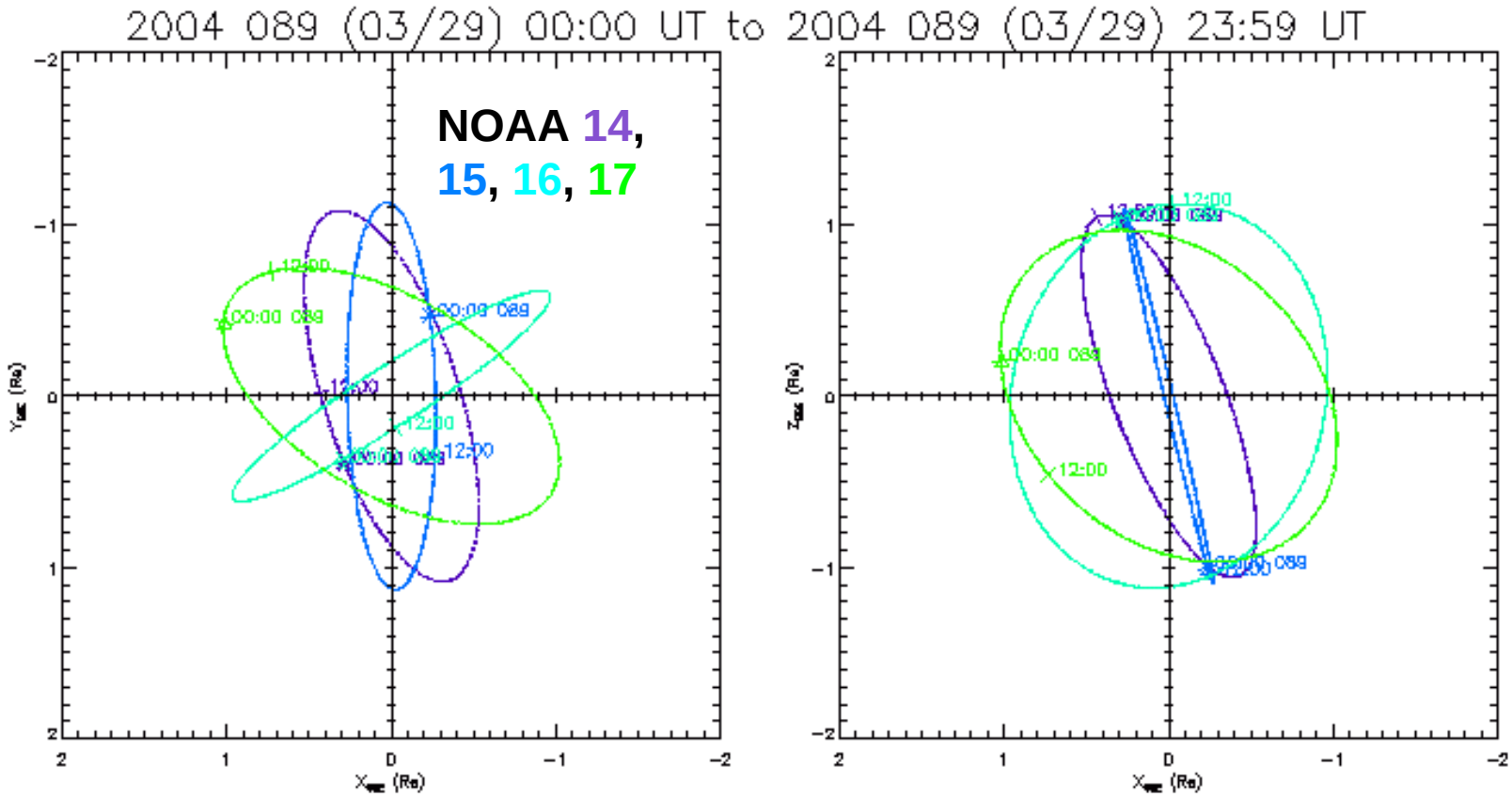
200
100
0
-100
-200
-300



FAST - dawn-dusk ionosphere

TIMED - pre-noon/pre-midnight ionosphere/atmosphere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Z_GSE (Re)
X_GSE (Re)

CEDAR/CAWSES Workshop

Evolving list of presentations & topics:

CAWSES Space Weather (~ 10 min)

- John Foster, Strong positive storm effects seen by MH Radar
- Larry Paxton, Unusual wavelike auroral forms 3 & 5 April storms
- Dave Anderson, Penetration electric field observations from magnetometers
- Mike Ruohoniemi. Enhanced convection from SuperDARN
- Jan Sojka, GAIM movie of the ionosphere for the CAWSES interval
- Larisa Goncharenko, E-region observations during the CAWSES campaign
- Rick Niciejewski. FPI & TIDI observations
- Eric Sutton, CHAMP thermospheric density and winds

CAWSES Atmospheric Coupling (~10 min)

- Marty Mlynczak (for Jim Russell) -- Perturbations in NOx & Ozone in April 2004 seen by UARS
- Marty Mlynczak -- SABER NO observations during March-April 2004
- Larry Paxton -- Thermospheric O/N2 Changes during March-April 2004

Comments (few slides contributions)

Qian Wu

CEDAR/CAWSES Workshop

Objective

- Take a first look at ITM observations during space weather (25 March - 6 April) & atmospheric coupling (March - April 2004) campaigns --
- Provide forum for initiating & developing collaborations
- Begin to collect science issues on which to focus analysis efforts worldwide

Question to Speakers

- What were the interesting features in your data?
- What new science questions were raised?
- What other interesting global maps can be created?