



# The ISWI Science Program

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# ISWI Objectives



- Develop the **SCIENTIFIC INSIGHT** necessary to understand the science, and to reconstruct and forecast near-Earth space weather
  - Instrumentation
    - Expand and continue deployment of new and existing instrument arrays
  - Data analysis
    - Expand data analysis effort for instrument arrays and existing data bases
  - Coordinate data products to provide input for physical modeling
    - Input instrument array data into physical models of heliospheric processes
    - Develop data products that reconstruct past conditions in order to facilitate assessment of problems attributed to space weather effects
  - Coordinate data products to allow predictive relationships to be developed
    - Develop data products to allow predictive relationships that enable the forecasting of Space Weather to be established
    - Develop data products that can easily be assimilated into real-time or near real-time predictive models
- Education, Training, and Public Outreach
  - University and Graduate Schools
    - Encourage and support space science courses and curricula in Universities that provide instrument support
  - Public Outreach
    - Develop public outreach materials unique to the ISWI, and coordinate the distribution



# ISWI Science Program



- **What can we (ISWI) do to advance the science if ISWI?**
- **ISWI coordinating science program → the International Heliophysics Year (IHY) Coordinated Investigation Programmes (CIPs)**
  - Use same principles as IHY scientific activities, but ...
  - Not be as formal as the CIPs but is it too late for this?
- **D. Webb willing to help coordinate these if useful.**
- **Overall goal of an ISWI science program → gain a more complete understanding of the universal processes that govern the Sun, Earth, planets and heliosphere.**
- **Involves scientists from a variety of disciplines:**
  - Solar Physics, Planetary Magnetospheres, Heliosphere and Cosmic Rays, Planetary Ionospheres, Thermospheres and Mesospheres, and Climate Studies
- **ISWI science projects focus on fundamental underlying physics of each phenomenon**
  - Facilitate discussions between different disciplines by focusing on relationships between these phenomena and commonalities in the physical processes.
  - Allow researchers to plan and participate in cross-disciplinary studies, culminating in a greater understanding of fundamental universal processes.



# Science Benefits: Why do This?



## What is Unique about ISWI Data?

- **By observing in new geographical regions, a more global picture of Earth's response to solar wind inputs can be obtained**
- **24/7 solar observing in radio and H-alpha**
- **Arrays provide 3-D information that can be used in tomographic reconstructions**
- **Over long term these networks will provide real-time data valuable for forecasting and nowcasting**
- **Modeling improvements will allow better exploitation of existing data sets**



# ISWI Science Program: Ideas for Implementation



- **At the UN-ISWI Workshop last year in Nigeria, the desire for an ISWI science program was announced and also mentioned in Newsletter**
- **The primary data sets (initially) would come from ISWI (IHY Legacy) Instrument Projects/Arrays**
  - **Currently 15 operational Instrument Projects**
  - **Instruments hosted by ~100 countries**
- **Main communication interface could be an internet site set up either directly through or via a link to the main ISWI web site:**
  - **<http://www.iswi-secretariat.org/>**
- **Aid in establishing space weather modeling centers around the world, e.g., in collaboration with NASA's Coordinated Community Modeling Center**
- **Interface with ISWI Space Science Schools and Public Outreach projects**
- **Would be part of new permanent UN agenda item called "Space Weather"**
- **Specific details made available through the ISWI Newsletter**

# ISWI Science Implementation (cont.)

- **Improve organization and availability of information on analyses of ISWI data and ISWI activities**
  - **Categorize arrays by science areas; e.g., solar & heliosphere, magnetosphere, ionosphere, etc.**
  - **List of all MS and PhD degrees under IHY-ISWI**
  - **List of all scientific papers published using IHY-ISWI data**
    - Organized by arrays, topics, etc.**
    - UN needs to distill results of published papers; emphasis on societal impacts**
    - Can be done through ADS searching – already underway?**
  - **Workshops and other meetings under or related to ISWI**
  - **Schools and outreach projects under or related to ISWI**
- **Develop and test models and simulations**
  - **New models and simulations**
  - **Use ISWI data to test existing models and simulations**
  - **Assimilation of ISWI data into models; esp. space weather models; extend to all instru. arrays and/or to other data sources**
- **Need to develop cooperative studies using data from other ISWI arrays and other data sources.**

- **Maybe need an ISWI science workshop; next year?**
  - **Focus on scientific results**
  - **Possibly like CDAW where data analysis prepared in advance, data interfaces provided and results presented and published in one volume.**
- **Next some examples of cooperative science projects involving ISWI array data**
- **Then examples from this meeting of combining data from several ISWI arrays or other “outside” data sources:**



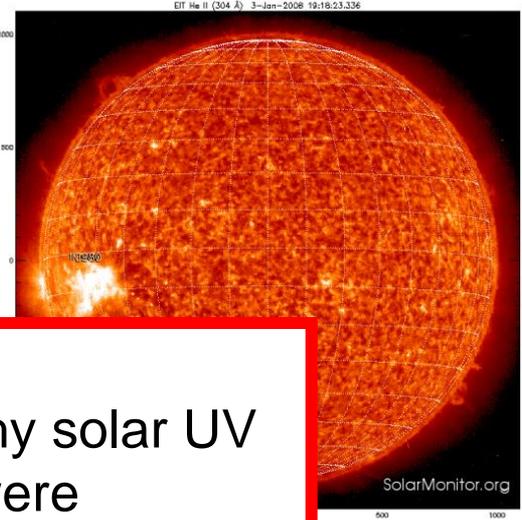
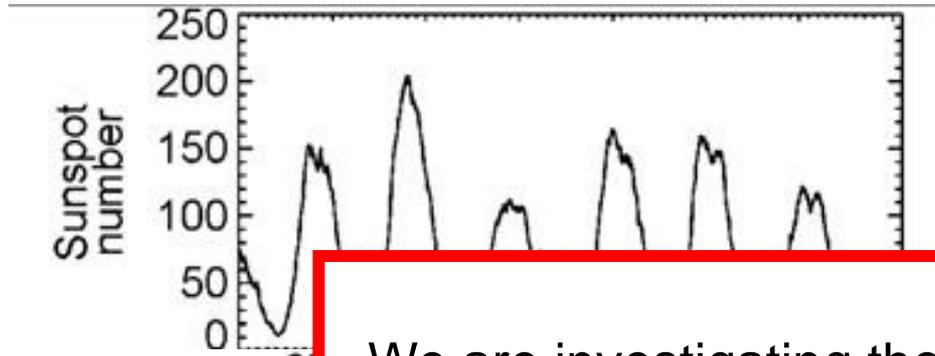
# ISWI Links with Other Science Programs



- **International Study of Earth-Effecting Solar Transients (ISEST)**
  - ***Coordinator: Jie Zhang (George Mason University, USA)***
  - **ISEST program being implemented in 2012 - 2013 under the framework of Task Group 3 of SCOSTEP/CAWSES II**
  - **Three international workshops will be organized**
  - **An international effort to address the following specific issues**
    - \* **Create a comprehensive database of Earth-effecting solar and heliospheric transient events in solar cycle 23 and 24 (partial)**
    - \* **Develop advanced theoretical models of heliospheric transients**
    - \* **Develop prediction tools of heliospheric transients**
- **Two intl. programs I am chairing:**
  - **IAU Working Group on International Collaboration on Space Weather**
  - **STEREO Space Weather Group**
    - **<http://secchi.nrl.navy.mil/spwx/>**
- **ISWI Study of Radio Transients**
  - **Coordinator: Nat Gopalswamy**

Why Sq variation and solar UV radiation show unusual fall at solar minimum phase around 2008 ?

SoHO/EIT 30.4 nm



We are investigating the reason why solar UV radiation from low latitude region were sufficiently weak around 2008 by using chromospheric images obtained with CHAIN telescopes.

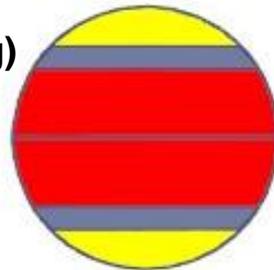
HER  
(34.43S,  
19.23E)

Sq-her  
[nT]

1950 Time 2010

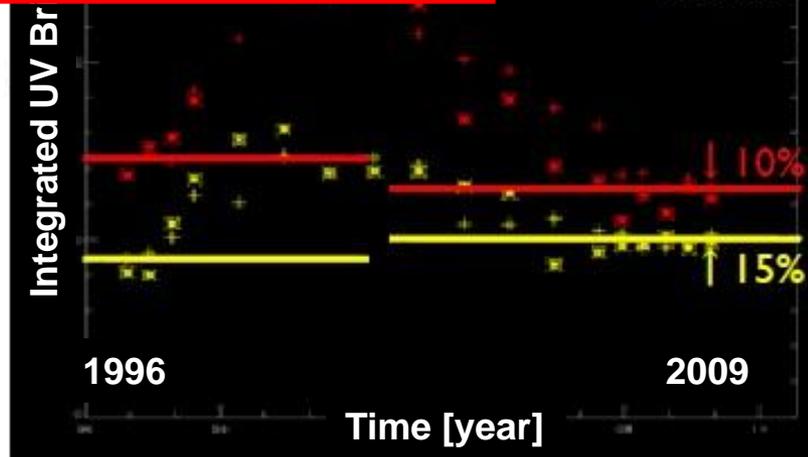
High Latitude Region  
(-90 to -60, +60 to +90 deg)

Low Latitude Region  
(-30 to 0, 0 to +30 deg)



Latitude Region  
Latitude Region

\* North  
+ South



Asai, Kitai, UeNo et al.

We think this kind of study will also become an influential candidate as a theme of the future international cooperative studies.

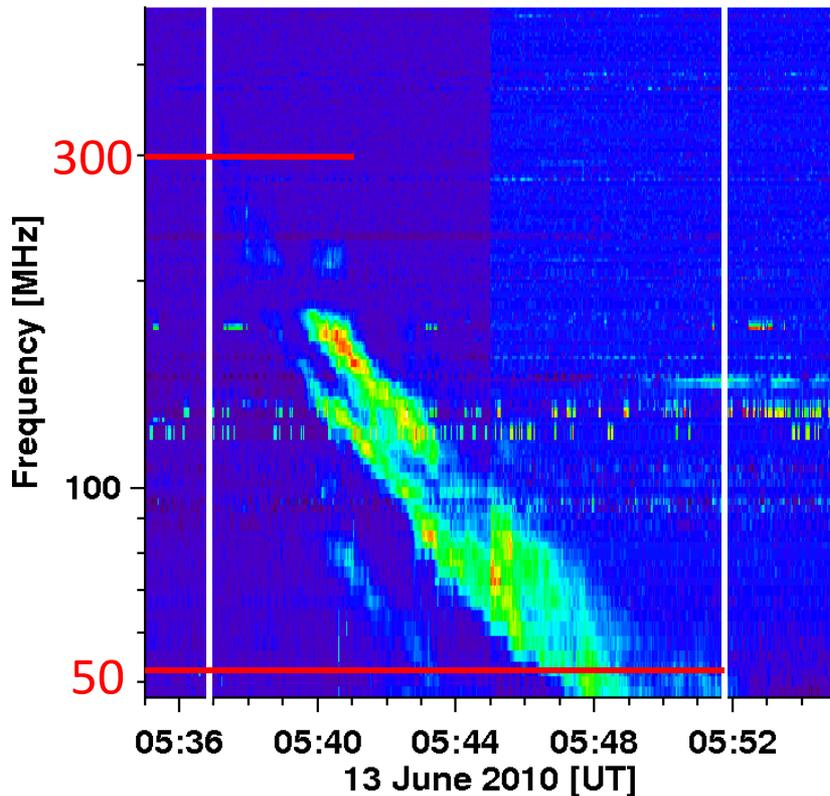
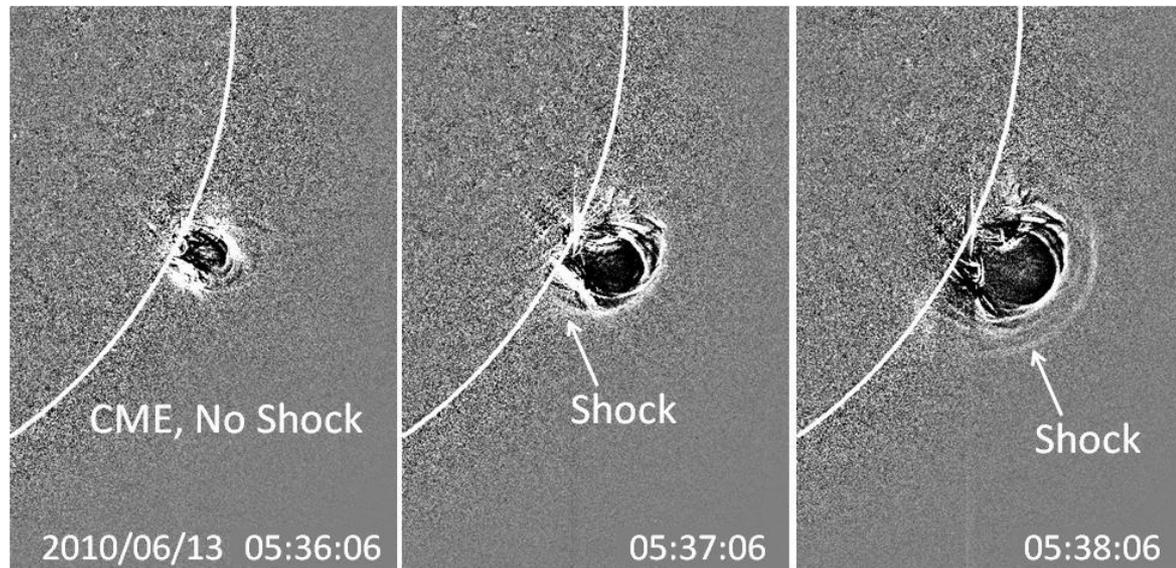
For example, in this year, the Pakistan/ Space and Upper Atmosphere Research Commission(SUPARCO) made proposal to CHAIN-project to cooperatively study on the following themes:

- Study of Maximum Electron Density NmF2 at Karachi and Islamabad **during Solar Minimum (1996) and Solar Maximum (2000)**
- Variations in F2-layer parameters and comparison with IRI over Pakistan **for deep solar minimum**
- Ionospheric variability of low and mid latitude **for solar cycle 22 and 23**
- **Solar cycle effect** on coupling of neutral and ionized species at F2 altitude



# CALLISTO Type II Burst: 2010 June 13

Callisto/OOTY



## Solar Dynamics Observatory

Type II burst starts exactly at the time the shock appears in the corona at 1.2  $R_s$

We can probe the coronal medium as well as the shock structure by combining type II and EUV/coronagraph observations

$$df/dt = 0.28 \text{ MHz/s}; (1/f)df/dt = (0.28/175) \text{ s}^{-1}$$

$$V = 600 \text{ km/s}; L = 189,000 \text{ km}$$



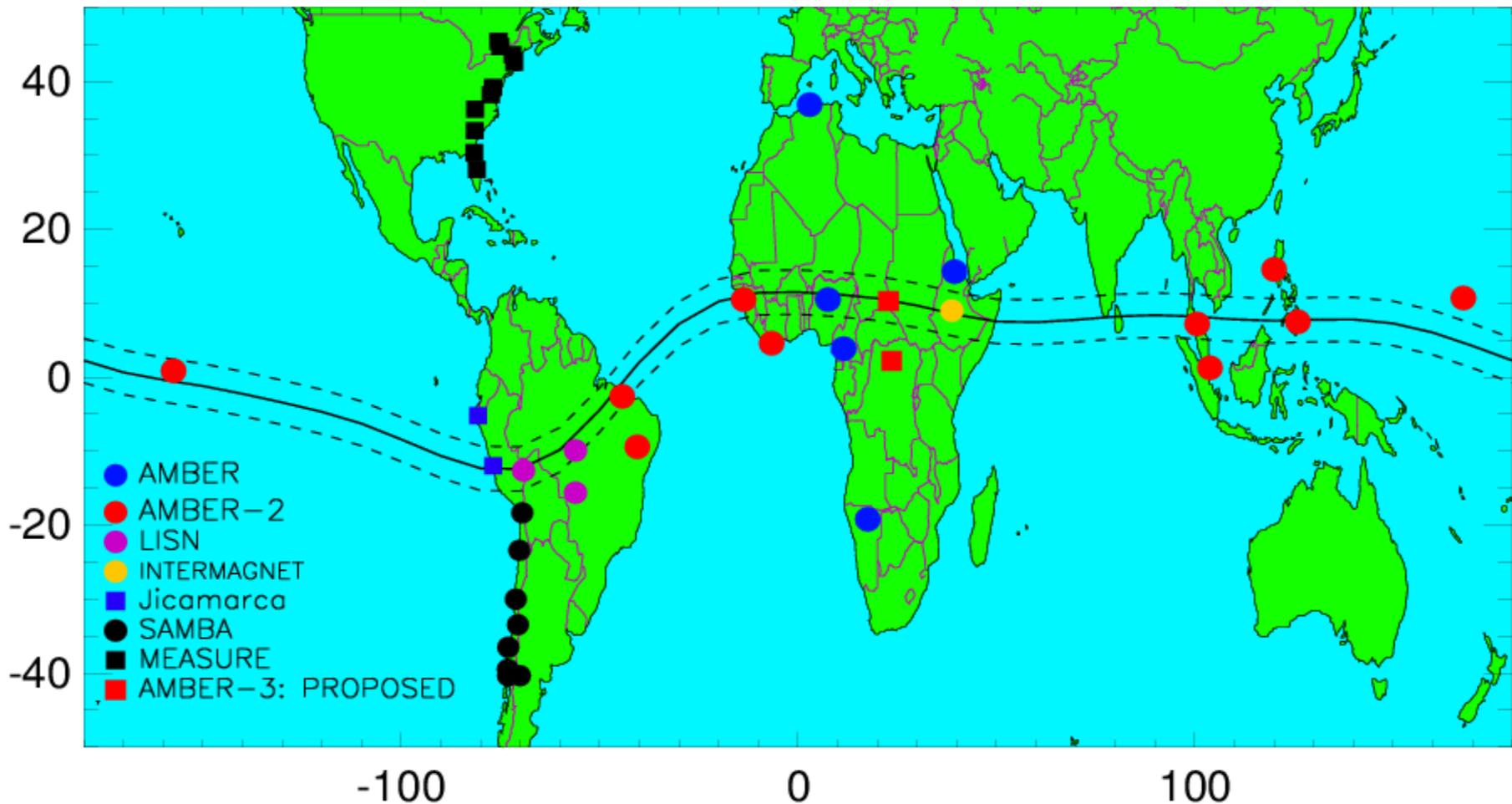
# Use CALLISTO Data!

- CALLISTO produces science quality data
- Detects tiny eruptions from the Sun
- CALLISTO data being utilized for a Indo-US project on solar eruptive events
- Need to identify a set of good instruments for continuous coverage over the whole frequency range
- CALLISTO is one of the success stories of ISWI instruments

Courtesy N. Gopalswamy, NASA

# AMBER and other Magnetometer Networks

- AMBER & AMBER-2 PI: **Endawoke Yizengaw**
- LISN PI: **Cesar Valladeres**
- SAMBA PI: **Eftyhia Zesta**
- MEASURE PI: **Mark Moldwin**





# ISWI Science Program: Conclusions



- Initial emphasis has been on data analysis of ISWI Instrument projects, but need to expand to cooperative studies with other ISWI arrays and other data sets to best address science.
- Interface with ISWI Space Science Schools, Public Outreach projects and other science programs
- Need feedback on how to proceed on enhancing the science from all 15 instrument projects
- Please contact David Webb ([david.webb@bc.edu](mailto:david.webb@bc.edu)) :
  - To be placed on general email list
  - Need your ideas for ISWI science projects