



# **CAWSES: Some Early Accomplishments and Future Prospects**

**Sunanda Basu, Boston University  
Chair, Science Steering Committee,  
CAWSES**

***STP-11, Rio de Janeiro  
March 5-12, 2006***



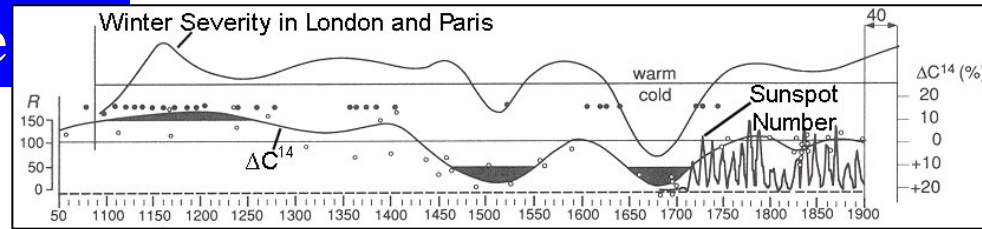
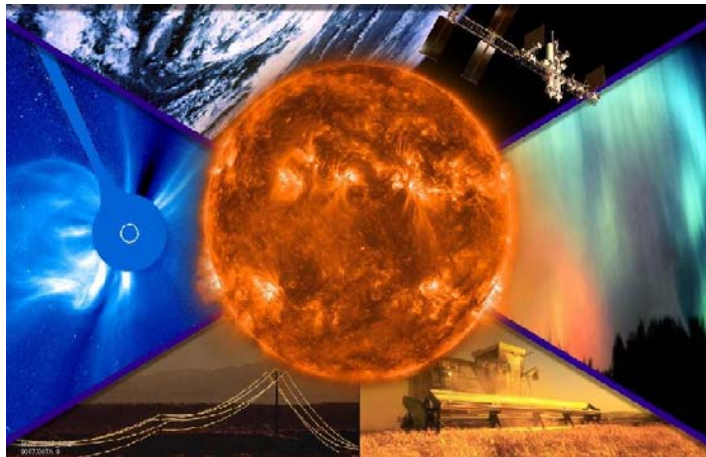
# CAWSES Scientific Steering Group

- Chair: Sunanda Basu, BU, USA
- Jean-Louis Bougeret, CNRS, France
- Joanna Haigh, Imperial College, UK
- Yohsuke Kamide, STEL, Japan
- Arthur Richmond, NCAR, USA
- C.-H. Liu, NCU, Taiwan
- Lev Zelenyi, IKI, Russia
- D. Pallamraju, Scientific Coordinator
- E. Buck, Program Admin.

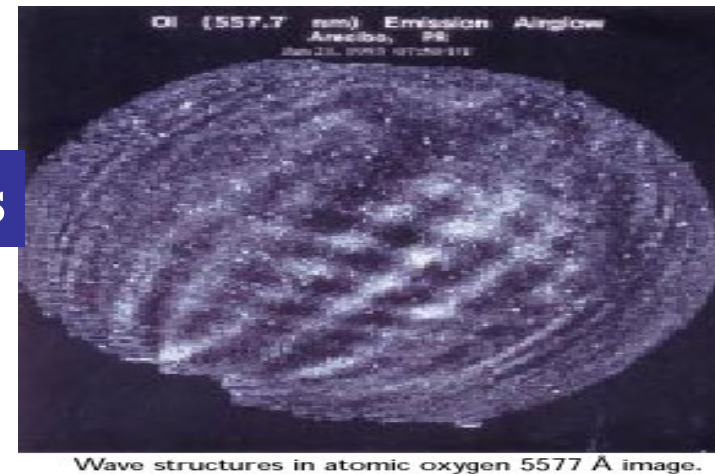


# Four Themes under CAWSES

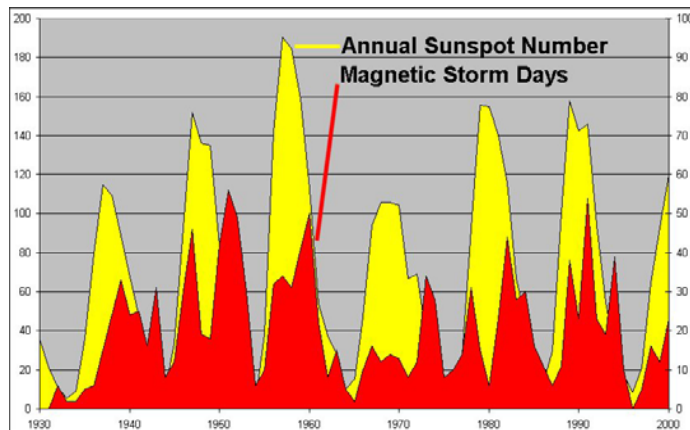
## Solar Influence on Climate



## Space Weather: Science and Applications



## Atmospheric Coupling Processes



## Climatology of the Sun-Earth System



## **Theme 1: Solar Influence on Climate**

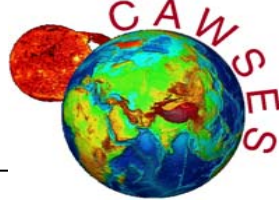
*Co-Chairs: Michael Lockwood (UK) and Lesley Gray (UK)*

### **WG 1.1: Assessment of Evidence for Solar Influence on Climate:**

*Juerg Beer (Switzerland), Lon Hood (USA), Judith Lean (USA), Augusto Mangini (Germany), Roddam Narasimha (India), Gerry North (USA), Ilya Usoskin (Finland), Warren White (USA).*

### **WG 1.2: Investigation of Mechanisms for Solar Influence on Climate:**

*Ulrich Cubasch (Germany), R. Garcia (USA), Kuni Kodera (Japan), Jon Kristjansson (Norway), R. Bradley (USA).*



## **Theme 2: Space Weather Science & Applications**

*Co-Chairs: Janet Kozyra (USA) and Kazunari Shibata (Japan)*

### ***Overview Theme2 Panel: Sun-to-Earth System Science***

*Santimay Basu (USA), Walter Gonzalez (Brazil), Anatoly Petrukovich (Russia), Rainer Schwenn (Germany), Wei Feng Si (China) and R. Sridharan (India)*

### ***WG 2.1 Enhanced Resolution GPS TEC Maps:***

*Anthea Coster (USA), M. Hernandez Pajares (Spain), WG Leaders*

### ***WG 2.2 CAWSES/IAGA/GEM World Magnetospheric Observations:***

*Ian Mann (Canada), WG Leader*

### ***WG 2.3 Solar Sources of Geoeffective Disturbances:***

*Nat Gopalswamy (USA), WG Leader*

### ***WG 2.4 Continuous Ha Imaging Network (CHAIN): H. Kurokawa (Japan), WG Leader***

### ***WG 2.5 Space Weather Applications: TBD***

### ***WG 2.6 Models, Simulations and Data Assimilation: S. T. Wu (USA), WG Leader***

### ***WG 2.7 Coordinated Data Analysis: TBD***

# **Theme 3: Atmospheric Coupling Processes**

*Co-Chairs: Franz-Josef Luebken (Germany) and Joan Alexander (USA)*

## **WG 3.1: Dynamical Coupling and its Role in the Energy and Momentum Budget of the Middle Atmosphere**

*Martin Mlynczak (USA), William Ward (Canada), David Fritts (USA), Nikolai Gavrilov (Russia), S. Gurubaran (India), Maura Hagan (USA), Alan Manson (Canada), Dora Pancheva (UK), Kauro Sato (Japan), Kazuo Shiokawa (Japan), Hisao Takahashi (Brazil), Robert Vincent (Australia) and Yi Fan (China)*

## **WG 3.2: Coupling via Photochemical Effects on Particles and Minor Constituents in the Upper Atmosphere**

*Martin Dameris (Germany), Charles Jackman (USA), Ulf Hoppe (Norway), Manuel Lopez-Puertas (Spain), Daniel Marsh (USA), James Russell (USA), and David Siskind (USA)*

## **WG 3.3: Coupling by Electrodynamics including Ionospheric Magnetospheric Processes**

*Gang Lu (USA), M. Yamamoto (Japan), Steve Cummer (USA), Peter L. Dyson (Australia), Inez S. Batista (Brazil), Archana Bhattacharya (India), Martin Fullekrug (Germany), and Roland Tsunoda (USA)*

## **WG 3.4: Long-Term Trends in Coupling Processes (*inter-connected with 4.4*)**

# **Theme 4: Space Climatology**

*Co-Chairs: Claus Froehlich (Switzerland) and Jan Sojka (USA)*

## **WG 4.1: Solar Irradiance Variability**

*Judit Pap (USA) and Gerard Thuillier (France)*

*Peter Fox (USA), Coordinator*

## **WG 4.2: Heliosphere Near Earth**

*Leif Svalgaard (USA)*

## **WG 4.3: Radiation Belt Climatology**

*Takahiro Obara (Japan)*

*S. Bourdarie (France), S. Fung (USA), D. Heynderickx (Belgium), H. Matsumoto (Japan), Y. Miyoshi (Japan), M. Panasyuk (Russia)*

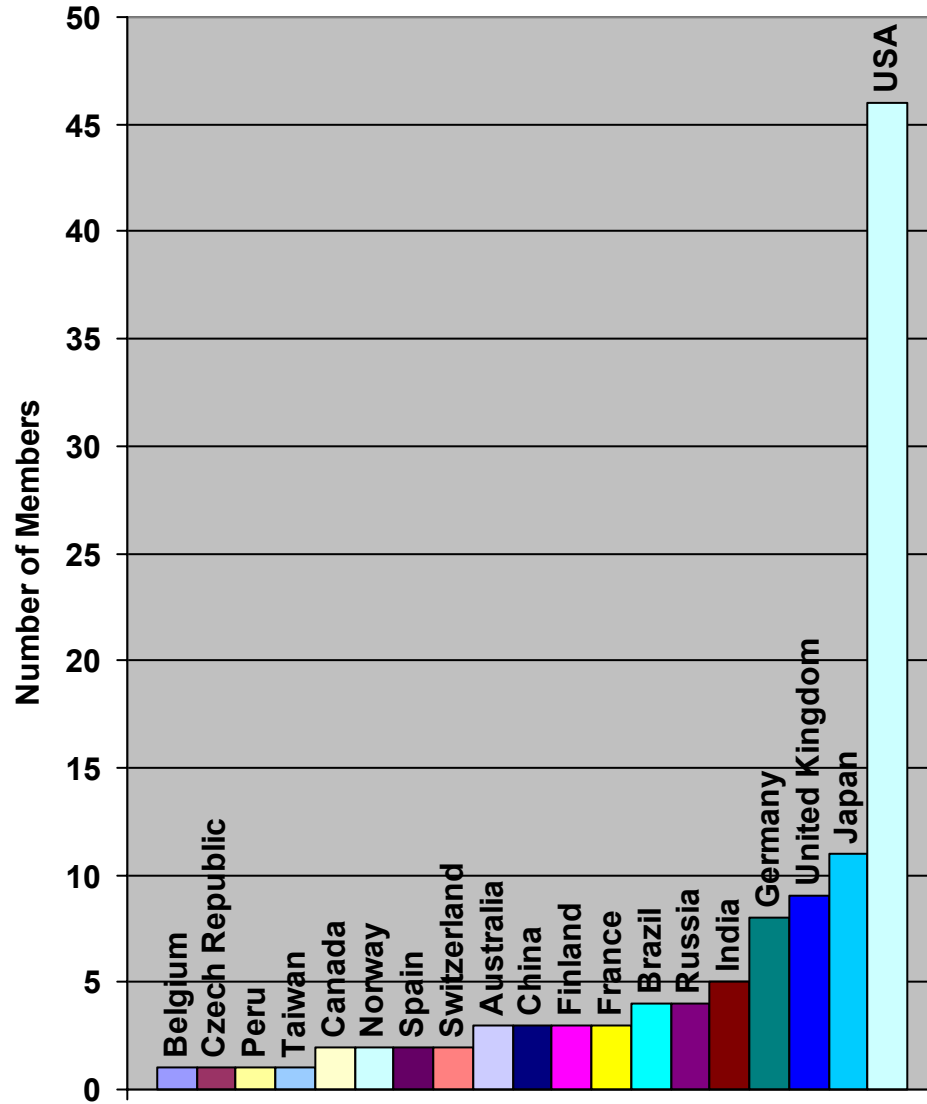
## **WG 4.4: Long-Term trends in Ionospheric and Upper-Atmospheric Variability (inter-connected with 3.4)**

*M. Jarvis (UK) and John Emmert (USA)*

*R. Akmaev (USA), G. Beig (India), G. Burns (Australia), J. Chau (Peru), A. Danilov (Russia), R. Niciejewski (USA), H. Rishbeth (UK), T. Ulich (Finland) and J. Lastovicka (Czech)*

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# CAWSES Team



**Total # 111  
Countries - 19**



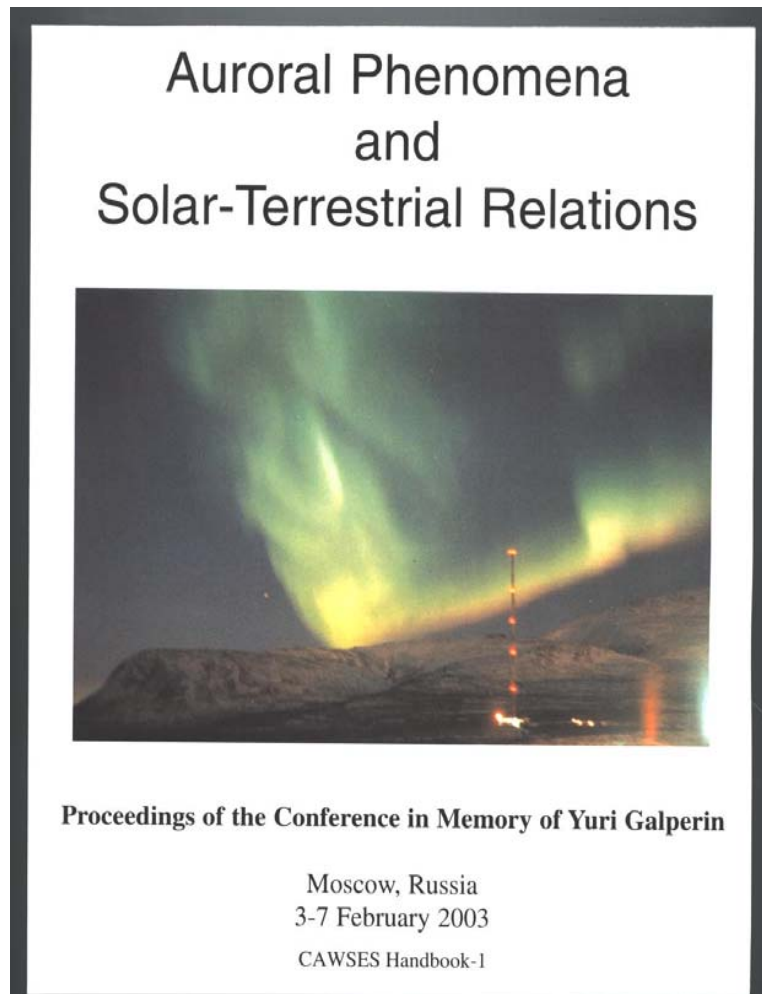
# Capacity Building & Education

Co-Chairs: Marv Geller, S. T. Wu and Joe Allen

- CAWSES will hold meetings and provide specialized training courses for scientists from developing nations and help with computational and data resources
- Establish partnerships between developing & industrialized nations
- CAWSES – AOPR Center in Taipei will facilitate such activities



# First CAWSES Handbook Published



- **Proceedings of the Yuri Galperin Memorial Meeting, Moscow, Russia, Feb 3-7, 2003, Editors, L. Zelenyi, M. A. Geller, and J. H. Allen**
- **Yuri Galperin was member of SCOSTEP Bureau from 1997-2001**
- **62 papers by 143 authors**
- **Publication funded by NASA**

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# **Overview of Significant Developments in the CAWSES Program 2004 – 2006**

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# CAWSES – National and Regional Programs

- **US NSF has funded the CAWSES Office at BU for 2005-07 on the basis of peer-reviewed proposal**
- **German Science Foundation (DFG) has funded CAWSES as a priority program for 2005-11 with first year funding of 3 Million Euros covering 18 Institutions**
- **JSPS has funded “Basic Study of Space Weather” at \$800K/year for 5 years with K. Shibata as PI**
- **CAWSES-India has funded 13 projects for Rs. 10 Million**

# CAWSES Science Planning Meetings

## 2006:

- Brazilian Science Meeting on March 8, 2006 in Rio de Janeiro, 2006
- 3<sup>rd</sup> CAWSES Science Planning Meeting in Beijing, China, July 23,2006

## 2005:

- Meetings during IAGA in Toulouse, France
  1. CAWSES Theme 3 Science meeting, July 20, 2005
  2. 2<sup>nd</sup> CAWSES Science planning meeting on Saturday July 23, 2005
  3. CAWSES Theme 2 Planning meeting on July 26, 2005

## 2004:

- Meetings during COSPAR in Paris, France
  1. 1<sup>st</sup> CAWSES Science Planning on July 17, 2004
  2. Theme 3 Science Planning meeting on July 22, 2004

# Observational Campaigns

## 2006:

- Space Weather/LTCS Campaign, March 6 – April 6, 2006

## 2005:

- Joint Space Weather and Atmospheric Coupling Campaigns, Sep. – Oct. 2005.
- The 2005 Campaign on Ice Layers in the Summer Mesosphere

## 2004:

- Space Weather Campaign along with CPEA, March – April, 2004

# CAWSES Science and Capacity Building Workshops

2005:

- CAWSES Space Weather Workshop

ISEA-11 meeting in Taipei, Taiwan, May 14, 2005 (Theme 2 activity)

*Conveners: D. Pallamraju and C. Huang*

- CAWSES /CPEA Workshop

ISEA-11 meeting in Taipei, Taiwan, May 14, 2005 (Theme 3 activity)

*Conveners: M. Yamamoto and C.J. Pan*

- CAWSES Workshop on Solar Variability and Planetary Climates (Theme 1 activity)

ISSI in Bern, Switzerland, June 6-10, 2005

*Convener: L. Gray*

- CAWSES Workshop on Solar Irradiance Variability, (Theme 4 activity)

Catone, Italy, July 1, 2005, *Conveners: J. Pap and P. Fox*

- Joint Workshop on ICESTAR-CAWSES campaigns, (Theme 2 activity)

CEDAR Workshop in Santa Fe, NM, USA, July 1, 2005

*Conveners: L. Paxton and J. Kozyra*

- CAWSES Session on Solar Activity and its Influences on Earth's Weather & Climate

IAMAS in Beijing, China, August 2-11, 2005 (Theme 1 activity)

*Convener: J. Haigh*

- First Capacity Building Workshop on Space Science (Theme 5 activity)

NCU, Taiwan, November 7 - 15, 2005, *Convener: Shin-Yi Su*

- CAWSES Space Weather Workshop, December 10-12, 2005, (Theme 2 activity).

Stanford University, CA, USA, *Conveners: K. Shibata and J. Kozyra*

# CAWSES Science and Capacity Building Workshops 2006:

- **EGU session on Climate and Weather of the Sun-Earth System (CAWSES)**  
EGU General Assembly in Vienna, Austria on April 2-7, 2006.  
*Conveners: F. Lübken, L. Gray and W. Ward*
- **CAWSES Workshop on Ice Layers, May 15 – 17, 2006**  
Kühlungsborn, Germany (Theme 3 activity)  
*Conveners: Franz-Josef Lübken, Ulf-Peter Hoppe and Scott Bailey.*
- **Coupling from the Sun to the Ground: Results from the CAWSES campaigns during 2004 and 2005, (Themes 1, 2, 3 and 4)**  
AGU Joint Assembly in Baltimore, Maryland, 23 - 26 May, 2006  
*Conveners: D. Pallamraju, J. Kozyra, W. Ward, L. Goncharenko, N. Gopalswamy, and A. Weatherwax.*
- **4<sup>th</sup> IAGA/ICMA/CAWSES Workshop on Long-Term Changes and Trends in the Atmosphere, Sodankylä, Finland, Sept. 4 – 8, 2006, (Theme 4 activity).**  
*Contact: Thomas Ulich*
- **2<sup>nd</sup> CAWSES Capacity Building Workshop**  
NCU, Taiwan, November 7 – 15, 2006 (Theme 5 activity).  
*Convener: Shin-Yi Su*
- **CAWSES International Workshop on Space Weather Modeling (CSWM),**  
Yokohoma, Japan, November 14 – 17, 2006, (Theme 2 activity).  
*Conveners: Kanya Kusano and Kazunari Shibata*

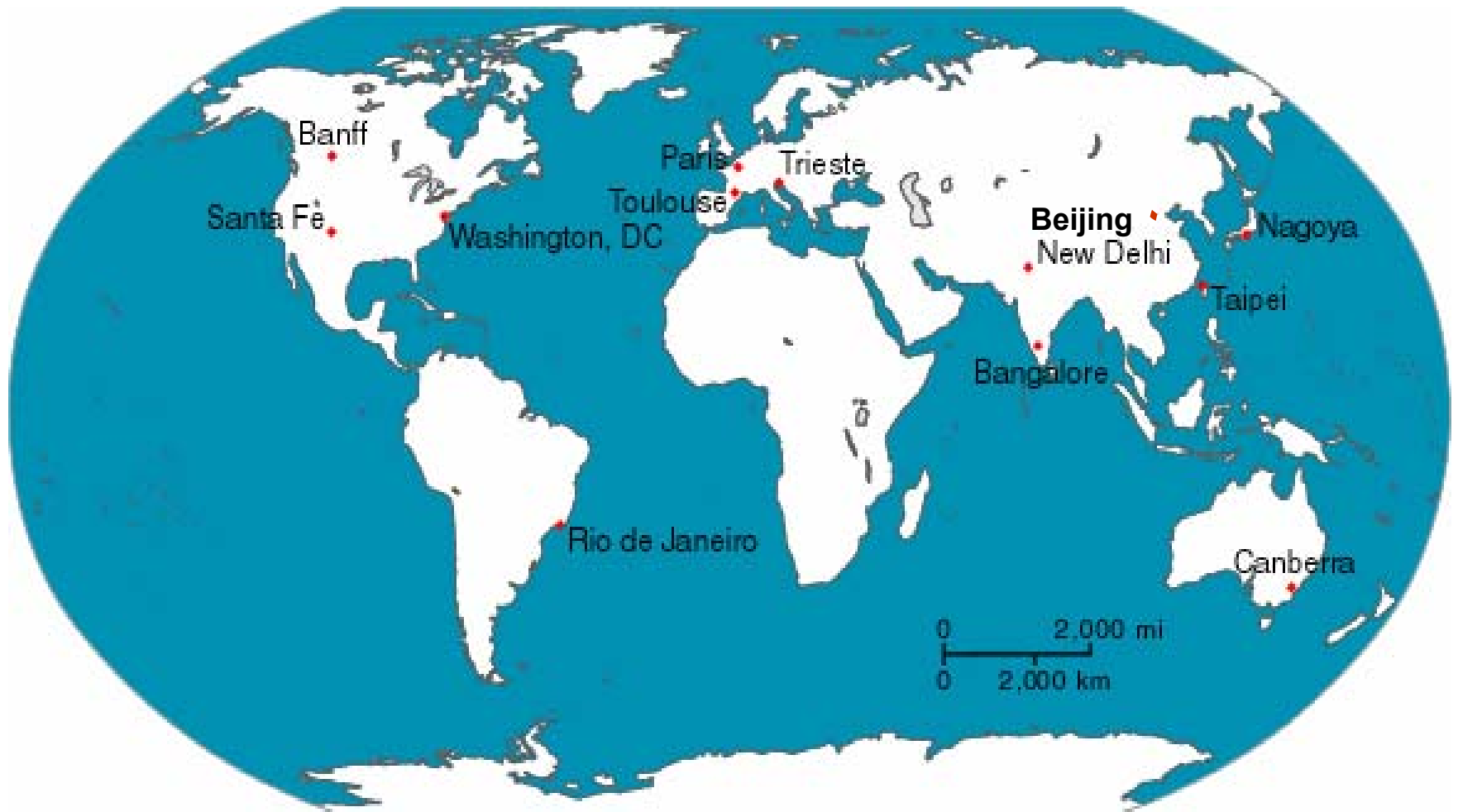


## **CAWSES Related Talks:**

### **2005 - 2006**

- **Keynote talk on CAWSES at the Australian Institute of Physics Meeting in Canberra in January 2005 presented by *Janet Kozyra for Sunanda Basu***
- **On “CAWSES Science and its relation to I\*Y programs” during CEDAR meeting in Santa Fe, NM, USA on June 28, 2005 by D. Pallamraju**
- **On “CAWSES Science”, IAGA Association Lecture during IAGA meeting in Toulouse, France on July 27, 2005 by *Sunanda Basu***
- **CAWSES Talk at ICSU in October, 2005, by Marvin Geller**
- **On “Impacts of Extreme Solar Disturbances on the Earth’s Near-Space Environment”, URSI General Lecture on October 28, 2005 in New Delhi, India by Sunanda Basu**
- **CAWSES Talk at IHY Congress in Paris in January, 2006 presented by Brigitte Schmieder for Sunanda Basu**

# Around the World for CAWSES during 2004-06



## **CAWSES/SCOSTEP support for capacity building and workshops**

### **2005**

- Five graduate students from developing countries were supported to attend the ISEA Meeting in Taipei, Taiwan, 2005
- Partial support for CAWSES Workshop on Solar Irradiance Variability held on July 1, 2005 during Solar Variability & Earth and Climate Meeting in Catone, Italy
- Supported two sessions during IAGA. (i) Low latitude atmosphere-ionosphere-magnetosphere coupling, dynamics and energetics and (ii) Long term trends in the upper atmosphere, Toulouse, France, 2005
- One graduate student was supported to attend IAGA in Toulouse, France, 2005

### **2006**

- Co-sponsor of International Advanced School on Space Weather, ICTP, Trieste, Italy, to be held May 2 – 19, 2006
- Co-sponsor for Commission C Sessions at COSPAR, Beijing, July 2006
- Co-sponsor for the IAGA/ICMA/CAWSES Long Term Trends Workshop during September 4 – 8, 2006 to be held in Finland.

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## Refereed publication on CAWSES Science:

- A news article entitled, “CAWSES Fosters Sun-to-Earth Observations” by *Sarah Simpson*, was published in the November 2005 issue of the *Space Weather Journal*
- An article on “Science Rationale for CAWSES: SCOSTEP’s interdisciplinary program for 2004 – 2008” by *S. Basu and D. Pallamraju* is in press to be published in *Advances in Space Research*, 2006
- Several papers presented at the CAWSES Space Weather and CPEA workshops during ISEA-11 meeting are under review and will be published in a special issue of *Annales Geophysicae* in 2006 along with other papers presented at ISEA-11 in 2005

## Publication of CAWSES News:

- Two issues each have been published in 2004 and 2005 and the first issue for 2006 is under preparation. These Newsletters and the CAWSES Webpage have been exceedingly important in developing a sense of community within the Program
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# I\*Y 2007 – Celebrations of IGY + 50

- **IPY** - The International Polar Year concentrates its attention on the high latitude zones of Earth
- **IHY** - The International Heliophysical Year expands the frontier of the IGY to the boundary of the heliosphere with a focus on fundamental processes
- **eGY** - The Electronic Geophysical Year is a cross-cutting program aimed at the development of optimized and interoperable data and processing systems that can serve the needs of an interdisciplinary research environment



# Value of CAWSES to IPY, IHY & eGY



- **Progressively develop a set of new international data analysis tools**
  - Valuable asset for space research
  - Combined with satellite data they give new ways of investigating important science questions
  - Lasting legacy after I\*Y celebrations
- **Collect & preserve comprehensive sets of international sun-to-Earth observations**
  - Valuable for developing assimilative space weather models
  - Important for testing understanding and predictive capabilities of sun-to-Earth models
  - Worldwide resource for sun-Earth system science during and after I\*Y
- **Build up an international community familiar with campaign tools & collaborative analysis ready to participate in the I\*Y**
- **Help refine science questions and needs for worldwide campaigns over the next 2 years in preparation for the I\*Y celebration.**

# Some thoughts for the future

- **More SCOSTEP member countries need to develop national CAWSES programs if CAWSES is to attain its ultimate objective of understanding Sun-Earth system science**
- **Co-authored publications necessary to show the power of Sun-Earth system science**
- **Other regional AOPR-like Centers necessary to accelerate capacity building**
- **Concerted effort required to develop scientific linkages with African scientists – particularly from the Sub-Saharan region**
- **Extensive discussions necessary regarding the role of CAWSES vis-à-vis I\*Y & its evolution beyond 2008**
- **Finally, the time has come to pass the baton to a new leader and perhaps to a new organizational structure as befits the mature status of CAWSES!**