THE INTERNATIONAL SPACE WEATHER INITIATIVE

A FOLLOW-ON TO THE INTERNATIONAL HELIOPHYSICAL YEAR (IHY)

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Additional Information: http://iswi-secretariat.org, http://ihy2007.org

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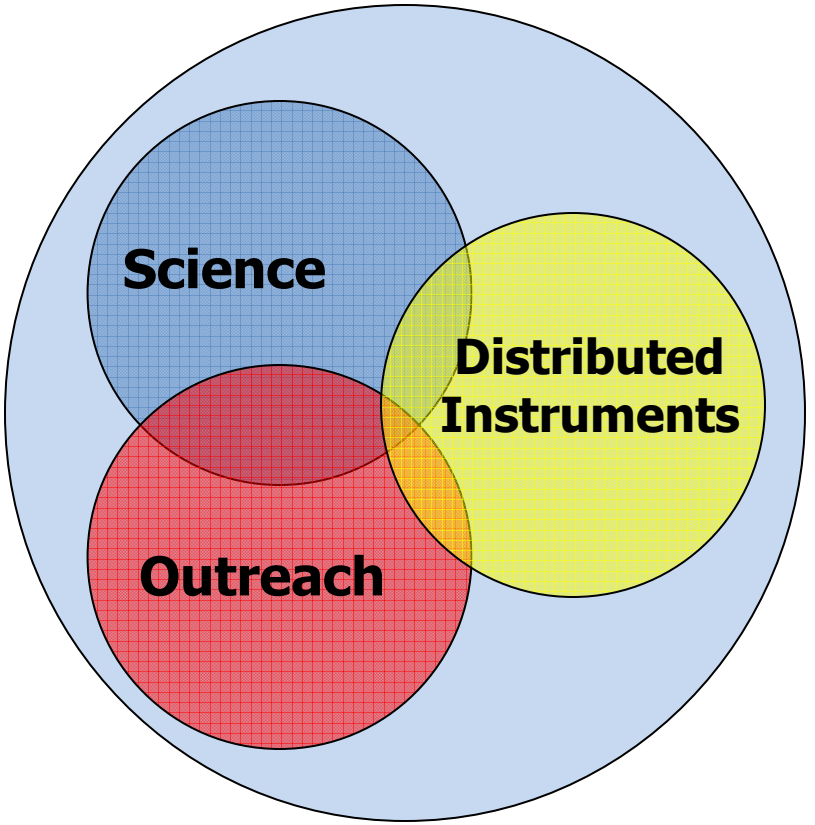
IHY/ISWI Leadership in International Space Science

- Developing new data sources for space weather forecasting and nowcasting
- Establishes new university based space research groups in non-traditional countries
- Provides new opportunities for graduate research in space physics at BSc, MSc, and PhD levels
- Engages the public (100,000s) in space science outreach worldwide



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**
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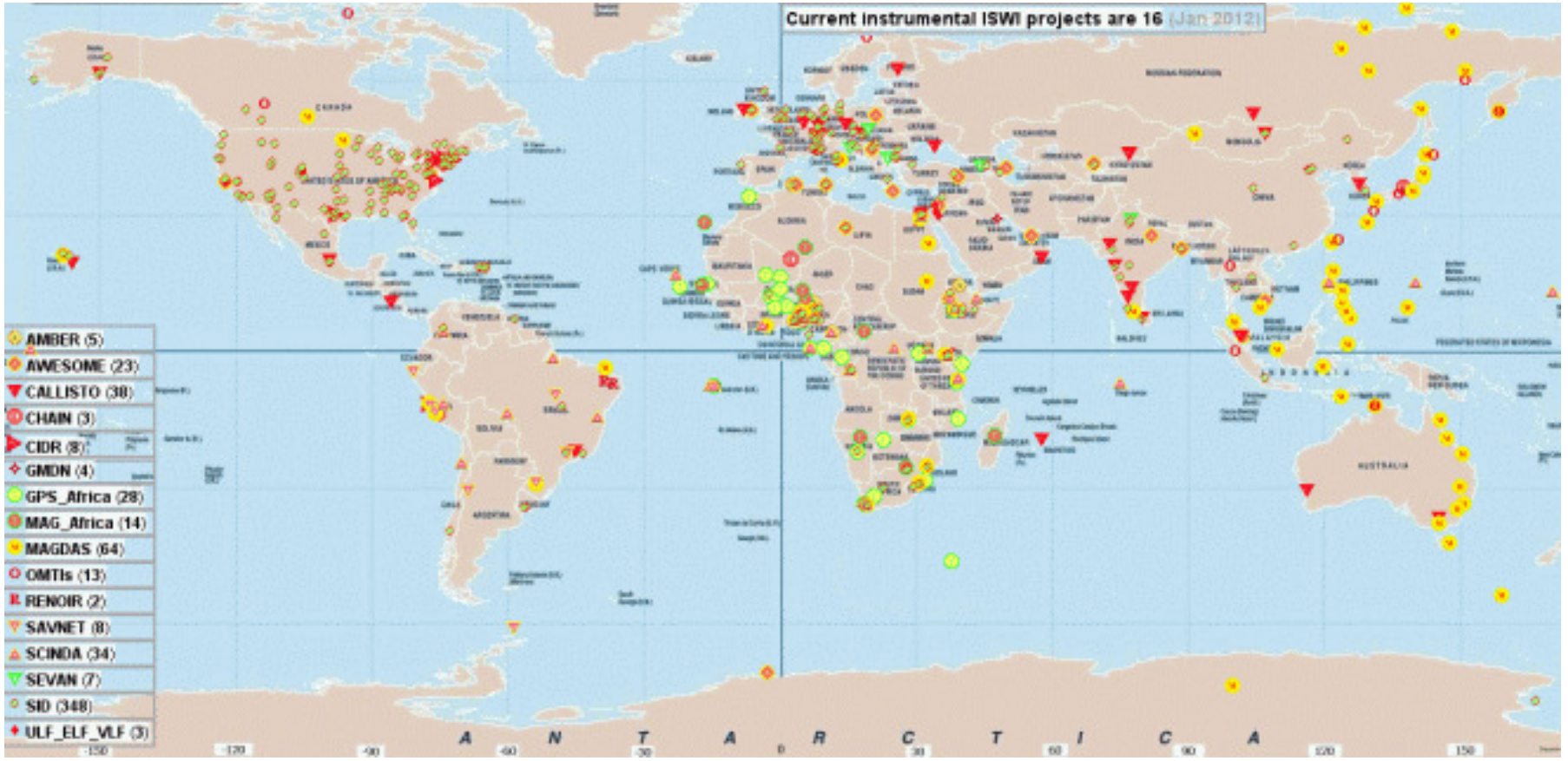
ISWI Participation (Jan 2012)



- 14 Distributed instrument teams observatory program
- ~1000 participating locations
- More than 100 Countries participating

Current Instrument Arrays

ID	INSTRUMENT	Lead Scientist	Country	Objective
1	Scintillation Network Decision Aid (SCINDA)	K. Groves keith.groves@hanscom.af.mil (Hanscom AFRL)	USA	Study equatorial ionospheric disturbances to aid in the specification and prediction of communications degradation due to ionospheric scintillation in the Earth's equatorial region
2	Ionospheric Tomography Network of Egypt (ITNE) Coherent Ionospheric Doppler Receiver (CIDR)	A. Mahrous amahrous@helwan.edu.eg (Helwan University) T. Garner garner@arlut.utexas.edu (University of Texas)	USA	To tomographically reconstruct the ionosphere and to provide input to data assimilation models
3	Atmospheric Weather Education System for Observation and Modeling of Effects (AWESOME) and Sudden Ionospheric Disturbance monitor (SID)	U. Inan inan@stanford.edu M. Cohen mcohen@stanford.edu D. Scherrer deborah@solar2.stanford.edu (Stanford University)	USA	Lightning, sprites, elves, relation to terrestrial gamma ray flashes, whistler induced electron precipitation, conjugate studies. Education and public outreach.
4	Remote Equatorial Nighttime Observatory for Ionospheric Regions (RENOIR)	J. Makela jmakela@illinois.edu (University of Illinois)	USA	Study the equatorial/low-latitude ionosphere/thermosphere system, its response to storms, and the irregularities that can be present on a daily basis
5	African GPS Receivers for Equatorial Electrodynamics Studies (AGREES)	E. Yizengaw (Boston College) ekassie@igpp.ucla.edu M. Moldwin (University Mich)	USA	Understand unique structures in equatorial ionosphere, low/mid latitude plasma production, effect of ionospheric and plasmaspheric irregularities on communications
6	African Meridian B-field Education and Research (AMBER)	M. Moldwin (University Mich) mmoldwin@igpp.ucla.edu E. Yizengaw (Boston College)	USA	Understand low latitude electrodynamics, ULF pulsations, effect of Pc5 ULF on MeV electron population in inner radiation belts

Current Instrument Arrays (continued)

ID	INSTRUMENT	LeadScientist	Country	Objective
7	Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO)	A.Benz benz@astro.phys.ethz.ch C. Monstein monstein@astro.phys.ethz.ch (ETH)	Switzerland	Study of radio flares caused by solar activity in view of space weather and climate change
8	South Atlantic Very Low frequency Network (SAVNET)	J.-P. Raulin raulin@craam.mackenzie.br (University Presbiteriana)	Brazil	Study of the SAMA region at low ionospheric altitudes and its structure and dynamics during geomagnetic perturbations
9	Magnetic Data Acquisition System (MAGDAS)	K. Yumoto yumoto@serc.kyushu-u.ac.jp (Kyushu University)	Japan	Study of dynamics of geospace plasma changes during magnetic storms and auroral substorms, the electromagnetic response of iono-magnetosphere to various solar wind changes, and the penetration and propagation mechanisms of DP2-ULF range disturbances
10	African Dual Frequency GPS Network	C. Amory-Mazaudier christine.amory@lpp.polytechnique.fr (CETP/CNRS)	France	To increase the number of real-time dual-frequency GPS stations worldwide for the study of ionospheric variability, response of the ionospheric total electron content (TEC) during geomagnetic storms over the African sector

Current Instrument Arrays (continued)

ID	INSTRUMENT	LeadScientist	Country	Objective
11	Space Environmental Viewing and Analysis Network (SEVAN)	A.Chillingarian chili@aragats.am (Aragats University)	Armenia	A network of particle detectors that aims to improve fundamental research of the particle acceleration in the vicinity of the Sun and the space environment, as well as to provide forewarnings of dangerous consequences of space storms
12	Global Muon Detector Network (GMDN)	K. Munakata kmuna00@		ecrease of es place e Earth- ejection
13	Flare Moni Telescopes the Continu Imaging Net	(Kyoto University)		velocity field of solar activity, flares, filament eruptions and shock waves (Moreton waves) by using multi-wavelength H-alpha images of the full-disk Sun.
14	Optical Mesosphere Thermosphere Imagers (OMTIs)	K. Shikawa shiokawa@stelab.nagoya-u.ac.jp (Nagoya University)	Japan	Dynamics of the upper atmosphere through nocturnal airglow emissions http://stdb2.stelab.nagoya-u.ac.jp/omti/index.html

ULF/ELF/VLF network
Lead Scientist: *Prof. Colin Price* (Tel Aviv University) **Israel**
Objective: To monitor geomagnetic storms, ionospheric Alfven resonances, and ULF pulsations

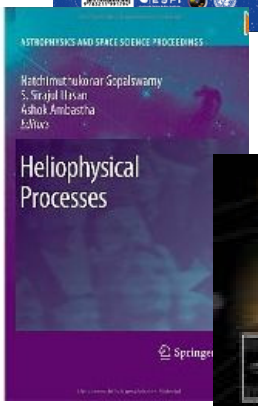
Scientific Benefits: Why do this?

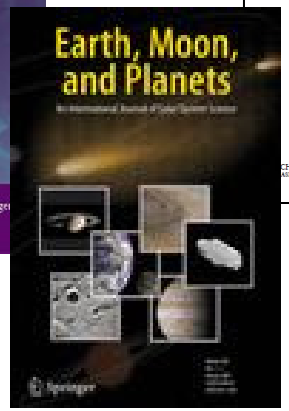
- By observing in new geographical regions, a more global picture of Earth's response to solar wind inputs can be obtained
- Longitude coverage, 24/7 solar observing in radio and H-alpha, satellite collaboration (C/NOFFS, THEMIS)
- Arrays provide 3D information that can be used in tomographic reconstructions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

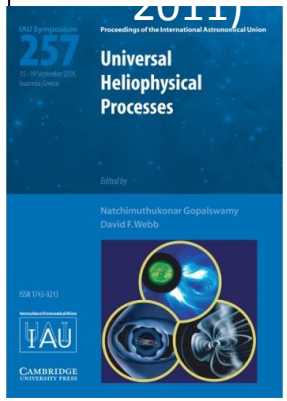
Data Analysis

Results are documented in scientific publications

- **Books, scientific proceedings**
- **180 Scientific papers published 2010-201**
  - **Most joint publications with Array leaders and participants as co-authors**







(Solar Physics dedicated volume Dec 2011)

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New Collaborations

- 1st UN ISWI Meeting in Helwan Egypt November 6-10, 2010
- 2nd Workshop in Abuja Nigeria October 17-21, 2011
- 3rd Workshop in Quito, Equador October 8-12, 2012

Communication and Outreach

- ISWI website maintained at Bulgarian Academy of Science
- ISWI newsletter published by Kyushu University

Website: http://iswi-secretariat.org

Training Young Researchers

- 6 Schools organized during the IHY
- ISWI Schools
  1. Bahir Dar University – Nov 2010
  2. Slovakia – Aug 2011
  3. Kinshasa, RDC – Sept 2011
  4. Rabat, Morocco – Dec 5-16 2011
  5. Lagos, Nigeria – Aug 2011
  6. Goa, India (VLF)- Oct 2011
  7. Bandung, Indonesia-Sep 2012
- This year Space Science School and Workshop Sep 2013 in South Africa

SOME RESULTS DURING IHY CAMPAIGN

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[4] patrick.lassudrie; [5] olivier.bock

1. Koudougou University GPS station since November 2008

GPS station buildi

GPS anter

GPS receiver

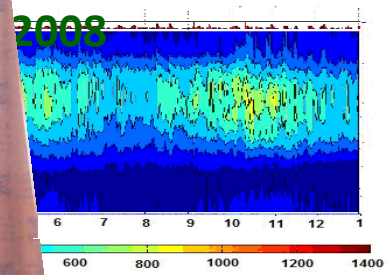
2. Equinoctial

PS station data

Year

CODG/NIAMEY 2008

2008



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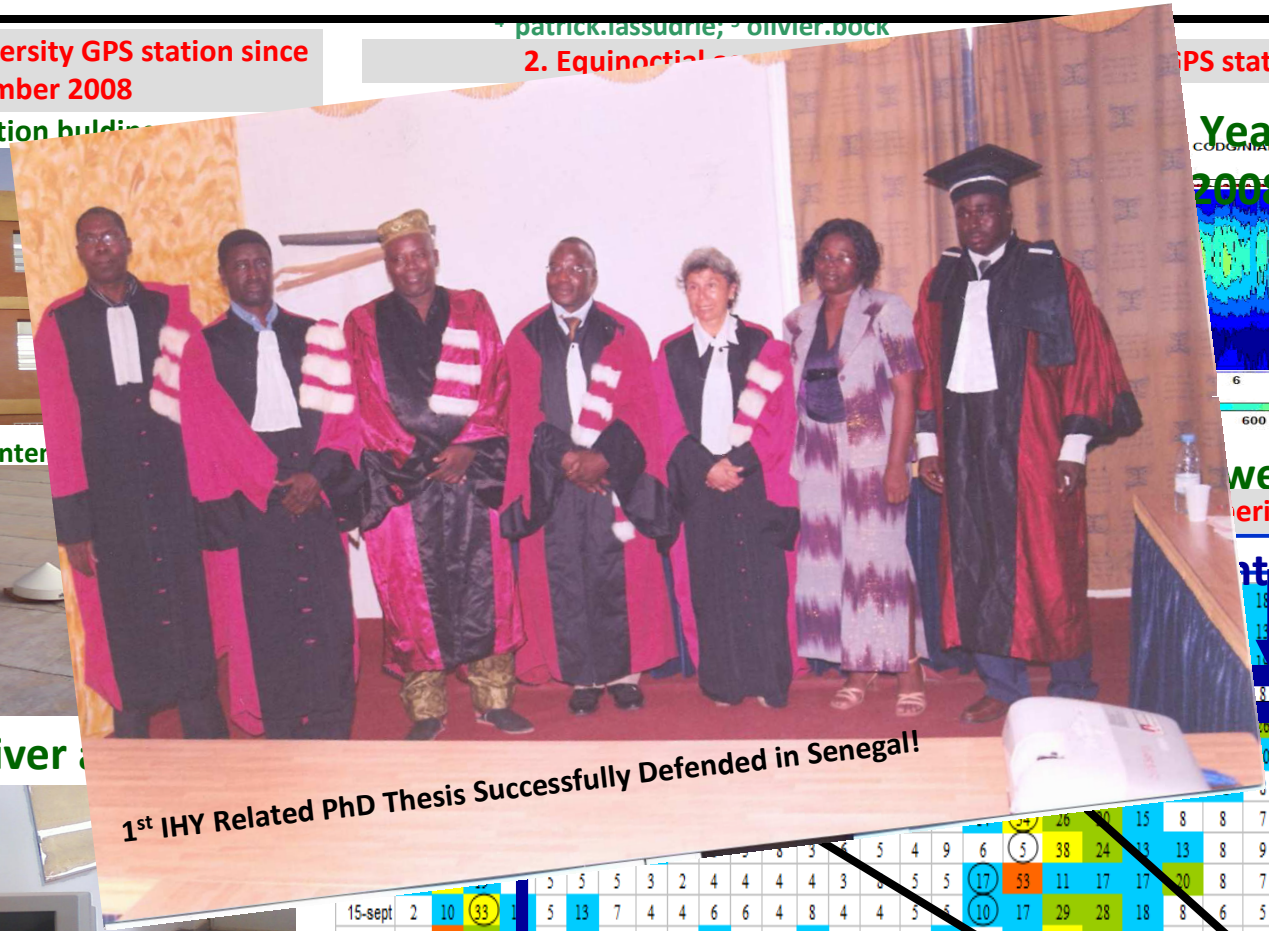

Fluctuating events: 6-9 April

IHY Period: 21 March – 16 April of Year 2008

From Ouattara Frédéric, PhD Santander, Spain, 2009

Recommendations from Quito

- It is recommended that the ISWI **continue the deployment of instruments both in existing instrument arrays, and new instrument arrays**.
- It is recommended that the ISWI undertake a process to **use pathfinder data sets** to determine data utility, to develop **connections with virtual observatories** to make data more readily available, and to **facilitate collaborative modeling** of regions of interest (e.g. the equatorial ionosphere) in collaboration with modeling centers of the ESA JAXA, NASA, and others.

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Recommendations from Quito (2)

- It is recommended that data from ISWI instrument arrays be **combined with space-based data** to advance space weather science leading to quality papers in international journals.
- Space Science Schools are an integral part of ISWI, providing training for young and new researchers in instrument operation and the science of heliophysics. It is therefore recommended that the ISWI **Space Science School continue** this training. The **partnerships already established with organizations such as SCOSTEP need to be strengthened** to assure that these capacity building activities are accomplished efficiently and for the benefit of all member states.

ISWI is Making a Difference

- **Scientific understanding of Space Weather**
- **Bringing space science to all member states**
- **First African Chapman Conference organized in Ethiopia**
- **African Geophysical Society formed**