THE INTERNATIONAL SPACE WEATHER INITIATIVE

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

Joseph M Davila and Nat Gopalswamy
NASA-Goddard Space Flight Center

Contact: Joseph Davila, 410-979-7329, joseph.m.davila@nasa.gov

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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 that 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
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ISWI Participation (Jan 2012)

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

IHY (http://iswi-secretariat.org)
## Current Instrument Arrays

<table>
<thead>
<tr>
<th>ID</th>
<th>INSTRUMENT</th>
<th>Lead Scientist</th>
<th>Country</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scintillation Network Decision Aid (SCINDA)</td>
<td>K. Groves <a href="mailto:keith.groves@hanscom.af.mil">keith.groves@hanscom.af.mil</a> (Hanscom AFRL)</td>
<td>USA</td>
<td>Study equatorial ionospheric disturbances to aid in the specification and prediction of communications degradation due to ionospheric scintillation in the Earth’s equatorial region</td>
</tr>
<tr>
<td>2</td>
<td>Ionospheric Tomography Network of Egypt (ITNE) Coherent Ionospheric Doppler Receiver (CIDR)</td>
<td>A. Mahrous <a href="mailto:amahrour@helwan.edu.eg">amahrour@helwan.edu.eg</a> (Helwan University) T. Garner <a href="mailto:garner@arlut.utexas.edu">garner@arlut.utexas.edu</a> (University of Texas)</td>
<td>USA</td>
<td>To tomographically reconstruct the ionosphere and to provide input to data assimilation models</td>
</tr>
<tr>
<td>3</td>
<td>Atmospheric Weather Education System for Observation and Modeling of Effects (AWESOME ) and Sudden Ionospheric Disturbance monitor (SID)</td>
<td>U. Inan <a href="mailto:inan@stanford.edu">inan@stanford.edu</a> M. Cohen <a href="mailto:mcohen@stanford.edu">mcohen@stanford.edu</a> D. Scherrer <a href="mailto:deborah@solar2.stanford.edu">deborah@solar2.stanford.edu</a> (Stanford University)</td>
<td>USA</td>
<td>Lightning, sprites, elves, relation to terrestrial gamma ray flashes, whistler induced electron precipitation, conjugate studies. Education and public outreach.</td>
</tr>
<tr>
<td>4</td>
<td>Remote Equatorial Nighttime Observatory for Ionospheric Regions (RENOIR)</td>
<td>J. Makela <a href="mailto:jmakela@illinois.edu">jmakela@illinois.edu</a> (University of Illinois)</td>
<td>USA</td>
<td>Study the equatorial/low-latitude ionosphere/thermosphere system, its response to storms, and the irregularities that can be present on a daily basis</td>
</tr>
<tr>
<td>5</td>
<td>African GPS Receivers for Equatorial Electrodynamics Studies (AGREES)</td>
<td>E. Yizengaw (Boston College) <a href="mailto:ekassie@igpp.ucla.edu">ekassie@igpp.ucla.edu</a> M. Moldwin (University Mich)</td>
<td>USA</td>
<td>Understand unique structures in equatorial ionosphere, low/mid latitude plasma production, effect of ionospheric and plasmaspheric irregularities on communications</td>
</tr>
<tr>
<td>6</td>
<td>African Meridian B-field Education and Research (AMBER)</td>
<td>M. Moldwin (University Mich) <a href="mailto:mmoldwin@igpp.ucla.edu">mmoldwin@igpp.ucla.edu</a> E. Yizengaw (Boston College)</td>
<td>USA</td>
<td>Understand low latitude electrodynamics, ULF pulsations, effect of Pc5 ULF on MeV electron population in inner radiation belts</td>
</tr>
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</tr>
</tbody>
</table>
| 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                                                                                                                                      |
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<td>11</td>
<td>Space Environmental Viewing and Analysis Network (SEVAN)</td>
<td>A. Chillingarian&lt;br&gt;<a href="mailto:chili@aragats.am">chili@aragats.am</a> (Aragats University)</td>
<td>Armenia</td>
<td>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.</td>
</tr>
<tr>
<td>12</td>
<td>Global Muon Detector Network (GMDN)</td>
<td>K. Munakata&lt;br&gt;<a href="mailto:kmuna00@shinshu-u.ac.jp">kmuna00@shinshu-u.ac.jp</a> (Shinsu University)</td>
<td>Japan</td>
<td>To identify the precursory decrease of cosmic ray intensity that takes place more than one day prior to the Earth-arrival of shock driven by an interplanetary coronal mass ejection.</td>
</tr>
<tr>
<td>13</td>
<td>Flare Monitoring Telescopes under the Continual H-alpha Imaging Network</td>
<td>S. Ueno&lt;br&gt;<a href="mailto:ueno@kwasan.kyoto-u.ac.jp">ueno@kwasan.kyoto-u.ac.jp</a> (Kyoto University)</td>
<td>Japan</td>
<td>Dynamics of the upper atmosphere through multi-wavelength H-alpha images of the full-disk Sun.</td>
</tr>
<tr>
<td>14</td>
<td>Optical Mesosphere Thermosphere Imagers (OMTIs)</td>
<td>K. Shikawa&lt;br&gt;<a href="mailto:shiokawa@stelab.nagoya-u.ac.jp">shiokawa@stelab.nagoya-u.ac.jp</a> (Nagoya University)</td>
<td>Japan</td>
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**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
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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
  4. Rabat, Morocco – Dec 5-16 2011
  5. Lagos, Nigeria – Aug 2011
  7. Bandung, Indonesia-Sep 2012
- This year Space Science School and Workshop Sep 2013 in South Africa
SOME RESULTS DURING IHY CAMPAIGN

1 Ouattara, F., 2 Amory-Mazaudier, C, 3 FLEURY, R 4 LASSUDRIE DUCHESNE, P. 5 BOCK, O.

1 École Normale Supérieure de l’Université de Koudougou, BP 376, Koudougou, Burkina Faso

1 fojals@yahoo.fr 2 christine.amory@lpp.polytechnique.fr 3 rolland.fleury@telecom-bretagne.eu

1. Koudougou University GPS station since November 2008

2. Equinoctial asymmetries observed in Niamey GPS station data

3. Different kinds of solar events during IHY period

IHY Period: 21 March – 16 April of Year 2008

1st IHY Related PhD Thesis Successfully Defended in Senegal!

From Ouattara Frédéric, PhD State Thesis, 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.
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