UN/ESA/NASA/JAXA Workshops
Basic Space Science
International Heliophysical Year 2007
International Space Weather Initiative


Information Dissemination: 178 UNDP, 185 PM

BSS Workshops 1991-2004
Telescopes, Planetariums
Literature: ADS
Images: VO

IHY Workshops 2005-2009
Instrument arrays

ISWI Workshops 2010-2012
Array of arrays

Regional Education Centres
Education Curricula: RS, SM, SC, SS, GNSS, SL
UN Information Dissemination Network

- United Nations International Space Information System (UNISIS)
  

- United Nations Development Programme (UNDP) Offices
  
  - 178 offices worldwide
  
  - 185 Permanent Missions of 192 UN Member States

UNDP Regional groupings
Basic Space Science Workshops

- Regional:
  India, Costa Rica, Colombia, Nigeria, Egypt

- Inauguration of optical telescopes:
  Sri Lanka, Honduras, Jordan

- International:
  Germany, France, Mauritius, Argentina

- Review of all workshops:
  P.R. China
BSS TRIPOD: Telescope, Observing, Teaching

- **Government of Japan:**
  - Japanese Cultural Grant Aid
    - 45cm reflecting telescope
  - CCD & computer equipment
  - Building/ dome/ maintenance provided by local institution

- **American Association of Variable Star Observers (AAVSO):**
  - Hands-on Astrophysics
  - Setting Up a Variable Star Observing Programme
  - Astronomy, mathematics, computer science
BSS TRIPOD: Telescope, Observing, Teaching

- **International Astronomical Union (IAU):**

  - **Astrophysics for University Physics Courses**
    - Study/comparison of university education curricula in developing countries
    - Elementary calculus
    - Classical mechanics
    - Statistical mechanics
    - Thermodynamics applied to astronomy
    - Advanced teaching material recommended: K.R. LANG / J. BENNET et al.
Planetariums

- Government of Japan
- Host country
- UNOOSA

International Virtual Observatory Alliance and ADS

VO

TRIPOD

space technology

ADS

space science

Astrophysical Data System
Final Report BSS
International Heliophysical Year 2007

UN/ESA/NASA/JAXA Workshops

1st 2005, Al-Ain, UAE
   Instrument providers and hosts
   Coordinated investigation programmes
   Education and outreach

2nd 2006, Bangalore, India

3rd 2007, Tokyo, Japan

4th 2008, Sozopol, Bulgaria

5th 2009, Seoul, South Korea
IHY TRIPOD: Instrument Array, Data, Teaching

- Since 2005, deploying small inexpensive instruments such as magnetometers, radio antennas, GPS receivers, particle detectors around the world to make global measurements of ionospheric, magnetospheric, and heliospheric phenomena

- Partnership between instrument providers and instrument host nations.
  Provision of instrumentation by PI
  Host institution makes available manpower, facilities, and operational support

- Data taking, sharing, analysis, publication

- Teaching space science at university level utilizing data
This model for developing instrument networks was proven during the IHY.
THE 5TH
UN/ESA/NASA/JAXA WORKSHOP
ON BASIC SPACE SCIENCE AND THE INTERNATIONAL
HELIOPHYSICAL YEAR 2007

22 - 25 September 2009
HYATT REGENCY JEJU IN KOREA

Topics
Fundamental Physics
Astronomy and Astrophysics
Solar-terrestrial Interaction and Its Influence on Terrestrial Climate
Planetary and Atmospheric Studies
Origin of Life and Exo-biology

Hosted by Korea Astronomy and Space Science Institute (KASI)
on behalf of Korean Ministry of Education, Science and Technology (MEST)
## Current Instrument Arrays (July 2009)

<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>Coherent Ionospheric Doppler Radar (CIDR)</td>
<td>T. Garner <a href="mailto:garner@arlut.utexas.edu">garner@arlut.utexas.edu</a> (U 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>, D. Scherrer <a href="mailto:deborah@solar2.stanford.edu">deborah@solar2.stanford.edu</a>, M. Cohen <a href="mailto:mcohen@stanford.edu">mcohen@stanford.edu</a> (U Stanford)</td>
<td>USA</td>
<td>Lightning, sprites, elves, relation to terrestrial gamma ray flashes, whistler induced electron precipitation, conjugate studies</td>
</tr>
</tbody>
</table>
# Current Instrument Arrays (July 2009)

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<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> (U 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 <a href="mailto:ekassie@igpp.ucla.edu">ekassie@igpp.ucla.edu</a> M. Moldwin (UCLA)</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 <a href="mailto:mmoldwin@igpp.ucla.edu">mmoldwin@igpp.ucla.edu</a> E. Yizengaw (UCLA)</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>
<tr>
<td>ID</td>
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</tr>
<tr>
<td>7</td>
<td>Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO)</td>
<td>A.Benz [<a href="mailto:benz@astro.phys.ethz.ch">benz@astro.phys.ethz.ch</a>] C. Monstein [<a href="mailto:monstein@astro.phys.ethz.ch">monstein@astro.phys.ethz.ch</a>] (ETH-Zentrum)</td>
<td>Switzerland</td>
<td>Study the magnetic activity of a wide range of astrophysical objects with emphasis on the Sun and cool stars</td>
</tr>
<tr>
<td>8</td>
<td>South Atlantic Very Low frequency Network (SAVNET) No webpage?</td>
<td>J.-P. Raulin [<a href="mailto:raulin@craam.mackenzie.br">raulin@craam.mackenzie.br</a>] (U Presbiteriana)</td>
<td>Brazil</td>
<td>Study of the SAMA region at low ionospheric altitudes and its structure and dynamics during geomagnetic perturbations</td>
</tr>
<tr>
<td>9</td>
<td>Magnetic Data Acquisition System (MAGDAS) [<a href="http://www.serc.kyushu-u.ac.jp/magdas/%5C">www.serc.kyushu-u.ac.jp/magdas/\</a>]</td>
<td>K. Yumoto [<a href="mailto:yumoto@serc.kyushu-u.ac.jp">yumoto@serc.kyushu-u.ac.jp</a>] (Kyushu U)</td>
<td>Japan</td>
<td>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</td>
</tr>
<tr>
<td>10</td>
<td>African Dual Frequency GPS Network No webpage?</td>
<td>C. Amory-Mazaudier [<a href="mailto:christine.amory@lpp.polytechnique.fr">christine.amory@lpp.polytechnique.fr</a>] (CETP/CNRS)</td>
<td>France</td>
<td>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</td>
</tr>
<tr>
<td>No.</td>
<td>Instrument Array</td>
<td>Contact Person(s)</td>
<td>Country(s)</td>
<td>Description</td>
</tr>
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</tr>
<tr>
<td>11</td>
<td>Space Environmental Viewing and Analysis Network (SEVAN)</td>
<td>A.Chillingarian <a href="mailto:chilli@aragats.am">chilli@aragats.am</a> (Aragats)</td>
<td>Armenia, Croatia, Bulgaria, India, Slovakia</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 and research on atmospheric electricity.</td>
</tr>
<tr>
<td>12</td>
<td>Global Muon Detector Network (GMDN)</td>
<td>K. Munakata <a href="mailto:kmuna00@gipac.shinshu-u.ac.jp">kmuna00@gipac.shinshu-u.ac.jp</a> (Shinsu U)</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>Continuous H-alpha Imaging Network (CHAIN)</td>
<td>S. UeNo <a href="mailto:ueno@kwasan.kyoto-u.ac.jp">ueno@kwasan.kyoto-u.ac.jp</a>, K. Shibata (Kyoto U)</td>
<td>Japan</td>
<td>Solar activity, flares, filaments, filament eruptions.</td>
</tr>
<tr>
<td>14</td>
<td>Optical Mesosphere Thermosphere Imager (OMTI)</td>
<td>K. Shikawa (Nagoya U)</td>
<td>Japan</td>
<td>Dynamics of the upper atmosphere through nocturnal airglow emissions.</td>
</tr>
</tbody>
</table>
Space Weather Monitor Sites

IHY Distribution 2007-2009

- AWESOME research monitors (26)
- SID student monitors (300)

Locations:
- USA
- Germany
- Mexico
- Nigeria
- Ethiopia
- China

MAGDAS I & II Projects at SERC, Kyushu U.
(MAGnetic Data Acquisition System/Circum-panPacific Magnetometer Network)

- 96° MM Chain
- 210° MM Chain
- Magnetic Equator Chain

Map showing locations and equipment details.

Inset images of equipment and sensors.
GPS Network and AMBER Mags
Final Report IHY
International Space Weather Initiative (ISWI)

UN/ESA/NASA/JAXA Workshops

1\textsuperscript{st} 2010, Luxor, Egypt  ESCWA

- Instrument providers and hosts
- Coordinated investigation programmes
- Education and outreach

2\textsuperscript{nd} 2011 ECA

3\textsuperscript{rd} 2012 ECE

4\textsuperscript{th} 2013 ECLAC

5\textsuperscript{th} 2014 ESCAP
The Regional Centres for Space Science and Technology Education were created under the auspices of the United Nations.

Goal: to develop, through in-depth education, an indigenous capability for research and applications in the core disciplines of:

- Remote Sensing & GIS
- Satellite Communications
- Satellite Meteorology and Global Climate
- Space and Atmospheric Sciences

Regional Centres located in:

- African region: CRASTE-LF (Morocco), CSSTE-E (Nigeria)
- Asia and the Pacific region: CSSTEAP (India)
- Latin America and the Caribbean: CRECTEALC (Brazil/Mexico)
Regional Centres for Space Science and Technology Education (affiliated to the UN)

\[ ds^2 = -\left(1 + \frac{2\Phi}{c^2}\right)(c\ dt')^2 + \left(1 - \frac{2\Phi}{c^2}\right)(dx^2 + dy^2 + dz^2) \]

Future: GNSS, Space Law

Meteorology
Communications
Remote Sensing
Space Science
Centre for Mathematical Sciences (CMS)
Pala, Kerala, India


Lecture Notes available on request from cmspala@gmail.com or downloadable at www.cmsintl.org

2008 SERC School on Matrix Variable Calculus and Statistical Distribution Theory and Applications in Data Analysis, Model Building and Astrophysics Problems
15 April – 17 May 2009
Generalizing Boltzmann-Gibbs statistical mechanics

B.G. Statistics - A reminder.
- Entropy: \[ S = -k \sum \rho_i \ln \rho_i \]
- Constraints: \[ \begin{align*} 1 &= \sum \rho_i \\ U &= \sum \rho_i \epsilon_i \end{align*} \]
- Maximize the objective: \[ J = -k \sum \rho_i \ln \rho_i + \sum \rho_i + \beta \sum \rho_i \epsilon_i \]
- Yields distribution: \[ \rho_i = \frac{e^{\beta \epsilon_i}}{Z} \quad \text{where} \quad Z = \sum_i e^{\beta \epsilon_i} \]


Generalized entropy:
\[ S_q = k \frac{1 - \sum \rho_i^q}{q-1} \]
where \( q \) characterizes the extensivity of the statistics.

Note: For \( q=1 \) regular B.G. Statistics is recovered:
\[ S_{q \rightarrow 1} \rightarrow -k \sum \rho_i \ln \rho_i \]