

International Space Weather Initiative (ISWI)

Annual Report 2018

Nat Gopalswamy

1. **The Goal of ISWI** is to develop the scientific insight necessary to understand the science, and to reconstruct and forecast near-Earth space weather. This includes instrumentation, data analysis, modeling, education, training, and public outreach.

2. ISWI Steering Committee:

Christine Amory-Mazaudier	France	GPS
Sharafat Gadimova	Austria	UNOOSA
Katya Georgieva	Bulgaria	SCOSTEP/VarSITI
J. Americo Gonzalez-Esparza	Mexico	UNAM/ Instituto Geofisica
Nat Gopalswamy	US	Chair
Keith Groves	US	Scintillation Networks
Lika Guhathakurta	US	NASA HQ
Norbert Jakowski	Germany	SOFIE and GIFDS
Ian Mann	Canada	U. Alberta
Christian Monstein	Switzerland	CALLISTO
Terry Onsager	US	ISES
Babatunde Rabi	Nigeria	NASRDA
Jean-Pierre Raulin	Brazil	SAVNET
Kazunari Shibata	Japan	CHAIN project
Elsayed Talaat	US	NOAA
Chi Wang	China	Space Weather Meridian
Akimasa Yoshikawa	Japan	MAGDAS

3. Instrument Arrays

Full details about the instruments and PIs are available on the web site (<http://www.iswi-secretariat.org>). The following is a high-level summary.

3.1 Atmospheric Electric Field Network in South America (AFINSA)

Lead Scientist: Dr. Jean-Pierre Raulin (Universidade Presbiteriana Mackenzie) Brazil

Objective: To obtain a daily variation curve of the fair weather Atmospheric Electric Field (AEF) based on means on different time scales, such as monthly, seasonal and annual.

3.2 African Dual Frequency GPS Network (AMMA)

Lead Scientist: Dr. Christine Amory-Mazaudier (CETP&CNRS) France

Objective: 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.

3.3 African Meridian B-field Education and Research (AMBER)

Lead Scientist: Lead Scientist: *Dr. Endawoke Yizengaw* (Boston College) and *Dr. Mark Moldwin* (University of Michigan) United States

Objective: Understand low latitude electrodynamics, ULF pulsations, effect of Pc5 ULF on MeV electron population in inner radiation belts

3.4 Atmospheric Weather Education System for Observation and Modeling of Effects (AWESOME) and SID (Sudden Ionospheric Disturbance Monitor)

Lead Scientist: *Dr. Umran S. Inan*, *Dr. Morris Cohen* and *Dr. Deborah Scherrer* (Stanford) United States

Objective: Lightning, sprites, Elves, relation to terrestrial Gamma Ray flashes , whistler induced electron precipitation, conjugate studies

3.5 Boston University All-Sky Imaging Network (BU_ASI)

Lead Scientist: *Dr. Michael Mendillo* and *Dr. Carlos Martinis* (Boston U.) United States

Objective: The BU all-sky imager network has been built to study magnetically conjugate processes in the thermosphere-ionosphere from low latitudes to sub-auroral latitudes.

3.6 Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO)

Lead Scientist: *Dr. Arnold Otto Benz* and *Dr. Christian Andreas Monstein* (ETHZ) Switzerland

Objective: Study the magnetic activity of a wide range of astrophysical objects with emphasis on the Sun and cool stars

3.7 Continuous H-alpha Imaging Network (CHAIN)

Lead Scientist: *Dr. Kazunari Shibata* and *Dr. Satoru UeNo* (Kyoto U) Japan

Objective: Solar activity, flares, filaments, filament eruptions

3.8 Coherent Ionospheric Doppler Receivers (CIDR)

Lead Scientist: *Prof. Ayman Mahrous* (Helwan University, Egypt) and *Dr. Trevor W. Garner* (U Tex) United States

Objective: To tomographically reconstruct the ionosphere and to provide input to Data Assimilation models

3.9 Global Ionosphere Flare Detection System (GIFDS)

Lead Scientist: *Dr. Norbert Jakowski* and *Daniela Wenzel* (German Aerospace Center) Germany

Objective: To issue warnings for mitigating space weather impact on sensitive technologies

3.10 Global Muon Detector Network (GMDN)

Lead Scientist: *Dr. Kazuoki Munakata* (Shinsu U) Japan

Objective: 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

3.11 Low-latitude Ionosphere Sensor Network (LISN)

Lead Scientist: *Dr. Cesar Valladeres* (Boston College) United States

Objective: To monitor and specify the conditions of the equatorial and low-latitude ionosphere over South America.

3.12 Magnetic Data Acquisition System (MAGDAS)

Lead Scientist: *Dr. Kiyohumi Yumoto* and *Dr. Akimasa Yoshikawa* (Kyushu U) Japan

Objective: 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

3.13 Optical Mesosphere Thermosphere Imager (OMTIs)

Lead Scientist: *Dr. Kazuo Shiokawa* (Nagoya U) Japan

Objective: Dynamics of the upper atmosphere through nocturnal airglow emissions

3.14 Remote Equatorial Nighttime Observatory for Ionospheric Regions (RENOIR)

Lead Scientist: *Dr. Jonathan J. Makela* (U Illinois) United States

Objective: Study the equatorial/low-latitude ionosphere/thermosphere system, its response to storms, and the irregularities that can be present on a daily basis.

3.15 Realistic Ionosphere (RI)

Lead Scientists: *Dr. Bodo Reinisch* and *Dr. Ivan Galkin* (U of Mass. Lowell) United States

Objective: To provide accurate and prompt nowcast of the 3D global plasma density distribution in the subpeak ionosphere.

3.16 South America Very Low frequency Network (SAVNET)

Lead Scientist: *Dr. Jean-Pierre Raulin* (U Presbiteriana) Brazil

Objective: Study of the SAMA region at low ionospheric altitudes and its structure and dynamics during geomagnetic perturbations

3.17 Scintillation Network Decision Aid (SCINDA)

Lead Scientist: *Dr. Keith Groves* (Boston College) United States

Objective: Study equatorial ionospheric disturbances to aid in the specification and prediction of communications degradation due to ionospheric scintillation in the earth's equatorial region

3.18 Space Environment Viewing and Analysis Network (SEVAN)

Lead Scientist: *Dr. Ashot Chilingarian* (Aragats) Armenia

Objective: To improve short and long-term forecasts of dangerous consequences of space storms

3.19 Solar Flares detected by Ionospheric Effects (SOFIE)

Lead Scientist: *Dr. Norbert Jakowski* (Institute of Communications and Navigation and the School-Lab at DLR Neustrelitz) Germany

Objective: To detect solar radio bursts (solar flares) by measuring continuously the intensity of VLF radio signals considering ionospheric propagation effects on radio waves

4. Secretariat: Solar Physics Laboratory, NASA/GSFC, Greenbelt, MD 20771, USA

4.1 Personnel:

Nat Gopalswamy (Executive Director), NASA/GSFC

Shing Fung (Director for Data Coordination) NASA/GSFC

George Maeda (ISWI Newsletter Editor), Kyushu Institute of Technology, Japan

Katya Georgieva and Mitko Danov (Web Service) Bulgarian Academy of Sciences

Sharafat Gadimova (UNOOSA), UN Liaison

Pat Doherty (Boston College), Workshop Coordinator

4.2 ISWI Membership Subcommittee

The membership committee adds new ISWI member countries, identify ISWI national coordinators, and update the list available at the ISWI web site.

Chair: Christine Amory (France)

Members:

Mitko Danov (webmaster)

Babatunde Rabi (Nigeria)

Christian Monstein (Switzerland)

Richard Marshall (Australia)

J. Americo Gonzalez-Esparza (Mexico)

4.3 ISWI Data Subcommittee

The data subcommittee deals with the ISWI data issues. The subcommittee developed the current data policy and rules of the road for data usage.

Chair: Shing Fung (USA)

Members:

Christine Amory (France)

Keith Groves (USA)

Christian Monstein (Switzerland)

Terry Onsager (USA)

Babatunde Rabi (Nigeria)

George Maeda (Japan)

Jesper Gjerloev (USA)

5. Recent Activities:

5.1. The ISWI School on Space Weather and Global Navigation Satellite Systems (GNSS):

This school was the main activity for 2018. The school was held in Baku, Azerbaijan during 8 – 12 October 2018. The purpose of the school was to advance the topics of space weather and Global Satellite Positioning Systems to scientists, engineers and graduate level students who are pursuing doctorate (PhD) in solar physics, space science and engineering. Some Masters level students who have already some exposures in solar/space physics were also selected. In addition to lectures and hands-on activities, field trips to the solar observatory, the Aviation Academy,

and the Azercosmos ground station were organized. The observatory site is being developed to host some ISWI instruments. The school was hosted by the Science Development Foundation (SDF) under the President of the Republic of Azerbaijan and Shamakhy Astrophysical Observatory of the Azerbaijan National Academy of Sciences. The school was sponsored by the NASA ISWI grant, the International Committee on GNSS (ICG) through the United Office for Outer Space Affairs (UNOOSA), and the Scientific Committee on Solar Terrestrial Physics (SCOSTEP).

5.2 Other activities: ISWI also supported three other space weather activities. (i) A mini space science school was organized in the context of the 11th Latin American Conference on Space Physics (Congreso Latinoamericano de Geofísica Espacial, COLAGE) by the Latin American Association of Space Geophysics (Asociación Latinoamericana de Geofísica Espacial or ALAGE). ISWI sponsored three lecturers from the US to teach at the school organized during the third week of April 2018. (ii) ISWI sponsored two lecturers to the COSPAR Capacity Building workshop held in Mekelle, Ethiopia during May 20-June 1, 2018. The workshop featured lectures in solar terrestrial science during the first week and data analysis in the second week to study the relation between coronal mass ejections and shock-associated radio bursts from the Sun. (iii) The 15th International Symposium on Equatorial Aeronomy (ISEA) held in Ahmedabad, India during October 22-28, 2018. During the ISEA symposium researchers from the fields of atmosphere, ionosphere and magnetosphere gather together to review the current state of research, present new results, and identify topics for future studies. Three scientists from the United States were sponsored by ISWI to attend this symposium to present results obtained from the analysis of ISWI data.

5.3. Science: A special issue of the journal Sun and Geosphere was recently published containing articles presented at the 2017 UN/USA ISWI workshop held in Boston College. The papers can be found at the following web site: http://newserver.stil.bas.bg/SUNGEO//sun_geo_content.html#v102. The special issue was guest-edited by Shing F. Fung, David F. Webb, and Manju Gopalapillai.

5.2. UN Report: Details on the deliberations of the UN/US Workshop have been published as the document A/AC.105/1096 by the United Nations Committee on Peaceful Uses of Outer Space (UNOPUOS) for the benefit of the international community. The report contains the observations and recommendations that are helpful in furthering the space weather agenda.

6. Future activities

6.1. ISWI/SCOSTEP School: The successful International Space Science Schools held in Indonesia (2012), Kenya (2013), Peru (2014), India (2016), and Azerbaijan (2018) have made the Schools very popular. Currently, there are requests from Uganda, Morocco, Nepal, and Portugal. After soliciting proposals from the potential hosts, the location of the next school will be decided. The School will be organized in collaboration with the Scientific Committee On Solar Terrestrial Physics (SCOSTEP) as in the past. The school will feature advanced training for PhD students and young scientists in the field of Solar Terrestrial Physics.

6.2. UN/ISWI Workshop: Following the tradition of ISWI workshops involving new results from the analysis of ISWI instrument data in conjunction with data from space missions, the next workshop will be held at the Abdus Salam Center for Theoretical Physics (ICTP), Trieste, Italy during May 20-24, 2019. The Workshop will be cosponsored by ICTP, the International Committee on Global Navigation Satellite Systems (ICG), Boston College, and the Scientific Committee on Solar Terrestrial Physics (SCOSTEP). Detailed information about the Workshop is available on the ICTP website at: <http://indico.ictp.it/event/8682/>. The deadline for abstract submission is February 15, 2019. India has expressed willingness to host the next workshop in the year 2020 near Thiruvananthapuram.

6.3 Outreach Activities: A total solar eclipse is crossing Chile and Argentina on July 2, 2019. In connection with this eclipse, a workshop entitled "Towards Future Research on Space Weather Drivers" (FReSWeD 2019, <http://www.iafe.uba.ar/freswed2019>), will be held in the city of San Juan, Argentina, from 2 to 6 July, 2019. ISWI will support a scientist from the US to participate in the outreach activities planned during the solar eclipse. Similarly, ISWI will provide some support to the 'African Geophysical Society (AGS) Conference on Space Weather 2019', to be held in Cairo, EGYPT, from 25-28 March 2019.