

The 2010 International Space Weather Initiative (ISWI) Summer School

28 Oct – 4 Nov 2010, Bahir Dar, Ethiopia

Report

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First International Space Weather Initiative (ISWI) Summer School

28 October - 4 November 2010

Bahir Dar, Ethiopia

Hosted by:

Bahir Dar University, Ethiopia

in collaboration with

Boston College, USA

Sponsors:

- ➔ National Aeronautics and Space Administration (NASA), USA
- ➔ European Office of Aerospace Research and Development (EOARD), UK
- ➔ Climate and Weather of the Sun-Earth System (CAWSES)/International Committee on Solar-Terrestrial Physics (SCOSTEP)
- ➔ Committee on Space Research (COSPAR)
- ➔ International Center for Theoretical Physics (ICTP), Italy
- ➔ Bahir Dar University, Ethiopia
- ➔ Boston College, USA
- ➔ Air Force Research Laboratory (AFRL), USA
- ➔ University of Michigan, USA
- ➔ Kyushu University, Japan
- ➔ University of Calgary, Canada
- ➔ Massachusetts Institute of Technology (MIT), USA
- ➔ German Aerospace Center , Germany

Introduction

The IHY program has successfully deployed a significant number of ground-based instruments in Africa to understand the physics behind the unique ionospheric irregularities in the equatorial African region that has been attracting a lot of attention. One of the many objectives of the IHY program is to lay down new space weather research infrastructure within the developing nations, like Africa. The International Space Weather Initiative (ISWI) is a continuation of the recently ended successful program called International Heliophysical Years (IHY). However, even if the ground-based instruments are available in their back yards, many African young professors do not well understand what kind of science they can do with the data they are collecting.

Therefore, to provide basic space science understanding, data analysis and data assimilation techniques to local, especially, young professors, post docs and post graduate students, the ISWI 2010 summer school was organized in Bahir Dar, Ethiopia during the period of 28 October – 4 November 2010. The summer school is a continuation of the very successful IHY-Africa 2009 summer school, which was held in Akure, Nigeria in February 2009. Additional aims of the summer school were to converge African and other international scientists under one roof, facilitate the deployment of new observational infrastructure to study space weather, spark interest in space science education and research, and encourage the next generation of African scientists to become interested in the space sciences. As has been exhibited from previous similar summer schools, we believe these young scientists and graduate students will contribute significantly to the future instrument operations in the African continent.

Attendees and Logistics

The school was organized by a committee that comprises of local and international members. A list of the members of this committee appears in *Appendix A*. A total of 56 delegates attended the school in Ethiopia. Of these delegates, 42 represented 16 different African countries (*see Figure 1* for the distribution of the participants) and 14 instructors travelled from 6 different countries (8 from USA, 1 from Canada, 1 from Germany, 1 from Japan, 1 from Nigeria, and 2 from Ethiopia). The list of African countries represented at the workshop is given in *Appendix B*, and a complete list of delegates can be found in *Appendix C*.



Figure 1. Distribution (red dots) of ISWI 2010 summer school participants among African countries.

Due to the generous sponsorship that the summer school received, 22 African delegates outside Ethiopia and three instructors were sponsored in full. Among these the airfare of 21 African participants and one instructor (from Nigeria) were sponsored by NASA. One African participant outside Ethiopia received airfare from Kyushu University. The accommodation and local expenses of all African participants outside Ethiopia were also sponsored by CAWSES and EOARD. Similarly, the remaining instructors were sponsored by different sponsors (three instructors by Boston College, two by AFRL, one by University of Michigan, one by NASA, one by ICTP, one by University of Calgary, one by Kyushu University, one by German Aerospace Center, and one (partially) by MIT). All participants from Ethiopia and all other local logistics were sponsored by EOARD, ICTP, COSPAR, and Bahir Dar University. Travel arrangements for all African participants outside Ethiopia and for one instructor from Nigeria were made using a travel agency in USA through NASA. The travel arrangements for the sponsored Ethiopian participants were made in Ethiopia through Bahir Dar University, and were coordinated by Dr Baylie Damtie.

The workshop was held in the Ethio Star Hotel in Bahir Dar. All participants, except the 14 instructors, who made their own accommodation arrangement elsewhere, were accommodated in the Ethio Star Hotel. The local organizing committee (LOC) coordinated all the accommodation arrangements with the Ethio Star Hotel, who also arranged meeting hall and all the meals and tea breaks.

The opening ceremony was held in the morning of Thursday 28 October 2010, and included presentations in the conference hall followed by an ice breaker dinner at Tana Hotel. The opening ceremony was chaired by Dr Baylie Damtie, Academic vice president of Bahir Dar University and chair of the organizing committee, and was attended by the vice presidents of Bahir Dar University, president of Bahir Dar University, Dr Yeshimebrat Mersha, and the deputy vice president of the Amhara Regional State and head of the bureau of industry and urban works, Honorable Ahmed Abtew. Presentations were made by Dr Natchimuthuk Gopalswamy, the International Space Weather Initiative Secretariat as well as a few representatives from the sponsors. The two Ethiopian guests of honor also made presentations which were motivating for science in Ethiopia. Especially, the deputy president of Amhara region, who represented the Ethiopian government, illustrated that the Ethiopian government's commitment to science and technology and vowed to continue supporting the space science development in the country. He also appreciated for the presence of the ISWI 2010 summer school in Bahir Dar.

Scientific Program

The scientific program of the summer school included the following main Heliophysics science sessions:

- Introduction to space science
- Scientific instruments for space exploration
- Modern data analysis, interpretation methods, and programming in open source
- Space Weather (Sun-to-Earth Coupling)
- Ground- and Space-based GPS TEC
- Equatorial electrodynamics
- Data Resource Pointer

These science sessions included more than 40 lectures, which are available online, with the main focus on what kind of science can be done with the data recorded by the instruments deployed in the African region and how can the data be utilized. Complete list of schedules of the summer school is shown in *Appendix D*.



Figure 2. ISWI 2010 summer school participants performing laboratory demonstration.

In addition there was one laboratory demonstration session using open software available which was convened by Dr Baylie Damtie at his well equipped computer laboratory (*see Figure 2*). This was largely welcomed by all participants, and expressed their wish to have such software demonstrations at the upcoming similar summer schools and even at workshops. There were also parallel instrument deployment process going on, in which participants had access for live demonstration to the site where VHF receivers were deployed by AFRL (*see Figure 3a*). Similarly, the German Aerospace Center deployed a GNSS receiver in parallel to the summer school (*see Figure 3b*).

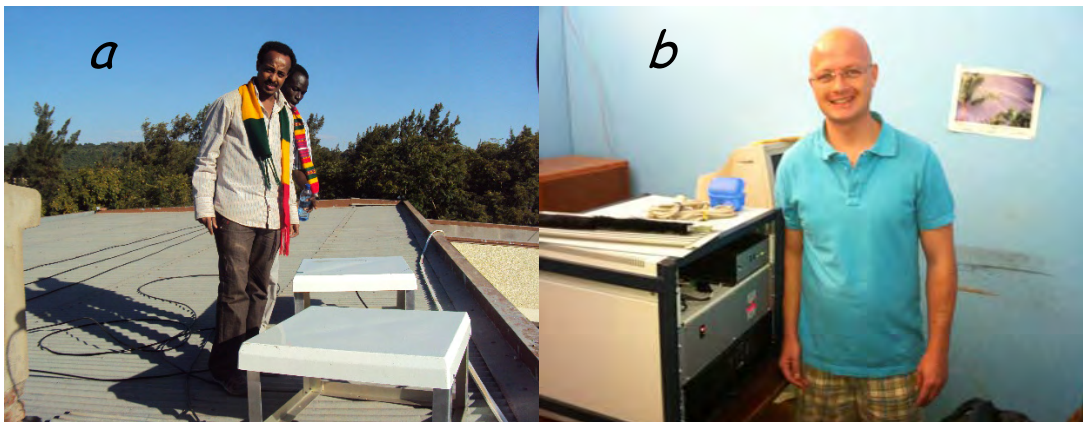


Figure 3. Instruments deployed in parallel with the ISWI 2010 summer school: (a) VHF receiver deployed by AFRL, (b) GNSS receiver deployed by German Aerospace Center

Included in the program was an open discussion forum, which was convened by Prof Mark Moldwin and Dr Babatunde Rabi. The panel discussion was targeted on the following main issues: this includes; instruments and databases, possible barriers for the expansion of space science education and research in the continent.

In the panel discussion all participants underlined such kind of additional training courses in space weather data analysis and interpretation is high priority for African young scientists. As Africa begins to employ and benefit from space weather applications, it is important to initiate programs in space science education and research at the university level for capacity building and sustainability. However, the main barrier in the region toward this effort was the lack of

resources such as articles, books, suitable software for data analysis. They unanimously echoed their request if there is a possibility that AGU can allow free access to African scientists for its articles. Prof Mark Moldwin has donated some of his books (*introduction to space weather*) to some of the participants.

Students and professors from Africa, who attended this summer school, have witnessed that they have gained a lot from this summer school and urged ISWI to continue such summer schools in different parts of Africa. Such summer schools not only supports ISWI goals but also accelerate the basic science understanding to provide education in Space Weather studies in the African countries who have never had space weather program in any of their universities. Also along these lines, Boston College (BC) and the International Centre for Theoretical Physics (ICTP) already made partnership and organized a series of workshops for university professors, young scientists and graduate students from Africa on GNSS hardware, applications and scientific exploration with GNSS. All participants, who attended at least one of the past workshops witnessed that they have benefited a lot from the workshop, and urged for the continuation of this series workshops which is highly essential for the needs of fostering science and technology understanding among African young generation. One of the main organizers of these series workshops, Prof Patricia Doherty who was one of the instructors at this summer school, announced that the third of these series workshops is scheduled to be held in Abuja, Nigeria in October 2011 which is its first time to be held in Africa.

Conclusion Remarks: The ISWI international secretariat, Nat Gobalswamy, confirmed that such ISWI summer schools will continue under the umbrella of ISWI. At the end of the summer school, unlike the previous summer schools and workshops, questionnaires (see *Appendix E*) were distributed to all participants, and the response we have received was enormous. The overall rating (that includes, quality of lectures, organization, accommodation, food, accessibility, etc) of the summer school by the participants was 9.2 out of 10. The most interesting point that is worth to mention it here was that almost 100% of the participants recommended for the continuation of such kind of summer schools once in a year. Finally, each participant received a “*Certificate of Appreciation*”. A copy of the certificate is shown in *Appendix F*.

Outreach

In parallel to the summer school Prof Mark Moldwin and Dr Endawoke Yizengaw spent one evening with Bahir Dar university physics department students. A short presentation was given to the students. Explanation about the importance of space weather and its impact to our daily life were some of materials presented in the short presentation. Moreover, the Bahir Dar city education office brought students (more than 500 students) from two high schools available in Bahir Dar to the city hall. Prof Mark Moldwin and Dr Endawoke Yizengaw were invited to meet these students make a short presentation about how science in general and space weather in particular is important to our daily life, and also to make some remarks about how the young generation can be inspired and develop interest to science. The students were introduced to the scientists who spent time with them, and entertained question and answer session which lasted for more than two hours.

Conclusion

The summer school was successful in covering several space science topics. The summer school was also used as a vehicle in bringing together African Space Scientists and providing a forum in which they could meet and make contacts with themselves and with international colleagues in the field. Social activities were also included in the program that may allow participants to interact and get to know each other (see *Figures 4*). A number of students were exposed to the Space Science field and to successful African scientists in the field. Summer schools like these form a very valuable part of fostering scientific research in Africa and should be encouraged and supported.

This Summer school would have not been possible without the support of the sponsors, who are listed at the front of this report, and our special thanks go to all sponsors. The school also would have not been successful without the support and hard work of the Ethiopian organizing team.



Figure 4. One of ISWI summer school participant from Kenya playing with one of the Ethiopian musical instrument, called “Masinko”, during her way to the Lake Tana monasteries.

APPENDIX A

ORGANIZING COMMITTEES

Baylie Damtie (bayliedamtie@gmail.com)
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APPENDIX B

Countries Represented at the ISWI 2010 Summer School

**Algeria
Cameroon
D. R. Congo
Ethiopia
Ivory Cost
Kenya
Madagascar
Malawi
Nigeria
Rewanda
South Africa
Sudan
Tanzania
Uganda
Zambia**

APPENDIX C

ISWI 2010 Summer School

Instructors		
Name	Affiliation	e-mail
Dr. Anthea Coster	Massachusetts Institute of Technology (MIT), USA	ajc@haystack.mit.edu
Dr. Christian Koch	German Aerospace Center , Germany	Christian.Koch@dlr.de
Dr. Endawoke Yizengaw	Boston College, USA	kassie@bc.edu
Prof. Kiyohumi Yumoto	Kyushu University, Japan	yumoto@serc.kyushu-u.ac.jp
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Prof. Mark Moldwin	Michigan University, USA	mmoldwin@umich.edu
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Dr. Babatunde Rabi	Federal University of Technology, Nigeria	tunderabiu@yahoo.com
Dr. Gizaw Mengistu	Addis Ababa University, Ethiopia	gizaw_mengistu@gmx.net
Dr Baylie Damtie	Bahir Dar University. Ethiopia	bayliedamtie@yahoo.com

ISWI Summer School Student Participants

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Appendix D

First International Space Weather Initiative (ISWI) Summer School
 28 October - 4 November 2010
 Ethio Star Hotel, Bahir Dar, Ethiopia
 Final Program

Date	Time	Title	Presenter	Convener
10/27/10	17:30 - 19:00	Registration and administrative formality	LOC	
Day 1	Opening Ceremony, Introduction, and Magnetometers			
10/28/10	08:00 - 09:00	Registration and administrative formality continue	LOC	
	09:30 - 09:40	Opening address and welcome	B. Damtie	
	09:40 - 09:45	ISWI - NASA representative	N. Gopalswamy	B. Damtie
	09:45 - 09:50	Space Science support in Africa	P. Doherty	
	09:50 - 10:05	Update on ISWI activities	N. Gopalswamy	

	10:05 - 10:20	History of Space Science activities in Ethiopia	E. Yizengaw	
	10:20 - 10:30	Bahir Dar University Official welcome address	Dr. Y. Mersha, BDU President	
	10:30 - 10:40	Regional Government official welcome address	Gust of honor from the government	
		Coffee Break		
	11:30 - 12:30	Introduction to Space Weather	E. Yizengaw	B. Damtie
	12:30 - 13:30	Space Weather Effects on Aviation Systems	P. Doherty	
		Lunch		
	15:00 - 16:00	Introduction to ionospheric currents and Equatorial electrojet	K. Yumoto	B. Damtie
		Coffee Break		
16:30 - 17:30	Update on MAGDAS Activities in Africa and Around the Globe	K. Yumoto	B. Damtie	
	END			
18:30 - 22:00	ICE Breaker Reception	LOC		

Day 2 Scientific instruments for space exploration					
10/29/10	08:30 - 09:30	Update on SCINDA activities in Africa and around the world	R. Caton/B. Heruska	G. Mengistu	
	09:30 - 10:30	Update on AMBER activates in Africa	E. Yizengaw		
		Coffee Break			
	11:00 - 12:00	Fundamentals of Incoherent Scattering Radar measurement technique	B. Damtie	G. Mengistu	
	12:00 - 13:00	Ionosonde Measurement Techniques	T. Bullet		
		Lunch			
	14:30 - 15:30	C/NOFS, DMSP, COSMIC, and other LEO satellite missions and their contribution to space weather studies in Africa	R. Caton	G. Mengistu	
		Coffee Break			
	16:00 - 17:00	How to Estimate Equatorial Electrojet and thus vertical drift velocity using magnetometer data	B. Rabi	G. Mengistu	
		END			
	Day 3 Modern data analysis and interpretation methods, and Programming in Open source				

10/30/10

08:30 - 08:50	Principle of Ionospheric Tomography	T. Kassa	Z. Tefera
08:50 - 09:10	Study of the ionospheric scintillations and TEC characteristics at solar minimum in an equatorial region using GPS data	J.-B. Ackah	
09:10 - 09:30	INVESTIGATION INTO QUIET AND MAGNETIC STORMS PERIODS ABOVE MAGADAN BETWEEN OCTOBER AND DECEMBER 2003	DAVID T. W.	
09:30 - 09:50	Effects of Ionospheric disturbances on GPS satellites signals during magnetic storm on July, 22, 2009 over Kenyan Airspace	Olwendo O.J	
	Coffee Break		
10:30 - 11:30	Bayesian Linear inversion method	B. Damtie	Z. Tefera
11:30 - 12:30	Numerical Methods for DE	A. Bires/B. Damtie	
	Lunch		

Laboratory Activities at BDU main campus
(bus will be ready @2:00PM)

	14:30 - 15:30	MATLAB in a nutshell	B. Damtie /T. Kassa	Z. Tefera	
	15:30 - 16:30	Numerical Exercise	A. Bires/Damtie		
		Coffee break			
	17:00 - 18:00	Linear Inversion	B. Damtie	Z. Tefera	
		END			
	Day 4				
	Open for Social Activities				
10/31/10	08:30 - 16:30	Social trip (to TBD by LOC)	LOC	LOC	
	18:30 - 22:00	ISWI Summer School Dinner	LOC		
Day 5					
Space Weather					
11/01/10	08:30 - 09:30	The Sun and the dynamo process	N. Gopalswamy	Mebrahtu	
	09:30 - 10:30	How can we identify CME and CIR storms	N. Gopalswamy		
		Coffee break			

	11:00 - 12:00	Heliosphere-Magnetosphere-Ionosphere coupling	M. Moldwin	Mebrahtu
	12:00 - 13:00	Plasmasphere-ionosphere coupling and its signature over Africa	A. Coster	
		Lunch		
	14:30 - 15:30	The Ionosphere and its advantage and disadvantage for our technological systems	M. Moldwin	Mebrahtu
	15:30 - 16:30	How to Estimate Equatorial Electrojet and thus vertical drift velocity using magnetometer data	B. Rabiou	
		Coffee break		
	17:00 - 18:00	Atmospheric Water Vapor from GPS network over Ethiopia	G. Mengistu	Mebrahtu
		END		

Day 6	Ground- and Space-based GPS TEC			
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11/02/10	08:30 - 09:30	Principles of GPS TEC measurements and Techniques	L. Ciruolo	G/E Kahsay
	09:30 - 10:30	Step-by-Step GNSS TEC data Processing technique	E. Yizengaw	
		Coffee Break		

	11:00 - 12:00	Ionospheric storms and their effect on GNSS	A. Coster	G/E Kahsay	
	12:00 - 13:00	Ionospheric Challenges for Positioning Application in Africa and around the world	S. Skone		
		Lunch			
	14:30 - 15:30	Introduction to Occultation technique	C. Koch	G/E Kahsay	
		Coffee break			
	15:30 - 19:00	Ground-Based Instrument Demonstration	R. Caton/B. Heruska	G/E Kahsay	
		END			
	Day 7				
	Equatorial electrodynamicics				
	11/03/10	08:30 - 09:30	The Physics of Equatorial electrodynamicics	M. Moldwin	G/Medhin
09:30 - 10:30		Introduction to plasma bubbles and Scintillation, how they occur, where do they often occur, and why?	R. Caton//K. Groves		
		Coffee Break			
11:00 - 12:00		Scintillation Phenomena and its effect on GNSS	S. Skone	G/Medhin	

	12:00 - 13:00	Sensing Ionospheric irregularities with LISN network	P. Doherty		
		Lunch			
	14:30 - 15:30	Ionosphere Modeling for Wide Area Differential GPS Applications	S. Skone	G/Medhin	
	15:30 - 16:30	Ionospheric modeling: NQuick model	L. Ciraolo		
		Coffee break			
	17:00 - 18:00	Review of current ionospheric and plasmaspheric models	M. Moldwin	G/Medhin	
		END			
	Day 8				
	Data Resource Pointer and Closing Ceremony				
	11/04/10	08:30 - 09:00	Ionosonde Measurement Techniques	P. Doherty	B. Damtie
09:00 - 09:30		Where to click to get data from all of the above instruments	E. Yizengaw		
09:30 - 10:30		Panel Discussion	Moldwin/Rabiu		
		Coffee Break			
11:00 - 11:20		Certificate Issuing ceremony	TBD	B. Damtie	

Blue				
	11:20 - 11:40	Wrapping up the ISWI school	Dantie/Gopalswamy	
	11:40 - 12:00	Closing remarks	TBD	
	12:00 - 13:00	Lunch		
	END of the 2010 ISWI Summer School			
Green	Green	Green	Green	Green

APPENDIX E

EVALUATION OF PFISR WORKSHOP

Please rate on a scale of 1-10 (10 = best, 1 = worst):

Topics covered	_____
Depth of material covered	_____
Usefulness of material covered	_____
Student Interaction	_____
Availability of Instructors	_____
Location of the school	_____
Food	_____
Accommodations	_____
Distribution of participants'	_____
Overall organization	_____

Questions:

What were your objectives in attending the ISWI summer school?

Did you achieve your objectives from the school?

What did you like best about the school?

What did you like least about the school?

What do you think about the order and quality of material presented? Can you suggest improvements?

What material or support would you like to receive following the school?

Do you recommend to continue having this type of summer school in the future? If the answer is YES, how often you suggested?

How could the content of the ISWI summer school be improved?

What information would have been helpful to see prior to the school?

What other location would you like to see the summer school at?

What is the likelihood that you will use data from ground- and spaced-instruments introduced at this summer school in the future?

Are you interested in participating in further exploring space science research in the African sector?

Any other comments or suggestions for us?

CERTIFICATE OF PARTICIPATION

This certificate is awarded to

Mr . _____

For Participating in the 2010 International Space Weather Initiative (ISWI) Summer School in Space Physics, Held on Oct. 28- Nov. 04, 2010, Washera Geospace and Radar Science Laboratory (WaGRL), Bahir Dar University, Bahir Dar, Ethiopia

DR. NATCHIMUTHUK GOPALSWAMY

NASA, SECRETARY OF ISWI

DR. BAYLIE DAMTIE

ISWI COUNTRY REPRESENTATIVE



NASA



EOARD



Boston
College



ICTP



MIT



AFRL



SERC



SCOSTEP



Michigan
University



BDU