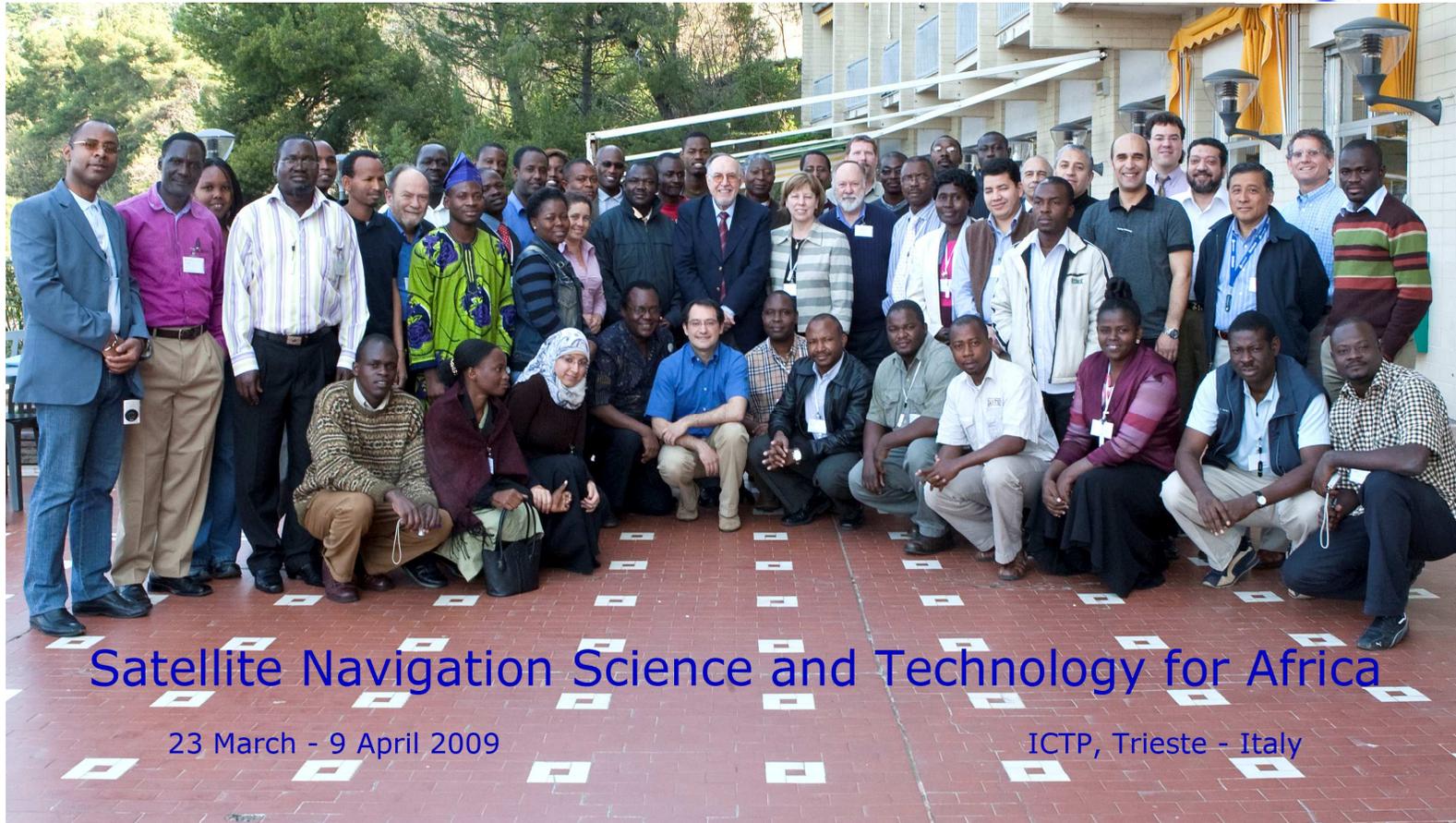


The Boston College/Abdus Salam International Centre for Theoretical Physics Collaboration and Outreach Workshops



Patricia H. Doherty, Boston College

Sandro M. Radicella, ICTP



UN/US ISWI Workshop – Boston College - August 3, 2017

Africa's Science and Technology Plan of Action (1) clearly states Africa's commitment to develop and use science and technology for socio-economic transformation and full integration into the world economy.



Global Navigation Satellite Systems (GNSS) are a space technology that can help meet that goal.

GNSS Applications

- Increase food security; manage natural resources; wildlife conservation
- Provide efficient emergency location services; disaster relief
- Improve mapping and surveying
- Provide greater precision and safety in land, sea and air navigation
- Scientific research and exploration – SPACE SCIENCE



Wildlife Conservation



Land Navigation



Precision Farming



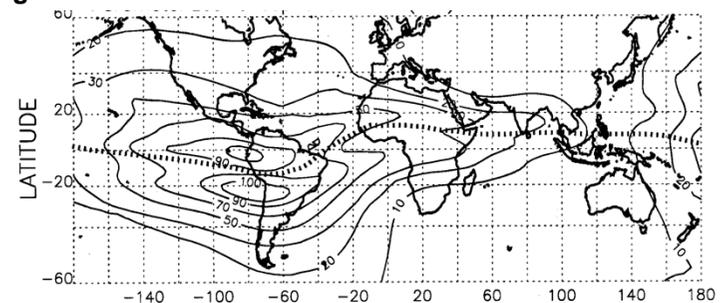
Water Navigation



Air Navigation



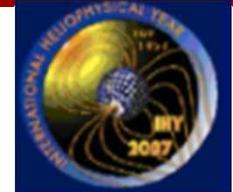
Disaster Relief



Scientific Exploration

Project Goals

- To help build a knowledgeable GNSS African workforce
 - A request at IHY-Africa 2007 – a need for training
- To encourage the use of GNSS for societal and economic development and scientific exploration
- Facilitate international collaborations
 - Increase food security; manage natural resources; wildlife conservation
 - Provide efficient emergency location services; disaster relief
 - Improve mapping and surveying
 - Provide greater precision and safety in land, sea and air navigation
 - Scientific research and exploration



International Committee on
Global Navigation Satellite Systems



9 Workshops held since 2006



- Most held at the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy
- 2014 held in Kigali, Rwanda
- Curriculum
 - Fundamentals of GNSS
 - State of the art GNSS Technologies
 - Scientific Exploration using GNSS
 - **Ionosphere, Space Weather**
 - Data acquisition, processing and analysis
 - Aviation Applications
 - Lego Robots Contest
 - Geocache Challenge
 - Android phones using GNSS





5th Workshop – 2014 Kigali, Rwanda African School on Space Science

GNSS fundamentals and scientific exploration together with a greater focus on space and solar physics and how solar events can affect our technology on Earth – specifically GNSS.



Themes have matured

GNSS, Space Weather, Navigation, Ionosphere

2009: Workshop on Satellite Navigation Science and Technology for Africa

2010: Second Workshop on Satellite Navigation Science and Technology for Africa

2012: Workshop on Science Applications of GNSS in Developing Countries

2013: Workshop on GNSS Data Application to Low Latitude Ionospheric Research

2014: African School on Space Science, Rwanda

2015: Workshop on Ionospheric Effects on SBAS and GBAS Applications at Low Latitudes

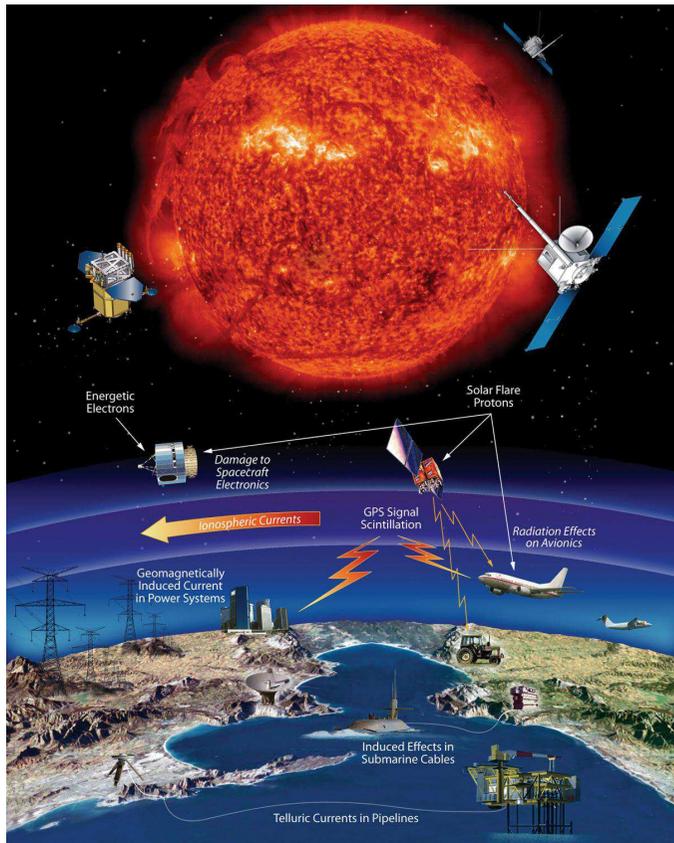
2016: Workshop on the Use of Ionospheric GNSS Satellite Derived TEC for Navigation, Ionospheric and Space Weather Research

Significant ISWI Relevance



2017 Workshop

Extended Workshop on Space Weather Effects on GNSS Operations



- > 40 participants
- 50% were women
- 24 countries
 - Argentina, Bosnia and Herzegovina, Brazil, Cote d'Ivoire, Egypt, Ethiopia, Indonesia, Malaysia, Nigeria, Peoples Republic of China, Peru, Republic of Cameroon, Rwanda, Uganda and Ukraine
- Prime focus on space weather

All topics relevant to ISWI interests.

International Centre for Theoretical Physics, Trieste, IT – May 22 – June 2, 2017

Increasing number of students and young scientists studying space science using GNSS

(Many more applications than we can support)



Increasing participation by women



17 women from 14 countries – May 2017

Lecturers;
Sandro Radicella
Christine Amory
Endawoke Yizengaw
Bruno Nava

Hands-On Laboratories

Lecturers;
Patricia Doherty
Keith Groves
Anthea Coster
Babatunde Rabi



Lecturers;
John Raquet
Frank Van Diggelen
Phil Ward



Lecturers;
Jean Uwamahoro
Charles Carrano
Jade Morton

Small Group Projects On Space Weather Events



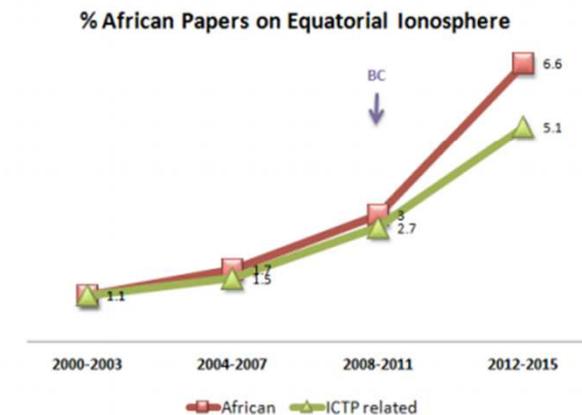
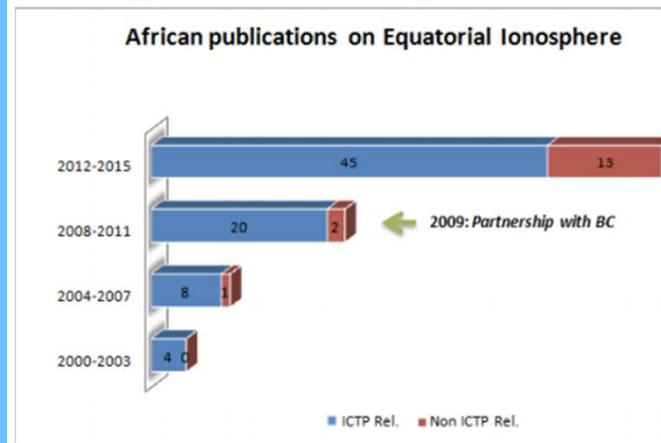
Workshops Resulted in Sustainable Developments



- Regional workshops
- Government interest
- Infrastructure
- Scientific collaborations
- Programs of study
- New PhD level scientists using GNSS
- Increased publications

A measure of impact in Africa

Papers published by African scientists working in Africa on “equatorial ionosphere” from World of Science website.



“ICTP Rel.” means scientists related to ICTP having attended one or more training activities organized by ICTP and BC or having been ICTP associates or in other ICTP programs like STEP.

African Success Stories – just a few of many

Dr. Babatunde Rabiū
Director NASDRA
1st President, **African Geophysical Society**
Delivered the 70th inaugural lecture
at Federal University of Technology, Akure

Dr. Baylie Damtie
President Bahir Dar University

Dr. Melesseuw Nigussie
Bahir Dar University – first PhD recipient

PhDs Awarded to former participants
Dr. Joseph Olwendo, Kenya
Dr. Amira Shimeis, Egypt
Dr. Ibrahim Salem, Egypt
Dr. John Bosco Habarulema, Uganda
Dr. Daniel Okoh, Nigeria
Dr. Patrick Sibanda, Zambia
And others...





What's next?



Workshop on Space Weather Effects on GNSS Operations at Low Latitudes

April 23 – May 4, 2018

The Abdus Salam International Centre for Theoretical Physics

The 10th Workshop – A larger program open to all countries. Featuring some of the success stories of our earlier participants.



International Committee on
Global Navigation Satellite Systems



Thank you to our participants,
lecturers and sponsors.
We hope to see you at the workshop in 2018.



May 2017 Workshop, ICTP, Trieste, IT