



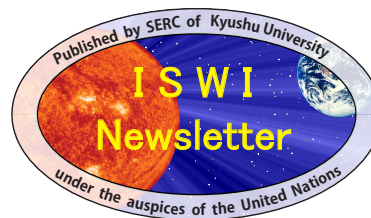
The Abdus Salam  
**International Centre  
for Theoretical Physics**

# ICTP and its T/ICT4D (former ARPL)

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*Head, Telecommunications/ICT*

*For Development Laboratory (T/ICT4D)*



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# What is ICTP?

- **First and leading *global* research institution for scientific research and education (emphasis developing countries!).**
- **Founded 1964 IAEA+Italian government (AS: Nobel Prize 1979)**
- **Since 1995: Tripartite: Italy+IAEA+UNESCO (category 1 institute) (over 85% of budget from Italy, ~10% IAEA, ~ 1% UNESCO)**

# Research at ICTP



## Research Sections

- **High Energy, Cosmology and Astroparticle Physics (1964)**
- **Condensed Matter and Statistical Physics (1974)**
- **Mathematics (1986)**
- **Earth System Physics (Climate Change+...)(1998)**

## Other Research Activities

- **Multidisciplinary Laboratory (microprocessors) (1985)**
- **Telecommunications/ICT for Development (ARPL) (1990)**

# Education at ICTP



## Postgraduate Education

- **Post-Graduate Diploma in each of 4 main research areas (1991, 1992, 2006)**
- **Post-Graduate Diploma in physics (2007)**
- **STEP (Sandwich PhD) (2002)**
- **PhD and Laurea Magistralis with U. of Trieste (2005)**
- **New joint PhD with SISSA ! (2011)**



# Outreach Activities

## Fighting the 'Brain Drain'

- **Associates and Federation Schemes (1964)**
- **Programmes at ICTP and developing countries (conferences, workshops, schools) (1964)**
- **TRIL (training and research in Italian laboratories) (1983)**
- **OEA (office of external activities) (1985)**

# ICTP Programmes

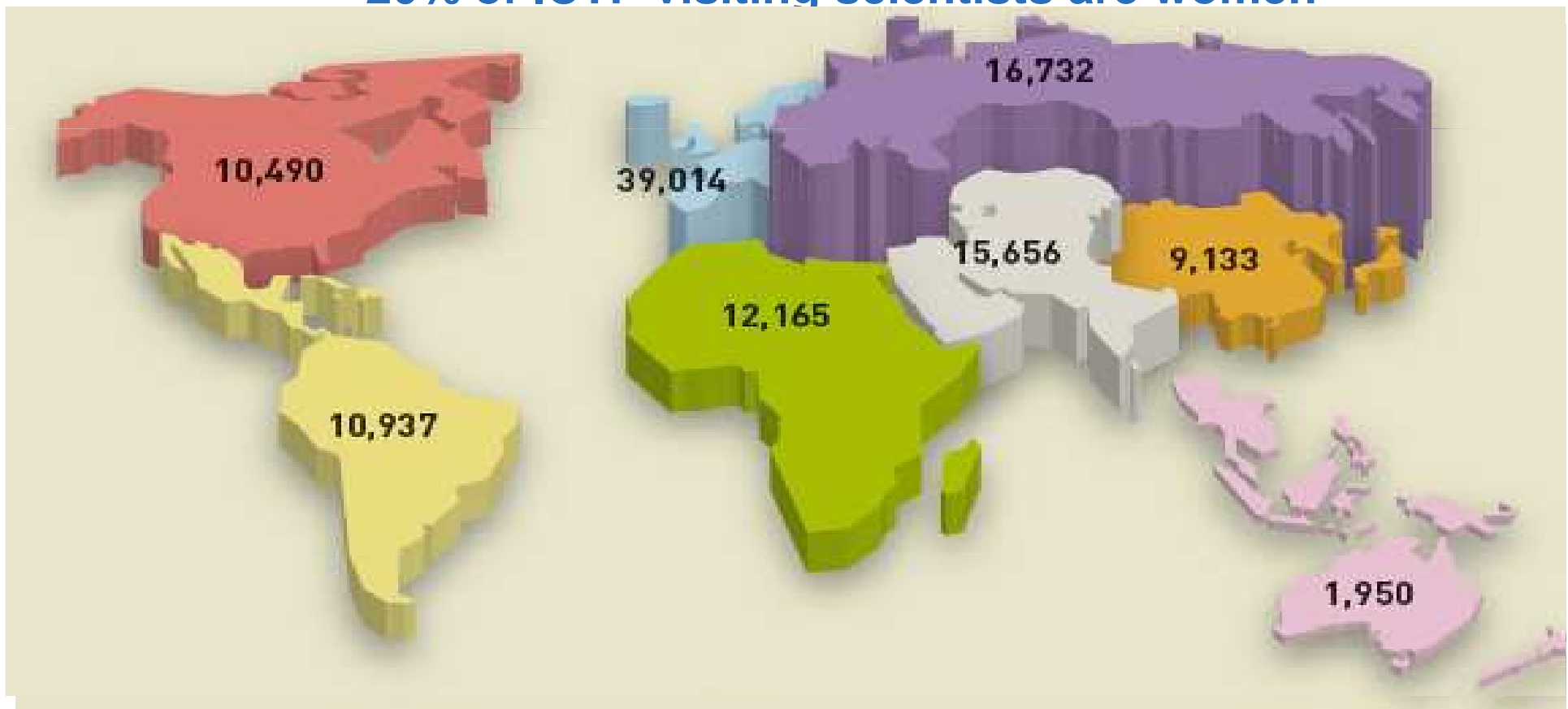


- **Schools, Conferences, Workshops around the year** (~ 50 at ICTP, ~15 hosted activities, ~15 in developing countries)
- **Half of them on subjects related to 4 main research areas (core).**
- **The rest on many subjects:** medical physics, optics, soil physics, plasma physics, electronics, high performance computing, biophysics, satellite navigation, science dissemination and e-learning, m-science, entrepreneurship, nuclear physics (IAEA), teacher training, etc.

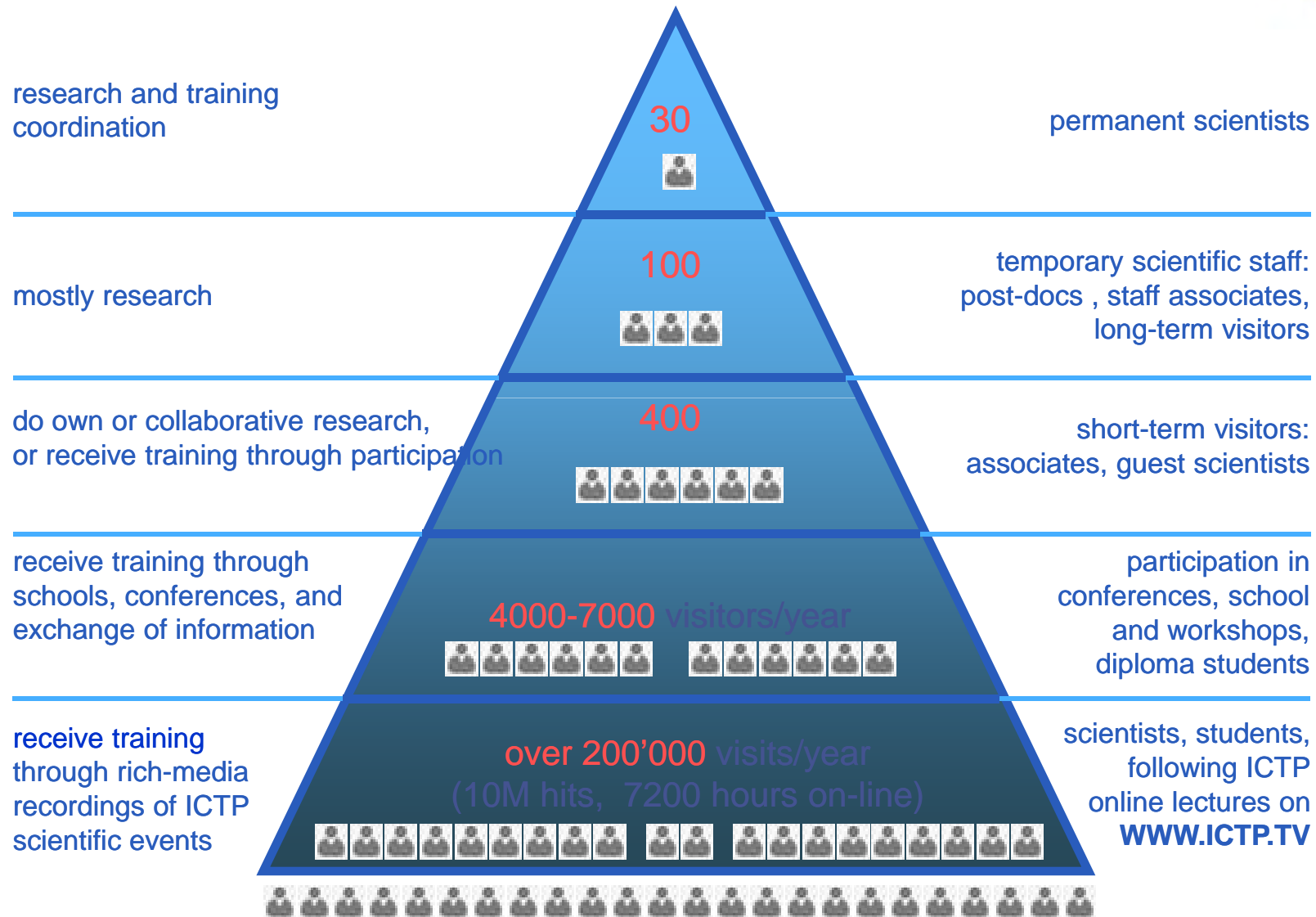
# ICTP Visitors



- More than 120,000 visits since 1970
- 184 countries represented
- 20% of ICTP visiting scientists are women



# ICTP Scientific 'users'







# ICTP and Africa

- ICTP's training and research efforts in and for Africa enter a fifth decade, the Centre is more committed than ever to providing quality physics and mathematics education.
- Since ICTP's inception, one of its main goals has been the development of scientific and technological capacity in Africa.





# ICTP and Africa

- ICTP carries out this task in various ways:
  - every year, on average 650 African scientists visit the ICTP, for 47 days
  - ICTP founded and is sponsoring 4 affiliated centres, five networks and PhD programmes in African universities
  - ICTP organizes and sponsors more than 20 scientific events in Africa every year
  - Furthermore, more than 13,000 African scientists have visited ICTP since its inception, staying from a couple of days to several months.
  - Although ICTP has traditionally focused on research and training in theoretical physics, over time it has broadened the range of its activities to more applied disciplines to meet the needs of developing countries. In this regard, ICTP has, in recent years, developed wide expertise on information and communication technology (ICT), GNSS science and applications, the forecasting of natural disasters, and nanotechnologies.

# T/ICT4D (former ARPL): two sections

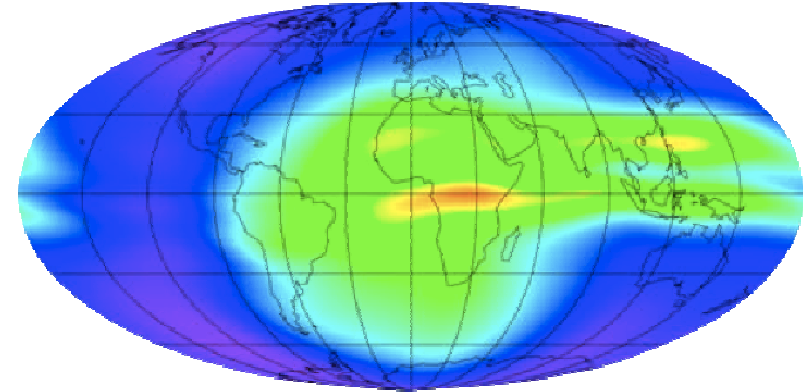


- **Ionospheric Radiopropagation**  
**(since 1990):**

*research and training in ionospheric physics  
with application to GNSS science and  
technology*

- **Wireless communications**  
**(since 1995):**

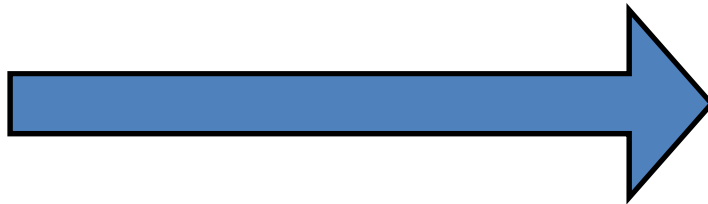
*research and training in Wireless ICT  
including Wireless Sensors Networks for  
Development*



# Why this two sections together?



Today trend



*Combined uses of GNSS (GPS, GLONASS, Galileo, Compass, etc.) and Information and Communication Technology (ICT):*

*Location Based Services*

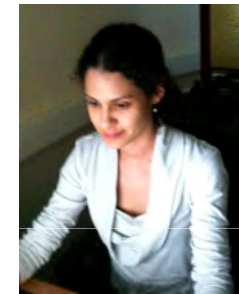
# T/ICT4D: personnel



*Head:* Sandro M. Radicella

*Ionospheric radiopropagation Section*

- Bruno Nava (coordinator)
- Yenca Migoya
- L. Ciruolo
- C. Papparini



*Wireless communications Section*

- Marco Zennaro (coordinator)
- Carlo Fonda
- Ermanno Pietrosevoli



*administrative assistant*

- Stanka Tanaskovic

*short and long-term visitors:*

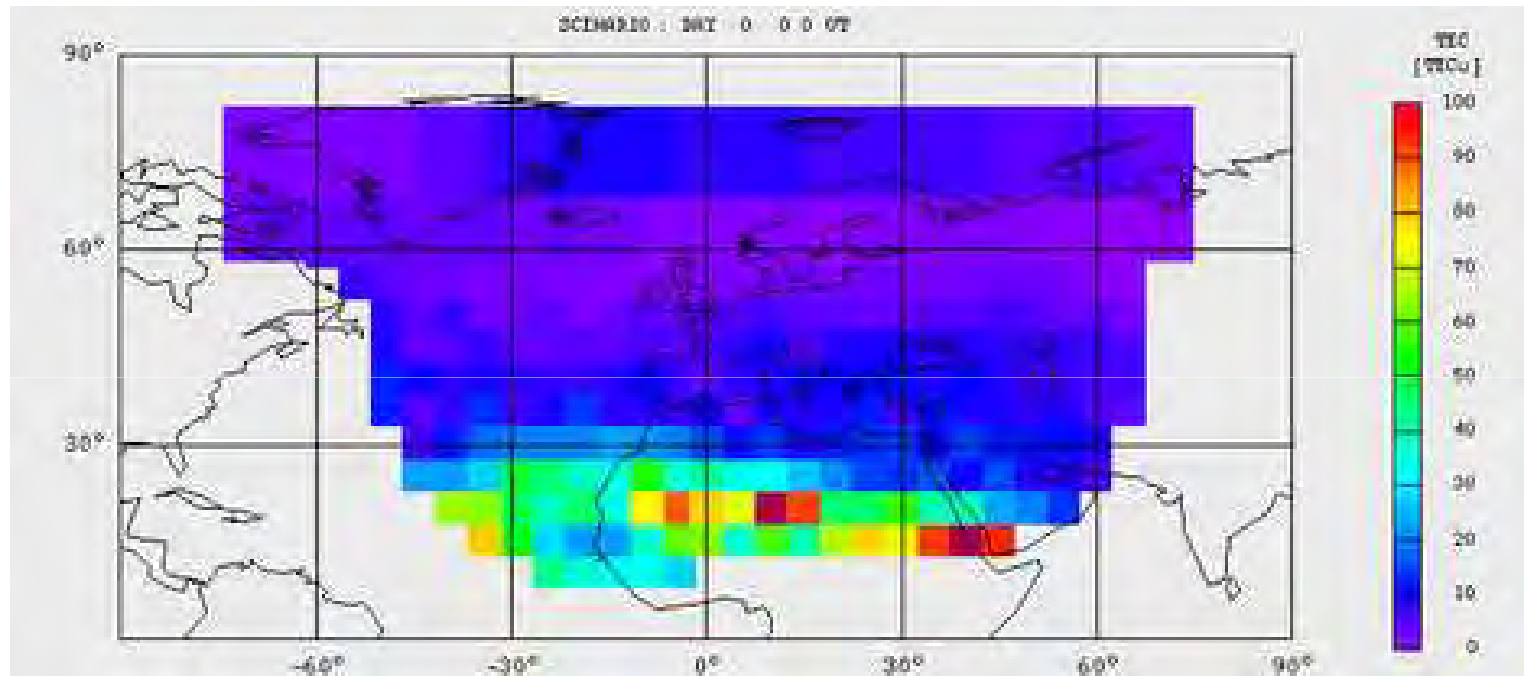
- mostly from Africa and Latin America

# Ionospheric Radiopropagation: models

- ◆ an advanced 4D ionospheric electron density model originally developed in collaboration with the University of Graz, Austria: *NeQuick*
- ◆ model simulation of ionospheric effects on GNSS systems (EGNOS, Galileo)
- ◆ data assimilation in models



# Early Use of NeQuick



*NeQuick* has been used to generate “worst case” ionospheric scenarios for the development and tuning of EGNOS (European Geostationary Overlay Service) algorithms

# Use of NeQuick



- *NeQuick* has been adopted to compute ionospheric correction in the European Satellite Positioning System *GALILEO*
- *NeQuick* is officially recommended by ITU for assessment of ionospheric effects in satellite communications and navigation
- *NeQuick* has been adopted as the default option for the IRI topside



## **From 2007 to 2010:**

42 publications mentioning the *concrete* use of NeQuick  
21 from developing countries



*T/ICT4D has a partnership with the Boston College (USA), to promote distributed observatories in Africa and to foster local research in GNSS science and applications in the continent*



Under the partnership joint training activities have been carried out in:

- Trieste
- Nigeria
- Egypt
- Kenya



# Ionospheric Radiopropagation: publications



## ***From 2002***

- 55 scientific publications
- 26 co-authored with scientists from developing countries

## ***From 2007to 2010:***

- 23 scientific publications
- 11 co-authored with scientists from developing countries



Advances in Space Research 42 (2008) 691–694

ADVANCES IN  
SPACE  
RESEARCH  
*(a COSPAR publication)*  
www.elsevier.com/locate/asr

### **Validation of $B_0$ and $B_1$ in the IRI 2001 model at low solar activity for Ilorin an equatorial station**

J.O. Adeniyi<sup>a,b,\*</sup>, S.M. Radicella<sup>a</sup>, I.A. Adimula<sup>b</sup>, A.A. Willoughby<sup>b</sup>,  
O.A. Oladipo<sup>b</sup>, O. Olawepo<sup>b</sup>

<sup>a</sup>The Abdus Salam International Centre for Theoretical Physics, Aeronomy and Radio Propagation Laboratory, Trieste, Italy  
<sup>b</sup>Physics Department, University of Ilorin, P.M.B. 1515, Ilorin, Nigeria

Received 15 May 2007; received in revised form 8 September 2007; accepted 16 September 2007

RADIO SCIENCE, VOL. 41, RS6S16, doi:10.1029/2005RS003386, 2006

### **A near-real-time model-assisted ionosphere electron density retrieval method**

B. Nava,<sup>1</sup> S. M. Radicella,<sup>1</sup> R. Leitinger,<sup>2</sup> and P. Coïsson<sup>1</sup>

Received 16 September 2005; revised 13 February 2006; accepted 20 April 2006; published 11 August 2006.

ANNALS OF GEOPHYSICS, VOL. 52, N. 3/4, June/August 2009

### **The NeQuick model genesis, uses and evolution**

Sandro M. Radicella  
ARPL, The Abdus Salam ICTP, Trieste, Italy

# T/ICT4D: academic collaborations



## *T/ICT4D Thesis Co-supervisors*

### *–PhD Students*

- 1, Ethiopia  
(Sandwich Training Education Program, ICTP)
- 1, Nigeria  
(Sandwich Training Education Program, ICTP)
- 1, Kenya

### *Master students*

- 2, Uganda
- 2, Malawi
- 1, Kenya
- 1, Burundi





# Ionospheric Radiopropagation projects and activities

# MONITOR



**MONITOR**: "MONitoring of Ionosphere by innovative Techniques coordinated Observations and Resources"

Financed by European Space Agency (ESA)



ICTP role:

Implementation/validation of a technique to provide in near real time a realistic 3D specification of the ionosphere electron density. The technique relies on the assimilation of GNSS derived ionospheric data into NeQuick model (duration 12 month)

ICTP team: B. Nava, S.M. Radicella



# SENECA



**SENECA: “Satellite Navigation Services for Civil Aviation”**

Financed by Telespazio

ICTP role:

development and implementation of ionosphere simulator as a part of a platform that will be used to test multi-constellation (GPS, EGNOS, Galileo) navigation solutions.

(duration 12 months)

ICTP team: Y. Migoya, B. Nava, S.M. Radicella  
C. Papparini, R. Cefalo (TS University).



# TRANSMIT



**TRANSMIT: Training Research and Applications Network to Support the Mitigation of Ionospheric Threats**

EC FP7, Marie Curie Action, Initial Training Network, duration: 48 months

Aim of the Project: to develop real time integrated state of the art tools to mitigate ionospheric threats to Global Navigation Satellite Systems (GNSS) and several related applications, such as civil aviation, marine navigation and land transportation.

ICTP role:

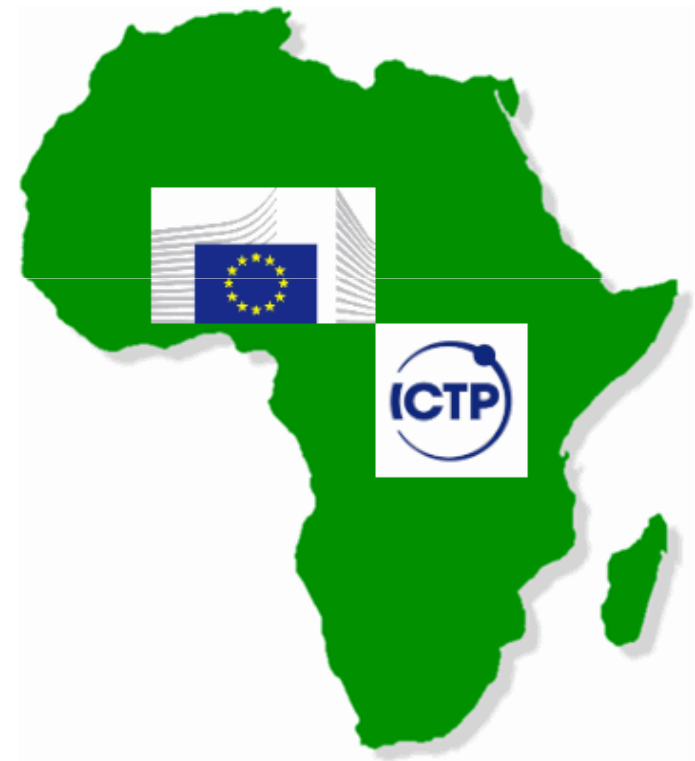
host and supervise students in the following research areas: 3D electron density modeling, data assimilation; Radio Occultation for ionospheric monitoring.

ICTP team: B. Nava, S.M. Radicella



# EC Contribution Agreement with ICTP

The European Commission has approved a Contribution Agreement with ICTP to carry out the project *Training on EGNOS-GNSS in Africa (TREGA)* aimed to provide technical assistance, capacity building and provision and use of test equipment for the implementation of GNSS/EGNOS in Sub-Saharan Africa.





# Appropriateness of ICTP



In the *Appropriateness of ICTP* note that justified the EC assignment to ICTP it is written:

**“The specific knowledge of the institute, and its experience in training people from developing countries, put this organization in a unique position for the participation in the project.”**

and:

**“The Aeronomy and Radiopropagation Laboratory of ICTP has a long-standing experience in training in the field of GNSS. It has also organized in the past a series of Workshops on Satellite Navigation Science and Technology for Africa, including formal lectures, and hands-on practice particularly oriented towards the scientific exploration using GNSS. The focus of the training has been to provide education to African university professors and graduate students on the use of Global Navigation Satellite Systems (GNSS) for social and economic development in Africa.”**

# The Project



The ICTP will provide:

- Training to the members of the EGNOS-Africa Joint Programme Office to be established and other participants to European-African projects in the field.
- Definition, procurement and use of simulation/testing platform for GNSS operation as a preliminary backbone infrastructure development in Sub-Saharan Africa.

ICTP team: S. M. Radicella, B. Nava, C. Onime and R. Torre



# Wireless communications projects and activities

# PISCES



**PISCES**: Pacific Island Schools Connectivity, Education and Solar Project.

Financed by Google and expected from Internet Society AT&T and Asian Development Bank



Aim of the project: to bring Internet connectivity to remote schools in Chuuk, Micronesia.

First phase is a training activity on wireless networking at the University of Guam. Will use the **Wireless Training Kit** developed at ICTP with **UNESCO** support (17-24 July 2012).



ICTP Team: E. Pietrosevoli and M. Zennaro.

**UNIVERSITY  
OF GUAM**

# Wireless Training in Africa



## Wireless Training in Africa

Financed by the Africa Adaptation Program (AAP) of UNDP and the Japan International Cooperation Agency.



Aim of the project: to train experts on wireless networking for scientific applications. AAP requested 3 training activities in Africa in 2012 and 2013.

First one in Lesotho in June 2012. Will use the **Wireless Training Kit** developed at ICTP with **UNESCO** support.



ICTP team: E. Pietrosevoli, C. Fonda and M. Zennaro



# The Future Internet Project



## The Future Internet Project

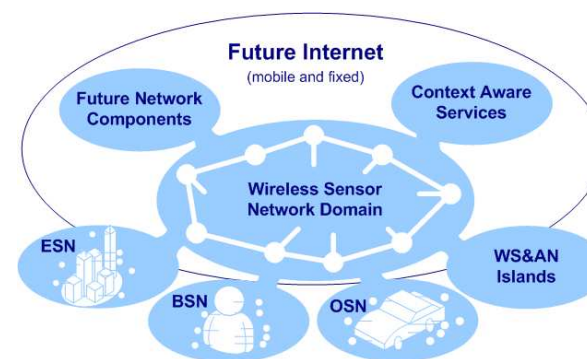
Financed by 6Deploy and Network the World.

Aim of the project: to develop training material on IPv6 and Wireless Sensors. Invited to participate in a FP7 call as partner in 2013.

Requested 4 training activities in 2012 and 2013.

First one in Panama in October 2012. Second in Dhar es Salaam in November 2012.

ICTP team: M. Zennaro invited as project manager.



# CLOMMUNITY



**CLOMMUNITY:** A Community networking Cloud in a box.

Financed by EC FP7 and coordinated by UPC in Barcelona, Spain.

Aims of the project: addressing the obstacles for communities of citizens in bootstrapping, running and expanding community-owned networks that provide community services organized as community clouds.

ICTP team: C. Fonda, M. Zennaro and E. Pietrosemoli.

This project has not been formally approved but the external evaluators rated it at 14.5/15, definite decision is expected next month.



# ICTP-ITU STRENGTHENING TRAINING CAPACITY IN WIRELESS NETWORKING IN AFRICA



## ICTP-ITU TRAINING IN WIRELESS NETWORKING NETWORKING IN AFRICA

Project financed by **ITU/BDT**

Aim of the project: to train a group of African trainers from ITU Excellence Centres in Rwanda and Senegal.

Eight weeks at ICTP and two activities in Africa between 2011 and 2012.

ICTP team: E. Pietrosemoli, C. Fonda and M. Zennaro





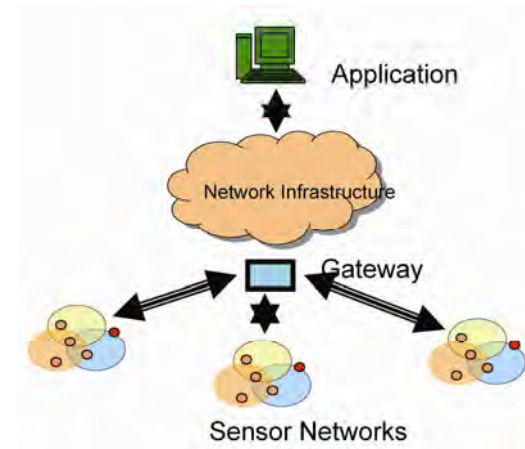
# TRAINING AND R&D IN WIRELESS SENSORS



## TRAINING AND R&D IN WIRELESS SENSORS

Financed by **IAEA**

Aim of the project: to provide training and to develop a low cost Remote Environmental Monitoring Station based on low power consumption wireless sensor networks.





THANK YOU FOR YOUR  
ATTENTION