The Abdus Salam International Centre for Theoretical Physics

United Nations Educational, Scientific and Cultural Organization

IAEA International Atomic Energy Agency

Workshop on Science Applications of GNSS in Developing Countries (11-27 April), followed by the: Seminar on Development and Use of the Ionospheric NeQuick Model (30 April-1 May)

Organizer(s): S.M. Radicella (ICTP), Patricia H. Doherty (USA)
Trieste - Italy, 11 April 2012 - 1 May 2012

Final programme

WEEK I - BASICS OF GNSS

Wednesday, 11 April 2012 - Opening Ceremony and Introductory Presentations (Room:Adriatico Guest House Kastler Lecture Hall)

11 April 2012

09:00 - 11:00	**Registration and Administrative Formalities**
11:00 - 11:30	**S. RADICELLA and P. DOHERTY** **Opening Ceremony - Remarks and Welcome**
11:30 - 13:00	**Opening Ceremony - Dr. Fernando Quevedo (Director, ICTP), Message from B.C. Provost, Message from the European Commission by Dr. Stefano Scarda, European Commission - Directorate General Enterprise and Industry, EU Satellite Navigation Programmes**
13:00 - 14:00	--- Lunch break ---
14:00 - 14:30	**M. MILLER/P. DOHERTY** / *USAF/BC* **Introduction to Satellite Navigation**
14:30 - 15:30	**F. VESPE** / *Italian Space Agency* **Use of GNSS Systems in the Field of Earth observations**

15:30 - 16:00 --- Coffee break ---

16:00 - 17:00 **B. Rabiu** / *NASRDA, Abuja, Nigeria*
GNSS in Africa: Trends of Applications and Prospect

17:00 - 17:30 **Final Remarks and Ending**

19:30 - 19:30 --- Welcome Dinner ---

Thursday, 12 April 2012 - Fundamentals of GNSS (Room:Adriatico Guest House Kastler Lecture Hall)

12 April 2012

09:00 - 10:30 **C. HEGARTY** / *MITRE Corporation*
Fundamentals of GNSS

10:30 - 11:00 --- Coffee break ---

11:00 - 13:00 **C. HEGARTY**
GPS Space and Control Segments

13:00 - 14:00 --- Lunch break ---

14:00 - 15:30 **C. HEGARTY**
GPS Measurements and Error Sources

15:30 - 16:00 --- Coffee break ---

16:00 - 17:30 **Introduction to the ICTP Computer Laboratory**

Friday, 13 April 2012 - Basics of GNSS (Room:Adriatico Guest House Kastler Lecture Hall)

13 April 2012

09:00 - 10:30 **C. HEGARTY**
GNSS Systems: Modernized GPS, GALILEO, GLONASS, COMPASS, IRNSS and QZSS

10:30 - 11:00 --- Coffee break ---

11:00 - 12:00 **K. Aoudia** / *ESP/ICTP*
GNSS for Earthquake and Volcanic Hazards Observations

12:00 - 13:30 **S. Radicella, P. Doherty, J. Adeniyi, P.V.S.Rama Rao, M. Mosert**
OPEN Discussion:

WEEKEND Free (**Saturday**)

WEEK 2 - GNSS FOR PNT and SCIENTIFIC EXPLORATION

Monday, 16 April 2012 - The Navigation Solutions and Laboratory, J. RAQUET (Room:Adriatico Guest House Kastler Lecture Hall)

16 April 2012

09:00 - 10:30	**J. RAQUET** **GPS Navigation Solutions**
10:30 - 11:00	--- Coffee break ---
11:00 - 13:00	**J. RAQUET** **GPS Navigation Solutions, continued**
13:00 - 14:00	--- Lunch break ---
14:00 - 15:30	**Differential GPS Concepts / Techniques**
15:30 - 16:00	--- Coffee break ---
16:00 - 17:30	**Practical Laboratory with J. RAQUET**

Tuesday, 17 April 2012 - GNSS Receiver Fundamentals, Kalman Filtering and Laboratory, J. RAQUET (Room:Adriatico Guest House Kastler Lecture Hall)

17 April 2012

09:00 - 10:30	**J. RAQUET** **GNSS Receiver Design Fundamentals**
10:30 - 11:00	--- Coffee break ---
11:00 - 13:00	**J. RAQUET** **GNSS Receivers continued**
13:00 - 14:00	--- Lunch break ---
14:00 - 15:30	**Kalman Filtering; Inertial Navigation Systems**
15:30 - 16:00	--- Coffee break ---
16:00 - 17:30	**Practical Laboratory with J. RAQUET**
19:30 - 19:30	--- Official Reception ---

Wednesday, 18 April 2012 - GNSS Scientific Applications (Room:Adriatico Guest House Kastler Lecture Hall)

18 April 2012

09:00 - 09:15	**P. Doherty** **Introduction to GNSS Applications**

09:15 - 10:00	**A. Di Fazio** / *Telespazio* **EGNOS Use in Road Applications**
10:00 - 10:30	**Basuti Bolo Mathangwane** / *Ministry of Agriculture, Gaborone, Botswana* **Participant Presentation: The application of GNSS in agriculture - Case Study - Botswana**
10:30 - 11:00	--- Coffee break ---
11:00 - 12:00	**L. HOTHEM** / *USGS* **Role of GNSS in Advancing Natural Hazards Monitoring and Risk Assessment: Earthquakes, Fault Zones, Volcanoes and Landslides**
12:00 - 13:00	**L. HOTHEM** **Remote Sensing Systems Integrated with GNSS for Monitoring and Measuring Changes for Natural Hazards**
13:00 - 14:00	--- Lunch break ---
14:00 - 14:30	**L. HOTHEM** **Open Discussion**
14:30 - 15:30	**A.J. Van DIERENDONCK** **Evolution to Modernized GNSS Ionospheric Scintillation and TEC Monitoring**
15:30 - 16:00	--- Coffee break ---
16:00 - 17:30	**A. MacAULAY, I. HOYAS ESTER** / *NovAtel Corporation* **Positioning Solved - Anytime, Anywhere GNSS Receiver Applications with NovAtel, Inc.,**

Thursday, 19 April 2012 (Room:Adriatico Guest House Kastler Lecture Hall)

19 April 2012

09:00 - 09:30	**B. ARBESSER-RASTBURG** / *ESA* **GNSS Science Applications: The ESA Vision**
09:30 - 10:30	**R. NOTARPIETRO** **GNSS Remote Sensing: Troposphere Profiling through Radio Occultation**
10:30 - 11:00	--- Coffee break ---
11:00 - 12:00	**B. NAVA** **GNNS Remote Sensing: Electron Density Profiling through Radio Occultation**
12:00 - 13:00	**Y. BENIGUEL** **Scintillation Modeling**
13:00 - 14:00	--- Lunch break ---
14:00 - 15:30	**T. WALTER** **Applications for Aviation**
15:30 - 16:00	--- Coffee break ---
16:00 - 17:30	**T. WALTER** **Aviation Continued**

Friday, 20 April 2012 - Ionospheric Monitoring - Laboratory (Room:Adriatico Guest House Kastler Lecture Hall)

20 April 2012

09:00 - 09:30	**S. DELAY** **Introduction to RINEX**
09:30 - 10:30	**S. DELAY, B. TWINAMASIKO** **RINEX Data Processing**
10:30 - 11:00	--- Coffee break ---
11:00 - 13:00	**RINEX Data Processing contd.**
13:00 - 14:00	--- Lunch break ---
14:00 - 15:00	**S. SKONE** **Challenges for Positioning in Africa**
15:00 - 15:30	**A.J. COSTER, S. SKONE** **IONOSPHERIC DATA LABORATORY**
15:30 - 16:00	--- Coffee Break ---
16:00 - 17:00	**Data Laboratory contd.**

Free - HAVE A GREAT WEEKEND! (**Saturday**)

WEEK 3 - SPACE WEATHER AND IONOSPHERIC EXPLORATION WITH GNSS

Monday, 23 April 2012 - The Ionosphere (Room:Adriatico Guest House Kastler Lecture Hall)

23 April 2012

08:30 - 09:30	**S. RADICELLA** **The Worldwide Ionosphere**
09:30 - 10:30	**E. YIZENGAW** **Introduction to Space Weather and its Impact on Our Daily Lives**
10:30 - 11:00	--- Coffee break ---
11:00 - 12:00	**C. VALLADARES** / *BC* **Sensing Space Weather with Distributed Observatories**
12:00 - 13:00	**A. J. Coster** **Ionspheric Storm Monitoring with GNSS**

13:00 - 14:00 --- Lunch break ---

14:00 - 15:30 **L. CIRAOLO**
Laboratory: GNSS Derived TEC Data Calibration

15:30 - 16:00 --- Coffee break ---

16:00 - 17:30 **K. ALAZO, L. CIRAOLO**
Laboratory: GLONASS Data Processing and TEC Calibration

Tuesday, 24 April 2012 - Space Weather (Room:Adriatico Guest House Kastler Lecture Hall)

24 April 2012

08:30 - 09:30 **L. McKINNELL**
The South African National Space Agency (SANSA)

09:30 - 10:30 **K. Groves**
Ionospheric irregularities and their impact on GNSS

10:30 - 11:00 --- Coffee break ---

11:00 - 12:00 **C. VALLADARES**
GPS Observations of Plasma Bubbles and Scintillations over Equatorial Africa

12:00 - 13:00 **Participant Presentations:**

Science Programming and Capacity Building Challenges of CORS Data in West African Countries (Seyi Fabiyi) 15'

The National Space Research and Development Agency, Nigeria: A brief overview (S.O. Mohamed, B. Rabiu, H.D. Dodo, S. Ali and F.N. Buba) 15'

Space and lower atmospheric research development in Addis Ababa (G. Abraha) 15'

Open Discussion 15'

13:00 - 14:00 --- Lunch break ---

14:00 - 15:00 **K. GROVES**
Scintillation Effects on Positioning at SCINDA Sites during Solar Cycle 24

15:00 - 15:30 **Participants Presentations**

Effects of GPS amplitude and phase scintillation of GNSS performance observed from Calcutta (A. Paul) 15'

On the ionospheric conditions over Ile Ife during the period of geomagnetic activity using GPS data (E.A. Ariyibi) 15'

15:30 - 16:00 --- Coffee break ---

16:00 - 17:30 **E. YIZENGAW**
Laboratory: Space Weather Information Laboratory

Wednesday, 25 April 2012 - Complementary Ionospheric Measurements (Room:Adriatico Guest House Kastler Lecture Hall)

25 April 2012

08:30 - 09:30 **K. Weins** / *AFRL, USA*
Update on SCINDA Activities around the Globe

09:30 - 10:30	**E. YIZENGAW** **AMBER Magnetometers Network and Longitudinal Differences of Equatorial Electrodynamics and Ionospheric Vertical Density Distribution**
10:30 - 11:00	--- Coffee break ---
11:00 - 12:00	**T. BULLETT** **Introduction to Ionosondes**
12:00 - 12:30	**E. YIZENGAW** **AMISR Technology: Possibilities for Africa**
12:30 - 13:00	**C. Valladares** **Physical Interpretation of TEC Values Measured with GPS Receivers**
13:00 - 14:00	--- Lunch break ---
14:00 - 14:30	**J. ADENIYI** **GNSS/Space Weather Research at the University of Ilorin**
14:30 - 15:00	**F. D''UJANGA** **Variability of TEC in the Equatorial Region (Uganda)**
15:00 - 15:30	**P.V.S. RAMA RAO, K. VENKATESH** **On the Variability of TEC in the Indian Low Latitude Sector**
15:30 - 16:00	--- Coffee break ---
16:00 - 17:30	**BC** **Laboratory (Terrace Level): GNSS TEC/Scintillation Receiver Demonstration**

Thursday, 26 April 2012 (Room:Adriatico Guest House Kastler Lecture Hall)

26 April 2012

08:30 - 09:00	**P. DOHERTY** **Space Weather Effects on Aviation Systems**
09:00 - 10:00	**K. GROVES** **Ionospheric Effects on the Expanding GNSS Spectrum**
10:00 - 10:30	**S. Radicella** **Ionospheric climate to ionospheric weather modeling: The New Path**
10:30 - 11:00	--- Coffee break ---
11:00 - 12:00	**B. NAVA** **Data Ingestion in Ionospheric Electron Density Models**
12:00 - 13:00	**S. PULINETS** **Iono-Seismic Effects Detection Using GNSS Observations**
13:00 - 14:00	--- Lunch break ---
14:00 - 14:30	**C. Valladares** **Automated Detection of Depletions**

14:30 - 15:30 **N. ZERNOV**
Theory of Radio Wave Propagation through Ionospheric Irregularities

15:30 - 16:00 --- Coffee break ---

16:00 - 17:00 **V. GHERM**
Exercises on Radio-Waves Propagation through Ionospheric Irregularities

17:00 - 17:00 **End**

19:30 - 19:30 --- Dinner (ICTP/BC) ---

Friday, 27 April 2012 - Closing Discussions and Closing Ceremony (Room:Adriatico Guest House Kastler Lecture Hall)

27 April 2012

08:30 - 10:30 **Participant Presentations**

The study of large day-to-day variability in TEC and its probable connection with seismic events in the Indian Region under quiet geomagnetic conditions during 2009 (S.P. Karia and K.N. Pathak) 15'

Characterization of the rate of change of the total electron content over Mbarara during solar maximum year 2001 (P. Mungufeni, E. Jurua, S.M. Radicella and S.K. Anguma) 15'

Using GPS-SCINDA observations to study the correlation between scintillation, total electron content enhancement and depletions over the Kenyan region (J.O. Olwendo, P.J. Cilliers, P. Baki and C. Mito) 15'

Occurrence of ionospheric scintillation during 2009-2010 based on GISTM data (Sri Ekawati) 15'

Ionospheric irregularities, scintillations and total electron content at an equatorial station, Lagos (A.O. Adewale and E.O. Oyeyemi) 15'

On the validity of the total electron content (TEC) derived from electron density profiles (K. Venkatesh and P.V.S. Rama Rao) 15'

NUR-GNSS-SCINDA mode installations and analysis of preliminary results (F. Akorli, V. Munyaburanga and B. Twinamasiko) 15'

Impacts of ionospheric scintillations on GPS receivers intended for equatorial aviation applications (A. Akala) 15'

Status of EISA (Tessema Solomon Belay) 15'

10:30 - 11:00 --- Coffee break ---

11:00 - 12:00 **Participants Presentations**

Status of installation of the new generation ionosonde at Maseno University (R.O. Manyala and G.O. Ondede) 15'

Tomographic imaging of ionospheric electron density over Ethiopia using GPS satellites (G. Kidanu Zewdie and G. Mengistu) 15'

Determination of the best fit tropospheric delay model and water vapour estimation using the Nigerian permanent GNSS network: Preliminary results (Joseph Dodo and Ali Laraba Salamatu) 15'

Development of ionospheric studies in Malaysia particularly in UKM - The National University of Malaysia (Siti Aminah Bahari) 15'

The use of NeQuick model on ESA missions and R&D activities (R. Orus Perez, R. Prieto--Cerdeira and B. Arbesser--Rastburg) 20'

Use of NeQuick for modeling of Transionospheric Radio-Waves Propagation (Gherm V. and Zernov N.) 20'

TEC ingestion ito NeQuick 2 for East_African ionosphere (Nigussie M. and more authors) 20'

A Comparison of GPS-TEC data at surat with IRI-2007 Models for the year 2009 (Karia S.) 20'

Estimation of the higher-order ionospheric errors in GNSS positioning based on a realistic 3-D electron density model (Kashcheyev A., Nava B. and Radicella S.M.) 20'

Radio Occultation Electron Density Profiles and Radio Tomographic Images of Equatorial Anomaly Compared with Their NeQuick and IRI Model Predictions (M.V. Lokota and V.E. Kunitsyn, E.S. Andreeva, E.A.Leontyeva) 20'

Comparison of topside electron density computed by ionospheric models and plasma density observed by DMSP satellites (Migoya-Orue Y. and more authors) 20'

The NeQuick model 2 (Migoya-Orue Y.) 20'

Topside Electron Density profiles: Some comparisons between observations and models (Mosert M.) 20'

Characterization of the rate of change of total electron content over Mbarara (Mungufeni P. and Jurua E. Radicella S.M. Anguma S.K. Ciraolo L.) 20'

NeQuick 2 model (Nava B.) 20'

NeQuick for tsunami monitoring assessment studies (Coïsson P.) 20'

A study of total electron content over equatorial African sector and comparison with IRI-2007 (Oyeyemi O. and Adewale A.O., Cilliers P.J., McKinnell L.A., Adeloye A.B.) 20'

Seminar on Development and Use of the Ionospheric NeQuick Model (Radicella S.M.) 20'

NeQuick in RWC Warsaw (Stanislawska I. and Pozoga M.) 20'

On the validation of the Total Electron Content (TEC) derived using electron density profiles (Venkatesh K. and Rama Rao P.V.S.) 20'

12:00 - 13:00 **Open Discussion: The Future - Where do we go from here?**

13:00 - 14:00 --- Lunch Break ---

14:00 - 15:00 **Final Remarks and Distribution of Certificates of Participation**

Monday 30 April
Seminar on Development and Use of the Ionospheric NeQuick Model (Room:Adriatico Guest House Kastler Lecture Hall)

30 April 2012

08:30 - 09:30 (Room: Adriatico Guest House (Lower Level 1))
Registration of New Participants

09:30 - 09:45 **Welcome of Prof. R. Leitinger and New Participants: Opening of the Seminar**

09:45 - 10:00 **S. M.Radicellla** / *ICTP*
Genesis and evolution of the NeQuick model

10:00 - 10:30 **B. Nava** / *ICTP*
NeQuick 2 model

10:30 - 11:00 (Room: Adriatico Guest House Cafeteria)
--- Coffee Break ---

11:00 - 12:30 **Y. Migoya-Orue** / *ICTP*
The NeQuick 2 code and laboratory demonstration

12:30 - 14:00 (Room: Adriatico Guest House Cafeteria)
--- Lunch Break ---

14:00 - 15:30 **Session 1: Use of the NeQuick for ionospheric simulations**

15:30 - 16:00 (Room: Adriatico Guest House Cafeteria)
--- Coffee Break ---

16:00 - 17:00 **Open Discussion**

19:20 - 21:20	(Room: Adriatico Guest House Cafeteria) **Seminar Dinner**

Tuesday 1 May (Room:Adriatico Guest House Kastler Lecture Hall) (**Labour Day**)

1 May 2012

09:00 - 09:30	**R. Orus** / *ESA* **The use of NeQuick model on ESA missions and R & D activities**
09:30 - 10:30	**Session 2: NeQuick validation**
10:30 - 11:00	(Room: Adriatico Guest House Cafeteria) --- Coffee Break ---
11:00 - 12:00	**Session 2 (contd.): NeQuick validation and comparisons**
12:00 - 12:30	**Open Discussion**
12:30 - 14:00	(Room: Adriatico Guest House Cafeteria) --- Lunch Break ---
14:00 - 15:30	**Session 3: Data assimilation in the NeQuick model**
15:30 - 16:00	(Room: Adriatico Guest House Cafeteria) --- Coffee Break ---
16:00 - 16:30	**Session 3 (contd.): Data assimilation in the NeQuick model**
16:30 - 17:30	**Open discussion and the closing of the seminar**