

## **Ionosphere-Atmosphere Coordination Workshop**

**UCAR Center Green Campus  
3080 Center Green Drive, Building # 1 (CG-1)  
Boulder, Colorado U.S.A.  
Friday 3 October 2014**

This workshop, convened by the Space Weather Sub-group of the International Radio Occultation Working Group (IROWG), will follow the Eighth FORMOSAT-3/COSMIC Data Users' Workshop hosted by UCAR from 9/30 to 10/2/2014.

**Background:** The third meeting of the CGMS IROWG recommended that an international workshop be held to discuss aspects of radio-occultation analysis involving the ionosphere. (See Meeting minutes of IROWG-3 IROWG/MM/2013<sup>1</sup>, Section 4.4, Recommendation to CGMS #2.) The World Meteorological Organization also recommended addressing ionosphere and neutral atmosphere issues in a synergetic way in order to help optimize the radio-occultation constellation.

### **Organizers:**

- Tony Mannucci, NASA/JPL <Anthony.J.Mannucci@jpl.nasa.gov>
- Jérôme Lafeuille, WMO <JLafeuille@wmo.int>
- Norbert Jakowski, DLR <norbert.jakowski@dlr.de>
- Geoff Crowley, ASTRA <gcrowley@astraspace.net>
- Bill Schreiner, UCAR <schrein@ucar.edu>
- Terrance Onsager, NOAA/SWPC <terry.onsager@noaa.gov>
- Paul Straus, Aerospace Corporation <Paul.R.Straus@aero.org>

### **Workshop Goals:**

- Increase synergy between ionosphere and neutral atmosphere use of GNSS.
- Increase scientific interaction between the two communities.
- Further the goal of dual-use of GNSS sensors: atmosphere and ionosphere.
- Make progress on issues related to data formats and future missions.

### **Specific Workshop Objectives:**

- Increase awareness of ionospheric issues for atmospheric users of GNSS radio occultation.
- Increase use of RO within the ionospheric community, including for input to assimilative models.
- Understand how the ionosphere can bias neutral atmosphere retrievals.
- Extend upper altitude of atmospheric retrievals (to 50 km and above).
- Improve understanding of ionospheric models for the atmospheric community.
- Increase awareness and understanding of atmosphere-ionosphere coupling.
- Understand the use of whole-atmosphere models for the RO community.

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<sup>1</sup> [http://irowg.org/wpcms/wp-content/uploads/2013/11/IROWG-3\\_Minutes\\_Summary.pdf](http://irowg.org/wpcms/wp-content/uploads/2013/11/IROWG-3_Minutes_Summary.pdf)

## Speakers

Tutorial speakers will address topics of interest to atmospheric and ionospheric users of GNSS radio occultation. In addition, there will be scientific talks addressing lower-upper atmosphere coupling and other topics.

## Agenda (Friday October 3)

### Room CG-1210 (South Auditorium)

#### Morning Session

9:00-9:10 AM Welcome from Jerome Lafeuille, World Meteorological Organization (remote).

9:10-9:20 AM Workshop Goals.

9:20 AM Tutorial Presentations.

- Radio occultation retrieval processing for ionospheric scientists  
William Schreiner, UCAR
- Ionosphere 101, for atmospheric scientists, including ionospheric models as tools for the RO community  
Geoff Crowley, ASTRA Associates
- How the ionosphere affects atmospheric retrievals and uses in NWP  
Sean Healy, ECMWF

10:50 AM Break

11:20 AM Scientific presentations

1. Nick Pedatella – Lower-upper atmosphere coupling
2. Tomoko Matsuo – Data assimilation in the ionosphere
3. Xinan Yue – Second order ionospheric effects
4. Tae-Kwan Wee – Development of a 2DVAR for Combined Retrieval of Ionosphere and Atmosphere: A NASA-funded Project

12:20 PM: Lunch Break

#### Afternoon Session:

1:40 PM : Discussions

General aspects:

Awareness of synergies between neutral and ionized atmospheric analysis, future requirements, e.g. extend retrieval height above 50km.

Methodological aspects:

Retrieval techniques, potential of improving ionospheric corrections, biases, how to handle signal perturbations (scintillations, E-layer), ionospheric data assimilation techniques.

Technical aspects:

Future missions optimizing combined neutral gas *and* ionosphere retrievals, data access and exchange, usefulness of common data formats, use of RO for global scintillation activity measurements.

Scientific aspects:

Coupling processes from below (acoustic, gravity, planetary waves), impact

of weather fronts, sudden stratospheric warming events, upper boundary specification for atmospheric models.

3:30 PM BREAK

4:00 PM Reconvene/Summarize/Action Items

5:00 PM Workshop close

**Practical information**

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