IROWG - Overview of and Plans for the Newest CGMS Working Group

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Overview

Introduction:

- Radio Occultation Principle
- Radio Occultation Impact

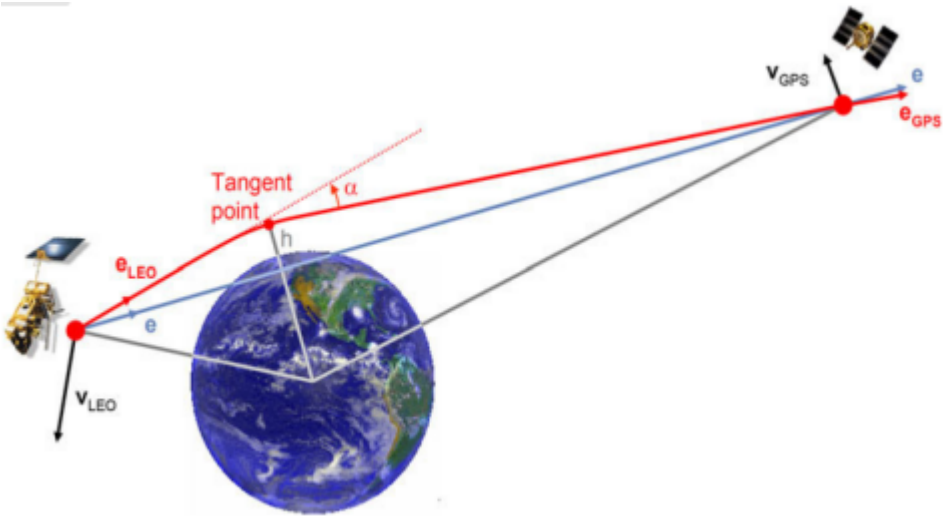
IROWG:

- Workshops
- Achievements
- The next 3-5 years

Summary

Introduction

Radio Occultation Principle



Principle: Observation of e.g. GPS satellite signals through the atmosphere; changing refractivity leads to bending of rays. Refractivity depends on pressure, temperature, water vapour. Depending on observation, either setting or rising events are observed.

RO observes GNSS (GPS) satellites:

- rising, setting (atmosphere)
- zenith (orbit)

observations:

- about 650 profiles/day (GPS)
- 0.2km – 1km vertical resolution

level 1b product (EUM timeliness):

- bending angle (2h 15 min)

level 2 products:

- refractivity (3h)
- T, WV (3h)
- climate applications

Radio Occultation Impact (1)

Radio occultation observations provide:

- stable measurement, independent of instrument (no external calibration required / essentially a time measurement)
- high vertical resolution (limb sounding)
- high accuracy; anchor/correct the model biases
- several benefits for NWP, climate monitoring, re-analysis runs, etc

Radio Occultation Impact (2)

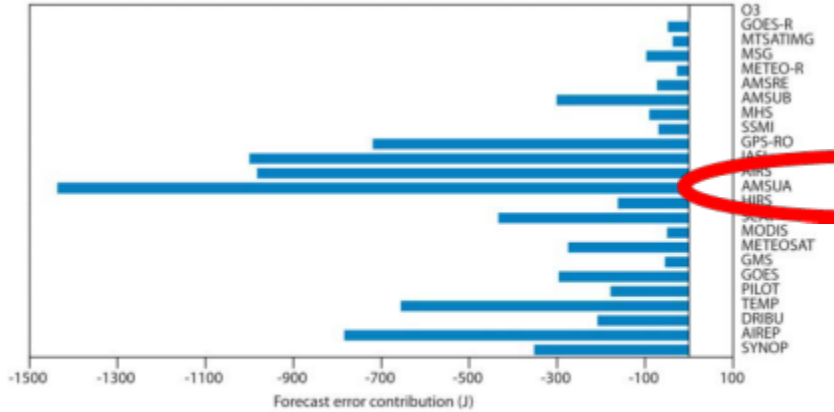
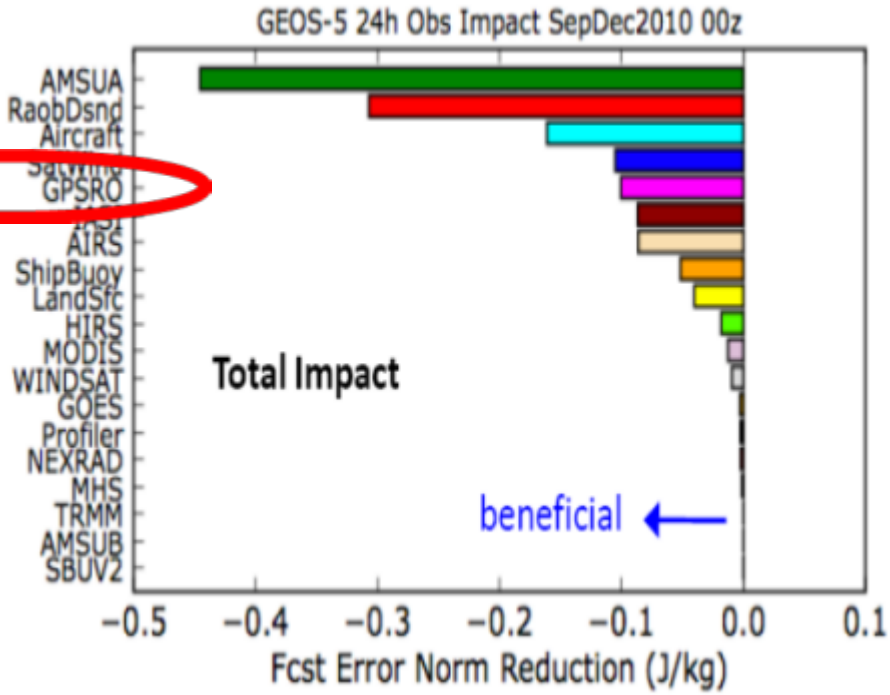
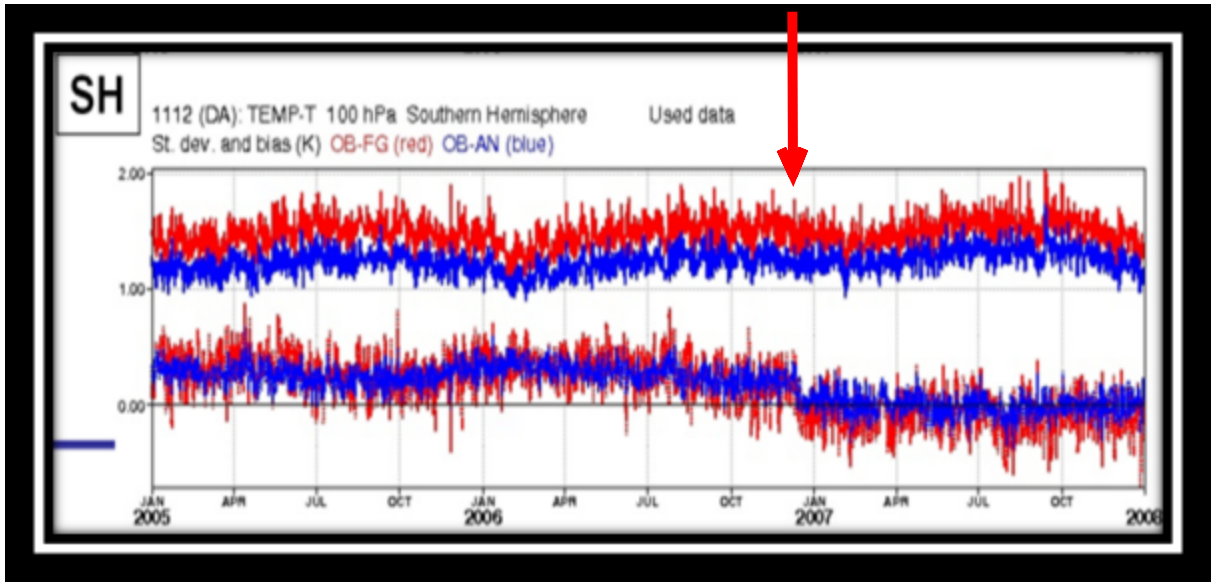


*Figure 11. 24-hour forecast error contribution (Joule*10^{-4}) of the components (types) of the observi system during September, October, November and December 2008. Negative (positive) values correspo to a decrease (increase) in the energy norm of forecast error.*



Impact of different observation types on forecast error reduction in modern NWP systems, RO marked in red (left: C. Cardinali, S. Healy (ECMWF); right: R. Gelaro (NCEP/NOAA))

Radio Occultation Impact (3)



COSMIC introduced to ERA-Interim December 2006 (arrow), Southern Hemis. Radiosonde temp departure 100hPa (P. Poli, S. Healy (ECMWF))

RO shows high impact in NWP and re-analysis assimilation despite their current low # of obs.

IROWG

Workshops

IROWG initiated at CGMS-39 (Oct. '09), quickly accepted by RO community:

•First meeting was extension of already scheduled meeting (covering only discussion/recommendations):

- IROWG #1 (Sep. 2010, joint OPAC, GRAS SAF, IROWG)
- Attended by > 60 scientists: major centres providing, assimilating data
- provided summary report to CGMS-38, leading to Action 38.30

•Second workshop was "first solo session, remotely", very well attended:

- IROWG #2 (Mar./Apr. 2012)
- Attended by > 70 scientists: major centres providing, assimilating data
- provided summary report, 2 WP (on CGMS-39 actions) to CGMS-40

•Third workshop will be joined one again, remotely:

- IROWG #3 (Sep. 2013, joint OPAC, IROWG)

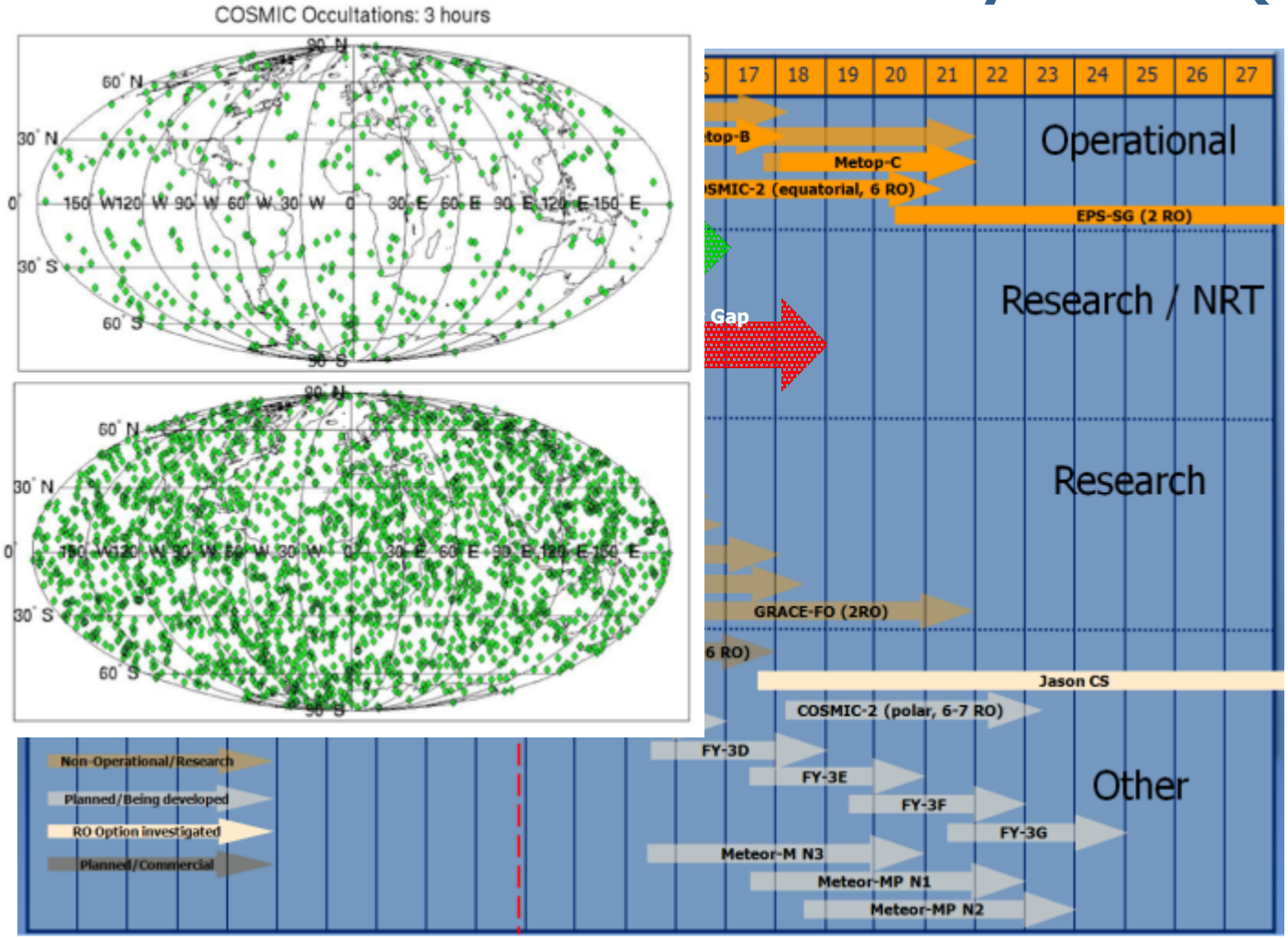
Main IROWG-2 Recommendations

- A need for an operational continuity plan for radio occultation – including troposphere and ionosphere – to provide a daily availability of at least 10,000 occultations;
- An urgent need for data gap filling using research / opportunity satellites, or commercial sources (if available) is required for the near term, but this is not a replacement for a long-term continuity plan to provide operational GNSS radio occultation data;
- CGMS agencies engage in re-processing of radio occultation data to maximize their utility in anchoring climate reanalyses.

Achievements

- one-stop-shop for RO issues (all providers, users, major science areas)
- accepted / used by community to convey information to CGMS
- accepted / used by community to justify proposals, prioritize work, etc
- foster cooperation / new projects (one workshop/lodging location)
- established itself as one of the main workshop providers
- started several data provision improvements (e.g. TerraSAR-X data in Near-Real-Time, C/NOFS data with improved coverage, ...) and data assimilation improvements (NWP impact study on-going)
- provide website hosting at www.irowg.org for community use (e.g. NWP impact study runs through site, plan to host community data)
- provide mailing list for RO community

The next 3-5 years (1)



- optimize the current RO GOS (urgent):
  - research data use (OC-2, SAC-D, MT)
  - foster collaboration with China, India, Russia
- work towards an operational RO observing system, providing > 10,000 occultations/day

The next 3-5 years (2)

- improve understanding / use of RO data:
  - contribution to reducing model bias (model anchor)
  - low altitude (ducting, penetration, high signal variability)
  - high altitude (ionospheric correction, GPS and LEO clock impacts, ...)
  - multiple GNSS systems (coverage, cross-correlations)
- improve research use of RO data:
  - climate and trend applications
  - ionospheric / space weather applications
  - neutral atmosphere / ionosphere combined use

Summary

Summary

- Radio occultation is an important information source in NWP, climate, etc
- IROWG was quickly accepted by RO community (strength of CGMS link)
- provide expertise to CGMS (several working papers prepared)
- provide expertise to WMO documents (ET-SUP, Satellite Data Use, etc)

- got lots to do in the coming years:
  - optimize the global observing system:
    - short term: improve use of research data / new data sources
    - long term: we need > 10,000 occ/day; best LEO constellation?
  - improve data use for NWP, climate, ionosphere

All working papers, full minute summaries of meetings, including all recommendations / actions are available at: http://www.irowg.org