

IROWG Coordination IROWG-8

Co-Chairs: Ulrich Foelsche (University of Graz)
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CGMS Meeting - Setup

During the plenary session there is only a **very short window of attention**, which needs to be **exploited**.
Even more demanding in an online setting.



WGII will already meet **April 26 – 28**
Plenary will be held **May 19 – 21**

During the WGII session there is
a bit more time – but not much!

Lessons learned

- IROWG **main recommendations** need to be **short** and **concise**.
- They need to be formulated in a way, that they can result in a CGMS **recommendation** or **action**.
- **But** such an action can come back as an **IROWG action**.
- We need to give feedback on the status of the actions.
- Note that the “never-ending” OSSE action is closed!

Example

CGMS-46 actions – WGII					
Actionee	AGN item	Action #	Description	Deadline	Status
IROWG	WGII/5	A46.08	IROWG to develop process and principles for RO data quality control to ease intercomparison of data from different providers.	2019	OPEN

Was transformed to

CGMS-48 ACTIONS - WGII					
Actionee	AGN item	Action #	Description	Deadline	Status
Space Agencies	WGII/3	A48.02	Data providers to document data processing QC processes (including a month of QC statistics, e.g.	April 2021	OPEN

But we will still be asked about the status

Actions

Note: **Baseline ≠ Target** (20 000 profiles per day ...)

Actionee	AGN item	Action #	Description	Action feedback/closing document	Deadline	Status	
IROWG, IAWG	WSA/14 (from WSA)	A47.11	CGMS baseline and RO: IROWG and 7th WMO Impact Workshop needs to validate the current baseline requirements in terms of the coverage, number, quality and sampling of RO.	<p>1121 11 Mar: The requirements have been confirmed. The main gap is the local time coverage beyond 40 degrees latitude. While the issue will be mitigated by FY-3 satellites in two different orbital planes together with Sentinel-6 in a drifting orbit the issue still remains and needs further discussion in the context of the constellation as discussed at the CGMS WGI in risk assessment. This action should be closed, but a new action should be formulated reflecting the above.</p> <p>2020 Jan: There is a gap between the current baseline and the HLRP objective - not just in terms of profiles per day, but in particular in terms of local time coverage. Since the baseline refers to current and near-future missions, it does not necessarily reflect an "ideal" constellation. (See also reply to WSA A47.04 - column 1)</p> <p>2020 May CGMS-40 WSA session: impact workshop</p>	CGMS-40 (CGMS-40)	OPEN	L2.8

- Formulate a response – taking into account FY-3 satellites in two different orbital planes together with Sentinel-6 in a drifting orbit

Coordination Group for Meteorological Satellites - CGMS

CGMS-8 WGII actions							
Actionee	AGN Item	Action #	Description	Action Feedback/Following document	Deadline	Status	SLPP
ICWG	WGII/3	WGII/A48.0 1	ICWG to establish a liaison with EUMETSAT Convective Working Group or SCOPE Nowcasting.	2021 21 May/2021 Jan: ICWG to be discussed at Convective WG which meets in April. SCOPE NWC limited progress to date.	Nov 2020	OPEN	4.1.4
CMAA, EUM, NOAA (Space agencies)	WGII/3	WGII/A48.0 2	Data providers to document data processing QC processes (including a month of QC statistics, e.g. rejection percentage at each QC step) and space sampling information and provide to IROWG.	2021 21 Mar: Waiting for IROWG meeting. 2021 Jan: CMAA, EUM, NOAA to consider and implement as far as is possible. IROWG noted that RO data from KOMPSAT-5 are also of interest. 2020 Dec from IROWG: Reference is made to previous IROWG action A48.0B: IROWG to develop process and principles for RO data quality control to ease intercomparison of data from different providers. o IROWG acknowledges there are about 30-30% observations rejected during the data processing and retrieval procedures for current missions. However, the quality control (QC) procedures are not consistent among different data providers and processing centers. They are very likely to differ between the current and future missions as well. Providers should document their QC procedures (e.g., QC pertains to orbits, space sampling/ inhomogeneity, neutral atmosphere or space-weather products, etc.) and share with IROWG. o IROWG recommends an action to data providers to document data processing QC processes (including a month of QC statistics, e.g. rejection	Apr 21	OPEN	CGMS/EC has contacted EUM,

- Formulate a response

Discussion Topics

CGMS “Commitment” (Report of WG III)

- “Defining CGMS’s commitment to the number of radio occultations: 6000 occultations from low inclination orbits distributed geographically and temporally; 1000 occultations from drifting high inclination orbits; and 7600 occultations from sun-synchronous orbits. Electron density profiles were also added;”
- Commercial RO supplement would be required to meet this commitment
 - Operational constellations do not meet the baseline
 - Considering: COSMIC-2, METOP (3 satellites), CMA (2 satellites) and Sentinel-6

Current baseline

- Current baseline (~15 000/day) is what the agencies are doing or planning
- Lack of full local time (LT) sampling at higher latitudes
- Brought up at inter-sessional meeting (by IROWG)
- CGMS is aware of the gap between the goals of the High Level Priority Plan (HLPP– 20 000/day) and the baseline
- CGMS also identified a gap after COSMIC-2
- Commercial constellations may help fill the gap, but if not purchased with a world license?

CGMS High Level Priority Plan (HLPP)

- From the WG III report: “Ensure that future missions in drifting orbits will carry Radio Occultation instruments”
- What can IROWG do to facilitate?
- Sentinel-6 is a positive example

Plans with Commercially Acquired Data

- What are agency plans? (NOAA, EUMETSAT, etc.)
- What determines decision to purchase with a world license or not?
- Option: choose to purchase fewer data but with a world license

We tried to convince CGMS to coordinate this – but have not yet been very successful:

- IROWG recommends that WMO and CGMS should co-ordinate any GNSSRO data purchases to avoid duplication amongst agencies. If purchased, the commercial GNSS-RO data should be bought with a world license, so that the data are equally available to all agencies.
 - WG II felt that whilst co-ordination of data purchases to avoid duplication amongst agencies would be beneficial it will be very difficult to achieve

JOINT WGII-WGIII REPORT

- 2.2 Radio occultation – What is the best way to characterise current/planned performance for NWP and space weather?
 - Minimum 6,000 occultation from low inclination orbits, 1,000 occultation from drifting high inclination orbits, and 7600 occultation from sun-synchronous orbits. Electron density profiles up to 500 km.

“The definition on the best way to characterize current/planned RO performance for NWP and space weather was discussed. It was agreed that **definition on space and time needs to be addressed**. Now many satellites are operating in similar inclinations, which significantly increases the number of RO observations available, however, the geographical coverage is relatively non-uniform. The definition was updated in CGMS Baseline to better represent the requirements also for the geographical distribution of coverage.”

WGIII REPORT

- According to status update of implementation of CGMS **High Level Priority Plan (2019-2023)** the meeting proposed following updates to be added to the CGMS High-Level Priority Plan (HLPP) for the period 2020-2024. Major updates are summarised below.
- “Ensure that future missions in drifting orbits will carry Radio Occultation instruments”
- “Advance the atmospheric Radio Occultation constellation, with the **long-term goal of providing 20 000 occultations** per day on a sustained basis”

IROWG co-chairs

- IROWG co-chair is not a lifetime job (rapporteur maybe ...)
- Sean will be stepping down – we need to (try to) replace him.
- Uli will be stepping down during/after IROWG-9
- We need to start the **election process**.
- Nominations are welcome! (e-mail to Tony and Uli)
- Preferably from the NWP community.

Note: Co-chairs are elected by IROWG, but the rapporteur needs to come from one of the CGMS member agencies/organizations.

IROWG perseveres!

“Neither snow nor rain ... “



And a big thank to the
subgroup co-chairs!

IROWG thanks!

Dear Heidi, Rich, Jan, Ben ...

Thank you very much!!!

Next slides:
IRWOG report to CGMS 48, WGII

Overview

- IROWG-7 main recommendations
 - September 19-25, 2019, Elsinore, Denmark
 - Workshop minutes and full recommendations are available at: <http://irowg.org/workshops/irowg-7/>
- Impact of COSMIC-2 data in NWP
- Outline of IROWG-7 discussions relating to commercial options
- Action item review
- IROWG-8

Main Recommendations IROWG-7

- IROWG encourages all providers of RO observations to classify these as **essential** in the sense of WMO Res 40. IROWG stresses the importance of **free and unrestricted access** to essential RO data **including archived raw** data.
- IROWG recommends **that WMO and CGMS should co-ordinate any GNSS-RO data purchases** to avoid duplication amongst agencies. **If purchased**, the commercial GNSS-RO data should be bought with a **world license**, so that the data – including raw data - are equally available to all agencies.
- IROWG recommends that GNSS-RO data - with at **least 20,000 occultations per day** - are **globally distributed** and provide good **sampling of the diurnal cycle**. This is important for NWP, Climate, and Space Weather.

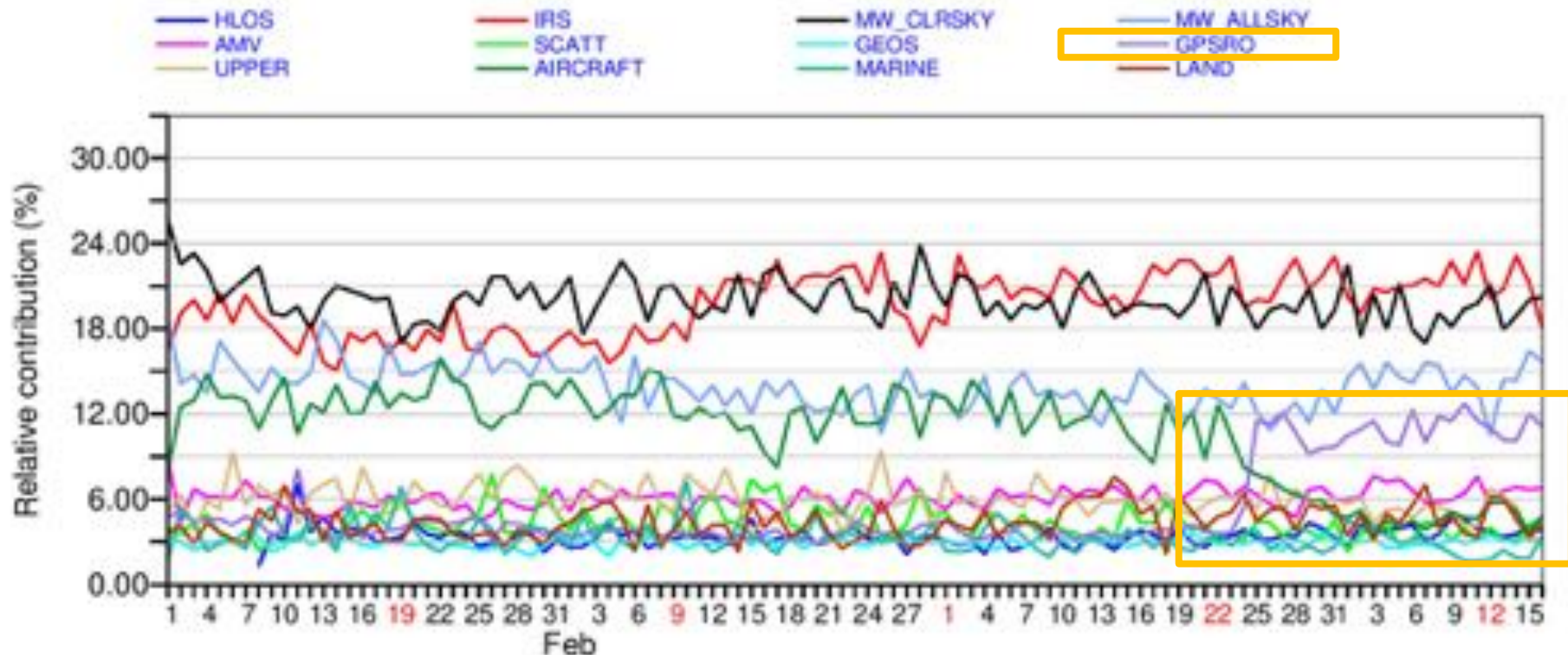
IROWG-7 Science Highlights (1)

- The “GPS” RO technique has evolved to a true “**GNSS**” RO **technique**, where **signals from all GNSS constellations** are on a path to being exploited.
- The **FORMOSAT-7/COSMIC-2** constellation (launch: 25 June 2019) provides RO data with **very high SNR** (> 2000 V/V), allowing for exciting new science applications.
It should, however, be noted that COSMIC-2 data are confined to **latitudes below $\sim 40^\circ$** , leaving a serious **gap in local time coverage at high latitudes**.
- IROWG has been invited by the **IPCC** to contribute to the upcoming **assessment report**.

IROWG-7 Science Highlights (2)

- The **PAZ satellite** (launch: 22 Feb 2018) provides the **first GNSS polarimetric radio occultation results**. RO observables at two linear polarizations have proved sensitivity to heavy rain as well as other hydrometeors.
- Great progress has been made in the field of **GNSS reflectometry**. In addition to the extensive GNSS-R data set from NASA/CyGNSS, other missions are under preparation, some are ready for launch.
- Based on the evidence provided during the meeting, IROWG notes that the **commercial GNSS-RO missions** (in particular Spire) continue to make very good progress. Nevertheless, there remains strong support for a “backbone” of agency-funded RO missions with **long-term commitment**.

Impact of RO data in NWP



Forecast Sensitivity Observation Impact (FSOI) at ECMWF: Contribution from RO increased sharply with COSMIC-2 (~3000 → ~8000 profiles per day)

IROWG-7 Discussions

- RO in the forefront of commercial data discussions.
- The meeting was an important opportunity for the IROWG community to hear the progress of the NOAA Commercial Weather Data Pilot (CWDP) Study. The NOAA CWDP team was active throughout the meeting, in both the oral sessions and working groups.
- There remains strong support for the CWDP within IROWG because it is essential for assessing the actual capabilities of the various GNSS-RO mission options. We hope that we can maintain a good dialogue between the IROWG and the NOAA CWDP team in the coming years.
- Our main aim is to ***ensure long-term measurement continuity and maximise the number of high quality RO observations that can be freely exchanged.***

Action Item Summary (1)

See working paper for details

- **A45.02:** IROWG to develop a detailed proposal for OSSEs regarding LEO-LEO MW occultation and GNSS-RO &-reflectometry.
 - Important progress has been made in the field of GNSS reflectometry. This part of the action is therefore regarded as not relevant anymore.
 - Key missing element: LEO-LEO OSSEs require the development of a LEO-LEO forward operator that can be used in NWP systems.
 - Development of the forward operator could be achieved with support for a two-year Postdoc, and 25% of senior researchers in the areas of (1) LEO-LEO instrument/observations, (2) radiative transfer, (3) microphysics and (4) NWP system integration (i.e. two senior researcher years in total), with nominal support for travel and publication.
- IROWG recommends to close or reformulate action A45.02.

Action Item Summary (2)

- **A46.08:** IROWG to develop process and principles for RO data quality control to ease intercomparison of data from different providers.
 - There are about 10-30% observations rejected during the data processing and retrieval procedures for current missions. However, the quality control (QC) procedures are not consistent among different data providers and processing centers. They are very likely to differ between the current and future missions as well. Providers should document their QC procedures (e.g., QC pertains to orbits, space sampling/inhomogeneity, neutral atmosphere or space weather products, etc.) and share with IROWG.
- IROWG recommends an action to data providers to document data processing QC processes (including a month of QC statistics, e.g. rejection percentage at each QC step) and space sampling information and provide to IROWG.

Action Item Summary (3)

- **A47.04:** IROWG to provide recommendation on orbital planes in order to improve coverage.
 - It is mandatory, that RO data are globally distributed and provide a good sampling of the diurnal cycle. This can be either achieved with a dedicated constellation with orbits that drift sufficiently fast in local time (such as COSMIC-2 **equatorial + polar**), or with satellites in six or more sun-synchronous orbit planes that provide an adequate sampling of the diurnal cycle.
 - The current (and near future) situation is unsatisfactory: Due to the cancellation of its polar component, COSMIC-2 data are confined to latitudes below $\sim 40^\circ$, leaving a serious gap in local time coverage at high latitudes – even more pronounced for ionospheric data, which are not provided by the first generation of MetOp satellites.

Action Item Summary (4)

- **A47.05:** IROWG to evaluate the outcome of agency funded commercial weather data pilot following IROWG-7 and report to CGMS-48.
 - Status: This task cannot be taken by the IROWG as the results are not open to the community
 - IROWG encourages the institutes evaluating commercial data to share their reports publicly.
 - It is noted that the following institutions are currently performing an evaluation:
 - NOAA (Spire and GeoOptics, level 1-2, supported by EUMETSAT),
 - NRL (Spire and GeoOptics, level 2 bending angle, level 1 podTEC),
 - NASA, USAF, MetOffice (Spire, L1b),
 - ESA (supported by EUMETSAT and U. Graz, Spire; level 1-2)
- IROWG recommends that CGMS makes a co-ordinated request for results from all commercial data studies to be made public.

Action Item Summary (5)

- **A47.31:** CGMS baseline and RO: IROWG and 7th WMO Impact Workshop needs to validate the current baseline in terms of the coverage, number, quality and sampling of RO
- **A47.32:** IROWG to review the CGMS baseline and validate wording that captures CGMS member contribution to RO data in terms of coverage, number, quality and sampling: and share impact studies of RO data between the CGMS baseline and WIGOS 2040 vision observing targets.
 - IROWG shares the concern of the WGIII risk assessment (03/2020), that there is “Continuity risk for the number and geographic distribution of radio occultations; especially in the low- to mid- latitudes”
 - This baseline is currently not sufficient to meet the HLPP objective (1.2) to advance the atmospheric RO constellation, with the long-term goal of providing 20000 occultations per day on a sustained basis.

2021
April
7-14

**National Capital Region,
USA**

8th
International
Radio
Occultation
Working
Group
Workshop

The eighth international workshop of the permanent Working Group of the Coordination Group for Meteorological Satellites (CGMS) focuses on the exchange of experiences in the exploitation of RO data for operational and research use.

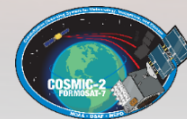


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Summary

- Recommendations from IROWG-7. They include:
 - IROWG encourages all providers of RO observations to classify these as essential in the sense of WMO Res 40.
 - IROWG recommends that WMO and CGMS should co-ordinate any GNSS-RO data purchases to avoid duplication amongst agencies. If purchased, the commercial GNSS-RO data should be bought with a world license, so that the data – including raw data – are equally available to all agencies.
 - IROWG recommends that GNSS-RO data - with at least 20,000 occultations per day - are globally distributed and provide good sampling of the diurnal cycle (will not be achieved with current and upcoming operational missions)
- IROWG-8: April 7-14, 2021, National Capital Region, USA