CGMS-54-IROWG-WP-01
15-April-2026

Prepared by: IROWG
Agenda Item 10.1
Discussed at WGII

Subject	**IROWG specific topics for coordination with the CGMS**
In response to CGMS action/recommendation	N/A
HLPP reference	1.1.4, 1.2.6
Executive Summary	The IROWG community has not held a workshop since CGMS-53. The next workshop, IROWG-11, is planned for 10-16 September, 2026 at the Seggau Castle in Austria. The IROWG co-chairs and rapporteur have been meeting virtually since CGMS-53 to discuss progress and updates. Updates in the following areas are described in this document: • Update on numbers of radio occultations (RO) • Comments on the 8th CGMS risk assessment workshop • ROMEX and its follow-up • Updates to the HLPP • Overview of the planned IROWG-11 workshop in September 2026
Action/Recommendation proposed	N/A

1 INTRODUCTION

The IROWG community has not met since CGMS-53. The IROWG co-chairs and rapporteur have been meeting virtually since CGMS-53 to discuss progress and updates. What follows is a report on updates in the following areas:

- Update on projected number of radio occultation (RO) profiles
- Comments on the 8th CGMS risk assessment workshop
- ROMEX and its follow-up
- Updates relevant to the High Level Priority Plan (HLPP)
- Planned IROWG-11 setup

The upcoming IROWG-11 workshop planned for September 10-16, 2026 at Seggau Castle in Austria, will be jointly held with the 8th International Workshop on Occultations for Probing Atmosphere and Climate (OPAC-8).

2 UPDATE ON PROJECTED NUMBER OF RO PROFILES

IROWG continues to monitor the number of real-time GNSS (Global Navigation Satellite System, e.g. GPS, Galileo, GLONASS, Beidou) RO observations available to numerical weather prediction (NWP) operational centres through the WMO GTS server. Christian Marquardt of EUMETSAT provided an update on the projected number of daily RO profiles considering both government-led and commercial systems. The update includes two satellite launches since CGMS-53 carrying RO instruments: Sentinel-6B and EUMETSAT Polar System-Second Generation (EPS-SG). In addition this update reflects NOAA's commercial purchase of 10,000 profiles per day from two vendors spanning September 2025-2026 as part of Delivery Order 5 of the NOAA NESDIS Commercial Data Program RO Data Buy 2 (RODB-2) Indefinite Delivery Indefinite Quantity (IDIQ) purchase totaling $35,536,400 to support weather forecasting and space weather applications. The graphical representation is below (Figure 1). The final delivery order (#6) or RODB-2 begins in September 2026 and is not reflected in the figure.

This update represents a significant milestone for RO: the IROWG target of 20,000 profiles per day is reached with the latest NOAA purchase of 10,000 profiles per day. Separate work as part of the Radio Occultation Modeling Experiment (ROMEX) has confirmed the continued positive impact of increasing numbers of profiles, to 20,000 and beyond. However, the IROWG target as reflected in the High Level Priority Plan (HLPP) task 1.2.6 is to reach 20,000 profiles per day "with uniform spatial (global) and local time coverage". Commercial and government satellites, except for COSMIC-2, tend to be in sun-synchronous orbits in a limited number of orbit planes. Full global

coverage is only achieved with the inclusion of approximately 5,000 daily profiles from the COSMIC-2 government-led constellation. COSMIC-2 profiles are not globally distributed but limited to latitudes between ± 40°. Figure 1 does not inform how close the RO numbers are to meeting the HLPP target 20,000 per day of *globally distributed* profiles.

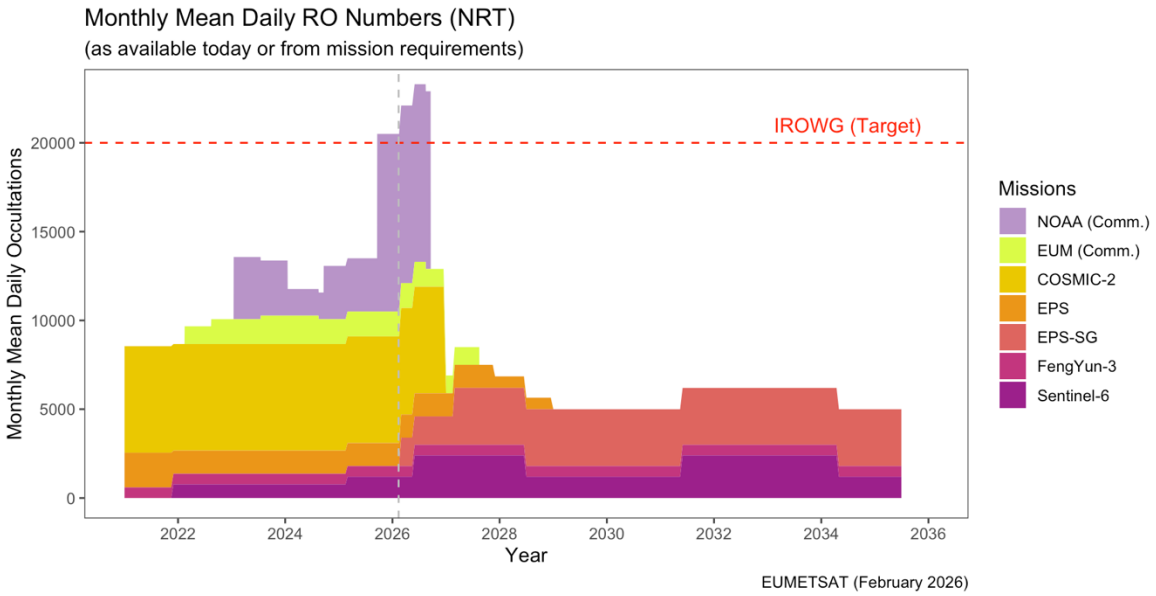

Figure 1. Graphical representation of the monthly mean number of daily RO profiles provided by different government systems and commercial data buys. Courtesy of EUMETSAT (Christian Marquardt).

The data of Figure 1 highlight a significant risk beyond the lifetime of the COSMIC-2 mission (brown-gold color in Figure 1). More discussion on this point is in the next section.

3 COMMENTS ON THE 8TH CGMS RISK ASSESSMENT WORKSHOP

The 8th CGMS Risk Assessment workshop was held in February 2026. A conclusion of this workshop is that there is a “high risk of a gap in service” in the later part of the 2020s due to lack of commitment for RO observations from low inclination orbits. The COSMIC-2 constellation is already past end-of-life and has been in extended mission operations since July 2024. Five of the original six spacecraft are still operating. A reliability analysis from 2023 predicted a 50% probability of one spacecraft failure every 2 years. Figure 2 is from the WGIII risk assessment presentation for CGMS-54 (February 2026 draft). It shows the growing risk of not meeting the CGMS baseline of 14600 daily profiles starting in late 2026 as the COSMIC-2 constellation degrades.

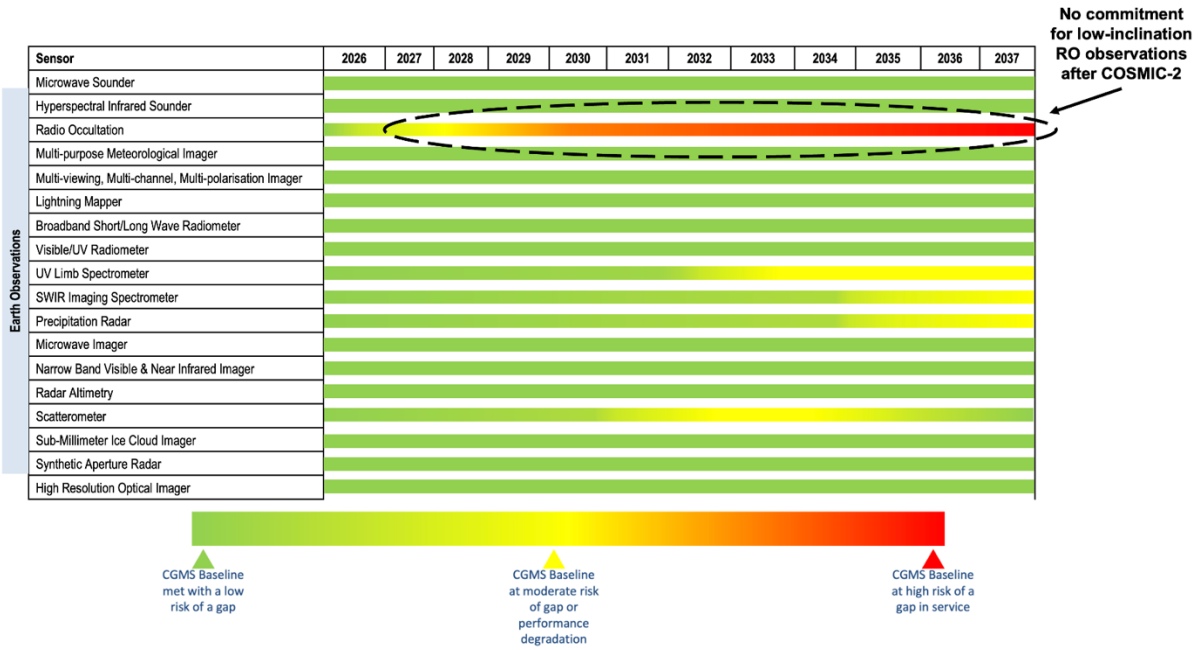

Figure 2. Figure representing the outcome of the 8th CGMS Risk Assessment workshop held 3-5 February 2026. A growing risk to a RO service gap starts in late 2026.

At the American Meteorological Association Meeting (AMS, Houston, January 2026) NOAA reported on GNSS RO planning activities. The NOAA/NESDIS goal for RO is a hybrid architecture consisting of commercial data and international partnerships. An RO Analysis of Alternative Study to meet NOAA needs through 2036 concluded that combining a low-inclination system (below inclinations of 40°) with polar sun-synchronous orbit components provides the best value to meet all weather and space weather constraints.

Considering the planned government constellations through the early 2030s (Figure 1), it is possible that commercial data will become the dominant contributor to meeting the CGMS baseline or HLPP target. There are scientific implications to acquiring data through purchase versus through provision by a government-owned satellite constellation. Some of the considerations are:

- Availability of documentation describing level-0 data and the receiver algorithms used to produce it
- Potential for pre-screening data before delivery to the customer that might inadvertently remove valid atmospheric profiles
- Limited availability of state-of-the-art data products due to pricing considerations
- Long-term archival risks associated with RO observations distributed across multiple commercial vendors, potentially impacting the continuity of long-term data records

These implications will be discussed at IROWG-11 and reported back to CGMS.

4 ROMEX AND ITS FOLLOW-UP

Endorsed at IROWG-9 in 2022, ROMEX has made significant contributions by providing CGMS and its partners with recommendations on RO observation numbers for NWP applications (ROMEX-NWP). For the first time, these recommendations are based on real observations from both baseline and commercial missions.

ROMEX has also created a valuable platform for the international RO community, enabling direct collaboration among data providers, processing centers, NWP centers, and the research community, all working toward improving NWP forecasts using RO observations.

Following two dedicated workshops and an IROWG meeting focused on ROMEX results, IROWG is concluding the ROMEX common experiment period. The dataset remains available to users who sign the user agreement, and related research continues. An overall synthesis of ROMEX results is currently under development, and a dedicated *Atmospheric Measurement Techniques* special issue is in progress.

The upcoming IROWG-11 will review the current status of ROMEX and include discussions on potential follow-up activities. Recommendations regarding the next phase of ROMEX are expected to emerge from this meeting.

5 UPDATES RELEVANT TO THE HIGH LEVEL PRIORITY PLAN (HLPP)

HLPP Task 1.1.4: *Ensure continuity of Radio Occultation observations with required quantity, geographical coverage and temporal sampling for numerical weather prediction and for ionospheric monitoring.*

As discussed above (Figure 2), the 8th CGMS Risk Assessment Workshop outcome identified a growing risk to ensuring continuity of RO starting in late 2026. This risk is primarily caused by the aging of the COSMIC-2 constellation and the importance of such a constellation to meet the required quantity, coverage and sampling.

At present, the CGMS baseline commitment in terms of numbers of profiles per day is being met. The recent NOAA data purchase agreement (start in September 2025) puts the number of available profiles near 20000/day, which is above the baseline commitment of 14600/day and reaches the long-term HLPP target of 20000 profiles/day. It is important to note that observations from COSMIC-2 are needed to meet the temporal sampling requirement for the baseline commitment. Without contribution from data purchase, the baseline commitment would not be met.

An action on IROWG to review the number of occultations provided by planned missions has already occurred. Given current circumstances, it is no longer necessary

for IROWG to characterize the gap between available observations and the baseline commitment. However, the distribution of profiles that may include the recent data purchases remains an important quantity to characterize. This characterization is probably best performed by an operational NWP center that assimilates RO data from government and commercial sources.

HLPP Task 1.2.6: *Advance the atmospheric radio occultation constellation, with the long-term goal of providing 20000 occultations per day with uniform spatial and local time coverage on a sustained basis.*

The IROWG continues to endorse the long-term goal of 20000 occultations per day. As profile numbers reach the target of 20000 per day, an important consideration is uniform global and local time coverage. Missions such as COSMIC-2 currently provide critical low-inclination observations. Studies including NOAA's Analysis of Alternatives, as reported at AMS in January 2026, indicate that a mix of low-inclination and high-inclination orbits in a constellation are needed for achieving the necessary distribution of observations. Commercial data purchases that contribute to reaching the target of 20000 profiles per day do not guarantee that the HLPP target is met, since the target also requires uniform global and local time coverage. The NOAA NESDIS stated plan is to use a hybrid architecture for continuing RO observations, consisting of commercial data purchase and international partnerships.

IROWG recommends the following wording for this task: "...*with uniform global and local time coverage."*

6 PLANNED IROWG-11 SETUP

The next IROWG workshop (IROWG-11) will be held on September 10-16, 2026 in Seggauberg, Austria. It will be hosted by University of Graz, and sponsored by various entities (the final sponsor list will be provided once the program is finalised).
The web site for the workshop is at:

https://opacirowg2026.uni-graz.at/en/

IROWG-11 will be a full workshop, including presentations, posters, sub-group discussions and social activities. The presentations/posters and the sub-groups will be organised according to the following specific topics, namely:

1. Numerical Weather Prediction (NWP)
2. Climate
3. Innovation
4. Space Weather

The "Innovation" sub-group has been renamed from "Receiver Technology and Innovative Occultation Techniques" based on sub-group discussions.

As for all IROWG workshops, IROWG-11 participants will be asked to summarise relevant activities within the scope of the sub-group in dedicated sub-group meetings and express recommendations which could either be relevant to CGMS, to the GNSS RO community, to providers of RO data, or within the IROWG. Recommendations will be discussed in the open plenary. Furthermore, the sub-groups will assess the status of the relevant CGMS actions and follow up on internal recommendations/actions.

7 CONCLUSIONS

The IROWG community has not held a workshop since CGMS-53. Therefore, we restate the five key recommendations previously presented at CGMS-53, endorsed by the IROWG community at IROWG-10, held on 12-18 September, 2024 in Boulder, Colorado, USA:

(1) IROWG recommends that a reliable replacement for the FORMOSAT-7/ COSMIC-2 tropical and subtropical radio occultation observations be in place by 2030 at the latest. As FORMOSAT-7/COSMIC-2 is past its nominal end of life, there is a high risk of serious degradation to numerical weather prediction (NWP) accuracy due to the degradation of the current RO observing system, as FORMOSAT-7/COSMIC-2 satellites stop acquiring observations over the coming years.

(2) IROWG notes that the current radio occultation observational network is highly beneficial to NWP and is among the top two or three observational systems in terms of forecast impact. IROWG therefore recommends the continuation and expansion of the RO observational network. Initial results from ROMEX suggest that increasing the numbers of daily radio occultation profiles with global coverage provides significant additional positive impact on the accuracy of NWP forecasts.

(3) IROWG recommends that Level 0 (raw) data from RO missions be permanently archived and that the government agencies that purchase the data be responsible for its archiving with an open data policy. All data acquired by RO instruments should be archived without pre-filtering or editing and without intentional degradation.

(4) IROWG recommends that relevant agencies undertake a ROMEX-like study for space weather.

(5) IROWG recommends improving planetary boundary layer (PBL) profiling from GNSS-RO through technology and retrieval developments, and utilization of information from the PBL in NWP data assimilation as well as the further exploitation of RO-derived water vapour.

The IROWG co-chairs and rapporteur have been meeting virtually since CGMS-53 to discuss progress and updates. In this report, the following areas are discussed:

Projected number of RO: the IROWG target of 20,000 profiles per day is currently reached with the latest NOAA purchase of 10,000 profiles per day. Full global coverage is achieved with the inclusion of approximately 5,000 daily profiles from the COSMIC-2 government-led constellation. The current data purchase agreement covers September 2025-2026.

Risk of a gap in service: A conclusion of the 8th CGMS Risk Assessment Workshop held in February 2026 is that there is a “high risk of a gap in service” in the later part of the 2020s due to lack of commitment for RO observations from low inclination orbits after COSMIC-2. The NOAA/NESDIS planning to address this gap defines a hybrid architecture consisting of commercial data and international partnerships. Commercial data may become the dominant contributor to meeting the CGMS baseline or HLPP target for the foreseeable future. Implications will be discussed at IROWG-11 and reported back to CGMS.

ROMEX update: ROMEX has provided CGMS and its partners with recommendations on RO observation numbers for NWP applications, based on more than 35000 daily profiles from both baseline and commercial missions. The ROMEX dataset remains available to users who sign the user agreement, and related research continues.

High Level Priority Plan (HLPP): The IROWG continues to endorse the long-term HLPP goal of 20000 occultations per day. Due to the current and planned use of a hybrid architecture consisting of international government-led constellations and commercially-acquired data, ongoing characterization of the uniformity of global and local time coverage is recommended.

IROWG-11 workshop: The next IROWG workshop (IROWG-11) will be held on September 10-16, 2026 in Seggauberg, Austria, hosted by the University of Graz. Updates will be posted at irowg.org.

Affiliations

Anthony Mannucci is with the Jet Propulsion Laboratory, California Institute of Technology, United States. Hui Shao is with the University Corporation for Atmospheric Research (UCAR)/Joint Center for Satellite Data Assimilation, United States. Ulrich Foelsche is with the University of Graz, Austria.
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