# Continuity risk level and potential impacts associated with a gap of low inclination RO

**Presented to CGMS-54 Working Group III session, agenda item 3.1**

**Co-Chairs:** Ulrich Foelsche (University of Graz)
Hui Shao (Joint Center for Satellite Data Assimilation, UCAR; transitioning to Naval Research Laboratory)
**Rapporteur:** Tony Mannucci (Jet Propulsion Laboratory, NASA)
**Presenter:** Christian Marquardt (EUMETSAT)

**With contributions from the IROWG members**

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## Executive summary of the WP

In this WP we will cover:

- Update on numbers of radio occultations (RO)
- Comments on the 8th CGMS risk assessment workshop
- Updates to the HLPP

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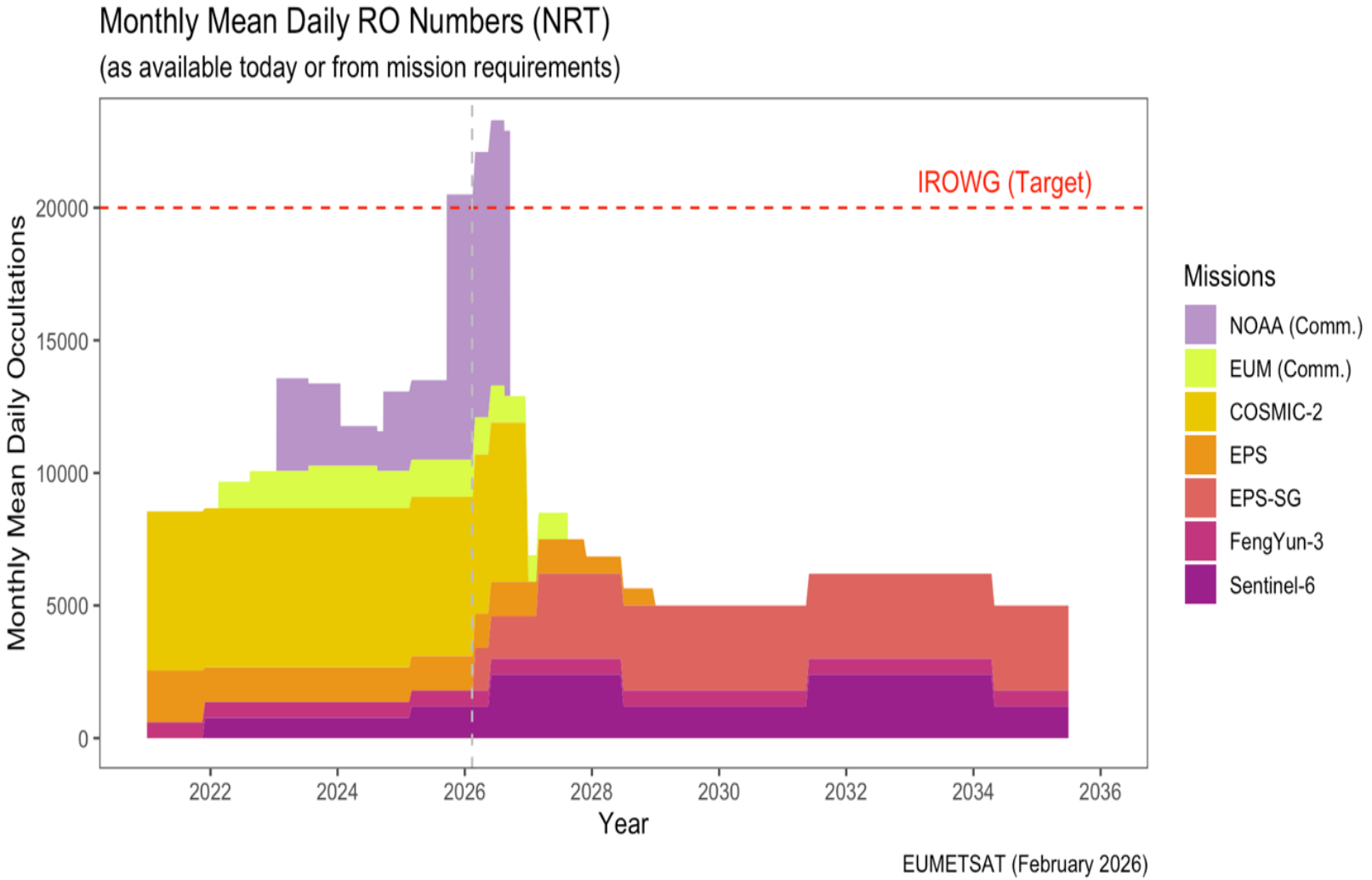
# Update on numbers of radio occultations (RO)




Credit: Christian Marquardt (EUMETSAT)

- This update reflects recent NOAA data purchase 10000 profiles/day (Sept. 2025-2026)
- Final delivery order of RO Data Buy 2 (Sept. 2026-2027) is not reflected in this figure
- Note that COSMIC-2 is past end of life and is degrading more slowly than reflected in the figure
- Meeting “uniform global and local time coverage” remains a goal
- COSMIC-2 profiles are limited to latitudes between ± 40°

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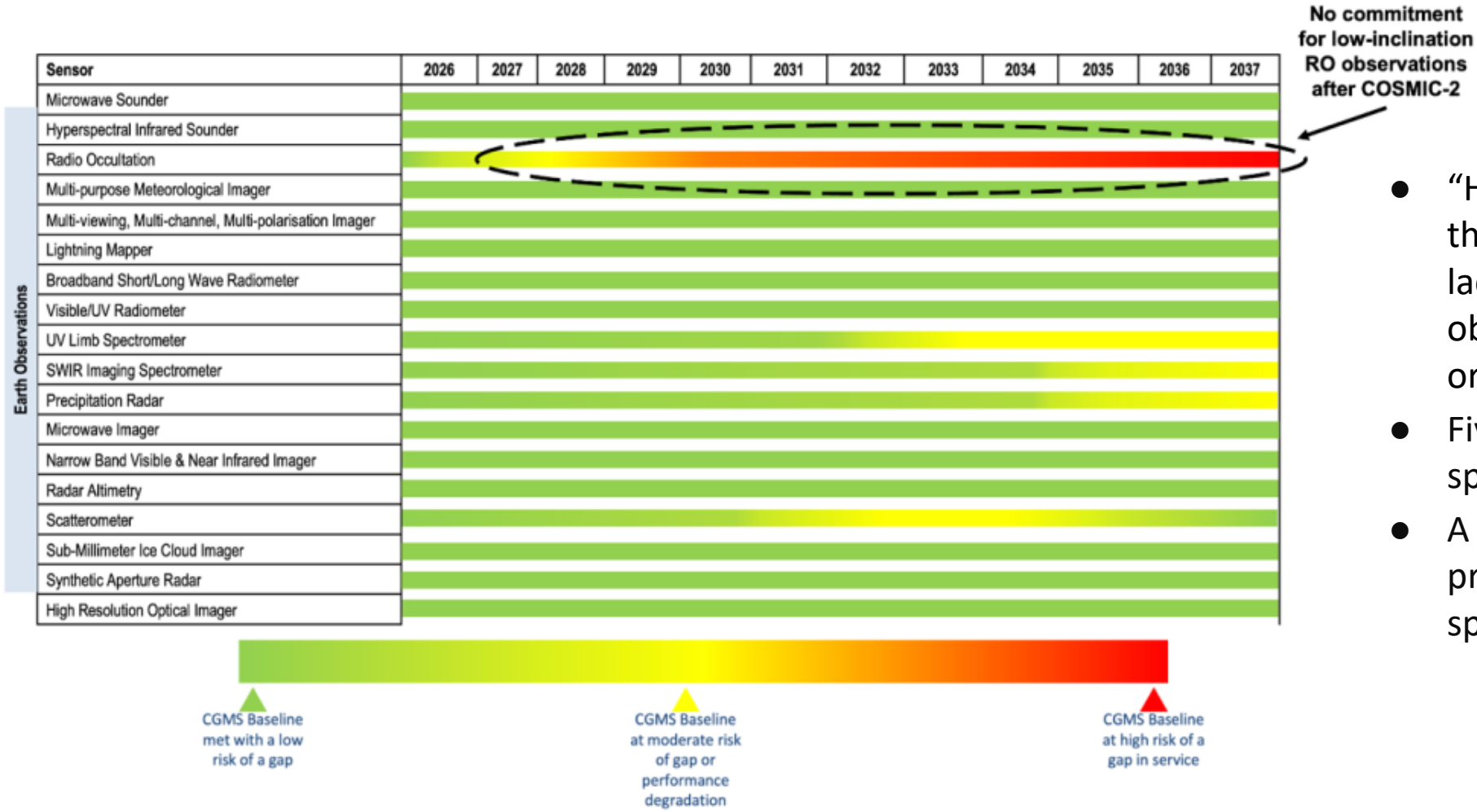
# Comments on the 8th CGMS risk assessment workshop (1)




- "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.
- Five of the original six COSMIC-2 spacecraft are still operating.
- A 2023 reliability analysis predicted a 50% probability of one spacecraft failure every 2 years.

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From the 8th CGMS Risk Assessment workshop held 3-5 February 2026.

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# Addressing the RO Continuity Risk

- As presented at the American Meteorological Meeting in Houston (January 2026) the NOAA/NESDIS goal for RO is a hybrid architecture consisting of commercial data and international partnerships.
- The “best value” to meet all weather and space weather constraints is by combining low-inclination orbits (below 40°) with polar sun-synchronous orbit components.
- Scientific considerations if acquiring a majority of data through purchase:
  - 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

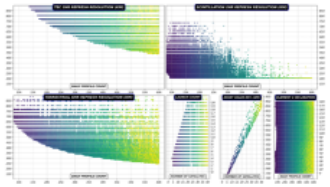
# Addressing the RO Continuity Risk (cont)

(NOAA, AMS 2026)

National Environmental Satellite, Data, and Information Service

## Architecture Performance Methodology & Results

*The RO AoA developed a simulation to evaluate the performance of space architecture designs against NOAA objectives*



Over 1.4 million solutions were repeatedly modeled and remodeled and assessed in a multi-objective trade space.

| Case | Model System: HIGH-INCLINATION SEGMENT SATELLITES | HIGH-INCLINATION SEGMENT LAUNCHES | HIGH-INCLINATION SEGMENT INCLINATION | LOW-INCLINATION SEGMENT SATELLITES | LOW-INCLINATION SEGMENT LAUNCHES | LOW-INCLINATION SEGMENT INCLINATION | TOTAL SYSTEM SATELLITES | TOTAL SYSTEM LAUNCHES | Output Performance: REFRESH RESOLUTION (KM) & DAILY COUNT PERFORMANCE NEUT. ATM. | TEC | Scintillation | Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 3 | SSO | | | | 9 | 3 | 515 | 2040 | 305 | 15,000 |
| 2 | 6 | 3 | SSO | 2 | 1 | 45 | 8 | 4 | 550 | 1285 | 315 | 13,000 |
| 3 | 9 | 6 | SSO | | | | 9 | 6 | 530 | 1050 | 280 | 15,000 |
| 4 | 6 | 3 | SSO | 3 | 1 | 0-31 | 9 | 4 | 500 | 990 | 205 | 14,000 |
| 5 | 6 | 3 | SSO | 6 | 1 | 36-45 | 12 | 4 | 440 | 770 | 205 | 18,500 |
| 6 | 3 | 3 | SSO | 6 | 1 | 20-36 | 9 | 4 | 500 | 990 | 205 | 13,500 |

Does not meet constraints/continuity

National Environmental Satellite, Data, and Information Service

80.000 profiles/day available from Yunyao and TianMu as of July 2025

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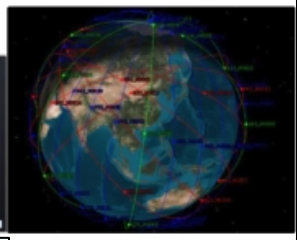
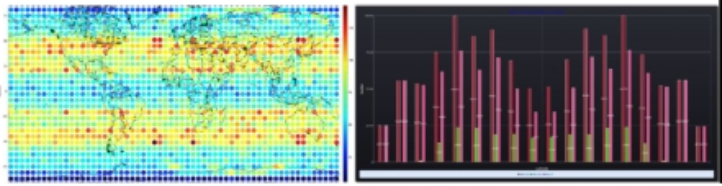
## Yunyao Aerospace Constellation | Complete Constellation Plan

- By the end of 2025, a meteorological constellation of 90 satellites in orbit will be completed.
- Effectively enhancing China's meteorological observation capabilities through rapid networking of low orbit meteorological satellites.
- More than 150000 atmospheric occultation profiles and over 60000 ionospheric profiles can be obtained every day.
- Global-scale data with a spatial resolution of 200 km x 200 km and time resolution of 12~20min.







(CMA, CGMS-52 WGII, 2024)

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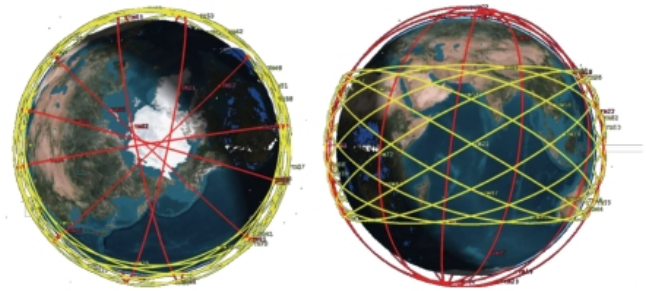
## TianMu-1 meteorological constellation

By 2025, the constellation construction will be completed, which can provide 80000 atmospheric profiles/day, enabling global coverage of the sea surface within 3 hours and providing 3D atmospheric detection data with a grid resolution of 200 kilometers within 6 hours.



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CMA, version 1.0, Apr 22, 2024

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"IROWG strongly supports an open data policy towards the purchase of commercial RO data and recommends that all agencies follow this model. IROWG stresses the importance of free and unrestricted access to essential RO data including archived raw or low-level (level 0) data" (CGMS-52)

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# Updates to the 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.*

- Risk posed by loss of functioning COSMIC-2 satellites over time (mission past end-of-life)
- If the risk is addressed with majority-commercial data, geographical and local time coverage should be characterized on an ongoing basis

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

- IROWG continues to endorse the long-term goal of 20000 occultations per day
- With recent data purchase, this goal is currently being met
- Without a low-inclination orbit component, even with recent data purchase, the goal is *not met* due to lack of necessary coverage

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# IROWG-11 Meeting Organization

- September 10 – 16, 2026, Seggau Castle, Austria, together with OPAC-8
- Hosted by the University of Graz
- The website for the workshop will be: https://opacirowg2026.uni-graz.at/en/
- Full workshop, including presentations, posters, plenary sessions, sub-group discussions, and social activities
- Four working subgroup meetings: Numerical Weather Prediction (NWP); Climate; Innovation; Space Weather
- Feature special ROMEX sessions
- Outcome: CGMS recommendations, internal action items, a summary of relevant activities, and meeting minutes




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# Backup