



Options for radiosonde launches with EUMETSAT Metop and Metop-SG overpasses A. von Engeln, R. Munro, V. Mattioli, F. de Angelis

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EPS-SG Program Overview

Radio Sonde Requirements

Campaign Options





- Primary mission: further improve observational inputs to Numerical Weather Prediction models.
- Continuation and enhancement of service from mid morning polar orbit in 2025 2046.
- Significant contributions to other real time applications: Nowcasting at high latitudes; Marine meteorology and operational oceanography; Operational hydrology; Air quality monitoring.
- Climate monitoring: expand by 20+ years the climate data records initiated in 2006 with EPS (first generation).

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EUMETSAT Responsibilities vis-à-vis Partners



Polar Stations Svalbard & McMurdo





21 years of system operations

EUMETSAT is the overall system authority



6x Launch Service



8 Satellite Application Facilities (SAF)



Metop-SG Satellites Deployment Schedule

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- ✓ Satellite nominal lifetime: **7.5 years** (9.5 years extended)
- ✓ Satellites will be **actively de-orbited**
- ✓ Launch schedule:

Metop-SG A1 planned for launch not earlier than December 2024 and readiness for launch of Metop-SG B1 foreseen in March 2025 (based purely on the development schedule). A third re-baselining of the space segment has been initiated and is now on-going and will also address issues such as minimum launch separation.

Metop-SGA1/Metop-CTandem Flight Proposal

- Driver is inter-generational cross-calibration in support of climate monitoring requirements
- Target is Metop-SG A1 cross-calibrated against Metop-C:
- Requirement to have observations by both satellites of the same targets under the same viewing angles (within ~0.1° zenith angle) → leading to a separation of 30 s +/- 5 s
- Will allow more conclusive cross-calibration of time series than a Metop-C / Metop-SG A1 pair separated by 180°
- Implies some fuel penalty on Metop-SG A1, but does not significantly impact operational life

Metop & Metop-SG Orbit Phasing Proposal (Flight Direction is Counter Clock Wise)

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Last Out Of Plane Manoeuvre for Metop-B.

> ~180 degree Phasing is maintained

(Metop-A already de-orbited)

SG-A1 would have a 3-6 months Tandem Flight with Metop-C.

SG-A1 and Metop-C to become primary pair. Metop-B LTAN drift is under way (remaining fuel reserved for de-orbiting)

SG-B1 needs no tandem flight, so goes directly to 9 o'clock position. Metop-B will be de-orbited end 2027 or end 2028.

Metop-C phase is maintained, until the slot needs to be freed up for Metop-SG-A2







1. SCA Scatterometer 2. RO Radio Occultation **3. MWI** Microwave Imaging for Precipitation 4. ICI Ice Cloud Imager 5. ARGOS-4 Advanced Data Collection System 2



EPS-SG System & Ground Segment



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Local Mission procurement: the contract for the procurement of the prototype software re-engineering was kicked off in June 2022; the development of the IASI-NG L1c local processor (L1cLOP) is proceeding with some delays; the first version of the NWC SAF VII L2 cloud mask (CM) processor is now available to other SAFs; the upgrade of L0 local processor to version-2 is progressing for completion by Q1 2023; in general, the delivery of the Local Mission software to NWP SAF remains as planned for launch minus 1 year (currently for Q4 2023).

• Satellite In-Orbit Verification:

- L + 3 verified satellite and instruments functionality, operability and performance against the space segment requirements
- Commissioning & Cal/Val:
 - L+6 validated L1 products
 - L+9 validated IASI–NG L1C, and L1D & L2
 - L + 12 completion of validation of L2 products
 - L + 12 validated SAF level 2 and level 3 products



Radio Sonde / Campaign Options





- Need for validation against radio sondes identified within the Cal/Val tasks for EPS-SG MWI and ICI (both on Satellite B):
 - Launch dedicated radiosondes 15 minutes before the satellite overpass to minimize overpasstime biases.
 - Launch only in calm (little radiosonde drift) and homogeneous clear-sky scene conditions to use resources efficiently, cover all latitude bands, cover day/night.
 - Use the most up-to date instrumentation, i.e. Vaisala RS41 (or newer) or comparable models as described in (<u>https://www.gruan.org/instruments/radiosondes/sonde-models/</u>).
 - Standard deviation due to scene inhomogeneity is usually larger than the radiometric noise. Therefore, many matches are needed to reduce the noise. At least few hundred matchups are necessary in this type of comparison.
 - Additional instrumentation at site is a bonus, small islands with low station elevation required (MWI), ICI less sensitive to surface emissions.
 - Requirement refinements within a currently on-going study.

GRUAN Station Collocation with GRAS-A



GRUAN selected stations, occurrence of collocation with a GRAS-A occultation over 300km in UTC and local time.

GRUAN Station Collocation with Metop Ground Track



GRUAN all stations, occurrence of collocation of ground track over 100km in UTC and local time. 29 days of data. Stations with \pm 1h around 00/12 UTC are marked.

- Campaign Options
- Either as short term Cal/Val campaign (required) or potentially as a long term activity, supporting Metop/Metop-SG product validation (under discussion)
- Long term campaign would:
 - require single point of contact for EUMETSAT, single PoC would need to deal with stations
 - stations covering all latitude bands, capability to launch for overpass, including restrictions on certain weather conditions
 - Ozone, FPH sondes (occasional) would be beneficial
 - US/ARM stations could be covered within bi-lateral EUM-NOAA
 agreement

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Thank you! Questions are welcome.