EUMETRAVES: Overview of EUMETSAT‘s Radio Sonde Service

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Background

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- The EUMETSAT Polar System – Second Generation (EPS-SG) features the Ice Cloud Imager (ICI), which includes unprecedented sub-millimetre channels (243, 325, 448, and 664 GHz).
- Validation heavily depends on Radiative Transfer Model (RTM) simulations, utilizing radiosonde data and Numerical Weather Prediction (NWP) profiles.
- The ICI Calibration/Validation (Cal/Val) Plan identifies the need of a dedicated radiosonde campaign based on fiducial reference measurements.

EUMETRAVES Initiative

- The Global Climate Observing System (GCOS) Reference Upper-Air Network (GRUAN) has been identified as the backbone for this validation effort.
- The discussion on the dedicated radiosonde campaign, named EUMETRAVES initiated in 2022 within the GRUAN WG and GRUAN Task Team Satellites, co-chaired by EUMETSAT.
- Expands support beyond ICI to EPS-SG missions (MWI, IASI-NG, MWS) and other EUMETSAT satellites (MTG-S/IRS) long-term monitoring.
- Aligns with NWP SAF Workshop recommendations (Jan 2025) to sustain in-situ observation networks.

EUMETSAT Radiosonde Validation Service

EUMETSAT has set up a framework agreement:

- Single external provider, which will interface with the radiosonde sites (CNR-IMAA).
- Focus on high quality radiosonde data, primarily targeting GRUAN and GRUAN-like stations.
- Network extensions easily possible – simple contract setup, launches are invoiced to the contract provider.
- EUMETSAT will provide satellite/site overpasses and observation requirements (e.g. clear sky, islands) to contract provider that will task the sonde launches.
- Flexibility to other sonde types (e.g. ozone, stratospheric humidity, dropsondes) if opportunity arises.

Radiosoundings:

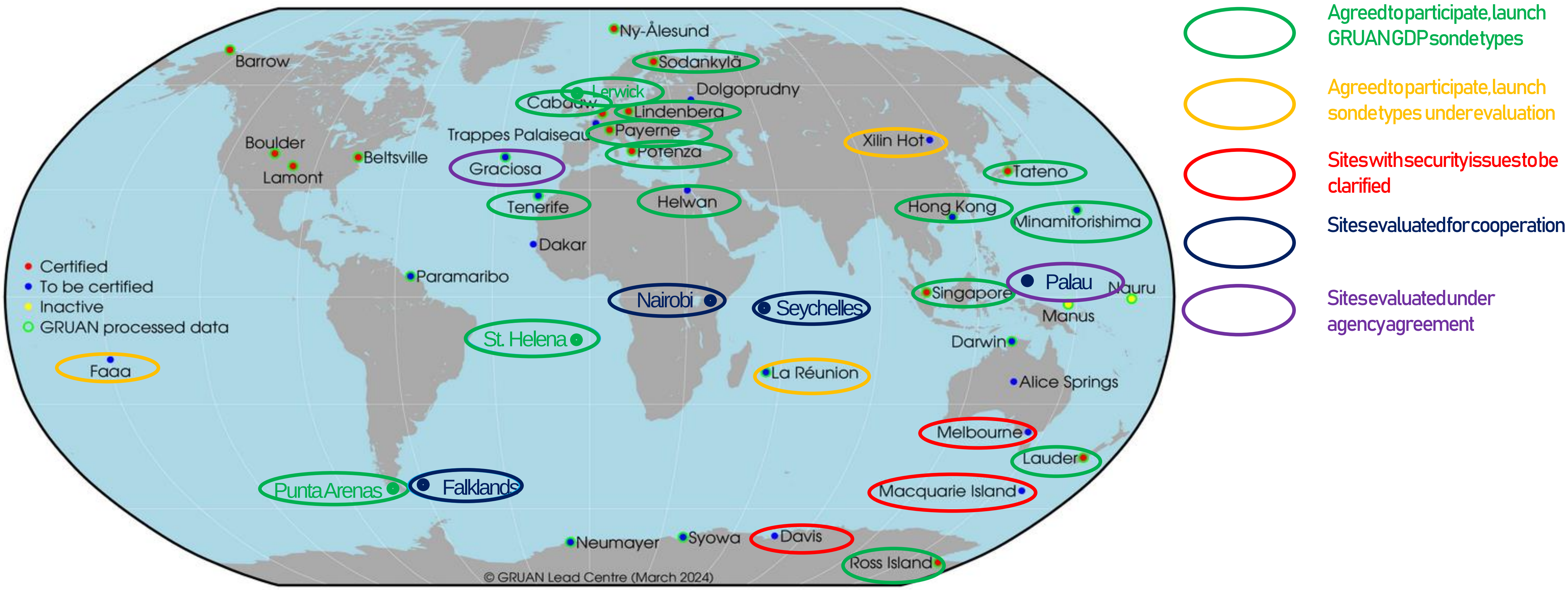
- Temperature/humidity/wind profiles, including uncertainties, aiming at 5hPa (about 35km).

Radiosonde Network Options

These sites were **<u>assessed for their suitability</u>** to contribute to the frame. **Initial network of sites is determined within Activity 1 (see also CNR Proposal inputs on later slide).**

Inclusion of ARM sites to be discussed in coordination with NOAA.

- Some sites launch sonde types that are not yet certified GRUAN data products (Modem M10 in certification process).



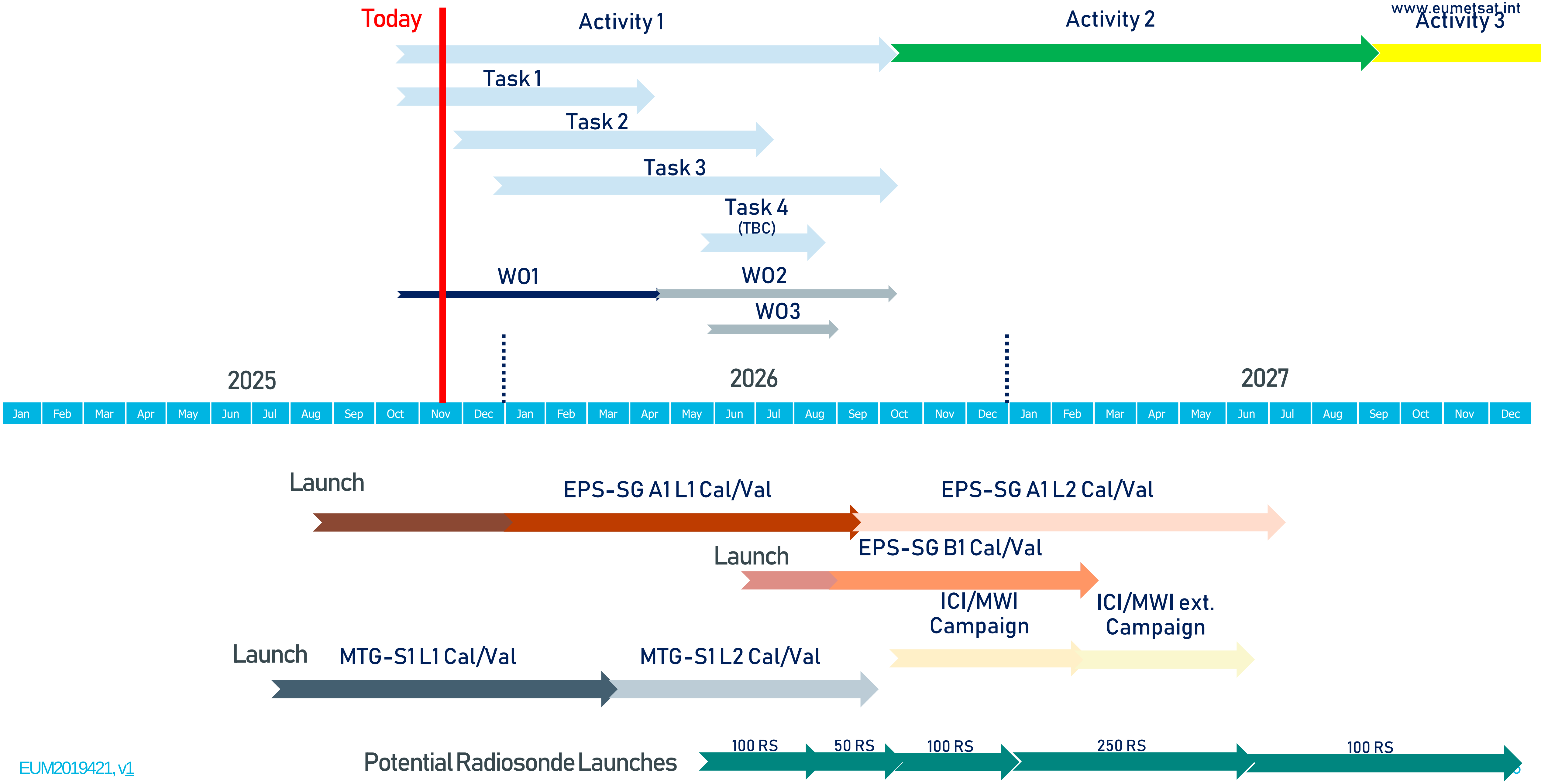
Initial plot from https://www.gruan.org/

Activity Overview

- **Activity 1:** Frame Contract Setup and first Proof of Concept
  - **Task 1**: contacting all GRUAN, potential GRUAN, and GRUAN-like stations, assessing whether they in general can contribute to such a service and at what cost; - WO1
  - **Task 2**: assessing the mechanism how stations invoice for a sonde launches (ideally a simple invoice system without setting up several sub-contracts); - WO1, WO2
  - **Task 3**: interface setup with identified stations and EUMETSAT; - WO2
  - **Task 4** (optional): end-to-end service test, where operational suitability of service is tested with targeted launches at selected stations. – WO3
- **Activity 2:** EPS-SG B1 MWI/ICI Cal/Val Support, Monitoring Activities
- **Activity 3:** Monitoring activities to EPS-SG A1, B1, MTG-S IRS, Cal/Val Support
- **Activity 4:** Monitoring activities and support to EUMETSAT missions

Each Activity, to be covered by WO, currently planned to last about 1 year.

Proposed Schedule



Occultation Prediction Update with new Missions/EUMETRAVES

The original occultation prediction / sub-satellite point was providing this only for EPS Metop – well, there was only that one. Now, we have for several years Sentinel-6A flying (S6B just being launched), and also the first EPS-SG RO instrument in orbit. Furthermore, the radiosonde service EUMETRAVES required to include the EPS-SG mission too. Thus:

⇒ ftp path was updated to: /pub/OPS/out/test-data/Occultation_Predictions/

⇒ more missions are provided, filenames start either with:

- ⇒ GRAS: as previously made available, though now split for: Metop-B (M01) and Metop-C (M03)
- ⇒ GRAS-2: predictions for EPS-SG radio occultation instrument (also for EUMETRAVES)
- ⇒ TRIG: Predictions for Sentinel-6A (and soon S6B) radio occultation instrument

⇒ Format specification/further info (will need an update) is available here

Objectives

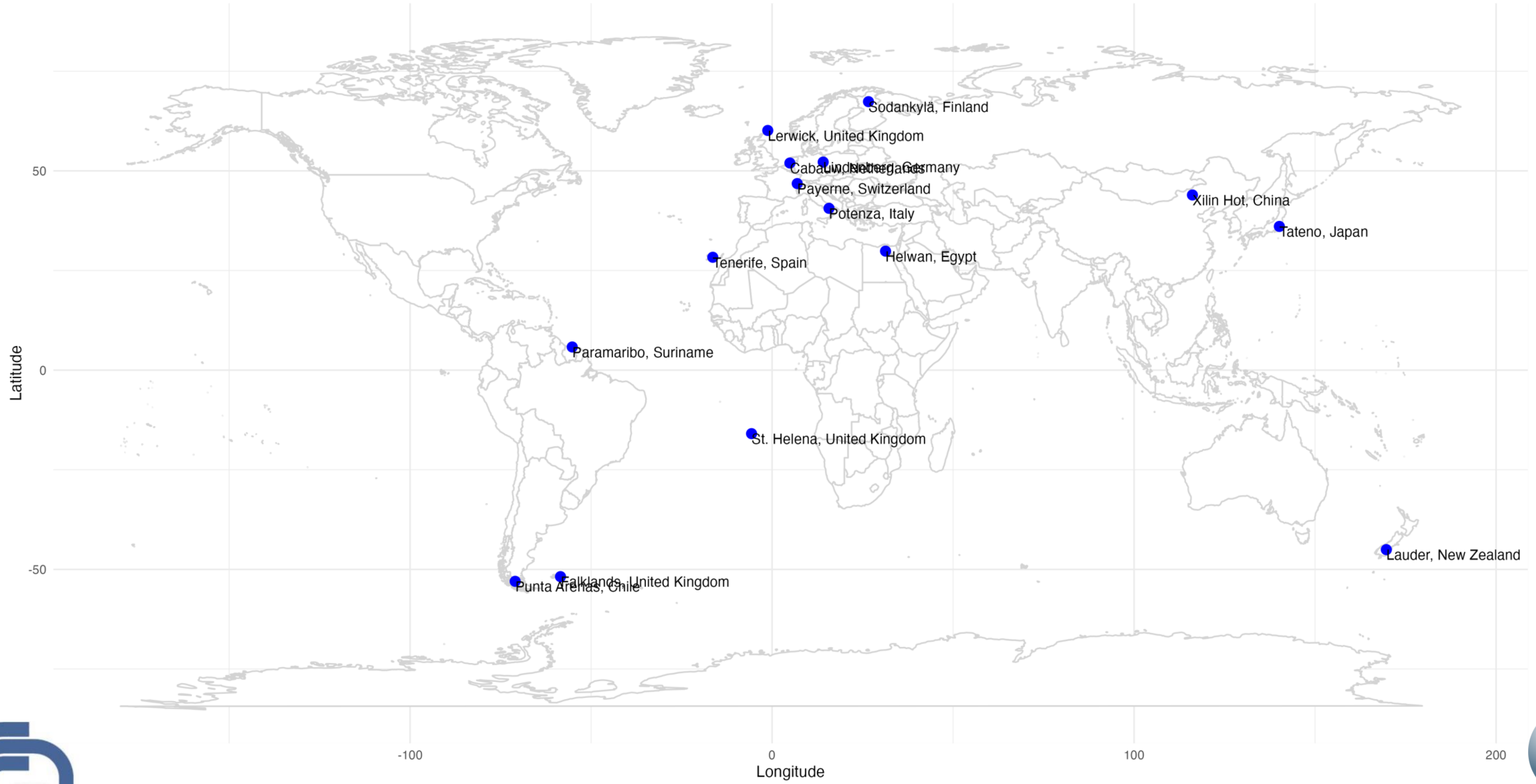
- The project focuses on establishing a dedicated system for upper-air data collection and provision from a global reference-quality network to support EUMETSAT's satellite calibration/validation (Cal/Val) and monitoring activities.

- This will be achieved through the provision of high-quality, fiducial reference radiosonde measurements, hereafter referred to as EUMETRAVES (EUMETSAT Radiosondes Validation Support for Earth-Observing Satellites).

- The primary goal of this proposal for EUMETRAVES is to coordinate a subset of stations that contribute on a sustained basis to the GRUAN (GCOS Reference Upper-Air Network) network, complemented by other high-quality stations not yet involved in GRUAN. These stations will launch radiosondes collocated with satellite overpasses under specific clear-sky conditions, enabling the creation of comprehensive, consistent time series of upper-air radiosonde data.

- These data will primarily include atmospheric temperature, pressure, relative humidity profiles, as well as wind measurements throughout the atmospheric column.

Map of stations involved in the validation campaign



Strategy

- Step 1: email and telegram messages with overpasses D-14 (day-of-launch minus 2 weeks)
- Step 2: email and telegram messages with overpasses D-2
- Step 3: NWP sent by CNR to the sites, the latter to check also other models according to their experience.
- Step 4: Day of launch, site to decide using NWP (main constraint) and ancillary measurements (oktas, ceilometer, radar, ….). Inform CNR if the launch cannot performed 24 hours in advance and if launch fails for any reasons ASAP. A form will be prepared by CNR to collect metadata/feedback on data launch/failure. Station must fill in it.
- Step 5: data collected and submission to the LC via the RSLaunchClient (not later than 1 week, recommended not later than 48 hours after the balloon burst)
- Step 6: CNR to verify the data submission via the hosted GRUAN back and the provision of GDPs.
- Step 7: CNR to check profiles
- Step 8: Submission to EUMETSAT (within 30 days from the measurement collection, recommended within 2 weeks)

Clear-sky conditions

1. From the NWP prediction sent by CNR-IMAA and/or directly chosen by all the stations, station to check if at the time of the launch and in the 3 hours before the cloud fraction is below a threshold, within 200-300 km around the sites.

   Commonly Used Thresholds in NWP Models:

   - **ECMWF**: Typically uses a 20% threshold for clear or partly cloudy skies.
   - **GFS**: Also uses a 20% threshold for clear skies.
   - **WRF**: Often uses a 10%-20% threshold, depending on specific configurations.
   - **COSMO**: Uses similar thresholds (10%-20%) for regional applications.

   20% threshold may be used, this is widely accepted for most meteorological and NWP applications.

2. On the launch day, sites will also use ancillary measurements (recommended), such as ceilometer, radar, sky imagers, and present weather, to confirm the NWP forecast and to the best to launch in clear sky conditions

Data archiving and filenames

- Data will be available from the GRUAN data archive (from LC and or any other where GDPs should be available in future).
- Files will have labelled properly in the metadata (predefined text in the field "g.Measurement.Comment» or define a specific "Setup" or "Campaign" the site use this "Setup" or add this "Campaign" to the measurement during upload (using RsLaunchClient).

Overpasses

- Email
- Telegram

Email shall include also spare stations which must be prepared in case a station will not be ready for the launch (inform about possible no later than 24 hours in advance of the overpass time).

Dry-run and periodic meetings

- In July-September 2025, all the stations will be requested to take part in a simulation of the preparation and operation needed during real measurements. Stations will receive the overpass and those requested to thereotically perform measurement will be requested to inform CNR of the data submission (Step 6 in the procedure)

- We may have «short» regular meetings (every 1/2 months) in the first 6 months (less frequent then) to discuss on collected measurements and issues met in the different tasks/stations.