EUMETSAT Invitation To Tender (ITT) 22/224312:
Study on the development of vicarious calibration tools
for MWI and ICI using <u>radiosoundings</u>

Responded with a proposal (20 Oct 2022):
Development of VIcarious Calibration tools for
MWI and ICI using RadioSoundings (**VICIRS**)

Awarded: 21 Nov 2022
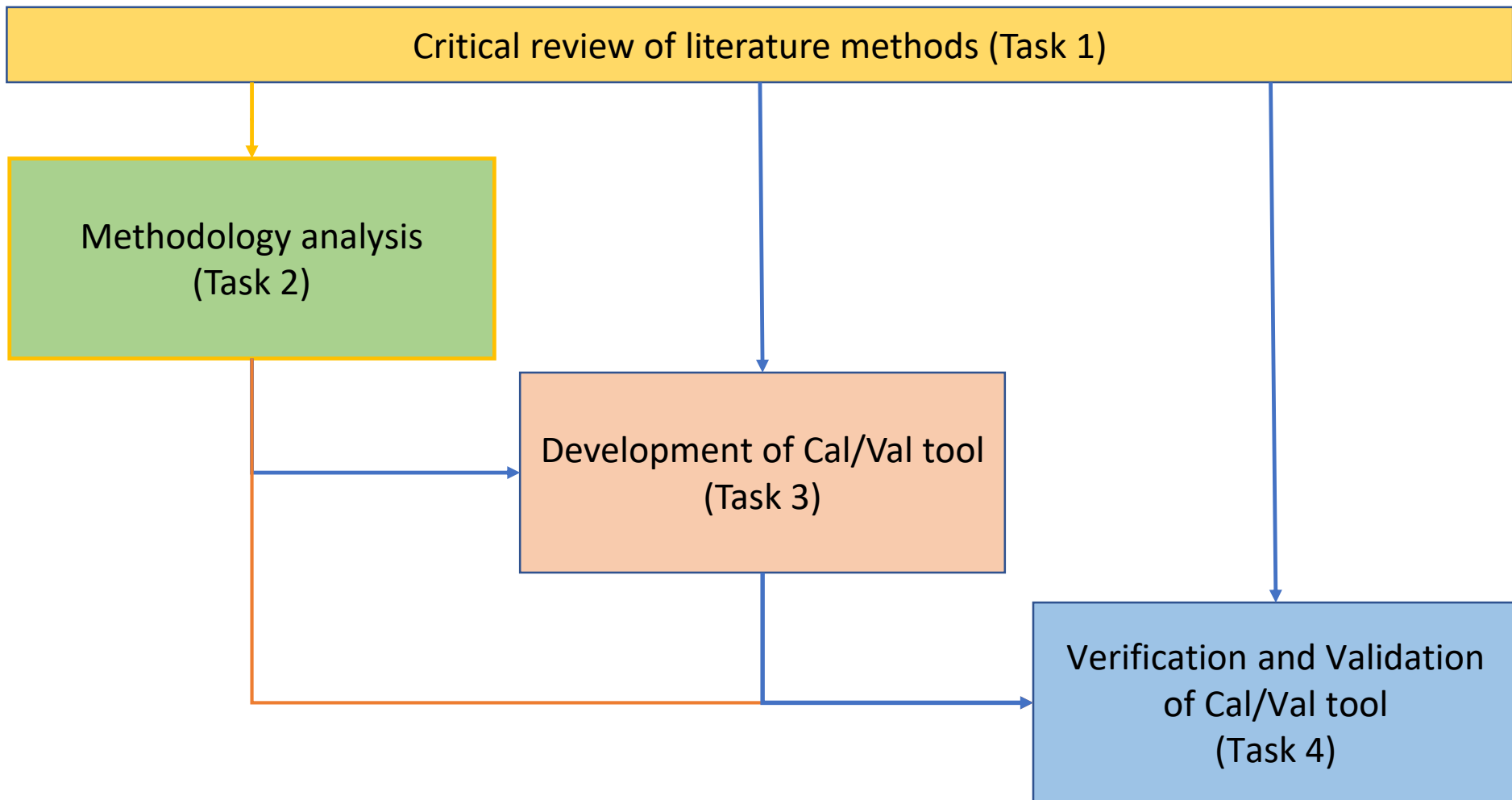**Tentative Kick-Off**: 6-7 December 2022

Introduction to VICIRS

Objective: Develop a Vicarious Calibration and Validation (Cal/Val) tool to compare MWI and ICI observations to radiosoundings

Vicarious calibration: post-launch calibration based on targets imaged near-coincidently by the sensor to be calibrated and by one or more well-calibrated sensors (from satellite, aircraft, balloon, or ground).

MicroWave Imager (**MWI**) and Ice Cloud Imager (**ICI**): conical-scanning microwave radiometers – will fly from 2025 onward aboard the 2nd generation European polar satellites (METOP-SG-B).
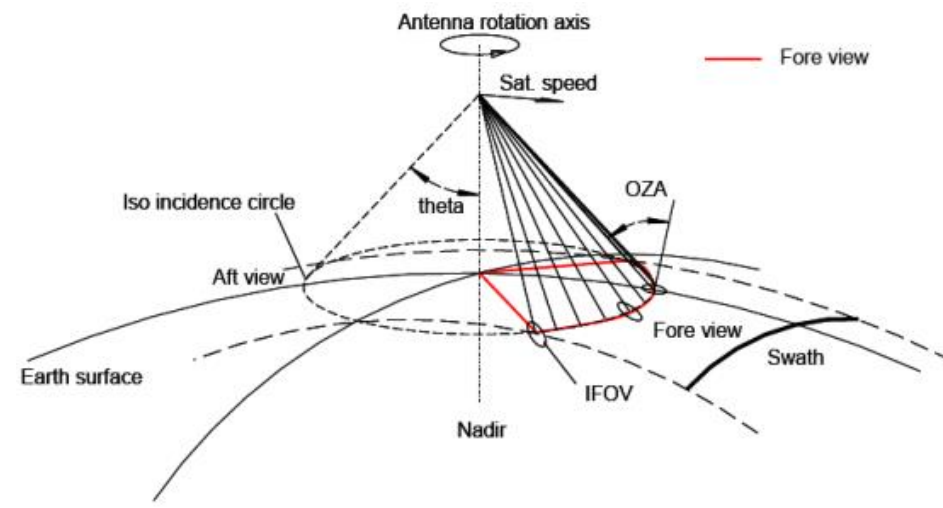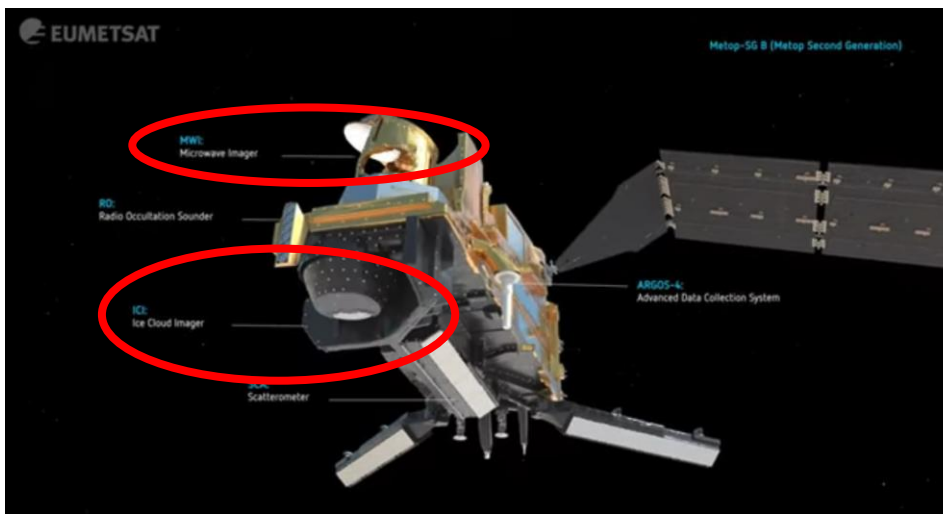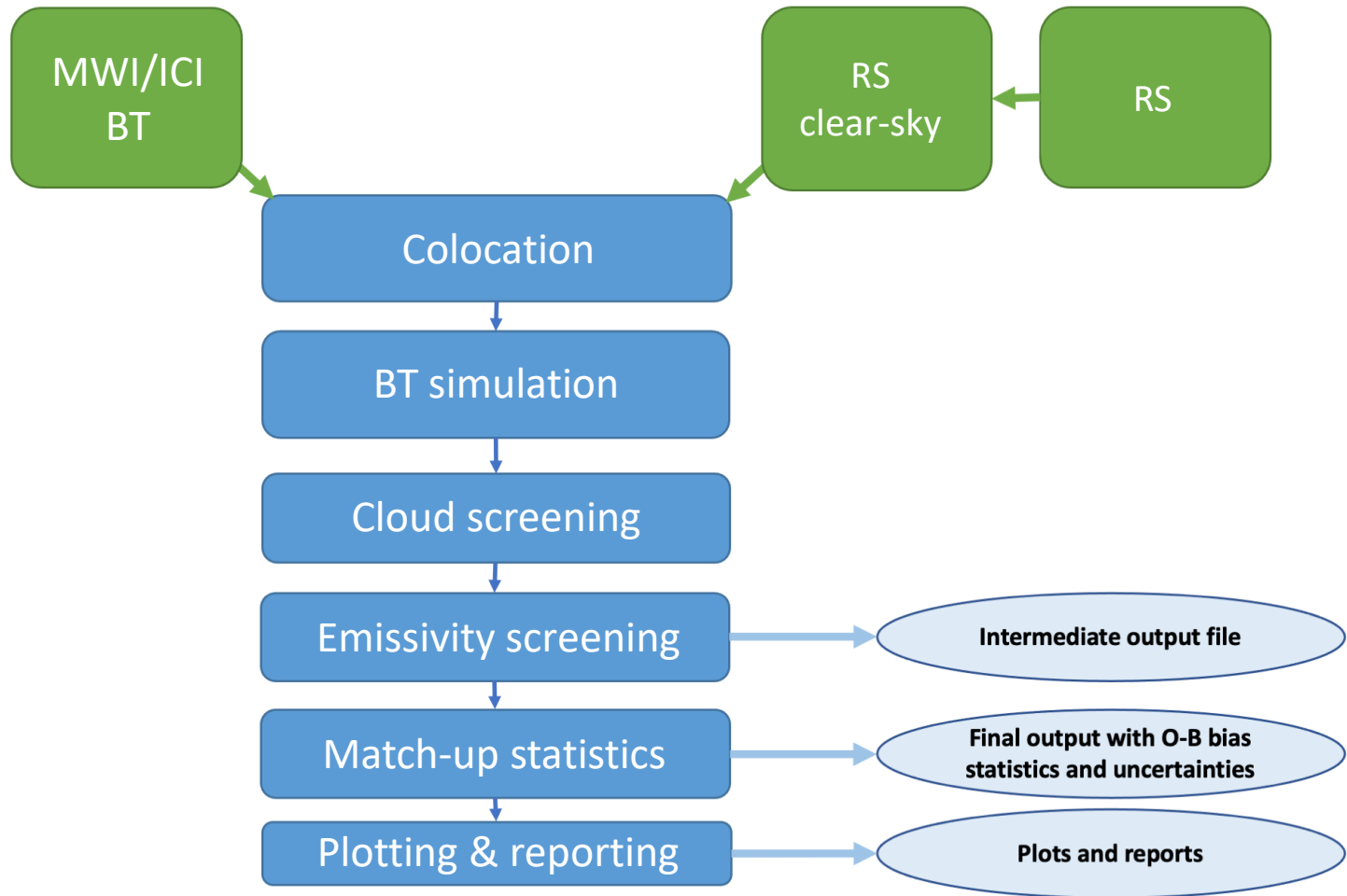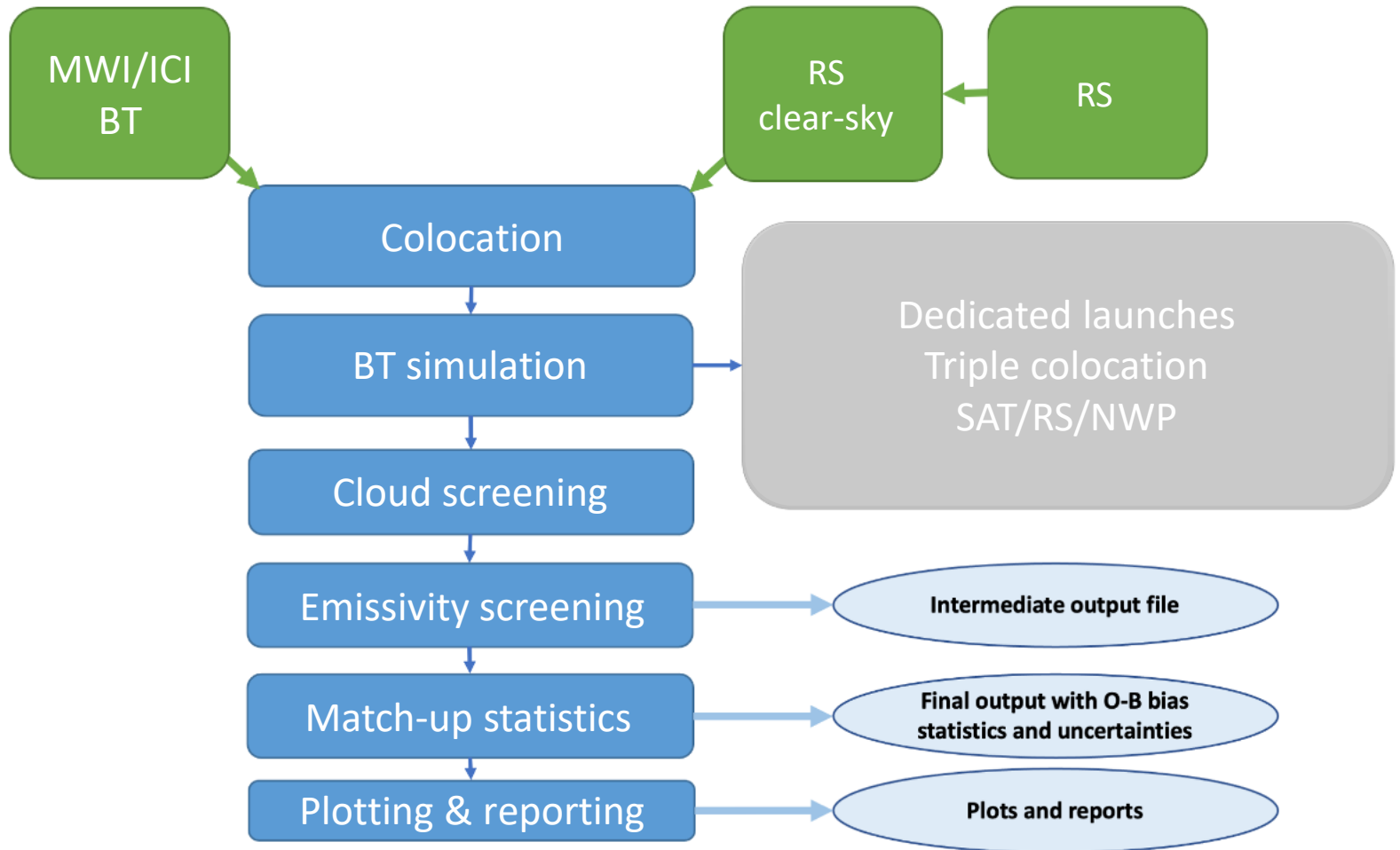
VICIRS approach

VICIRS schedule

2023 ——————————————————— 2024

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Months from KO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	

Task	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Task 0 Management, report & outreach	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Task 1 Critical Review	■	■	■												
Task 2 Methodology analysis			■	■	■	■									
Task 3 Development of Cal/val tool					■	■	■	■	■	■	■	■			
Task 4 Cal/Val tool verification and validation												■	■	■	■

Milestones

KO		PM1					PM2			PM3			PM4	FM

Deliverables

Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
D1														
D2	D2	D2	D2	D2	D2	D2	D2	D2	D2	D2	D2	D2	D2	D2
									D3					D3
	D4	D5							D6	D7	D8	D9	D10	D14
													D11	D15
													D12	D16
													D13	D17
														D18

Methodology

Methodology

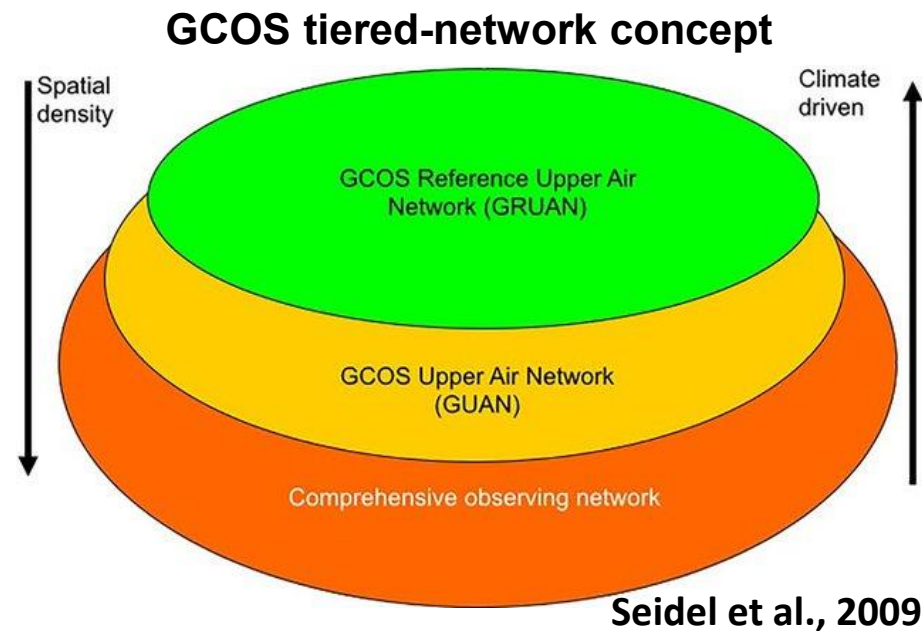# The VICIRS team

Contractor: National Research Council of Italy (CNR)

- **IMAA**: Institute of Methodologies for Environmental Analysis
- **ISAC**: Institute of Atmospheric and Climate Sciences

Radiosonde data

Seidel et al., 2009
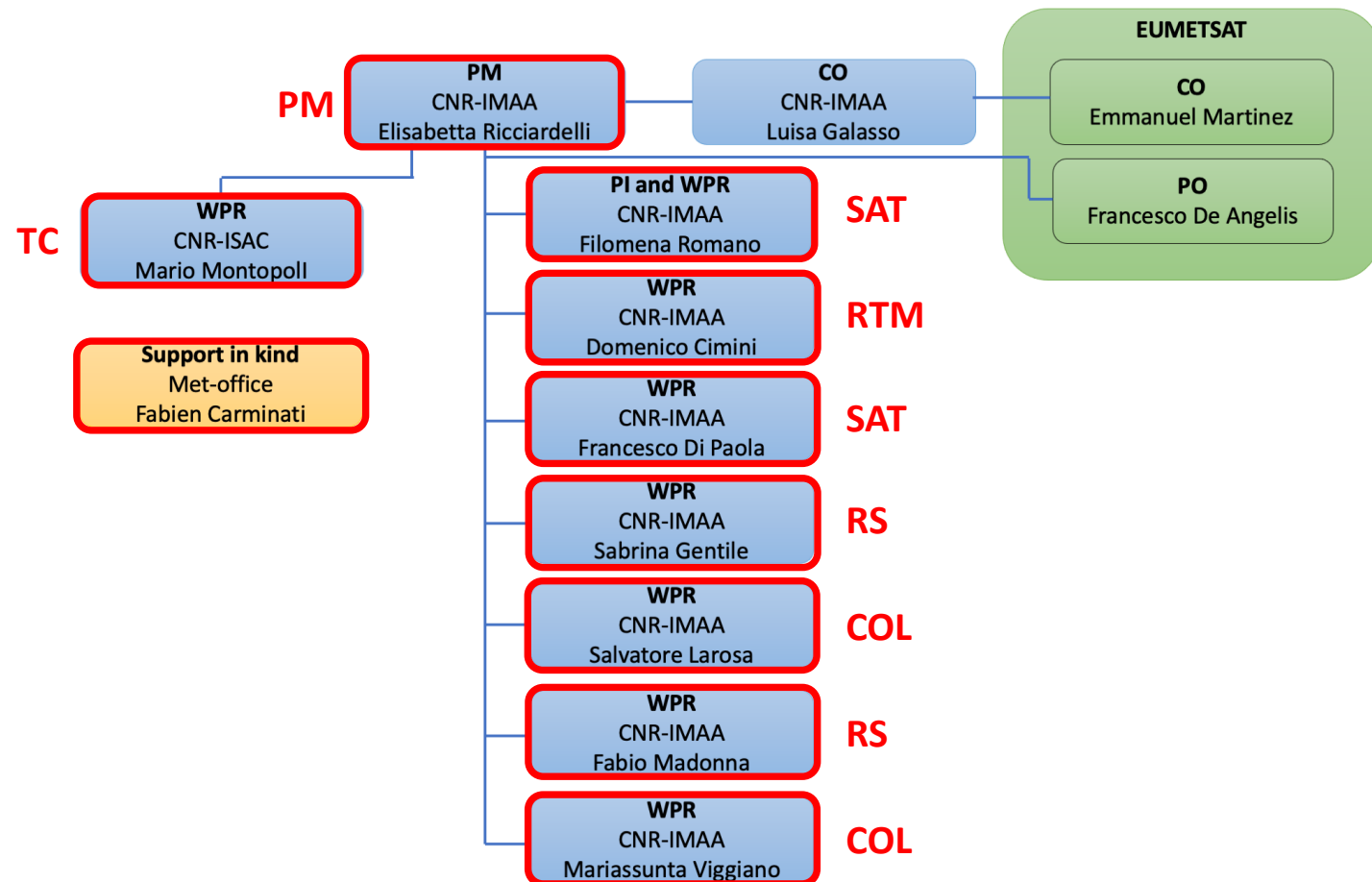
- The **Global Climate Observing System (GCOS) Reference Upper-Air Network (GRUAN)** - homogeneous and fully traceable - with quantified uncertainties.
    - 18 sites (12 certified)
    - Including dedicated launches (from Potenza, only 10 on budget)

- The **Copernicus Climate Change Service (C3S), Radiosounding HARMonization RHARM** (Madonna et al., 2022) - adjusted radiosounding observations of temperature, humidity and wind with estimated uncertainties (building on GRUAN expertise and intercomparison data)
    - 700 sites (including ships)

Radiative Transfer Model

- The **GRUAN processor** (Carminati et al., 2019, developed within **GAIA-CLIM**)

  - **Inputs**: spatially and temporally collocated GRUAN and NWP profile;
  - **Outputs**: BT simulated from the two profiles + BT uncertainty simulated from GRUAN perturbed profile.

- Current version (v6.1) is based on:
  - RTTOV v11.3
  - RadSim v1 ⎤ (both retired and superseded)

- To be updated with:
  - RTTOV v13.1
  - RadSim v3.1
  - Exploit RS41

Collocation criteria

- Temporal and spatial criteria will be defined considering ICI/MWI IFOV
    - 16 km for ICI
    - 10-50 km for MWI

- RS drift may be considered as well.
    - IFOV ⇒ Target Area (TA)
    - TA centred at the radiosonde launch site, whose radius and the number of included IFOVs will depend on balloon drift

- Screen out TA with BT standard deviation (SD) substantially larger than the MWI/ICI radiometric noise
    - As in e.g., Buehler et al. 2004, Moradi et al., 2013, Moradi et al. 2010, Bobryshev et al. 2018

Cal/val tool demonstrator

End-to-end demonstrator with:

- **simulated MWI and ICI Level 1-B data** provided by EUMETSAT (and corresponding radiosondes)

- **observations dataset** from either
  - METOP AMSU A/B
    - EUMETSAT legacy
    - Some overlap with MWI and ICI channels
      - e.g., 23.8, 31.4, 50.3, 52.8, 89, 183.31±7.0 GHz
  - NASA Global Precip Measurement (GPM) Microwave Imager (GMI)
    - Conical scanner (53°, like MWI and ICI)
    - Some overlap with MWI and ICI channels
      - MWI: 18.7, 23.8, 89, 165.5, 183.31±7.0 and ±3.0 GHz
      - ICI: 183.31±7.0 and 183.31±3.4 GHz.