EUMETSAT Scientific service for the support of CO2M product validation methods, reference data provision and processing

CO2M – Cal/Val

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PROGRAMME OF THE EUROPEAN UNION

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BIRA-IASB

ROYAL BELGIAN INSTITUTE FOR SPACE AERONOMY

Proposal consortium organizations

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And an advisory board
Dr. Thorsten Warneke, University of Bremen, TCCON co-chair – representative of Europe/Africa region
Dr. Frank Hase, Karlsruhe Institute of Technology, COCCON representative
Dr. Emmanuel Mahieu, University of Liege, NDACC-IRWG co-chair

=> EUMETSAT found this as a good idea but suggested to form an independent advisory board

Scientific service to support the following activities

Activity 1: Expand on the existing definition of requirements, methods and tools to support the validation and monitoring of the main CO2M user products (XCO_2, XCH_4, NO_2, and SIF), as well as aerosol abundance and optical properties.

Activity 2: Maintain the CO2M reference-data resource database.

Activity 3: Design the operational collection and the provision of (ground-based) reference data to the EUMETSAT CO2M Cal/Val facilities.

Activity 4: Develop and provide an operational CO2M GBP data processing system supported by EUMETSAT specifications and establish the operational provision of original as well as pre-processed GBP data.

Activity 5: Prepare for and support the CO2M Cal/Val team during the commissioning of CO2M products and their transition into operations in applying the resources developed under activity 1 to 4.

Task0

Objectives:

- Project management

Task Manager:

- Mahesh Kumar Sha (BIRA-IASB)

Output:

- progress reports (bullet-list) carried out over the course of one month in a bi-weekly email to EUMETSAT and to the consortia
- progress meeting reports
- financial reports
- contribution to the set-up and maintain a study web-site at the EUMETSAT study web-pages
- attending virtual progress meetings of CO2M level-2 studies (as needed)
- reporting to the CO2M Mission Advisory Group (as needed)

Task1.1: Documentation critical review

Objectives:

- Critical review of the previously developed methodologies and tools, and of the corresponding technical documentation
- Critical review of the “CO2M Ground-Based Network Reference Product Performance Requirements” with suggestions for updates.

Task Manager:

- Tijl Verhoelst (BIRA-IASB)

Output:

- Commented version of technical documentation from Cal/Val study phase 1 (BIRA-IASB, MBER)
- Commented version of the GBP requirements (MBER, BIRA-IASB)

Task1.2: Product Validation Methods (PVPs)

Final objective: requested "Technical note on validation methods and tools v2L" at the end of WP4

Objectives:

- Construct Product Validation Plan (PVP) for CO2 (BIRA-IASB)
- Construct PVP for CH4 (BIRA-IASB)
- Construct PVP for NO2 (BIRA-IASB)
- Map processing steps from the PVPs to corresponding HARP tools (if available) (S[&]T, BIRA-IASB)

Task Manager:

- Tijl Verhoelst (BIRA-IASB)

Output (WP1):

- Outline of technical note on validation methods and tools

Task1.3: Site and network characterization for gap analysis

Overarching objective: valorise the developed databases and tools to identify network gaps and potentially support procurement prioritization.

Objectives:

- Further site characterization building on input from Phase 1, yielding a concise (spreadsheet) sheet of site properties, focusing on geophysical properties relevant for Cal/Val. (BIRA-IASB)
- Network representativeness assessment based on the site characterization for existing and new locations. (BIRA-IASB)
- Key site identification in terms of probed measurement conditions and expected usable co-locations. (BIRA-IASB)

Task Manager:

- Tijl Verhoelst (BIRA-IASB)

Output:

- Spreadsheet with site characterization for networks contributing reference data for CO_2, CH_4 and NO_2
- Metric for calculating expected target parameter diffusion/variance

Task1.4: Construct station footprints and compute overpass statistics

Objectives:

- Maintain the processing chain for the computation of overpass statistics that was deliv-ered with the activity "Scientific Service Support for the Definition of Requirements for an Integrated Function for Cal/Val and Monitoring of GHG Products" (Cal/Val study phase 1)
- Improve the accuracy of the footprint computation and on the representativity of the footprints of the ground-based station network
- Improve the cloud filtering in the processing chain for the overpass statistics
- Update the station footprint data base and overpass statistics at regular time intervals re-flecting changes in the selected network configuration.

Task Manager:

- Thomas Kaminski (iLab)

Output:

- Update of station footprint data base
- Update of overpass statistics per station and month

Task2.1: (Re-)Create and maintain the CO2M GB RDB and WS

Objectives:

- Critical review of the previously developed CO2M reference data and groundbased station network database (BIRA-IASB)
- Further improvements of the content stored and presented via the website (BIRA-IASB)
- Update the database with new survey results of the existing and new sites participating in the networks and geoserver content with CO2M tailored products for emissions, other satellites and ancillary data sets as needed with respect to mission or newer information available during the course of the project (BIRA-IASB).

Task Manager:

- Mahesh Kumar Sha (BIRA-IASB)

Output:

- Recreated and expanded database
- Updated co2m.aeronomie.be website with new content stored as needed with respect to missions.

Task 3.1 (S[&]T) – overall scope

- Single data management service
  - Hosted in cloud environment (S[&]T tenant area at Open Telekom Cloud)
- Input streams from different sources:
  - TCCON/COCCON via MBER
  - NDACC IRWG&FRM4DOAS via BIRA-IASB
  - Other uploaded data
- Interface towards EUMETSAT:
  - Query interface: STAC web API?
    - Metadata definition
  - Web UI interface?
  - Download interface: https/sftp?
    - File naming and file format definition

Task3.2: Contractual framework for network data provision

Objectives:

- Establishing an initial list of potential data providers prepared to deliver data in support to CO2M validation and long-term monitoring
- Establishing and monitoring a contractual framework for managing the ground-base data provision

Task Manager:

- Michel Kruglanski (BIRA-IASB)

Output:

- Outline of contractual and management framework for network data reception

Task3.2: Contractual framework for network data provision

- Indicative schedule
  - WP1 (June 2025 – November 2025)
    - Outline of contractual and management framework for network data reception
  - WP2 (December 2025 – May 2026)
    - Finalised contractual and management framework for network data reception
  - WP3 (June 2026 – November 2026)
    - Contract with initial list of station providers established and start of network test-data reception.
  - WP4 (December 2026 – May 2027)
    - Contract with updated list of station providers established and start routine network test-data reception.
  - WP5 (June 2027 – November 2027)
    - Contract with updated list of station providers and data reception.
    - Pre-operational network data provision.
  - WP6 (December 2027 – May 2028)
    - Operational network data provision.

T 4.1 : Network-data level-1 to 2 processor development and provision of original network and CO2M dedicated GBP

Task Manager: M. Buschmann (MBER)

- Objectives
  a) Collect level-1 and auxiliary data from TCCON and COCCON networks
  b) Create and operate a GBP processing facility for level-2 data from TCCON and COCCON
- Contributors
  - MBER (Matthias Buschmann)

T 4.1 : Network-data level-1 to 2 processor development and provision of original network and CO2M dedicated GBP

Task Manager: M. Buschmann (MBER)

- Indicative schedule (as per Table 10.1)
  - WP1 (June 2025 – November 2025)
    - **Outline of GBP processing design**
  - WP2 (December 2025 – May 2026)
    - GBP processing design version 1 (technical note)
    - **GBP processing proto-type version 1**
  - WP3 (June 2026 – November 2026)
    - GBP processing design version 1.1
    - GBP processor, data provision interface version 1.1
    - **Start of GBP test-data provision**
  - WP4 (December 2026 – May 2027)
    - GBP processing design version 2L
    - GBP processor, data provision interface, and data products v2L
    - **Start of routine demonstrational GBP data provision**
  - WP5 (June 2027 – November 2027)
    - GBP processing design version 2L
    - GBP processor, data provision interface, and data products v2L
    - **Start of routine pre-operational GBP data provision**
  - WP6 (December 2027 – May 2028)
    - Expanded routine network data provision.
    - **Start of operational GBP data provision**

Task5.1: Scientific support to the commissioning phase of the CO2M products

Objectives:

- Further support for timely reference data provision, if needed from sites not operationally streamed (BIRA-IASB, MBER)
- Expert judgment of validation outputs from the EUMETSAT Cal/Val system (BIRAIASB)
- A one-time external validation of commissioning phase test data for CO2, CH4 and NO2 as a verification of the EUMETSAT Cal/Val system outputs (scope limited by the allocated resources) (BIRA-IASB)
- Operational provision of GBP (MBER)

Task Manager:

- Mahesh Kumar Sha (BIRA-IASB)

Output:

- Scientific support to CO2M validation: expert judgment and verification
- Operational provision of GBP level-2 data from Activity 4
- Additional reference data if needed