

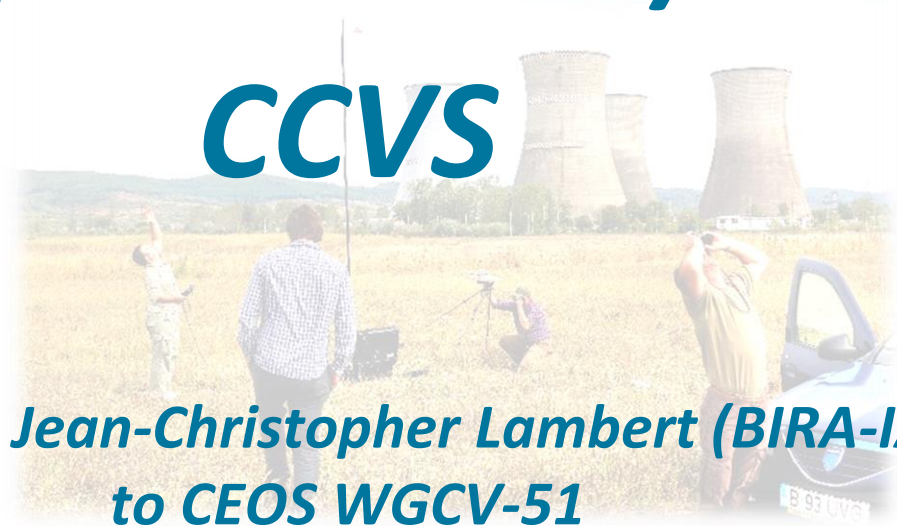


**CCVS**



# *EU H2020 Copernicus Cal/Val Solution*

## **CCVS**



*Reported by Jean-Christopher Lambert (BIRA-IASB)  
to CEOS WGCV-51*

*Tokyo, 3-6 October 2022*





CCVS

# Scope of the CCVS project

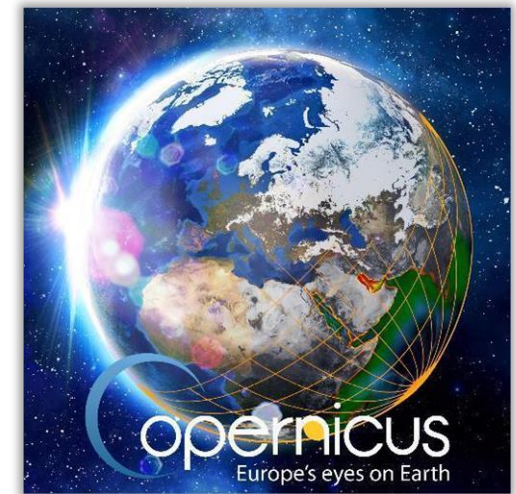
## ❖ Objective:

To define a holistic solution for all Copernicus Sentinel missions (either operational or planned) to overcome current limitations of Calibration and Validation (Cal/Val) activities.

❖ Project duration: Dec. 2020 to Nov. 2022

❖ Project website: <https://ccvs.eu>

❖ Contact us: [contact@ccvs.eu](mailto:contact@ccvs.eu)





CCVS

# Partners

Project Lead  
Sébastien Clerc



## 14 Partners



DLR



Koninklijk Nederlands  
Meteorologisch Instituut  
Ministerie van Infrastructuur en Waterstaat



UNIVERSITY OF TARTU  
Tartu Observatory



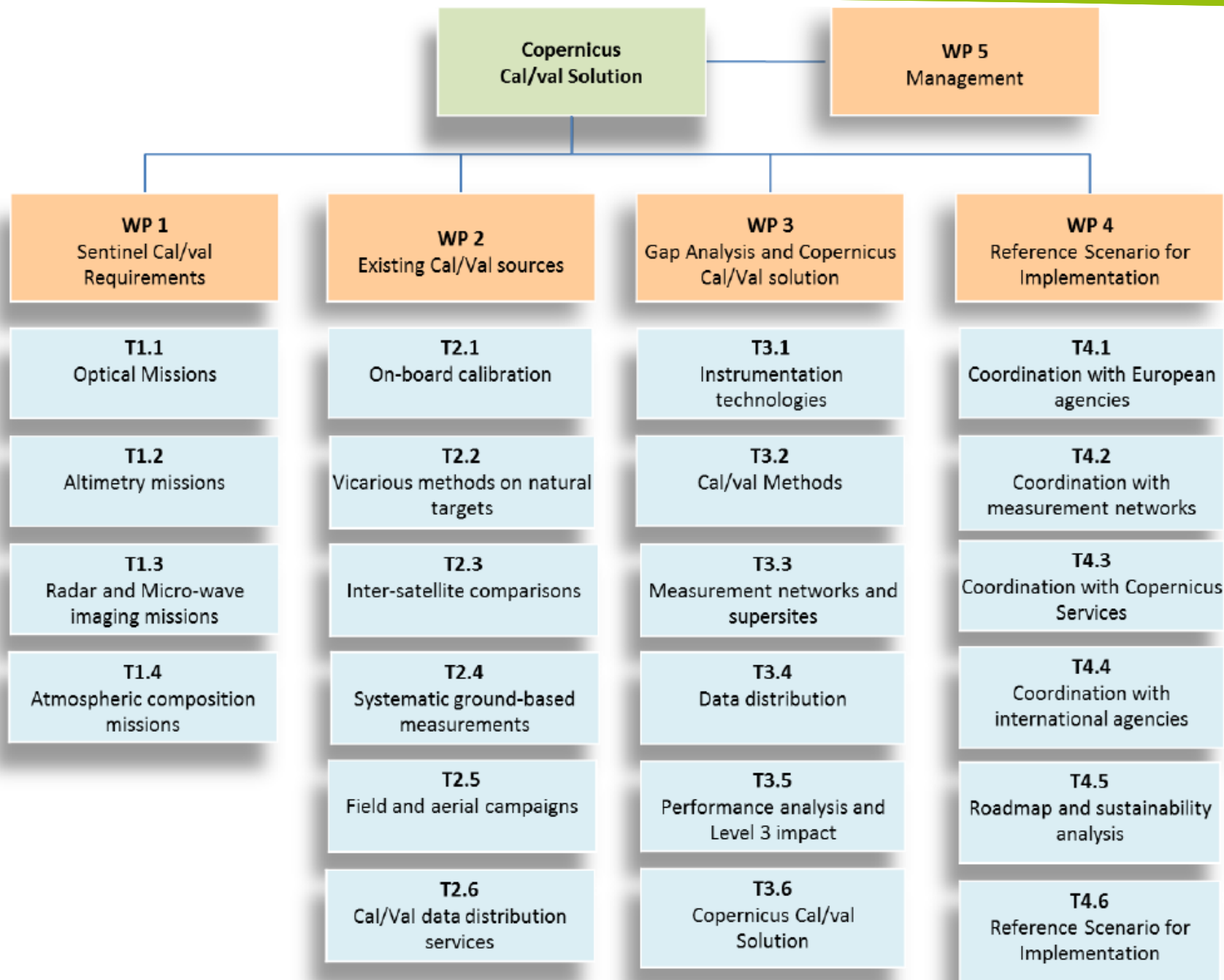
Universiteit  
Antwerpen

## Advisory Board



European  
Environment  
Agency









**CCVS**

# Sentinel Cal/Val Requirements

Listing all Sentinel L1 and L2 products (current and foreseen)

## WP 1

Sentinel Cal/val  
Requirements

### T1.1

Optical Missions

### T1.2

Altimetry missions

### T1.3

Radar and Micro-wave  
imaging missions

### T1.4

Atmospheric composition  
missions



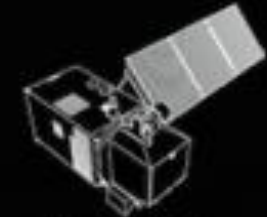
sentinel-6



sentinel-1



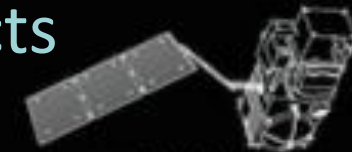
sentinel-5



sentinel-2



sentinel-sp



sentinel-3



sentinel-4

Establish calibration  
and validation needs  
for all Sentinel L1 and  
L2 data products

✓ Series of reports available via project website <https://ccvs.eu>

# Existing Cal/Val Sources, Methods and Services

WP 2

Existing Cal/Val sources

T2.1

On-board calibration

T2.2

Vicarious methods on natural targets

T2.3

Inter-satellite comparisons

T2.4

Systematic ground-based measurements

T2.5

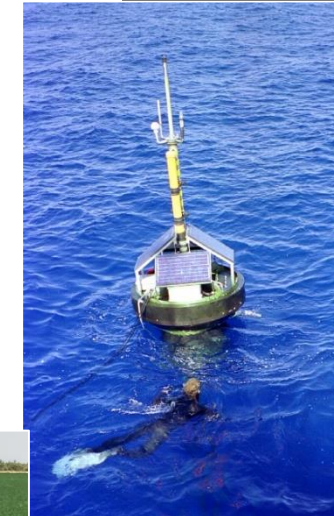
Field and aerial campaigns

T2.6

Cal/Val data distribution services

- ❖ Identify currently available Calibration and Validation sources
- ❖ Establish constraints and limitations affecting these sources (technical and operational)
- ❖ Identify perspectives on methods and emerging technologies

✓ Series of reports available via project website  
<https://ccvs.eu>



# Gap Analysis & Cal/Val Solution

**WP 3**  
Gap Analysis and Copernicus  
Cal/Val solution

**T3.1**  
Instrumentation  
technologies

**T3.2**  
Cal/val Methods

**T3.3**  
Measurement networks and  
supersites

**T3.4**  
Data distribution

**T3.5**  
Performance analysis and  
Level 3 impact

**T3.6**  
Copernicus Cal/val  
Solution

- ❖ Identify gaps in the current Cal/Val of Sentinel missions
- ❖ Identify synergies and cross-Sentinel harmonisation needs
- ❖ Define a network of core operational sites for the Sentinel missions
- ❖ Define an operational organization and procedures for the cal/val activities of the Sentinel missions (data curation and distribution)
- ❖ Analyse expected impact on uncertainty of Sentinel products and downstream products (including Level-3)



fiducial reference  
measurements for  
satellite ocean colour



fiducial reference  
measurements  
for vegetation



**EUMETSAT**  
CO2M FRM Study

**FRM4DOAS**



**FRM4STS**



FRM4ALT

FIDUCIAL  
REFERENCE  
MEASUREMENTS  
FOR ALTIMETRY



FRM4

RADAR



**pandonia**  
Fiducial Reference Measurements  
for Atmospheric Composition



+ making existing monitoring networks “FRM compliant”





**CCVS deliverables**

<https://ccvs.eu>

Ref.	Deliverable	Due Date	Description
D1.1	<a href="#">Optical Missions Cal/Val Requirements</a>	June 2021	Collection of Cal/Val requirements for the operational optical sensors (Sentinel-3 OLCI/SLSTR/SYNERGY, Sentinel-2) and the future optical missions (CHIME, LSTM)
D1.2	<a href="#">Altimetry Missions Cal/Val Requirements</a>	June 2021	Collection of Cal/Val requirements for the operational altimetry sensors (Sentinel-3 SRAL, Sentinel-6) and the future altimetry mission (CRISTAL)
D1.3	<a href="#">Radar and passive Microwave Missions Cal/Val Requirements</a>	June 2021	Collection of Cal/Val requirements for the operational radar missions (Sentinel-1) and the future radar and passive microwave missions (ROSE-L, CIMR)
D1.4	<a href="#">Atmospheric Composition Missions Cal/Val Requirements</a>	June 2021	Collection of Cal/Val requirements for the operational atmospheric composition missions (Sentinel-4, Sentinel-5) and the future atmospheric composition mission (CO2M)
D2.1	<a href="#">On-Board Calibration Sources</a>	June 2021	List of existing on-board calibration devices used for Sentinel missions and foreseen for future High Priority Copernicus Missions
D2.2	<a href="#">Vicarious Methods on Natural Targets</a>	June 2021	List calibration methods based on observation of natural sites/targets (including Moon, Sun and stars)
D2.3	<a href="#">Inter-Satellite Comparison Methods</a>	June 2021	Identify inter-satellite comparison methods (including SNO, tandem) and their current used for Sentinel missions. Identification of emerging methods and approaches
D2.4	<a href="#">Systematic Ground-Based Measurement Sites and Networks</a>	June 2021	Survey of instrumented sites and networks (including drifters) acquiring measurements in a systematic manner, in Europe and worldwide
D2.5	<a href="#">Field and Aerial Campaigns</a>	June 2021	Survey of field and airborne campaigns, in Europe and worldwide
D2.6	<a href="#">Cal/Val Data Distribution Services</a>	June 2021	Survey existing Cal/Val data distribution services and portals and their current use and perspective for the Copernicus program
D3.1	Recommendations for R&D activities on instrumentation technologies	September 2022	
D3.2	Recommendations for R&D activities on Cal/Val methods	September 2022	





# Reference Scenario for Implementation



- ❖ Define a way forward for the implementation of the Copernicus Cal/Val solution
- ❖ Establish roles and responsibilities among Copernicus stakeholders
- ❖ Analyse sustainability and identify funding gaps
- ❖ Define implementation schedule





# *Involvement of Space Agencies*

## **CCVS**

- ❖ Agencies on Advisory Board, progress meetings, review of deliverables
- ❖ CCVS presentations at WGCV meetings and EO focused conferences
- ❖ Participation of space agencies in major CCVS events
  - ❖ 1<sup>st</sup> CCVS workshop 13-15 October 2021
  - ❖ 2<sup>nd</sup> CCVS workshop “In-Situ” 9-11 May 2022
  - ❖ Space agencies WG meeting 27 July 2022
- ❖ List of recommendations for EO domains and cross-missions as
  - Actions, e.g., on calibration activities/operations, on documentation...
  - R&D activities, e.g., efforts to be continued/re-inforced
  - General and specific needs for reference data with uncertainty estimates
  - Challenges to be addressed for the Cal/Val of future missions
  - Organization and coordination aspects





**CCVS**

# ***WGCV Relevant Highlights***

## **❖ Uncertainty estimates for Copernicus data products**

- ❖ Methodologies for assessment of prognostics uncertainties need consolidation, harmonization and generalization
- ❖ Uncertainty propagation needed through the entire processing chain, including L3 and L4 Copernicus services products ideally
- ❖ Training / education on state-of-the-art expression and calculation of uncertainties

## **❖ Copernicus Cal/Val Data Service**

- ❖ CCVS would see a benefit for a coordination body at Copernicus level to oversee the collection and distribution of Cal/Val data for Sentinel and Copernicus services products
  - ✓ In coordination with ESA – EUMETSAT and CEOS WGCV and with in-situ data providers







**CCVS**

# ***WGCV Relevant Highlights***

## **❖ Labelling of FRM sites**

- ❖ CCVS recommends a “certification” mechanism for reference measurements.
- ❖ FRM-maturity evaluation based on self assessment and reporting
- ❖ Ideally an FRM-maturity level with several stages
- ❖ CEOS WGCV would be in the best position to deliver this “certification” and guidelines for further evolution towards FRM status where needed.

## **❖ Campaign coordination**

- ❖ Announcement of future campaigns (at CEOS level) to foster cooperation
- ❖ Formatting and archiving of Cal/Val campaign data

## **❖ Cross-mission Cal/Val activities**

- ❖ R&D to explore feasibility/usefulness, e.g., wave SAR/altimetry intercomparisons
- ❖ Need for an altimetry inter-calibration forum incl. Chinese and Indian agencies





**CCVS**

# **WGCV Relevant Highlights**

## **❖ State-of-the-art/advanced validation methods**

- ❖ R&D to mature and advance validation methods and fill in identified gaps
- ❖ Training / education on advanced validation methods

## **❖ Validation reporting**

- ❖ Cross-agencies harmonization of reporting approaches beneficial for users.

## **❖ Specific recommendations by EO thematic domain**

- ✓ See details in deliverables on <https://ccvs.eu> for

Optical

Altimetry

Orbit validation

Ocean/sea state, topography

Atmospheric composition

SAR and microwave imaging

## **❖ Special Issue of MDPI Remote Sensing**

[https://www.mdpi.com/journal/remotesensing/special\\_issues/J3CYH3OQV0](https://www.mdpi.com/journal/remotesensing/special_issues/J3CYH3OQV0)





CCVS

