



Copernicus Cal/Val synergy among current and future optical missions

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CCVS

Copernicus Cal/Val Solution

- ❖ Current Cal/Val activities are limited and insufficiently harmonized between different missions
- ❖ Project objective:
 - ❖ define a holistic solution for all Copernicus Sentinel missions for current and **upcoming Sentinel-missions**
 - ❖ exploit existing synergies between the missions
- ❖ What we did:
 - ❖ overview of existing calibration and validation sources and means
 - ✓ for sensor calibration and characterization as well as for product quality
 - ❖ identified gaps in the current cal/val practice
 - ✓ Copernicus Cal/Val maturity
 - ❖ proposing long-term solutions
 - ✓ Required developments in terms of technologies and instrumentation, Cal/Val methods, instrumented sites and dissemination service
- ❖ Based on experience from
 - ❖ many experts
 - ❖ different working groups gathering
 - ✓ European Space Agencies, Copernicus Services, measurement networks, International partners



Optical Component Copernicus Cal/Val Maturity

❖ Calibration and Characterization

- ❖ Main weak point: Pre-flight characterization
 - ✓ missing measurement uncertainties
 - ✓ improve SI-traceability (broken due to the impact of launch)
 - ✓ often inconsistent with observed in-flight performances
- ❖ Lessons learned:
 - ✓ better rely on in-flight characterization (tandem phases, inter-comparison with reference sensor, straylight from Moon observations, yaw maneuvers for diffuser characterization)
 - ✓ on-board spectral calibration or characterization for optical sensors is considered a weak point for current missions
- ❖ Geometric calibration of TIR channels limited (lack of permanent geometric features)



Optical Component Copernicus Cal/Val Maturity Overall Assessment

❖ Product quality

❖ Validation:

- ✓ very heterogenous validation maturity level among Sentinel core products
- ✓ L1 generally higher maturity than L2

❖ Uncertainties

- ✓ prognostic per pixel uncertainties mostly not provided
- ✓ very large effort needed to develop, generalize, produce and validate uncertainties
- ✓ uncertainty need to be propagated through the whole processing chain, including L3 and L4 Copernicus services products
- ✓ mission requirements have to be refined and updated accordingly

❖ Required R&D efforts for validation

- ✓ to improve models for natural scenes
(Rayleigh method, Pseudo-Invariant Calibration Sites, the Moon, Deep Convective Cloud)
- ✓ to improve RTMs
- ✓ to improve cloud and cloud shadow masks
- ✓ to improve validation methodologies for fire products
- ✓ to improve Cal/Val methods for surface reflectance



Optical Component Copernicus Cal/Val maturity Overall Assessment

❖ Reference measurements:

- ❖ Level of confidence established by the validation depends on the quality of the reference data
- ❖ lack of SI traceable reference measurements and FRM
 - ✓ poor representativeness (surface reflectance)
--> progressively develop an **operational network providing hyperspectral directional reflectance** validation products
 - ✓ poor timeliness and temporal sampling (chlorophyll concentration, fire radiative power)
 - ✓ inadequate accuracy (sea surface level, CO2 concentration)
reference data should have an uncertainty lower than the product under test
- ❖ a concerted reference data collection strategy and coordination body at Copernicus level is needed