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New Sentinel-2 radiometric validation approaches (SEOM program)

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SEOM is an ESA program element whose one of the objectives aims at launching state-of-the-art studies for the scientific exploitation of operational missions. In the frame of this program, ESA awarded ACRI-ST and its partners Rayference and National Physical Laboratory (NPL) early 2016 for a R&D study on the development and intercomparison of algorithms for validating the Sentinel-2 radiometric L1 data products beyond the baseline algorithms used operationally in the frame of the S2 Mission Performance Centre.

In this context, several algorithms have been proposed and are currently in development:

The first one is based on the exploitation of Deep Convective Cloud (DCC) observations over ocean. This method allows an inter-band radiometry validation from the blue to the NIR (typically from B1 to B8a) from a reference band already validated for example with the well-known Rayleigh method. Due to their physical properties, DCCs appear from the remote sensing point of view to have bright and cold tops and they can be used as invariant targets to monitor the radiometric response degradation of reflective solar bands. The DCC approach is statistical i.e. the method shall be applied on a large number of measurements to derive reliable statistics and decrease the impact of the perturbing contributors.

The second radiometric validation method is based on the exploitation of matchups combining both concomitant in-situ measurements and Sentinel-2 observations. The in-situ measurements which are used here correspond to measurements acquired in the frame of the RadCalNet networks. The validation is performed for the Sentinel-2 bands similar to the bands of the instruments equipping the validation site. The measurements from the Cimel CE 318 12-filters BRDF Sun Photometer installed recently in the Gobabeb site near the Namib desert are used for this method.

A comprehensive verification of the calibration requires an analysis of MSI radiances over the full dynamic range, including low radiances, as extreme values are more subject to instrument response non-linearity. The third method developed in the frame of this project aims to address this point. It is based on a comparison of Sentinel-2 observations over coastal waters which have low radiometry and corresponding Radiative Transfer (RT) simulations using AERONET-OC measurements.

Finally, a last method is developed using RadCalNet measurements and Sentinel-2 observations to validate the radiometry of mid/low resolution sensors such as Sentinel-3/OLCI. The RadCalNet measurements are transferred from the RadCalNet sites to Pseudo Invariant Calibration Sites (PICS) using Sentinel-2, and then these larger sites are used to validate mid- and low-resolution sensors to the RadCalNet reference.

For all the developed methods, an uncertainty budget is derived following QA4EO guidelines.

A last step of this ESA project is dedicated to an Inter-comparison Workshop open to entities involved in Sentinel-2 radiometric validation activities. Blind inter-comparison tests over a series of images will be proposed and the results will be discussed during the workshop.