International Ocean Colour Coordinating Group

Request to manufacturers of in situ and above-water spectral imaging radiometers in the UV, VIS and NIR range

The quality of the satellite Ocean Colour data products and user services relies on the quality of in situ radiometric measurements used in algorithm development and product validations (see list of current and scheduled Ocean Colour space missions on the IOCCG website). Exhaustive collections of in situ radiometric measurements, such as SeaBASS, OC-CCI and GLORIA, demonstrate the importance of the instruments that manufacturers provide to the Ocean Colour community. Satellite Ocean Colour observations are a vital means for understanding the ecology and biogeochemistry of our oceans as well as the threats they face in a changing climate. Ocean Colour is an Essential Climate Variable. The data are critical for managing aquatic resources and water quality to sustain a habitable planet, and safeguard human health and the health and biodiversity of aquatic ecosystems. Ocean Colour observations are, however, as priceless as they are difficult. The satellite signal coming from natural water bodies is low in the visible range of the spectrum due to a large contribution from the atmosphere, and is confounded with artefacts (for example, sea surface glitter). Space-borne instruments must be accurately calibrated and characterised before launch, monitored while in space, and additionally vicarious calibrated.

Similar calibration and characterisation activities are also performed on field radiometers, so that the community can depend on the validation and the algorithms that define the performance of satellite missions. However, these calibration/characterization activities are often hindered because of a lack of manufacturers' statements about field radiometer calibration uncertainties, and a lack of characterisation of critical effects such as non-linearity, internal spectral stray light, and variability of angular response. In this context, ESA (2016-2019) and EUMETSAT (2021-present) conducted a series of *FRM4SOC* (Fiducial Reference Measurements for Satellite Ocean Colour) projects with the overarching goal to promote the adoption of the Fiducial Reference Measurement (FRM) standards in Ocean Colour. These FRM standards include a series of requirements on radiometers to ensure documented traceability to SI units via an unbroken chain of calibrations, and the assessment of instrument-related uncertainties and a series of recommended characterisations. Among several documents issued in the frame of this project, one (D-27) is intended to inform radiometer manufacturers about a list of requirements to meet the FRM standard, as well as to provide recommendations from the user experience to improve the performance of the instruments (D-27, section 4).

Agencies and institutions work together to teach the Ocean Colour community the importance of calibration/characterization of their radiometers. They also provide guidelines, measurement procedures, support for calibrations, and tools (e.g. HyperCP). However, it is impossible to maintain the required FRM standard and assign uncertainties if **absolute radiometric response coefficients provided by the manufacturers do not have any measures of uncertainty assigned to them**.

The ocean colour community presents the following requests for your consideration:

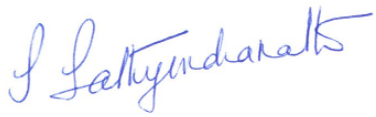
i. Provide absolute calibration coefficients with associated uncertainties.
This is most pressing. The calibration uncertainty associated with the radiometer absolute response is essential. It is required to provide traceability to SI. Without these, users may not be able to achieve the FRM standard.

ii. Participate in comparison experiments with national metrology institutes and/or secondary calibration laboratories.
Such experiments can provide metrology support on laboratory standards, laboratory set up, and ensure metrological compatibility of the absolute calibration coefficients.

iii. Help to propagate FRM guidelines, procedures and tools.
Information can be provided in radiometer manuals and in direct communication with customers about existing FRM resources, such as additional characterisations and enhanced calibrations needed to achieve the FRM standards, and guidance to the IOCCG and FRM4SOC documentation to ensure that manufacturers, calibration labs, and users have an unambiguous understanding.

A detailed and specific list of recommendations is included in the dedicated FRM4SOC D-27 document.

We hope, with this request, to convey the importance of joint collaboration with the ocean colour community on the quality of field radiometric measurements.



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