Proposal for an IOCCG Working Group

Working group title:

Options and approaches to the long-term vicarious adjustment of Ocean Colour sensors

Proposed by:

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Background and rationale

Timeliness for this working group

There are currently seven Ocean Colour sensors operated by seven space agencies or national organisations (ESA, EUMETSAT, ISRO, KARI/KIOST, NASA, NOAA, SOA). Another ten new missions from nine different institutions (CNSA, CONAE, DLR, ESA, ISRO, JAXA, KARI/KIOST, NASA, NOAA) are planned for launch between 2017 and 2022. The inflation of satellite ocean colour data available represents a great opportunity for global monitoring of the Earth environment as it ensures a continuous supply of Earth observation data. Nonetheless, the challenge remains to ensure that these data meet OCR uncertainty requirement.

The historical uncertainty requirement for remotely-sensed water leaving reflectance (ρw) was set at 5% in the blue green part of the spectrum for oligotrophic waters (Gordon & Clark, 1981, Gordon et al., 1983, Gordon, 1987, Gordon 1997). However, it has been demonstrated (Gordon, 1998, Hooker et al 1992, Hooker and McClain 2000) that reaching 5% accuracy on ρ_w requires an absolute accuracy on ρ_{TOA} between 0.25% and 1%, which cannot be achieved through purely instrumental calibration and characterisation. For this reason, we rely on a "system vicarious calibration" (SVC), therefore on a complementary calibration using ground-truth measurements (Franz et al. 2001, Franz et al. 2007; Bailey et al. 2008), to meet the requirement uncertainty.

System Vicarious Calibration (SVC) is therefore a fundamental and intrinsic part of a satellite ocean colour mission. It is consequently fundamental to bring in situ acquisition of OCR at the highest possible standard of precision, accuracy.

The proposed working group will foster a wide-ranging debate with the objective to provide guidelines on the best practices for SVC.

Why through the IOCCG?

Efficient ocean colour data validation and calibration of present and future missions requires

- improving the precision and accuracy of in situ data available ;
- improving the global distribution of the measurements;
- reaching SI traceability standards ;

Systems like BOUSSOLE, MOBY or AERONET-OC already produce OCR to a high quality standard and lessons learnt from their respective research group will be highly beneficial to the community. Widely spreading the conclusions of the working group would be facilitated through the IOCCG.

In addition, the working group and the proposed workshop (see below) fits into the recommendations of the INSITU-OCR White Paper, among which is "to organize a series of dedicated working group to actively address specific issues".

Relation with exiting activities

The working group will build up on:

- ESA project FRM4SOC (https://frm4soc.org/ ; June 2016 to June 2018) ;
- and EUMETSAT project OC-VCAL (October 2016 to October 2018) ;

One element of the FRM4SOC project is to organise a workshop on vicarious infrastructure (https://frm4soc.org/index.php/activities/workshop-on-vicarious-infrastructure/). The workshop will be the opportunity to bring together the international community and open the discussions.

Terms of reference

The prime objective of the working group is to define the best practices to reach a high standard of precision and accuracy for in situ OCR measurements necessary to fulfil the SVC requirements. To achieve this, the working group will address the following tasks:

- Review of historical and contemporary approaches to SVC
- Document lessons learned from international teams;
- Review the strengths and weaknesses of alternative methods and approaches to OCR satellite SVC;
- Review and define justified and traceable requirements for measurements to be appropriate for SVC of satellite OCR
- Review the costs to implement, operate and maintain satellite OCR SVC infrastructure
- The working group shall conclude with a consensus on the way forward to deliver the best scientific outcomes to support long-term ocean colour SVC

A second objective is:

- To assess the procedures used to derive SVC gains and in particular the impact of in situ data uncertainty

The workshop organized as part of the FRM4SOC project will end-up with a conference proceeding and a monograph. The latest to be reviewed by the working group members shall serve as a baseline for the IOCCG monograph.

Proposed membership

The proposed members of the work group are listed below. It represents a total of 15 institutions from the EU, USA, Korea, Japan and China.

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Draft time line

- February 2017: 3-day International workshop on SVC. This workshop is already in preparation with confirmed attendance of key research laboratories.
- Spring 2017: writing of the workshop report.
- Summer 2017: report review by WG members
- Spring/summer 2017: field inter-comparison experiment at the Acqua Alta oceanographic tower
- Summer/Fall 2017: first draft of the IOCCG report
- June 2018: Final report delivery

References:

Bailey, S. W., B. H. Hooker, D. Antoine, B. A. Franz and P. J. Werdell, 2008. Sources and assumption for the vicarious calibration of ocean color satellite observations, Applied Optics Vol. 47, No. 12, 2035 – 2045.

Franz, B. A., E. J. Ainsworth and S. W. Bailey, 2001. SeaWiFS, vicarious calibration: an alternative approach utilizing simultaneous in situ observations of oceanic and atmospheric optical, properties, NASA Tech. Memo. 209982, National Aeronautics, and Space Administration, Goddard Space Flight Center, Greenbelt, MD.

Franz, B. A., S. W. Bailey, J. Werdell, Ch. McClain, 2007. Sensor-independent approach to the vicarious calibration. of satellite ocean color radiometryc. Applied Optics, Vol. 46, No. 22, 5068 – 5082.

Gordon, H. R. (1987). Calibration requirements and methodology for remote sensors viewing the ocean in the visible. Remote Sensing of Environment,22,103–126.

Gordon, H. R., 1997. Atmospheric correction of ocean color imagery in the Earth observing system era, J. Geophys. Res. 102D, 17081 – 17106.

Gordon, H. R., & Clark, D. K. (1981). Clear water radiances for atmospheric correction of coastal zone color scanner imagery. Applied Optic,20, 4175–4180.

Gordon, H. R., Clark, D. K., Brown, J. W., Brown, O. B., Evans, R. H., & Broenkow, W. W.(1983). Phytoplankton pigment concentrations in the Middle Atlantic Bight: Comparison of ship determinations and CZCS estimates.Applied Optics,22,20–36.

Gordon, H. R. (1998).In orbit calibration strategy for ocean color sensors.Remote Sensingof Environment,63,265–278.

Hooker, S. B. and C. R. McClain, 2000. The calibration and valida-tion of SeaWiFS data, Prog. Oceanogr. 45, 427 – 465.

Hooker, S. B., W. E. Esaias, G. C. Feldman, W. W. Gregg and C. R. McClain, 1992. An overview of SeaWiFS and ocean color, NASA Tech. Memo. 104566, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD.