IOCCG and OCR-VC updates and status

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and

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What is the IOCCG?

- The International Ocean-Colour Coordinating Group (IOCCG), which was established in 1996, is an Affiliated Programme of the Scientific Committee on Oceanic Research (SCOR), and an Associate Member of CEOS.
- The group is made up of an international committee of experts comprising representatives from both the provider (Space Agencies) and user communities (scientists, managers).
- The objectives of the IOCCG are to develop consensus and synthesis at the world scale in OCR.
- Continuity of ocean colour radiance datasets is addressed through the CEOS OCR-Virtual Constellation.
- The IOCCG has a strong interest in capacity building, and conducts and sponsors advanced training courses.

IOCCG

http://www.ioccg.org/

Recent IOCCG working groups

(An IOCCG report will be published by each WG after 2-3 years investigation)

- In-flight Calibration of Satellite Ocean-Colour Sensors (IOCCG Report 14 (2013))
- Phytoplankton Functional Types (IOCCG Report 15 (2014))
- Ocean Colour Remote Sensing in Polar Seas (IOCCG Report 16 (2015))
- Harmful Algal Blooms
- Uncertainties in Ocean Colour Remote Sensing
- Intercomparison of Atmospheric Correction Algorithms over Optically-Complex Waters
- Earth Observations in Support of Global Water Quality Monitoring
- Ocean Colour Applications for Biogeochemical, Ecosystem and Climate Modelling

IOCCG Contribution to CEOS

- Ocean Colour Radiometry-Virtual Constellation (OCR-VC):
- INSITU-OCR: An INSITU-OCR White Paper was produced by an IOCCG working group chaired by Giuseppe Zibordi (JRC, Italy) and Sean Bailey (NASA GSFC, USA)
- Task Force for the Assessment of Ocean Colour Essential Climate Variables (ECVs)
  - Co chairs J. Yoder and N. Hoepffner → B. Franz and D. Antoine
- Task Force on satellite sensor calibration

Review progress with respect to OCR-VC action items in the Work Plan

VC-7	Catalog of Cal/Val infrastructure and activities	Q2 2015
VC-8	Action Plan for GEO Blue Planet Components	Q4 2015
VC-9	Implementation of the International Network for Sensor InTercomparison and Uncertainty Assessment for Ocean Color Radiometry (INSITU-OCR)	Q1 2015
VC-10	Recommend the creation of a GEO Water Quality of Practice	Q2 2015

- VC-7 – Agency mapping exercise complete
- VC-8 – Implementation plans being formulated/executed
- VC-9 – Moving forward with modular implementation
- VC-10 – Implementation plans being formulated/executed

VC-7: Catalog of Cal/Val infrastructure and activities

- In 2014, IOCCG undertook a relevant **"agency mapping" exercise** that included consideration of available, and planned, international agency assets and resources for OCR cal/val.
- As a first step towards implementation of the International Network for Sensor Inter-comparison and Uncertainty assessment for Ocean Colour Radiometry (INSITU-OCR) by IOCCG member agencies, the IOCCG asked that each agency indicate on the spreadsheet their potential area of contribution to INSITU-OCR implementation.
- At the 3-5 March 2015 IOCCG meeting, IOCCG asked the member agencies to provide an agency-based list of infrastructure and assets. IOCCG has collated this information. Once formatted **IOCCG will submit to CEOS-SIT**.
- Ewa Kwiatkowska (EUMETSAT) attended the WG-Cal/Val Meeting on behalf of the OCR-VC/IOCCG earlier this year, and will continue representing the OCR-VC in these meetings.
- At this meeting it was agreed to **strengthen cooperation between OCR-VC/IOCCG and WGCV** through IOCCG having a permanent seat on WGCV plenaries and through WGCV's review and endorsement of relevant IOCCG recommendations expressed in the documents such as INSITU-OCR White Paper and Report #13.

INSITU-OCR Mapping of Space Agency Contributions

Space Sensor Radiometric Calibration, Characterization and Temporal Stability

R1.1: Comprehensive pre-launch instrument calibration and characterization
R1.2: Open access to calibration and characterization data
R1.3: Permanent working group on satellite sensor calibration
R1.4: Vicarious calibration
R1.5: Support for calibration teams
R1.6: Assess and correct for instrument degradation

Development and Assessment of Satellite Products

R2.1: Distribution of calibrated and uncalibrated data
R2.2: Permanent working groups on algorithm topics
R2.3: Product uncertainties
R2.4: Regional bio-optical algorithms
R2.5: Open access to source codes for processing algorithms
R2.6: Long-term field measurement programs
R2.7: Validation protocols
R2.8: Level-3 data products generation
R2.9: Ancillary data

In situ Data Generation and Handling

R3.1: Improving traceability of in situ measurements
R3.2: Continuous consolidation and update of measurement protocols
R3.3: Uncertainty budgets
R3.4: Quality Assurance of in situ data
R3.5: Archival of in situ data
R3.6: Community processor for in situ data
R3.7: Priority for variables to be collected
R3.8: General coordination of field campaigns

Information Management and Support

R4.1: Accessibility and distribution of large volumes of data
R4.2: Processing capabilities for calibration and validation activities
R4.3: Accessibility to documentation
R4.4: Data formats
R4.5: Support for open source data processing and visualization

VC-9: Implementation of the International Network for Sensor InTercomparison and Uncertainty Assessment for Ocean Color Radiometry (INSITU-OCR)

- IOCCG requested that agencies identify resources to support the INSITU-OCR; IOCCG is using this information to identify gaps in infrastructure that agencies could collectively address.
- As of June 2015, agencies were requested to submit to the IOCCG Chair **a short list of actual gaps in support of existing/upcoming missions**, a list of priorities from their perspective, as well as areas where they need help, e.g., a need for more validation sites. Once the OCR-VC has this updated information compiled, it will be conveyed to CEOS-SIT via the OCR-VC Chairs.
- Additionally, there have been recent discussions about the format for submissions of in situ data to the agencies. For example, it would be beneficial to have an interagency standard template.
- Sustaining current operational activities and establishing new efforts (e.g., pilot investments and projects) to move the OCR-VC and INSITU-OCR forward is a very high priority. Some examples follow:
- NASA has supported three new projects in the areas of the vicarious calibration instrumentation competition for future ocean color missions, as a contribution to INSITU-OCR.

VC-9: Implementation of the International Network for Sensor InTercomparison and Uncertainty Assessment for Ocean Color Radiometry (INSITU-OCR)

- ESA is planning to release an open tender action this spring addressing the need for improved OCR in-situ instrumentation and community consensus protocols for instrument calibration and vicarious adjustments as well as establishing traceability to metrological institutes.
- NOAA continues to fund and sustain MOBY operations (including an on-going system refresh), supporting present and upcoming (operational) missions. Further, NOAA held an initial multi-agency VIIRS validation cruise last November, and it is anticipated that this will be an annual event.
- Additionally, all agencies will be asked to contribute towards the “protocols activity” (e.g., small committee to catalogue and share information regarding **in situ instrumentation (for calibration and validation) protocols**.
- The IOCCG will host a website to disseminate all relevant lists and information (see NASA prototype at oceancolor.gsfc.nasa.gov/cms/ioccg_proto_main).
- The ultimate goal is to enable communication about the refinement of in situ measurement protocols and to reduce redundancy in efforts, fill in gaps, and better target opportunities and key players. This is an early contribution to INSITU-OCR, and this multi-agency collaboration will advance its implementation.

International Ocean Colour Science Meeting 2015

http://iocs.ioccg.org/.

San Francisco, USA, 15 - 18 June 2015

Convened by the International Ocean Colour Coordinating Group (IOCCG)

Sponsored by NASA, NOAA, ESA, EUMETSAT, CNES, SCOR and the Gordon & Betty Moore Foundation

- The overall goal of the IOCS meetings is to bring together ocean colour research scientists and space agency representatives **to help build a strong global ocean colour user community by collectively addressing common issues and goals, and also to promote international linkages among the different communities**.
- The IOCS meetings help the IOCCG in its oversight role and also act to reinforce the voice of the ocean colour community when it comes to high-level discussions with space agencies.
- The overarching theme of IOCS-2015 was "Applications of Ocean Colour from Climate to Water Quality".

IOCS 2015 Meeting Structure

- Agency Reports
  - NASA (USA), NOAA (USA), EUMETSAT (Europe), ESA (Europe), KIOST (South Korea), JAXA (Japan), CNES (France), INPE (Brazil), CSA (Canada), SOA (China), ISRO (India)
- Keynote Addresses (seven speakers)
- Poster sessions
- Breakout Sessions

(1) Remote Sensing of Phytoplankton Composition – Possibilities, Applications and Future Needs

(2) Benefits and Challenges of Geostationary Ocean Colour Remote Sensing – Science and Applications

(3) Understanding and Estimating Uncertainty in Ocean Colour Remote Sensing Data and Derived Products

(4) Understanding and Estimating Uncertainty in Ocean Colour Remote Sensing Data and Derived Products

(5) Ocean Colour Remote Sensing in High Latitude Areas

(6) New Applications Using Very High Resolution Satellite Ocean Colour Data

(7) Joint Hyperspectral Remote Sensing Breakout Meeting

(8) Ecosystems and Climate Change Applications

(9) Satellite Instrument Pre and PostLaunch Calibration

(10) Joint use of Bio-Argo and Ocean Colour

Understanding and Estimating Uncertainty in Ocean Colour Remote Sensing Data and Derived Products

Co-Chairs: Kevin Turpie (UMBC), Emanuel Boss (Univ of Maine), Stéphane Maritorena (UCSB), Frédéric Mélin (EC-JRC), Roland Doeffer (Helmholtz Zentrum Geesthacht), Jeremy Werdell (NASA/GSFC).

- [Importance] Uncertainty estimation should help: improve user confidence in remote sensing data; define the range of possible applications of data products; support data assimilation in ecological and climate models; or support trend analysis in climate research.
- [Gaps] Current comparisons between satellite and in situ measurements are insufficient to determine uncertainty. It is improved by measurement networks, such as AERONET-OC, and will be improved by floats (such as Bio-Argo floats) in the future.
- [Methods] Investigators have offered multiple methods for producing spatially-resolved uncertainty estimates, considering uncertainties in (a) satellite algorithms, (b) the in situ measurements, and (c) sampling discrepancies between the satellite-derived quantities and the validation measurements.
  i) Class-Based Approach –satellite matchups with in situ measurements sorted by water types,
  ii) Machine Learning –in situ and satellite data to directly build relationships between satellite radiometry and derived products and their uncertainty,
  iii) Uncertainty Propagation – Takes measured or modeled uncertainty for the TOA sensor, and propagates it through remote sensing algorithms.
  iv) Algorithm-Based Method – Compares results of two algorithms, where one is known to have a much smaller uncertainty under given known conditions.
  v) Colocation Approach – Compares results from two different sensors that are measuring, ideally nearly simultaneously, the same quantity at the same location.

Understanding and Estimating Uncertainty in Ocean Colour Remote Sensing Data and Derived Products

[Recommendations]

1) It is recommended that the IOCCG establish a permanent group on uncertainty to coordinate and reinforce a dialog between data product users and developers, facilitated through common language and practice based on international standards.
2) The community leverage off of uncertainty studies conducted in other fields: atmospheric sciences were given as an example: field data used for matchup should have passed at least a rudimentary in-situ closure procedure.
3) Exploration of propagating uncertainties from at-sensor radiometry to Rrs uncertainties, propagating Rrs uncertainties into bio-optical algorithms, and propagating in situ measurement uncertainties into bio-optical algorithms are recommended.
4) The inherent algorithm uncertainty should be included in the propagation of uncertainty.
5) More work be done to compare and understand the pros and cons of the various methods for the evaluation of uncertainties.
6) Propagating uncertainties from Level-2 scenes to Level-3 composites should be explored further. As Level-3 composites are used in climatological research, we also need to better understand how trends are affected by all upstream sources of uncertainty.

Satellite Instrument Pre and PostLaunch Calibration

Session Chair: Gerhard Meister (NASA, GSFC)

The eleven speakers (ESA, EUMETSAT, ISRO, KIOST, NASA, NOAA, SOA) provided an overview of calibration activities of current and recent ocean color sensors.

- Fred Patt (NASA) introduced an approach that considers changes of less than 1 count (on the order of 0.1% TOA radiances), the SeaWiFS long term trend of water leaving radiances at 555nm changed significantly enough to be of concern to the ocean color community.
- Jack Xiong (NASA) presented the calibration efforts of the MODIS Calibration Support Team (MCST), focusing on the MODIS on the Aqua mission. MCST has started to use desert trending for those wavelengths to correct the solar diffuser trending.
- Ludovic Burg (ACRI-ST) presented the calibration improvements of the 4th reprocessing of MERIS. He showed that the prelaunch characterization of the MERIS solar diffuser did not fully explain the solar diffuser measurements on-orbit and described how an improved model will improve the accuracy.
- Prakash Chaun (ISRO) presented the status of OCM-2. Lunar calibration, vicarious calibration, Rayleigh calibration and a relative adjustment to correct for striping have been used for calibration adjustments.
- Seongick Cho (KIOST) presented on both GOCI and GOCI-II. The annual variation of the solar diffuser measurements of GOCI has been successfully modeled. GOCI-II will have an additional (pristine) solar diffuser, and lunar measurements.
- Xianging He (SOA) presented HY1B/COCTS calibration activities. A crosscalibration to SeaWiFS is used for instrument calibration, and an approach has been developed to characterize the polarization sensitivity using on-orbit data.
- Gene Eplee (SAIC) and Junqiang Sun (GST) reported on the VIIRS related calibration activities of NASA and NOAA, respectively. Both agencies adopted an approach of combining the lunar and solar diffuser measurements. The NASA team has developed a correction to the lunar irradiance model (ROLO) to correct for libration angle dependencies in the VIIRS lunar data.
- Constant Mazeran (Solvo) presented challenges for the vicarious calibration for spectral matching atmospheric correction algorithms (e.g. POLYMER), the vicarious gains are not always unique.
- Ewa Kwiatkowska (EUMETSAT) reported on preparations for the OLCI (Sentinel-3) calibration. The feasibility of an on-orbit characterization of the BRDF of the solar diffuser with spacecraft yaw maneuvers is currently being evaluated.

Discussions

- An action from the last WGCV-39 (http://ceos.org/meetings/wgcv-39/)

  "In order to strengthen the cooperation, the sub-group IVOS will evaluate the IOCCG documentation and consider endorsing IOCCG's cal/val-related recommendations as a starting point for future discussion and sharing of information."

- What IOCCG requests IVOS to review and endorsement are:
  - ✓ INSITU-OCR White Paper (http://www.ioccg.org/groups/INSITU-OCR_White-Paper.pdf)
  - ✓ The Agency Mapping Exercise (agency responses to the White Paper recommendations)
  - ✓ The IOCCG report #13 Mission Requirements for Future Ocean-Colour Sensors (http://www.ioccg.org/reports/IOCCG_Report13.pdf)

    4.2 Calibration Approach

    4.8 Radiometer Design (4.8.4 Radiometric quality, 4.8.5 Calibration requirements)

    4.9 Radiometer Pre-launch Characterization

    5 International Cooperation