IOCS 2019, 9-12 April 2019, Busan South Korea

Breakout workshop 6: Research to operations and applications (R2O&A)

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Final Report

The value to society of satellite-based ocean colour (OC) remote sensing observations is realized when they are used to improve decision outcomes. For OC to be incorporated routinely into downstream user operations, data products must be consistent, robust, routine, and sustained, mature, fit-for-purpose, discoverable, well-described and accessible in forms conducive to their use. The new paradigm of "operational" satellite data extends beyond near-real time to also include consistent, longer term time series (full missions and across missions). Given the multiple satellite missions now routinely providing robust OC data along with additional missions anticipated in the near future and out into the coming decades, OC has reached the maturity to be incorporated into downstream operational applications, yet barriers remain.

The 2013 IOCS splinter session, Operational Ocean Colour Data in Support of Research, Applications and Services, produced 15 recommendations. In the past ~6 years, many of these recommendations have been implemented or are in progress by operational agencies. The various reports from IOCCG helped tremendously to influence agencies to accept and adopt these practices and requirements.

Data quality, stability, continuity, sustainability, accessibility and operational maturity (2013 recommendations 1-5) have largely been the rule for NOAA (VIIRS on SNPP and JPSS-1/NOAA-20) and EUMETSAT (OLCI on Sentinels 3A and 3B).

Data products (2013 recommendations 6-13), with some exceptions, are available at multiple processing levels, near real-time streams and delayed mode streams are available for full missions. The requested availability of open source processors still requires further effort.

Stakeholder engagement (2013 recommendations 14 and 15) activities have been taking place at various levels (e.g., training programs) and progress is being made across the international community, especially through efforts of the IOCCG.

In this 2019 workshop we focused on the next level of progress from the perspectives of users (clients), remote sensing scientists, and those working to bridge gaps between them in order to get OC data into more applications where they can make a positive impact on decision outcomes. The scope included both 1) broad, efforts in making OC data more accessible (intellectually and functionally) to a wider audience and 2) narrow, vertically integrated services that drive the value chain from earth observations to actionable information for targeted applications.

The Session organizers asked presenters to address the 3 Key Questions listed and ensured time for discussions involving all session participants.

3 "Key Questions"

1) What are the user requirements for operational OC products and where should the main research and technical efforts be concentrated?
2) What developments in approaches, techniques and/or tools are needed to address users at multiple levels of sophistication, how best to supply necessary details while not overwhelming as needed for free and open access to data through multiple outlets and serving distinct and diverse audiences?
3) What mechanisms are useful to bring developers and users together at early stages and how best to engage parties to achieve successful implementation?

Some of the suggested topics listed above generated more focused discussions (shown in bold) than others.

- **Need for low latency NRT - within 2-3 hours with data quality adequate for purpose (case-by-case)**
- **Cross-mission continuity and consistency of datasets (differences in products are problematic)**
- **More value-added products, e.g., Primary Productivity, PFTs, Anomalies (especially for chl and SST)**
- Better inter-parameter viewing, querying, data access - need an attractive front end
- **User support for large data volumes**, e.g. data sub-setting, cloud computing with on-the-fly processing tools and tools for online analyses
- **Merged multi-mission time series (e.g., one daily composite)**
- **Regionally relevant products, where standard products currently do not work**
- Serving model results and downstream applications (but see bullet #2)
- Metadata (describe the dataset "well" and "interoperably", i.e. GHRSST-like)
- Documentation of product quality (i.e., performance, uncertainties, for what purposes are the data "fit", ATBDs)
- ***TRAINING, TRAINING, TRAINING (e.g.: weather service approach; product training for sector-specific users and for commercial users, etc.)**

Summary and IOCCG Recommendations

In summary, our detailed and productive discussions encompassed users/clients, products, and training. Some specific recommendations to IOCCG have been extracted from these.

<u>Summary</u>

- USERS/CLIENTS: Clients knowledge and technical capabilities (and/or resources) span a wide range forming a "matrix" of needs to be served. For example, a non-satellite subject matter expert may use a highly sophisticated model and possess advanced processing capabilities, but may know little about how to choose an appropriate ocean color dataset or s/he may have a relatively good understanding of the meaningfulness of a downstream ocean color product and prefer it be produced "ready-made" to simplify and streamline their use of data to quickly, routinely address their application/decision.

- PRODUCTS: Users want single consistent and stable product time series, long-term to NRT, merged from multiple instruments which are regionally adjusted to assure the highest quality, as well as anomaly products.
- TRAINING: Need to actively engage with different type of users, provide on-line resources (guide for different applications e.g. fisheries, HABs, aquaculture), workshops, training, also opportunities for the OC community to engage with higher level users.

Recommendations to IOCCG

Recommendations to IOCCG arising from this R2O&A Breakout Session include:

Support outreach materials (e.g., refreshed handbook of examples reflecting current operational satellite ocean color products) and promote training activities (e.g., non-expert training courses) directed to non-satellite-expert users focused by sector or by application.

Support ocean color science research and development of higher level products (e.g.: endorse the development of an operational consistent, multi-mission NRT and long term time series with "guarantee" to continue forward), products especially useful for model assimilation, and regionally adapted products.

Allocate portions of future IOCS and IOCCG events dedicated to hearing from non-ocean-color-expert clients (or potential clients) from multiple sectors (management agencies, commerce, research, etc.).

For the record, here is agenda

Co-chairs	Veronica Lance (NOAA) and Ewa Kwiatkowska (EUMETSAT)
14:00 – 14:10	Overview “operational” ocean colour satellite remote sensing, review and update on the 2013 recommendations, set out the objectives for this workshop Veronica Lance (NOAA) and Ewa Kwiatkowska (EUMETSAT)
14:10 – 14:20	Discussion: identification of recommendations from 2013 which are incomplete but still relevant, input on session objectives
Obstacles and successes with operational OC data services	
14:20 – 14:30	Dabin Lee (Ph.D. student, Pusan National University, S. Korea) – Remote sensing for applied fisheries research
14:30 – 14:40	Cara Wilson (NOAA, US) – NOAA Fisheries Management
14:40 – 14:50	Stewart Bernard (CSIR, South Africa) - National Oceans and Coastal Information Management System (OCIMS)
14:50 – 15:00	Mario Castro de Lera and Pablo Ruiz Sánchez, Deep Blue Globe, UG (EU commercial; ESA incubator)
15:00 – 15:20	Discussion: where is the biggest gap in achieving fit-for-purpose OC data? Where should the main research, technical, training and outreach efforts be focused?
Approaches, techniques, tools to address users at multiple levels of sophistication	
15:20 – 15:30	Experience from user training Hayley Evers-King (EUMETSAT / PML)
15:30 – 15:50	Discussion: what details best to supply what to do not to overwhelm
Bringing agencies, information services and users together	
15:50 – 16:00	Assuring the broad uptake of OC data services Gianluca Volpe (Copernicus Marine EMS)
16:00 – 16:20	Discussion: how to know if data are “fit-for-purpose”?
16:20 – 16:30	Key points, synthesis and actions Veronica Lance (NOAA) and Ewa Kwiatkowska (EUMETSAT)