

Water Quality Demonstration

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Introduction

Water Quality is crucial to human health, economy and ecosystems functioning, and therefore remains one of the most commercial and policy-relevant applications in our domain. Satellite observations have tremendous potential to deliver routine and synoptic products for Water Quality monitoring and forecasting at global, regional, and local scales. Industry has confirmed that there is a big market for Water Quality services using satellite data. Space agencies and environment/water management institutions have showcased a variety of successful operational Water Quality products and services. The products identify cyanobacteria blooms, map phytoplankton biomass and water transparency, chart bathymetry and benthic habitats in shallow waters, and model nutrient concentrations. The services produce Water Quality alerts for aquaculture, fisheries, water treatment plants, and recreation. New applications also support compliance assurance or income loss indexing e.g. in aquaculture.

However, only some of these services are commonly adopted by users. The roadblocks include a lack of awareness and trust in the potential of satellite data, lagging policy regulations that rely on sparse in situ sampling, legal issues, and few guidelines. For the most desired Water Quality applications that are focused on coastal zones and inland waters, the current satellite data have limitations in spatial, spectral, and temporal coverage.

The ultimate goal should be operational satellite services for Water Quality monitoring and forecasting, alike to services for weather forecasting, which would provide measurable benefits to human health, national economies, businesses and water ecosystems. The aim of the session was to discuss the roadblocks and the lessons learned, as well as potential solutions, priorities, and actions to further unlock satellite observations for the Water Quality, especially in inland and coastal waters.

Session Summary

Four presentations were given by

- Tiit Kutser to summarize the feedback from the preceding keynote and panel discussion,

- Jenni Attila to discuss the requirements from water monitoring agencies in the context of European policies and the experiences from developing the Finnish service,
- Bridget Seegers to draw lessons learned from the successful NASA/EPA/NOAA/USGS CyAN project, and
- Jongkuk Choi to describe applications and services achieved from the Korean geostationary missions.

The second half of the session was dedicated to discussions and to drafting of the recommendations.

Review of Existing IOCS Recommendations

Past IOCS meetings recommended continued collaboration with end users and training activities to ensure that the satellite data are fit for purpose. Less accurate data are sometimes better than no data for different levels of monitoring and reporting. These recommendations are still applicable.

Recommendations to use higher spatial resolution sensors like Landsat and Sentinel 2 constellation have been followed up by the agencies and the community.

New IOCS Recommendation(s)

1. **Engage all stakeholders in developing satellite services for Water Quality**, to understand the needs and deliver the relevant data products and services that are actually needed. The stakeholders include the space agencies, national environmental or water authorities, regulatory institutions, relevant international organizations, private and commercial sectors, economists, as well as local communities and decision makers. Engage early from the beginning in the user own language, build trust, support policy and guideline definitions.

The action is on the space agencies and all members of the IOCS community.

2. **Implement sustained operational missions with specifications suitable for coastal and inland Water Quality applications.** Only sustained availability of satellite data with suitable specifications warrants the long-term investment needed in downstream services. In particular:
 - Dedicated water colour sensors are required from geostationary satellite platforms (the value of diurnal monitoring and improved coverage in catching sudden or evolving Water Quality events).
 - PACE to be followed by PACE II mission (for service continuity).

- Dedicated water colour sensors are required for coastal and inland waters (the need for adequate spatial resolution together with spectral, radiometric and SNR characteristics).
- S3NGO and S2NG to uphold their specifications, currently tentative, for coastal and inland waters (e.g. S3NGO 150m hyperspectral), which are adequate to meet the requirement in the bullet above.
- Operational satellites that perform well like S2A and S3A, not to be decommissioned (the value of stable platforms for long-term time series, increased spatial and temporal coverage).

The action is on the space agencies.

3. **Coordinate across the space agencies to deliver data products and services suited for Water Quality applications.** Water Quality data needs may be different from typical water products from the space agencies, and these needs should be established through direct engagement with the stakeholders, as recommended in point 1. Some data examples include GeoTIFF images, presence/absence flags, or Water Quality indicators as used in reporting. Although many of these data specifications may be different across countries and applications, some commonalities will exist and should be coordinated.

The action is on the IOCCG and the space agencies.

4. **Coordinate across the space agencies to collect in situ measurement holdings suited for Water Quality applications.** Global coastal and inland Water Quality products require calibration and validation over the whole range of optical properties and bio-optical regimes. Collection of the corresponding in situ measurements is typically fragmented and the data holdings are sometimes not maintained. Here, the agencies are recommended to provide long-term sustained maintenance of in situ datasets for the community. IOCCG is recommended to take a leading role in initiating and coordinating in situ data collection to cover under-sampled coastal and inland water types. Ideally, FRM-quality radiometry should be collected together with water constituents, IOPs and other water parameters. In parallel, IOCCG should support training to collect good FRM quality data.

The action is on the IOCCG and the space agencies.