Water Quality Demonstration

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Introduction

Water Quality is crucial to human health and economic production 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 on the global, regional, and local scale. Industry has demonstrated 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 tools and products, which have identify cyanobacteria blooms, provide proxies for Water Quality indicators, and produce Water Quality alerts for aquaculture and fisheries. New applications also support compliance assurance or income loss indexing e.g. in aquaculture.

However, there are far more ways to utilize satellite observations to create Water Quality applications and services that reach the broad range of user needs . The roadblocks for expanding remote sensing applications include a lack of awareness and trust in the potential of satellite data, lagging policies regulations that rely on sparse in situ sampling, legal issues, few guidelines, as well as limitations of current satellite data spatially, spectrally, and temporally for the desired Water Quality applications in coastal zones and inland waters.

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.

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 Recommendations

1. **Engage all stakeholders in developing satellite services for Water Quality**, to build trust, understand the needs, support policy and guideline definitions, and deliver the relevant data products and services. 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, persistently, and in their own language.
   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).
   - S3NGO and S2NG to uphold their specifications, currently tentative, for coastal and inland waters (e.g. S3NGO 150m hyperspectral).
   - Operational satellites that perform well like S2A and S3A, not to be decommissioned (the value of stable platforms for long-term time series, and increased 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**. To improve algorithm performance for Water Quality applications, FRM-quality in situ data are required in coastal and inland waters across different bio-optical regimes. IOCCG was already recommended to coordinate access to in situ data holdings from the space agencies and the community. Here, the agencies are recommended to provide long-term sustained maintenance of in situ datasets for the community. Furthermore, IOCCG is recommended to identify optical water types not covered through in situ data collection across inland and coastal water types and to coordinate agencies to acquire such data or leverage from existing programs. Ideally, FRM-quality radiometry should be collected together with water constituents and IOPs. In parallel, IOCCG should support training to collect good FRM quality data.
The action is on the IOCCG and the space agencies.