Feasibility Study for an Imaging Spectrometer for Water Quality.

Ad-Hoc Working Group CEOS
Presented by A.G. Dekker
IGWCO/AquaWatch joint meeting
Koblenz, Germany, 8th June 2016
• The Committee on Earth Observation Satellites (CEOS) response to the Group on Earth Observations System of Systems (GEOSS) Water Strategy developed under the auspices of the Water Strategy Implementation Study Team (WSIST) was endorsed by CEOS at the 2015 Plenary.

• CSIRO has taken the lead on Water Strategy recommendation C.10: A feasibility assessment to determine the benefits and technological difficulties of designing a hyperspectral satellite mission focused on water quality measurements…….expanded to:

  1) undertaking a high-level feasibility assessment of the benefits and technological difficulties of designing a hyperspectral satellite mission focused on inland, estuarine, deltaic and near coastal waters - as well as mapping macrophytes, macro-algae, seagrasses and coral reefs - at significantly higher spatial resolution than 250m and ….
CEOS notes that new information has emerged from the GEO Water Quality community in recent months suggesting that alternative approaches, involving *augmenting designs of spaceborne sensors for terrestrial and ocean colour applications to allow improved inland, near coastal waters and benthic applications*, could offer an alternative pathway to addressing the same underlying science questions. Accordingly, CEOS will also analyse the benefits and technological difficulties of this option.
2) Also to examine threshold and baseline observation requirements for sensors suitable for water quality applications. This information will inform CEOS Agencies when considering the potential to adapt their sensors to add this application area to their mission designs.

3) That the GEO Water community define inland and near-coastal and benthic habitat essential variables for water quality, including an assessment of relative priority, linked to defined economic, social and environmental benefits. This information would be of great value in informing investment decisions.
CEOS Team
“Feasibility Study imaging Spectrometer”:

Lead: CSIRO Arnold Dekker
Coordinator: DLR Nicole Pinnel
Members: (in brackets organisations that support)
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CNR Federica Braga ( Claudia Giardino & Vittorio Brando )
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NASA Kevin Turpie
(USGS) Thomas Cecere
(NSO) Mark Loos & Joost Carpaaij: experts pending…..
Table of Contents: Feasibility Study for an Imaging Spectrometer for Water Quality vs 1.0 25th May 2016 by AD.

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6. References
April 2016: Team created
May 2016: Contents established
June 2016: Self nomination process chapter leads and co-authors

Timeline:
By September 2016 a first draft for presentation at CEOS Strategic Implementation Team (CEOS-SIT) Oxford UK
By November 2016 at CEOS Plenary a full draft Brisbane, Australia
By January 2017 final draft.
Driven by colour
Information in spectral reflectance

- Suspended solids
- Coloured dissolved organic matter
- Phycocyanin
- Chlorophyll
- Suspended solids
Sentinel-3 @ 300 m resolution

**Phycocyanins**

**Chlorophyll**

**Suspended Solids**

**Colored dissolved organic matter**
Sentinel-2 @ 10 m spatial resolution could have been very suitable for inland waters with 2 or 3 additional spectral bands – opportunity missed!!
If also to be made suitable for:

- Coral Reefs
- Seagrasses
- Macro-Algae
- Macrophytes (freshwater)
- Shallow Water Bathymetry

......then imaging spectrometry makes most sense,
Earth Observation for Water Resources Management: Current Use and Future Opportunities for the Water Sector

Note 1: products in development are: coarse particle size distributions and phytoplankton functional types. Note 2: integrated products could be: eutrophication index; water quality index, algal bloom index; carbon contents and flux; contaminant estimation. CHL=Chlorophyll; CYP=cyanobacterial pigments such as cyanophycocyanin and cyanophycoerythrin; TSM=total suspended matter; CDOM = coloured dissolved organic matter; Kd= vertical attenuation of light coefficient; Turb= Turbidity; SD=Secchi Disk transparency.
Non-meteorological Applications

The Ad Hoc Team on Non-Meteorological Applications for Next Generation Geostationary Satellites

The 2016 CEOS Chair’s Ad Hoc Team on Non-meteorological Applications for Next Generation Geostationary Satellites (NMA) investigates the combined potential of advanced meteorological geostationary (GEO) and Low Earth Orbit (LEO) satellites to deliver continuous monitoring of the high-temporal dynamics of the land, oceans, and atmosphere. This data will enhance and complement the LEO-based applications that have been the workhorse for monitoring of the broader environment.

The CEOS Ad Hoc Team on NMA was initiated at the 29th CEOS Plenary meeting in 2016 and tasked with developing a report that provides comprehensive and pragmatic guidance to CEOS on the new opportunities arising from next generation geostationary satellites and GEO-LEO synergies.

Links and Key Documents

- Presentation on 2016 CEOS Chair Initiatives (29th CEOS Plenary Item 38; November, 2015)
- The Ad Hoc Team on NMA Proposal (version 2.0)
### Water-leaving Radiance

**- Remote sensing reflectance**

**Dependencies:** Validation data, cloud masking algorithm, glint masking algorithm, glint correction algorithm, surface pressure map, ozone map

**Potential end users:** GBRMPA, BoM, CSIRO, JCU, JFA, JCG

<table>
<thead>
<tr>
<th>Algorithm Type</th>
<th>Developing Institution</th>
<th>Estimated Resources</th>
<th>Currently Funded</th>
</tr>
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<tbody>
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<td>Artificial Neural Network</td>
<td>CSIRO (4), JCU (5)</td>
<td>0.3 FTE</td>
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<tr>
<td>Iterative coupled atmosphere-ocean inversion model</td>
<td>CU (1)</td>
<td>TBD</td>
<td>No</td>
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<td>Gordon and Wang algorithm</td>
<td>JAXA/EORC (3)</td>
<td>0.1 FTE</td>
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