Validation of Satellite-derived Optical and Water Quality Parameters

Water Quality Validation

7-9 June 2022, University of Wisconsin-Madison

Lab and other measurements for high quality validation data

Fresh Cheese Curds.

Should Squeak when chewed

Sold in bags. Comes in fun flavors like Garlic Dill, Bloody Mary, and Taco season ing

Fried Cheese Curds.

Preferably Beer battered.

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Lab and other measurements for high quality validation data

Where we are at, best practices, recommendations, gaps

What are the priority variables for water quality
Protocols
Ensure Usability of Data and Quality Control/Assurance.
How to encourage adoption of standardized approaches.

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Where we are at, best practices, recommendations, gaps

Speakers

- Joaquin Chaves, *NASA Ocean Ecology Lab*
- Joan Albert Sánchez Cabeza, *ICML, Universidad Nacional Autónoma de México (UNAM)*
- Lachlan McKinna, *Go2Q*, Impacts of Measurement Uncertainty

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Breakout Session

Where we are at, best practices, recommendations, gaps

❤□♣□♦□ ♠□What are the priority variables for water quality

❤□♦□ Protocols

Protocols Vs. Methods
Are existing protocols usable?
Who should develop protocols?
What should be included? - uncertainties, errors, sensitivities
How to make protocols accessible to all users

♣□♠□ Ensure Usability of Data and Quality Control/Assurance.

Instruments
Sampling strategies, satellite overpass, tools
Lab comparisons
How to make them accessible to all users

❤□♣□♦□ ♠□How to ensure/encourage adoption of standardized approaches.

The following slides include a summary
of discussion points from the breakout sessions

Priority variables for water quality

CDOM,
CHL,
Nutrients,
Total Suspended Matter,
Turbidity
Pigments (HPLC)
WHO guidance for HABs: cell counts, biomass
Particle size distribution

- Parameter
- Chl
- CDOM
- Turbidity
- Algal toxicity metrics
- TOC
- Cyanobacterial pigments
- T
- S
- Inorganic/organic particulates
- DO
- Kd/PAR
- Organic micropollutants
- Plastics
- Heavy metals
- Seagrass
- Filamentous algae
- Benthic microalgae

Microbial activity

A glassy day on Lake Superior

Gaps

- GEO Aquawatch examining terminology as it is currently eclectic and not well defined
- EPA protocols exist for the determination of some parameters, e.g., TSM
- Propose a tiered approach: expensive, less expensive, citizen science-type
- We need validation data, and for it to be collected by a widely distributed network of data collectors:
  - Need affordable sensors/data collection systems
- Need to look to existing infrastructure/projects, e.g.: MONOCLE, CERTO, PrimeWater, WaterForce (all in Europe)
- Who do data collectors send their data to? Who/where is the data repository?
- How do we empower the end users to support the validation of measurement programs? (USA example is the development of Applications programs, e.g., PACE Applications)
- Need effective communication strategies for connecting to different stakeholders? E.g., use of social media. Example: CyanoTracker
- How can we facilitate development of stakeholders and measurement networks in developing nations? (World Bank, Bill and Melinda Gates Foundation,…?)

Accessibility

- Translation of key documents/information into several languages
- YouTube instructional videos
- Open Source software
- Open Science principles – decolonizing science, accessibility to all components of reproducible science, inexpensive but reasonably performing sensors
- FAIR (findable, accessible, interoperable, reusable) data principles – also ties into Open Science philosophy

Usability of Data and Quality Control/Assurance.

Instruments. Sampling strategies, satellite overpass. Lab comparisons. How to make them accessible to all users

Discussion Highlights

Instruments: More data is better? List by quality of data produced.
Sampling Strategies: Match-ups to satellite. Clouds +-1 or 3 days, +-2 hours. Pixels 1,3 or 9. Clear sky conditions

Quality: Certified labs
SeaDAS quality check. Does inland water need an equivalent?
Calibration guidance for instruments.
Lab intercomparisons
Trainings: Explain the importance of calibration
Taking advantage of people already going to the field need to expand training to avoid nonsense results
Access to experienced scientists. Transfer of knowledge
More opportunities like the NASA/UofMaine summer course

FUNDING! Monitoring versus research funding. Monitoring is/can be research, but funding streams are more limited.
Collaborations: joint campaigns. Who has instruments and how has water quality questions.
Also leads to better quality data.

Accessibility of data. Where are the data bases. Which are highest quality? GLORIA for inland water
Lots of volunteers doing the work
Validation program: Agency funding maintains a certain number of instruments.
Standardization of process. Keeps instruments cross calibrated. Highly consistent. Single data format. Updated over time

Break Summary Hearts Group

•What are the issues with the protocols?
•Cdom one calls for the cuvette length that is longer than the spectrometer supports
•How do we get different user communities to be involved in the protocol development so that they work for the capabilities, level of understanding, equipment available
    - Leverage folks' like Joan, networks to get their inputs.
    - Are they aware of the protocols and opportunities to comment?
    - List the language capabilities of the editors on the contact page
    - Offer trainings with practical tips
    - He thinks folks are aware of the protocols, but they are still at the chl level; also virtual trainings do not work well, but ocean teacher GA something platform emerged where teachers recorded a course in small modules and now open for all; methodologies vs protocols - different folks have different instruments and protocols with specific corrections are not always applicable and methodologies would be more informative and practically useful to his communities

•they do inland waters - small boats and can't take nitrogen or a filtering rig; they take niskin bottles and go back to the lab. The protocols are not optimized for limnologists methods of sampling and collecting water. Equipment is too heavy, bulky; not useful. How good is good enough for ocean color validation?
•Protocols built for open ocean waters are built to be golden standard and have sensitivity for those waters. The coastal and inland waters have different magnitudes and appropriate validation data obtained from less precise methods. Build flexibility into the protocols and ensure that uncertainties for each method capture the different processes and instruments.
•Protocols should have different tiers of measurement. With associated uncertainties for each method.
•pictures or a plain language summary can help (1cm cuvette length can be fine if you have high levels of cdom in the water; a picture of those conditions can help); methodologies, a practical cookbook, is desperately eroded and valuable
•consider more diverse and different reviewers than the usual suspects; more applied users so these protocols are more broadly applicable and have cross-user-community buy-in
•Igor & Steve: GEO Aquawatch could maybe put out their own more applied user-focused SoPs
• they have compiled a methodology they put out on how to compute uncertainty
•is there a way to leverage LaTex to edit these as a way to democratize the editing of these like with software and git
•there needs to be someone managing these, someone paid to manage and version control and review and accept edits with succession plans for their career moves/departures
•be cautious about adding more barriers when considering platforms or technologies (Word, gDoc, LaTex, git)
•Priority variables
•Jochl and dissolved organic matter (DOC in mass/vol) because of the nature of the content in the water
•water clarity, secchi disk, turbidity - things accessible with citizen science
•phycobilins, phycocyanin, since they are looking for cyanos in their inland and coastal waters
•TSS and turbidity for coastal environments (Joaquin is leading the SPM protocol and will engage her on this)
•secchi disk algorithm or measure of gradient of color (greenness) like how coral bleaching is measured (Igor: there is an app like this); her group is looking at CDOM, Chl, and suspended sediments (and secchi disk for heritage/continuity)

How to ensure/encourage adoption of standardized approaches.

Validation program: One or multi-agency funding (maybe states and universities) maintains a certain number of instruments. Instrument lending library.
Standardization of process. Keeps instruments cross calibrated. Highly consistent. Single data format. Updated over time.

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Laboratory Measurements

The International Ocean-Colour Coordinating Group (IOCCG)

Measurement Protocol of Absorption by Chromophoric Dissolved Organic Matter (CDOM) and Other Dissolved Materials

Particulate Organic Matter Sampling and Measurement Protocols: Consensus Towards Future Ocean Color Missions

Aquatic Primary Productivity Field Protocols for Satellite Validation and Model Synthesis (DRAFT)

A glassy day on Lake Superior

Validation of Satellite-derived Optical and Water Quality Parameters

Laboratory Measurements

Topics

- Priority Variables
  - What are water quality parameters?
  - Chl-a, Cell counts, biomass, turbidity, CDOM, POC, Primary Production, community composition, HPLC (pigments)
- Standardization of methods
  - What is available? Who should be producing protocols?
- Uncertainty • Instrumentation • Calibration
- Satellite overpass schedule
- Spreadsheet templates
- Quality assurance, quality control and processing

A glassy day on Lake Superior