Highlights from Workshop 1, March 12-13 2014, NASA Glenn Research Center

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Great Lakes Workshop Series on Remote Sensing of Water Quality

Workshop 2: May 7-8, 2014, NOAA GLERL, Ann Arbor, MI
Developing the Great Lakes RS Community

- Approx. 60 in-person attendees and 18 web participants took part in Workshop 1
- Participants were able to make new connections and share ideas
- Workshop 2 and the community website will facilitate continuing growth of this regional thematic research community
  - All plenaries from Workshop 1 are online and those from Workshop 2 will be shortly
  - Executive summaries of both workshops will be released by Memorial Day
Workshop 1 indicated NASA’s strong interest in providing next-gen satellites pertinent to GL problems.

As indicated by some of the Workshop 1 plenary talks, under the GLRI, the EPA, NOAA, USGS, USFWS, and NPS have embraced the use of remote sensing to solve problems, e.g.,

- Invasive species monitoring
- Nuisance vegetation growth
- HABs
- Water quality monitoring
- Bathymetric mapping
Great Lakes Remote Sensing Priorities: Sensor Optimization

- Most instruments in orbit are optimized for land or open ocean in terms of band placement, temporal repeat and dynamic range.
- Higher spatial and temporal resolution are important for better mapping of the Great Lakes nearshore and AOCs.
  - Would also enable us to sense more of the ponds & rivers that impact the Lakes.
- Enhanced dynamic range in the visible bands would increase water quality capabilities.
- A range out to 3500 nm will allow differentiation of siliciclastics and carbonates.
Great Lakes Remote Sensing Priorities: Hyperspectral Imaging

- Group came to consensus on positive support of the continuing development of PACE, GeoCape, HyspIRI, Sentinel-3, and OLCI
- Hyperspectral provides potential to separate algal & mineral composition
- Need for hyperspectral capabilities available on a shorter timescale
  - Aircraft or drones on demand
  - Venture class (disposable) satellites and microsats
Great Lakes Remote Sensing Priorities: Research Gaps

- Methods are needed for better nearshore retrieval of chl, other CPAs
- Differentiation of substrate types/texture from RS data
- Extend river plume mapping capabilities to smaller plumes
- Different parameterization of turbidity – instead of retrieving mass concentration, should we be looking at the cross-sectional area of particles?
Many potential end users don’t know much about what’s already available

Need for an “information-agnostic applications portal” for end users who are not remote sensing-savvy

– One-stop shopping that includes remote sensing products, in situ data and model outputs
– Tailored to region and either type of user or issue of interest (e.g., *E. coli*)
– Outreach would be needed so potential end users know about the resource
– Demand for terrestrial and nearshore data as well as offshore water quality
Great Lakes Remote Sensing Priorities: Data & Modeling Integration

- Need better integration between remote sensing data, in situ data & modeling communities
  - In many cases (for example phosphorus), the item of interest can’t be remotely sensed but we can sense proxies that would be useful for modeling to derive the end product
    - Examples: E. coli, phosphorus, microplastics, surfactants, hypoxia, mussel densities
  - Increase use of RS to validate and improve forecasting methods
  - RS is better used as a component of an integrated system rather than as standalone tools
  - Modeling and RS should inform each other
Great Lakes Remote Sensing Priorities: Technology Gaps

- Power-charging docking stations for remote / unmanned mobile devices (underwater, airborne)
- Cabled observatories in the Great Lakes – deployment for longer time periods than buoys
- Wireless data transmission underwater – more rugged, fewer cables
- Crowd-sourcing data collection tools / technologies – making it easier for the citizen scientist to contribute data
- Ice thickness sensors – use for shipping, science / impacts of a changing climate
- Webcams – digital imaging sensors that are easily
- SAR platforms – no U.S. data source currently exists for radar data for ice monitoring, vegetation mapping, etc.
- Cubesats & other small satellites – could be used more to lower the cost of satellite imagery collection & make it more frequent
- Buoys, gliders, AUVs, UAVs, surface vehicles, balloons – there is a need to take greater advantage of these rapidly developing hardware platforms
Community responsibility for algorithms – need to open up algorithm development to be testable by others

Applying multiple algorithms to the same problem – there’s no single approach that works best for all datasets
  – Similar experiments conducted in different environments – what works in one lake might not in another
Great Lakes Remote Sensing Priorities: Algorithm Validation

- What constitutes “real validation”?
  - Everyone has their own metrics, they’re sometimes hard to interpret

- Strict cal/val would give us confidence and help with algorithm development

- Standard suite of measurements with strong cal/val standard needed
  - Protocols for collection of calibration data, data storage & processing methods
  - Central community archive for regional RS calibration data
  - Community data gathering cruises would be useful for validating models under development
Atmospheric (aerosol) correction needs to be coincident with the scene

Two ways to do that
- Ground-based instrumentation
- Instrumentation on the same or a close-following platform

Some atmospheric correction procedures have been validated over land but not water and currently produce negative radiance values over water

It would be really useful to advise users when/where to use different corrections, provide warnings on data fidelity
Future Directions

- Can we use higher-resolution sensors and/or other data types from drones, etc. to characterize within-pixel variability for ocean color products?

- Potential for increasing role for public/private partnerships (ex. Google Earth Engine)

- We should reach out to non-remote sensing scientists (ex: those who do lakewide experiments) about how aerial/fine scale remote sensing could benefit their research in the near term