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Evaluation of satellite-derived water quality variables using satellite remote sensing in San Luis Reservoir

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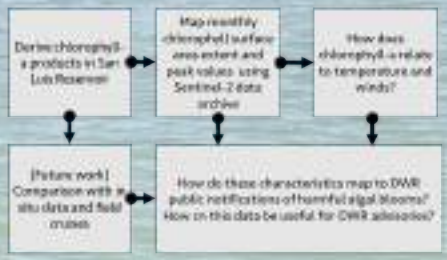
Abstract

Water quality is a critical element of freshwater supply and availability, particularly in times and areas of drought. Limited water resources can be further strained if water quality concerns are not effectively and efficiently addressed. While there are measures in place to safeguard human and environmental health from poor and risky water quality conditions, implementation of these measures frequently relies on physical water samples and fixed station data, both of which can have gaps in spatial and temporal coverage of water quality conditions.

San Luis Reservoir (SLR) is an artificial lake and the fifth largest reservoir in California; it functions as a reservoir for water from the San Joaquin-Sacramento River Delta. SLR is also the site of frequent algal blooms, some of which contain blue-green algae capable of producing toxins. In this presentation, we assess chlorophyll-a extent at SLR using the normalized chlorophyll difference index with Sentinel-2 to understand characteristics of algal blooms and whether peak intensities and occurrence coincides with CDWR public notifications of harmful blooms, and begin to assess the relationship at this site between chlorophyll-a extent and meteorological data such as air temperature and winds.

Project Workflow



Methodology

Remote sensing reflectance at red / NIR bands in Sentinel-2, incorporating optical properties of water (absorption and backscattering characteristics)

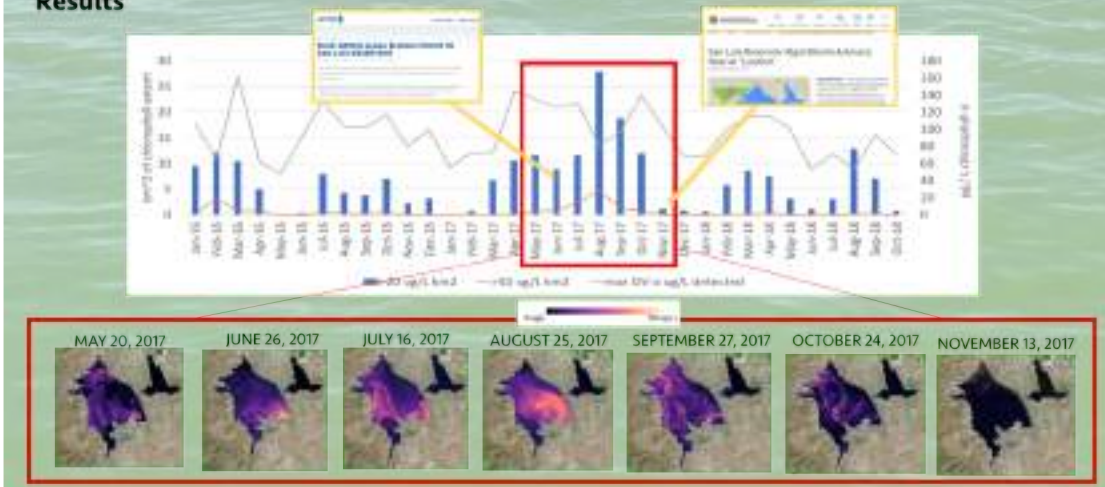
Normalized Difference Chlorophyll Index (NDCI) $= \frac{[R_{rs}(704.1) - R_{rs}(664.6)]}{[R_{rs}(704.1) + R_{rs}(664.6)]}$

$$Chl\text{-}a = f(NDCI) = a_0 + a_1 NDCI + a_2 NDCI^2$$

a_0, a_1, a_2: based on calibration in turbid-productive waters

Mishra and Mishra 2012

Results



Findings

- Monthly wind speed trend appears to lag with monthly temp values, increasing temperatures associated with increasing chl-a extent > 20 ug/L
- Max chlorophyll value over three year record observed in August 2017
- May be two cycles of bloom formation each year – need to extend record
- For the bloom event in summer/fall 2017, satellite based chlorophyll surface extent aligned well with DWR advisories

Next Steps

- Comparison with in situ data, including chl-a, turbidity, temp
- Comparisons with NDCI-based chlorophyll using radiometric data and updated coefficients
- Continue comparisons of chlorophyll extent and characteristics w CDWR algal bloom advisories
- Discuss with DWR utility of satellite data for earlier detection of blooms (eg, use met and satellite data to forecast)
- Model chl-a as a function of meteorological parameters
- Archive and visualize data products in Bay Delta Live portal

Acknowledgments

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