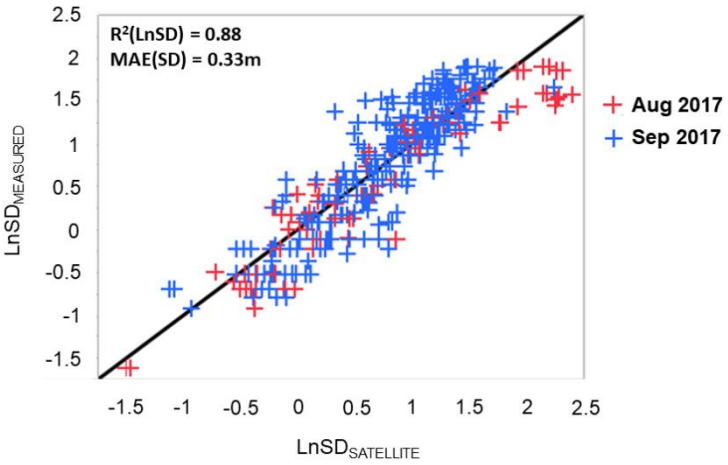
Current Methods

Our current image processing procedures to retrieve water quality data for Minnesota lakes build on our earlier methods, described in the Past Methods page, with four important updates.

First, our earlier procedures essentially used raw imagery, i.e. uncalibrated radiance values measured by satellite sensors. This meant that each image needed to be validated to ground-based data in order to account for differences in atmospheric conditions that affect the intensity of surface reflectance actually received by satellite sensors. We now use imagery atmospherically corrected to yield surface reflectance (R_{rs}) data, using a modified atmospheric correction for inland waters (MAIN) (Page et al. 2019).

Second, the use of atmospherically corrected (R_{rs}) imagery allows us to process multiple images using algorithms developed with Minnesota in situ data for a given water quality parameter that can be applied to new imagery. The figure at the right illustrates how atmospherically corrected images acquired a month apart fit a single water clarity (SD) model. In turn, this model then can be applied to other images that have undergone the same atmospheric correction. The image manipulations are done within the University of Minnesota's Super Computing Institute HPC system, which allows more efficient analysis of imagery over broad geographic regions, such as the whole state of Minnesota.



Third, because of the availability of imagery from the two European Sentinel-2 satellites, which have more sensor bands than Landsat satellites, we now are able to accurately retrieve a broader array of water quality data, including water clarity (SD), chlorophyll, total and volatile suspended solids, turbidity, and CDOM.

Fourth, with the more frequent acquisition of imagery by the constellation of Landsat-8 and Sentinel-2 satellites, we have a much greater likelihood of capturing data associated with a given event or time. In some cases, we also are able to mosaic a sequence of images together to visualize how specific water quality conditions change over time in a lake or group of lakes. Examples of this capability can be found for turbidity in western Lake Superior on the Turbidity and Suspended Solids page and for chlorophyll changes in lakes of the western Twin Cities metro area over a summer season on the Chlorophyll page.

Reference

Page, B. P., L. G. Olmanson, and D. R. Mishra. 2019. A harmonized image processing workflow using Sentinel-2/MSI and Landsat-8/OLI for mapping water clarity in optically variable lake systems. *Remote Sens. Environ*. **231**: 111284.