

# Satellite Monitoring of Minnesota Lake Clarity



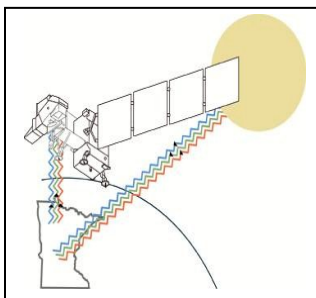
Research by the University of Minnesota has documented a strong relationship between Landsat multispectral data and on-site measurements of water clarity. **The high quality, geographic coverage, and availability of Landsat data make it particularly useful for monitoring inland lakes.** The geographic coverage of 12,000 square miles per image allows for rapid, inexpensive monitoring of thousands of lakes throughout Minnesota. Its spatial resolution of 30 meters is suitable for monitoring lakes as small as 10 acres and can be used to map in-lake variability. There is strong agreement between in-situ measurements and Landsat estimates.

## Summary

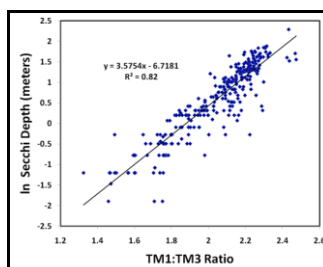
1. Citizens measure clarity of approximately 1,000 lakes



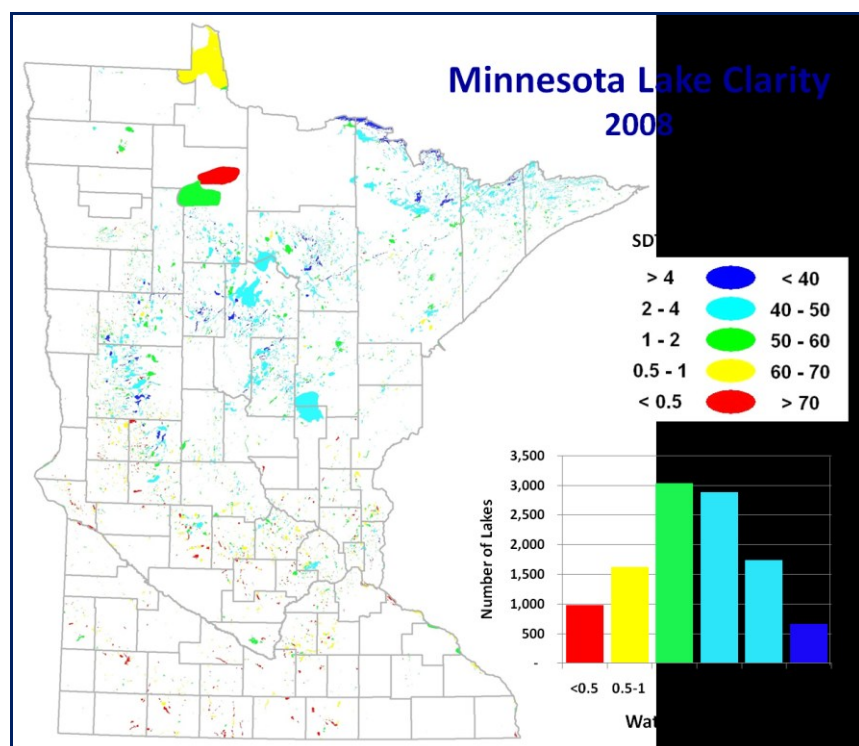
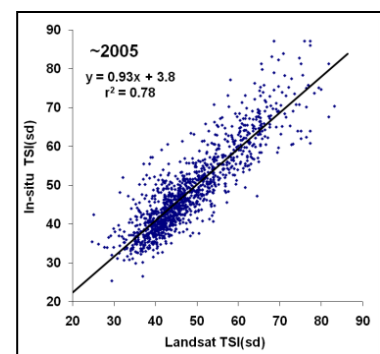
2. Near the same time, Landsat collects imagery



3. Build statistical models relating spectral response to Secchi depth transparency



4. Estimate clarity of all lakes



Classifications at approximately five-year intervals from 1975 to 2008 provide an **unprecedented** record of Minnesota lake quality. We have analyzed the data for temporal trends and geographic patterns, and relationships of water quality to land use, lake properties and demography. Analyses are possible for individual lakes and lake basins, as well as by county, ecoregion, and watershed.

Mean water clarity at the state level has remained relatively stable; 4.6% of lakes had increased clarity and 6.2% decreased. However, there are strong geographic patterns with lower clarity in the south and higher clarity in the north. Deeper lakes tend to have higher clarity and are more stable than shallow lakes and agricultural and urban land use are associated with lower clarity.

## Data and Information Delivery

Data for all lakes and years are available in the **LakeBrowser**, a web-based mapping tool that enables searches and display of results for individual lakes at: [water.umn.edu](http://water.umn.edu). The data are widely used by the **Minnesota Pollution Control Agency** and other agencies and citizens with more than 50,000 annual visits to the website.

## Partners

Initial research for extending Landsat data to statewide monitoring was supported by a NASA Regional Earth Science Applications Center (RESAC) grant. That was followed by support from the Legislative and Citizens Commission on Minnesota Resources with funding from the Environment and Natural Resources Trust Fund. More recently, the Minnesota Pollution Control Agency has provided continued support for monitoring the state's lakes.



Minnesota Pollution  
Control Agency

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