

Minnesota Lake Water Clarity 1975–2015 Metadata

Abstract

The classification of lake clarity, a key indicator of water quality, using Landsat satellite imagery has proven to be an effective and cost-efficient method for monitoring lake conditions in Minnesota. The University of Minnesota's Remote Sensing and Geospatial Analysis Laboratory, with support from the Minnesota Pollution Control Agency (MPCA), the Legislative and Citizens Commission on Minnesota Resources, and the National Aeronautics and Space Administration (NASA), has developed the capability to use satellite remote sensing to classify the clarity of over 10,500 lakes in Minnesota.

This GIS dataset comprises water clarity measurements derived from Landsat imagery, primarily from Landsat 5 Thematic Mapper, Landsat 7 Enhanced Thematic Mapper Plus, and Landsat 8 Operational Land Imager, focusing on Minnesota lakes with a surface area of eight hectares or larger. It contains late summer (July 20 to Sept. 20) lake water clarity data for over 10,500 lakes at five-year intervals from 1985 to 2005, as documented in Olmanson et al. (2008) and four subsequent assessments for the years 1975, 2008, 2011, and 2015. Additional background information and documentation for the Water Clarity data can be accessed at <https://water.rs.umn.edu/>.

The 1975 assessment was conducted using Landsat Multi-Spectral Scanner (MSS) imagery and should be interpreted with caution, as it may not be as reliable as the other datasets. The reliability of the data from 1985 to 2005 was evaluated by examining the precision of repeated measurements of individual lakes over short periods, using information from adjacent overlapping Landsat paths. Additionally, the water clarity computed from Landsat data was compared with field-collected Secchi depth measurements. The correlation between satellite data and field measurements of Secchi depth within Landsat paths was strong, with an average R^2 of 0.83 and a range of 0.71 to 0.96. Similarly, the relationships between late summer Landsat data and field-measured Secchi depths for the combined statewide data were robust, with R^2 values ranging from 0.77 to 0.80 for individual periods, and an overall R^2 of 0.78 for the entire database.

The 1985–2005 database was analyzed to explore spatial distributions, temporal trends, and relationships with both in-lake and watershed factors that could affect lake clarity. Overall, water clarity at the state level has remained relatively stable; 4.6% of lakes showed an increase in clarity, while 6.2% experienced a decrease during this period. However, strong geographic patterns were observed, with lower clarity found in the southern regions and higher clarity in the northern regions. Deeper lakes generally exhibited higher and more stable clarity compared to shallow lakes. Additionally, lakes located in forested areas tended to have greater clarity, whereas those in agricultural and urban settings were associated with lower clarity (Olmanson et al. 2013).

Purpose

The dataset was created as part of the Minnesota Pollution Control Agency's Environmental Data Access System, which provides public access to surface water monitoring data.

Attribute Field Detail

- MN_LK_NUM: unmlknum with MN before the lake ID to indicate Minnesota
- unmlknum: Updated 2010 UMN lake number and the only unique ID for all 12,193 polygons
- umnlknum_o: The original UMN lake number from polygon layer created in 2000
- dowlknum_1: umnlknum centerpoint linked to the dow lake number from December 2010 DNR lake polygons - this is the number to link to other DNR data - Note there may be multiple polygons with the same dowlknum since the umnlknum polygons are at a finer scale for some lakes
- RNAME_1: Name of the waterbody associated with the lake polygon.
- PWI_CLASS: Public Waters Inventory (PWI) class as defined by Bulletin No. 25 - An Inventory of Minnesota Lakes http://www.dnr.state.mn.us/waters/watermgmt_section/pwi/bulletin25.html
- AREA_BASIN: Lake area in acres from Bulletin No. 25 - An Inventory of Minnesota Lakes
- WETTYPE: Public waters wetlands type 3, type 4, and type 5 wetlands (as defined in U.S. Fish and Wildlife Service Circular No. 39, 1971 edition)
- X_UTM: Map coordinate from Bulletin No. 25 - An Inventory of Minnesota Lakes
- Y_UTM: Map coordinate from Bulletin No. 25 - An Inventory of Minnesota Lakes PolyAcres: Polygon area in acres calculated from the lake polygon.
- SDM_2000: e.g. Mean late summer water clarity in meters for the year ~2000 measured during the late summer period (July 20 through September 20). Imagery from late summer in Minnesota may include images from the year before or after 2000, as the availability of clear images across the entire state may be limited for some year.

Citations

- Olmanson, L.G., Brezonik, P.L. and Bauer, M.E. 2013. Geospatial and temporal analysis of a 20-year record of Landsat-based water clarity in Minnesota's 10,000 lakes. *J. Amer. Water Resour. Assoc.* 50(3): 748-761. <https://doi.org/10.1111/jawr.12138>
- Olmanson, L.G., M.E. Bauer, and P.L. Brezonik. 2008. A 20-year Landsat water clarity census of Minnesota's 10,000 lakes. *Remote Sens. Environ.* 112:4086-97. <https://doi.org/10.1016/j.rse.2007.12.013>

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