

Measuring lake turbidity and trophic state

Why measure lake turbidity and trophic state?

Turbidity is a key indicator of water clarity, quantifying the haziness of the water and acting as an indicator of underwater light availability. Trophic State Index refers to the degree at which organic matter accumulates in the water body and is most commonly used in relation to monitoring eutrophication. In this context both water parameters may be used to infer a particular state, or quality, of a freshwater body.

Description of the method used to globally map reservoir area

The global dataset measures two lake water parameters: Turbidity (TUR) and an estimate of Trophic State Index (TSI). The products were produced by the [Copernicus](#), the Earth Observation program of the European Union. For the two parameters the dataset documents monthly averages as well as multi-annual per-monthly averages for the periods 2006-2010 and 2017-2019. The products are mapped at a 300x300 meter pixel resolution capturing data for a total of 4265 lakes. Each lake has individual identification information allowing it to be related to other hydrological datasets. A list of all lake IDs and additional information (location, name – where known, area) is available. Turbidity is derived from suspended solids concentration estimates and the Trophic State Index is derived from phytoplankton biomass by proxy of chlorophyll-a.

Trophic classification	Trophic State Index, CGLOPS TSI values	Chlorophyll-a (µg/l) (upper limit)
Oligotrophic	0	0.04
	10	0.12
	20	0.34
	30	0.94
Mesotrophic	40	2.6
	50	6.4
Eutrophic	60	20
	70	56
Hypereutrophic	80	154
	90	427
	100	1183

Table

2: Trophic state index and related chlorophyll-a concentration classes (according to Carlson (1977))

Products in the period 2006 - 2010 are based on observations from the MERIS sensor, whereas the product 2017-2019 is derived from OLCI sensors. Land/water buffer maps as well as ice maps were applied to improve the accuracy of the data. The following figure is an example visualisation of the two lake water parameters for Lake Huron showing Trophic State Index 10-day average (left) and turbidity 10 day-average (right).

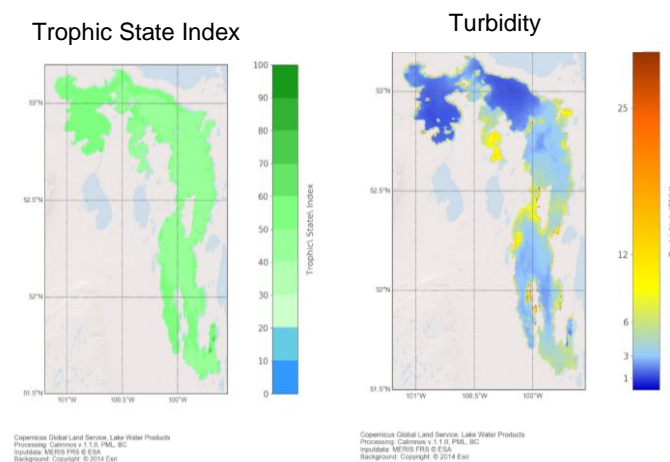


Figure 5: Lake Winnepegosis - Trophic State Index (left) and turbidity (right) monthly product July 2019

The products were tested against consistency (time series) and against in situ data, both for a selected set of lakes. A detailed technical methodology is available to download at the SDG661 data portal ([SDG661.app](#)).

Calculating Turbidity and Trophic State Index statistics

A baseline reference period has been produced comprising monthly averages across 5 years of observations for the period 2006-2010. From these five years of data, 12 monthly averages (one for each month of the year) for both trophic state and turbidity, were derived. A further set of observations are then used to calculate change against the baseline data. These monthly data comprise years 2017,18,19. The 12 monthly averages for these three years have been derived. Monthly deviation of the multiannual baseline is computed using the following equation: $(\text{month_average} - \text{Month_baseline}) / \text{Month_baseline} \times 100$. For each pixel, and for each month, the number of valid observations has been counted and the number of months where there were monthly deviations, falling in one of the following range of values: 0-25%, 25-50% (medium), 50-75%, 75-100% (high). An annual deviation synthesis is also produced.