

# LakeAnalyzer: Lake Internal Dynamics Analysis Software – Fact Sheet

Linking lake restoration with end users for positive environmental outcomes



## What is *LakeAnalyzer*?

*LakeAnalyzer* is a computer program used to calculate indices of mixing and stratification, which are critical to understanding biogeochemical cycles of lakes and reservoirs. Lake physical stability indices, surface mixing depth and thermocline depth are calculated according to established literature definitions and returned to the user in a time-series format.

*LakeAnalyzer* was developed to analyse high-frequency data collected from instrumented lake buoys (Figure 1). It provides a way to compare mixing and stratification indices in lakes across gradients of climate, hydro-physiography, and time, and provides a basis for understanding of the resulting biogeochemical transformations at different spatial and temporal scales.

*LakeAnalyzer* was produced through collaboration between LERNZ, GLEON (Global Lake Ecological Observatory Network), and other research institutes. The program has become increasingly popular since it was first released in 2011.

## Brief History

LERNZ researchers started the *LakeAnalyzer* project as a global collaboration with the Global Lake Ecological Observatory Network (GLEON), in 2007. The objective was to automate the processing of lake observation data from around the world. Due to the lack of standardised practices, the project had to create standards for formatting high-frequency data inputs and outputs.

## Description

*LakeAnalyzer* uses the following input files: Bathymetry (.bth), Water Temperature (.wtr), Wind Speed (.wnd), Salinity (.sal). Outputs from *LakeAnalyzer* include water temperature, wind speed, thermal layer and thermocline depths, wind friction velocity, stratification parameters (Lake Number, Wedderburn Number, Schmidt Stability), the vertical seiche period, and Brunt-Väisälä buoyancy frequency. Secondary outputs for several of these indices delineate seasonal stratification from the shallower diel stratification. The inputs required vary depending on the specified output variables. For more information visit <http://lakeanalyzer.gleon.org/> and download the latest manual and background information.



Figure 1. High-frequency monitoring buoy on Lake Waikaremoana  
Photo: Matt Osborne

## Case Study 1: Lake Rotorua

*LakeAnalyzer* was used to summarise two years of high-frequency data from Lake Rotorua (Figure 2). The coloured contour profile shows the seasonal variation in temperature and development of the thermal layers during summer. The stability of those layers, described by how much wind energy is required to mix the entire water column, is presented below. The variation in stability (known as Schmidt stability) illustrates the multiple mixing events occurring over both seasonal and annual time-scales. This is primarily due to the shallowness (mean depth approximately 10 m) of Lake Rotorua in relation to its surface area.

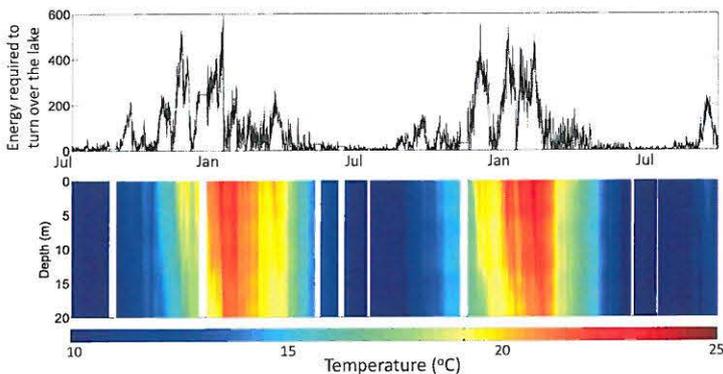


Figure 2. Summary of *LakeAnalyzer* outputs from high-frequency monitoring in Lake Rotorua for 2007 – 2010. Top: physical stratification index; bottom: vertical thermal profiles.

## Case Study 2: Lake Waikaremoana

Two years of high-frequency monitoring buoy data from Lake Waikaremoana were summarised using *LakeAnalyzer* (Figure 3). The thermal profile shows even stronger seasonal variation in temperature than Lake Rotorua with increasing thermal stability during the summer. However, unlike Lake Rotorua, the stability index has a single peak each year, illustrating that the lake only mixes once during the year. At a depth of 260 m, Lake Waikaremoana is the deepest Lake in the North Island, making it difficult for complete mixing by wind. Mixing only occurs when the surface water layer cools in the autumn.

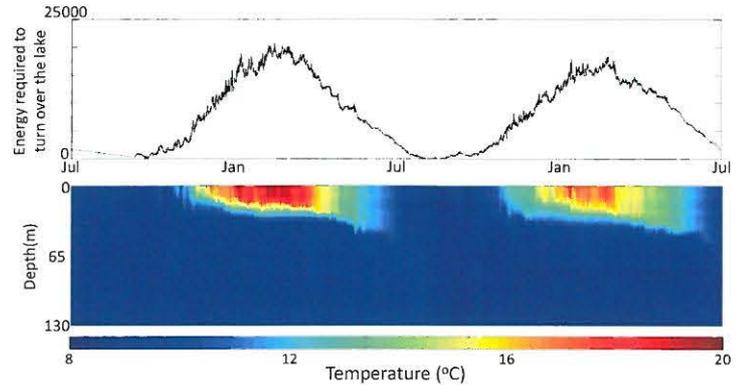


Figure 3. Summary of *LakeAnalyzer* outputs from the thermistor chain record in Lake Waikaremoana for years 2010 – 2012. Top: physical stratification index; bottom: vertical thermal profiles.

## Benefits of LakeAnalyzer

The development of lake monitoring buoys to collect high-frequency data has been a major advance in the field of limnology. With this has come the challenge of processing of vast amounts of data in an efficient and reliable manner. *LakeAnalyzer* provides an ability to analyse and interpret data sets of tens of thousands of observations, including the ability to quickly visualise changes in a lake's water column and thermal stability over several years of observations.

## Available Versions

*LakeAnalyzer* is open-source software. The program was developed for **Matlab** and **R** environments and there is also an easy-to-use **web version**.

- 1) **Matlab**: The original version in Matlab
- 2) **R package**: A version for R program users
- 3) **Web**: An online version not requiring any installation.

## Programme Location

<http://lakeanalyzer.gleon.org/>

## Reference

Read et al. (2011). Derivation of lake mixing and stratification indices from high-resolution lake buoy data. *Environmental Modelling & Software*, 26: 1325-1336.