Automated Water Quality and Weather Monitoring in Lakes Jyväsjärvi, Konnevesi and Vanajavesi

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Abstract

University of Jyväskylä currently manages two automated water quality and weather stations that are located in lakes Jyväsjärvi and Southern Konnevesi. The stations are collecting high frequency data into a database with several water quality and weather parameters. Both stations have a vertical profiler system which monitor continuously the water quality from surface to bottom by steps of 0.5 to 1 m.

Helsinki University carries out water quality measurements at high temporal frequency on Lake Vanajavesi, in Häme, Southern Finland. The water quality monitoring stations are collecting data from several important parameters, including water temperature, dissolved oxygen concentration, chlorophyll a fluorescence, phycocyanin fluorescence and conductivity at 30 minutes interval.
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1 Introduction

University of Jyväskylä and University of Helsinki are operating several automated water quality and weather monitoring stations in lakes Jyväsjärvi, Konnevesi and Vanajavesi. Data produced with these stations has been refined and distributed during the MMEA project. This document introduces the stations, their characteristics and monitored parameters.

2 Monitoring station of Lake Jyväsjärvi

Automated water quality monitoring station (AWQMS) with water quality sensors and weather station was set close to deepest basin of Lake Jyväsjärvi, Jyväskylä, Central Finland (62.237297 N, 25.779141 E) in 2001 (Figure 1). Electricity to the floating raft with a cabin is provided by an underwater cable and air temperature in the cabin is kept at 8 °C in winter with a radiator. The service well in the bottom of the raft is covered with two disks including a duct for water quality sensor cables.

2.1 Weather station

Since 2001, AWQMS has measured meteorological variables of air temperature, barometric pressure, humidity, precipitation, wind speed, wind direction and UV and solar radiation with a meteorological station (Vantage Pro 2, Davis Instruments Corp., Hayward, California, USA) at 4 meters above water surface in 15 minutes interval. Since 2014 the weather data have been collected with Research-Grade Weather Station (Campbell Scientific Inc, Logan, Utah, USA) with the same interval, discarding the measurements of humidity.

2.2 Water quality measurements

Since 2001, year-round surface water (1 meter) temperature and dissolved oxygen (DO) data were collected in one hour interval (Oxygen Optode 3835, Aanderaa Data Instruments, Bergen, Norway). Since 2008, a year-round vertical profiles of both variables have been measured from 1 to 15 m by step of 0.5 meters (max depth 16 meters at the location, one profile per hour). The profiler is operated with a winch (Superwinch ATV2000, Superwinch LLC, Dayville, Connecticut, USA), capable of carrying multiple sensors across the water column. Depth is measured with a pressure sensor (DMU 08, AFRISO-EURO-INDEX, Güglingen, Germany) and the winch has a power cutting system for malfunction. The winch system enables one sensor solutions for the whole water column monitoring and allows multiple sensors to be connected to the profiler. In 2010 and 2011 new Cyclops-7 fluorometers (Turner Designs, Sunnyvale, California, USA) were installed to the profiler to measure Chlorophyll $a$ (Chl $a$), phycocyanin (PC) pigment of blue-green algae, turbidity and dissolved organic matter (DOM) fluorescence. Turbidity sensor was later removed due to recurring malfunction of the device. Since 2014 the rest of the previous water quality monitoring sensors were replaced with EXO2 Multiparameter Sonde (YSI Inc, Yellow Springs, Ohio, USA) and during this time additional parameters of conductivity and pH started to be measured. The AWQMS was moved...
to a new location at the deepest basin (25 meters) in spring 2014.

Figure 1. Monitoring station on Lake Jyväsjärvi, Central Finland
3 Monitoring station of Lake Konnevesi

AWQMS with water quality sensors and weather station was set to Näreselkä basin of Lake Konnevesi, Central Finland (62.643573 N, 26.412140 E) in spring 2013 (Figure 2). Electricity to the floating raft is provided with two 12 V solar panels. The AWQMS is operated during open water season by Konnevesi Research Station (KRS) staff. The site of the AWQMS belongs to the long-term monitoring program of water temperature and the data are managed by Finnish Environment Institute (SYKE) on Hertta-database. KRS operates the additional water temperature measurements approx. every 10 days.

Figure 2. Monitoring station on Lake Konnevesi, Central Finland

3.1 Weather station

Since 2013 AWQMS has measured meteorological variables of air temperature, humidity, precipitation, wind speed, wind direction and UV and solar radiation with aWeather weather station (A-Lab Oy, Keuruu, Finland) at 2.4 meters above water surface in 30 minutes interval. Starting from open water season 2015 the weather data will be collected with General Research-Grade Weather Station (Campbell Scientific Inc, Logan, Utah, USA) in 15 minutes interval, variables identical with current Jyväsjärvi weather station.

Water quality measurements

AWQMS on Lake Konnevesi measures water temperature, DO, Chl a fluorescence, DOM fluorescence, PC fluorescence, pH and conductivity (6600V2-4, ja speksit)
every 3 hours with YSI profiler (YSI Inc, Yellow Springs, Ohio, USA) in 1 meter step (depth at the location 52 meters).

4 Monitoring stations of Lake Vanajavesi

Water quality sensors and weather station with data transfer were set to Lake Vanajanselkä, southern Finland (61.14893 N, 24.27368 E), in spring 2012. Electricity to the instruments is provided with 12 V batteries. All sensors are operated during the open water season, and the staff of Lammi Biological Station is operates the installations. The site is a part of a long-term monitoring program focusing on Vanaja water basin with a number of water quality instruments upper part of the catchment down to the Vanajanselkä.

Figure 3. Monitoring netwok on the Vanaja basin, southern Finland

4.1 Weather station

Meteorological station measures variables such as air temperature, humidity, precipitation, wind speed, wind direction, and solar radiation (PAR; installed in 2014) with a Vaisala Inc. weather station at 2 meter above water surface in 30 minutes interval.

4.2 Water quality measurements

AWQMS measures air temperature, water temperature, DO, Chl a, fluorescence, phycoerythrine fluorescence, PC fluorescence, and conductivity (6600V2-4) once in 30 minutes. In addition, six MiniDOT DO-loggers have been deployed into different depths of the epilimnion (together with YSI 6600 sensor from 0.5 m to 8 m).
Besides the AWQMS installations in Vanajanselkä, there is a river monitoring network based on five UV-VIS Spectrolyser S::can devices. In 2014 also Eddy Covariance greenhouse gas measurements were started in Vanajanselkä by the department of Physics, University of Helsinki. Except one S::can Spectrolyser and MiniDOT sensors, all other instruments provide near on-line data to the web.

Figure 4. Monitoring buoy on Lake Vanajanselkä, southern Finland

5 Data availability

Data is currently graphically available on our websites, at locations

- http://www.paijanne.org

For more specific use, there are tools like WETBox (developed by University of Jyväskylä, location: http://www.paijanne.org/wetbox) and Emmi (developed by Masinotek Ltd in cooperation with the Lammi Biological Station).

The systems require credentials, which can be obtained from data producers. For development use, data is also available via machine interfaces.