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Thermal and chemical destratification in a subtropical lake: a plea for on-line monitoring

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In warm-monomictic Lake Kinneret the downward movement of the thermocline begins in October with the cooling of the water column. The subsequent destratification process is far from being linear and it was the goal of this study to document vertical and temporal short-term variations in the oxic–anoxic interface in response to physical and biogeochemical processes. This was achieved by frequent profiling of temperature, redox intensity, dissolved oxygen, pH, turbidity, chlorophyll and conductivity with a novel autonomous profiler at the center of the lake modified for use under hydrogen sulfide conditions. The results show that thermocline, oxycline and chemocline do not necessarily follow the same path of descend and at times oscillate with amplitudes up to 14 m.

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An automated high-frequency vertical profiling platform for monitoring of phytoplankton ecology and ecosystem functioning

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In a rapidly changing world, innovative approaches to lake-ecosystem monitoring and its integration with ecosystem models are required for a correct management of water resources, the biodiversity that they harbour and the ecosystem services they deliver. Ecological functioning and ecosystem services are highly dependent on functional diversity of different trophic levels, but arguably above all on diversity of the primary producers, in deep lakes the phytoplankton. We developed an innovative and potentially ground-braking tool for high frequency monitoring of lake phytoplankton. With the aim of detecting and understanding patterns in phytoplankton community dynamics, we have designed a lake monitoring platform for the characterisation and counting of algal cells based on advanced scanning flow-cytometry, coupled with measurement of the physical water environment (multiparameter probe) and meteorological conditions.
The aims of our technology are (i) to automatically and with high frequency monitor the following parameters: meteorological conditions; physico-chemical parameters, phytoplankton diversity, composition and abundance, with an emphasis on functional traits; (ii) and to automatically collect this information over the vertical profile of the water column (i.e. taking the large depth of alpine lakes into account).

The Aquaprobe platform performed its first monitoring program in full functional mode between the 28th of April and 31st of May 2010 in Lake Lugano on border of Switzerland and Italy. Data were collected with a frequency of 2 vertical profiles of the water column per day (day and night): the first 20 m of the water column have been characterised on basis of physico-chemical parameters and several types of pigment fluorescence, and the first 12 m on basis of functional phytoplankton abundance and composition. Surface data such as air temperature and light radiation have been monitored in continuum. Automated data were checked against fortnightly taken water-samples, for independent water column measurements of physico-chemical, phytoplankton and zooplankton data, allowing assessment of the actual capabilities of our technology. Results of our automated platform compared well with traditional monitoring data. Our description of phytoplankton diversity patterns however offered levels of statistical reproducibility, depth resolution and high frequency that are unachievable with traditional limological campaigns.
Our technology provides a unique opportunity to: (i) understand phytoplankton diversity dynamics under prospects of environmental change and its influence on lake ecosystem functions and services; (ii) to test for the role of deterministic (niche based) versus stochastic (neutral) processes in community assembly in a realistic setting with regards to the frequency of events and their spatial organisation; (iii) to test for chaotic behaviour in natural algal populations, allowing estimates of the maximum time-frame for possible prediction of lake phytoplankton dynamics.

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Eco-Engineered Management of Runoff and Stormwater at China Three Gorges University

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I have been visiting China Three Gorges University in Yichang on a near annual basis since 2004 and noticed the clearly intentional layout of campus water features. This fall, as a visiting professor in the College of Chemistry and Life Science, I've walked the campus extensively and taken a closer look. I was fascinated by the clear functionality of the features and it quickly became clear that I was observing eco-engineering in action. As I took pictures to show my colleagues and students back at Ferrum, I started wondering, "just how complete and systematic is this eco-engineering project?" and made a mental note to ask one of the graduate students. As it turns out, there is interest in eco-engineering at the highest levels of the university and the CTGU campus has been a working lab since its establishment in 2000.

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Development and Use of Automatic Calibration of DYRESM-CAEDYM

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Automated calibration of complex deterministic surface water quality models which require a large number of biological and chemical parameters for calibration has the potential to take advantage of computer power while limiting time-consuming human iterative judgements of model fit. We undertook auto-calibration of the one-dimensional hydrodynamic-ecological lake model DYRESM-CAEDYM, using a Monte Carlo sampling method. The auto-calibration model is implemented by following a number of steps. First, all physical and biogeochemical parameters were fixed in their respective inputs files (physical - *.par, biological - *.bio, chemical - *.chm, sediment - *.sed). Where the model output was not sensitive to the parameter or where fixed parameter values can be used (e.g., stoichiometric parameters), the minimum and maximum value were set to be equal and the parameter deemed unnecessary for calibration. A random search module (MCS) was then run for all remaining parameters to produce files with combinations of parameters which could then be used to generate independent runs of the model. After all the user-determined iterations, the model performance with different "parameter set" will be evaluated statistically by root-mean-square-error (*RMSE*) , Pearson correlation coefficients (*r*) or Nash-Sutcliffe efficient coefficient (*Nr*) based on the comparisons of model outputs with measured data. The 'optimal parameter set' will be yielded with the smallest error between simulations and measurements and then can be transferred to the three-dimensional hydrodynamic-water quality model.

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Estimating the diffuse light attenuation coefficient (Kd) from paired high-frequency thermistors

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We have developed a method for estimating the diffuse light attenuation coefficient (Kd) by fitting similarity profiles of daily water temperature from two thermistors positioned at different depths in the water column. The daytime gain of water temperature due to penetrating shortwave radiation is a function of the attenuation of the incoming energy, yielding different rates of thermal gain at various depths. During conditions that support the gain of surface stratification (low wind, low cloud-cover; negligible difference in diffusive fluxes), thermistor measurements at two depths should vary in scale and in offset only. By solving for the scaling factor between profiles and by knowing the distance between the two, we approximate the energy attenuation coefficient of incoming shortwave radiation. We have employed this method on buoy data from various GLEON lakes, with results in good agreement to field estimates of KdPAR. We found the ideal spacing and location of the two thermistors to be dependent on Kd (with darker lakes benefiting from closer spacing), and higher temporal resolution thermistors to yield more accurate estimates of Kd.

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A nine-day observation on the process of vertical stratification of physicochemical variables was taken in Taihu, a large shallow lake of China. Frequent stratification processes occurred during the 9 days. But the stratifying state was unstable, and normally last less than 1 day. The main factors causing stratification were water temperature and its diel variation, cyanobacterial bloom scum and wind-induced wave disturbance. The vertical difference of water temperature may reach 3.94 °C, which was mainly influenced by diel variation of air temperature and solar radiation. And the stratification of water temperature was the basic factor causing the stratification of dissolved oxygen, electric conductivity, and pH. Cyanobacterial bloom scum could cause the strongest stratification, which could cause vertical difference of 8.67 mg/L of dissolved oxygen, 48 µC/cm of electric conductivity, 1.49 of pH, 9.1 µg/L of chlorophyll-*a* and 26.5 NTU of turbidity. Besides turbidity, stratification of physicochemical became weaker with increase of wind speed. No stratification happened during strong wind period in which of wind speed over 6 m/s, while it often happened during weak condition in which of wind speed less than 2 m/s. The study indicated that, stratification processes could frequently short-term occurred in the large shallow lakes. And the stratification may have potential influence on the processes of biological activities and exchange on air-water interface and water-sediment interface in large shallow lakes.