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Uprising measurements for the study of convective mixing in the upper mixed layer of a lake

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During periods of calm wind conditions, convective mixing can become the most relevant mixing mechanism in the upper layer, determining the evolution of the water column stratification and leading to the transport of phytoplankton. However, the generation and vanishing of the convective boundary layer, an important process in lakes which affects the surface mixed layer intermittently, is poorly studied because it requires measurements close to the water surface which are difficult to obtain. Here we present the characteristics of a measuring system operated from land to obtain uprising measurements at 200 m from the coast in a lake and which allowed us to sample the water column up to the surface and therefore to follow the night convective cycle. The measuring profiler used in this system contained sensors of small scale shear, fast response temperature and precision conductivity and temperature, together with other optical sensors to obtain the Chlorophyll and turbidity contents. We present a series of 75 profiles measured with this device during 22 hours covering a night convective event. Data were recorded at the Boadella reservoirs in Catalonia, Spain, on the 28th of March 2010. High sampling rates together with slow profiling velocity allowed the small spatial resolution needed to resolve the turbulent scales and obtain several turbulent variables including the dissipation rate of thermal variance and turbulent kinetic energy. Based on these results we discuss the different turbulence characteristics in depth and their evolution during the entire cycle and we review different velocity scalings used for the convective layer by other authors. In addition, meteorological data during the campaign are available from a meteorological station located 1 km from the lake so existing energy parameterizations within the convective layer are compared with our data. Finally, during the second part of the experiment, the velocity of the whole water column was recorded with an ADCP so that we could also evaluate the importance of the internal wave field responsible for the up and down displacements of the phytoplankton shown by our data. Relevance of the inflow and outflow dynamics in the reservoir is also analyzed.

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