SPATIAL AND METHODOLOGICAL VARIABILITY OF VERTICAL EDDY DIFFUSIVITY (Kz) MEASUREMENTS IN A SMALL, TEMPERATE LAKE

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Result are reported of a project whose aims were (I) to compare values of vertical turbulent eddy diffusivity (Kz) measured using four different techniques; and (ii) to determine the spatial variability of Kz profiles within Esthwaite Water, a small lake in NW England. The four techniques compared were: the “heat budget” method of Jassby & Powell (1975, *Limnology and Oceanography* 20), which derives basin-wide average hypolimnetic values of Kz from thermistor chain data; the “wind” method of Wüest et al (2000, *Limnology and Oceanography* 45), which estimates basin-average Kz values from wind speed and stratification data alone; fitting Batchelor spectra to power spectra of microprofiler (SCAMP) thermal data; and finally using profiles of the concentration of Radon-222 emitted from the lake bed. Our results show that the optimum choice of method depends on what data are available, the scales for which the Kz values are required, and the conditions in which data are required. Thus, we recommend (1) using the heat budget method where temporally-resolved, whole-lake vertical mixing rates are required and where continuous thermal profile data is available; (2) where spatial resolution is important, SCAMP must be used, but this requires significant temporal averaging; (3) in isothermal conditions, the radon method must be used, but this is only viable where there is a sufficient radon flux, and for near-bed depths; and (4) the wind method will provide depth-integrated average value for the hypolimnion. We also use SCAMP data to identify the spatial variability of Kz values across the lake. We derive, from the Kz values, time scales for turbulent mixing of material from the lake bed to the surface. We find that this time scale reaches its maximum values at locations in the lake where the depth is intermediate – in between shallow areas, where the water column is well-mixed and the deepest areas of the lake, which are also the most exposed, and are thus where wind-related and internal mixing mechanisms are at their most energetic.

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