Geophysical Research Abstracts
Vol. 18, EGU2016-16637, 2016
EGU General Assembly 2016


# Bio-mixing due to Diel Vertical Migration of Daphnia spp. in a Small Lake

Stefano Simoncelli (1), Danielle Wain (1), and Stephen Thackeray (2)

(1) Department of Architecture and Civil Environmental, University of Bath, United Kingdom, (2) Centre for Ecology and Hydrology - Lancaster Environment Centre, Lancaster, United Kingdom

Bio-turbulence or bio-mixing refers to the contribution of living organisms towards the mixing of waters in oceans and lakes. Experimental measurements in an unstratified tank by Wilhelmus & Dabiri (2014) show that zooplankton can trigger fluid instabilities through collective motions and that energy is imparted to scales bigger than organism's size of few mm. Length scales analysis, for low-Reynolds-number organisms in stratified water by Leshansky & Pismen (2010) and Kunze (2011), estimate eddy diffusivity up two orders of magnitude larger than the molecular thermal diffusivity. Very recently, Wand & Ardekani (2015) showed a maximum diffusivity of $10^{-5}$ m$^2$/s for millimetre-sized organisms from numerical simulations in the intermediate Reynolds number regime. Here we focus our attention on turbulence generated by the vertical migration of zooplankton in a small lake, mostly populated by *Daphnia spp.* This very common species, belonging to *Cladocera* order, is engaged in a vertical migration (DVM) at sunset, with many organisms crossing the thermocline despite the density stratification. During the ascension they may create hydrodynamic disturbances in the lake interior where the stratification usually suppresses the vertical diffusion.

We have conducted five turbulence experiments in Vobster Quay, a small (area $\sim$ 59,000 m$^2$), deep (40m) man-made basin with small wind fetch and steep sides, located in the South West UK. Turbulence was measured with a temperature microstructure profiler. To asses the zooplankton vertical concentration we used a 100 $\mu$m mesh net, by collecting and analyzing samples in 8 layers of the lake. A bottom-mounted acoustic Doppler current profiler was also employed to track their concentration and migration with the measured backscatter strength.

Measured dissipation rates $\varepsilon$ during the day showed low turbulence level (<= $10^{-8}$ W/Kg) in the thermocline and in the zooplankton layer. Turbulence, during the DVM in two different days, is highest on the surface, likely due to surface processes. Peaks of $10^{-6.5}$ W/kg were measured within the migrating zooplankton layer with respect to profiles before sunset and estimated eddy diffusivity was as much as $10^{-5}$ m$^2$/s. Before and after the time series there was no wind and penetrative convection associated with night-time cooling wasn't active during the experiments. Given the uncertainty in measuring the length scales of turbulence associated with small zooplankton and the presence of turbulence patches outside the migrating layer, further datasets are needed for definitive conclusions.