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Vertical migration of motile phytoplankton chains through turbulence ERIC CLIMENT, SALVATORE LOVECCHIO, Institute of Fluids Mechanics - Toulouse - France, WILLIAM DURHAM, Sheffield University, UK, ROMAN STOCKER, ETH Zurich - Switzerland — Daily, phytoplankton needs to migrate vertically from and towards the ocean surface to find nutrients such as dissolved oxygen. To travel through the water column they need to fight against gravity (by swimming) and fluid turbulence (1) which can make their journey longer. It is often observed that cells migrate across the water column as chains. The first benefit to form chains is that micro-organisms sum up their thrust while reducing their drag. Therefore, upwards swimming is faster for chains in a quiescent fluid with steady vertical orientation. However, as chain length increases their tendency to periodically tumble in turbulent structures increases which reduces orientation stability and limits their capacity to swim upwards. The purpose of our study is to elaborate on this apparent contradiction. We carried out direct numerical simulations and physical analysis of the coupled system of homogeneous isotropic turbulence and chain trajectories through Lagrangian tracking. Formation of chains is indeed favorable for vertical migration through the upper layer of the ocean. (1) - Turbulence drives microscale patches of motile phytoplankton. W. M. Durham, E. Climent, M. Barry, F. De Lillo G. Boffetta, M. Cencini and R. Stocker. Nature Communications (2013) 4:2148

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