Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Turbulent unmixing: how marine turbulence drives patchy distributions of motile phytoplankton WILLIAM DURHAM, Oxford University, ERIC CLIMENT, Institut de Mecanique des Fluides, MICHAEL BARRY, MIT, FILIPPO DE LILLO, GUIDO BOFFETTA, Universita di Torino, MASSIMO CENCINI, Consiglio Nazionale delle Ricerche, ROMAN STOCKER, MIT — Centimeter-scale patchiness in the distribution of phytoplankton increases the efficacy of many important ecological interactions in the marine food web. We show that turbulent fluid motion, usually synonymous with mixing, instead triggers intense small-scale patchiness in the distribution of motile phytoplankton. We use a suite of experiments, direct numerical simulations of turbulence, and analytical tools to show that turbulent shear and acceleration directs the motility of cells towards well-defined regions of flow, increasing local cell concentrations more than ten fold. This motility-driven 'unmixing' offers an explanation for why motile cells are often more patchily distributed than non-motile cells and provides a mechanistic framework to understand how turbulence, whose strength varies profoundly in marine environments, impacts ocean productivity.

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Date submitted: 02 Aug 2013 Electronic form version 1.4