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Shaken, but not stirred: how vortical flow drives small-scale aggregations of gyrotactic phytoplankton MICHAEL BARRY, WILLIAM DURHAM, MIT, ERIC CLIMENT, IMFT, ROMAN STOCKER, MIT — Coastal ocean observations reveal that motile phytoplankton form aggregations at the Kolmogorov scale (mm-cm), whereas non-motile cells do not. We propose a new mechanism for the formation of this small-scale patchiness based on the interplay of turbulence and gyrotactic motility. Counterintuitively, turbulence does not stir a plankton suspension to homogeneity but drives aggregations instead. Through controlled laboratory experiments we show that the alga *Heterosigma akashiwo* rapidly forms aggregations in a cavity-driven vortical flow that approximates Kolmogorov eddies. Gyrotactic motility is found to be the key ingredient for aggregation, as non-motile cells remain randomly distributed. Observations are in remarkable agreement with a 3D model, and the validity of this mechanism for generating patchiness has been extended to realistic turbulent flows using Direct Numerical Simulations. Because small-scale patchiness influences rates of predation, sexual reproduction, infection, and nutrient competition, this result indicates that gyrotactic motility can profoundly affect phytoplankton ecology.

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