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Turbulence and motility conspire to generate small-scale phytoplankton patchiness[1] ROMAN STOCKER, MIT, ERIC CLIMENT, Institut de Mecanique des Fluides de Toulouse, WILLIAM DURHAM, MIT — Phytoplankton are heterogeneously distributed at nearly all scales in the Ocean. Small-scale patchiness is often thought to result from a passive "top down" process where large patches of phytoplankton are broken into subsequently smaller ones by turbulent motion. Here we demonstrate instead a "bottom up" process in which patchiness is generated *ex novo* by the coupling of turbulence and cell motility. We implemented an individual based model (IBM) for phytoplankton cells within a direct numerical simulation (DNS) of turbulence. The IBM describes the movement behavior of gyrotactic cells, for which the swimming direction is dictated by the interaction of cell morphology (e.g. bottom-heaviness) and fluid shear. Two dimensionless parameters govern the dynamics: the ratio of the Kolmogorov velocity to swimming velocity, and the ratio of Kolmogorov time scale to cell reorientation time. We find that this mechanism can indeed generate strong patchiness and discuss the parameter regime under which this occurs. An analytical single-vortex model helps to shed light on the fundamental physics at play. These findings strongly highlight the importance of microbial motility in the Ocean.

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