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Plankton dynamics in thermally-stratified free-surface turbulence
SALVATORE LOVECCHIO, ALFREDO SOLDATI, University of Udine — Thermal stratification induced by solar heating near the ocean-atmosphere interface influences the transfer fluxes of heat, momentum and chemical species across the interface. Due to thermal stratification, a region of large temperature gradients (thermocline) may form with strong consequences for the marine ecosystem. In particular, the thermocline is believed to prevent phytoplankton from reaching the well-lit surface layer, where they can grow through the process of photosynthesis. In this paper, we use a DNS-based Eulerian-Lagrangian approach to examine the role of stratification on phytoplankton dynamics in thermally-stratified free-surface turbulence. We focus on gyrotactic self-propelled phytoplankton cells, considering different stratification levels (quantified by the Richardson number) and different gyro tactic re-orientation times. We show that the modulation of turbulent fluctuations induced by stable stratification has a strong effect on the orientation and distribution of phytoplankton, possibly leading to trapping of some species within the thermocline. Specifically, we observe the appearance of a depletion layer just below the free-surface as stratification increases, accompanied by a reduction in the vertical stability of phytoplankton cells.

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