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Turbulence effects on particle dispersion in free-surface flow SALVATORE LOVECCHIO, CRISTIAN MARCHIOLI, ALFREDO SOLDATI, University of Udine — We study the dispersion of light particles in a two-dimensional (2D) flow on a flat free-slip surface that bounds a three-dimensional (3D) volume in which the flow is turbulent. This simplified configuration mimics the motion of active/passive ocean surfactants (e.g. phytoplankton, floaters or drifters) when surface waves and ripples are absent. We perform direct numerical simulation of turbulence coupled with Lagrangian particle tracking, considering different values of the shear Reynolds number (Re=171 and 510) and of the Stokes number ($0.06 < \mathrm{St} < 1$ in viscous units). Simulations show that particles reach the free surface upon entrainment in upwelling motions, then quickly move toward downwelling regions where they are trapped for long residence times and advected by the mean flow. Surface flow is neither compressible nor incompressible but strongly influenced by the 3D flow underneath the surface. Results highlight the fractal nature of particle distribution at the surface, which appears to be driven by flow scales different from those of incompressible 2D/3D homogenous isotropic turbulence. In particular, we observe an asymptotic scaling of particle transport dynamics with the Lagrangian integral time scale of the fluid at the surface.

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