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Impacts of meso and submesoscale dynamics on the horizontal dispersion of sinking particles from the surface to the deep ocean

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Energetic eddy fields generated by meso and submesoscale dynamics induce tridimensional particle transport pathways, which complicate the interpretation of observed Particulate Organic Carbon (POC) fluxes using sediment traps. It is therefore of importance to understand how horizontal dispersion of particles is structured by these dynamics from surface to depth. In this modelling study, we use a Lagrangian method to backtrack sinking particles collected at various depths ranging from 500 m to 4700 m at the PAP (Porcupine Abyssal Plain) site. Particle trajectories are computed using high-resolution simulations of the Regional Ocean Modelling System (ROMS). Our results show that the horizontal distribution of particles with sinking velocities below 100 m d^{-1} presents a large small-scale heterogeneity. Mesoscale eddies act to define the general structure of particle patches while submesoscale features shape particle distributions through convergence/divergence processes. Distribution patterns of particles tracked from different depths suggest regime shifts of particle dispersion between subsurface layers. To identify and quantify these regimes, we perform 2d experiments at specific depths from 100 m to 4000 m and relate the Lagrangian statistics to the characteristics of the different dynamical regimes identified using vertical profiles of eddy energy and Finite Size Lyapunov Exponents (FSLE) approach.