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Characterization of the structure and cross-shore transport properties of a coastal upwelling filament using three-dimensional finite–size Lyapunov exponents

João Bettencourt (1), Vincent Rossi (2), Emilio Hernández-García (3), Martinho Marta-Almeida (4), and Cristóbal López (3)

(1) LEGOS, Toulouse, France (jhbettencourt@protonmail.com), (2) MIO, Marseille, France, (3) IFISC, Palma de Mallorca, Spain, (4) IEO, A Coruña, Spain

The three dimensional structure, dynamics and dispersion characteristics of an upwelling filament in the Iberian upwelling system are analyzed using Lagrangian tools applied to a regional simulation of the western Iberian shelf using realistic forcings, which is coincident with an in-situ campaign that studied the oceanography of the area. We compute 3d fields of finite–size Lyapunov exponents (FSLE) from 3d velocity fields and extract the field's ridges to obtain proxies to the Lagrangian structures that form the boundaries of a cold water filament that develops due to the interaction of a mesoscale eddy with the upwelling front. The cold, upwelled waters move along the filament, conserving their density. The filament itself
is characterized by small dispersion of fluid elements in its interior. The comparison with potential temperature gradient fields shows that the limits of the filament coincide with large gradient regions, which explain the isolation of the interior of the filament from the external waters. We conclude that the Lagrangian analysis used in this work is useful in explaining the dynamics of across shore exchanges of material between coastal regions and the open ocean due to mesoscale processes.