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Observation and modelling of an upwelling filament west of cape São Vicente, SW Portugal

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In October 2004 an oceanographic cruise including CTD and ADCP observations to study the Cape St. Vincent filament. This paper describes the hydrography and dynamics of the filament from the observations and from dynamical simulations from a 3D hydrodynamical numerical model. The offshore transport associated with the filament was 0.6 Sv. Since the Ekman transport accompanying the filament was about 10% of the observed transport, the notion that the filament resulted from an alongshore equatorward upwelling jet instabilized close to Cape St. Vincent emerged. Observations revealed that the filament appeared similar to other filaments in the northwestern Iberian peninsula rather than to observations in the west US coast or in northwestern Africa. Although it appeared associated with an offshore jet, its dynamical structure was relatively weak. The filament appeared associated with meanders of a geostrophically adjusted upwelling jet embedded in a field of persistent eddies with which it interacted. Observations evidenced structural asymmetry. Accordingly, spatial derivatives of the geostrophic velocity field revealed that relative vorticity around the filament was negative to the north and more strongly positive to the south. The surface flow circulated around a cyclonic shear zone between the offshore jet and the onshore flow, dissected by a conspicuous anticyclonic turn. The result was a cold region populated with smaller sub-mesoscale ($\sim$ 30 km diameter) cyclones. The causes of the discrepancies between the dynamical signature of the west US coast and the Cape St. Vincent filaments appeared related with the enhanced baroclinicity (understood as the isopycnal slope) in the California Current system in versus much more smoothed horizontal gradients in the Iberian region. Interaction between the surface and the sub-

surface circulation was obserevd, with an active subsurface layer below the upwelling circulation including the presence of Mediterranean outflow. Part of a cyclone associated to the detachment of a neighboring meddy-cyclone dipole seemed to cross the the study area with velocity values greater than 0.20 m/s below 400 m depth. This could contribute to the formation of the October filament through increased baroclinic instability. A Primitive Equation (PE) numerical model, using a high-resolution embedded nested grid was used to generate the upwelling circulation along the western Iberian Peninsula. The model was forced with daily surface fluxes and was able to reproduce the upwelling circulation and the generation of a host of mesoscale features including meanders, jets, eddies and filaments. The formation of a particularly developed upwelling filament similar to that observed in October 2004 was noted. Both filaments shared some of the most characteristic features, like the structural asymmetry, the surface-trapped nature and the independence of the prevailing winds. A difference emerged as the modelled filament featured a slightly smaller vertical extent than the observed one.