

The southern Senegal coastal ocean: a low enrichment-high retention upwelling center

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Abstract

The circulation associated with coastal upwelling is well understood in simple 2D alongshore invariant situations. Southern Senegal is the southern tip of the Canary upwelling system. Its coastal ocean hosts an upwelling center which shapes sea surface temperatures over several degrees in latitudes, ~ between 12 and 15N. Near this latter latitude, the Cape Verde headland and a sudden change in shelf cross-shore profile are two major sources of heterogeneity present in the southern Senegal upwelling sector (SSUS), whose dynamics is herein investigated by means of primitive equation numerical simulations, using the hydrodynamical Regional Ocean Modeling System (ROMS). Configuration realism and resolution ($dx \sim 2$ km) are sufficient to reproduce the frontal system present during the upwelling season in the SSUS. Our main focus is on the 3D upwelling circulation which turns out to be profoundly different from 2D theory: coastal upwelling is strongly concentrated within a few tens of kilometers south of Cape Verde and largely arises from flow divergence in the alongshore direction; most injections of cold water onto the shelf take place in the same northern area; a significant fraction of the upwelled waters are retained nearshore over long distances while travelling southward under the influence of northerly winds. Another source of alongshore complexity, regional scale alongshore



pressure gradients, also contributes to the overall retention of upwelled waters over the shelf. Varying the degree of realism of atmospheric and oceanic forcings does not appreciably change these conclusions. The study sheds light on the dynamics and circulation underlying the recurrent SST pattern observed during the upwelling season and offers new perspectives on the connections between SSUS physical environment and its ecosystems.

Keywords: Canary upwelling system, sea surface temperatures, Cape Verde headland, southern Senegal upwelling sector, Regional Ocean Modeling System (ROMS).



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