

## Observed and modeled patterns of circulation in a semi-enclosed bay: Ria de Vigo (NW Iberia)

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The Ría de Vigo, as a semi-enclosed bay, belonging to the area so-called Rias Baixas, located at the northern tip of the Iberian coastal upwelling system. The circulation of the Ría de Vigo, being one of the major areas of mussels production, has become the subject of intensive research. The Ría de Vigo behaves as a partially-mixed estuary with a two-layered residual circulation, and is influenced by water exchange with the surrounding ocean. During northerly (upwelling favorable) winds, water enters into the Ría through the northern mouth and leaves through the surface layer of the southern mouth, in a double layer circulation at this mouth. Nearly opposed situation occurs during downwelling favourable wind periods. Numerical models have become useful tools to study the hydrology and circulation of the Ría de Vigo. In this research we used the ROMS - AGRIF model. The implementation of several nested domains to increase the spatial resolution (up to 150m resolution) allowed solving the interactions between Ría de Vigo and surrounding coastal ocean in a realistic way. We have obtained a detailed description of the circulation with good agreement between observational data (ADCP moorings at both mouths, and weekly hydrological cruises) and predicted currents, salinity and temperature fields.

Two new patterns of circulation in the Ría are revealed by our research:

-In particular conditions associated with northerly wind relaxation, there are two-layer circulation occurs in both mouths of the Ría, consisting of outflow and inflow through the surface and bottom layers. This situation happens in the absence of stratification during winter.

-Also during winter, one-layer circulation in the southern mouth of the Ría (typically there are two layers) can occur during long periods of persistent and strong upwelling-favourable wind.

Our research has provided a detailed study of the circulation and hydrology of the Ría de Vigo, explaining specifically different mechanisms of water exchange with coastal waters. The impact of northerly winds strength on the water masses transport, is an important issue in the biological production, since nutrient and oxygen rich upwelled waters from the Atlantic Ocean prevent the buildup of hypoxic conditions and additionally constitute an important source of biogenic materials.