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A preliminary study of the Ria de Aveiro plume dispersal

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Over the last years several studies have been performed about the hydrodynamic and the water properties transport in the Ria de Aveiro lagoon, but none of them had the focus on the dispersal of the lagoon plume into the adjacent Atlantic Ocean.
This buoyant plume injects less dense water in to the ocean during the ebbing, which penetrates onto the coastal zone generating an offshore movement in the surface layer. The structure of the estuarine plume is usually characterized by a buoyant bulge, propagating radially form the lagoon inlet. Its shape depends on several factors: density differences between ocean and estuarine water; bathymetric changes and meteorological parameters variability, in particular of the wind direction and intensity.
The main objective of this study is to perform a preliminary study of the Ria de Aveiro estuarine plume, as well as its qualitative assessment during extreme river discharges conditions (maximum and minimum) and also a typical estuarine inflow/outflow value for the Winter (January).
A baroclinic finite volume numerical model, MOHID was implemented separately to the Ria de Aveiro and to the adjacent coast. The lagoon application was performed in a 2D mode, and has the purpose of quantifying the flow (and its properties) that the Ria de Aveiro injects into the ocean. The coastal application consisted in a numerical implementation using a three level baroclinic nesting model. The model domain includes the whole Iberian Peninsula using a realistic coastline and bottom topography. Initial ocean stratification and tide are from the MERCATOR solution and FES Global tidal solution, respectively. The hourly lagoon discharge, previously calculated through the model runs of the Ria de Aveiro estuarine model, was imposed in the lagoon mouth location of the coastal application, in order to allow the study of the estuarine plume dynamics. The model results were compared with satellite images, to assess the models performance.
For an intense river inflow event, the surface results for SST and salinity for the coastal zone adjacent to the Ria de Aveiro show similar patterns to those obtained with satellite imagery. For the extreme (highest) flow simulation, it was found that initially the plume expands to about 25 km from the coast, creating a bulge in front of the lagoon mouth. Then, it is advected to the right (due to the Coriolis effect), and after the establishment of the geostrophic balance the plume is advected northward along the coast. For the typical inflow results were found similar patterns, but less pronounced. The plume expands only to about 14 km from the coast and the bulge size is smaller. The simulations for the minimum inflow rate show that the estuarine plume is almost nonexistent. In this scenario, the salinity differences between estuarine and coastal ocean waters are minimal. In this case the thermal gradients tend to control the density patterns and, consequently, the estuarine plume establishment.
This approach could be a starting point for further studies and improvements in the monitoring of the dynamics of Ria de Aveiro estuarine plume.