Effect of the river discharge implementation in an operational model for the West Iberia coastal area.

Authors: F. J. Campuzano[1], I. Kenov[1], D. Brito[1], M. Juliano[2], R. Fernandes[1], L. Pinto[1] and R. Neves[1]

[1] *MARETEC, Dep. De Eng. Mecânica, Instituto Superior Técnico, Universidade de Lisboa. Av. Rovisco Pais 1049-001 Lisbon. campuzanofj.maretec@tecnico.ulisboa.pt.*

[2] *LAMTec-ID, Universidade dos Açores. Edificio LAMTec, Marina, Apartado 64, 9760 Praia da Vitória, Ilha Terceira, Açores*

Abstract

In order to evaluate the relative importance of the nutrients reaching the coast from river watersheds and their impact on the coastal primary production an integrated catchment-estuarine system was incorporated to the Portuguese Coast Operational Modelling System (PCOMS). At the watershed level, the Mohid Land model provided operationally water flow and properties, including nutrients, for the main river catchments of Western Iberia with a 2 km horizontal resolution. Downstream, several operational hydrodynamic and biological estuarine applications used the previous results as fresh water input flows, filling the gaps in the observation network. From the estuarine models, the tidally modulated water and properties fluxes to the coast were obtained. These fluxes were finally imposed in the PCOMS System, a fully 3D baroclinic hydrodynamic and ecological regional model that covers the Iberian Atlantic coast.

Keywords: Numerical modelling, Mohid, Catchment, Estuary, PCOMS, Nutrients

1. Introduction

In the Iberian Peninsula, the largest rivers, with the exception of the Ebro River, discharge on the Atlantic coast draining on its way almost two thirds of the territory. They are an important source of nutrients and sediments to these coastal areas. It is critical to determine the inland waters contribution to the open ocean, in terms of volume and composition.

A watershed model has been applied to the Iberian Peninsula to characterise the river discharges and their influence on the coastal circulation and nutrient processes. By linking this watershed model to a hydrodynamic and ecological model for the Portuguese coastal region the influence of the land inputs were evaluated.

The different interfaces found by the water from the watersheds to the open ocean were reproduced through numerical models for the first time for the Portuguese coast using the different components of the Mohid Water Modelling System (Neves, 2013).

2. Modelling approach

The Mohid Land model provided operationally water flow and properties, including nutrients, for the main river catchments of the Western Iberian Peninsula area. Downstream, several operational hydrodynamic and biological estuarine applications used the previous results as fresh water input flows, filling the gaps in the observation network. From the estuarine models, the tidally modulated water and properties fluxes to the coast were obtained. These fluxes were finally imposed on the Portuguese Coast Operational Modelling System (hereafter referred as PCOMS, Figure 2, Mateus *et al*., 2012).

This complex system of models is integrated and synchronised through the ART software (Automatic Running Tool), a software for model simulations automation developed at IST. The ART tool pre-processes the boundary conditions from different sources needed to run the model; executes the Mohid water and Mohid Land depending of the application using the configured files and store, graphs and distributes the model results via OPeNDAP, smartphone and Webpages.

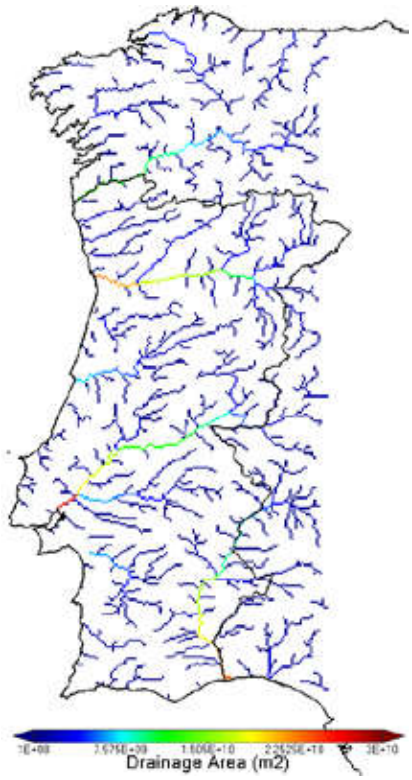

Figure 3 Main water lines in the Western Iberian Peninsula indicating the drainage area obtained for the 2 km resolution.

2.1 Watershed modelling

Two application domains with different resolution and area covered were designed in order to provide high resolution results for Portugal and also able to reproduce the spatial scale of large trans-boundary rivers discharging in Western Iberia such as the Tagus, Douro and Guadiana rivers. Using the NASA digital terrain elevation two domains were constructed

- the Iberian Peninsula domain (IP domain) 10 km horizontal resolution
- the Western Iberia domain (WI domain) 2 km horizontal resolution (Figure 1)
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Both domains were populated with data from the Corine 2006 land cover and JRC soil database allowing the model to estimates the amount of water flowing in the water lines without taking into account the human consumption, water reservoirs and dams that could influence the river flow and the amount of water reaching the coastline.

2.2 Integration with ocean model

The watershed models are linked through estuarine models that receive the water from the watershed models (i.e. Aveiro, Minho, Lima, etc.) or, when existing, from the SNIRH observing system (Douro, Tagus, Mondego). From these estuarine models, section fluxes are obtained and in the next step introduced in the 3D hydrodynamic and ecological regional model PCOMS. If the estuarine model is 3D, the discharge would be distributed at the corresponding depths, as is the case of the Tagus estuary mouth (Campuzano *et al.*, 2012), the rest of the estuarine models are 2D and thus the discharge is imposed in the surface layer. The rest of the river discharges are directly imposed in the regional circulation model PCOMS.

2.3 Ocean modelling

In order to estimate the influence of the river discharges in terms of nutrient fluxes a set of 3D polygons were defined in the PCOMS application. The PCOMS model is a 3D full baroclinic hydrodynamic and ecological regional application that downscales the Mercator-Océan PSY2V4 North Atlantic solution with a horizontal resolution of 0.06º and with 50 vertical levels (43 in Cartesian and 7 in sigma coordinates) with a resolution of almost 1 m near the surface (Figure 2). Tides are forced using the global tide solution FES2004 along the ocean boundary (Lyard *et al.*, 2006).

3. Results and discussion

The addition of the estuarine fluxes modifies the coastal circulation and could create sharp haline fronts such as the one observed in June 2012 where the combination of several estuarine discharges created a front that occupies the centre and north of Portugal. Salinity values over 35 psu (Figure 2). This phenomena, named as the West Iberia Buoyant Plume, was observed during summer campaigns by Peliz *et al.* (2002). The same configuration has been used to implement a forecast service the results of which can be accessed at http://forecast.maretec.org/

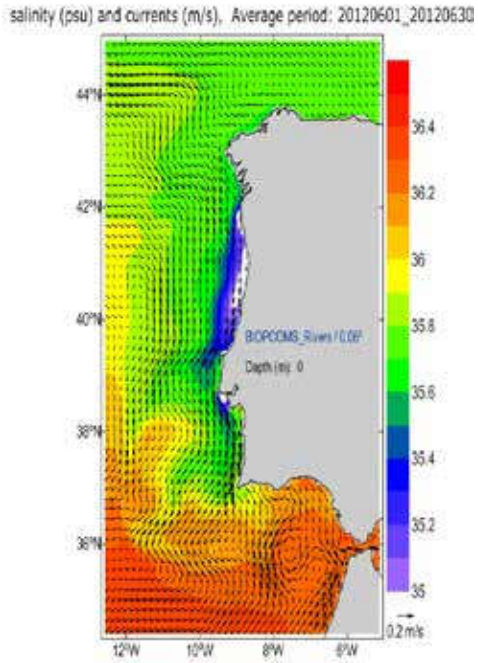

Figure 2 Average sea surface salinity for the month of June 2012 White values correspond to values below 35 psu.

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