A comparison study of 6 Mediterranean lagoons with numerical modeling

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A numerical model (SHYFEM) has been applied to 6 Mediterranean lagoons and a comparison study between the lagoons has been carried out. The lagoons are the Venice lagoon and the Marano-Grado lagoons in the Adriatic Sea, the Taranto basin in the Ionian Sea, The Cabras lagoon in Sardinia, the Mar Menor in Spain and the Nador lagoon in Morocco. These lagoons give a representative picture of the lagoons situated around the Mediterranean basin.

The model has been applied in its 2D version in order that the results can be easily compared with each other. The model is a finite element model, especially suited to shallow water basins with complicated geometric and morphologic variations. The model can compute the basic hydrodynamics, dispersion of tracers, temperature and salinity evolution, sediment transport and ecological parameters.

This study has been mainly focused on hydrodynamics, exchange rates and residence time description. The lagoons range from a leaky type of lagoons to a choked type. The number of inlets ranges from just one in the Nador lagoon to 6 in the case of the Marano-Grado lagoons. Tidal range is from nano-tidal to micro-tidal. The depth ranges from an average depth of 1 m to up to 6 meters.

All lagoons show strong impact of wind forcing. In most lagoons fresh water input is small, but it is relatively strong in the Marano-Grado case. Wind and tidal stirring normally prevent the lagoons from developing stratification, which justifies the application of the 2D version of the model. The exchange rate depends mainly on the inlet configuration, but also on the wind regimes in the case of multi-inlet lagoons. The exchange rate is also the most important factor determining the residence time distribution inside the lagoons.

Residence time is a powerful concept that allows lagoons to be characterized with a time scale. Apart from residence times also the transit time has been used to characterize the basins. Both time scales can be easily computed through a Eulerian and Lagrangian approach. In the case of the studied lagoons the residence time ranged from some days in the Marano-Grado lagoon to up to one year in the case of the Mar Menor.

The numerical study proved to be a powerful tool for the inter-comparison of the lagoons. The study will be enlarged in the future in order to comprise also ecological applications.