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The distribution of salinity and main forcing effects in the Berre lagoon

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The results from previous studies in lagoons and well mixed estuaries indicate that salt transport is primarily in response to advection associated with freshwater outflow, tidal diffusion, and to shear effects arising from spatial correlations of vertical and especially transverse deviations in salinity and current speed (Smith, 1994). Therefore, the inflow of fresh and salt water into coastal lagoons is an important factor influencing the structure and function of lagoonal ecosystems worldwide (Lirman et al., 2007). The predominance of marine or freshwater inflow leads to the different ecosystems. Among several lagoons located along the Mediterranean shore of France, the Berre lagoon has been under intense anthropogenic pressure for several decades (Delpy et al., 2012). Moreover, the salinity level of the Berre lagoon was varying dramatically from the 19th century up to now. In this work, a special attention is focused on the salinity variation in the Berre lagoon due to the three dominant abiotic forcing mechanisms, i.e. incoming sea tide, runoff from a hydropower and a strong wind. Four different model scenarios were considered in order to examine the impact of each forcing mechanism or combined effects, i.e. : (a) tide only, (b) runoff only, (c) combined tide and runoff, and (d) an N-NW wind, tide and runoff together. Numerical modeling and interpretation of numerical results are based on three-dimensional hydrodynamic model MARS3D. It is found that the strongest negative impact is related to the huge hydropower runoffs, inducing the desalinization of the surface and subsurface waters not only in the centre of the lagoon, but also in the entire water column in the coastal seagrass recolonization zones. In the absence of wind, the huge inputs of freshwater from the hydropower lead to a haline stratification and thus, to anoxic conditions, making most of the lagoon unproductive. On the contrary, strong winds play a positive role on the salinity level of the Berre lagoon by destroying rapidly (in a few hours) the vertical stratification, thereby reducing the risk of anoxia. The results from these model scenarios are useful to further understand the ecosystem of the Berre lagoon and to help the designers of seagrass restoration program.

References

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