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Bottom shear stress and salinity distribution in a windy Mediterranean lagoon

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This work concerns the wind influence on bottom shear stress and salinity levels in a Mediterranean semi-enclosed coastal lagoon (Etang de Berre), with respect to a replanting program of Zostera noltii. The MARS3D numerical model is used to analyze the 3D current, salinity and temperature distribution induced by three meteorological, oceanic and anthropogenic forcings in this lagoon. The numerical model has been carefully validated by comparison with daily observations of the vertical salinity and temperature profiles at three mooring stations, for one year. Then, two modelling scenarios are considered.
The first scenario (scen.#1), starting with an homogeneous salinity of S=20 PSU and without wind forcing, studies a stratification process under the influence of a periodic seawater inflow and a strong freshwater inflow from an hydropower plant (250 m3/s). Then, in the second scenario (scen.#2), we study how a strong wind of 80 km/h can mix the haline stratification obtained at the end of scen.#1. The most interesting results concern four nearshore replanting areas ; two are situated on the eastern side of EB and two on the western side. The results of scen.#2 show that all these areas are subject to a downwind coastal jet. Concerning bottom salinity, the destratification process is very beneficial; it always remains greater than 12 PSU for a N-NW wind of 80 km/h and a hydropower runoff of 250 m3/s.
Special attention is devoted to the bottom shear stress (BSS) for different values of the bottom roughness parameter (for gravels, sands and silts), and to the bottom salinity. BSS presents a maximum near the shoreline and decreases along transects perpendicular to the shoreline. There exists a zone, parallel to the shoreline, where BSS presents a minimum (close to zero). When comparing the BSS value at the four replanting areas with the critical value, BSScr, at which the sediment mobility would occur, we see that for the smaller roughness values (ranging from z0=3.5 e−4 mm, to 3.5 e−2 mm) BSS largely surpasses this critical value. For a N-NW wind speed of 40 km/h (which is blowing for around 100 days per year), BSS still largely surpasses BSScr - at least for the silt sediments (ranging from z0=3.5 e−4 mm, to 3.5 e−3 mm). This confirms the possibility that the coastal jet could generate sediment mobility which could have a negative impact for SAV replanting.

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