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Influence of the surface drag coefficient (young waves) on the current structure of the Berre lagoon

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Due to the shallowness, currents and hydrodynamics of Berre lagoon (South of France) are closely conditioned by the bottom topography, and wind affects the entire water column, as for many other Mediterranean lagoons (Perez-Ruzafa, 2011). Wind stress, which is caused by moving atmospheric disturbance, is known to have a major influence in lagoon water circulation.
According to the numerical simulation for the main directions of the wind: N-NW, S-SE and W (wind speed of 80 km/h) it is observed that the current is maximal alongshore in the wind direction; the bottom nearshore current being larger in shallower area.
This fact is coherent with fundamental principle of wind-driven flows in closed or partially closed basins which states that in shallow water the dominant force balance is between surface wind stress and bottom friction, yielding a current in the direction of the wind (Mathieu et al, 2002, Hunter and Hearn, 1987; Hearn and Hunter,1990). A uniform wind stress applied at the surface of a basin of variable depth sets up a circulation pattern characterized by relatively strong barotropic coastal currents in the direction of the wind, with return flow occurring over the deeper regions (Csanady, 1967; Csanady, 1971). One of the key parameters characterizing the wind stress formulation is a surface drag coefficient (Cds).
Thus, an effect of a surface drag coefficient, in the range 0.0016 – 0.0032, will be analyzed in this work. The value of surface drag coefficient Cds = 0.0016 used in our previous studies (Alekseenko et al., 2012), would correspond to mature waves (open sea). But, in the case of semi-closed lagoonal ecosystem, it would be more appropriate to consider “young waves” mechanism. A dependency of this coefficient in terms of the wind speed is given by Young (1999) in both cases of mature waves and young waves. For “young waves” generated at a wind speed of 80 km/h, Cds = 0.0032. So, the influence of Cds on the vertical profile of the velocity in the water column is analyzed in the range 0.0016 – 0.0032.
For the three main wind directions considered in this work, for a wind speed of 80 km/h, the complex current structure of the Berre lagoon is analysed. In the nearshore zones, strong alongshore downwind currents are generated, reaching values of the order of 1m/s (up to 1.5 m/s) at the free surface, and 0.5 – 0.6 m/s at the bottom.

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