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Three-dimensionnal coupled modeling of wave- and wind/buoyancy- driven currents: An application in the Gulf of Aigues-Mortes (NW Mediterranean sea, France)

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Hydrodynamics of nearshore tidalless continental shelf depends on two main processes : wave- and wind/buoyancy- driven currents. These processes interact and show strong vertical variations in intensity and/or direction. It is thus necessary to take into account their three-dimensionnal coupled effects. On the one hand, wind and buoyancy- driven currents can be simulated by a 3D coastal circulation model like Symphonie (Estournel et al, 1997). On the other hand, wave- driven currents can be computed by a wave propagation model like REFDIF (Kirby and Dalrymple, 1984). Simulations on the Gulf of Aigues-Mortes (GAM, NW Mediterranean sea, France), a prototypic area, show that the intensity of the two types of currents have the same order of magnitude. It is thus necessary to take into account the two processes as well as their interactions.

First, the effect of the general circulation on the modulation of wave frequency is introduced via the so-called "Doppler velocity" (e.g Kirby and Chen, 1989). Second, following the physics described by Mellor (2003), the three dimensional effects of the waves are introduced in the coastal circulation model. Velocities and pression being the sum of mean, turbulent and wave components, new terms appear in the primitive equations. This forcing terms are : first, the derivative of the vertically dependent radiation stresses corresponding to those given by Longuet-Higgings and Stewart

(1961,1962,1964) and Phillips (1966) in a 2D integrated model ; and second, the over-pressure terms due to the waves.

The Symphonie model was modified to take into account these forcing terms. The numerical applications performed on a linear and idealized bathymetry, show the strong influence of the forcing terms which cannot be neglected anymore in nearshore areas like the GAM. In-situ ADCP measurements, acquired in marsh 2005, will allow to test and to validate the coupled model.