Geophysical Research Abstracts
Vol. 15, EGU2013-6245, 2013
EGU General Assembly 2013
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Three dimensional effects of the surface gravity waves on the river plume dynamics: the example of the Mississippi River plume

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The first numerical simulations of the three dimensional wave effects on the Mississippi River plume dynamics are presented in this study. The different processes governing the three dimensional wave/swell effects on the plume stratification and dynamics at the nearfield and farfield scales are analyzed and the Coupled-Ocean-Atmosphere-Wave-Sediment Transport model (COAWST) is employed to carry out both a process orientated study - with simple baseline simulations, and a sensitivity study - with realistic runs. The baseline model is forced only by one river flow and different scenario of swell/wave, in the presence of a simplified bathymetry. Tides, wind stress, surface heat flux and ocean boundary conditions are the forcing added in the realistic model of the Mississippi River - used in order to reproduce realistic events. This study, based on numerical experiments, relies on the Vortex Force approach (McWilliams et al., 2004) implemented in the COAWST model and the wave effects on the plume stratification and dynamics at different scales and under different wave conditions is numerically assess and quantify. The simplified baseline simulations illustrate the different processes involved in the complex hydrodynamics of river plume in presence of waves and allow a first quantification of the wave/swell effects on the plume stratification. The main purposes of the realistic simulations are (1) to validate the model against measurements and (2) to understand the importance of the wave/swell effects on the plume dynamics in comparison with the other complex forcing.

McWilliams, J. C., Restrepo, J. M. and Lane, E. M., 2004. An asymptotic theory for the interaction of waves and currents in coastal waters, Journal of Fluid Mechanic, 511, pp 135-178.