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Numerical simulation of wave-current interaction under strong wind conditions

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Although ocean surface waves are known to play an important role in the momentum and other scalar transfer between the atmosphere and the ocean, most operational numerical models do not explicitly include the terms of wave-current interaction. In this work, a numerical analysis about the relative importance of the processes associated with the wave-current interaction under strong off-shore wind conditions in Gulf of Tehuantepec (the southern Mexican Pacific) was carried out. The numerical system includes the spectral wave model WAM and the 3D hydrodynamic model POLCOMS, with the vertical turbulent mixing parametrized by the kappa-epsilon closure model. The coupling methodology is based on the vortex-force formalism. The hydrodynamic model was forced at the open boundaries using the HYCOM database and the wave model was forced at the open boundaries by remote waves from the southern Pacific. The atmospheric forcing for both models was provided by a local implementation of the WRF model, forced at the open boundaries using the CFSR database. Preliminary analysis of the model results showed that the magnitude of the wave-current interaction terms Stokes-Coriolis and vortex-force are $\sim$1e-6 ms^{-2}. This resulted in a modifications of about 20% of the magnitude of the ageostrophic mean currents (Ekman currents not included), which were mainly due to the vortex-force term. The most important differences in the surface currents magnitude are related with the use of a wave dependency in the diffusion term. However, the effect of the wave-current interactions on the computation of total currents is relatively small; currents differences between the coupled and uncoupled model results are smaller that 5%.