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Depth averaged wave-current interaction in the multi bank morphology of the southern North Sea

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The effects of wind induced waves on the barotropic mean flow during a storm event in the southern North Sea are investigated. The well known radiation stress gradient theory of Longuet-Higgins and Stewart (1962, 1964) together with the influence of waves through the Stokes drift (Hasselmann, 1971 and Garret, 1976) are incorporated in the RANS equation system of the COHERENS circulation model (Luyten et al., 2005) following the methodology worked out by Bennis et al. (2011) . The SWAN spectral wave model (version 40.91, http://www.swan.tudelft.nl/) is used to provide the wave information. This allows us to take into account the dissipative terms of wave momentum flux to the mean flow such as depth induced wave breaking and bottom friction as well as the conservative terms of wave effects such as the vortex-force and wave induced pressure gradient.

The resulting coupled COHERENS-SWAN model has been validated using the well known planar beach test case proposed by Haas and Warner (2009) in depth averaged mode. For the application in the southern North Sea, a series of nested grids using COHERENS (circulation model) and WAM cycle 4.5.3 (spectral wave model applied to the North Sea shelf area, Monbaliu et al. 2000; Günther, H. and A. Behrens, personal communications, May 2012) is set up to provide the hydrodynamic and wave boundary conditions for the COHERENS-SWAN two way coupled wave-current model for the Belgian coastal zone model. The improvements obtained in hindcasting the circulation processes in the Belgian coastal area during a storm event will be highlighted. But also difficulties faced in the coupling of the models and in the simulation of a real case storm will be discussed. In particular, some of the approaches for dealing with the numerical instabilities due to multi bank morphology of the southern North Sea will be addressed.

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