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Particle transport model sensitivity on wave-induced processes in the coupled model system

Joanna Staneva (1), Marcel Ricker (2), Arno Behrens (1), Oliver Krüger (1), Sebastian Grayek (1), Øyvind Breivik (3), and Corinna Schrum (1)

(1) HZG, Institute for Coastal Research, Geesthacht, Germany (Joanna.Staneva@hzg.de), (2) ICBM, University of Oldenburg, Oldenburg, Germany, (3) Norwegian Meteorological Institute, Henrik Mohns Plass 1, 0313 Oslo, Norway

Different effects of wind waves on the hydrodynamics in the North Sea-Baltic Sea are investigated using a coupled wave (WAM) and circulation (NEMO) model system as part of the Geestacht Coupled cOAstal model SysTem GCOAST. The terms accounting for the wave-current interaction are: the Stokes-Coriolis force, the sea-state dependent momentum and energy flux. The role of the different Stokes- drift parameterizations is investigated using a particle-drift model. Those particles can be considered as simple representations of either oil fractions, or fish larvae. In the ocean circulation models the momentum flux from the atmosphere, which is related to the wind speed, is passed directly to the ocean and this is controlled by the drag coefficient. However, in the real ocean, the waves play also the role of a reservoir for momentum and energy because different amounts of the momentum flux from the atmosphere is taken up by the waves. In the coupled model system the momentum transferred into the ocean model is estimated as the fraction of the total flux that goes directly to the currents plus the momentum lost from wave dissipation. Additionally, we demonstrate that the wave-induced Stokes-Coriolis force leads to a deflection of the current. During the extreme events the Stokes velocity is comparable in magnitude to the current velocity. The resulting wave-induced drift is crucial for the transport of particles in the upper ocean. The performed sensitivity analyses demonstrate that the model skill depends on the chosen processes. The using of a coupled model system reveals that the newly introduced wave effects are important for the drift-model performance, especially during extremes. Those effects cannot be neglected by search and rescue, oil-spill, transport of biological material, or larva drift modelling.