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Coupling the WAM wave model to EC-Earth GCM: Will it reduce the Southern Ocean bias?

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In an attempt to accelerate progress on the reduction of the well-known ocean SST bias in the Southern Ocean (SO), research has been undertaken to include the WAM wave-model in to the EC-Earth GCM. EC-Earth v3.1 is based on the ECMWF IFS atmosphere model and uses NEMO to describe the ocean circulation.

The SST bias in EC-Earth, as in many other coupled GCMs, is predominantly a summer problem. In that season mixed layer depths are shallow because strong radiative forcing leads to strong vertical temperature stratification. Realistic sea states and surface wave breaking will feedback on to the upper layers of the oceanic circulation, for example through enhanced vertical mixing. Without actual sea state information, NEMO relies on certain parameterizations that involve atmospheric surface windstress. However, during a "growing"/"decaying" sea state, the net stress entering the ocean is lower/higher than the atmospheric wind stress. Without real-time information of the sea state, ocean models such as NEMO can only assume a sea-state in equilibrium with the wind at all times, a situation which is rather rare.

We present first results of the effect of including surface ocean waves (WAM) into EC-Earth. If only IFS-WAM interaction is included, effects on the SO bias are limited. The small changes in the wind patterns (and thereby windstress), induced by the wave-induced modified drag-coefficients, are clearly not large enough to substantially modify the SST pattern. If WAM-NEMO interactions are included as well the changes are more substantial (as they modify the vertical mixing), but not necessarily everywhere in the right direction regarding the SST bias.