EGU24-5940, updated on 22 Mar 2025
https://doi.org/10.5194/egusphere-egu24-5940
EGU General Assembly 2024

Implementation of form drag into the ocean – sea ice model NEMO-SI3, calibration of input parameters with ICESat-2 surface heights and its impact on sea ice and ocean circulation

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The efficiency of air-sea momentum exchange depends on top and bottom sea ice surface roughness which varies with ice types and conditions, but constants are applied in most climate models. Future sea ice reduction is expected to lead to an increase in efficiency of air-sea momentum transfer. Accurate representation of momentum transfer processes will be a requirement for realistic model predictions. Within the CANARI project (Climate change in the Arctic-North Atlantic Region and Impacts on the UK) we have implemented the CICE form drag scheme into the sea ice model SI^3. Based on parameters of the ice cover such as ice concentration, size, and frequency of the sails and keels, freeboard and floe draft, and size of floes and melt pond fraction, the total form drag can be computed as a sum of form drag from sails and keels, form drag from floe edges, form drag from melt pond edges, and a reduced skin drag due to a sheltering effect. Ocean – sea ice simulations reveal that the inclusion of form drag has a significant impact by reducing sea ice drift and near surface ocean currents by more than 20% in the marginal sea ice regions. However, results depend on the poorly know input variables which are parameterised from the volume of ridged ice. We apply a new surface topography data set which has been derived from the ICESat-2 ATL03 global geolocated photon height data product. We use the continuous data sets of surface roughness, sail heights and frequency of pressure ridges across the Arctic to calibrate the form drag parameterization and present new simulation results.