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Atmospheric transfer coefficients in climate models for different topography and stability regimes over polar sea ice

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The transport of energy and momentum over the polar oceans depends strongly on the small scale heterogeneity of sea ice cover. In traditional parametrizations used in climate models this impact is accounted for by flux aggregation methods which result in a linear dependence of drag coefficients on the sea ice concentration. In recent years we have developed a method that accounts not only for sea ice concentration, but also for the sea ice topography which generates form drag with a maximum effect at 50-60% sea ice concentration so that drag coefficients depend non-linearly on the sea ice concentration. A first application of a "test"-parametrization accounting for form drag in a global climate model (ECHAM6-FESOM) reveals the potentially large impact of the new parametrizations on simulations of the coupled Arctic climate system. In this contribution a further advanced drag parametrization will be presented. It will be investigated in detail how the form drag dependence on stability can be taken into account and how this influences the effective drag coefficients over a mixture of sea ice and open water. Furthermore, the corresponding coefficients related only to the sea ice and open water part are considered that are required in climate and sea ice models. The further focus is on the simplification of integral expressions that would complicate the application of the stability corrected transfer coefficients in climate models. Formulations of drag coefficients are finally proposed which depend on the Louis (1979) stability functions that are used in many climate and weather prediction models. Results are compared with formulations based on Monin-Obukhov stability functions as proposed by different authors