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Pan-Arctic neutral atmospheric drag coefficient estimates derived from ICESat-2 laser altimeter measurements

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The effect that sea ice topography has on the momentum transfer between ice and atmosphere is not fully quantified due to the vast extent of the Arctic and limitations of current measurement techniques. As a result, coupled sea ice–ocean–atmosphere models struggle with characterizing drag, the force acting opposite to the relative motion of ice floes moving with respect to the atmosphere and ocean. This is because the models often have to assume drag force to be constant Arctic-wide or base the variations on sparse airborne and in-situ measurements that are insufficient to characterize such a dynamic and vast area. Our findings show that assuming a constant drag coefficient in both space and time misrepresents the variability of momentum fluxes near the surface and thus the main forcing of sea ice drift. Different methods to account for the different components of sea ice drag coefficients exist, e.g., centimeter-scale roughness related drag (skin drag), distinct obstacle related sea ice drag (form drag) from floe edges and ridges, but no dataset that combines all these components has previously been developed at similar spatial and temproal scales. Here we present a pan-Arctic monthly drag coefficient data product that is derived from NASA's ICESat-2 laser altimeter topography data. For model applications, we add ridge form drag to the other already incorporated components of drag, e.g., ice skin drag and form drag due to floe edges, to achieve the most inclusive and best resolved total drag coefficient dataset. We now aim to find correlations between our new data product and modelled sea ice properties to better account for drag in a coupled atmosphere-ocean-sea ice model. Preliminary results of this model study will be presented on at the seminar in addition to the satellite-based drag coefficient data.