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A new free drift sea ice velocity dataset for improved representations of ice drift trajectories

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Previous work shows that tracking the motion of sea ice in a Lagrangian framework can be used to produce skillful seasonal forecasts of sea ice at the pan-Arctic scale (Williams et al. 2016) and at the regional scale (Brunette et al. 2019) and can also be used to analyze socio-environmental impacts related to sea ice circulation (Newton et al. 2017). However, the Polar Pathfinder sea ice motion dataset from the National Snow and Ice Data Centre (Tschudi et al. 2019), which is commonly used for calculations of ice drift trajectories, contains biases in sea ice drift speed and angle. The bias is particularly strong in the summer when less satellite drift-vectors are available, and the Polar Pathfinder composite product relies more heavily on poorly-constrained free drift estimates (ice motion in response to wind forcing and ocean drag in the absence of internal stresses), that have up to a 60% low speed bias when compared to buoy drifts. These free drift estimates are notoriously ill-constrained, since information on the ocean forcing from below and lateral forces within the ice pack are lacking. To improve the quality of ice motion estimates in the summer, we propose to compile a new free drift sea ice motion dataset, based on surface winds from ERA-Interim and calibrated on drifting buoys from the International Arctic Buoy Program. We include dependencies of free drift velocity on sea ice concentration and thickness, which will improve the representation of temporal and spatial variability of sea ice in a free drift regime. We present work on the parameterization of an ice state dependent transfer coefficient between wind velocity and ice velocity, and estimates of the near surface oceanic currents that are necessary to constrain ice motion.

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