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Relative roles of wind forcing and ice dynamics for predicting short-term sea-ice movement as estimated from in-situ observations

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Understanding and predicting short-term sea-ice movement is equally a problem of improving surface wind estimates and incorporating these into an appropriate sea-ice dynamical model. This study will present observed relationships between surface winds, free-tropospheric winds, geostrophic winds, and sea-ice movements from on-ice field programs that have such measurements, primarily the Surface Heat Budget of the Arctic Ocean (SHEBA) field program. Furthermore, atmospheric fields from reanalysis data sets and fine-scale numerical simulations using the Weather and Research Forecasting (WRF) model are also used to explore these relationships. The objective of this study is to determine the source of errors in the short-term prediction of sea-ice movement, whether the errors are due to uncertainties in atmospheric forcing or whether they are due to incomplete or inaccurate accounting of ice-dynamics contributions. The former problem involves obtaining surface wind observations or detailed free-tropospheric wind observations combined with a high-quality boundary-layer model to project the momentum transport to the surface. In the SHEBA case, it isn't clear whether errors in the free-tropospheric winds or in the boundary-layer scheme were primary to producing the errors in WRF and ERA-40 surface wind estimates, which produced comparable floe-track errors. Utilizing surface stress rather than surface wind fields only provides a minor improvement to the floe movement projections over using just winds.