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A data assimilation application for improving estimates of Arctic sea ice thickness variability and change since the turn of the 21st century

Molly Wieringa and Cecilia Bitz
University of Washington, Dept. of Atmospheric Science, Seattle, WA, United States of America

Current sea ice prediction systems exhibit significant room for improvement compared to idealized estimates of sea ice predictability, a gap that could be closed by improving the initial conditions provided to prognostic models. Sea ice volume, the area-weighted integral of sea ice thickness (SIT), in particular, demonstrates long initial value predictability; in other words, accurate forecasting of Arctic sea ice requires highly accurate SIT initial conditions. Continuous records of SIT are, unfortunately, few and far between. To address this conundrum, we have explored applications of the Data Assimilation Research Testbed (DART) to constrain the Los Alamos Sea Ice Model (CICE5) within the Community Earth System Model using satellite-derived SIT observations from 2003 to present day. Our data assimilation system has been fine-tuned using new and highly accurate freeboard measurements from NASA's ICESat-2 mission. Using SIT information alone, we generate two assimilation products: the first using DART with CICE5 and the second with an offline assimilation method. We compare these products to one another and to the community standard SIT record, PIOMAS. Future work will introduce multivariate assimilation of SIT with other sea ice variables, including sea ice concentration, sea ice skin temperature, and sea surface temperature.