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The ROMS-CICE data assimilation system for sea-ice assimilation

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This study introduces a new data assimilation framework for the state-of-the-art coupled model system including the Regional Ocean Modeling System (ROMS) and the Los Alamos sea-ice model (CICE). The aim of this study is to investigate the effect on the model system by assimilation of various sea-ice observations.
The new assimilation system is based on the deterministic ensemble Kalman filter (DEnKF) from the EnKF-c code for assimilation, and includes 20 ensemble members. Different observations are assimilated one-by-one to assess the assimilation system. These observations are EUMETSAT OSISAF sea-ice concentration, Cryosat thick ice thickness observations, and SMOS thin ice-thickness observations. For the assimilation systems utilizing ice thickness, both ice concentration and thickness were assimilated simultaneously.
We show that assimilation of the two sea-ice thickness products have significant effects on the model sea-ice thickness, while the short-term multivariate effects on ice concentration were found to be small. Assimilation of SMOS observations show some multivariate effects, while Cryosat observation assimilation shows no multivariate effects on sea-ice concentration.
We show that a realistic model thickness obtained from sea-ice thickness assimilation is important for summer sea-ice forecasts. With thickness assimilation, the summer sea-ice concentration forecast is significantly improved as compared to the system with only assimilation of concentration. The summer sea-ice concentration forecast is found to show higher skills for the assimilation system with Cryosat thick sea-ice observations compared to the SMOS thin sea-ice thickness assimilation system.
Our study shows that assimilation of sea-ice thickness observations is important for a realistic model representation of sea-ice thickness. And that a realistic modelled sea-ice thickness improves sea-ice forecasts in summer.