Predicting sea-ice and ocean state by combining AWI climate model AWI-CM3 with sea-ice and ocean data assimilation and atmospheric nudging

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Over recent decades under the amplified conditions of Arctic see ice decline, a reliable sea ice prediction is urgently requested for scientific researches and social-economic needs. Numerical sea ice, ocean, climate and earth system models in combination with observational information have been considered as efficient instruments for providing the requested forecast information. As such a data assimilative climate model, the AWI Coupled Prediction System (CPS) has been developed by Mu et al. (2022). The current version of the system is based on the AWI climate model AWI-CM v3.0 (Streffing et al. 2022) that includes FESOM2.0 as a sea-ice ocean component and the Integrated Forecasting System (OpenIFS) as an atmospheric component. The sea ice concentration, sea ice thickness, sea ice drift, sea surface high, and sea surface temperature and salinity are assimilated into the system with an Ensemble-type Kalman filter within the Parallel Data Assimilation Framework (PDAF; Nerger and Hiller, 2013). In the previous AWI-CM3-CPS version (Mu et al. 2022), the assimilation of sea ice and ocean observational data demonstrated promising performance with respect to the predicted ocean and sea ice states. To improve further the predictive skills we have augmented the sea ice and ocean data assimilative system with a relaxation of the large scale atmospheric dynamics to the ERA5 reanalysis data. This nudging of the large scale atmospheric circulation towards reanalysis has allowed to reduce possible biases originated from the the diverged atmospheric states and, therefore, also to reduce the analysis increments. As one would expect the most prominent improvement has been achieved for the predicted sea ice drift. These first conclusions have been drawn based upon the data assimilation experiments conducted for the year 2018. More comprehensive analysis will be performed with the new system running over the time period 2003 – 2022.

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