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Better constraints on the sea-ice state using global sea-ice data assimilation

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Abstract. Short-term and decadal sea-ice prediction systems need a realistic initial state, generally obtained using ice–ocean model simulations with data assimilation. However, only sea-ice concentration and velocity data are currently assimilated. In this work, an ensemble Kalman filter system is used to assimilate observed ice concentration and freeboard (i.e. thickness of emerged) data into a global coupled ocean–sea-ice model. The impact and effectiveness of our data assimilation system is assessed in two steps: firstly, through the use of synthetic data (i.e. model-generated data), and secondly, through the assimilation of real satellite data. While ice concentrations are available daily, freeboard data used in this study are only available during six one-month periods spread over 2005–2007. Our results show that the simulated Arctic and Antarctic sea-ice extents are improved by the assimilation of synthetic ice concentration data. Assimilation of synthetic ice freeboard data improves the simulated sea-ice thickness field. Using real ice concentration data enhances the model realism in both hemispheres. Assimilation of ice concentration data significantly improves the total hemispheric sea-ice extent all year long, especially in summer. Combining the assimilation of ice freeboard and concentration data leads to better ice thickness, but does not further improve the ice extent. Moreover, the improvements in sea-ice thickness due to the assimilation of ice freeboard remain visible well beyond the assimilation periods.

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