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Assimilation of sea ice freeboard and concentration data in a coupled ice-ocean model.

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Before 2003, satellite sea ice data were limited to sea ice concentration. Since 2003, other satellite sea ice variables are available as the total freeboard, and in the near future, the sea ice thickness will be routinely measured. Data assimilation system allows to account for these data in numerical simulations to improve the reanalysis and forecasts.
The implementation of a data assimilation system (the Ensemble Kalman filter) in a coupled ice–ocean model is presented. The model system consists of the dynamic–thermodynamic sea ice model (LIM2) coupled with the ocean general circulation model NEMO in a global configuration at 2° resolution. The observed variables used in this study are the sea ice concentration from passive microwave sensor data (SSM/I) and the total freeboard from laser altimeter (ICESat).
The assimilation of ice concentration has the desired effect of reducing the difference between observations and model results. Comparison with a free-run experiment shows that assimilation of sea ice concentration leads to large differences in sea ice area, especially in summer. In winter, the differences are relatively small. The assimilation of sea ice concentration has the strongest impact close to the ice edge, where it ensures a correct location of the limits of the pack throughout the simulation. The assimilation of total freeboard over the 6 laser campaigns during the period 2005-2007 in the Arctic yields large differences in sea ice thickness, while the sea ice area is only marginally affected. The modification in sea ice thickness due to total freeboard assimilation is not completely lost between two laser campaigns. Finally, we show that assimilation of both sea ice concentration and total freeboard allows improving sea ice in term of both area and thickness.