Skill improvement of seasonal Arctic sea ice forecasts using bias-correction and ensemble calibration

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We explore the standard error and skill of dynamical seasonal sea ice forecasts of the Arctic using different bias-correction and ensemble calibration methods. The latter is often used in weather forecasting, but so far has not been applied to Arctic sea ice forecasts. We use seasonal predictions of Arctic sea ice of a 5-member ensemble forecast using the fully coupled GCM EC-Earth, with model initial states obtained by nudging towards ORAS4 and ERA-Interim.

The raw model forecasts contain large biases in total sea ice area, especially during the summer months. This is mainly caused by a difference in average seasonal cycle between EC-Earth and observations, which translates directly into the forecasts yielding large biases. Further errors are introduced by the differences in long term trend between the observed sea ice, and the uninitialised EC-earth simulation.

We find that extended logistic regression (ELR) and heteroscedastic extended logistic regression (HELR) both prove viable ensemble calibration methods, and improve the forecasts substantially compared to standard bias correction techniques. No clear distinction between ELR and HELR is found. Forecasts starting in May have higher skill (CRPSS > 0 up to 5 months lead time) than forecasts starting in August (2-3 months) and November (2-3 months), with trend-corrected climatology as reference. Analysis of regional skill in the Arctic shows distinct differences, where mainly the Arctic ocean and the Kara and Barents sea prove to be one of the more predictable regions with skilful forecasts starting in May up to 5-6 months lead time. Again, forecasts starting in August and November show much lower regional skill.

Overall, it is still difficult to beat relative simple statistical forecasts, but by using ELR and HELR we are getting reasonably close to skilful seasonal forecasts up to 12 months lead time. These results show there is large potential, and need, for using ensemble calibration in seasonal forecasts of Arctic sea ice.