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Memory of Arctic sea ice in model simulations, observations, and reanalyses

Céline Gießе[1,2], Dirk Notz[1], and Johanna Baehr[1]
[1]Institute of Oceanography, Universität Hamburg, Hamburg, Germany (celine.giesse@uni-hamburg.de)
[2]International Max Planck Research School on Earth System Modelling, Max Planck Institute for Meteorology, Hamburg, Germany

The strong decline of Arctic sea ice in recent years has raised growing interest in seasonal-to-interannual predictions of Arctic sea ice. Previous studies have revealed a large predictability gap between potential and operational forecast skill of Arctic sea ice, which could indicate a strong potential for improvement of operational sea ice predictions or hint at a systematic overestimation of sea ice memory in current climate models.

Here, we assess and compare memory of Arctic sea ice in terms of lagged correlations of sea ice area anomalies on seasonal to interannual time scales in a large model ensemble (MPI Grand Ensemble) as well as several reanalysis and observational products. While the different datasets show good agreement for short-term memory on time scales of a few months on which persistence is the dominant source of memory, we find substantial differences between model and observational memory behaviour on longer time scales. In particular, we find that memory from the summer sea ice minimum into the following year is significantly overestimated in the model, as lagged correlation values in all observational datasets are outside the range of model variability. Reanalysis data show correlation values that lie in between observational and model mean values, underpinning the hybrid nature of reanalyses combining observations and model behaviour. Extending the analysis of sea ice memory to a regional scale provides further information on the spatial origin of specific memory features in the different datasets and helps in understanding differences between model and real-world behaviour on a physical process level.

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