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General characteristics of sea ice thickness variability in GCMs

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Skillful Arctic sea ice forecasts may be possible for lead times of months or possibly even years owing to the persistence of thickness anomalies. In this work we characterize sea ice thickness variability in fully-coupled general circulation models (GCMs) in CMIP5 and ice-ocean models (IOMs) that are forced with atmospheric reanalysis and satellite observations.
Overall, sea ice thickness is most variable along Arctic Ocean coastlines and where sea ice is thickest. Sea ice thickness anomalies have a typical timescale of up to 20 months, which can extend to 30 months when accounting for their transport, and a typical lengthscale of about 500-1000 kilometers. We find a large spread across models; an estimate of the number of thickness monitoring locations required to characterize sea ice thickness variability in the Arctic basin lies between 3 and 10 depending on the model. Models with a thinner mean sea ice state tend to have smaller thickness anomalies that are generally shorter lived, but have a larger spatial scale. Additionally, variability in IOMs is damped due to strong compensation between the dynamic and thermodynamic processes that force sea ice. We also find that the relative contribution of dynamic and thermodynamic processes to sea ice thickness variability is a function of the mean state of the model and changes significantly in 21st Century simulations.