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Prediction of sea ice thickness cluster in the Northern Hemisphere

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Sea ice thickness (SIT) has a potential to contain substantial climate memory and predictability in the northern hemisphere (NH) sea ice system. We use 5-member NH SIT, reconstructed with an ocean-sea-ice general circulation model (NEMOv3.3 with LIM2) with a simple data assimilation routine, to determine NH SIT modes of variability disentangled from the long-term climate change. Specifically, we apply the K-means cluster analysis - one of nonhierarchical clustering methods that partition data into modes or clusters based on their distances in the physical – to determine optimal number of NH SIT clusters (K=3) and their historical variability. To examine prediction skill of NH SIT clusters in EC-Earth2.3, a state-of-the-art coupled climate forecast system, we use 5-member ocean and sea ice initial conditions (IC) from the same ocean-sea-ice historical reconstruction and atmospheric IC from ERA-Interim reanalysis. We focus on May 1st and Nov 1st start dates from 1979 to 2010. Common skill metrics of probability forecast, such as rank probability skill core and ROC (relative operating characteristics - hit rate versus false alarm rate) and reliability diagrams show that our dynamical model predominately perform better than the 1st order Marko chain forecast (that beats climatological forecast) over the first forecast year. On average May 1st start dates initially have lower skill than Nov 1st start dates, but their skill is degraded at slower rate than skill of forecast started on Nov 1st.