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Propagation of Thermohaline Anomalies and their predictive potential in the Northern North Atlantic

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In this study we assess to what extent seven different dynamical prediction systems can retrospectively predict the winter sea surface temperature (SST) in the subpolar North Atlantic and the Nordic Seas in the time period 1970-2005. We focus in particular on the region where warm water flows poleward, i.e., the Atlantic water pathway, and on interannual-to-decadal time scales. To better understand why dynamical prediction systems have predictive skill or lack thereof, we confront them with a mechanism identified from observations – propagation of oceanic anomalies from low to high latitudes – on different forecast lead times. This observed mechanism shows that warm and cold anomalies propagate along the Atlantic water pathway within a certain time frame. A key result from this study is that most models have difficulty representing this mechanism, resulting in an overall poor prediction skill after 1-2 years lead times (after applying a band-pass filter to focus on interannual-to-decadal time scales). There is a link, although not very strong, between predictive skill and the representation of the SST propagation. Observational studies demonstrate predictability several years in advance in this region, thus suggesting a great potential for improvement of dynamical climate predictions by resolving the causes for the misrepresentation of the oceanic link. Inter model differences in simulating surface velocities along the Atlantic water pathway suggest that realistic velocities are important to better circulate anomalies poleward, and hence, increase predictive skill on interannual-to-decadal time scales in the oceanic gateway to the Arctic.