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Is AMOC more predictable than North Atlantic heat content?

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Discussions of prospects for decadal prediction often focus on the overturning circulation of the Atlantic, which is hypothesized to be an especially predictable component of climate variability. Predictions have limited range because the climate system is chaotic, but according to this hypothesis the impact of initializing predictions will have a detectable, and potentially beneficial, influence at longer prediction ranges for AMOC than for other components of the state. In this study we test this hypothesis by comparing the initial value predictability properties of AMOC with another component that is often featured in studies of decadal prediction, namely the heat content of the North Atlantic. We do this by finding the initial value predictability of these two fields in nine CMIP5 models using analog and regression techniques. These methods produce predictability estimates from the statistics of long control runs, rather than from conventional perturbation ensemble experiments, so that many initial states can be considered.

The results of our research indicate that the potential impact of initializing predictions varies substantially from one model to another, but for almost every model initial value predictability is lower for AMOC than for heat content on decadal time scales. AMOC predictability becomes more similar to heat content predictability if 5 or 10 year averages are predicted rather than annual means, but even then its predictability is less. One of our very optimistic findings is that there are certain patterns of AMOC and heat content variability that are predictable two or three times longer than generic variability. But for these special patterns, too, AMOC is less predictable than North Atlantic heat content. Lastly, we find AMOC also gains less predictability from the effect of external forcing than does heat content. Indeed, on decadal time scales, information added to predictions by inclusion of their response to RCP scenarios is much less for AMOC than for heat content.