Multi-year predictability in the Atlantic Ocean

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Given the inherently chaotic nature of the atmosphere, prospects for multi-year climate prediction lie in the interaction of the atmosphere with slower parts of the climate system: the ocean, the cryosphere, and the geosphere. The impact of ocean initialization on climate predictions, termed ‘‘initial-value predictability,” has been intensely studied over recent years; in particular phases 5 and 6 of the Coupled Model Intercomparison Project (CMIP5 and CMIP6) include initialized decadal prediction experiments. Initialized predictions suggest that the Atlantic is a region of enhanced predictability for sea surface temperature (SST) and upper ocean heat content (UOHC). In fact, the North Atlantic is the only region where ocean initialization leads to statistically significant increase in skill in SST forecasts on multi-year timescales. A number of studies have suggested that predictability of North Atlantic SSTs and UOHC is related to variations in the Atlantic meridional overturning circulation (AMOC). However, due to the presence of large wind-driven variations in the AMOC, the AMOC is generally found to be less predictable than UOHC, and successful decadal prediction in the North Atlantic may not rely on prediction of the AMOC. Recent work suggests that the geographic variations in predictability timescales in the Atlantic are related to variations in the wintertime mixed layer depth. This work suggests that the longer predictability timescales in the North Atlantic (compared to, e.g., the North Pacific) may simply be due to the deeper mixed layer depths in the North Atlantic.