The Atlantic Meridional Overturning Circulation (AMOC) is a major contributor of ocean variability in the North Atlantic and impacts to the decadal climate over the adjacent continents. However, the AMOC is embedded in a complex interplay between various climate sub-systems, such as the troposphere that supplies heat and momentum fluxes, particularly by the North Atlantic Oscillation (NAO), or the cryosphere that contributes by freshwater supply. Despite the complexity much of the memory on decadal timescales resides in the ocean, making the AMOC a key parameter for climate prediction.

Here an ensemble of simulations from the forced MPI ocean model (MPIOM) is applied to illustrate processes governing decadal climate variability in the North Atlantic. Coupling of the atmosphere-ocean system is described via the synchronous variations of observed atmospheric modes, such as the NAO, and ocean circulation characteristics such as the AMOC.

Having established the vital role of the AMOC for a coupled climate system, the initialization of a coupled model (ECHAM5/MPIOM) for decadal climate predictions with ocean data is considered. The skill is investigated within a set of hindcasts. It can be shown that there is significant skill of the AMOC several years ahead.

Finally, the relative roles of other sub-components for decadal climate prediction are discussed. This includes the questions whether implementation of new components such as the stratosphere or initialization of atmospheric components improves assimilation and forecast skill.