Decadal predictions of the AMOC in the GFDL initialized coupled models experiments

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We examine the prediction skill of the Atlantic Meridional Overturning Circulation (AMOC) in the GFDL initialized simulations that were conducted as part of the CMIP5 decadal prediction experiments. These predictions are carried out over the period 1961-2011 using the fully coupled climate model CM2.1 in which both the atmosphere and the ocean are initialized through a full-field assimilation to bring the state of the coupled model close to observations with balanced initial conditions. We assess the skill arising from natural variability with respect to that in response to external forcings by comparing the initialized forecasts to uninitialized projections. Further understanding is gained by combining the decadal prediction analysis with a mechanistic study. An abrupt North Atlantic warming associated with a decline of the subpolar oceanic circulation has been observed in the mid-1990s. Previous idealized studies suggested that a preconditioning of the ocean through a persistent positive NAO driving an intensification of the AMOC might have contributed to this climate shift. This event is a valuable opportunity to test the skill of our prediction system and the impact of initializing the AMOC. We show that the 1995 climate shift in ocean heat content is rather well predicted by the GFDL system and that initializing the AMOC at a high state is critical to capture the warming. Our results are consistent with recently published results based on different prediction systems, suggesting some robustness across models. We briefly discuss the link of this AMOC-related North Atlantic warming with the observed 1995 shift in Atlantic hurricane frequency, which is also retrospectively predicted by the GFDL system. Whereas the lack of deep ocean observations appears as a strong challenge to properly initialize the AMOC using assimilation methods, we show that the shortness of the RAPID observational record still makes it difficult to assess with confidence any decadal predictability beyond the seasonal cycle. These early results are however encouraging and provide a valuable opportunity to test and improve climate models and observing systems. The limited predictability outside the Atlantic also highlights that the AMOC remains one major source of decadal predictability, and that a better understanding of its variability should remain a high priority.