Dependence of the mechanisms associated with a potential multi-decadal AMOC-AMO-NAO feedback loop in MIROC model

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Atlantic Multi-decadal Oscillation (AMO) is a low frequency fluctuation of sea surface temperature (SST) over the North Atlantic basin with wide-ranging impacts on a global scale. A synthesis of previous studies suggests that there possibly exists a multi-decadal feedback loop among AMO, Atlantic Meridional Overturning Circulation (AMOC), and North Atlantic Oscillation (NAO). In this work, we investigate the existence and the mechanisms of this potential multi-decadal feedback loop with use of two versions of a state-of-the-art climate model: MIROC5 and MIROC6. Identifying this potential multi-decadal feedback loop could entail important implications for predictability of the multi-decadal climate phenomena, as well as for isolating the impacts of the anthropogenic warming from those of the natural variability.

Our preliminary results indicate that the updated version of the model, MIROC6, with a high-top and a shallow convection scheme, better simulates the tropical part of the AMO-associated SST pattern, which is commonly underrepresented in climate models. MIROC6 appears to be also better at simulating a coherent relationship among AMO, AMOC, and NAO within the model, with its lead-lag relationship of each link being consistent with the previous observational and modelling studies. Some of the previously suggested mechanisms linking each of these climate components in this multi-decadal feedback loop, however, seem to be associated with different time scales within MIROC6; in particular, the mechanisms linking the AMO and the opposite-signed NAO on the multi-decadal scale is likely linked with the shorter timescales in MIROC6, leaving the mechanisms associated with the multi-decadal relationship still unexplained. In this talk, we will illustrate differences in mechanisms associated with the multi-decadal and shorter timescales within the model and show that the conventional AMO definition computed with a low-pass filtering may lead to a convolution of processes associated with different timescales.

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