Unveiling the Global Oceanic Influence of Atlantic Multidecadal Variability using Pacemaker Experiments

*Weimin Jiang[1], Claude Frankignoul[2], Guillaume Gastineau[2], Juliette Mignot[2], Feili Li[1]

1. State Key Laboratory of Marine Environmental Science and College of Ocean and Earth Sciences, Xiamen University, Xiamen, China, 2. UMR LOCEAN, Sorbonne Université/CNRS/IRD/MNHN, Paris, France

Atlantic multidecadal variability (AMV) significantly impacts regional and global climate, as evidenced by observations and climate model simulations. Previous sensitivity experiments investigating the AMV were mostly based on climate model simulations in which the North Atlantic sea surface temperatures (NASSTs) were nudged to a fixed AMV pattern. Here, the global influence of AMV is explored using an ensemble of pacemaker experiments where NASSTs are nudged to the time-varying observational records. Ten ensemble members proved sufficient to distinguish forced signals from internal climate variability. Using high-pass filtered data to inform how the response to the AMV is established, we confirm that the AMV primarily affects the global ocean through its tropical component. The oceanic response to a warm AMV anomaly unfolds in four phases: (1) warming of the western Pacific warm pool and development of anomalous easterlies in the Western Indo-Pacific driven by diabatic heating over the tropical Atlantic within the first 6 months, (2) eastward propagation of equatorial thermocline anomalies and establishment of La Niña-like conditions in the eastern Pacific after 7-10 months, (3) persistence of La Niñ a conditions during 11-20 months via Bjerknes feedback and weakening of the Aleutian low thru tropical teleconnections, and (4) emergence of a negative Pacific Decadal Oscillation pattern in the North Pacific after 21-25 months. Our findings highlight the importance of using time-varying SST observations in pacemaker experiments to capture the full complexity of inter-basin connections.

