

An Investigation of the Ocean's Role in Atlantic Multidecadal Variability

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Because the Atlantic Multidecadal Variability (AMV) has a significant impact on global and regional climate, a mechanistic understanding of this variability is desirable. Though ocean dynamics have long been invoked to explain the AMV, recent studies have cast doubt on its role. Here we evaluate the necessity of ocean dynamics for the AMV using an observationally-based idealized model that isolates the contribution of atmospheric forcing to AMV. By demonstrating that this model underestimates the observed sea surface temperature anomaly (SSTA) variability in the extratropical North Atlantic, we infer that ocean dynamics contributes significantly to the low-frequency AMV variability in this region. Importantly, we illuminate a trade-off between the SSTA e-folding time and the atmospheric heating of the mixed layer, which hampers atmosphere to adjust the SSTA variability to that observed. We also quantify the combination of atmospheric forcing, anthropogenic aerosol and mixed layer depth variability in forcing the AMV SSTA. Since these forcing mechanisms collectively underestimates the SSTA variability, we conclude that ocean dynamics is a necessity for AMV SSTA.