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# Sea-level fluctuations show Ocean Circulation controls Atlantic Multidecadal Variability

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We present observational evidence that ocean circulation controls the decadal evolution of heat content and consequently sea-surface temperatures (SST) in the North Atlantic. One of the most prominent modes of Atlantic variability is the Atlantic multidecadal oscillation (AMO) observed in SSTs. Positive (negative) phases of the AMO are associated with warmer (cooler) SSTs. Positive phases of the AMO have been linked with decadal climate fluctuations including increased summer precipitation in Europe; increased northern hemisphere land temperatures, fewer droughts in the Sahel region of Africa and increased Atlantic hurricane activity. It is widely believed that the Atlantic circulation controls the phases of the AMO by controlling the decadal changes in heat content in the North Atlantic. However, due to the lack of ocean circulation observations, this link has not been previously proven.

We present a new interpretation of the sea-level gradient along to the east coast of the United States to derive a measure of ocean circulation spanning decadal timescales. We use this to estimate heat content changes that we validate against direct estimates of heat content. We use the longevity of the tide gauge record to show that circulation, as interpreted in sea-level gradient changes, drives the major transitions in the AMO since the 1920's.

We show that the North Atlantic Oscillation is highly correlated with this sea-level gradient, indicating that the atmosphere drives the circulation changes. The circulation changes are essentially integrated by the ocean in the form of ocean heat content and returned to the atmosphere as the AMO.

An additional consequence of our interpretation is that recently reported accelerations in sea-level rise along the US east coast are consistent with a declining AMO that has been predicted by a number of authors.