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A Possible Cause for Recent Decadal Atlantic Meridional Overturning Circulation Decline

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The Atlantic Meridional Overturning Circulation (AMOC) is a major oceanic current system with widespread climate impacts. AMOC influences have been discussed among others with regard to Atlantic hurricane activity, regional sea level variability, and surface air temperature and precipitation changes on land areas adjacent to the North Atlantic Ocean. Most climate models project significant AMOC slowing during the 21st century, if atmospheric greenhouse gas concentrations continue to rise unabatedly. Recently, a marked decadal decline in AMOC strength has been observed, which was followed by strongly reduced oceanic poleward heat transport and record low sea surface temperature in parts of the North Atlantic. Here, we provide evidence from observations, re-analyses and climate models that the AMOC decline was due to the combined action of the North Atlantic Oscillation and East Atlantic Pattern, the two leading modes of North Atlantic atmospheric surface pressure variability, which prior to the decline both transitioned into their negative phases. This change in atmospheric circulation diminished oceanic heat loss over the Labrador Sea and forced ocean circulation changes lowering upper ocean salinity transport into that region. As a consequence, Labrador Sea deep convection weakened, which eventually slowed the AMOC. This study suggests a new mechanism for decadal AMOC variability, which is important to multiyear climate predictability and climate change detection in the North Atlantic sector.