Drivers of Atlantic Multi-decadal Variability

The impacts of Atlantic multi-decadal climate variability (AMV) are widespread, but its causes remain uncertain. There are several leading candidates. Perhaps the most common is multi-decadal variability in the ocean circulation, in particular the Atlantic Meridional Overturning circulation (AMOC), which converges heat in the North Atlantic ocean. Another perspective is that variability in heat fluxes driven by stochastic atmospheric processes can explain basin-wide warming and cooling events in the North Atlantic. A third candidate is multi-decadal variations in external climate forcings, such as anthropogenic aerosols, volcanic forcing, and solar variability. In this project, the student will use newly developed elements of a Community Earth System Model (CESM) hierarchy, simple analytical models, and observational datasets from the atmopshere and ocean. These tools will be used to address: How much is the ocean contributing to multi-decadal variations in the Atlantic basin? What are the dominant ocean processes responsible for this? How much is the atmosphere contributing, including externally forced changes in composition, as well as cloud-radiative feedbacks? What are the causes of the impacts associated with the AMV around the Atlantic basin?

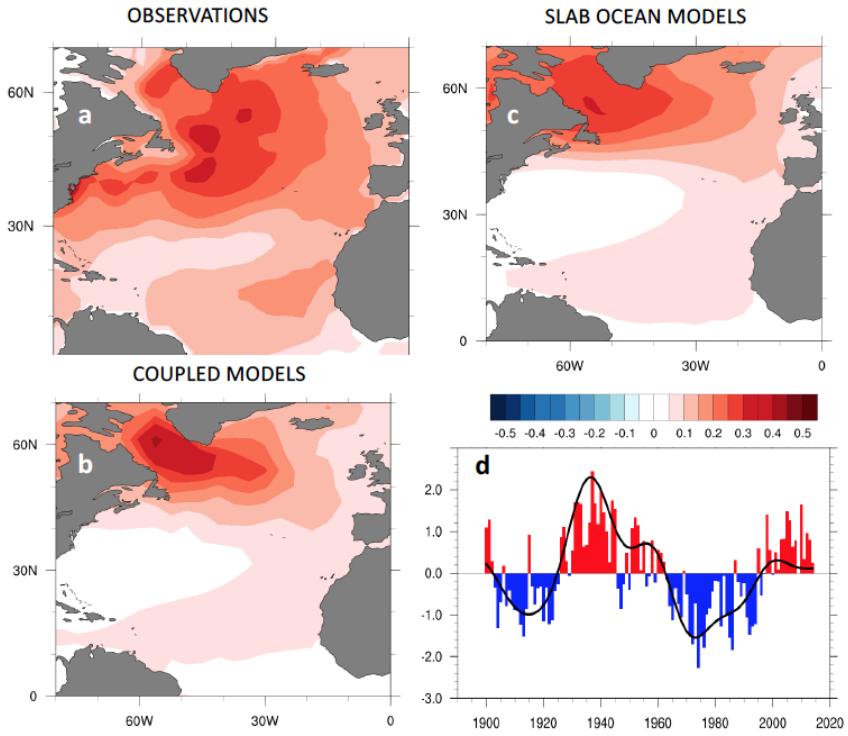

Figure 1: (adapted from Clement et al. 2015) The regression of North Atlantic sea surface temperatures on the standardized AMV index (the detrended average SST over the North Atlantic from 0 to 55N, and low pass filtered with a 4th order 20-year Butterworth Filter. (a) Observed (ERRSTv4 reanalysis for the period from 1854-2014). (b)The multi-model mean of the pre-industrial (constant forcing) CMIP3 model simulations. (c) Same as (b) but coupled to a slab ocean model (SOM). The models included are the same as in C15. (d) Time series of the AMV index. Annual averages in color, low pass filtered values as a black line.

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