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Role of the Atlantic Multidecadal Variability on extreme climate conditions over North America

Yohan Ruprich-Robert (1,2), Thomas Delworth (2), Rym Msadek (3,4), Frederic Castruccio (5), Stephen Yeager (5), and Gokhan Danabasoglu (5)

(1) Princeton University, Princeton NJ, United States (yohan.ruprich-robert@noaa.gov), (2) GFDL, Princeton NJ, United States, (3) Cerfacs, Toulouse, France, (4) CNRS, France, (5) NCAR, Boulder CO, United States

The Atlantic Multidecadal Variability (AMV) is associated with marked modulations of climate anomalies observed over many areas of the globe like droughts, decline in sea ice or changes in the atmospheric circulation. However, the shortness of the historical observations compared to the AMV period ($\sim$60-80yr) makes it difficult to show that the AMV is a direct driver of these variations. To isolate the AMV climate response, we use a suite of global coupled models from GFDL and NCAR, in which the North Atlantic sea surface temperatures are restored to the observed AMV pattern, while the other ocean basins are left fully coupled. In order to explore and robustly isolate the AMV impacts on extreme events, we use large ensemble simulations (between 30 and 100 members depending on the model) that are integrated for 10 years. We investigate the importance of model resolution by analyzing GFDL models that vary in their atmospheric resolution and we assess the robustness of the results by comparing them to similar experiments performed with the NCAR coupled model. Further, we investigate the influence of model surface temperature biases on the simulated AMV teleconnections using a flux-adjusted experiment based on a model configuration that corrects for momentum, enthalpy and freshwater fluxes. We focus in this presentation on the impact of the AMV on the occurrence of the North American heat waves. We find that the AMV modulates by about 30% the occurrence of heat waves over North Mexico and the South-West of USA, with more heat waves during a warm phase of the AMV. The main reason for such an increase is that, during a warm AMV phase, the anomalously warm sea surface temperature leads to an increase of the atmospheric convection over the tropical Atlantic, as well as to a an anomalous downward motion over North America. This atmospheric response to AMV inhibits the precipitation over there and drives a deficit of soil moisture. In the summer, the latent heat of evaporation usually cools the surface precluding strong surface temperature warming. But the lack of soil moisture allows less evaporation, which leads to positive surface temperature anomalies and an increase of the occurrence of heat waves. By comparing the results from all the model configurations, we highlight the importance of the representation of the soil moisture by the model on the modulation of heat waves by the AMV. We also stress the influence of model's mean state biases on the simulated AMV impacts.