

The atmospheric bridge linking AMV and summer European climate in a climate model

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By using the 20th Century reanalysis, the summer Atlantic Multidecadal Variability (AMV) has been shown to affect the European climate through an associated atmospheric baroclinic response which has been called North-Atlantic-European East West (NEW) mode (Ghosh et. al. 2016). Here, we continue this analysis, by using control simulations and AMIP-type of sensitivity experiments with the Max-Planck Institute Earth System Model (MPI-ESM) and investigate the model response to AMV type SST and its similarities and differences from the response in the reanalysis.

In the control simulations of the coupled model version MPI-ESM, both low resolution (LR, approx. 200km in the atmosphere) and high (HR, approx. 100km) resolution can simulate a similar AMV type of SST pattern likewise the 20th century reanalysis. The AMV response of the LR, however, is found more sensitive to tropical branch of the SST and thus the North-Atlantic-European (NAE) climate is mainly influenced by the stationary Rossby wave response from the tropics. In HR, the impact of the tropical SST variations on extra-tropics is weaker due to lesser eddy-mean flow interactions. However the NEW mode is not found in any of these control simulations which could be due to a relatively strong SST bias over the extra-tropical North Atlantic in the model. Hence, we further conducted AMIP-like sensitivity experiments with the observed AMV type SST pattern on the atmospheric component of the LR, the ECHAM version 6.3. The results from the experiments underlines that in the positive phase of the AMV, the NAE climate is mainly influenced by the tropical branch of the AMV. Here, again a stationary Rossby wave response is associated with negative surface air temperature (SAT) anomalies over the C-E Europe; which is opposite to what is found in the re-analysis. However, in the case of the negative phase of AMV, the NAE climate is mainly governed by the extra-tropical branch of SST through a baroclinic-like response, which leads to negative SAT anomalies over C-E Europe. This is similar to what it is found in the reanalysis. In summary, we find that the model simulates the observed baroclinic response, but only in AMV-type of experiments and in the negative phase of the AMV. For the positive phase, in agreement with the previous findings, the model is very sensitive to the tropical branch of the AMV SST, which generates a stationary Rossby wave and influences the extra-tropics.

Ghosh, R., Müller, WA., Baehr, J. & Bader, J., 2016. Impact of observed North Atlantic multidecadal variations to European summer climate: a linear baroclinic response to surface heating. *Clim. Dyn.*, pp. 1-17