



## Atmospheric response to Atlantic multidecadal ocean variability: The role of the stratosphere

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Pronounced Atlantic Multidecadal Variability (AMV) with about 70 year timescale is observed in North Atlantic sea surface temperature (SST). Model studies indicate that these are associated with fluctuations of ocean circulation. Understanding the atmospheric impact of AMV and its relation to the North Atlantic Oscillation (NAO) is crucial for skilful decadal predictions and validations of simulated coupled atmosphere/ocean variabilities in the extratropics. Here this is investigated using the observation and model simulations.

It is shown using observations and reanalysis that the AMV warm (cold) phase is associated with negative (positive) NAO and Northern Annular Mode signals. This results in positive (negative) NAO trend associated with warm-to-cold (cold-to-warm) AMV transition. Both NAO-phases and trends appear in the stratosphere during the early winter and persist between the lower stratosphere and troposphere in the mid to late winter.

A set of model experiments under the 1950s-warm conditions was conducted using the low top ECHAM5 model and its high top version MAECHAM5, which includes the whole stratosphere and lower mesosphere. It is shown that Atlantic warm SST anomalies associated with the fifties-warm AMW period can force the observed negative NAO pattern only if the stratosphere is included. This reflects the importance of stratospheric dynamics in the atmospheric response to the large-scale SST anomalies and is consistent with The Charney-Drazin criterion, in which the large-scale disturbances propagate deeper into the stratosphere. Additional experiments, in which forcing in tropical and extratropical Atlantic was considered separately, show an almost linear superposition of both regions in term of NAO response.

The robustness of these experiments is assessed in further experiments using different SST forcing and model resolution. The mechanisms of the atmospheric response to large-scale SST anomalies associated with AMV are being investigated using a two dimensional wave diagnostic. The separate effects of low and high frequency Atlantic SST on the atmosphere and their linear superposition are also being investigated in further experiments.