# Modulations of European and North American weather variability and extremes by interdecadal variability of the atmospheric circulation over the North Atlantic

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The dominant mode of wintertime covariability between sub-seasonal surface air temperature (SAT) variability and (multi-) decadal mid-tropospheric circulation anomalies over the North Atlantic sector is identified through singular value decomposition analysis applied to century-long reanalysis data. This mode highlights a tendency for sub-seasonal SAT variability over Europe and eastern North America to be enhanced during the negative phase of the North Atlantic Oscillation (NAO). This (multi-) decadal NAO is characterized by a stationary Rossby wave train that originates from the subtropical Atlantic, propagates northward into the subpolar Atlantic, and finally refracts towards Europe and the Middle East. An increase in precipitation in the subtropics under the enhanced supply of heat and moisture from the Gulf Stream and its surroundings appears to act as a source for this wave train. The influence of interdecadal NAO variability on sub-seasonal SAT variability is explained primarily by the modulated efficiency of baroclinic conversion of available potential energy from the background atmospheric flow to sub-seasonal eddies. The combination of enhanced sub-seasonal variability and below-normal winter-mean temperature associated with the negative phase of the NAO increases the frequency of cold extremes affecting Europe and the eastern U.S.

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