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North Atlantic early 20th century warming and impact on European summer: Mechanisms and Predictability

Wolfgang Müller
Max Planck Institute for Meteorology

During the last century, substantial climate variations in the North Atlantic have occurred, such as the warmings in the 1920s and 1990s. Such variations are considered to be part of the variability known as the Atlantic Multidecadal Variations (AMV) and have a strong impact on local climates such as European summers. Here a synthesis of previous works is presented which describe the occurrence of the warming in the 1920s in the North Atlantic and its impact on the European summer climate (Müller et al. 2014, 2015). For this the 20th century reanalysis (20CR) and 20CR forced ocean experiments are evaluated. It can be shown that the North Atlantic Current and Sub-Polar Gyre are strengthened as a result of an increased pressure gradient over the North Atlantic. Concurrently, Labrador Sea convection and Atlantic meridional overturning circulation (AMOC) increase. The intensified NAC, SPG, and AMOC redistribute sub-tropical water into the North Atlantic and Nordic Seas, thereby increasing observed and modelled temperature and salinity during the 1920s.
Further a mechanism is proposed by which North Atlantic heat fluxes associated with the AMV modulate European decadal summer climate (Ghosh et al. 2016). By using 20CR, it can be shown that multi-decadal variations in the European summer temperature are associated to a linear baroclinic atmospheric response to the AMV-related surface heat flux. This response induce a sea level pressure structure modulating meridional temperature advection over north-western Europe and Blocking statistics over central Europe. This structure is shown to be the leading mode of variability and is independent of the summer North Atlantic Oscillation.

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