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The recent abrupt cooling over Subpolar North Atlantic: Exploring the variability of the North Atlantic

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North Atlantic is one of the regions experiencing substantial decadal variability which have been linked to important climate impacts. Observations during the 20th century indicates that subpolar North Atlantic (SPG) experienced periods of both abrupt cooling (e.g., around 1970, and more recently round 2010) as well as rapid warming (e.g., in mid-1990s). Model studies suggested that abrupt SPG cooling may result from either disruption of the Atlantic Meridional Circulation (AMOC) or a collapse of SPG convection, both are possible responses to the global warming trend. On a longer timescale, the SPG is a also known as no long-term warming in contrast to the anthropogenically induced global warming.

In this study, we investigate the relative role of natural variability to the anthropogenic forcing in driving the abrupt changes in SPG using atmospheric and ocean reanalysis data as well as climate models. Multi-century model simulations with preindustrial forcings (ie., piControl experiment) are analyzed to assess the natural variability in the region. Preliminary results indicate that significant warming and cooling trends of 15-20 years occur frequently and alternatively. In particularly the strength of the cooling trends are comparable with that observed in mid-2010s. The analysis extended to the CMIP5 historical and RCP 8.5 experiments show similar results, suggesting the recent observed SPG cooling may well be phenomenon of natural climate variability. To understand the mechanism leading to different trends, the upper ocean heat content, the stratification in SPG, as well as the AMOC associated with the warming and cooling will be assessed and compared to present-day observations. Their connection with the atmospheric North Atlantic Oscillation will also be investigated.