



## The evolution of North Atlantic oscillation during the last millennium in a climate system model

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The variability of North Atlantic oscillation (NAO), which is prevalent during winter time and strongly affects the climate over the Northern Hemisphere, is investigated with a climate system model run under transient external forcing for the last 1,000 years. Low frequencies are observed in the simulated NAO with two centers of action in the sub-polar and sub-tropical Atlantic regions respectively. During the pre-industrial epoch (PrE), the SLP variation over the sub-polar region is stronger than that over the sub-tropical region. However, the latter is intensified and becomes comparable with the sub-polar variability during the recent epoch (ReE). The stronger variability in PrE in the sub-polar region is manifested in a significant warming (cooling) during positive (negative) phase of NAO. This relationship is no longer true in ReE, since the positive NAO trend corresponds to a global warming. Rising tropical sea surface temperature and intensified upper tropospheric westerlies are obvious in ReE and are believed to play roles in the trend of NAO. It is interesting to note that there is an in-phase variation of NAO with the Atlantic meridional overturning circulation (AMOC) before 1800. But this relationship disappears afterward.