Natural forcing influence on decadal subpolar North Atlantic temperature variations and implications for predictions

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Abstract

Attribution of the contribution of different forcings and internal variability to observed climate variations is crucial for understanding predictive potential (or *skill*), as different driving factors of climate variations imply different predictability. In this context, we analyze decadal re-forecasts and historical simulations from 28 Coupled Model Intercomparison Project phase 6 (CMIP6) models for the period 1965-2014. We assess the contribution of internal variability as well as different forcings to observed annual mean North Atlantic subpolar gyre sea surface temperature (SPG SST) variations in simulations of the Detection and Attribution Model Intercomparison Project (DAMIP).

We find that CMIP6 simulations reproduce observed SPG SST variations better than CMIP5 simulations. This is related to an increase of explained variance between historical simulations and observations in CMIP6 (65%) compared to CMIP5 (50%), which indicates a larger

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role for forcing in modulating decadal SPG SST changes than found previously. After 1980, natural forcing simulations explain most of the observed SPG SST changes at 55%, whereas greenhouse gas (16%) and aerosol forcing (0%) are less involved in modulating recent SPG SST variations. A conceptual model confirms that volcanic eruptions (as part of the natural forcing) may be a major driver of observed decadal North Atlantic SST variations after 1980. CMIP6 models have improved in reproducing observed North Atlantic SST variations compared to CMIP5. Due to strong contribution of unpredictable volcanic eruptions to SPG SST, this does not necessarily imply improved predictions of the future. However, we also find significant prediction skill of internal SPG SST variability in CMIP6.

Keywords: North Atlantic, decadal predictions, CMIP6, natural forcing, DAMIP, DCPP