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Influence of the winter North Atlantic Oscillation (NAO) on ENSO in the following winter by Multi-model evaluation

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This study tested the hypothesis that occurrence of a warm (clod) phase of El Niño/Southern Oscillation (ENSO) in a given winter can be predicted 1 year in advance by the North Atlantic Oscillation (NAO). A one-year-lagged relationship between the NAO in winter and ENSO in the following year was examined with a multi-model ensemble analysis using Coupled Model Intercomparison Project phase 3 models and reanalysis data. On the basis of a 51-year statistical analysis of reanalysis data, we propose that El Niño outbreak in the winter is linked to the negative phase of the NAO in the previous winter.

A coherency index was developed as a measure of the coherence between the NAO and ENSO in each model and used as a weighting factor in the ensemble model. Weighted multi-model ensemble means of the regressed field on the maximum covariance analysis coefficients between the surface pressure field in the North Atlantic (NAO field) and the sea surface temperature field in the equatorial Pacific (ENSO field) were explored. The results indicated that when the wintertime NAO was in its negative (positive) phase, anomalous atmospheric circulation associated with a large (small) Eurasian snow mass anomaly intensified (weakened) the Asian cold surge and the westerly wind burst (WWB) in the warm pool region. Intensification of the WWB initiates El Niño. A sensitivity experiment using an idealized dry general circulation model revealed that the atmospheric response to anomalous, near-surface cooling associated with an anomalous Eurasian snow mass induced higher surface pressure near the Tibetan plateau and thus intensified the Asian cold surge and WWB. Linear regression analyses applied to the reanalysis data strongly supported the model results. Our results therefore suggest an influence of the NAO on the initiation of El Niño via a process that involves Eurasian snow anomalies associated with the NAO phase.