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ENSO-driven abrupt phase shift in North Atlantic Oscillation in early January

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El Niño-Southern Oscillation (ENSO) teleconnections exhibit a strong dependency on seasonally and intraseasonally varying mean states, which leads to impactful short-term variations in regional climate. The North Atlantic Oscillation (NAO)-ENSO relation is a typical example, in that its phase relationship reverses systematically between the early and late winter. However, the details and underlying mechanisms of this relationship transition are not well understood yet.

Here based on observations and an ensemble of atmosphere-only climate model simulations, we first reveal that this NAO phase reversal occurs synchronously in early January, which indicates strong abruptness. We demonstrate that this abrupt NAO phase reversal is caused by the change in ENSO-induced Rossby wave-propagating direction from northeastward to southeastward over the northeastern North American region, which is largely governed by a climatological alteration of the local jet meridional shear. We also provide evidence that the North Atlantic intrinsic eddy–low-frequency flow feedback further facilitates and amplifies the NAO responses. This abrupt NAO phase reversal signal is strong enough during the ENSO winter to be useful for intraseasonal climate forecasting in the Euro-Atlantic region.