Negative NAO as a precursor of SSW events evolving from displacement type to split type

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Sudden stratospheric warming (SSW) events preceded by a displacement in polar vortex center are characterized by whether they retain their displaced form or split into two vortices after onset. Here, we show that a change in type during the course of the SSW life cycle can be attributed to differences in the tropospheric geopotential height (GPH) distribution in the North Atlantic. Positive geopotential height anomalies in the north and negative anomalies in the south of the North Atlantic, which resemble the negative North Atlantic Oscillation (NAO) pattern, occur more frequently before the onset of displacement-split type SSW events compared with those that do not exhibit this transition. The geopotential height differences seem to result in distinct tropospheric-stratospheric dynamical coupled processes; the anomalous planetary wave pattern favors vertical propagation during the negative NAO, which decelerates the westerly wind in the high-latitude lower stratosphere. More than 178 SSW events obtained by 350 years of simulated current climate using the atmospheric general circulation model also support these observations. Therefore, NAO can be regarded as a useful predictor for determining the type of forthcoming SSW events.

Key words: sudden stratospheric warming, North Atlantic Oscillation, precursor, displacement-split type, tropospheric-stratospheric dynamical processes