Pacific modulation of the North Atlantic storm track response to sudden stratospheric warming events
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1 SUMMARY
Sudden stratospheric warming (SSW) events have been suggested to be followed by a surface impact, though this response varies between events. Using reanalysis data, we identify two types of tropospheric responses to SSWs: two thirds of the SSW events are dominated by an equatorward shift of the jet in the Atlantic, consistent with the canonical SSW response in the form of a negative signature of the North Atlantic Oscillation (NAO). For the remaining third of SSW events the response is associated with a poleward shift of the jet in the North Atlantic. Anomalous transient eddy kinetic energy in the eastern North Pacific is found to be consistent with North Atlantic anomalies. The Pacific is here suggested to contribute to the sign of the North Atlantic response, as synoptic wave propagation from the Eastern Pacific links the Pacific and Atlantic storm tracks, increasing the persistent downward impact of SSWs in the Atlantic for both the equatorward and poleward jet response.

2 METHODS
We use daily ERA-Interim reanalysis (Dee et al., 2011) for the years 1979-2014. The midlatitude storm track is diagnosed from the vertically-integrated transient eddy kinetic energy (EKE) computed by bandpass filtering daily horizontal winds using a Butterworth filter with a cutoff period of 3-10 days, integrated between 1000 and 200 hPa. Major SSW events for the period 1979-2014 are chosen according to Butler et al., 2014 ERA-Interim. Between 1979 to 2014 events we use the zonal wind at 300 hPa to define the type of the SSW downward impact on the troposphere. SSWs followed by an equatorward shift of the North Atlantic jet (the canonical negative NAO response, e.g., Baldwin and Dunkerton, 2001) are defined as zonal wind anomalies, computed with respect to the daily climatology, averaged over a period of 30 days after the SSW central date and over the midlatitude Atlantic region (45°N to 60°N, 300°E to 340°E, red box in Fig.1b) are negative. If a SSW is followed by mean positive zonal wind anomalies in this region it is defined as being followed by a poleward Atlantic jet shift response. This yields a criterion for the two composites, representing the variability of the tropospheric response: either an equatorward Atlantic jet shift or a poleward shift. We identify 16 out of 24 SSWs (66.6%) as equatorward Atlantic jet shift (EQ) and 8 (33.3%) as poleward Atlantic jet shift (PL) events.

3 RESULTS

4 CONCLUSIONS
- After SSW events North Atlantic storm track activity is reduced, while the North Pacific exhibits a weaker and opposite response.
- We identify two distinct tropospheric responses, one symmetric and the other asymmetric with respect to the Atlantic and Pacific.
- The type of downward response tends to be linked to anomalies in the eastern North Pacific. In particular, different states of transient eddy activity can be observed in the North Pacific between SSW composites followed by an equatorward or poleward jet shift in the Atlantic, hinting at a North Pacific forcing.
- By shaping synoptic wave propagation into the Atlantic sector, the Pacific is suggested to modulate the North Atlantic response to SSWs, and increase the persistence of the tropospheric response to stratospheric forcing in the Atlantic.

5 REFERENCES