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# Distinguishing stratospheric sudden warmings from ENSO as key drivers of wintertime climate variability over the North Atlantic and Eurasia

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Stratospheric conditions are increasingly being recognized as an important driver of North Atlantic and Eurasian climate variability. Mindful that the observational record is relatively short, and that internal climate variability can be large, we here analyze a new 10-member ensemble of integrations of a stratosphere-resolving, atmospheric general circulation model, forced with the observed evolution of sea surface temperature (SST) during 1952-2003. We confirm previous studies, and show that El Niño conditions enhance the frequency of occurrence of stratospheric sudden warmings (SSWs), whereas La Niña does not appear to affect it. We note, however, large differences among ensemble members, suggesting caution when interpreting the relatively short observational record. More importantly, we emphasize that the majority of SSWs are not caused by anomalous tropical Pacific SSTs. Comparing composites of winters with and without SSWs in each ENSO phase separately, we demonstrate that stratospheric variability gives rise to large and statistically significant anomalies in tropospheric circulation and surface conditions over the North Atlantic and Eurasia. This indicates that, for those regions, climate variability of stratospheric origin is comparable in magnitude to variability originating from tropical Pacific SSTs, so that the occurrence of a single SSW in a given winter is able to completely alter seasonal climate predictions based solely on ENSO conditions