Interactions between Decadal to Multidecadal Ocean Variability and Stratospheric Sudden Warmings

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Major sudden stratospheric warmings (SSWs) are largest instances of the boreal polar stratospheric variability. Their effects extend farther from the polar stratosphere, affecting for example near-surface circulation. According to observations, SSWs are not equally distributed along time, with decades with almost no events and decades with SSWs happening almost every winter. This suggests the existence of multidecadal variability of SSWs. Some previous studies have pointed to phenomena in the ocean surface as the main precursors of this low-frequency variability. However, the relatively short observational record and the need of long model simulations with daily output have not enabled an analysis of the influences of these oceanic phenomena on SSWs.

The goal of this study is to investigate the effects of Atlantic Multidecadal Variability (AMV) and Pacific Decadal Variability (PDV) on SSWs. To do so, we use for the first time a large ensemble of historical experiments (Max Planck Grand Ensemble) that allows us to examine the modulation of the frequency, precursors and surface impact of SSWs by both types of oceanic variability. Our results reveal that PDV has an impact on the frequency of SSWs, with a significant higher rate of SSWs for its positive than the negative phase. As for AMV, the main effect of AMV is centered on the tropospheric response to SSWs, with almost no modulation in the occurrence of the event. This last finding would be useful in order to predict the tropospheric fingerprint of SSWs.