

Changes in Frequency of Stratospheric Sudden Warmings in Response to Pacific SST Variations

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We investigated changes in the occurrence frequency of stratospheric sudden warmings (SSWs) in response to sea surface temperature (SST) variations in the Pacific region, such as El Niño / La Niña (ENSO). The statistical analysis is conducted by using the historical experiment (HPB) in the database for Policy Decision making for Future climate change (d4PDF), that is, the 100-member ensemble climate simulations by a high-resolution atmospheric general circulation model. It is revealed that the frequency of SSW during El Niño winters is doubled compared to that during ENSO-neutral winters. On the other hand, the frequency during La Niña is almost the same as or slightly higher than that during ENSO-neutral winters. Further, examinations of the tropospheric height field for each SST condition are conducted to explain this tendency of SSW frequency. In the mid-latitude North Pacific region, the seasonal-mean height anomalies are formed in a symmetric manner to the ENSO phase; negative (cyclonic) anomalies in El Niño winters and positive (anticyclonic) anomalies in La Niña winters. However, the standard deviations among ensemble members in this region are found to be smaller during El Niño and larger during La Niña. Therefore, the temporal variability of the height field (the probability of the existence of cyclonic anomalies) increases in the mid-to-high latitude North Pacific during La Niña. This high variability in the North Pacific explains why the SSW frequency during La Niña does not decrease as expected from the seasonal-mean anomaly. The variability in this region is key to understanding the tendency of extreme events in different SST conditions. In fact, analyses of SSWs and other investigations of changes in the SSW frequency in response to mid-latitude SST variations confirm the importance of the North Pacific variability. We would like to add considerations on the expected changes in future projection scenarios.

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