



Stratosphere-Troposphere Dynamics and North American Cold Spells: A Quantile Generalized Additive Approach

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Stratospheric variability can significantly impact the tropospheric circulation and influence surface weather conditions. While many studies have established links between changes in the stratospheric polar vortex strength or the downward reflection of Rossby waves and modulations of the mid-latitude tropospheric circulation, challenges remain in developing quantitative approaches to explore these interactions systematically. Addressing this gap, we propose applying quantile generalized additive models (QGAMs) to statistically explore the connections between stratospheric variability, tropospheric circulation patterns and 2-m temperatures.

This study focuses on the North Pacific and North America, regions where stratospheric processes are known to modulate tropospheric circulation patterns and surface extremes. While the lower quantiles of 2-m temperatures are predominantly governed by tropospheric weather regimes, incorporating stratospheric information can further improve the representation of cold temperatures in some regions of North America at time lags of about two weeks. Given the potential of the stratosphere as an additional predictor for North American cold spells, we further investigate the statistical link between stratospheric dynamics and North American weather regimes.

By providing new insights into stratosphere-troposphere coupling mechanisms we can improve our understanding of the large-scale circulation features driving cold spells and other surface weather extremes. This approach has important implications for advancing their predictability on sub-seasonal to seasonal timescales, potentially informing more effective early-warning systems.