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Characteristics of atmospheric Kelvin waves during warm and cold ENSO phases observed with GPS RO

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Inter-annual variability in the Earth's troposphere at low and middle latitudes is dominated by the El Niño–Southern Oscillation (ENSO) phenomenon. While ENSO emerges from an atmosphere-ocean interaction in the tropical Pacific, it has a significant impact on global weather and climate. Atmospheric wave dynamics plays a crucial role in this context. However, current understanding of this wave dynamics is mostly based on climate model output and reanalysis data.

We use observational data from Global Positioning System (GPS) radio occultation (RO) measurements to investigate characteristics of atmospheric Kelvin waves during warm and cold ENSO phases. Due to their high accuracy and vertical resolution, RO data provide reliable and valuable information on wave-induced temperature oscillations with short vertical wavelengths of a few kilometers.

After the launch of the six micro-satellites of the Formosat-3/COSMIC mission in April 2006, the number of RO measurements per day increased significantly compared to earlier time periods. With an appropriate binning strategy, the sampling is therefore sufficiently dense from mid-2006 onwards in order to capture the main characteristics of large-scale atmospheric waves. Frequencies and wavelengths of atmospheric Kelvin waves are extracted from space-time spectral analysis for overlapping 60-day time series centered on each month.

In this study we focus on the northern hemisphere winter season DJF (December, January, February) using data from DJF 2006/07 to DJF 2011/12. Comparative results are presented for warm ENSO phases, which occurred in DJF 2006/07 and DJF 2009/10, and for cold ENSO phases in DJF 2007/08, DJF 2010/11, and DJF 2011/12.