

Atmospheric climate change – Insights from GNSS RO

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The atmosphere is a fundamental component of our climate system. In particular, the upper troposphere–lower stratosphere (UTLS) region plays an essential role for many climate aspects such as the global radiative balance, the transfer of energy, and the exchange of water vapor, ozone and other constituents between the troposphere and stratosphere. GNSS RO observations are uniquely suited for studying the UTLS, which shows strong spatial and temporal variability ranging from sub-seasonal to inter-annual timescales. With their accuracy and precision as well as high vertical resolution, global availability, and long-term stability, RO measurements provide information on the atmospheric structure and variability as well as on climate trends.

RO data have been instrumental in quantifying the different sources of variability including atmospheric waves at different scales as well as atmospheric oscillation modes such as the quasi-biennial oscillation, Madden-Julian oscillation, and El Niño-Southern oscillation. RO observations have also revealed novel details on the atmospheric structure associated with, e.g., tropical storms or volcanic eruptions and particularly on characteristics of the tropical tropopause. With almost 20 years of measurements available, the RO record has become part of recent assessments on atmospheric changes gaining further importance in this respect.

In this presentation, I will review the contributions of RO observations to the understanding of the three-dimensional structure of UTLS phenomena and their variability (Scherllin-Pirscher et al., 2020). Furthermore, I will present highlights of recent assessments of atmospheric changes, where essential information was provided from RO on temperature trends (Steiner et al., 2020) and atmospheric heat gain (von Schuckmann et al., 2020). Results show that GNSS RO observations have contributed in new ways to the understanding of atmospheric climate change, which emphasizes the need for long-term atmospheric observations for climate monitoring and freely available data for climate research.

References:

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