Advances in GNSS Radio Occultation for Atmospheric Climate Monitoring

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High quality observations are required for monitoring and detecting atmospheric climate change. This implies that climate data records need to be homogeneous, long-term stable, and traceable to standards of the international system of units (SI). The uncertainty in observing essential climate variables (ECVs), such as temperature and water vapor, must be smaller than the signals expected from long-term change.

Radio Occultation (RO) based on Global Navigation Satellite System (GNSS) signals provides an observational record of high quality in the upper troposphere and lower stratosphere region since 2001. Traceability to fundamental time standards with precise atomic clocks enables a long-term stable and consistent multi-satellite record (Angerer et al., 2017) with global coverage, high accuracy and vertical resolution. Error characteristics are well understood and advances are ongoing towards establishing RO as a reference record of ECVs with integrated uncertainty estimation.

We give an overview on climate quality aspects and on recent advances in monitoring climate variability and change with RO. We present vertically resolved atmospheric trends in the troposphere and lower stratosphere and discuss atmospheric variability (Wilhelmsen et al., 2018) due to the Quasi-Biennial Oscillation, El Niño–Southern Oscillation, and volcanic eruptions. We compare RO trend results to trends from reanalyses and radiosondes as well as layer-average brightness temperatures of AMSU microwave soundings. Finally, we discuss the use of RO for the evaluation and testing of climate models (Steiner et al., 2018) and next steps towards establishing a climate benchmark record.

Key words: GPS radio occultation, climate monitoring, atmospheric trends, variability, ECV

References

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