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Vertically resolved trends from GPS Radio Occultation and their uncertainties

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Monitoring atmospheric variability and climate change requires observations of high quality. While surface temperature trends are in accordance among different groups, there are still unresolved issues regarding upper-air climate trends. Though overall agreement on a long-term warming of the troposphere and a cooling of the stratosphere is given, there is larger uncertainty in trend rates particularly in the upper troposphere and stratosphere across different upper-air datasets.

GPS Radio Occultation (RO) now provides 15 years of continuous observations. From a climate perspective this is still a short record, but the traceability to fundamental time standards with precise atomic clocks enables a long-term stable and consistent data record with global coverage. Error characteristics are well understood and advances are ongoing towards establishing RO as a reference climate record.

We investigate vertically resolved atmospheric change signals in the troposphere to lower stratosphere based on the WEGC RO record 2001 to 2016. Applying a multiple linear regression analysis we separate the different contributions to atmospheric change, including the seasonal cycle, the Quasi-Biennial Oscillation, El Niño–Southern Oscillation, volcanic eruptions, and solar variability. We show the relevance of these contributions in terms of explained variability and discuss subtleties, challenges, and uncertainties regarding detection of vertically resolved short-term trends.