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Impact of November 2010 volcanic activity on the UTLS temperatures

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Recent studies have shown an increase of stratospheric aerosol optical depth in the last 20 years despite the absence of large volcanic eruptions in the same period, contributing to supporting the hypothesis that several minor eruptions could impact the atmospheric variability as a large one. November 2010 was a relatively active volcanic period in the tropical belt, three eruptions with Volcanic Explosivity Index higher than 3 occurred in a time span of about 3 weeks: Merapi, Tengger Caldera and Tungurahua. Merapi was the largest eruption of the three, directly overshooting the stratosphere and injecting a large amount of sulfur dioxide. In this study, we analyse the impact of this series of eruptions on the temperature derived from radio occultation observations in upper troposphere lower stratosphere at the local, regional and global scale. The impact of the Quasi-Biennial Oscillation, El Niño–Southern Oscillation, and linear trend on temperature is estimated and removed from temperature time series using multiple linear regression. Signatures of volcanic eruptions in temperature are analysed using post fit residuals. The results show significant warming in the lower stratosphere between 10°S and 0° for a period of 7 months after the eruptions with a maximum anomaly amplitude of about 1.4 K at 18 km altitude. Whilst the maximum warming in Merapi’s vicinity occurred 4 months after the eruption and reached the magnitude of almost 4 K.