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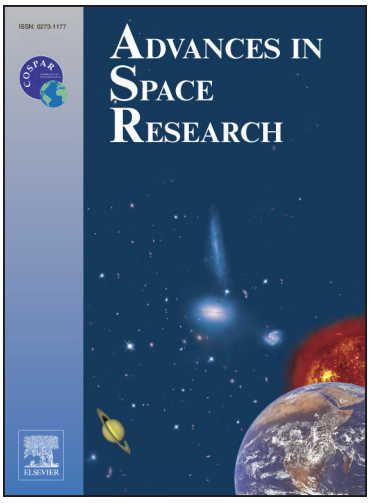

Supporting the detection and monitoring of volcanic clouds: a promising new application of Global Navigation Satellite System radio occultation

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Supporting the detection and monitoring of volcanic clouds: a promising new application of Global Navigation Satellite System radio occultation

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Abstract

The altitude of volcanic clouds and the atmospheric thermal structure after volcanic eruptions are studied using Global Navigation Satellite System (GNSS) Radio Occultation (RO) profiles co-located with independent radiometer images of ash and sulfur dioxide plumes. We use geographically co-located RO profiles to detect the top altitude of volcanic clouds and to analyze their impact in terms of temperature change signatures. We obtained about 1300 RO profiles co-located with two representative eruptions (Puyehue 2011, Nabro 2011) and found that an anomaly technique recently developed for detecting convective cloud tops and studying the vertical thermal structure of deep convective systems can also be applied to volcanic clouds. Analyzing the atmospheric thermal structure after the eruptions, we found clear cooling signatures induced by volcanic cloud tops in the upper troposphere for the Puyehue case. For the Nabro case we detected a significant warming in the stratosphere which lasted for several months, indicating that the cloud reached the stratosphere. The results are encouraging for future large-scale use of RO data for supporting the monitoring of volcanic clouds and their impacts on weather and climate.

Keywords: GNSS radio occultation; Volcanic clouds; Nabro; Cloud tops; Climate monitoring

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