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Volcanic effects on climate: revisiting the mechanisms

H.-F. Graf¹, Q. Li², and M. A. Giorgetta²

¹Centre for Atmospheric Science, University of Cambridge, UK

²Max-Planck-Institute for Meteorology, Hamburg, Germany

Abstract. The characteristics of planetary wave energy propagation are being compared based on NCEP reanalysis data from 1958 to 2002 between boreal winters after strong volcanic eruptions, non-volcanic winters and episodes of strong polar vortex lasting at least 30 days. It shows that in the volcanically disturbed winters much more planetary wave energy is produced in the troposphere, passes through the lowermost stratosphere and enters the upper stratosphere than in any other times. This is contradicting earlier interpretations and model simulations. Possibly the observed El Ninos coinciding with the three significant eruptions in the second half of the 20th century contributed to the planetary wave energy. In order to produce the observed robust climate anomaly patterns in the lower troposphere, these planetary waves are suggested to be reflected near the stratopause instead of breaking. While a strong polar vortex is observed after volcanic eruptions in the stratosphere and in the troposphere, specific episodes of strong polar vortex regime exhibit much stronger anomalies and different dynamics. Hence it is suggested that the climate effects of volcanic eruptions are not being explained by the excitation of inherent zonal mean variability modes such as Strong Polar Vortex or Northern Annular Mode, but rather is another mode that possibly reflects upon the North Atlantic Oscillation.

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