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Revisiting the mechanisms of volcanic impact on climate

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The characteristics of planetary wave energy propagation were compared based on 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 volcanically disturbed winters much more planetary wave energy is produced in the troposphere and enters the upper stratosphere than in any other times. This is contradicting earlier interpretations and model simulations. To what degree the observed El Ninos coinciding with the three significant eruptions in the second half of the 20th century contributed to the planetary wave energy anomalies will be discussed. In order to produce the observed robust climate anomaly patterns in the lower troposphere, these planetary waves must be reflected near the stratopause instead of breaking. While a strengthened 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. Climate effects of volcanic eruptions are not induced by the excitation of an inherent zonal mean variability mode such as Strong Polar Vortex or Northern Annular Mode, but rather by another, zonally non-symmetric mode that possibly reflects upon the North Atlantic Oscillation.