

A SKYHI GCM Study of Winter Warming and Summer Cooling due to Pinatubo Aerosols

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Aerosols in the stratosphere produced due to major volcanic eruptions can substantially perturb the climate of the stratosphere and the surface-troposphere system. In this study, we investigate the radiative, climatic and dynamical responses in the stratosphere and in the troposphere due to the aerosols produced by the Mount Pinatubo volcano. The effects are studied using the SKYHI GCM for a 2-year period during which the Pinatubo aerosols reached a maximum and then slowly decayed. The responses are determined by doing an ensemble of eight GCM integrations with different initial conditions and with the observed aerosol properties as input.

The temperature of the tropical lower stratosphere increased by a statistically significant 3K. The stratospheric temperature change caused by volcanic aerosols and the subsequent equator-to-pole temperature gradient affects the dynamical circulation in the stratosphere, which in turn can cause changes in the troposphere through the propagation of zonal wind anomalies. The ensemble runs clearly show that the stratosphere can evolve quite differently depending on the initial meteorological conditions, with differing equator-to-pole temperature gradients and significant year-to-year variability in the polar temperatures. These differing features in turn affect the surface temperature patterns. During the first winter the surface temperatures are warmer over Eurasian region and North America though with reduced magnitude when compared to observations. Details of the analysis on winter warming and summer cooling due to the Pinatubo aerosols will be presented and discussed.