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Quantifying the impact of moderate volcanic eruptions on the stratosphere


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It is expected that the aerosols in the stratosphere, are predominantly sulfates resulting from natural or anthropogenic sources of precursor gases mainly: carbonyl sulfide (OCS), sulfur dioxide (SO₂). Sulphate aerosols are regarded as the main constituent of the ‘Junge layer’ between the tropopause and about 30 km. This assumption is regularly challenged by detection of solid aerosols with aircraft and balloon measurements. The direct injection of gaseous SO₂ into the stratosphere by major volcanic eruptions is likely to generate significant amounts of sulfate aerosols that can stay for several years. Recently, Vernier et al. (2011) have shown from satellite measurements that moderate volcanic eruptions modulate the aerosol content during periods not influenced by major volcanic eruptions, called ‘background’ periods. Surprisingly, the radiative impact of the background stratospheric aerosols over the last decades, has been found to be significant with a counterbalance to global warming (Solomon et al., 2011).


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Measurements. The direct injection of gaseous SO₂ made by secondary aerosols. WACCM-CARMA simulations with Asian regional emissions are planned to improve our understanding of the role of aerosols in the climate system. The good agreement between the WACCM-CARMA model and the observations gives evidence that moderate stratospheric eruptions control the variability of the Junge Layer. Moderate eruptions like the Sarychev eruption have the potential to increase the background aerosol loading by a factor 2 to 10.

Perspectives

The climate effects of volcanic eruptions are well understood. These effects are due to the formation of a layer of sulfate aerosols in the lower stratosphere, which leads to direct radiative forcing, increased the planetary albedo, and cooling the earth surface. The climate effects of aerosols, studies, however, remain challenging and the nature and size of the aerosols in the stratosphere are not yet fully understood.