Geophysical Research Abstracts
Vol. 12, EGU2010-6652, 2010
EGU General Assembly 2010

Simulations of recent and historical volcanic eruptions using a new radiative model implemented into the IPSLCM4 atmosphere-ocean coupled model

Myriam Khodri (1) and Frederic Fluteau (2)
(1) LOCEAN/IRD, Paris, France , (2) Institut de Physique du Globe de Paris, Paleomagnetisme, Paris, France (fluteau@ipgp.jussieu.fr)

The understanding of volcanic eruptions impacts on climate has considerably improved during the last decade. Among the gas and solid particles released during volcanic eruptions, large amount of sulphur (tens of teragrams) injected into the stratosphere during plinian eruptions has been observed. Once in the stratosphere, sulphur gas is chemically converted into sulphate aerosols in several weeks. It has been shown that these aérosols may act on the Earth radiative budget by backscattering the incoming solar flux and consequently reducing the net incoming solar flux at the Earth surface leading to a surface cooling and absorbing the infrared emission leading to a stratospheric warming. It has also been highlighted that sulphate aerosols affect the chemical equilibrium of stratosphere (ozone depletion for example). However the most significant and direct effect is the global cooling, which occurs immediately after the volcanic eruption. In case of the recent Pinatubo volcanic eruption (20 Tg of sulphate aerosols produced), a global cooling of 0.3°C has been detected the year following the eruption (1991). The historical volcanic eruptions may also help to better understand the impact on climate. Presence of acidity peaks in ice cores drilled into the Greenland and Antarctica ice sheets have allowed to reconstruct the successive volcanic eruptions having released sulphur into the stratosphere and produced sulphate aerosols. The climatic consequences of historical volcanic eruptions are potentially recorded by proxy data and/or documented by historical archives.
In order to investigate the impact of volcanism on climate at various timescales (present, historical, geological timescales), we have developed a module, which mimics the direct radiative effect of sulphate aerosols. This radiative model is implemented into the IPSL ocean-atmosphere coupled model (IPSLCM4). The physical properties of stratospheric sulphate aerosols in the visible optical band (effective radius, single-scatter albedo, etc) are accounted for. The IPSLCM4 model is forced with the monthly mean optical thickness reconstructed by Amman et al (2003) and Gao et al (2008) which mimics the amount of sulfate aerosols in the stratosphere. We have performed ensembles of simulations for recent and historical volcanic eruptions to explore the range of climatic consequences. We will also discuss about the influence of the size of sulfate aerosols in case of volcanic eruptions injecting very large amount of sulfur into the atmosphere. We have compared our simulations with various sets of observations as well as those previously obtained with other models.