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Impact of stratospheric sulphur injections on the hydrological cycle: A Mount Pinatubo case study

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The increasing awareness of possible consequences of climate change caused by greenhouse gases has fostered the discussion of geo-engineering actions to reduce the magnitude of future climate change. One geo-engineering strategy that has recently received considerable attention is the artificial increase of the stratospheric aerosol loading to reduce the amount of incoming solar radiation absorbed by the Earth. Large volcanic eruptions are a good analogue for this albedo enhancement strategy. In particular the June 1991 eruption of Mt. Pinatubo serves as a good test bed to investigate possible side effects as it was the best observed eruption that ever happened. After the Mt. Pinatubo eruption not only a decrease in surface air temperature, atmospheric water vapor and sea level have been observed but also a substantial decrease in runoff and in precipitation over land. During the winter following the Mt. Pinatubo eruption an El Nino took place. It is currently uncertain to what degree this has influenced the response to high stratospheric aerosol loading. Hence, we have carried out a series of Mt. Pinatubo experiments with a fully coupled Atmosphere-Ocean GCM (ECHAM5/MPIOM) to improve our current understanding of the impact of a large stratospheric sulphur loading on the hydrological cycle. The volcanic forcing is calculated online in the model using a realistic space-time distribution of aerosol optical parameters derived from satellite observations. Here, we present results of ensemble simulations for Pinatubo-like eruptions occurring during different states of the ocean circulation: before the onset of an El Nino, during an El Nino event, and for a climato-

logical mean state. The discussion includes changes in radiation, temperature and the hydrological cycle (precipitation, evapotranspiration, runoff, atmospheric water vapor content).