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Is there a Limit of Sulfate Injections for Climate Engineering?

Ulrike Niemeier // Max Planck Institute for Meteorology

The injection of sulfur dioxide into the stratosphere to form an artificial stratospheric aerosol layer is considered as an option for the reduction of solar radiation to counterbalance the impact of anthropogenic climate change. The related reduction in radiative forcing depends upon the injected amount of sulfur.
Studies of the microphysical evolution of sulfate concentration show a decrease in efficiency with increasing injection magnitude, however, none of these studies consider injection strengths above the 10
Mt(S)/y necessary to counteract the strong anthropogenic forcing expected if 'business as usual' conditions continue throughout this century. For this numerical study we calculated the forcing of strong sulfur injections up to 100 Mt(S)/y, and estimate the reliability of the given results by varying the injection strategy and compare the results to previous studies. Our calculations show that the efficiency of the aerosol layer, expressed as the relationship between sulfate aerosol forcing and injection strength, has the form exponential decay. This result implies that the solar radiation management strategy required to keep temperatures constant at that anticipated for 2020, whilst maintaining 'business as usual conditions', would require atmospheric injections of the order of 60 Mt(S)/y which amounts to 5 - 10 times that emitted from of the Mt.~Pinatubo eruption each year.