Dependency of surface air temperature change by sulfate aerosols on CO_2 concentration

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Sulfate aerosols are estimated to mitigate global warming through aerosol-radiation interactions by scattering solar radiation and through aerosol-cloud interactions enhancing it by cloud droplets. Under the present situation in which emissions of anthropogenic SO_2, a primary precursor of sulfate aerosol, are decreasing and, on the other hand, atmospheric CO_2 concentrations are increasing, it is anxious about accelerating global warming. In the previous study, a change in surface air temperature with perturbed SO_2 and black carbon emissions (factors of 0.0, 0.1, 0.3, 0.5, 0.8, 1.5, and 2.0 relative to present emissions) were analyzed using an atmosphere-ocean general circulation model coupled with an aerosol process model, MIROC-SPRINTARS (Takemura and Suzuki, 2019). In this study, extended experiments were performed with CO_2 concentrations both of present (369 ppm, recorded in 2000) and double (738 ppm, close to SSP3-7.0 scenario for 2080) for each SO_2 emission factor. The experimental results show that reducing SO_2 emission at high CO_2 concentration brings an enhanced increase in surface air temperature. The warming is especially strong over land at the mid- and high- latitudes in the Northern Hemisphere because of an larger increase in water vapor that is a greenhouse gas, a weaker increase in liquid water path, and stronger ice-albedo feedback under the higher CO_2 concentration.

Reference: Takemura, T., and K. Suzuki, Sci. Rep., 9, 2019, doi:10.1038/s41598-019-41181-6.

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