Impact of stratospheric aerosol geoengineering on PV and CPV output

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Pumping sulphide gases into our upper atmosphere, the stratosphere, is considered a last-resort fix for climate change [1,2]. The sulphide molecules oxidise and condense to form droplets, or aerosols, of sulphuric acid. These aerosols are effective at scattering visible light, so reflecting a fraction of solar radiation back into space that would otherwise warm the earth's surface and lower atmosphere. However, with reduced visible radiation reaching the earth's surface, will the output of PV and CPV decrease? The eruption of Mount Pinatubo in 1991 injected 20 Tg of SO_2 into the stratosphere, and this event is often used as an analog and inspiration for geoengineering. A reduction in global average temperatures of 0.5°C for 3 years can be attributed to this eruption, but the peak output of SEGS, a CSP generator in California, reduced by 20% [3].

Using a global climate model called HadGEM2, we simulate the injection of 10 Tg of SO_2 per year from 2020 onwards [4]. The injection takes place between 16 km and 25 km altitude from a single point on the equator, at Ecuador, perhaps from aircraft. Electricity output for fixed-angle PV reduces by 1% on average, and for tracking PV by 3%. A reduction in CPV output by more than 10% in some regions near the equator is seen, with a decrease of 6% on average. The different response from different technologies can be understood by recognising that tracking PV and CPV utilise increasing fractions of direct irradiance. The stratospheric aerosols transform direct irradiance into diffuse irradiance through increased scattering.

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