Stratospheric solar geoengineering without ozone loss?

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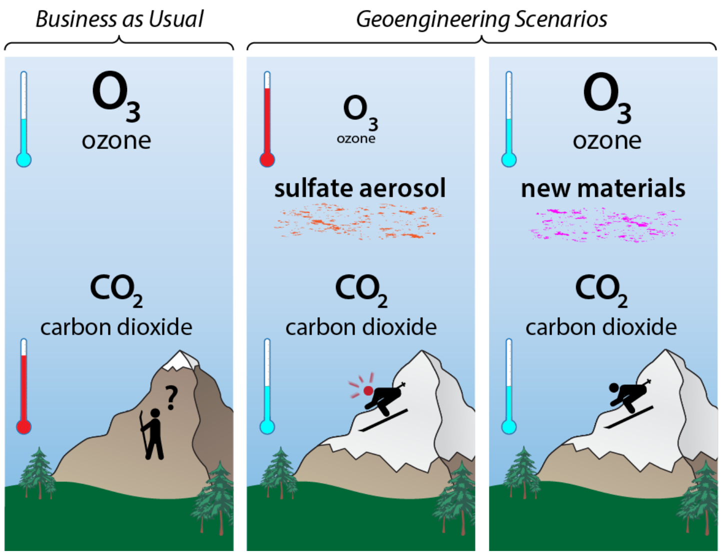

Solar radiation management (SRM), a geoengineering approach to modify Earth's climate on a global scale, has been receiving growing attention. SRM may reduce some climate risks, but it also entails new risks including ozone loss and heating of the lower tropical stratosphere that tends to increase stratospheric water vapor concentrations that cause additional ozone loss and global warming. Although most work has focused on introduction of sulfate aerosol into the stratosphere to reduce solar radiation at the surface, a number of other materials have also been considered. To date, the detailed chemical and physical properties of these materials have mostly been treated in a simplified manner. As an example of the role physicochemical detail plays in understanding consequences of SRM, I will discuss the implications of a more detailed treatment of titania (TiO_2), including the role of different titania polymorphs. I will also present results investigating the injection of calcite ($CaCO_3$) aerosol, which could reduce net radiative forcing while simultaneously increasing column ozone towards its pre-anthropogenic baseline. A radiative forcing of -1 Wm^{-2}, for example, might be achieved with a simultaneous 3.8% increase in column ozone outside of the poles using 2.1 Tg yr^{-1} of 275 nm radius calcite aerosol with ten-fold less radiative heating sulfate would be caused by sulfates. The combination of reactive alkaline solids with high refractive index materials may provide less risky solar geoengineering although large uncertainties, including impact on polar ozone, remain.