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Simulations of the transient climate response to climate engineering in the form of cirrus cloud seeding

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We present a global modeling study of a so far understudied climate engineering mechanism (CEM), namely the seeding of cirrus clouds to reduce their lifetimes in the upper troposphere, and hence their greenhouse effect. Different from most CEMs, the intention of cirrus seeding is not to reduce the amount of solar radiation reaching Earth's surface. This particular CEM rather targets the greenhouse effect, by reducing the trapping of infrared radiation by high clouds. This avoids some of the caveats that have been identified for solar radiation management, for example the delayed recovery of stratospheric ozone or drastic changes to Earth's hydrological cycle.

Here, we contrast transient simulations of the 21^{st} century, using a modified version of the Community Earth System Model (CESM). We simulate three future scenarios: (i) A simulation with the conventional high emission scenario RCP8.5, (ii) A simulation in which climate engineering in the form of high-latitude cirrus seeding is introduced in the middle of the century without any accompanying emission reductions, and (iii) The same as (ii), but with emissions that are reduced by 50% over the period 2050 to 2100. We consider the last scenario to be one in which climate engineering is used to buy time for mitigation efforts to become effective, while scenario (iii) is one in which high emissions are allowed to continue due to the naïve belief that climate engineering can be used to prevent global warming in perpetuity. Our analysis focuses on the contrasts between the regional and global climates of year 2100 produced by the three scenarios.