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Does the dust direct radiative effect cool or warm the planet?

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Desert dust aerosols affect Earth's global energy balance through interactions with radiation, clouds, and ecosystems. But the magnitudes of these effects are so uncertain that it remains unclear whether atmospheric dust has a net warming or cooling effect on global climate. Consequently, it is still uncertain whether large changes in atmospheric dust loading over the past century have slowed or accelerated anthropogenic climate change, and the climate impact of possible future alterations in dust loading is similarly disputed. Here we use an integrative analysis of dust aerosol sizes and abundance to constrain the climatic impact of dust through direct interactions with radiation. Using a combination of observational, experimental, and model data, we find that atmospheric dust is substantially coarser than represented in current climate models. Since coarse dust warms global climate, the dust direct radiative effect (DRE) is likely less cooling than the ∼0.4 W/m2 estimated by models in the AeroCom ensemble. We constrain the dust DRE to -0.20 (-0.48 to +0.20) W/m2, which suggests that the dust DRE produces only about half the cooling that current models estimate, and raises the possibility that dust DRE is actually net warming the planet.