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Decomposing the direct and indirect radiative effects by mineral dust aerosols in CMIP6

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Mineral dust aerosols play an important role in the Earth's radiative budget. Dust aerosols interact with radiation in both the longwave and shortwave spectrum through direct radiative effects by absorption and scattering, and indirect effects through influencing cloud microphysical properties. Understanding dust-climate interactions are becoming increasingly important as effective air quality measures are reducing anthropogenic aerosol emissions and desertification in arid and semi-arid regions of the world are projected to increase in the face of climate change.

In this work, we aim to better understand dust-climate interactions in the CMIP6 models by diagnosing the dust direct and indirect effects in 9 CMIP6 models participating in the piClim-2xdust experiment under AerChemMIP. The piClim-2xdust experiment doubles the dust emission in the model while keeping the other aerosols at pre-industrial levels. This means that any changes to the clouds and clear sky top of the atmosphere energy balance can be attributed to dust-cloud or dust-radiation interactions. We assess the robustness of the dust radiation and cloud response in the CMIP6 models and discuss the impact of differences in the representation of dust aerosols between the models.