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Observational constraints of the aerosol influence on cloud liquid water path

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Aerosols impact liquid cloud properties through both microphysical and radiative processes. Increasing the number concentration of aerosol particles can increase the cloud droplet number concentration (CDNC). Through impacts on precipitation processes, this increase in CDNC may also be able to impact the cloud fraction (CF) and the cloud liquid water path (LWP). Recent studies have suggested that the aerosol impact on LWP may be small, such that many global climate models overestimate the LWP response.

Observational constraints have been developed using “natural experiments” such as volcanos and shiptracks, but producing a global estimate of the aerosol impact on LWP remains challenging due to large variations in cloud properties and the confounding effect of local meteorology. Any property, such as relative humidity or windspeed, that affects both aerosol and cloud properties has the potential to generate a systematic bias, obscuring the causal impact of aerosol on LWP.

In this work, we look at possible observational constraints on the aerosol-LWP relationship generated from natural experiments and multiple sources of satellite data to examine how aerosols can influence the LWP. We then look at how these observational constraints can be tested using global-aerosol climate models. The results from this work will lead to improvements in the representations of clouds in climate models, helping to reduce the uncertainty in the global impact of anthropogenic aerosols on clouds and the climate.