Aerosols Help Deep Convective Clouds Form

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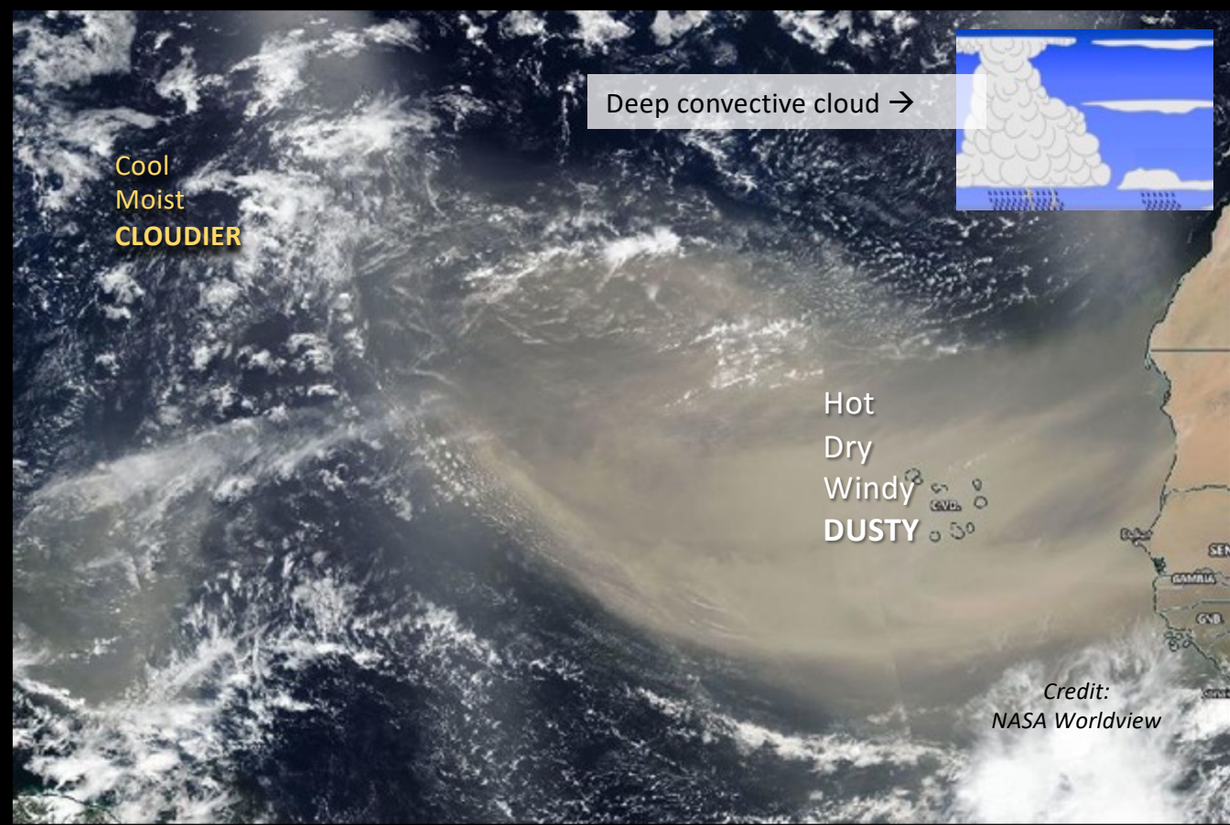
Deep convective clouds like thunderstorms supply massive amounts of precipitation to tropical regions and have a large influence on climate and atmospheric chemistry. How do particles in our atmosphere like dust, smoke, and pollution (referred to here as aerosols) affect the formation of these clouds?

To investigate this, we used over 7 million observations of clouds from the CloudSat satellite and data products from Goddard's Global Modeling and Assimilation Office. We separated these observations into groups depending on different meteorological conditions, so that within groups, aerosol effects on clouds dominated over meteorological effects and could thus be quantified.

We found that dust, marine aerosols (sea-spray made of salt and organics), and combustion aerosols all increased convective cloud prevalence by more than 50%. Marine aerosols had the largest effects on the clouds, but were moderated by the presence of of dust.

Aerosol-cloud interactions (ACI) are a Decadal Survey priority and a major uncertainty in climate science. The technique developed here can be applied in other measurement-based studies to reduce ACI uncertainties.



It is challenging to quantify aerosol effects on clouds, in part because aerosols often co-occur with meteorological conditions that also impact clouds. For example, we must account for Saharan dust co-occurring with dry air, which inhibits cloud formation (above).

L. Zamora, R. Kahn (613), "Saharan Dust Aerosols Change Deep Convective Cloud Prevalence, Possibly by Inhibiting Marine New Particle Formation," *Journal of Climate*, **33**, 9467 (2020)