The complexities of clouds and the seeds that make them

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Clouds are complicated. Each cloud formation depends on the timing of the water cycle, in which water evaporates from Earth's surface, condensates in the atmosphere and falls back down, as well as the types of aerosols in the atmosphere.

In an effort to understand exactly how the cloud micro- and macro-properties interact with atmospheric particles, a collaborative research team conducted a modeling study analyzing three well-documented weather systems that occurred in March of 2000 over the southern Great Plains in the United States.

The results were published in *Advances of Atmospheric Sciences*, and included in a special issue on aerosols, clouds, radiation, precipitation, and their interactions. Scientists from the California Institute of Technology, Texas A&M University, Brookhaven National Laboratory, University of Arizona and McGill University contributed to the study.

"The results from this modeling study highlight the complexity of the aerosol-cloud-precipitation-radiation interactions that vary on a case-by-case basis," said Yuan Wang, first author on the paper and a research scientist in the division of geological and planetary sciences at the California Institute of Technology. "Aerosols are so small and mutable, so it's hard to quantify their impact."

Aerosols, commonly known as cloud seeds, are tiny particles of things such as sea salt or pollution in Earth's atmosphere.

Researchers found that different simulated aerosols had significant influence in each of the three systems, but other factors, such as solar radiation changes due to aerosol pertubations, also greatly contributed to cloud formation and development.

"This study has shown that studying the aerosol microphysical effect alone is insufficient to assess the changes of clouds in the real atmosphere, as the aerosol radiative effects can also produce profound impacts on cloud development and precipitation processes," Wang said.

In climate predictions, computer program can model global climates based on observational data or theoretical information. According to Wang, the global climate model is a good tool, but it doesn't fully appreciate the influence of aerosols. Its scale eclipses the microphysical properties of aerosols and their impact.

"We are still seeking the right way to represent aerosols and their effects in global climate models," Wang said. "We're interested in the interactions between the microscale model and the global climate model, and we're working to bridge the scales between the two."

Global climate models are used to assess the Earth's future climate, but they may not provide the full picture.

"The impact of aerosols needs to be fully assessed," Wang said. "We should consider the complexities of aerosol-cloud interactions in the global climate model in a smart way."

More information: Yuan Wang et al, Aerosol microphysical and radiative effects on continental cloud ensembles, *Advances in Atmospheric Sciences* (2018). DOI: 10.1007/s00376-017-7091-5

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