Scientists examine how aerosol types influence cloud formation

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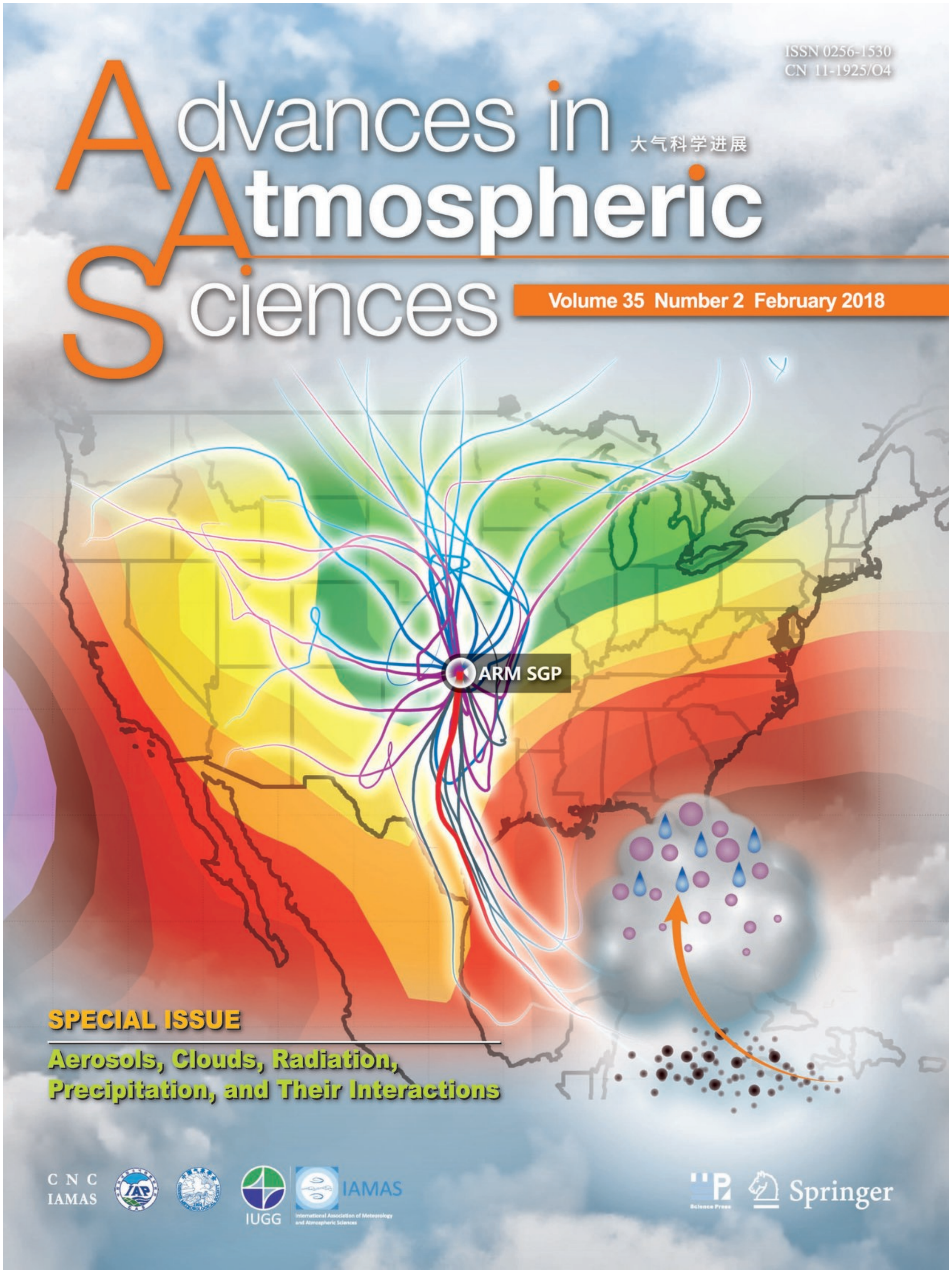
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Transport pathways of clean, continental air masses from the north and polluted, maritime air masses from the south are given by trajectory (colored lines) and meteorological (colored shading) analyses. Credit: *Advances in Atmospheric Sciences*

Not all aerosols are made equally. Sea salt and some types of wild fire smoke can take flight to create clouds and, eventually, rain, while other aerosols, such as mineral dust, do not work as well. Scientists are beginning to understand exactly how these different particles influence cloud formation and resulting precipitation over land and sea.

Researchers from Texas A&M University and the University of Arizona published their latest study in *Advances of Atmospheric Sciences*. "Certain aerosol types can become cloud condensation nuclei and their number concentration can dictate cloud behavior," said Timothy Logan, an instructional assistant professor in the department of atmospheric sciences at Texas A&M University and an author on the paper. "The dependence on aerosol type is the key to understanding under which conditions clouds will develop as well as how much precipitation comes from them."

Logan and his team previously studied aerosols over the ocean and their ability to seed clouds as surface cloud condensation nuclei, which determine precipitation type and duration. In this paper, they compare those results with data collected over the Great Plains, a landlocked strip bisecting the United States.

Aerosols not only act as cloud condensation nuclei, but they can also enhance or limit the concentration of the cloud condensation nuclei. This concentration influences the lifetime, thickness and brightness of clouds, as well as resulting precipitation. Known as the aerosol indirect effect, this relationship may be just as damaging as the aerosol direct effect, in which aerosols fill the atmosphere and block the sun. Previous research tends to rely on the number, rather than the type, of cloud concentration nuclei, according to Logan.

"Aerosol type does matter when it comes to the aerosol indirect effect and should be taken into account when modeling aerosol-cloud-precipitation interactions rather than solely using the [number concentration]," Logan said.

Beyond formation, the researchers examined how clouds move, crossing from ocean to land. Logan noted wind patterns are capable of transporting aerosols hundreds to thousands of kilometers away from their source regions.

Using ground and space observational techniques, the team plans to conduct a long-term observational study and model the behavioral sensitivity between aerosols, clouds, and precipitation, with a focus on air masses that transport aerosols to regions where clouds and precipitation develop.

"Certain aerosol and air mass types are dominant during certain times of the year and exhibit a seasonal pattern," Logan said. "This pattern can be used to determine the magnitude of the [aerosol indirect effect], as well as the distribution of precipitation over land and ocean with respect to climate change."

More information: Timothy Logan et al, Aerosol properties and their impacts on surface CCN at the ARM Southern Great Plains site during the 2011 Midlatitude Continental Convective Clouds Experiment, *Advances in Atmospheric Sciences* (2018). DOI: 10.1007/s00376-017-7033-2

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