Scientists in China are seeing a decrease in light rainfall over the past 50 years, with the southern part of eastern China experiencing the greatest loss. The study, conducted by Yun Qian and colleagues from the U.S., China, and Sweden, used data from 162 weather stations in eastern China to chart trends in rainfall from 1956 to 2005.

The team determined that while the northern part of eastern China has seen increased amounts of total rainfall per year, the southern part has seen less rain and more droughts. Light rainfall, which is critical for agriculture, has decreased everywhere. Over the last 50 years, the southern part of eastern China has seen 23 percent more days of light rain in the eastern half of the country.

The study links for the first time high levels of pollutants in the air with conditions that prevent the light kind of rainfall critical for agriculture. Led by atmospheric scientist Yun Qian at the Department of Energy's Pacific Northwest National Laboratory, the study appears August 15 in the Journal of Geophysical Research - Atmospheres.

"People have long wondered if there was a connection, but this is the first time we've observed it from long-term data," said Qian. "Besides the health effects, acid rain and other problems that pollution creates, this work suggests that reducing air pollution might help ease the drought in north China."
The Sky Is Not Falling: Pollution In Eastern China Cuts Light, Useful Rainfall

Qian. The work was supported by the Office of Biological and Aerosols on precipitation under different atmospheric and pollution conditions.”

To probe what caused the loss of rainfall, the team looked at how much water the atmosphere contained and where the water vapor traveled. Most parts of eastern China saw no significant change in the amount of water held by the atmosphere, even though light rains decreased. In addition, where the atmosphere transported water vapor didn't coincide with light rain frequency.

These results suggested that changes in large-scale movement of water could not account for the loss of the precipitation.

Some of pollution's aerosols can seed clouds or form raindrops, depending on their size, composition and the conditions in which they find themselves. Because these skills likely contribute to rainfall patterns, the researchers explored the aerosols in more depth.

Cloud droplets form around aerosols, so the team determined the concentration of cloud droplets over China. They found higher concentrations of droplets when more aerosols were present. But more droplets mean that each cloud droplet is smaller, in the same way that filling 10 ice cream cones from a quart of ice cream results in smaller scoops than if the same amount were put in only five cones.

This result suggested that aerosols create smaller water droplets, which in turn have a harder time forming rainclouds. The team verified this with computer models of pristine, moderately polluted or heavily polluted skies. In the most heavily polluted simulation, rain fell at significantly lower frequencies than in the pristine conditions.

An examination of the cloud and rain drops showed that these water drops in polluted cases are up to 50 percent smaller than in clean skies. The smaller size impedes the formation of rain clouds and the falling of rain.

Qian said the next step in their research is to examine new data from the DOE's Atmospheric Radiation Measurement Climate Research Facility in the central eastern Chinese city of Shouxian. The data was collected from April to December of 2008.

“This work is important because modeling studies of individual cases of pollution's effect on convective clouds have shown varying results, depending on the environmental conditions,” said coauthor Ruby Leung. “The ARM data collected at Shouxian should provide more detailed measurements of both aerosols and clouds to enable us to quantify the impacts of aerosols on precipitation under different atmospheric and pollution conditions.”

The work was supported by the Office of Biological and Environmental Research within the DOE Office of Science under a bilateral agreement on regional climate research with the China Ministry of Science and Technology.

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