Are Clouds Darkening China?

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HAZE DYNASTY

China has darkened over the past half-century. Where has all the sunshine gone? The usual suspect, at least to a climatologist, would be cloud cover.

But in the most comprehensive study to date of overcast versus cloud-free days in China, a team led by the Department of Energy's Pacific Northwest National Laboratory, reporting in the current advance online issue of Geophysical Research Letters, has found that cloud cover has been decreasing for the past 50 years.

Eliminating clouds from the dimming equation now leaves little doubt that human activity, in the form of a nine-fold increase in fossil fuel emissions over the same half-century period, has entrenched China in a foggy haze that absorbs and deflects the sun's rays.

For the study, PNNL senior research scientist and lead author Yun Qian and colleagues surveyed records from more than 500 weather stations across China for the years 1954 to 2001. To remove the subjectivity and ambiguity of "partly cloudy" reports, they consulted only records of an either/or nature—cloud-free and overcast days. Their statistical analysis noted a clear trend: overcast days decreased .78 percent each decade while cloud-free days increased .6 percent for the same period.

The results, said co-author Ruby Leung, a PNNL laboratory fellow, "strongly suggest that increasing aerosol concentrations (particles, mainly soot and sulfur, that pollute the air) in the past has produced a fog-like haze that has reduced solar radiation (surface heat from sunshine), despite more frequent clear days that should lead to increased solar radiation."

In fact, a report in Science last year showed that most of the planet's surface is brightening, attributable to air-pollution regulation throughout most of the industrialized world. The report even showed a curious blip in surface brightness in China in the mid-90s, Leung noted. "Our results showed a similar trend in the mid-90s, consistent with the Science paper.

"However, air pollution in China has not decreased in the 1990s, so it is not clear if the short term increasing trend in solar radiation in China is due to cleaner air, as the Science paper suggested."

If anything, the pollution outlook in China is likely to grow darker as population and economic activity burgeon, said Qian. "Haze doesn't just block the solar radiation. It is also infamous for acid rain and respiratory diseases."

What's more, the haze has masked the effects of global warming across large parts of China, particularly in the central and eastern regions, where daily high temperatures have actually been decreasing. This may seem like good news, Qian said, but any success China has in curbing emissions will accelerate the effects of global warming in those areas when cooling is unmasked.

And that may not be the worst of it. Qian pointed to a Proceedings of the National Academy of Sciences report last year on haze, or "atmospheric brown clouds," in South Asia that implicated air pollution in disrupting the water cycle. As less radiation reaches the surface, the atmosphere may become more stable and clouds more persistent than usual and less water will evaporate from the surface, a finding corroborated by Qian's China study. The result is less water vapor available for clouds or precipitation.

Simulations cited in the PNAS paper calculate that up to 50 percent of the surface warming in South Asia has been masked by haze. If emission trends continue, the subcontinent will face twice as many droughts in the next decade.

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