Eastern and central China become brighter due to clean air action

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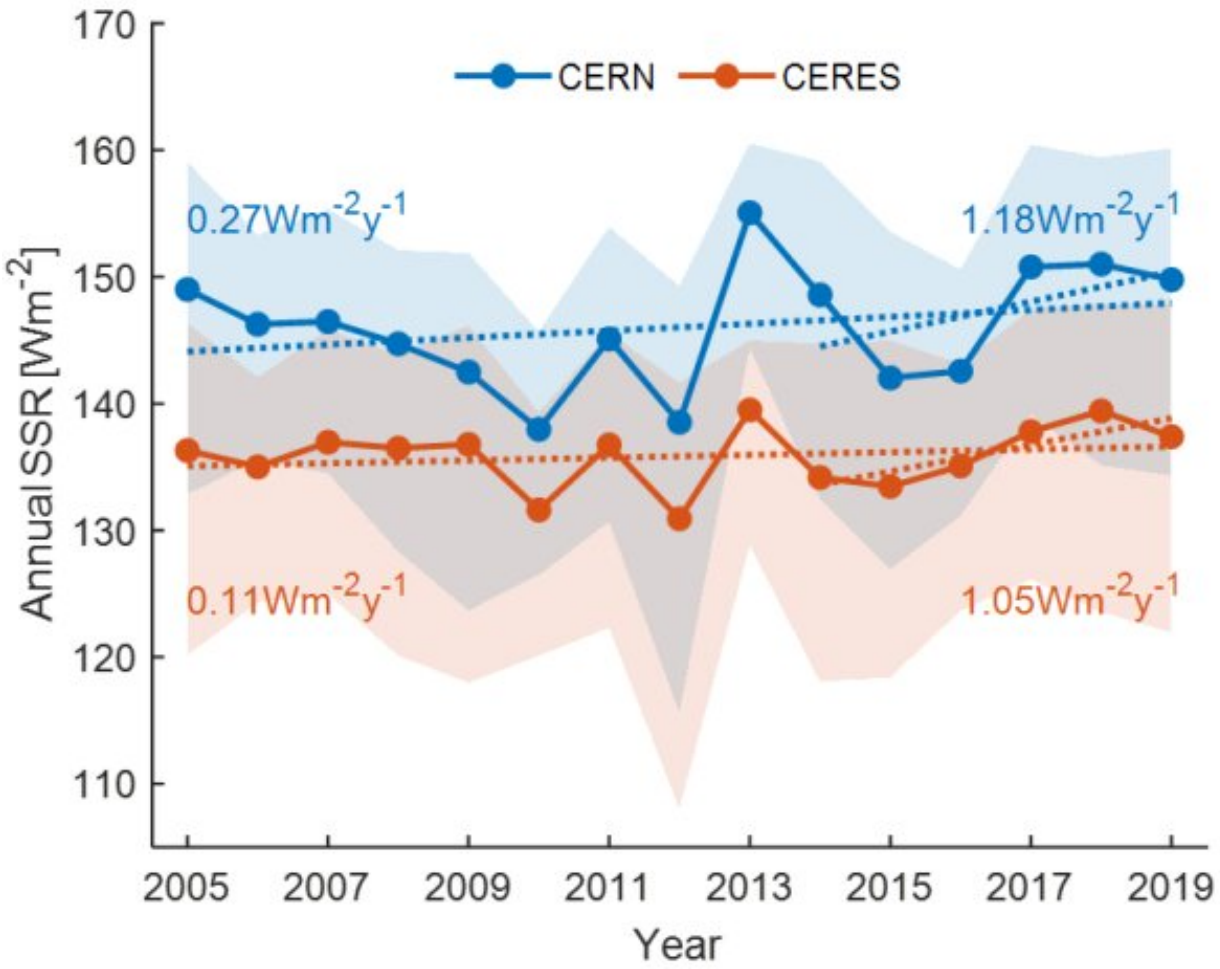

Trends of annual mean SSR from 2005 to 2019, and trends of annual mean SSR during 2014-2019 are also presented for comparison. (Image by SHI Hongrong)

Since 2013, China has implemented the strictest ever air pollution control policies, which resulted in substantial reductions in aerosol concentrations.

However, extreme and persistent haze events frequently occur during wintertime in China. In winter haze events, aerosol-related reductions of surface solar radiation (SSR) have comparable impacts on clouds over eastern provinces.

Recently, researchers from the Institute of Atmospheric Physics (IAP) of the Chinese Academy of Sciences and the Pacific Northwest National Laboratory of the United States (PNNL) and their collaborators conducted a study to further understand the underlying chemical mechanisms driving winter haze events and how the recent stringent control measures affect SSR.

Observational analysis unexpectedly showed a much weaker decrease in particle matters, known as PM, during winter compared with other seasons. "State-of-the-art model simulations suggest that the weakened wintertime PM decline is mainly attributed to the increase in wintertime atmospheric oxidation capacity and the enhanced conversion of nitric acid to nitrate by ammonia, which are induced by anthropogenic emission reductions," said Dr. Bin Zhao from PNNL, one of the corresponding authors of the studies published in *Geophysical Research Letters*.

"We find a dramatic increasing trend in SSR during 2014-2019 over the eastern and central China, which is among the world's fastest brightening in the last few decades," said Dr. SHI Hongrong from IAP. "Further, we use a novel method to elucidate the relative contributions of the aerosol and cloud radiative effects to the SSR trends."

The results showed that the strongly declining aerosol radiative effect

due to the strict control policies played a dominant role in producing the upward SSR trends.

According to their studies, previous pollution control policies did not effectively mitigate severe wintertime PM pollution due to these unfavored chemical processes. Stricter control policies targeting oxidants and wintertime emission sources are imperative to counteract the buffering chemical mechanisms over China.

"Our findings indicate that the air pollution control actions can lead to not only considerable environmental and health improvements, but also increases in solar photovoltaic energy production," said Dr. SHI. "This is potentially an important co-benefit of air pollution controls in China which deserves more attention in future decision making."

More information: Hongrong Shi et al. Surface brightening in eastern and central China since the implementation of the Clean Air Action in 2013: causes and implications, *Geophysical Research Letters* (2020). DOI: 10.1029/2020GL091105

Danny M. Leung et al. Wintertime Particulate Matter Decrease Buffered by Unfavorable Chemical Processes Despite Emissions Reductions in China, *Geophysical Research Letters* (2020). DOI: 10.1029/2020GL087721

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