

Study reveals mechanisms that promote icing responsible for power disruptions

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Wire icing occurred from the 20th-25th January 2016. Credit: Shengjie Niu

Chinese scientists have shed light on the meteorological conditions

responsible for the rate of icing growth on electric power transmission lines. Having a clearer understanding of what promotes icing on transmission lines during cold surges can help researchers better forecast and mitigate against crippling power outages caused by these events.

Their findings were published on Nov 18, 2018 in *Advances in Atmospheric Sciences*. The journal is sponsored by the Institute of Atmospheric Physics of the Chinese Academy of Sciences and published by Springer.

"Wire icing can significantly impair the normal functioning of electric power transmission lines, negatively impacting productivity and everyday life," says Shengjie Niu, professor at the School of Atmospheric Physics, Nanjing University of Information Science & Technology, and corresponding author of the paper.

The impact of [power outages](#) resulting from transmission wire icing can disrupt business activity and have other negative spinoffs. For example, "from January to February in 2008, four large-scale freezing rain and snow weather events in southern China caused huge economic losses, causing widespread concern in the research community," explains Professor Niu.

Power disruptions and the resulting economic losses associated with icing have captured the attention of researchers around the world, and many scientists are now working on this issue, said Niu, noting that a clearer understanding of the mechanism responsible for icing accumulation can significantly help us improve forecasting that will in turn enable us to provide an early warning of freezing disasters.

For this study, the researchers monitored the icing process of agglomerate fog, an event where massive amounts of fog come together, at the Lushan Meteorological Bureau Observatory, in Southeast China

during a cold surge that occurred from the 20th-25th January 2016, which lasted for 102 hours. Situated between Poyang Lake and the Yangtze River, Lushan has abundant moisture resources which contribute to the formation of ice during cold surges.

The duration, frequency and droplet spectrum distribution of agglomerate fog were analyzed, together with the effect that rain, snow and supercooled fog—essentially a supercooled cloud containing water droplets in liquid form at temperatures below zero degrees celsius that forms just above the Earth's surface—had on the rate of icing [growth](#) on wires laid out at two different heights: 10 meters (on an observation tower) and 1.5 meters (on an observation icing frame located underneath the tower).

They found that during this timeframe 218 agglomerate fogs, which lasted on average around 10 minutes, as well as snow and rain, contributed to the icing process. Ice accumulated on the wires rapidly during the freezing rain phase, but the rate of icing growth was much lower during the dry snow phase. However, certain meteorological conditions—the presence of supercooled fog, lower temperatures and increased [wind speed](#)—helped fuel the rate of icing growth during the dry snow phase.

The researchers observed significant differences in the thickness and density of the accumulated ice, as well as the mechanism that contributed to icing growth and the duration of the icing at the two different heights.

"The differences in temperature and wind speed were the main reasons for the differences in thickness, duration, density, and growth mechanism of icing at the two heights," said Niu, "which indicated that the icing thickness, duration, density, and growth mechanism were all closely related to height."

In order to make observation results closer to that of icing observed on actual high-voltage transmission lines, the authors suggest that the height of icing observation frames should be raised, and that more comparative observation studies of the relationship between different heights and icing growth should be conducted.

"Further observational results show that the sticking efficiency of snow particles has a significant impact on icing growth rate, which will be considered in the next wire-icing numerical simulation," said Professor Niu, who also hopes to establish methods to forecast wire [icing](#) in the future.

More information: Tianshu Wang et al, Observational Study on the Supercooled Fog Droplet Spectrum Distribution and Icing Accumulation Mechanism in Lushan, Southeast China, *Advances in Atmospheric Sciences* (2018). [DOI: 10.1007/s00376-018-8017-6](https://doi.org/10.1007/s00376-018-8017-6)

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