Pollen affects cloud formation and precipitation patterns, researchers find

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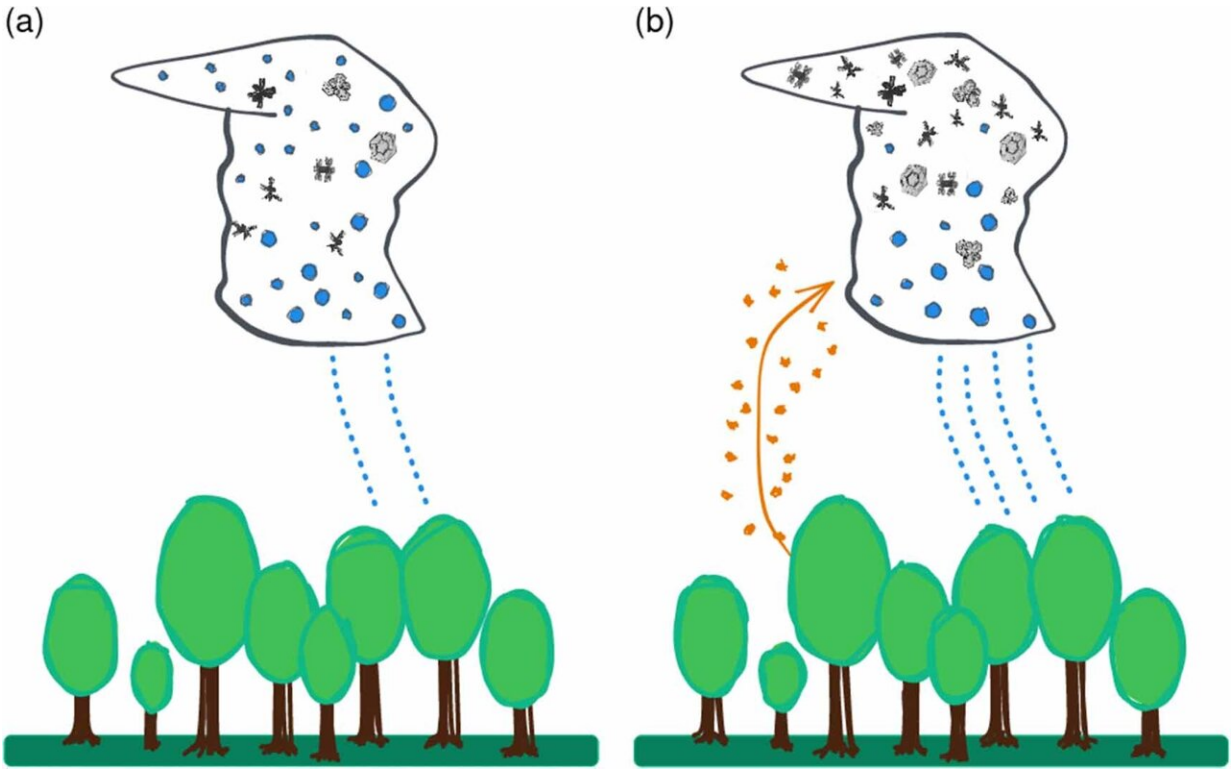

Schematic depiction of the proposed glaciating effect of pollen on mixed-phase clouds. During pollen season (b), cloud ice fraction is increased compared to situations with low pollen concentration (a), consequently leading to an increase in rain frequency. Credit: *Environmental Research Letters*, (2024). DOI: 10.1088/1748-9326/ad747a

Ground-based and satellite observations in the United States show that

increased pollen concentrations in spring lead to more cloud ice and more precipitation—even at temperatures between minus 15 and minus 25 degrees Celsius.

"This is supported by laboratory results showing that pollen acts as an ice nucleus, influencing the freezing temperature of water in clouds and promoting precipitation," says meteorologist Dr. Jan Kretzschmar, lead author of the study. Without these ice-nucleating particles (INPs), water in clouds only freezes at temperatures below minus 38 degrees Celsius. The findings were published in *Environmental Research Letters*.

"In the Breathing Nature Cluster of Excellence project, we therefore asked whether this effect could be detected outside the laboratory, and how climate change and biodiversity loss affect it," says co-author Professor Johannes Quaas, Professor of Theoretical Meteorology at Leipzig and spokesperson of the Breathing Nature consortium.

On a global scale, the effect of pollen on ice formation is relatively small compared to, for example, dust, but it is significant on a regional and seasonal scale. Particularly in spring, large amounts of pollen are released, rising into the atmosphere and entering cold air layers.

Kretzschmar explains, "Because of its size, pollen stays in the atmosphere for only a short time. Our study highlights the importance of smaller pollen fragments, which are produced when pollen ruptures under humid conditions. These smaller particles remain in the air longer and, in sufficient quantities, can enter cold atmospheric layers, where they trigger ice formation."

Climate change intensifies pollen impact—biodiversity a key factor

Anthropogenic climate change is shifting the start of the pollen season, lengthening it and increasing pollen concentrations in the air. These trends are expected to intensify by the end of the century, which could lead to more frequent and intense local precipitation.

A further aspect of the study is the importance of biodiversity. Many plant species release large amounts of pollen at the same time each spring, which affects cloud formation and the amount of ice particles in the atmosphere. These interactions require further research to better understand the role of pollen in climate evolution and to incorporate this into future climate models.

"If we can correctly simulate the effect of pollen and how it interacts with the climate, we will be able to make more accurate predictions," says Kretzschmar.

The Institute for Meteorology at Leipzig University, the Leibniz Institute for Tropospheric Research (TROPOS), the German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig and the Max Planck Institute for Biogeochemistry were involved in the study.

More information: Jan Kretzschmar et al, From trees to rain: enhancement of cloud glaciation and precipitation by pollen, *Environmental Research Letters* (2024). DOI: 10.1088/1748-9326/ad747a

Provided by Leipzig University