

Cold skies: Researchers increase our understanding of how ice clouds form

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Ice clouds play an important role in the energy balance at the top of the atmosphere and in the surface energy balance of the arctic. Scientists, including PNNL's Dr. Xiaohong Liu and Dr. Steve Ghan, created a computational module that aids researchers in better understanding how ice crystals form in these clouds.

(PhysOrg.com) -- A team of atmospheric researchers designed a new computational module that helps scientists better understand how ice crystals form in the atmosphere. The team, including Dr. Xiaohong Liu and Dr. Steve Ghan of Pacific Northwest National Laboratory, showed that ice crystal formation depends on both aerosols and humidity.

They also showed that [ice](#) crystal growth reduces the humidity of the air. The new module will enable scientists to use the Community Atmosphere Model (CAM5) to study global climate and climate change.

Ice clouds play a significant role in the energy balance at the top of the atmosphere and in the energy balance of the arctic. Historically, climate models crudely represented ice clouds because the understanding of ice formation in clouds is limited. This new module in CAM5 more accurately reproduces observed patterns and frequency of ice

supersaturation and ice water content, providing more confidence in our understanding of how human-made and natural particles in the air impact ice clouds.

This approach allows supersaturation with respect to ice, represents homogeneous and heterogeneous ice nucleation by sulfate and dust [aerosol particles](#), and treats ice cloud cover consistent with ice microphysics. It was evaluated against a suite of in-situ and [satellite observations](#) using climatological simulations and hindcasting techniques. It represents an important advancement in ice microphysics in [climate models](#)

What's next: The research builds on an ice nucleation code, also developed by PNNL's Liu, as well as a new description of water [vapor deposition](#) to ice crystals in mixed-phase [clouds](#) where cloud liquid and ice coexist. This represents one of many new features introduced as part of CAM5.

Further studies of the performance of CAM5 for emissions scenarios will be used to explore the sensitivity of its simulated climate to emissions, and the role ice nucleation plays in the climate response. In addition, improvements in the treatment of aerosol affects on ice crystal nucleation will be applied to this model and evaluated using the same methods described in the study.

More information: Gettelman, A., X. Liu, S. J. Ghan, H. Morrison, S. Park, A. Conley, S. A. Klein, J. Boyle, D. Mitchell, and J.-L. F. Li, 2010. "Global simulations of ice nucleation and ice supersaturation with an improved cloud scheme in the community atmosphere model." *J. Geophys. Res.*, 115(D18216), [doi:10.1029/2009JD013797](https://doi.org/10.1029/2009JD013797)

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