

The Influence of Parameterized Ice Habit on Simulated Mixed-Phase Arctic Clouds

Research Highlight

The Arctic climate is changing with sea-ice melting at rates that are greater than those predicted by most climate models. At the same time, some recent analyses show that sea-ice melting rates are correlated with cloud cover over the Arctic. However, predicting cloud types and amounts in the Arctic regions has posed a challenging problem.

The problem of cloud prediction is challenging because many Arctic clouds are mixed-phase meaning that they are composed of a combination of liquid drops and ice crystals. Ice crystals grow to large sizes causing the relatively small liquid drops to evaporate. The consequences of this process are that mixed-phase clouds can dissipate easily by ice precipitation. Since the Arctic sea-ice is apparently sensitive to cloud amount, capturing the life-cycle of mixed-phase clouds in numerical models is potentially critical for correctly simulating the energy balance in the Arctic. However, simulating the mixed-phase cloud life-cycle is complicated by the fact that the liquid-ice balance in the clouds depends critically on the number of ice crystals and the ice crystal type. Prior studies of ours and others show that mixed-phase clouds depend strongly on the number, and type, of ice-forming aerosols that exist in mixed-phase clouds. Our present study shows that the life-cycle of mixed-phase clouds also depends critically on the way ice crystals grow. Numerical models must use simplified methods for calculating the growth of ice crystals. Our work shows that these simplified methods cause a significant amount of uncertainty in predicting mixed-phase cloud life-cycles. In particular, our work shows that the cloud mass, cloud amount, and the number of cloud layers predicted by a numerical model depend in critical ways on the methods used to calculate the growth of ice crystals.

Our results indicate that improving ice crystal growth calculations in numerical models is as significant as correctly calculating the dependence of ice formation on ambient aerosols.

Reference(s)

Avramov A and JY Harrington. 2010. "Influence of parameterized ice habit on simulated mixed phase Arctic clouds." *Journal of Geophysical Research – Atmospheres*, 115, D03205, doi:10.1029/2009JD012108.

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Cloud Modeling