



## **The persistent precipitation of ice crystals from supercooled layer clouds**

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This study is the supercooled layer cloud conundrum: how it is possible for ice crystals to continually nucleate and precipitate for a prolonged period of time, when the ice nuclei should run out. A recent study by Westbrook and Illingworth (2013) answered this quantitatively through the use of in situ and radar observations. Their results led them to propose that single-layer mixed-phase clouds persist due to slow stochastic nucleation.

There are contrasting theories, however, with alternative explanations including ice multiplication processes, for example, droplet shattering (Leisner et al., 2014). Field et al. (2017) detail the importance of secondary ice production mechanisms when concerned with an excessive amount of ice crystals. Ice nuclei recycling (Solomon et al., 2015) has also been suggested as a potential cause of layer clouds persisting. Additional research, therefore, is needed in order to clarify which mechanisms play a role and moreover, which has the most significance under typical conditions.

The project to be carried out here aims to test the idea of a slow nucleation process using a bulk microphysics model. It is hoped that this will allow for further understanding of the dynamics involved and the characteristics of such long-lived layer clouds. Work such as this is important if the representation of mixed-phase clouds in models is to be improved.

### References

- Field, P.R. et al. (2017). Secondary Ice Production: Current State of the Science and Recommendations for the Future. *Meteorological Monographs*, 58, 7.1-7.20.
- Leisner, T. et al. (2014). Secondary ice processes upon heterogeneous freezing of cloud droplets. 14th Conf. on Cloud Physics and Atmospheric Radiation, Boston, MA, Amer. Meteor. Soc., 2.3.
- Solomon, A. et al. (2015). The role of ice nuclei recycling in the maintenance of cloud ice in Arctic mixed-phase stratocumulus. *Atmos. Chem. & Phys.*, 15, 10631-10643.
- Westbrook, C.D. and Illingworth, A.J. (2013). The formation of ice in a long-lived supercooled layer cloud. *Q. J. R. Meteor. Soc.*, 139, 2209-2221.