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## Asymptotic states of ice clouds

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Ice clouds in the cold temperature regime ( $T < 235\text{K}$ ) are important features of the upper troposphere; however, these clouds are still not well understood. For instance, the measured ice crystal number concentrations show strong differences in comparison with theoretical investigations. In theory, we often consider the ice crystal number concentrations for nucleation events in clear air and use these as a benchmark. However, it is not clear how often such undisturbed nucleation events really happen, or if it is more probable to assume pre-existing ice for nucleation events.

A simple ice model is consistently derived from a more complex model. It consists of a 3D system of ordinary differential equations with variables number and mass concentration and saturation ratio. The model is analyzed in terms of dynamical systems properties. The system contains two Hopf bifurcations depending on the parameters vertical velocity and temperature, respectively. The stable states and limit cycles, respectively, show much smaller ice crystal number concentrations than the peak values in undisturbed nucleation events. These results agree with in situ measurements inside ice clouds.