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Tropical ice clouds validation in Global Storm Resolving Models using active sensor retrievals

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Tropical ice clouds play an important role in the energy balance of the tropical atmosphere, yet their modeling has been a challenge and feedback from high clouds in climate models is very uncertain. The new generation of Global Storm Resolving Models (GSRM) is capable of resolving convective and mesoscale motions globally, and therefore promises to greatly advance our understanding of tropical clouds. This new generation of model also creates new opportunities for comparison with measurements since their horizontal resolution is comparable to that of active sensor measurements. Here we show the value of metrics evaluating cloud fraction, ice mixing ratio and longwave cloud radiative heating to validate tropical ice clouds simulated by Global Storm Resolving Models using A-Train ice cloud retrieval products. For this purpose, we use the X-SHiELD experimental Cloud Resolving Model, developed at NOAA/GFDL, and observations based on the 2C-ICE and DARDAR products, with the addition of the 2B-FLXHR-LIDAR radiative transfer algorithm for the validation of broadband fluxes. We show that, by aggregating model output and measurements in ice water path – pressure space, biases in the ice distribution can be revealed, whereby the position of the anvils is too low in the model. Such biases point to deficiencies in the microphysics of cloud ice, are likely shared by other models using similar microphysics packages, and have important consequences on thermal emission properties.