Ice Microphysics Across Scales:

With a Focus on Particle Aspect Ratio

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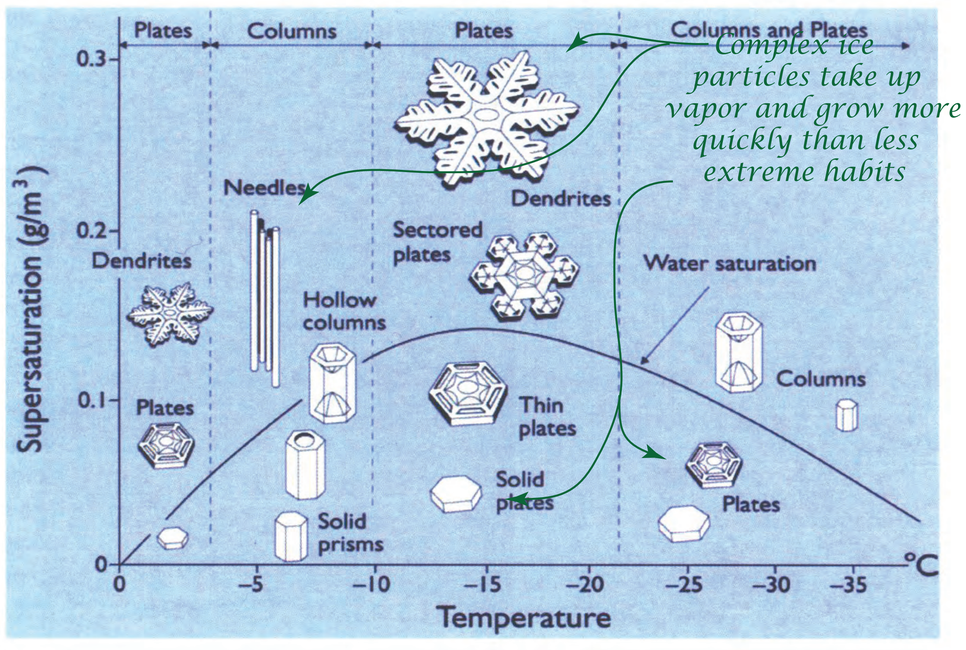
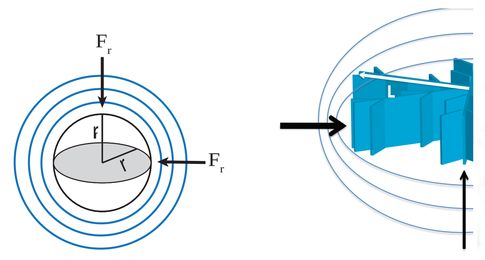
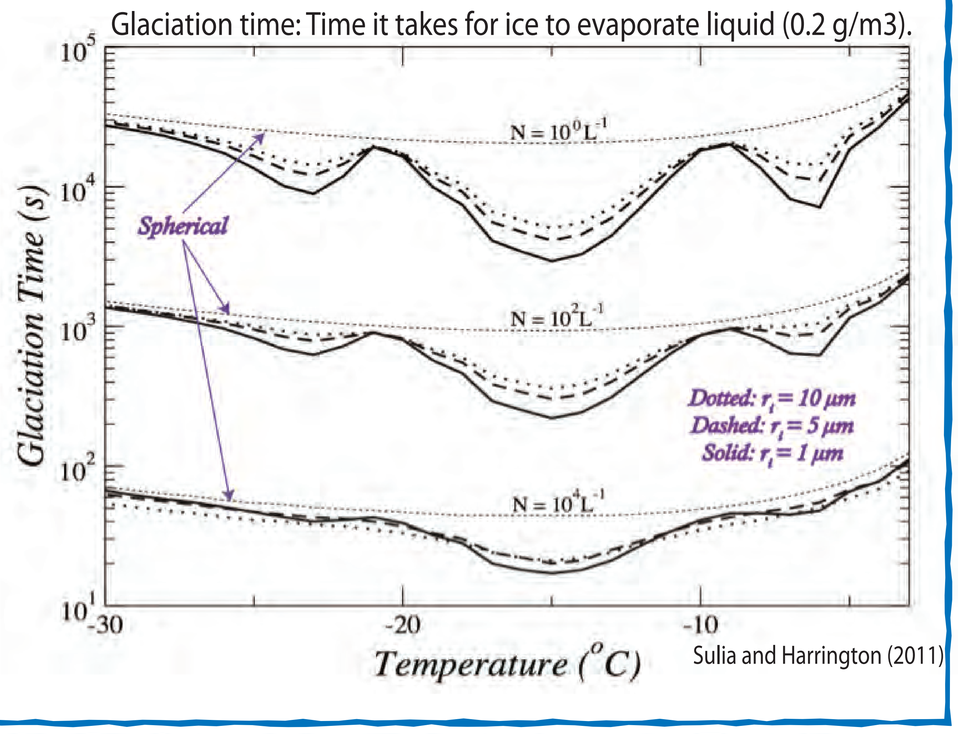
Ice Growth Matters: The Effect of a Single Particle

The complex growth of ice crystals can ***glaciate*** mixed-phase clouds, enahancing ice precipitation, & leading to cloud dissipation.





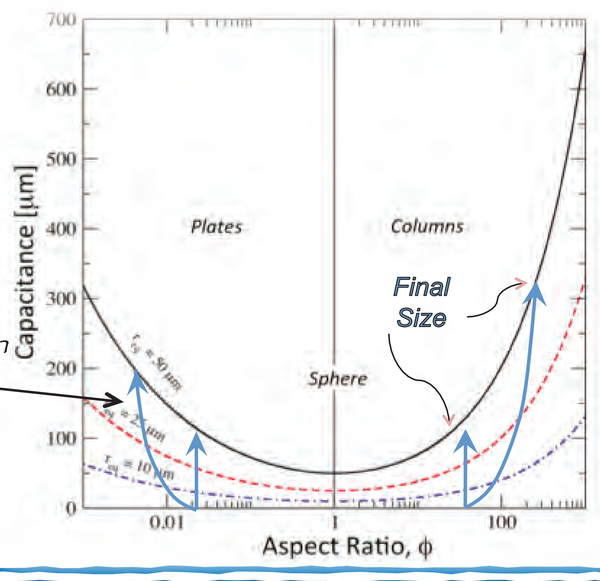
Using spheres *underestimates* vapor diffusion and liquid depletion



Sulia and Harrington (2011)

Adaptive Habit Growth on a Bulk Scale

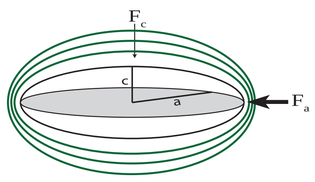
Growth is underpredicted if φ is held constant in time



To accurately model crystal growth, must provide the link between growth and aspect ratio evolution.

(Following Chen and Lamb, 1994)

$$\frac{dc}{da} = \Gamma \frac{c}{a} \qquad \Gamma \alpha \frac{Fc}{Fa}$$

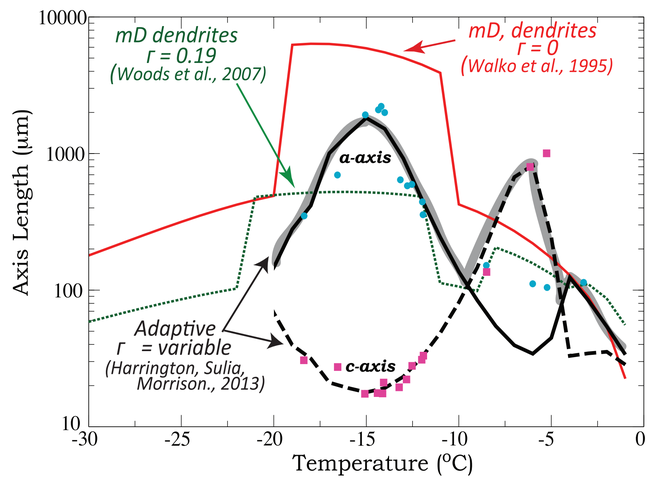


Bulk parameter δ is used to relate c and a in time.

$$c = a_o^{1-\delta} a^{\delta}$$

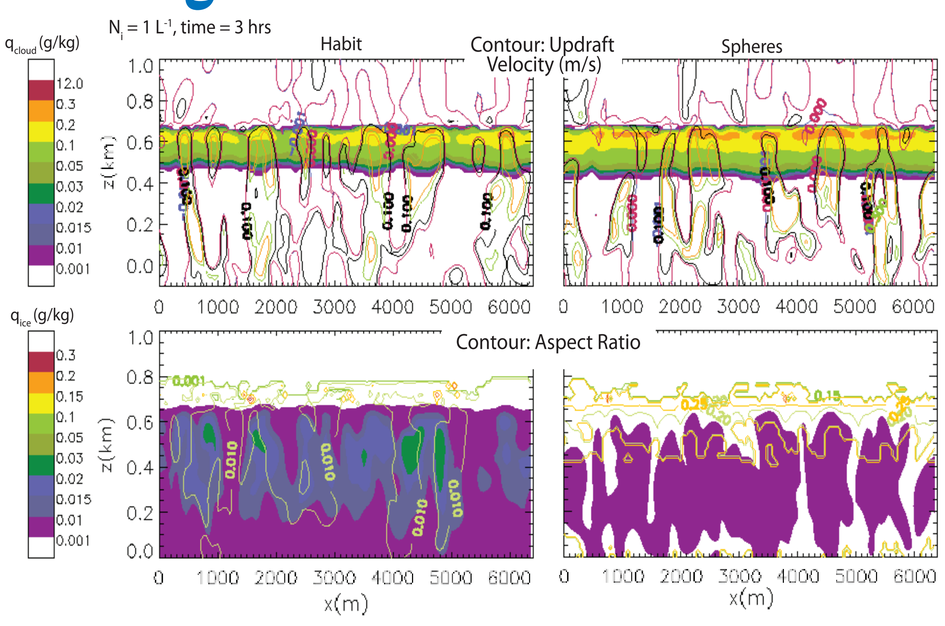
where

$$\delta = F(\Gamma(T,t))$$



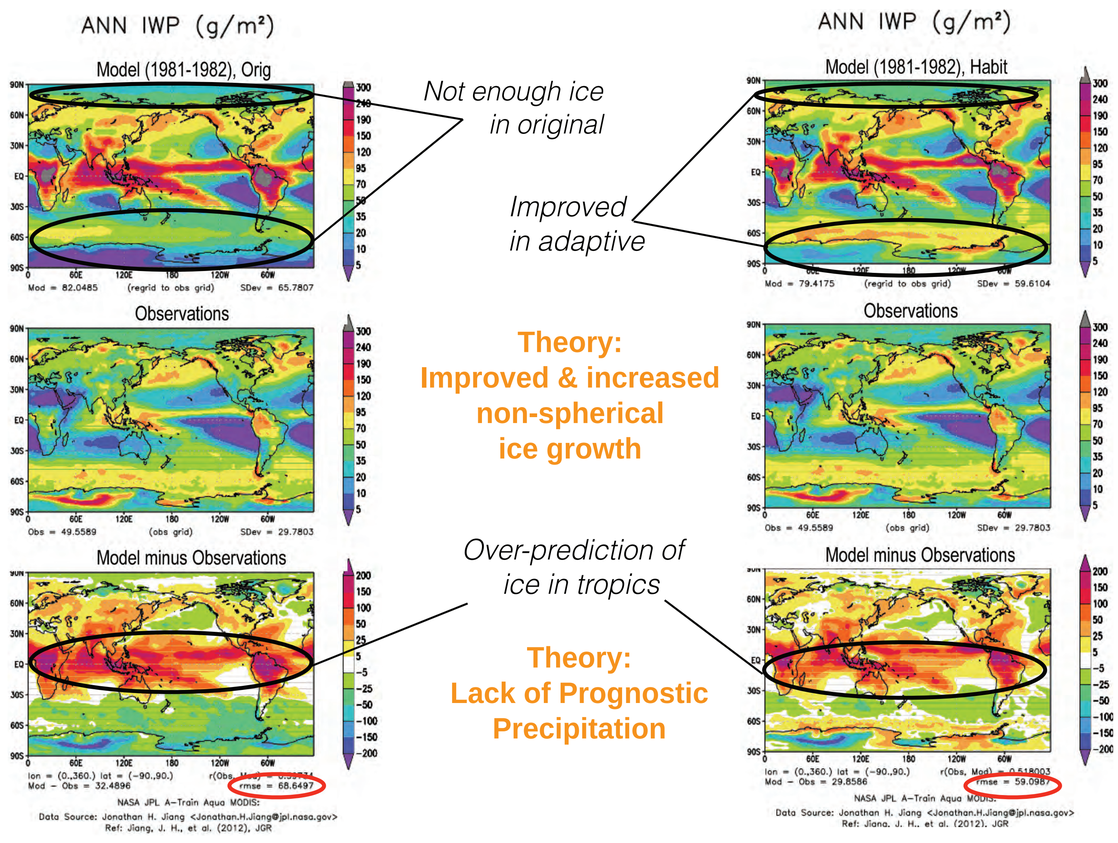
Tests of the new ice growth method with laboratory data show critical improvement over other methods.

Testing in an LES & a GCM



LES tests indicate cloud stability, liquid maintenance, and an increase in IWC for the Adaptive Habit method as compared to spherical results.

GFDL Atmospheric Model (AM3)



Theory: Improved & increased non-spherical ice growth

Theory: Lack of Prognostic Precipitation

Newly-implemented Adaptive Habit Model is a solid first-step in improving and understanding GCM microphysics.

Preliminary GCM testing with Adaptive Habit Model provides improvements over previous theories and indicates other microphysical areas that can benefit from further numerical accuracy.

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