CAM5/CARMA Comparisons to Global Hawk Observations: A Look at In Situ vs. Detrained Ice Model Parameterizations

C. Maloney, O.B. Toon, C. Bardeen, G. Diskin, M. McGill, A. Rollins, T. Thornberry, and S. Woods

Photo by Dave Fratello

Focus

- To evaluate CAM5/CARMA at 1x1 degree resolution with aircraft observations.

  - Improve cirrus cloud representation in the model

- Can we learn anything new about cirrus cloud microphysics with this comparison?

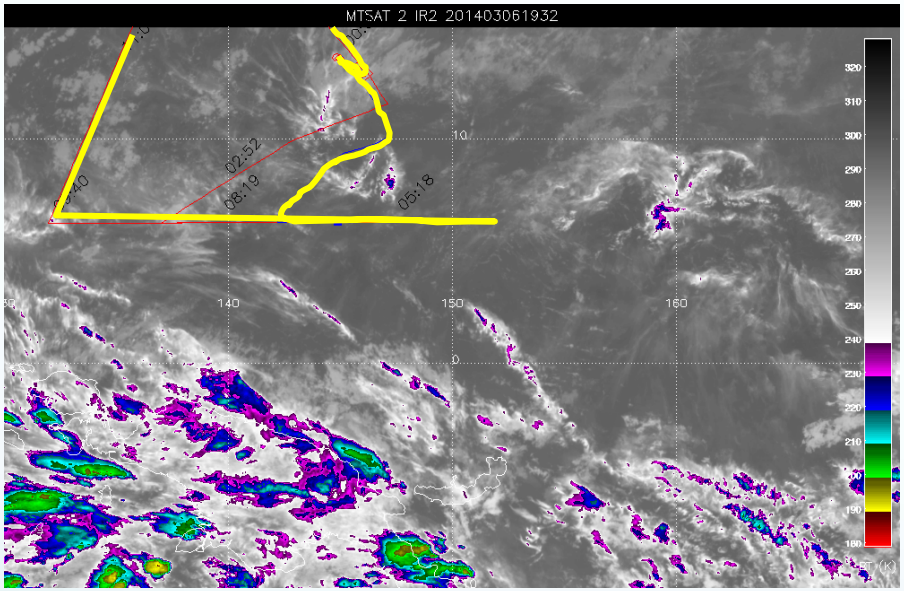
  - in situ clouds vs. detrained clouds?

We compare global model simulations to aircraft observations

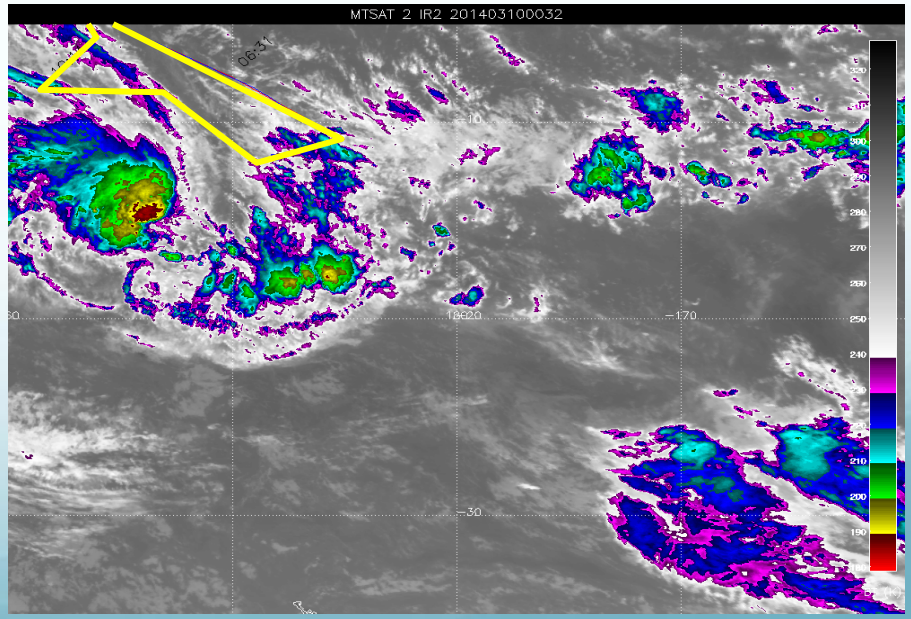
- Model was run at 1x1 degree resolution
- Interpolated grid boxes along the flight track
  - 4 closest horizontal grid boxes
  - Last and current time step
- Model nudged by GEOS5 re-analysis data
- CAM5/CARMA uses subgrid parameterizations

Two flights that might be very different

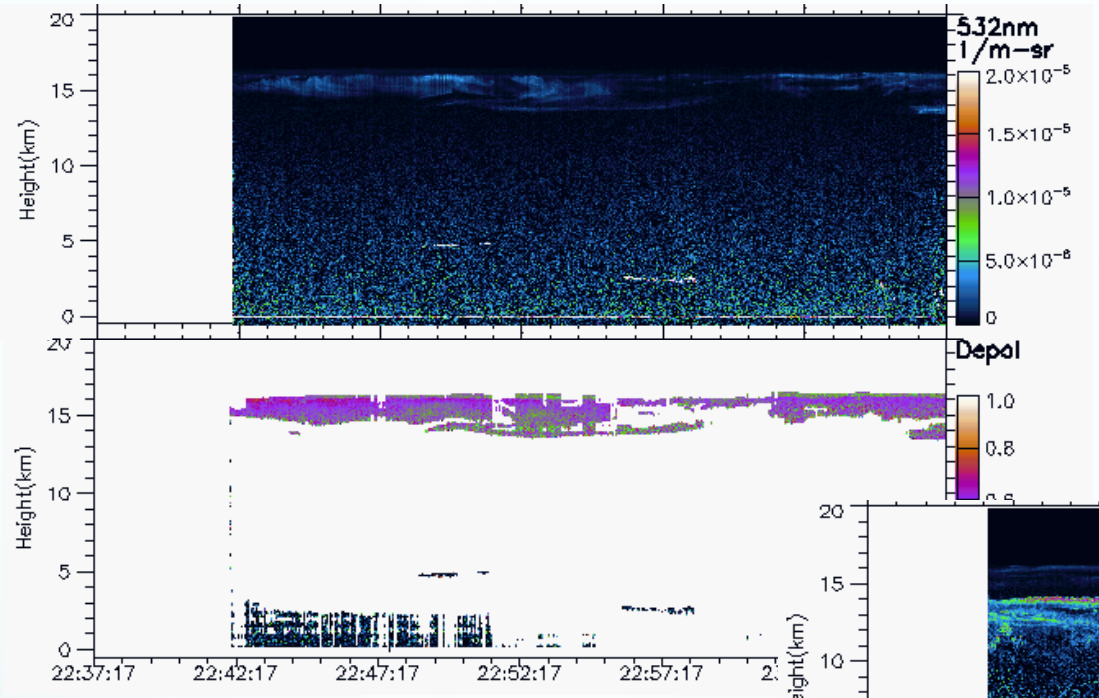
03/06/14



03/09/14



Do They Look Different?



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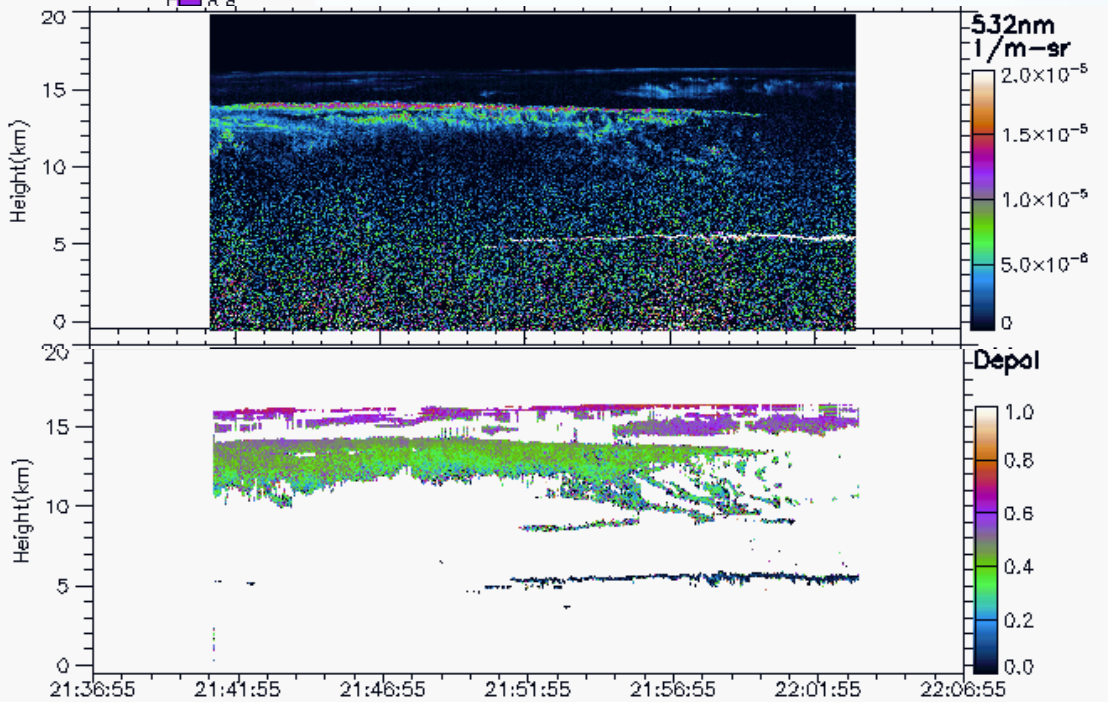

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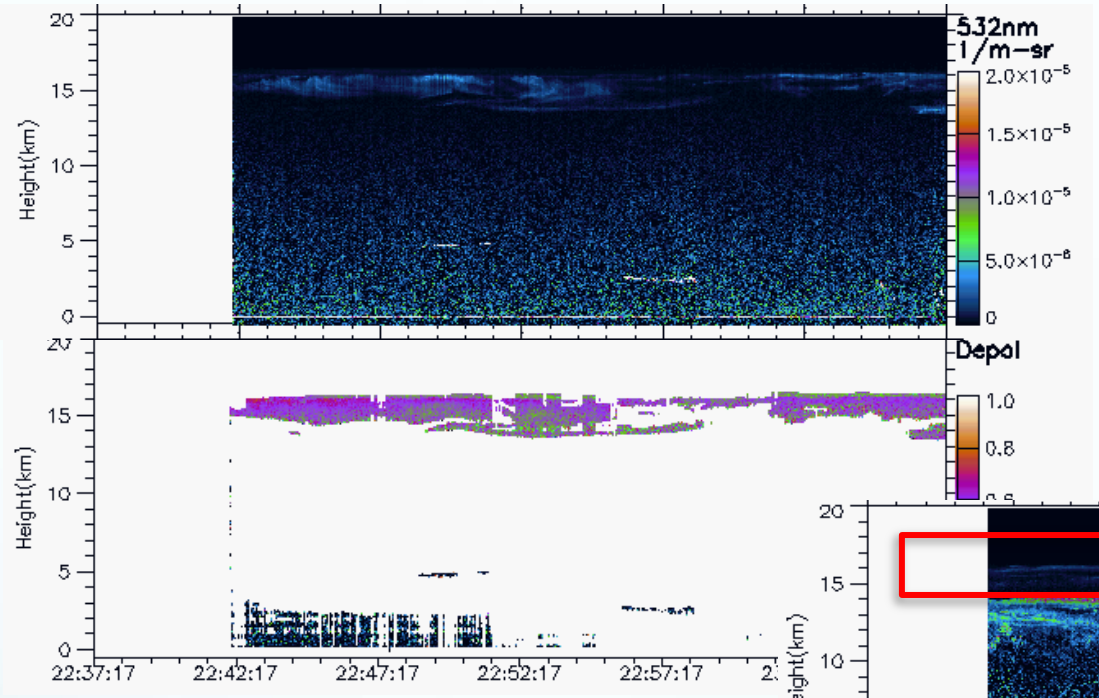

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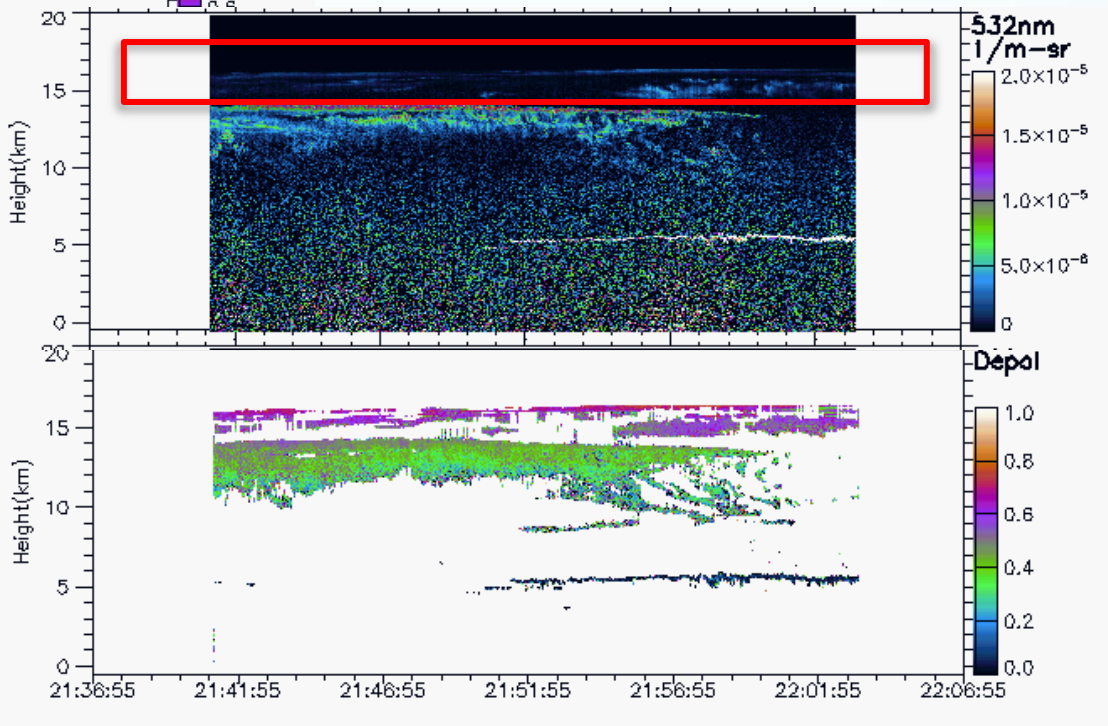
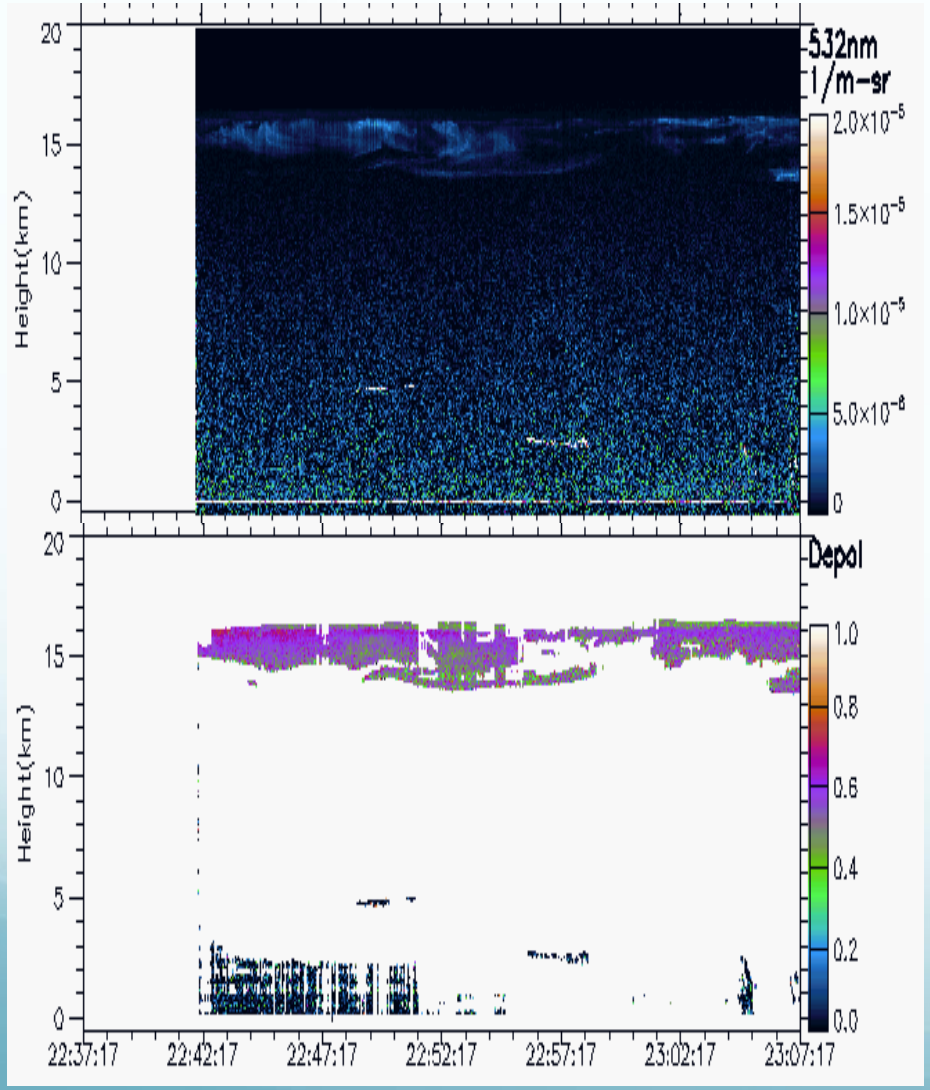
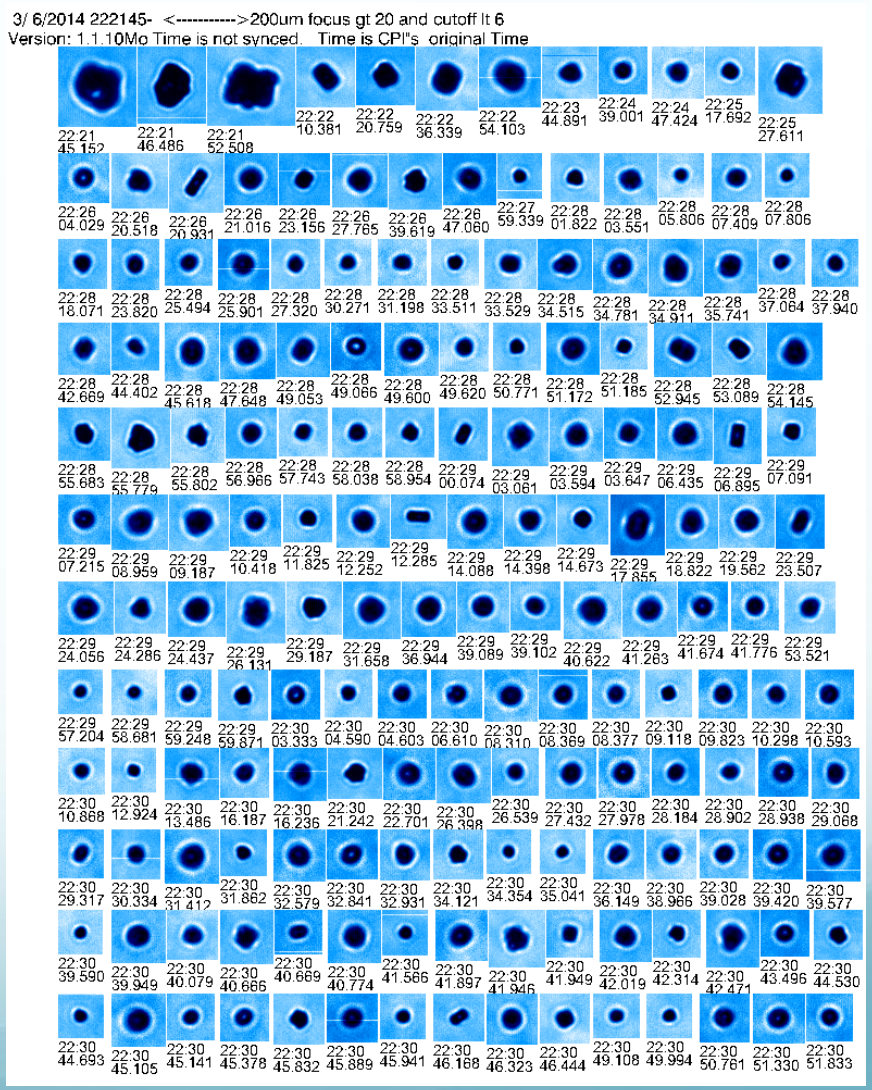


Thin clouds on 03/06/14 flight appear to be in situ

22:21 to 22:30 UTC from 13.7km to 15km





Two cloud layers seen in 03/09/14 flight

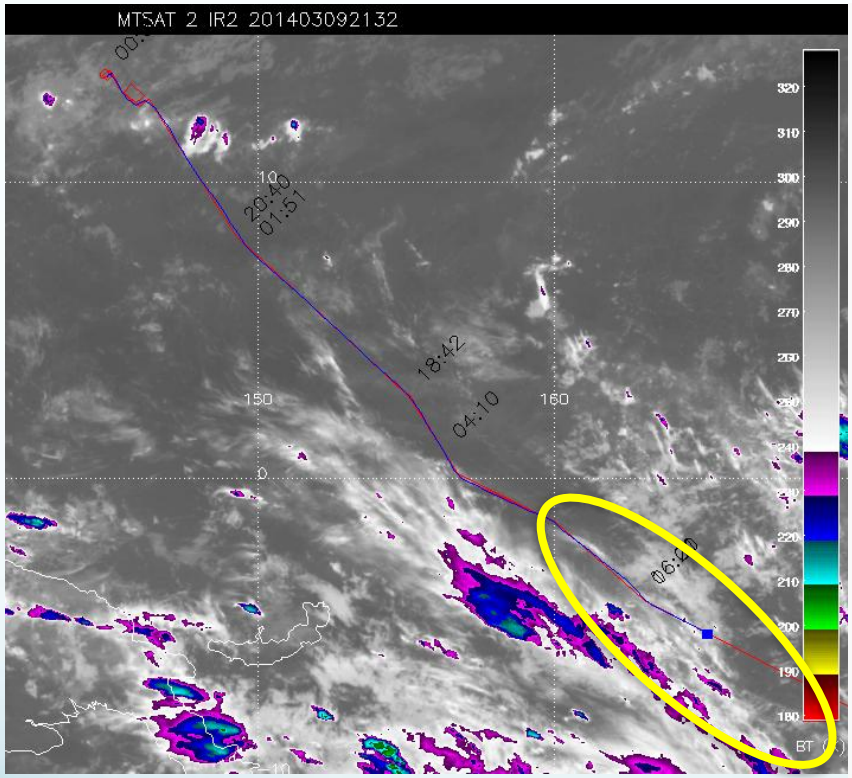
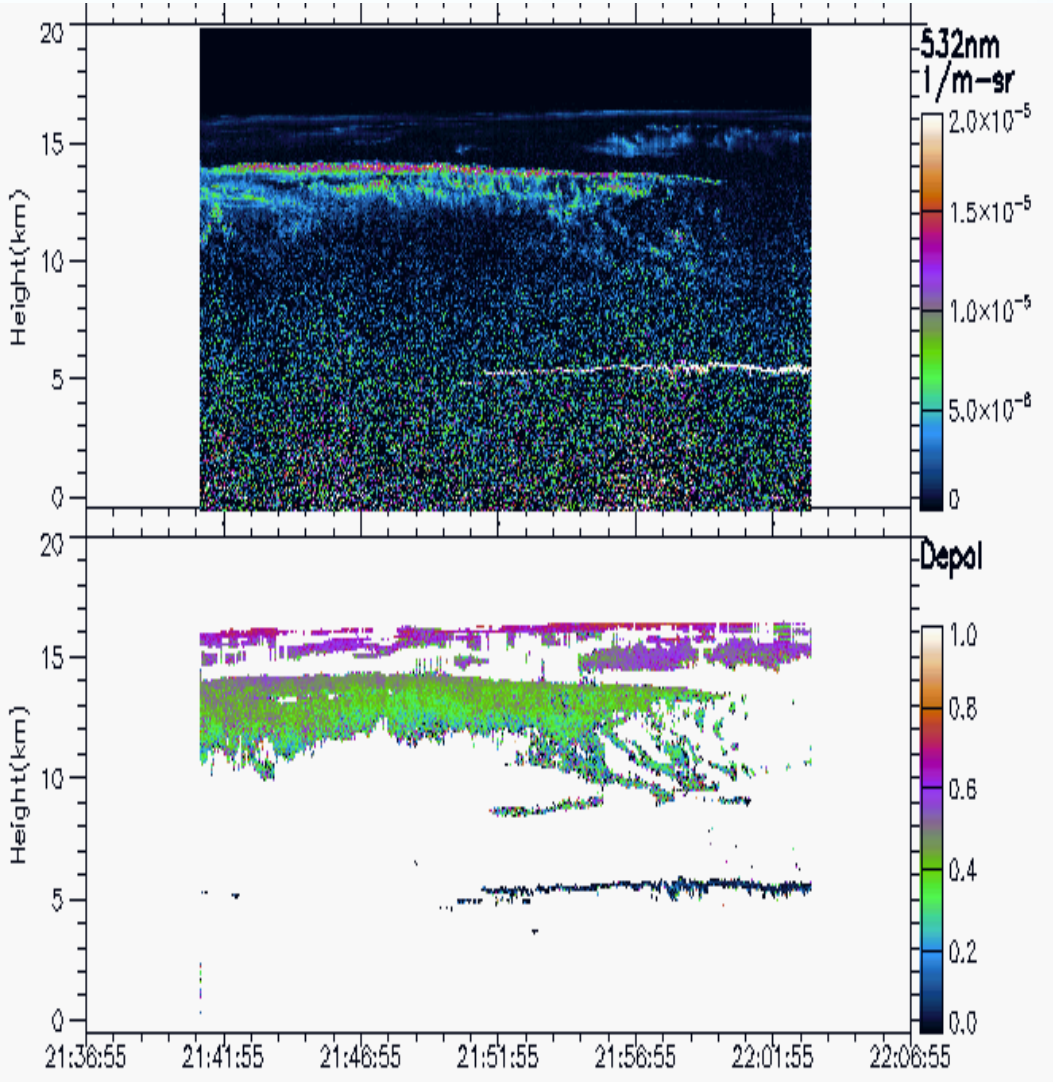
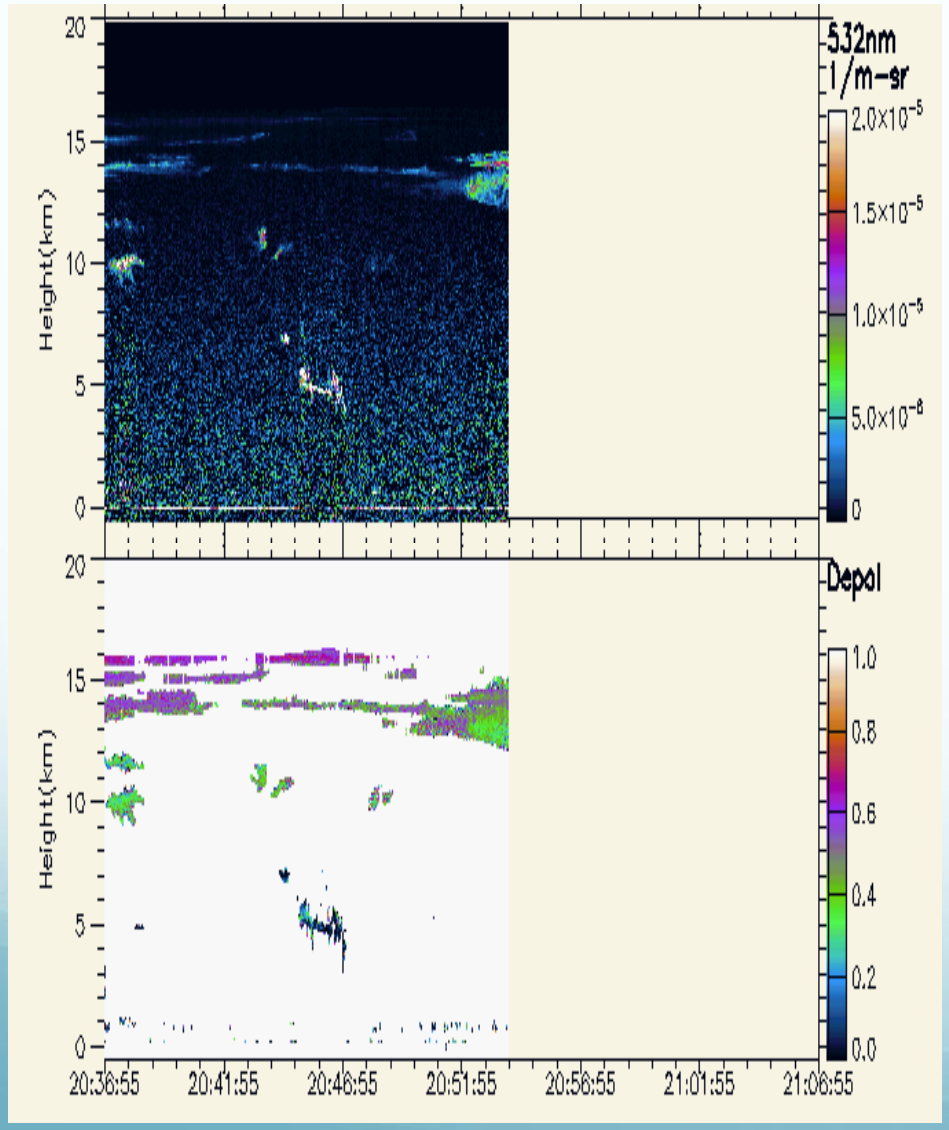


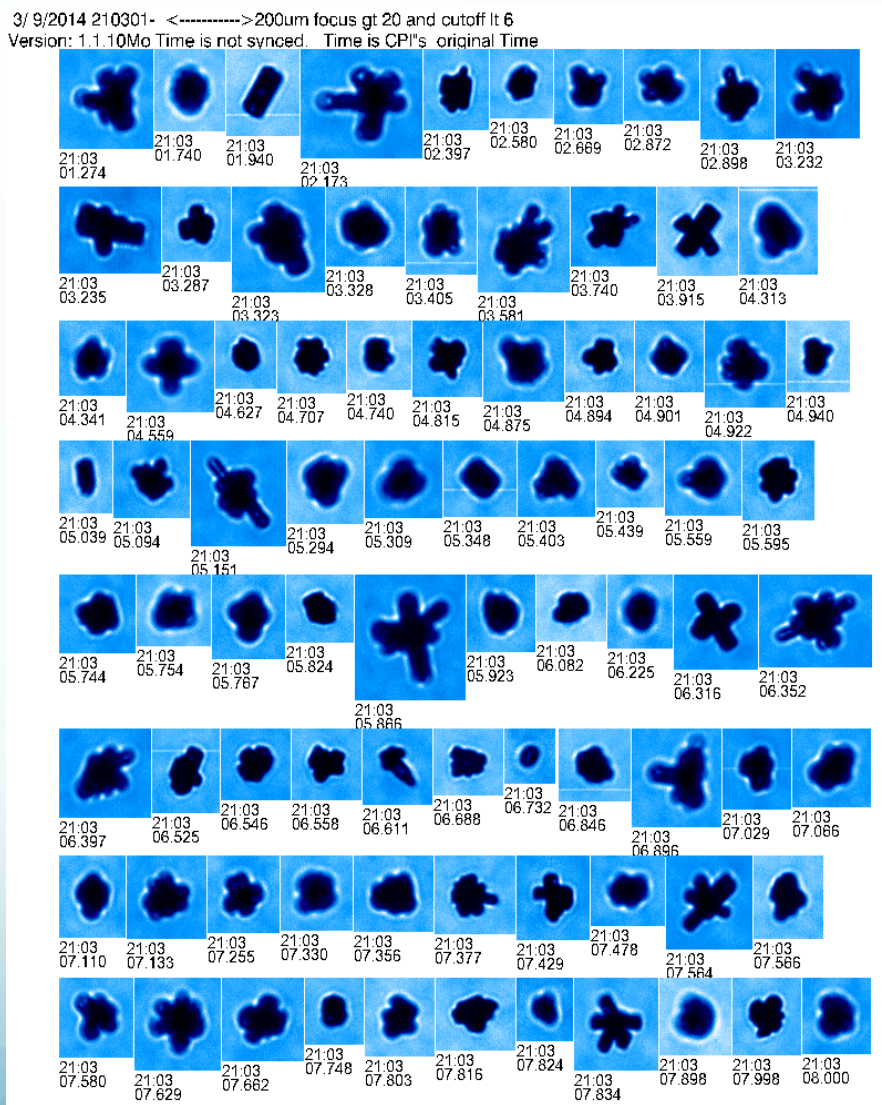
Image at 21:32 UTC



Low cirrus shows large bullet rosettes

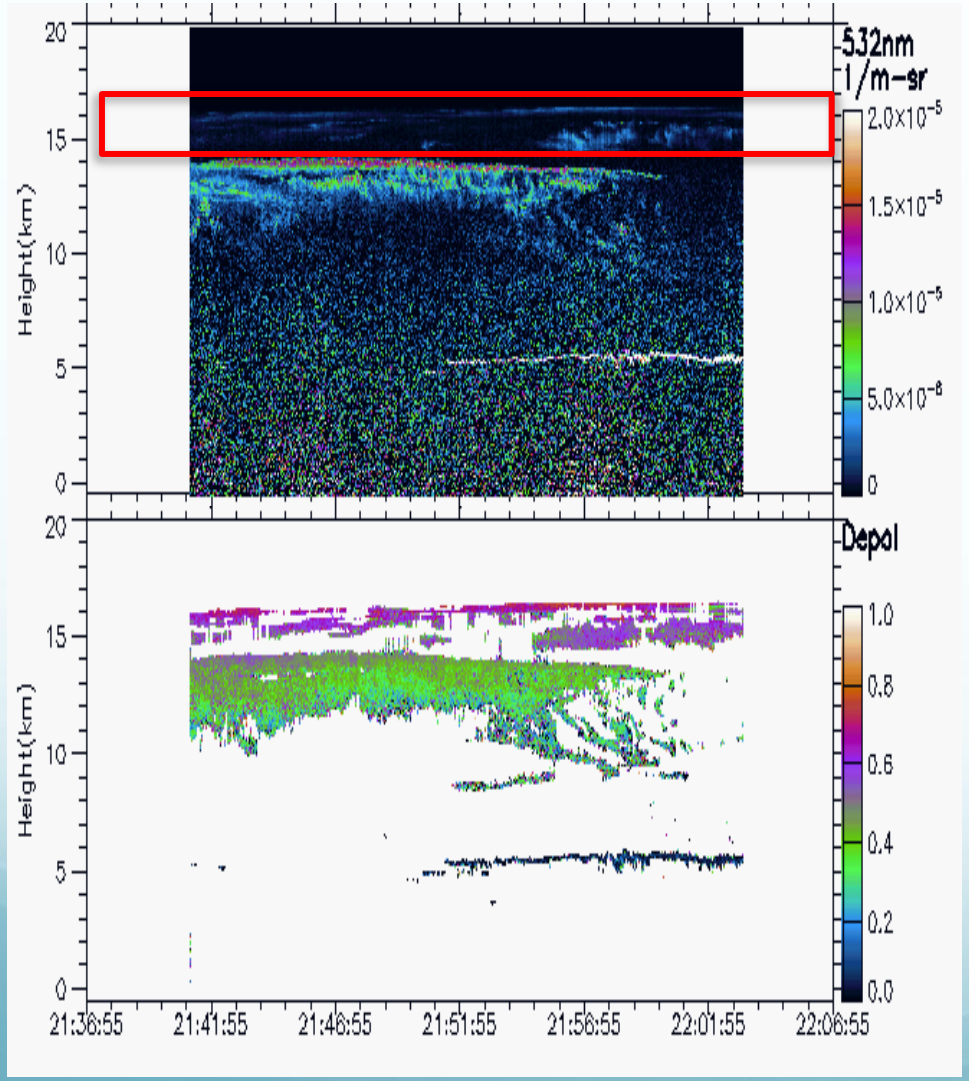
Images at 21:03 at 14.7 km

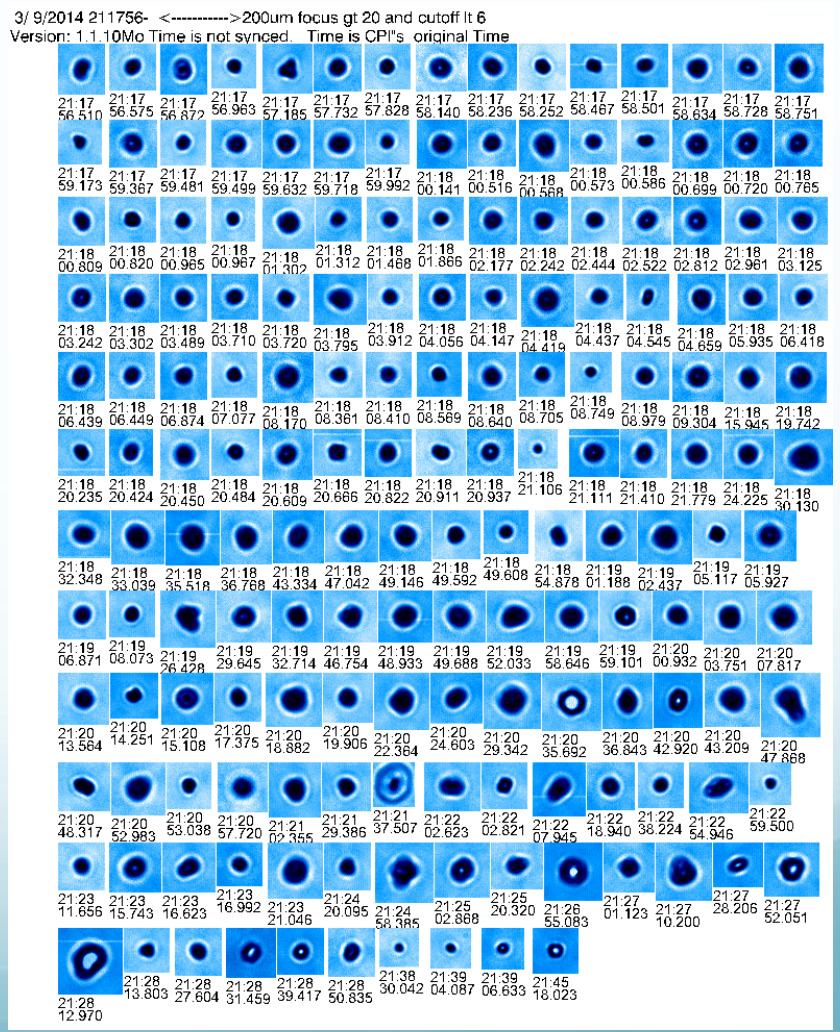




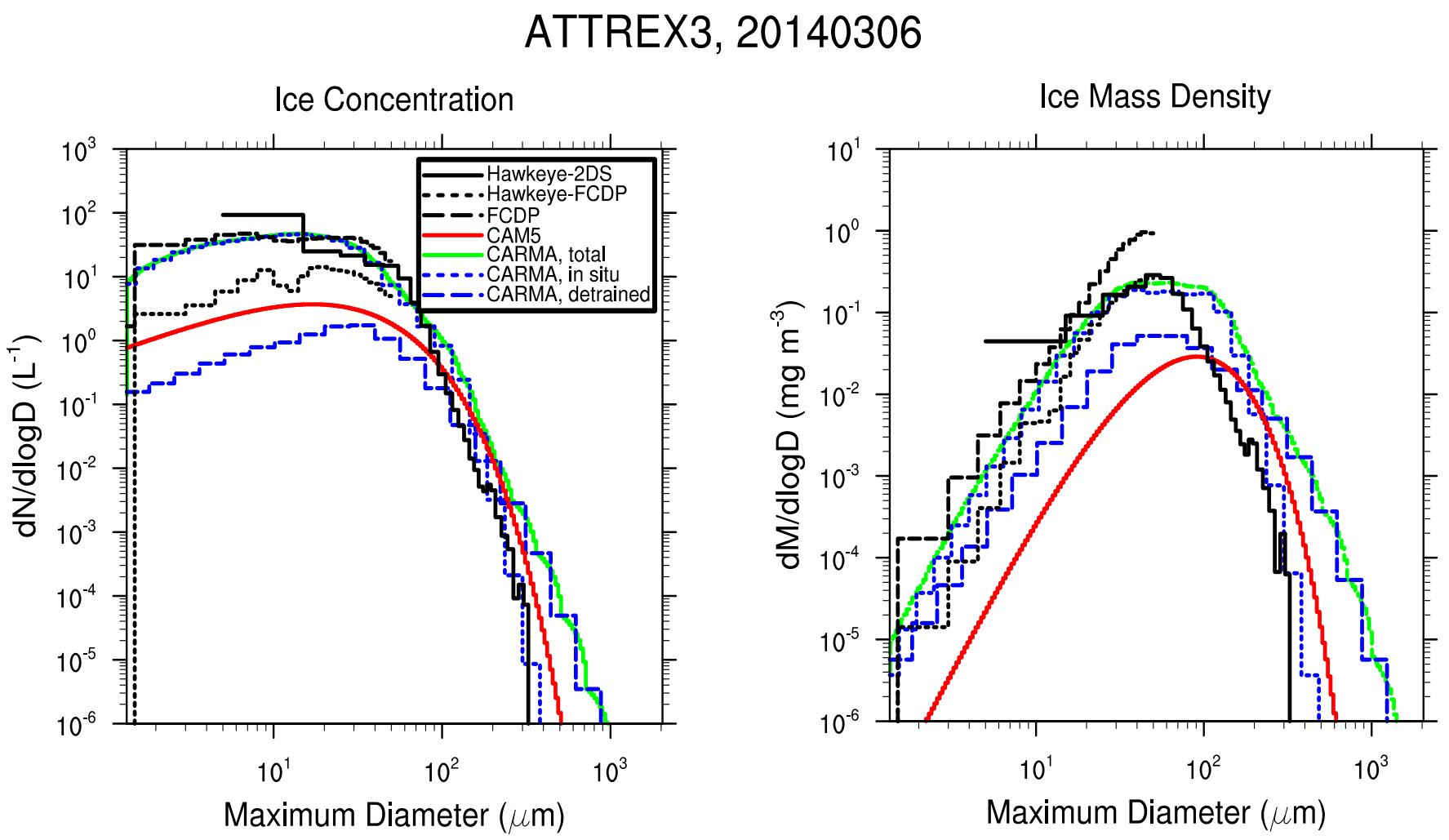
High cirrus layer shows small spheroids and plates

Images from 21:17 – 21:45 UTC at 13.7 km to 15.7 km





What does our model show?



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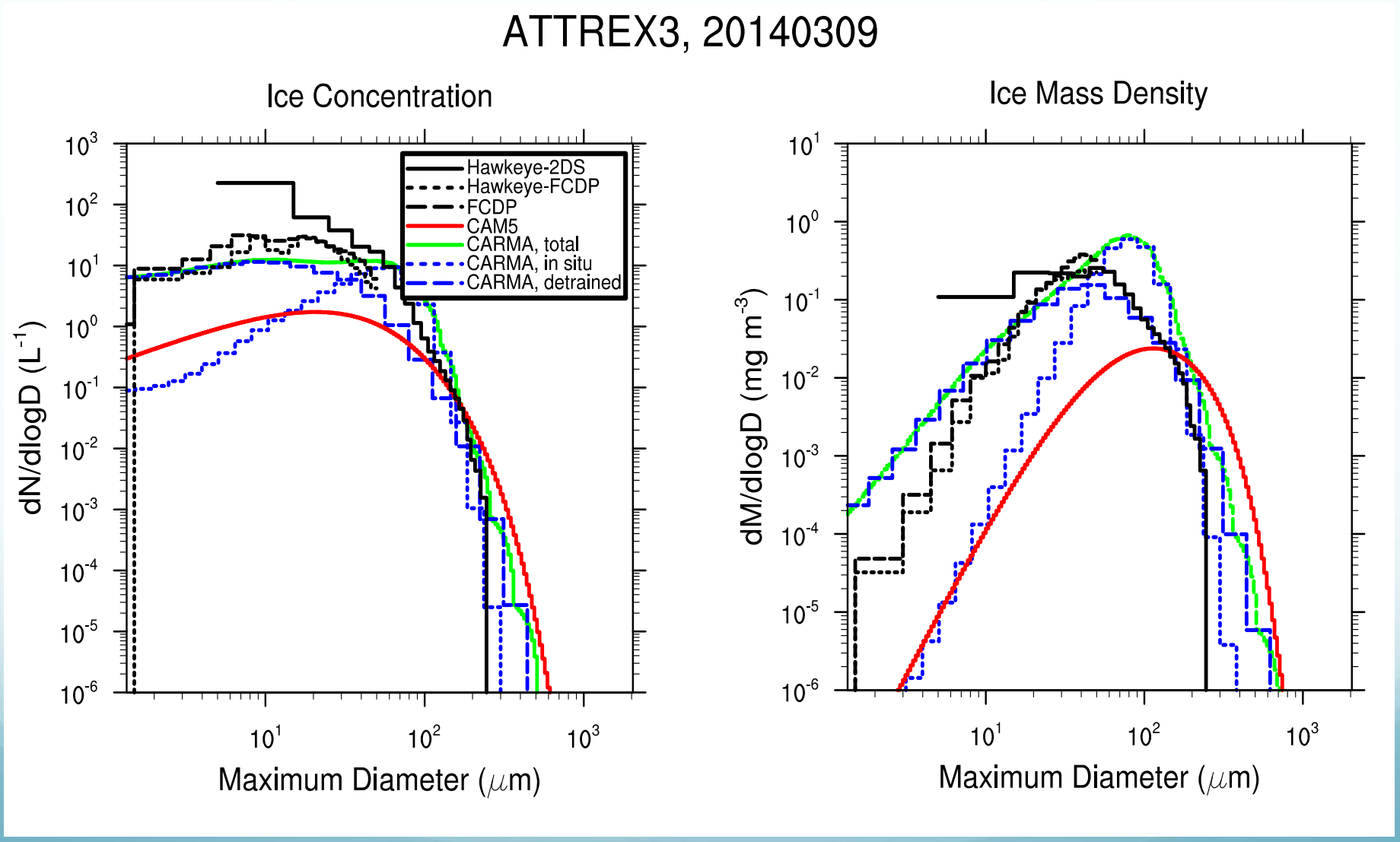
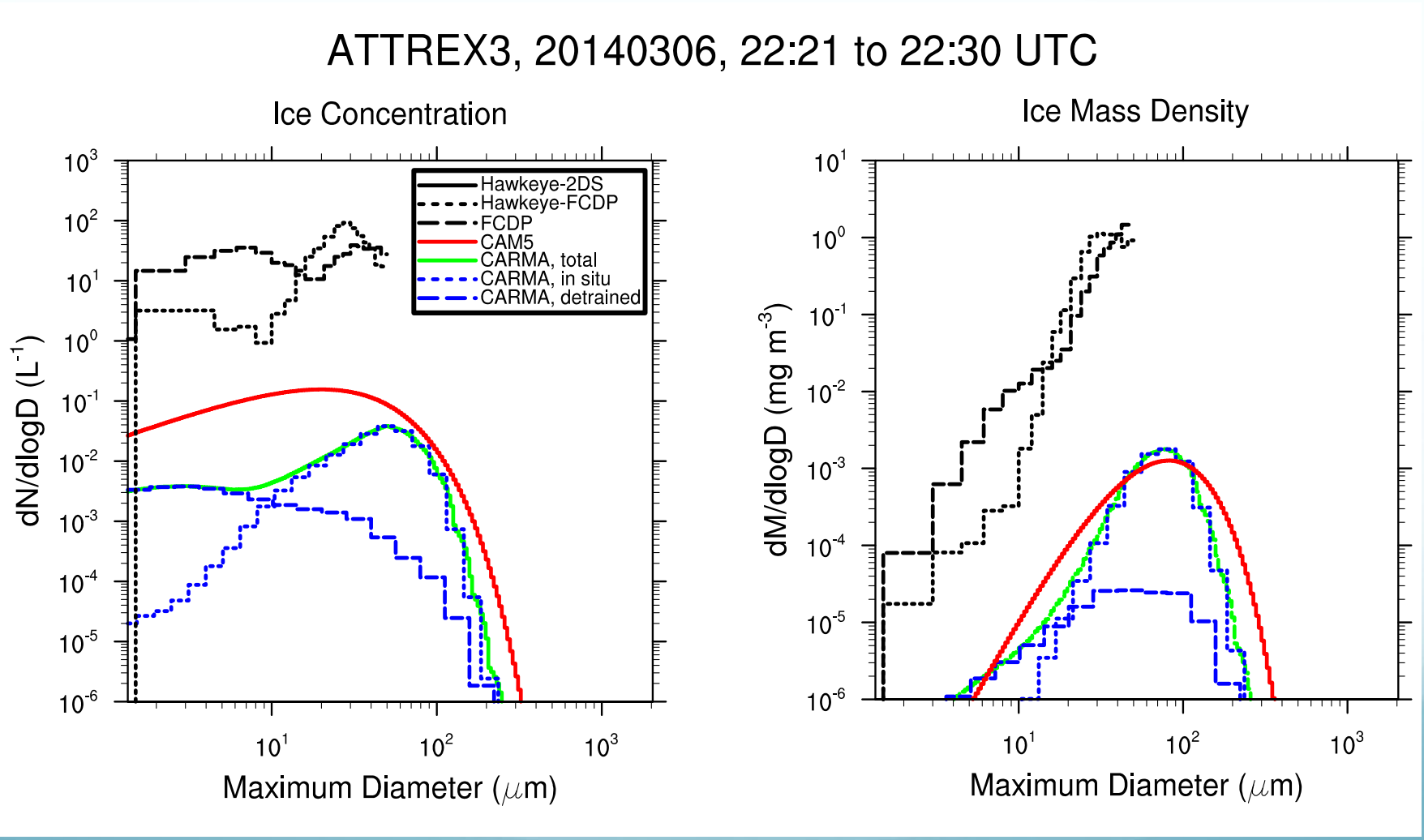
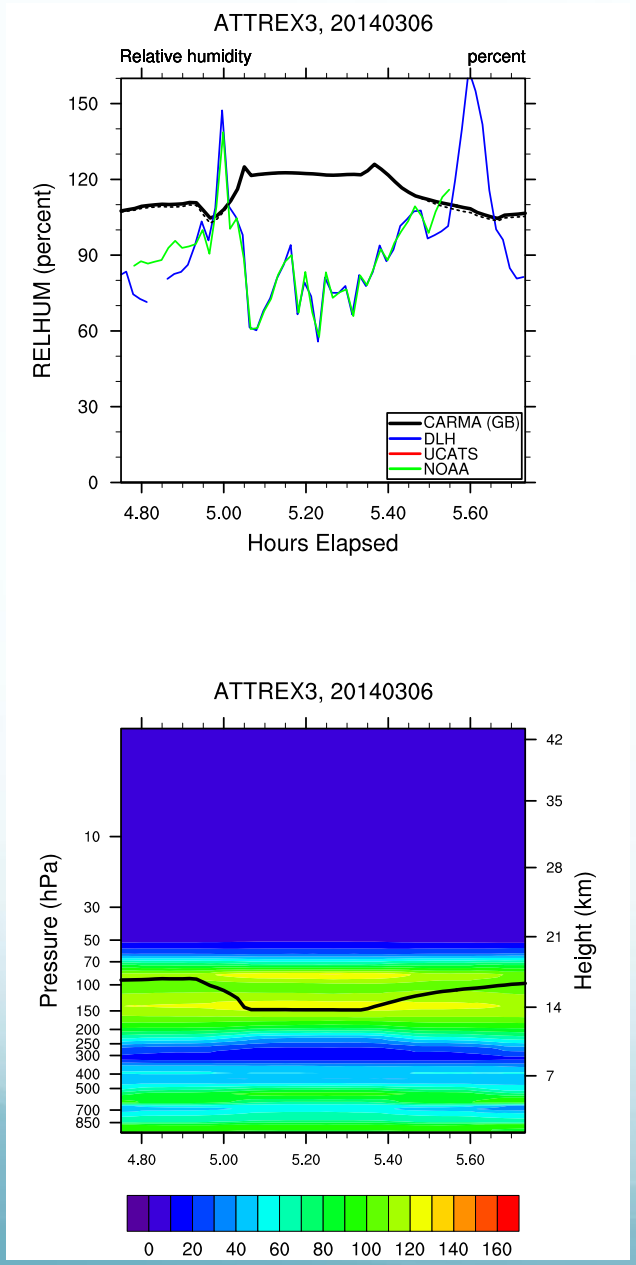
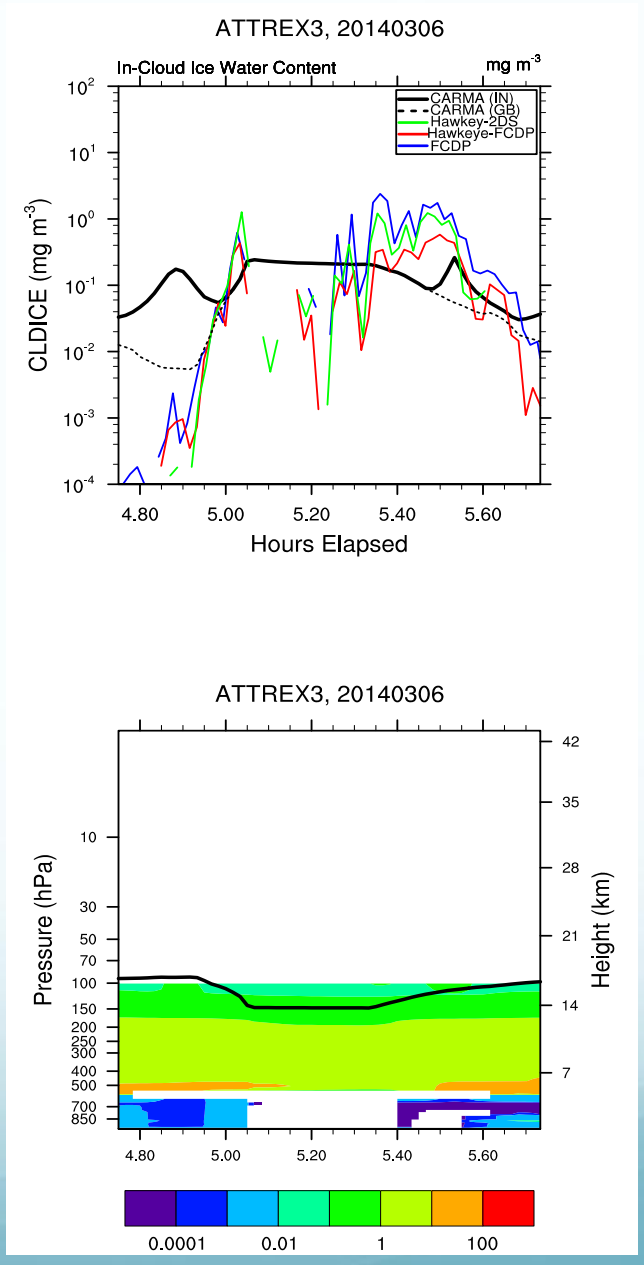


Model representation of 03/06/14 flight segment of interest



Flight Segment Profile





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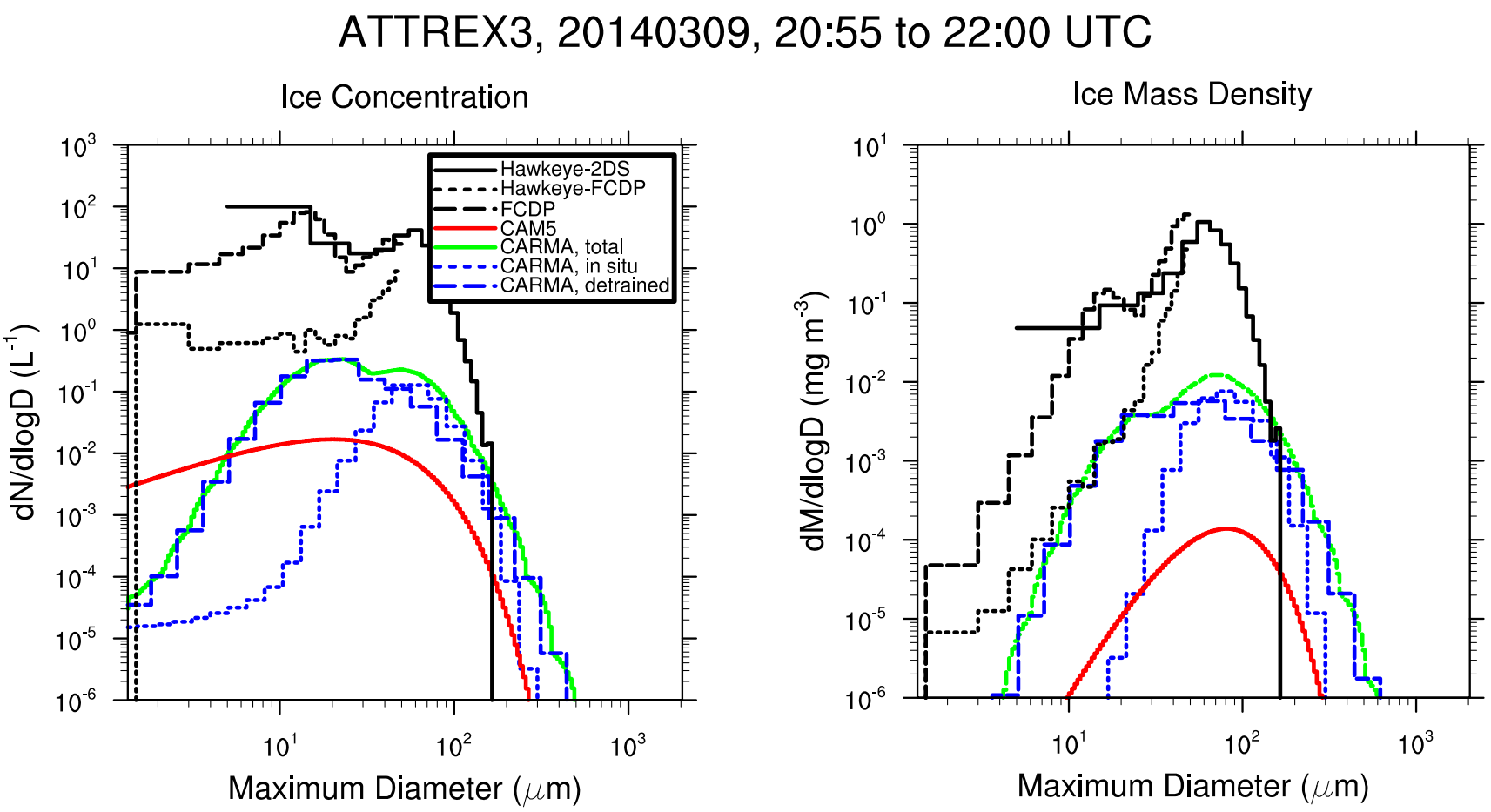
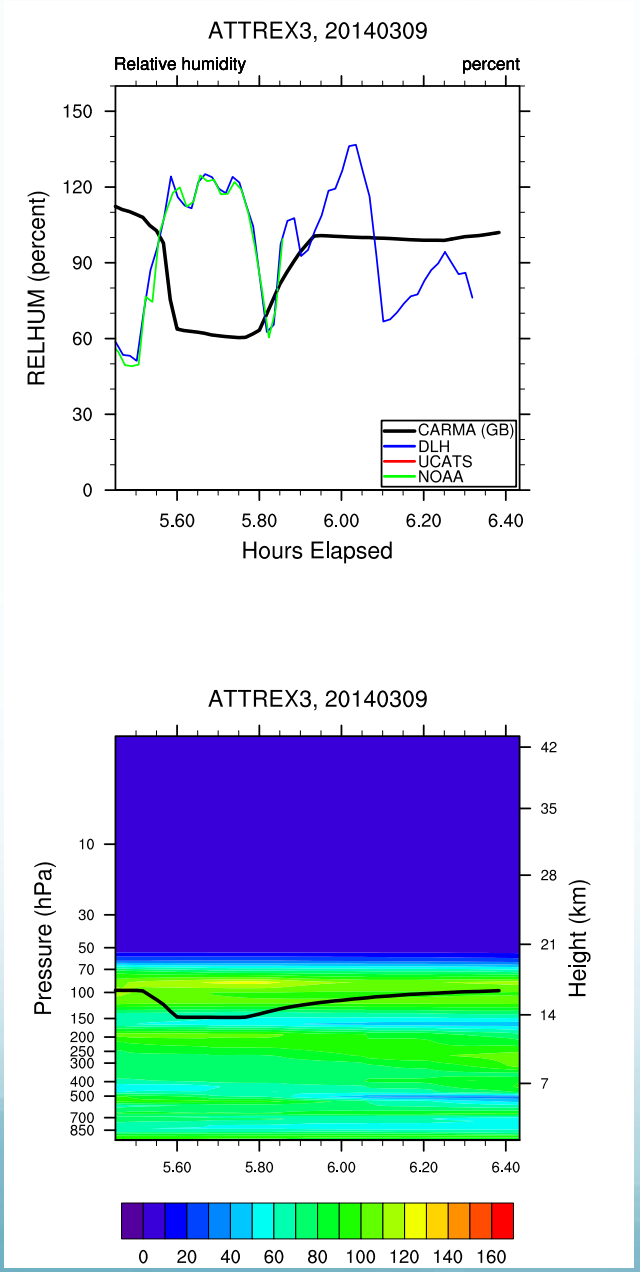


Flight Segment Profile



Recap

- Performed a comparison of the CAM5/CARMA model to observations from the Global Hawk at a 1x1 degree resolution
- Different types of in situ cirrus are seen in the observations, but the model ice habit in the 03/09/14 case disagrees.
- Model struggles capturing detailed features along the flight track

Future work

- Increase field of view to compare gross features such as cloud fields in the region

  - Use CALIPSO data

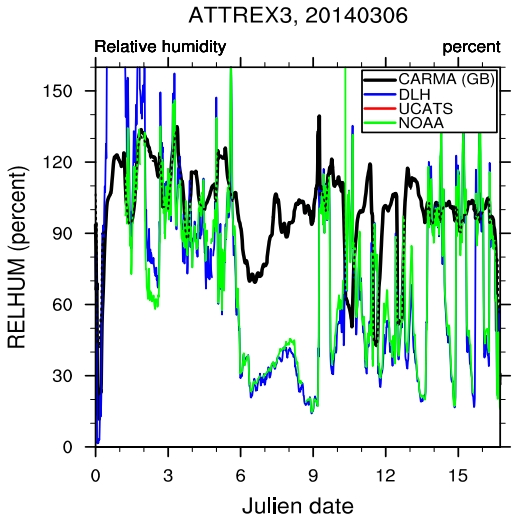
- Evaluate best ice habit assumptions for CARMA

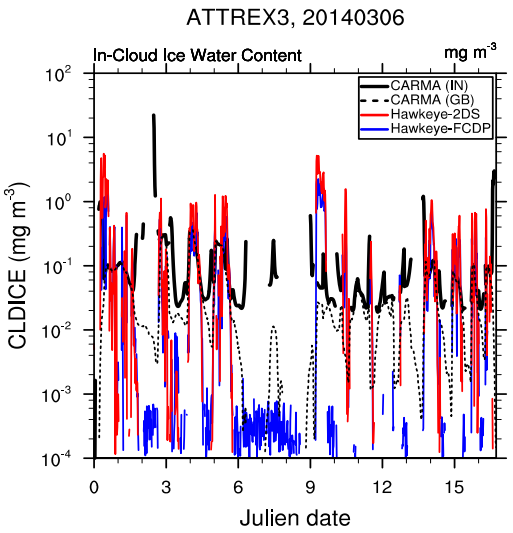
- Continue to modify treatment of water vapor in CAM5/CARMA

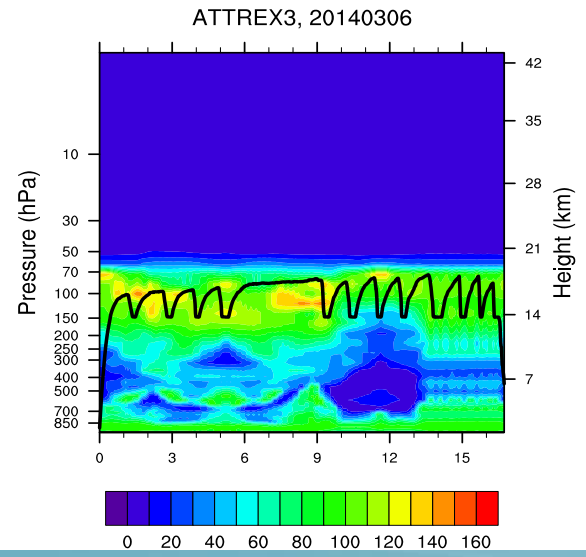
Thank You

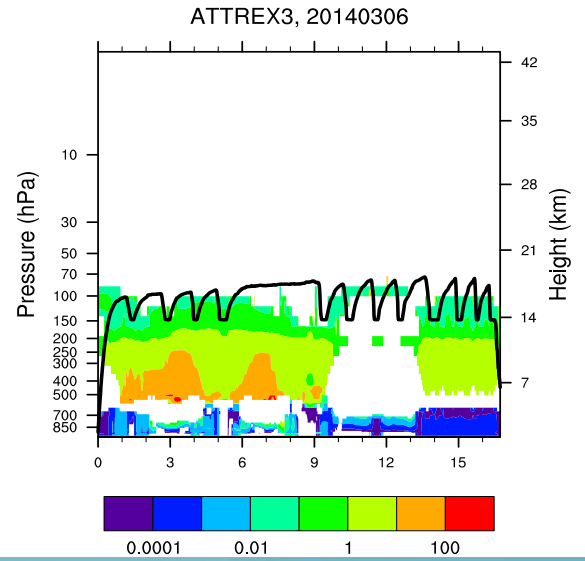
Extra Slides

Full 03/06/14 flight profile

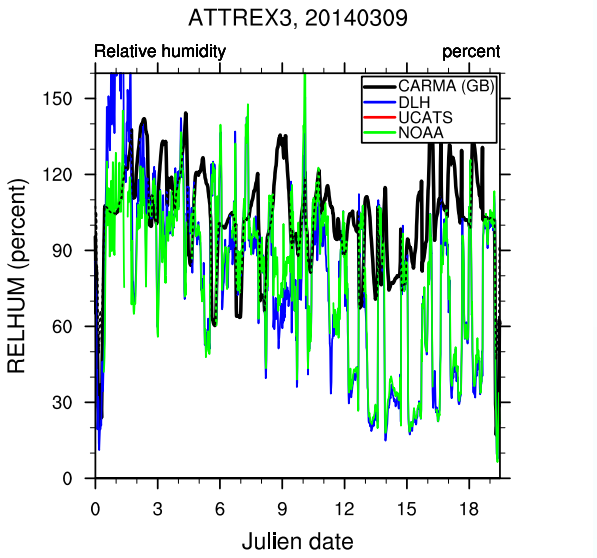


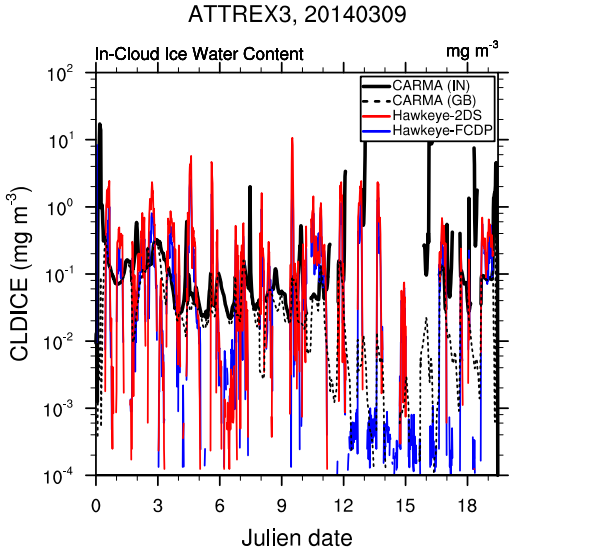


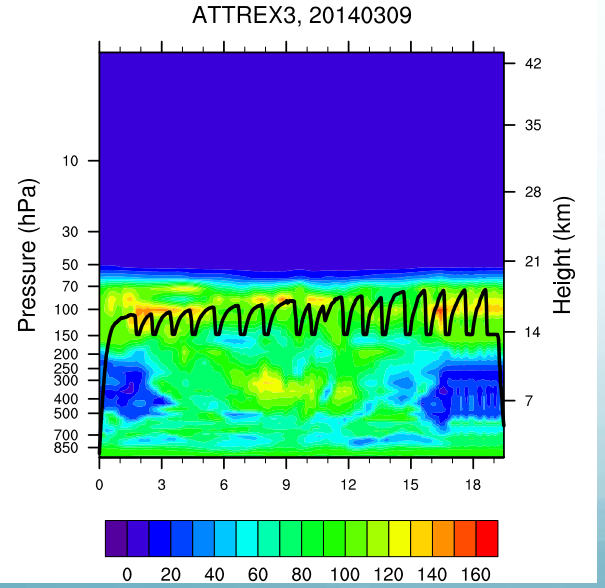


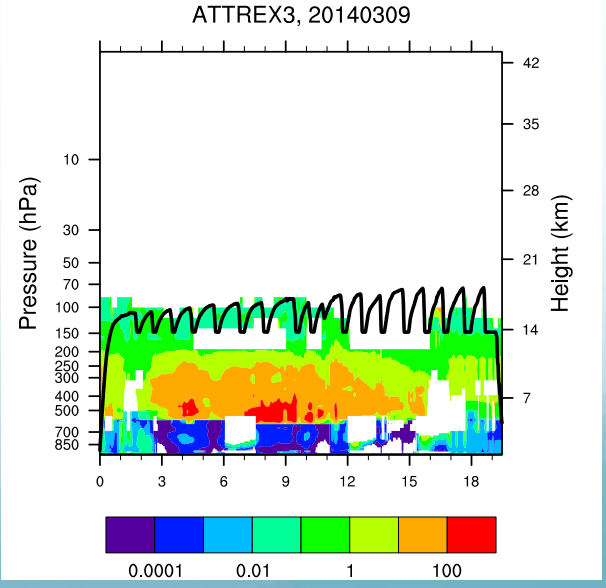


Full 03/09/14 flight profile

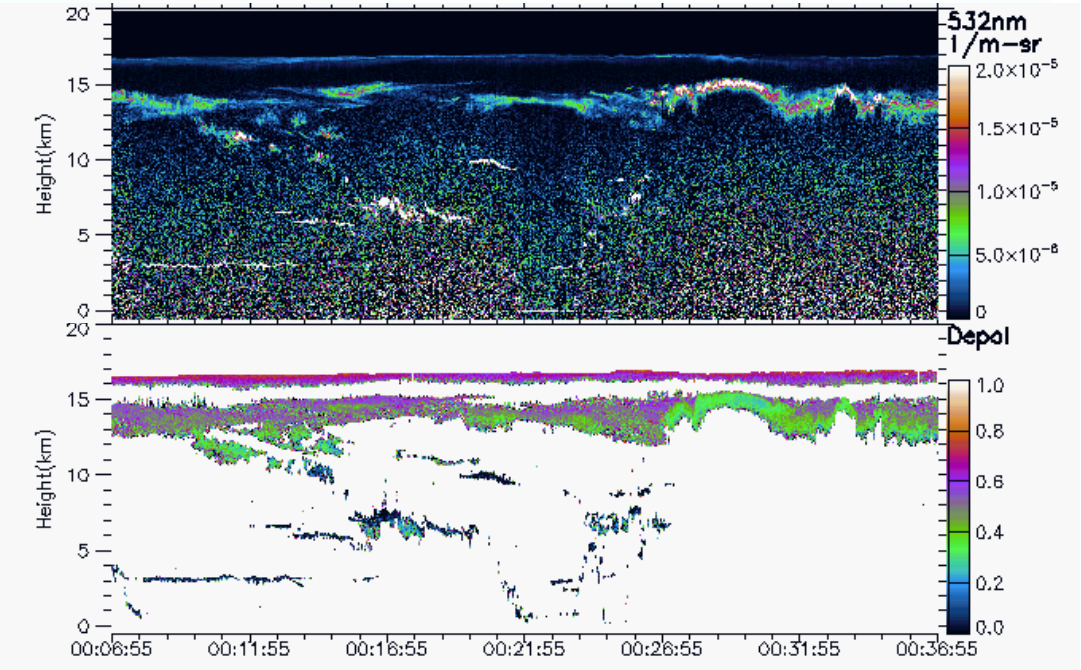


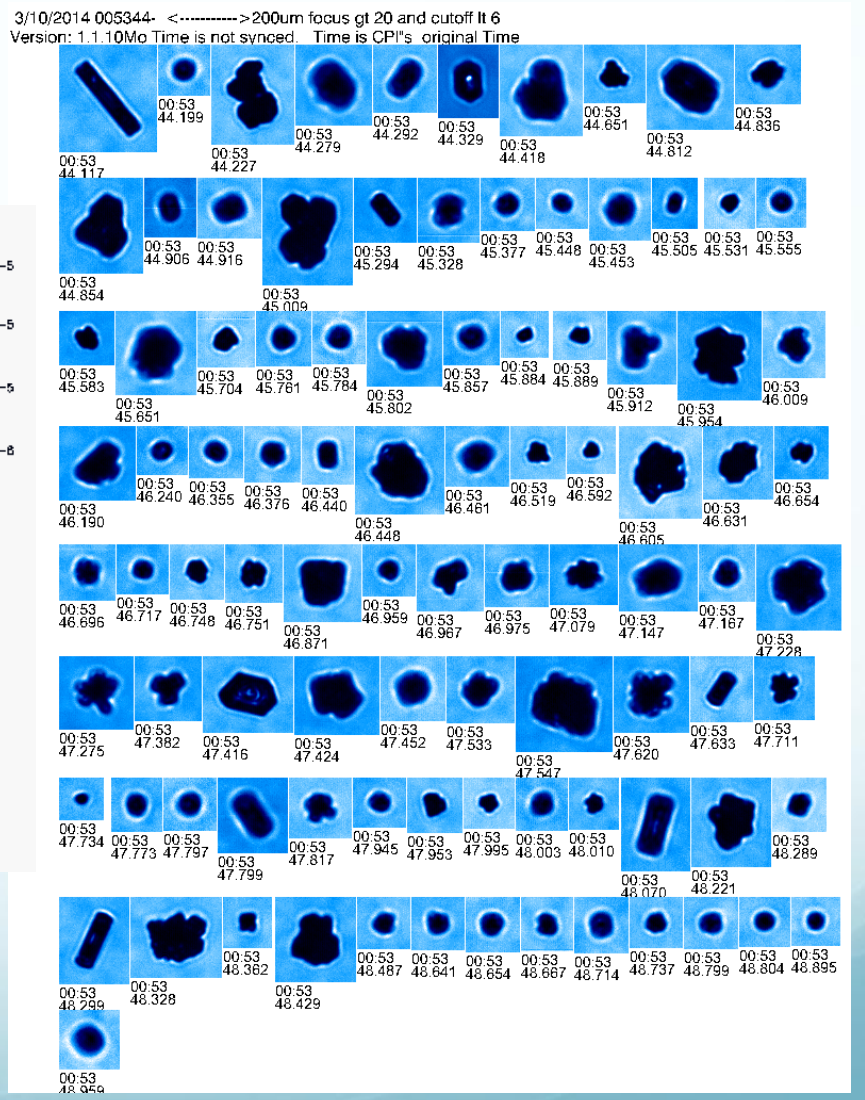




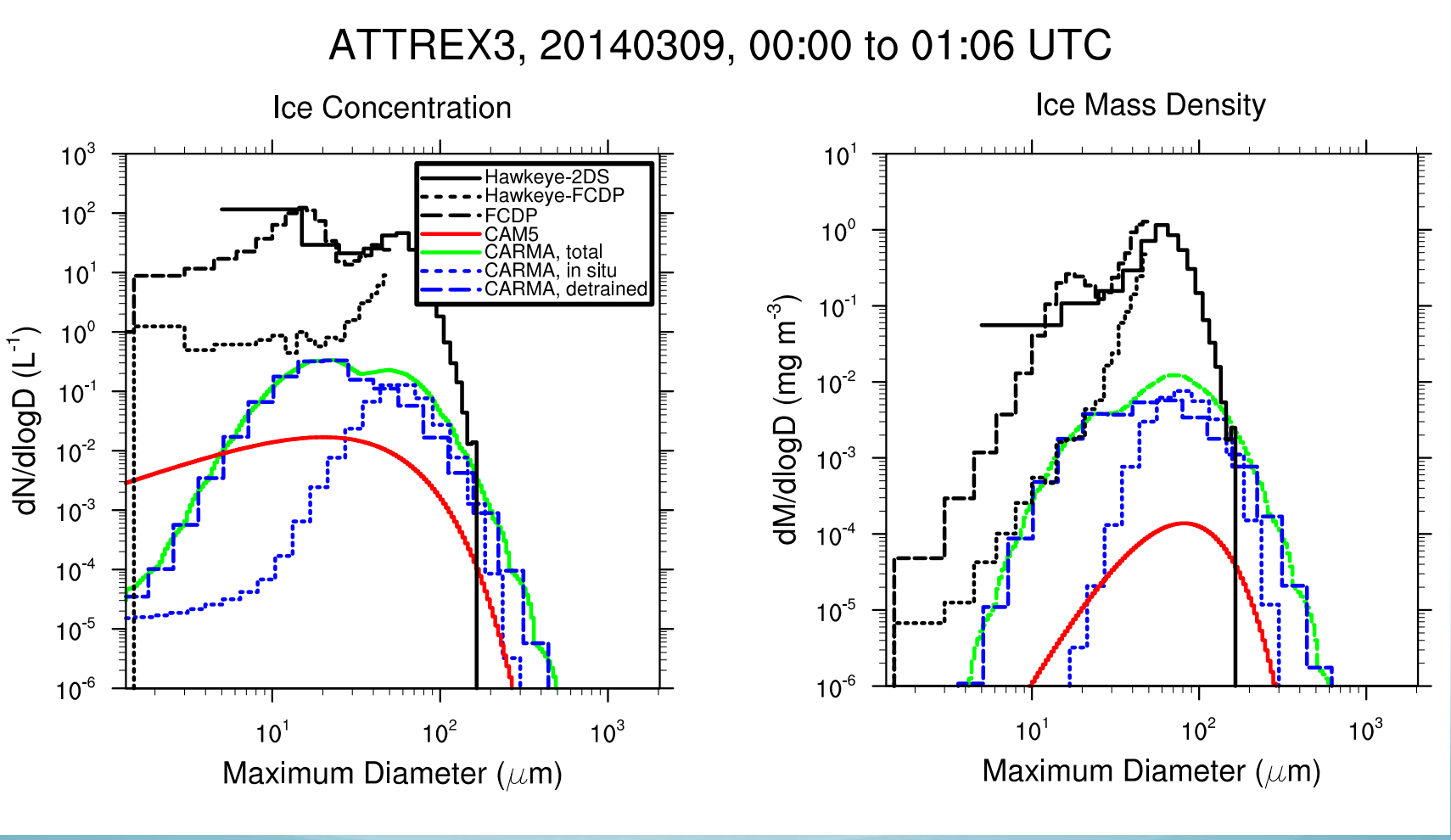


Southern convection of 03/09/14 flight





Model representation of flight segment



Previous studies show CAM5/CARMA improves on CAM5

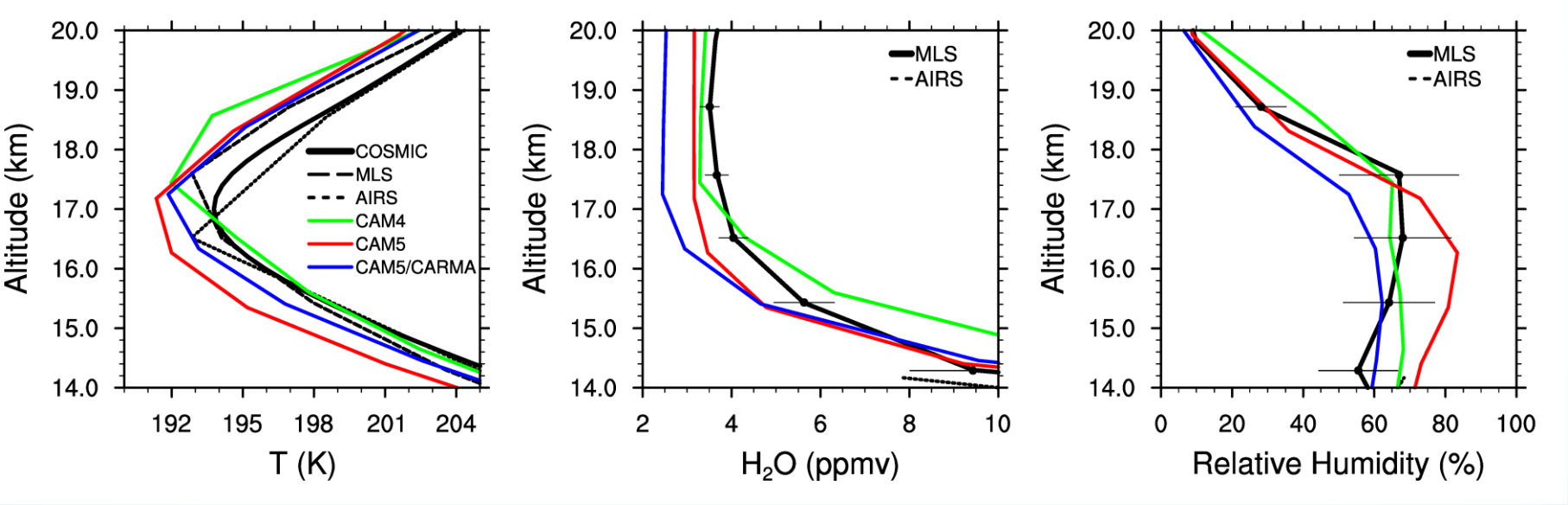


Figure 9 from Bardeen et al (2013) showing annual tropical averages compared to MLS, AIRS, COSMIC satellite data sets

- CAM5/CARMA excels at altitudes below Tropopause

We compare global model simulations to aircraft observations

- Model was run at a resolution of 1x1 degrees
- We then interpolated grid boxes along the flight track
  - 4 closest horizontal grid boxes
  - Last and current time step
- Model was nudged by GEOS5 re-analysis data
- CAM5/CARMA uses subgrid parameterizations