A 2-d modeling approach for studying the formation, maintenance, and decay of Tropical Tropopause Layer Cirrus associated with Deep Convection utilizing observations from the Tropical Composition, Clouds and Climate Coupling Experiment.

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INTRODUCTION

Cirrus located in the Tropical Transition Layer (TTL) have become a focal point much of research over the last decade. Understanding their role and contribution to the overall water vapor concentration in the stratosphere has drawn significant interest. In particular, recent studies have been conducted to study the ice nucleation processes and the role of aerosols during these deep convective events. Simulations in this study will utilize a new microphysical scheme that has been created called AMPS, which predicts multiple distributions of CCN and IN, liquid and ice mass spectral. The ice scheme called SHIPS is unique in that ice particle properties (such as size, particle density, and crystal habitats) are explicitly predicted in a CRM (Hashino and Tripoli, 2007, 2008). Also, a new radiative transfer model to handle ice particles with arbitrary density and shape was developed for AMPS. This technology provides a particularly strong tool that effectively enables the explicit modeling of the TTL cloud microphysics and dynamical processes.

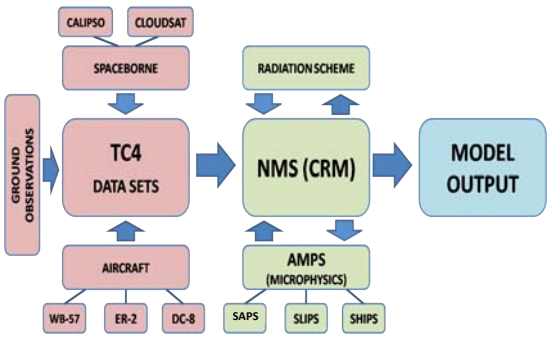
There is a residue of humidity and possibly aerosols left at upper reaches of the troposphere by the Radiative Convective Equilibrium process.

What role does Deep convection play in the formation, maintenance and distribution of sub visible cirrus in the TTL

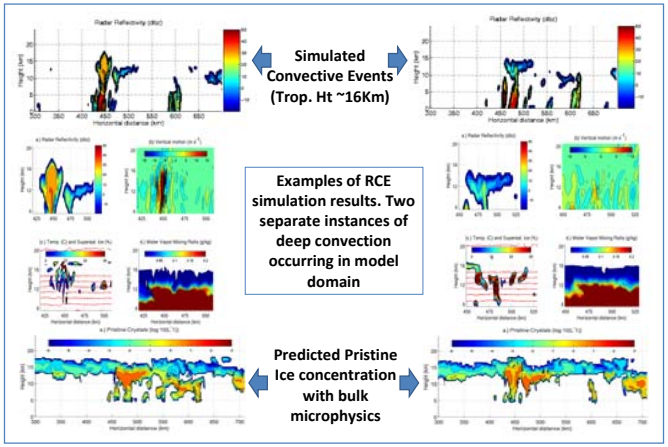
What role do soluble aerosols such as sulfates play in the ice nucleation processes and maintenance of ice crystals in cirrus observed in the TTL

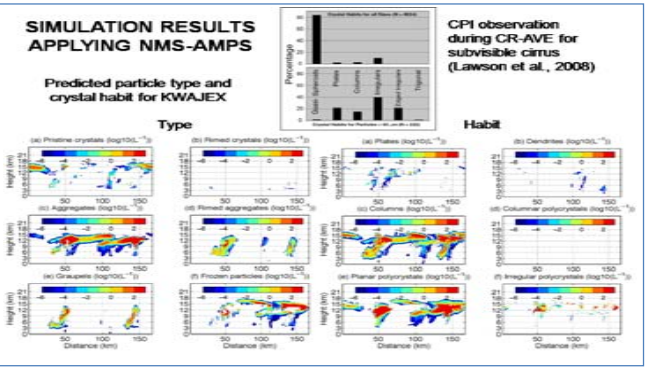
DESIGN SETUP

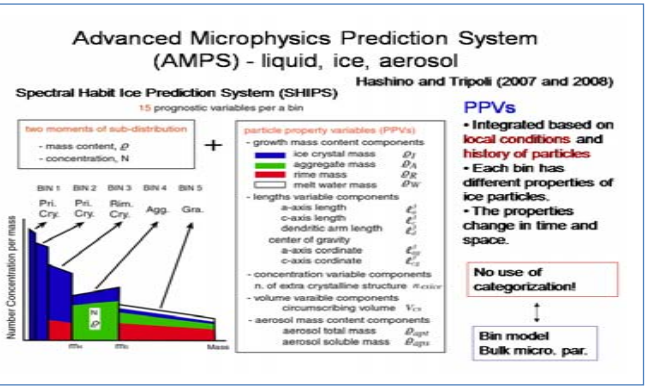
In July and August of 2007, NASA conducted The Tropical Composition, Clouds and Climate Coupling (TC4) campaign primarily in Costa Rica and Panama. Both CALIPSO and CloudSat observations of the TTL were supplemented by an extensive aircraft field campaign to provide a comprehensive in situ dataset to better understand processes occurring in the upper troposphere lower stratosphere (UTLS). Below is a basic flow chart showing the experimental model design setup.



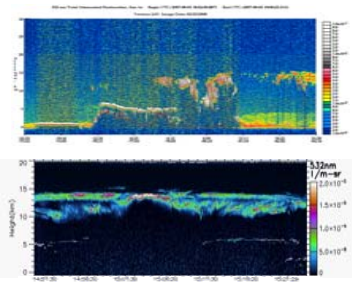
PRELIMINARY RESULTS







SPACE BORNE AND AIRCRAFT OBSERVATIONAL DATA



Data Sample: CALIPSO vs. ER-2 CPI Lidar images of 532 nm Attenuated Backscatter from 8/5/07 and below ER-2 CRS Doppler image

CONCLUSIONS

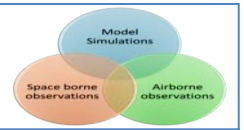
•2-d simulations of deep convection in the tropics were carried out first employing a bulk microphysics scheme. The simulation was run to Radiative Convective Equilibrium (RCE) in balance with the Hadley Circulation, surface fluxes and radiative loss and gain from space. This work demonstrated to us that this model setup was able to capture the effect of mesoscale convective systems moving through the region over time that drives the equilibration process as was originally done in Tripoli, 1992.

•2-d simulations of cirrus associated with deep convection were run using NMS-AMPS applying KWAJEX observational data. Explicit modeling of predicted ice type and crystal habit is shown and are compared with simulation results from RCE simulations as well as observations from CR-AVE

•Simulations incorporating AMPS microphysical scheme and TC4 observational data sets are ongoing at this time.

DISCUSSION ON WHAT'S TO COME

We will be comparing the ice nucleation and aerosol properties simulated at the tropopause by NMS/AMPS model to the Cloudsat and Calipso observations during this period as well as the in situ and remote sensed ER-2, WB-57, and DC-8 aircraft observations.



•Full simulation of the TTL using the AMPS system
•High-resolution simulation of local cloud processes for case study dates to determine cirrus cloud development, maintenance, and dissipation dynamics.
•Aerosol studies to determine the role of sulfates on ice crystals in the TTL
•Validation of high-resolution simulations through collected data.
•Final Interpretation of results

References

Tripoli, G.J., 1992: A nonhydrostatic mesoscale model designed to simulate scale interaction. *Mon. Wea. Rev.*, **120**, 1342-1359.

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