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RAL/MMM SEMINAR SERIES

Speaker: Paul Lawson
SPEC Incorporated
Boulder, Colorado
Date: February 5, 2015
Time: 3:30pm – 4:30pm
Place: FL 2 – Room 1001

Title: In situ Observations and Simulations of Rapid Glaciation in Tropical Cumulus Updrafts: Results from ICE-T

Abstract:

The rapid glaciation of tropical cumulus clouds has been an enigma and debated in the literature for over 60 years. Possible mechanisms responsible for the rapid freezing have been postulated, but until now, direct evidence has been lacking. Recent high-speed photography of electro-statically suspended supercooled drops in the laboratory has shown that freezing events produce small secondary ice particles, via fracturing and from spicules that eject bubbles.

Aircraft observations from the Ice in Clouds Experiment – Tropical (ICE-T), strongly suggest that the drop-freezing secondary ice production mechanism is operating in strong, tropical cumulus updrafts. The result is production of small ice particles settling at a few tens of cm s⁻¹ colliding with and freezing large supercooled drops falling rapidly at a few m s⁻¹. The large drops freeze and produce more small ice, generating a cascading process that results in rapid glaciation of water drops in the updraft.

Results are presented from data collected using state-of-the-art cloud particle probes during 54 Learjet penetrations of strong (5 to 20 m s⁻¹) cumulus updrafts in a temperature range from +5 to –20 °C. Repeated Learjet penetrations containing 3 to 5 g m⁻³ supercooled liquid show an order of magnitude decrease in liquid mass concentration 3 to 5 min later at an elevation 1 to 1.5 km higher in the cloud.

The aircraft observations were simulated using a one-dimensional cloud model with explicit bin microphysics. The model was initialized with drop and ice particle size distributions observed prior to rapid glaciation. Simulations show that the model can explain the observed rapid glaciation by the drop-freezing secondary ice production process and subsequent "riming", which results when large supercooled drops collide with ice particles.

This seminar will be Webcast - Webcast link
<http://www.fin.ucar.edu/it/mms/fl-live.htm>