ATS/CIRA Colloquium

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Pressure perturbations in cumulus convection

Hosted by Russ Schumacher

Friday, Jan. 20, 2017

ATS room 101
Discussion will begin at 11:15 a.m.
Refreshments will be served at 10:45 a.m. in the weather lab

Pressure perturbations are regions of anomalously low or high pressure in deep convection and play key roles in modulating the magnitude and distribution of vertical velocities within cumulus clouds. A cloud's vertical momentum budget is primarily regulated by two pressure forces: *Effective buoyancy pressure acceleration (EBPA)*, and *dynamic pressure acceleration (DPA).*

I will first discuss *EBPA*, which drives upward (downward) acceleration of air parcels if they are anomalously less (more) dense than their surrounding environments. I show that *EBPA* is dependent on (1) the temperature perturbation within an updraft, (2) the temperature immediately surrounding an updraft, and (3) the updraft's width-to-height aspect ratio. A consequence of (3) is that wider and/or shallower clouds have weaker vertical velocities than narrower and/or deeper clouds, all else being equal. I will then discuss *DPA*. Dynamic pressure perturbations arise from spatial gradients in wind velocity and preserve approximate zero mass-flux convergence in the atmosphere. For a general, un-sheared updraft, *DPA* is oriented upward below the updraft's level of maximum temperature perturbation, and downward above the updraft's level of maximum temperature perturbation. This leads to a cloud's maximum vertical velocity occurring near the middle troposphere, rather than near the tropopause (as parcel theory would suggest).

Are there ways that we can better understand *EBPA* and *DPA* and their impact on deep convection? To address this question, I will first discuss potential avenues for improving the representation of *EBPA* and *DPA* in cumulus parameterization. I will then address a specific example of how *DPA* constrains the predictability of supercell behavior in certain atmospheric environments. For supercells in vertical wind shear, *DPA* causes the supercell's motion to deviate to the left or right of the mean tropospheric wind (this behavior is called "deviant motion"). I will use a series of sensitivity experiments to show that the character of *DPA* deviant supercell motion is highly sensitive to lower-tropospheric temperature and model grid spacing.

Link to colloquium videos and announcement page: http://www.atmos.colostate.edu/dept/colloquia.php