Mesoscale Analysis and Forecasting

Review sheet for 3rd Midterm Exam: 3 April 2008

This exam will count for 12.5% of your final grade.

Unit 3 includes the topics that we covered beginning with boundaries and extending through supercells (and forecasting of storm mode). Tornadoes will be on the Unit 4 exam (not this exam). The relevant chapters of the text are: 6, 8, and 9. The exam will be conceptual, and will not require you to do derivations. However, we spent some time using and working out some important equations. You should have enough familiarity to recognize these equations, and to apply them. Examples include:

- Definitions for buoyancy including the hydrometeor loading terms; CAPE and DCAPE
- Diagnostic pressure equation (do not memorize, but be able to apply it to simple situations)

Other things to have down:

- Know your way around skew-$T$ ln-$p$ diagrams and hodographs
- Be able to draw phenomena: thermal circulations and boundaries, ordinary cells, multicells, and supercells... plan views and cross–sections... reflectivity, flow fields, cloud outlines, etc.
- Review the SPC handout and have a familiarity and comfort level with the SPC Outlook products.

Unit 3 questions/topics for thought and review:

- Can you list a wide variety of situations in which differential heating will produce a mesoscale circulation? What other kinds of mesoscale boundaries exist? Why are they important?
- What is convection? Deep moist convection? Forced/active/passive convection? What does mixing do to convective clouds? What is needed for a convective cloud to produce precipitation? How are convective storms initiated?
- What is the life span for an ordinary cell? What governs this time scale? What are the basic elements of a forecast for deep moist convection? For severe storms? How does dry air aloft impact moist convection?
- How do downdrafts come about? What are their possible impacts on the convection? On society? What are the key properties of environments for dry and wet microbursts? For heat bursts? What happens when a pool of cold outflow develops at the surface? What impacts the speed of the outflow boundary? What are multicells like? What do they require in order to be long–lived? Why?
- Why do supercells rotate? What are the key terms in the vorticity equation? What is the difference between crosswise and streamwise vorticity? Why does this matter? What enables a supercell to be long–lived? Why do storms split? What storm–scale processes account for wall clouds? Shelf clouds? The bounded weak echo region (BWER)? The hook echo? The rear flank downdraft (RFD) and forward flank downdraft (FFD)? The flanking line? What selects between mirror–image splitting supercells and predominant left or right–movers? What is storm–relative helicity? How is it determined from a hodograph? Why is it important? How is it that supercells can persist in environments with low CAPE? What are the differences between classic, LP and HP supercells?
- Know the keys on the “basic, ingredients–based approach to the convective forecasting process” handout. What are the key environmental parameters that select between ordinary cells, multicells, and supercells? Why is each parameter physically relevant for each mode?
- What are the ingredients in the supercell composite parameter? Why is each ingredient important? Which is more important: for one ingredient to be very large, or for all ingredients to be sufficient? Why?
- Revisit the COMET module lab exercise... What is the impact of high versus low CAPE? A dry sounding versus a moist sounding? Deep shear versus shallow shear? Curved versus straight hodographs? Quarter–turn versus half–turn hodographs?
- How are advection, propagation, and motion different? How are discrete and continuous propagation different? Can you explain the motion of multicells and supercells?