Mesoscale Analysis and Forecasting

Review sheet for 2nd Midterm Exam: 28 February 2008

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

Unit 2 includes the topics that we covered beginning with instabilities and extending through boundary layer phenomena (including low–level jets and drylines). The exam will be conceptual, and will not require you to do derivations. However, we spent some time using and working out some results that included mathematics. You should have enough familiarity to recognize these results, and to apply them. Examples include:

- Basic criteria for each instability
- Definitions of important quantities like angular velocity, tangential velocity, angular momentum, and geostrophic/linear momentum

Other things to have down:

- Know your way around skew-$T$ ln-$p$ diagrams and hodographs
- Be able to draw phenomena: Kelvin–Helmholtz waves, drylines, low–level jets, ABL properties, etc.
- Know how to decode basic METAR observations, how to read surface charts, etc.
- All basic conversions... °F to °Celcius and K, kts to m/s, temperature to potential temperature, etc.
- Know the keys on the “basic, ingredients-based approach to the convective forecasting process” handout.

Unit 2 questions/topics for thought and review:

- What is an instability? Which instabilities are important to the mesoscale? When do these instabilities exist? How are they released/realized?
- What are the fundamental physics of shearing instabilities? When are they present? What mesoscale phenomena can be attributed to them?
- What determines whether a laterally displaced parcel will return to its original position in the flow field? What is inertial instability? Symmetric instability? Conditional symmetric instability? How could you find them on plan view maps? How could you find them on cross sections? What is the absolute linear momentum and how does it factor into the problem? How is it related to the absolute vorticity? Why are slantwise displacements important for SI and CSI? What are the restoring forces along these slantwise trajectories?
- Why does the ABL develop? What is the ABL like? Can you explain the diurnal cycle of boundary layer profiles and boundary layer depth? What fuels turbulence in the ABL?
- What are the basic properties of the nocturnal low–level jet? Why is it important? Can you explain the key physical mechanisms that have been hypothesized to cause the low–level jet? How does each hypothesis fit with the climatology of the low–level jet?
- What is the dryline? Why does it develop? How does it move? What accounts for the wind fields in its vicinity? How might the dryline relate to convective initiation?