

METR 4433 Final Exam Study Guide

Spring 2007

In addition to the materials covered by the previous two studies guides, we covered the following new topics. The new topics will roughly have 60% weight, while the earlier materials will have roughly 40% weight. The total score of final exam will be 200 points, accounting to 30% of the final score. Exam time will be 10:30 – 12:30 Wednesday May 9th.

Bow Echoes

- Rear inflow notch and its association with rear inflow jet.
- Favorable environment for severe bow echoes
- Derechoes and their forms and weather

Meoscale Convective Complexes

- Definition and significant weather
- The typical structure and evolution

Supercell Storms

- Supercell storm, definition, typical weather
- Types of supercell storms, LP, HP and classic supercell storms
- Supercell characteristics, typical internal flow structure, main branches of flow, roles and behaviors of updraft and downdraft
- Typical echo patterns of supercell storm in both horizontal and vertical plane views and the causes of such patterns
- Wall clouds and processes by which they form
- Effects of environment on storm types, CAPE and vertical environmental shear
- The vorticity equation and the individual source terms in the equation
- Processes by which vertical vorticity can be changed – advection, stretching and tilting. Following an air parcel, only the latter two.
- Use of the vorticity equation to explain the origin and intensification of updraft rotation
- Generation of horizontal vorticity and its role in storm dynamics
- Diagnostic pressure equation and the forcing terms
- Use of the pressure equation to explain the enhancement of updraft by rotation and one of the causes for storm splitting
- Use of the equation to explain the favoring of one of the split members of storm and the effect of the hodograph curvature
- The concept and definition of streamwise vorticity, storm-relative helicity, and relative helicity

- The dependency of storm behavior on low-level storm-relative helicity and physical explanation of the behaviors
- The determination of environmental shear, vorticity from hodographs, and the effect of the curvature of hodograph and the relative position of storm-motion vector on storm-relative helicity and storm behavior
- Storm-relative environmental helicity, its definition and calculation, and the parameter as a predictor of tornado potential.
- Bulk Richardson number as a predictor of storm types
- Pros and cons of BRN and helicity as predictors, what they are best for?
- Helicity contours on hodograph

Tornado Dynamics

- Tornado climatology, what factors contributed to the high tornado frequency in the central Great Plains of the US?
- Conceptual model of tornadic supercells, the typical location of tornadogenesis related to the parental supercell storm and why?
- Typical changes that occur when a supercell storm transitions into its tornadic phase and the cause and effect
- Source(s) of low-level rotation responsible for tornadogenesis
- Life cycle of a typical fully developed tornado and the processes involved throughout the life cycle
- Multi-vortex tornadoes and why they tend to be more damaging?
- Non-supercell tornadoes, and their causes
- Flow structures inside tornado

Hurricanes

- Hurricanes, the phenomena and climatology. Key factors in and the necessary conditions for hurricanes
- The weather and damaged by hurricanes
- Flow and thermodynamic structures of hurricanes, in both horizontal and vertical plane views
- The CISK and air-sea interaction theories of hurricane formation