Mesoscale Meteorology (METR 4433)
Spring 2015
Study Guide for Hour Exam #2

The following is intended to serve as a general guide for your exam preparation, and is not necessarily all inclusive. Questions one all aspects covered in the lectures are possible.

Single Cell Storms

- Know the definition of a thunderstorm.
- Understand the classification system of thunderstorms, the characteristics of single cells, multicells, lines and supercells, and the principal differences in environmental conditions among them.
- Understand the concept of water loading and how it contributes to updraft acceleration/deceleration.
- Understand the concept of CAPE and how it relates to updraft acceleration. Be sure you understand the approximations associated with relating the two.
- Be able to compute the CAPE and Wmax (via integration) if given an appropriate expression for buoyancy.
- Understand how CAPE is represented on a thermodynamic diagram.
- Understand and be able to explain convective inhibition (CIN) and its role in promoting or inhibiting moist convection.
- Be able to explain mechanisms by which CAPE and CIN can increase or decrease.
- Know the principal ingredients needed for thunderstorms to form and the role of environmental wind shear.
- Be able to define and apply the bulk Richardson number to determine storm classification.
- Understand and be able to explain the characteristics and life cycle of single-cell storms, including the built-in self-destruct mechanism.
- Understand the origin and forcing mechanisms (entrainment, water loading, evaporation) for storm downdrafts.
- Be able to explain the cold-air outflow and the importance of the gust front.
- Be able to define microbursts and explain their origin and structure.
- Be able to explain the differences between wet and dry microbursts.
- Be able to explain why microbursts pose a hazard to aviation, using graphics to back up your arguments for an airplane on takeoff or landing.
- Be able to describe, in general, the systems now in place to detect and predict microbursts.

Multicell Storms

- Understand the characteristics of multicellular storms and how they differ from isolated, single cell storms.
- Be able to explain the environmental conditions that are conducive to the formation of multicell storms.
- Know the types of weather typically associated with multicell storms.
- Be able to explain the life cycle of a classic multicellular storm.
- Understand the mechanisms of multicell propagation/movement and how cell motion influences storm system motion.
- Understand the vorticity dynamics of cold-air outflows and be able to explain the flow pattern behind the gust front
- Understand how an integral of the equations of motion can be used to estimate gust front propagation speed and be able to explain the physical mechanism by which gust fronts/cold outflows propagate.
- Be able to explain the presence of turbulence atop a cold outflow including the association pressure perturbations and their possible influence on gust front propagation speed.
- Understand why a pressure jump occurs in the environment ahead of a propagating gust front.
- Be able to draw a schematic of a cold outflow/gust front system and explain the importance of the flow.
- Be able to describe the life cycle of cells triggered along the gust front in a multicell storm system and the manner in which updrafts and downdrafts either work together or in competition.

Bright Bands.

- The phenomena, and reason that they exist.

Bow Echoes

- The phenomena and weather.
- The conceptual model, typical life cycle of bow echoes, and the stages that typical bow echoes evolves though.
- Bookend vortices, their origin and their impact on low-level circulation and surface winds
- Rear inflow notch and its association with rear inflow jet.
- Favorable environment for severe bow echoes
- Derechoes and their forms and weather

Mesoscale Convective Complexes

- Definition and significant weather
- The typical structure and evolution

Squall lines

- General characteristics of squall lines
- Conceptual models of squall lines
- Flow pattern in mature squall lines
- Weather associated with mature squall lines
- Different ways squall line forms
- Effect of vertical shear on long-lasting squall lines
- Behaviors and evolutions of squall lines forming in environmental shear of different strength
- Perturbation pressure patterns associated with squall lines and their cause and effect
- Effect of vorticity sources on the evolution of squall lines
- Rotunno, Klemp and Weisman's views of the role of low-level shear and cold in long lived squall lines
- RKW's Optimal condition for long-lasting squall lines

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