Mesoscale Meteorology

METR 4433 | Exam #1 Study Guide | Spring 2015

Below are listed the principal topics, concepts, and capabilities for which you will be responsible on the first exam. The absence of a topic from this sheet *does not* imply that it will be absent from the exam.

Definitions of Mesoscale

- Know the definition of mesoscale
- Be able to perform scale analysis on the atmospheric equations of motion. Know the typical magnitude and relative importance of terms in the equations for the corresponding scales.
- Know the methods for categorizing atmospheric motion into various scales, and the general characteristics of such motion.
- Know the role of mesoscale in the energy cascade processes in the atmosphere.
- Be able to give examples of atmospheric phenomena that fall into different scales.

Mountain Wave Dynamics and Related Phenomena

- Know the steps and procedures by which solutions of linear mountain waves in flows of constant Scorer parameter over a sinusoidal or bell-shaped mountain are obtained.
- When given mountain wave solutions, be able to discuss their properties and sketch the solution schematically
- Understand the role of the Scorer parameter, and how the environmental parameters affect the value of this parameter, and how vertical variation of the Score parameter affects gravity wave propagation
- Know the condition under which low-level lee waves form
- Know the reasons for the formation of low-level rotor circulation and sometimes rotor clouds to the lee of mountains.
- Know the Froude number as a key parameter in flow over finite amplitude 2D or 3D mountains and know how it affects the flow/mountain wave behaviors.
- Know wave breaking as a result of wave amplification and the potential effect of wave breaking on wave activity below the breaking zone.
- Know the phenomena of severe downslope wind storm and two theories explaining its formation.

- Know the phenomena of Karman vortex street to the lee of an isolated mountain.
- Know the process bywhich cold air damming is established.
- Know the phenomena of gap flow and how Froude number affects gap flow.

Planetary Boundary Layer and Related Phenomena

- Know the definition and role of atmospheric PBL, and the main characteristics of and differences between PBL and the free atmosphere
- Know the typical vertical structure of both day and night time PBL, the properties of the surface layer, mixed layer, inversion layer, and residual layer, and the reason for their formation. Be able to draw the typical profiles of potential temperature, wind, mixing ratio of day and night time boundary layer.
- Know the typical diurnal evolution of PBL
- Know the definition of dryline and the primary physical processes responsible for the formation and movement of drylines
- Know the typical structures, in both horizontal and vertical, of drylines, in terms of temperature, humidity and wind.
- Know the role of drylines in convective initiation
- Know the definition, characteristics, climatology, and significance of boundary layer low-level jet.

Equations

- All relevant equations will be provided on the exam.
- This *does not* guarantee that physical parameters will be given, such as F_{r}, N^2, etc.