

Fall 2017
ATM 612: Convective Storm Dynamics and Forecasting

Instructor: Dr. Morris Weisman

Purpose of the course: To gain an understanding of the dynamics and predictability of severe convective storms and mesoscale convective systems, and to become familiar with the wide range of the severe weather scenarios found across the continental US.

Primary Textbook (required): *Mesoscale Meteorology in Midlatitudes* by Markowski and Richardson.

Other Useful References (not required): *Severe Convective Storms and Tornadoes: Observations and Dynamics* by Bluestein; *Cloud Dynamics* by Houze; *Atmospheric Convection* by Emanuel.

Comet Online Modules:

- A Convective Storm Matrix, Shear and Buoyancy Dependencies
- An MCS Matrix

WRF-ARW Ensemble Case Studies:

- Covering current and past severe weather events across the US.

Course Outline

Introduction

- Overview of convective storms and systems.
- Dynamical questions pertaining to convection.

Equations for convective motions

- Basic momentum equations
- Vorticity and circulation equations
- Diagnostic pressure equation

Gravity current dynamics

- Gravity current propagation
- Cold pool-vertical wind shear interactions

Supercell dynamics

- Development of updraft rotation
- Dynamic vertical pressure gradient forcing
- Effects of hodograph curvature

Tornado genesis

- Tornado observations

- Tornado-vortex dynamics
- Theories of tornadogenesis

Helicity

- The concept of streamwise vorticity
- The basic dynamics of helical flows
- Comparisons with the vertical wind shear viewpoint

Mesoscale Convective Systems

- Observations of convective systems
- 2-D squall-line circulations
- The generation of line-end vortices
- Influences of Coriolis forcing: the generation of balanced mesoscale vortices
- Upscale growth of convection
- Bow echoes / Derechoes
- MCC's
- Nocturnal convective systems
- Flash Flooding

Severe Weather Forecasting

- The basis of convective predictability
- Capabilities of high-resolution convective forecast ensembles
- Large-scale severe weather patterns
- The generation of thermodynamic instability and vertical wind shear
- Convective triggering mechanisms

Grading: 50% of the grade will be based on the successful completion of Labs and homework assignments; 50% will be based on exams.