

Synoptic Dynamic Meteorology (ATM 511)
Spring Semester 2019
Class Number: 5847 (3 credits)

Lecture: Tuesday & Thursday 8:45-10:05 in ES B13
<http://www.atmos.albany.edu/daes/atmclasses/atm511>

Instructor:

Professor Ryan Torn

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Office hours: Monday 12:30-1:30 and Wednesday 1:00-2:00, or by appointment

Course Objective:

This course will apply the governing equations of the atmosphere to understand the dynamics of synoptic to planetary-scale features (> 1000 km), such as fronts, jet streaks, and cyclones.

Prerequisites:

ATM 500 or consent of the instructor.

Text:

An Introduction to Dynamic Meteorology by J. R. Holton and G. J. Hakim, 5th ed. (HH)

Supplementary reading:

An Introduction to Dynamic Meteorology by J. R. Holton, 4th ed. (H)

Mid-Latitude Atmospheric Dynamics: A First Course, by J. E. Martin

Synoptic-Dynamic Meteorology in Midlatitudes, by H. B. Bluestein

Course Requirements:

4 Homework assignments 20%

2 Laboratory assignments 35%

Midterm exam (TBD): 20%

Final exam (Thursday May 16 10:30-12:30): 25%

Grading: A-E

Course Outline:

1. Introduction

- Overview of Balanced Weather Systems
- Review of Governing Equations of Atmosphere (H2+4, HH2+4, Martin 3+4)

2. Quasi-Geostrophic Dynamics and Potential Vorticity

- Derivation of Quasi-Geostrophic (QG) Equations (H6.2, HH6.2, Martin 5.4)

- QG Vorticity, Thermodynamic, and Energy Equations (H6.2, HH6.2, Martin 5.4)
- Potential Vorticity (H6.3, HH6.3, Martin 9.1-9.2)
- PV Inversion and Applications (H6.3, HH6.4, Martin 9.5, and class notes)

3. Vertical Motion

- Omega Equation: Vorticity and Thermal Advection Form (H6.4.1, HH6.5, Martin 6.3)
- Q Vectors and Application to Vertical Motion (H6.4.2, H6.5, Martin 6.4)

4. Frontogenesis

- Kinematic and Dynamic Description of Frontogenesis (H9.2, HH9.2, Martin 7.1)
- Vertical Motion at Fronts (Martin 7.2)
- Semi-geostrophic Equations (Holton 9.2.2, HH9.2.2, Martin 7.3)
- Upper-level Fronts (Martin 7.4, Class Notes)

5. Midlatitude Cyclogenesis

- QG Height Tendency Equation (Holton 6.3.1, Martin 8.3)
- Cyclogenesis from the QG Perspective (Martin 8.4, Class Notes)
- Cyclogenesis from the PV Perspective (Martin 9.3, Class Notes)
- “Flavors” of Midlatitude cyclones (Class Notes)

6. Atmospheric Waves and Instabilities

- Atmospheric Waves (H7.2, HH5.2)
- Baroclinic and Barotropic Instability (H8.4.3, HH7.4.3, Class Notes)
- Role of Latent Heat Release (Class Notes)
- Downstream Development (Class Notes)
- Wave Breaking (Class Notes)
- Global Energy Cycle (H8.4, HH10.4, Class Notes)