EVSC 4460/EVAT 7460 Synoptic Meteorology (4 credits)

Spring 2023

Lecture: MWF 1:00 p.m. – 1:50 p.m. (Clark Hall 101)

Lab: Fridays 2:00 p.m. – 4:00 p.m.

**Course Description**

Synoptic meteorology is the study of the weather systems (high- and low-pressure systems, waves in the jet stream, fronts, etc.) that impact our day-to-day weather. This class will introduce you to the foundational theories of meteorology and allow you to practically apply them to understand the rapid changes in the weather that regularly affect our daily lives in Virginia. A large fraction of the class will be devoted to the case study of past and current significant weather events. Upon completion of this course, you will be able to skillfully interpret weather maps and understand the theoretical reasoning behind daily weather forecasts.

The class will focus on weather systems that impact the East Coast of North America, particularly during winter and spring months. Among the questions we will answer this semester are:

* What determines whether it will snow or rain during winter months?
* What does the jet stream have to do with our weather?
* What ingredients are necessary to produce significant East Coast snowstorms (“nor’easters”)?
* Why is it often cool, damp, and drizzly for consecutive days during the winter in Virginia?
* Why is it more common to get springtime thunderstorms ahead of a cold front than a warm front?
* How do meteorologists forecast the weather?

**Prerequisites**

* For graduate students, no prior knowledge of atmospheric science is required. Having some background in physics will be helpful.
* For undergraduate students, EVSC 3300 (Atmosphere and Weather) is recommended.

**Textbooks**

There is no required textbook for this class. A recommended textbook is:

* *Midlatitude Synoptic Meteorology: Dynamics, Analysis, and Forecasting*, by Gary Lackmann, American Meteorological Society, 2015

I will be using many examples and figures from Lackmann’s textbook throughout the semester, but the book is not required, as the level of physics and math in the book is intended for advanced atmospheric science students and is therefore not appropriate for all students enrolled in this class.

**Other Useful Textbooks**

For students without any background in atmospheric science, a good reference is the book we use in our undergraduate EVSC 3300 (Atmosphere and Weather) class:

* *Meteorology Today: An Introduction to Weather, Climate, and the Environment,* by C. Donald Ahrens, Brooks/Cole, Any Edition

For students wanting a deeper background in atmospheric science, consider also:

* *Atmospheric Science: An Introductory Survey*by John M. Wallace and Peter V. Hobbs, Academic Press, 2006 (Second Edition)
* *Applied Atmospheric Dynamics* by Amanda H. Lynch and John J. Cassano, 2006
* *An Introduction to Dynamic Meteorology, 5th Edition,* by James R. Holton and Gregory J. Hakim, 2012

**Useful Online References (FREE!)**

*Practical Meteorology: An Algebra-based Survey of Atmospheric Science*, by Ronald B. Stull, University of British Columbia, 2017

* Available at https://www.eoas.ubc.ca/books/Practical\_Meteorology/

University of Illinois Online Meteorology Study Guide

* Available at http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/home.rxml

**Assessment and Evaluation**

Exam 1 (Friday March 17): 20%

Exam 2 (TBD): 20%

Lab Assignments: 50%

Weather Discussion: 10%

*Exams:* Exams will be given on Friday March 17 (covering material from the first half of the semester) and during the final exam period (focusing on material from the second half of the semester). Each exam will be worth 20% of the final course grade. The exams will primarily be short answer questions and essay-type questions to explain the application of theoretical knowledge to case studies of past weather events. Students who miss exams without prior approval of the instructor will receive a zero on the exam.

*Lab Assignments:* There will be seven lab assignments over the course of the semester. These lab assignments are a critical component of the course, as they provide hands-on experience with weather maps and showcase the application of theoretical knowledge to real-world examples. Most Friday afternoon classes will be devoted to the laboratory assignments (see Collab for schedule), allowing students to work on the labs during class and ask questions to the professor and teaching assistant. Labs will be due a minimum of one week after the in-class period devoted to each lab. Students are encouraged to work together on lab assignments, but must turn in their own solutions. Copying of another student’s solutions is a violation of the Honor Code. For undergraduate students, the seven in-class lab assignments will be weighted equally to determine the lab component of the course grade.

*Graduate students only*: Graduate students enrolled in EVAT 7460 will be responsible for an additional lab assignment (Lab 8). This assignment will be due at the end of the semester (date: TBD). In this assignment, the student will identify a past weather event of interest and provide a 2–3-page single-spaced written weather discussion of this event (page limit does not include any attached weather maps). At least five topics from the course must be incorporated into the explanations. Students are encouraged to pick a weather event that is useful for their research (e.g., a day at a field site when samples were collected). **This additional lab assignment will be worth double credit** (i.e., the lab component of the course grade = [{sum of Labs 1–7} + {2 x Lab 8}]/9).

*Weather Discussion:* At the beginning of each class period, I will provide a 5–10-minute summary of the current weather scenario and provide a brief discussion of the relevant course concepts at play. After Spring Break, each student in the class will be responsible for leading a weather discussion at the beginning of one class. A detailed list of expectations for these weather discussions will be provided in February. Undergraduate students may elect to work on the weather discussion with a partner. Graduate students should each give their own discussion.

*Grading Scale*

A+: 99-100 A: 93-98 A-: 90-92

B+: 87-89 B: 83-86 B-: 80-82

C+: 77-79 C: 73-76 C-: 70-72

D+: 67-69 D: 63-66 D-: 60-62

F: Less than 60

**Preliminary Course Outline**

* Air Masses and Fronts
* Pressure, Thickness, and Wintertime Precipitation Types
* Wind and Its Driving Forces
* Geostrophic Balance, Thermal Wind Balance, and Jet Streams
* Gradient Wind Balance, Surface Winds, and Jet Streaks
* Lake Effect Snow
* Cold Air Damming
* Lifecycle of Extratropical Cyclones
* Frontogenesis
* Rossby Waves
* Introduction to Vorticity and Quasi-Geostrophic Theory
* Synoptic Set-ups for Severe Weather
* Weather Forecasting and Numerical Weather Prediction

A detailed course outline is provided under the Schedule tab on the course Collab website. Please check the outline regularly as it will be updated throughout the semester with lecture notes and assignments.

**Questions??**

Class participation and asking questions in class is strongly encouraged.

Questions outside of class can be addressed to either the instructor or graduate teaching assistant via email, or in person during office hours. Please schedule an appointment to meet with the instructor and TA outside of office hours.