Atm Sci 360 – Synoptic Meteorology I
Lecture: TR 9:30-10:45a, EMS E150
Lab: W 2-3:50p, EMS W434
Fall 2018

Instructor:	Prof. Clark Evans
Contact:	(414) 229-4469, evans36@uwm.edu, EMS W401
Office Hours:	MW 12:30-1:45p and by appointment
Prerequisites:	Junior standing; passing grades in Atm Sci 240, Math 232, and Physics 210
Course Website:	http://derecho.math.uwm.edu/classes/AtmSci360.html

Lab Instructor:	Austin Harris
Contact:	harri377@uwm.edu, EMS W422
Office Hours:	TBD

Course Overview

Synoptic meteorology can be broadly defined as "the study, analysis, and application of synoptic weather information," where synoptic weather information alludes to data at the surface and aloft that describes the atmospheric state *over a large area at one or more times*. Synoptic meteorology is thus often incorrectly conflated with map analysis or forecasting. To be sure, these are important elements of synoptic meteorology, but they are meaningless in the absence of appropriate physical and dynamical theories to guide the analysis and forecast. Thus, in this class, we develop and apply meteorology theory so that we can analyze synoptic-scale, midlatitude meteorological phenomena. Our focus is on five key aspects of the discipline:

- **Introduction to Synoptic Meteorology:** horizontal and vertical coordinate systems; map projections; types of meteorological data; meteorological analysis principles; partial derivatives, finite difference approximations, and total derivatives/material conservation; Lagrangian and Eulerian reference frames.

- **Atmospheric Balance:** hydrostatic balance; the hypsometric equation; thickness and its applications; geostrophic balance; thermal wind and its applications; the influences of friction upon flow within the boundary layer; gradient and cyclostrophic wind balances.

- **Atmospheric Kinematics:** streamlines versus trajectories; kinematic properties of the wind, including divergence, vorticity, deformation, and horizontal shear; the relationship between divergence and vertical motion; Dines' compensation.

- **Atmospheric Stability:** importance of stability; analysis of thermodynamic properties and stability indices on skew-T diagrams; the parcel and layer methods of atmospheric stability assessment.

- **Fronts, Jets, and Cyclones:** the structure, movement, and modification of air masses; frontal archetypes; horizontal and vertical frontal structure; frontal analysis, particularly at the surface; upper-level jet streams; the relationship between fronts and jets; the structure, formation, and evolution of middle latitude synoptic-scale cyclones.

In lecture, we will emphasize the careful derivation and interpretation of the relevant physical and dynamical equations that guide the evolution of synoptic-scale weather systems. In lab, we will emphasize the application of this information to understand the evolution of real-world synoptic-scale meteorological phenomena. Emphasis will be given to critically thinking about the material and its applications rather than merely "doing" or "memorizing."

Learning Objectives

Upon completion of this course, students will be able to:

- Describe the relationships between mass (e.g., temperature, pressure, geopotential height) and kinematic (e.g., wind) fields applicable on the synoptic- and larger-scales.
- Apply these relationships in the interpretation of real meteorological data.

Textbooks

Required: *Midlatitude Synoptic Meteorology*
(Gary M. Lackmann, University of Chicago Press, $65-100)

Optional: *Mid-Latitude Atmospheric Dynamics*
(Jonathan E. Martin, Wiley, $60-90)

Weather Analysis
(Dusan Djurić, Prentice Hall, $30-100)

Most lectures and course assignments will be derived from lecture notes provided by the instructor. *Please note that I expect that you will read each set of lecture notes prior to their being discussed in class!* To large extent, only material from Chapter 1 of the Lackmann text will be covered this semester; we will cover more from the text in the spring. The Martin and Djurić texts are each highly recommended, the former for its comprehensive approach to fundamental derivations and the latter for its treatment of weather analysis principles.

Grading

Your grade will be based on your performance on the following:

39%	Examinations	[Three in total, each worth 13% of your final grade.]
48%	Labs	[Twelve in total, each worth 4% of your final grade.]
8%	Exercises	[Eight in total, each worth 1% of your final grade.]
5%	Participation/Attendance	

There will be three exams given during the semester. Exams are closed book and non-cumulative to the extent that the material allows. Make-up examinations will only be given in the event of an excused absence from class, including absences for university-recognized personal matters such as religious observances. If you are in doubt about whether your absence will qualify, please ask ahead of time and I will be happy to clarify.

There will be twelve labs given during the semester, each involving the application of fundamental concepts developed during lecture to data analysis. These will be assigned following the schedule outlined in the "Course Outline" section of this syllabus and due *by the start of lab one week after their assignment*. Late work will be accepted only with a 33% per day penalty. Exceptions will only be granted in the circumstance of an approved emergency. More information regarding the lab is available in the syllabus provided by Austin Harris.

There will be eight exercises given during the semester. These short activities are intended to serve two separate purposes: (1) deepen your understanding of course material or (2) introduce you to the Python programming language for visualizing and analyzing meteorological data. These will be assigned following the schedule outlined in the "Course Outline" section of this syllabus and will be due *by the start of the next class after their assignment*. Each will be graded on a *good-faith basis*: if you receive at least a 70% on the assignment, you will be given full credit (100%) for that assignment; otherwise, you will receive the grade that you earned.

Your attendance at each scheduled class session is mandatory unless explicitly excused. Please notify me as soon as possible if you foresee needing to miss class. In the case of an absence due to an emergency, please notify me as soon as feasible. Unexcused absences result in a 1% deduction in your final course grade per absence after the first absence. *Please come to each lecture prepared to ask questions and to participate in discussion!*

Grades will be assigned based on the following scale:

A	92.5-100%	**A-**	90-92.49%	**B+**	87.5-89.99%	**B**	82.5-87.49%
B-	80-82.49%	**C+**	77.5-79.99%	**C**	72.5-77.49%	**C-**	70-72.49%
D+	67.5-69.99%	**D**	62.5-67.49%	**D-**	60-62.49%	**F**	0-59.99%

A grade of an "A" is intended to reflect your mastery of the presented material. Grades of "B" and "C" are intended to reflect minor and major deficiencies, respectively, in your mastery of the presented material. Grades of "D" and "F" reflect no mastery of the presented material. Minor deficiencies include incomplete attribution while major deficiencies include incorrect attribution.

Course Outline

The following outline, apart from exam and lab dates, is provided only as a guideline.

Week	Dates	Topic(s) To Be Covered
1	Sep. 4, 6	Types of Meteorological Data; Meteorological Analysis Principles
2	Sep. 11, 13	Coordinate Systems, Reference Frames, and Map Projections
3	Sep. 18, 20	Derivatives, Finite Differences, and their Atmospheric Applications
4	Sep. 25, 27	Hydrostatic Balance, the Hypsometric Equation, and Thickness
5	Oct. 2, 4	Geostrophic Balance
6	Oct. 9, 11	Thermal Wind Balance; **Mid-Term Exam #1**
7	Oct. 16, 18	Thermal Wind Balance cont'd.; Fronts
8	Oct. 23, 25	Frontal Analysis; Jets and Jet Streaks
9	Oct. 30, Nov. 1	Jets and Jet Streaks; Other Wind Balances
10	Nov. 6, 8	Other Wind Balances cont'd.; Kinematic Properties
11	Nov. 13, 15	Kinematic Properties
12	Nov. 20, 22	**Mid-Term Exam #2**; **No Class Nov. 22 (Thanksgiving)**
13	Nov. 27, 29	Divergence and Vertical Motion; Skew-T Diagrams
14	Dec. 4, 6	Thermodynamic Parameters; Atmospheric Stability
15	Dec. 11, 13	Atmospheric Stability, cont'd.; Mid-Latitude Synoptic-Scale Cyclones

Exam #1: Thursday, October 11
Exam #2: Tuesday, November 20
Exam #3: Thursday, December 20, 7:30-9:30 am

Labs: All Wednesdays except Oct. 10, Nov. 14, and Nov. 21.
Exercises: Sept. 13, 20, 27; Oct. 4, 18, 25; Nov. 15; and Dec. 6.

I will be on travel for at least three weeks during the semester: October 9-11, October 23-25, and December 4-6. Austin Harris will lecture during these weeks. If additional absences are necessary, I will notify you ahead of time.

Course Credit Hour Statement

This course is a four-credit course. This means that this class represents an investment of time of at least 192 hours by the average student. Of these 192 hours, 64 are associated with in-class instruction and examinations, 60 are associated with the completion of the twelve course lab assignments, 16 are associated with the completion of the eight course assignments, and the remaining 52 are associated with each student's study of course materials.

Departmental Regulations

All room changes or course cancellations will be posted on departmental letterhead only.

University Regulations

University-Wide Rights and Regulations

The University of Wisconsin-Milwaukee has established a series of policies relating to student rights and regulations in this and all UWM-offered courses. You are encouraged to read through these policies at http://uwm.edu/secu/wp-content/uploads/sites/122/2016/12/Syllabus-Links.pdf at your earliest convenience. Please notify me if you need special accommodations to meet course requirements.

Statement of Academic Misconduct

The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonestly. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors. Further information can be found at http://uwm.edu/academicaffairs/facultystaff/policies/academic-misconduct/.

Statement of Sexual Harassment

Sexual harassment is reprehensible and will not be tolerated by the University. It subverts the mission of the University and threatens the careers, educational experience, and well-being of students, faculty and staff. The University will not tolerate behavior between or among members of the University community which creates an unacceptable working environment. The policy on discriminatory conduct, including sexual harassment, can be found at http://www4.uwm.edu/secu/docs/faculty/2847_S_47_Discr_olicy_clean.pdf.