Atm Sci 360 – Synoptic Meteorology I
Lecture: TR 9:30-10:45a, EMS E423
Lab: W 2-3:50p, EMS W434
Fall 2014

Instructor: Prof. Clark Evans
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Office Hours: TR 11:00a – 12:15p and by appointment
Prerequisites: Junior standing; passing grades in Atm Sci 240, Math 232, Physics 210
Course Website: http://derecho.math.uwm.edu/classes/AtmSci360.html

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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, taken both at the surface and aloft, that describes the state of the atmosphere over a large area at one or more times. Synoptic meteorology is thus often incorrectly conflated with map analysis or forecasting.

To be sure, map analysis and forecasting are key elements of synoptic meteorology, but they are not the totality of synoptic meteorology. Underlying both, and underlying synoptic meteorology as a whole, is study, which itself is drawn from theory. Thus, elements of both physical and dynamical meteorology, not to mention mathematics, are integral to synoptic meteorology.

In this class, we seek to develop and apply meteorological theory to the analysis of synoptic scale meteorological phenomena, with an emphasis upon phenomena found within the middle and higher latitudes. We will thus focus on five key aspects of synoptic meteorology, spending approximately three weeks on each:

- **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 wind balance.

- **Atmospheric Kinematics:** streamlines versus trajectories; vector analysis principles; kinematic properties of the wind, including divergence, vorticity, deformation, and horizontal shear; the relationship between divergence and vertical motion and Dines' compensation; why do we care about vertical motion?

- **Atmospheric Stability:** why do we care about atmospheric stability?; analysis of thermodynamic properties and stability indices on skew-T diagrams; the parcel, layer, and slice methods of assessing atmospheric stability; the stability change equation.

- **Fronts, Jets, and Cyclones:** the structure, movement, and modification of air masses; types of fronts and their horizontal and vertical 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. Particular emphasis will be given to critically thinking about the material and its applications rather than merely "doing" or "memorizing."

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:

45%	Examinations	[Three in total, each worth 15% of your final grade.]
50%	Labs/Assignments	[Ten in total, each worth 5% of your final grade.]
5%	Participation/Attendance	

There will be three one hour exams given during the course of the semester. All 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 ten labs/assignments given during the course of 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 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 situation. More information regarding the course lab is available in the syllabus provided by the lab instructor.

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 situation, please notify me as soon as is feasible. Unexcused absences will 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!* Note that participating in discussion by its very nature is associated with refraining from using the computers in our classroom during lecture.

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. 2, 4	Types of Meteorological Data; Meteorological Analysis Principles
2	Sep. 9, 11	Coordinate Systems, Reference Frames, and Map Projections
3	Sep. 16, 18	Derivatives and their Atmospheric Applications
4	Sep. 23, 25	Hydrostatic Balance; Thickness

5	Sep. 30, Oct. 2	Geostrophic Balance; **Mid-Term Exam #1**
6	Oct. 7, 9	Geostrophic Balance cont'd.; Thermal Wind Balance
7	Oct. 14, 16	Thermal Wind Balance cont'd.; Other Wind Balances
8	Oct. 21, 23	Other Wind Balances cont'd.; Kinematic Properties
9	Oct. 28, 30	Kinematic Properties
10	Nov. 4, 6	Divergence and Vertical Motion; **Mid-Term Exam #2**
11	Nov. 11, 13	Skew-T Diagrams, Thermodynamic Properties, and Stability Indices
12	Nov. 18, 20	Assessing Atmospheric Stability; Stability Change Equation
13	Nov. 25, 27	Introduction to Surface Fronts; **No Class Nov. 27 (Thanksgiving)**
14	Dec. 2, 4	Surface Frontal Analysis; Vertical Structure of Fronts
15	Dec. 9, 11	Upper Level Jets; Mid-Latitude Synoptic-Scale Cyclones

Exam #1: Thursday, October 2
Exam #2: Thursday, November 6
Exam #3: Thursday, December 18, 10:00 am to noon

Lab Dates: Sep. 10, Sep. 17, Sep. 24, Oct. 8, Oct. 15, Oct. 22, Oct. 29, Nov. 12, Nov. 19, Dec. 3

I will be on travel at two times during the semester: October 14 and November 4-6. Course coverage for classes during which I am absent will be announced at a later date.

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 ten course lab assignments, and the remaining 68 are associated with each student's study of course materials.

Departmental Regulations

Any and 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://www.uwm.edu/Dept/SecU/SyllabusLinks.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://www4.uwm.edu/acad_aff/policy/academicmisconduct.cfm.

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.