METR 4424: Synoptic Meteorology Laboratory (Fall 2012)

Instructor: Prof. Steven Cavallo
Class meetings: MTWR 2-3:45pm in NWC 5600
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Office hours: Tuesday and Thursday 1-2pm

Prerequisites: Grade of C or better in METR 3123 (Atmospheric Dynamics II), METR 3223 (Physical Meteorology II). See also the knowledge expectations at `http://som.ou.edu/content/pdf/ke_4424.pdf`.

Course description

The purpose of this lecture/laboratory course is to gain an understanding of the observed behavior of the atmosphere through the application of basic theoretical principles. Concepts will be developed for studying atmospheric circulations, particularly extra-tropical cyclones and anticyclones. Laboratory work will include the development of diagnostic techniques suitable for a better understanding of the current weather and will use modern technological tools. Students will be expected to explain theoretical concepts in an oral and written format. They also will be expected to demonstrate mastery in understanding various physical processes that impact weather analysis and forecasting, surface and upper air analysis, fronts and wave cyclones, satellite meteorology, sounding analysis, thermodynamic diagrams, cross sections, forecasting, NCEP models, MOS, radar meteorology, and severe spring and winter weather.

Required text

"Midlatitude Synoptic Meteorology: Dynamics, analysis, and forecasting" by Gary Lackmann.

Class format

Lectures will be on Monday, Tuesday, and Thursday. Wednesdays will be devoted to laboratory exercises. Many lab exercises will involve computer exercises, so we will also use NWC 5720 on lab days. Students who have their own laptops are encouraged to bring them on lab days as space in NWC 5720 is limited.

There will be announced quizzes, usually at the beginning of class Thursdays on the week of a scheduled quiz (see course outline for schedule), unless otherwise announced. No make-up quizzes are permitted. To accommodate an excused or unintended absence on the day of a quiz, the lowest quiz grade will be dropped.

Students will also learn to communicate and synthesize weather information to an audience through in-class weather briefings and in part from a final term project. Weather briefings will be held at the beginning of each class period throughout the semester, and students will be chosen randomly to lead the discussions on those particular days.

Grading

Course grade determination:

In-class laboratory work (∼12 total)	40%
In-class quizzes (∼8 total; lowest dropped)	30%
Weather Briefing	5%
Project	25%

Weather briefings

Each student will be required to lead an impromptu weather briefing during the semester. Grades will be based upon criteria handed out at the beginning of the semester, and the written evaluations based on these guidelines will be provided by the instructor, TA, and student peers. Students will only be expected to synthesize the information that has already been covered in the course or in previous courses.

Project

There will be no in-class written final exam in this course. Instead, students are required to complete a project of their choice. Students are also required to work in groups of 3. Groups of 2 may be permitted only by the approval of the instructor if there are exceptional circumstances. General expectations are that students will choose to examine and evaluate a particular synoptic weather event using the tools learned in this course.

The final work will be presented orally to the class at the end of the semester; the only written component required is a project summary, **due at the end of week 8**. The project summary is expected to contain the following: (1) topic, (2) short literature review of related studies on your topic or case, (3) research goal and hypothesis stating what you expect to find, and (4) a proposed research plan for examining your hypothesis.

Oral presentations will be given during the last week of the semester. Students will be expected to demonstrate the ability to thoroughly examine a problem through use of the scientific process. Due to the number of students enrolled in the course, **there will be a strictly enforced time limit of 15 minutes** for each group. Students should plan to prepare a 12 minute presentation ahead of time to allow 3 minutes for questions from their peers, instructor, and TAs. Each student in the group will be expected to speak, but it is up to the group members to determine the particular allocations. Each student in a group should carry an equal work load overall (including the analysis work), which will be considered in the evaluation by the instructor and TA. Timeline and components:

Week 6	Topic and authors	2%
Week 8	1-2 page project summary due	3%
Weeks 9-15	Project research. Students will be given some time in class to work on them, however outside time will likely be required to complete it.	
Week 16	Oral presentations	20%

Tentative schedule				
Wk	**Date**	**Topic(s)**	**Reading**	**Lab**
1	Aug. 20	Course overview, review introduction to Python	Ch. 1 Ch. 12 (pp. 327-331)	Hand map analysis: Upper air; Python install party
2	Aug. 27	Surface analysis, fronts **Quiz 1**	Ch. 6 (§6.1,§6.4) Ch. 12 (pp. 331-334)	Python basics: Reproduction of hand analyses
3	Sept. 3	Frontogenesis Technical tools **No class Sept. 3**	Ch. 6 (§6.2,§6.3)	No lab
4	Sept. 10	No lectures		Hand map analysis: Surface, 250 hPa Python lab: Diagnosing frontogenesis
5	Sept. 17	Quasigeostrophic theory **Quiz 2**	Ch. 2 (pp. 35-50)	QG Omega Equation: Python diagnostics
6	Sept. 24	Quasigeostrophic theory **Quiz 3** **Project topic due**	Ch. 2 (pp. 50-67)	QG Height Tendency Equation: Python diagnostics
7	Oct. 1	Thermodynamic diagrams Extratropical cyclones: Vorticity perspective **Quiz 4**	 Ch. 5 (pp. 95-108)	Hand analysis: Skew T log-p
8	Oct. 7	Potential vorticity, Isentropic analysis, Upper-level fronts **Project summary due**	Ch. 3+4 Ch. 6 (§6.5) Ch. 12 (§12.3)	Python: Plotting PV
9	Oct. 15	Extratropical cyclones: PV perspective History of cyclones **Quiz 5**	Ch. 5 (§5.3.6) Ch. 5 (pp. 117-126)	Python: Extratropical cyclogenesis; Vorticity vs. PV perspectives
10	Oct. 22	Severe weather forecasting **Quiz 6**		Python: Jet streaks
11	Oct. 29	Winter weather forecasting	Ch. 9	
12	Nov. 5	Numerical weather prediction: Dynamical cores **Quiz 7**	Ch. 10: Sections 10.1-10.3	Python: Finite differencing and numerical integration
13	Nov. 12	Numerical weather prediction: Data assimilation Ensemble forecasting	Ch. 10: §10.5 §10.6	Python: Ensemble data assimilation
14	Nov. 19	Numerical weather prediction: Model physics **Quiz 8 (Tuesday Nov. 20)** **No class Nov. 21,22**	Ch. 10: §10.4	No Lab
15	Nov. 26	Conclusion		Work on projects
16	Dec. 3	**Project presentations**		None
		No Final Exam		