METR 5004: Fundamentals of Atmospheric Science (Fall 2013)

Instructor: Prof. Steven Cavallo
Class meetings: MTWR 10:00-10:50 in NWC 1313
Linux Lab available: MW 10:00-10:50 in NWC 5720
Office/Phone/email: NWC 5349 / 325-2439 / cavallo@ou.edu
Office hours: MTW 11am-12pm
Course web page: `http://weather.ou.edu/~scavallo/classes/metr_5004/f2013/`
Graders: Sam Lillo and Matt Elliott (NWC 5340)

Prerequisites: Graduate standing in a meteorology, physical science, or engineering program, or permission by instructor. Incoming graduate students are expected to have a working knowledge of calculus through ordinary differential equations (MATH 3113 or MATH 3413).

Course description:

Present a rigorous survey of the fundamental concepts in atmospheric science to provide the foundation for future graduate course work in meteorology and in related disciplines. The benefit to students in the graduate meteorology program who have undergraduate degrees outside of meteorology will be to provide sufficient background knowledge so that the students are prepared to successfully undertake graduate course work in meteorology. The benefit to graduate students with undergraduate degrees in meteorology is to present a breadth of subject areas that are not typically covered in most undergraduate programs and to cover these areas at the level of rigor expected in graduate studies. Graduate students in related fields, such as hydrology and radar engineering, will benefit from a survey of the important concepts in the atmospheric sciences. The course will be taught at a rapid pace due to the large amount of material covered.

Required text:

(1) "Atmospheric Science: An introductory survey" by John M. Wallace and Peter V. Hobbs.

Non-required but potentially helpful text books:

(1) "Atmospheric Chemistry and Global Change" by Guy P. Brasseur, John J. Orlando, and Geoffrey S. Tyndall
(2) "Introduction to Atmospheric Chemistry" by Daniel J. Jacob (available for free in its entirety at `http://acmg.seas.harvard.edu/people/faculty/djj/book/`)
(3) "Basic Physical Chemistry for the Atmospheric Sciences" by Peter V. Hobbs
(4) "Introduction to Atmospheric Chemistry" by Peter V. Hobbs
(5) "Doppler Radar and Weather Observations: Second Edition" by Richard Doviak and Dusan Zrnic

Notices:

It is the policy of the University to excuse absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required class work that may fall on religious holidays.

Any student in this course who has a disability that may prevent him or her from fully demonstrating his or her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your education opportunities.

Grading:

Grade percentages will be determined as shown below. Note that there will almost certainly be a grading curve, with *final grades based on a relative grade distribution of the class.* Course grade weights:

Component	**Tentative date**	**Relative weight**
Chemistry Midterm Exam	Thursday September 19	10%
Exam 1	Thursday October 24	20%
Exam 2	Thursday November 21	25%
Final Exam	Thursday December 12 8-10am	30%
Group tools tutorial	Monday or Wednesday	10%
Reading quizzes	Some Thursdays	5%

Reading quizzes:

Occasionally there will be short quizzes over the reading material from the Wallace and Hobbs (denoted as "W&H" on the schedule) textbook. Material will be *very similar* to homework problems provided at the end of each chapter in W&H. The best way to perform well on quizzes is to do the homework problems at the end of the corresponding chapters before the quiz. Each quiz will be closed notes and closed books, and will contain 3 sections: (1) Recitation of important constants and formulas, (2) explanations or interpretations of given phenomena, and (3) problems. Although quizzes will focus on the reading material of that particular week, there may also be questions from earlier material (especially if there was a problem missed by a large sample of the class).

There may be additional quizzes from material covered by guest lecturers that may not be from W&H. This will be up to the particular lecturer, and you will notified of the instructions for their preparation if necessary. You will be allowed to drop one reading quiz without penalty to take into account travel or an unavoidable absence.

Chemistry midterm exam:

Note that there will be an exam covering basic physical chemistry *before* your atmospheric chemistry unit in order to help you brush up on your chemistry background before jumping into atmospheric chemistry. Please read chapters 1,2,3,4,and 7 of "Basic Physical Chemistry for the Atmospheric Sciences" by Peter V. Hobbs before taking this exam. We will provide you with handouts of these chapters, so it is not necessary to buy this book. Exam questions will be similar to the problems found at the end of the corresponding chapters. We will also provide you with a handout containing hints and solutions to selected exercises from these textbook problems. The exam is closed notes and closed books.

Exams:

There will be 2 regular exams, tentatively planned for the dates listed on the schedule. Note that while the second exam will focus on the material covered after the first exam, there may be questions or concepts from earlier material. Exams will be closed notes and closed books.

Final exam:

The final exam is scheduled for Thursday Dec. 12 8-10am. It will be cumulative, closed notes, and closed books.

Group tools tutorial:

We will devote time for learning the fundamental "tools of meteorology." Students in this class bring in a wide, diverse range of computing and programming skills that can be used for scientific research analysis. Given the knowledge range students already bring in various areas, students will form small groups of around 3 people, and will lead the class through a tutorial of a research tool that they think they can offer their expertise.

The SoM "Linux Lab" (Room 5720) will be available each Monday and Wednesday during class time for you to give your tutorial, so try to include hands-on exercises where the class can apply the tools you are discussing. A list of possible topics is provided below, but feel free to suggest topics not listed below. Please let the instructor know what topic you would like to cover in your tutorial as soon as possible. If your topic is already taken, then use this as an opportunity to learn the basics of another research tool. It is often easier to show others something you recently learned yourself.

Suggested topics: Shell scripting, Version control, GitHub, Fortran, C, C++, HTML, Python, MATLAB, IDL, R, NCL, NetCDF, NetCDF operators (NCO), Data (i.e. where to find it, formats, various types available), LaTex, Makefiles, classes and objects, etc.

Tutorial format: Be creative in your method to show the class your research tool. One approach might be to provide a short overview presentation (∼10-15 minutes), then spend the rest of the time doing an active, hands-on exercise for all class members to try.

Tutorial grading

It is extremely important to evaluate the effectiveness of your tutorial. Otherwise, it is very difficult to improve your teaching and presentation skills in the future. The grade of your tutorial will reflect both the presentation **and** its effectiveness through the following grading options:

Option 1: You can choose to give the entire class a short quiz over the material covered in your tutorial at the end. This can either be written, or in the form of exercises/tasks that apply your tool. It could also be an in-class quiz, or a "take-home" quiz or homework set. Further requirements would be up to you (i.e. whether it is closed notes, open notes, length, etc.). You will be responsible for grading it and handing back corrected results to the class. **YOUR** grade will be the mean of the class scores.

Option 2: You present your tutorial without class feedback and/or participation. This leaves me as the sole grader for your tutorial and no attempt at quantifying your effectiveness.

Note that while you could choose to develop and hand out an evaluation form, this score would not sufficiently evaluate whether the class learned anything. Be sure that there is a sufficiently good attempt at quantifying its overall effectiveness.

Tentative schedule

Wk	Date	Topic(s)	Reading
1	Aug. 19	Introduction; The Earth System **Quiz: W&H Ch.1-2**	Ch. 1 Ch. 2
2	Aug. 26	Atmospheric dynamics **Quiz: W&H Ch.7**	Ch. 7
3	Sept. 2 **No class Sept. 2**	Atmospheric thermodynamics	Ch. 3
4	Sept. 9	Atmospheric thermodynamics (cont'd) Weather Systems I: Midlatitude meteorology **Quiz: W&H Ch.3,8**	Ch. 3 Ch. 8 (through 8.3)
5	Sept. 16	Weather Systems I: Midlatitude meteorology (cont'd)	Ch. 8
		Thursday September 19: Chemistry Midterm Exam Preparation: Ch. 1,2,3,4,7 of "Basic Physical Chemistry for the Atmospheric Sciences" by Peter Hobbs.	
6	Sept. 23	Atmospheric chemistry Guest lecturer: Dr. John Orlando (NCAR)	Ch. 5
7	Sept. 30	Cloud microphysics **Quiz: W&H Ch. 6**	Ch. 6
8	Oct. 7	The atmospheric boundary layer **Quiz: W&H Ch. 9**	Ch. 9
9	Oct. 14	The atmospheric boundary layer (cont'd) Radiative transfer **Quiz: W&H Ch. 4**	Ch. 9 Ch. 4
10	Oct. 21	Radiative transfer (cont'd)	Ch. 4
		Thursday October 24: Exam 1	
11	Oct. 28	Radar meteorology Guest lecturer: Dr. Richard Doviak (NSSL)	TBD
12	Nov. 4	Radar meteorology (cont'd) Guest lecturer: Dr. Richard Doviak (NSSL)	TBD
13	Nov. 11	Weather Systems II: High latitude and tropical meteorology Guest lecturer: Prof. Dave Parsons	Ch. 8.4 Journal articles TBD
14	Nov. 18	Numerical weather prediction Data assimilation Guest lecturer: Dr. Lou Wicker (NSSL)	TBD
		Thursday November 21: Exam 2	
15	Nov. 25 **No class Nov. 27, 28**	Climate Dynamics	Ch. 10
16	Dec. 2	Climate Dynamics **Quiz: W&H Ch. 10**	Ch. 10
		Thursday Dec. 12: Final Exam 8-10am	

Tools tutorial schedule		
Date	**Topic(s)**	**Lecturer**
Aug. 26,28 (Monday,Wednesday)	Introduction to Computing	Dr. Mark Laufersweiler
Sept. 4,11 (Wednesday, Wednesday)	[Group 1]	
Sept. 30, Oct. 2 (Monday, Wednesday)	[Group 2]	
Oct. 16,23 (Wednesday, Wednesday)	[Group 3]	
Oct. 30, Nov. 6 (Wednesday, Wednesday)	N/A	
Nov. 13,20 (Wednesday, Wednesday)	[Group 4]	
Dec. 2,4 (Monday, Wednesday)	[Group 5]	