ATMS 491: ATMOSPHERIC CONVECTION

Instructor: Dr. Jeff Frame
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Office Hours: M, W 1:30-2:30; T, Th 3:30-4:30
Also by appointment

Meeting Time: M W F, 11:30 - 12:20, 109 Atmospheric Sciences

Credits: 3 hours

Prerequisites: ATMS 301 (Atmospheric Thermodynamics), ATMS 302 (Atmospheric Dynamics I), or graduate standing.

Required Text: *Atmospheric Convection,* by Kerry Emanuel. ISBN 0-19-506630-8.

Course Description: This course provides a rigorous examination of atmospheric convection. Our investigation of convective processes will be both qualitative and quantitative to stress the linkage between convection as observed in the real atmosphere and its theory and governing dynamics. We will begin by formally defining convection (it is not just a synonym for thunderstorms!) and by reviewing select topics from traditional dynamics and thermodynamics courses. Topics to be covered in this course include the buoyancy force, the Boussinesq and anelastic approximations, local convection, boundary layers and Rayleigh-Benard convection, cumulus clouds and entrainment, convective storm environments, ordinary (single-cell) convection, multicellular convection, mesoscale convective systems, supercelluluar convection, tornadoes, and numerical simulations of deep moist convection.

Course Websites: Important course information, including lecture summaries, in-class animations, homework assignments, course announcements, and other materials will be made available online via Compass on a regular basis. Downloading this material is **not** an adequate substitute for attending class; it is intended to provide you with some of the imagery shown during the lectures. Many key details will be missing from these summaries and will be given in class. Course Website: http://compass2g.illinois.edu

COURSE WORK:

Homework Assignments: Homework sets will be assigned occasionally throughout the semester. These assignments may consist of weather analyses, qualitative reasoning questions, and quantitative problems (occasionally rigorous) designed to help you learn the material and to develop your scientific problem solving skills. Assignments will be posted on Compass and handed out in class. You may work together on these assignments; however, each of you must submit the solutions in your own words and include all details of any work

which led to the solution. *Verbatim copying of answers on homework assignments will not be tolerated under any circumstances*. Late homework assignments will be penalized by 20% for each day that they are late. If you have a valid excuse for not being able to complete an assignment on time, please let me know before it is due.

Exams: There will be two exams during the semester. The first exam will be held in the evening and the second exam will be held during finals week (dates and times TBA). The exams will not be designed to be cumulative; however, it is the nature of meteorology courses that many concepts covered early in a course are often necessary for a complete understanding of the materials covered later in a course. The focus of any exam will be on the material covered since the previous exam. **You are required to take exams during the scheduled time.** Exams cannot be made up except in extremely unusual circumstances and absolutely must be cleared with me in advance.

Quizzes: Brief quizzes will be given in class throughout the semester. These quizzes will always be announced at least one class period in advance and will be designed to test your understanding of a particular topic. If you will be absent on a quiz date, you must let me know *in advance* to be permitted to make up that particular quiz. Failure to do so will result in a grade of zero for that quiz, except in unusual circumstances.

Final Project: All students will be required to submit a final project by the end of the semester. This project will consistent of a five page (double-spaced) paper (not including figures) summarizing at least one peer-reviewed manuscript relevant to the course material (e.g., theoretical foundations of convection, dry convection, convective storm environments, maintenance of mesoscale convective systems, supercell and tornado dynamics). All papers must be approved by me prior to beginning the project. The deadline for manuscript selection is Friday, November 1.

Class Participation: The best learning environments are when students participate actively in the class discussions via asking questions and contributing personal weather experiences and knowledge. Asking questions in class is always encouraged.

Grading: Your grade will be calculated as follows:

15% Exam I	A+	> 97%	C	72 - 77%
20% Final Exam	A	92 - 97%	C-	70 - 71%
15% Quizzes	A-	90 - 91%	D+	68 - 69%
15% Final Project	B+	88 - 89%	D	62 - 67%
30% Homework Assignments	B	82 - 87%	D-	60 - 61%
5% Class Attendance and Participation	B-	80 - 81%	F	< 60%
	C+	78 - 79%		

TENTATIVE READING LIST

Below is a list of topics to be covered in this course, along with the relevant pages to be read from the textbook. When we are nearing the conclusion of a certain topic in class, please begin reading about the following topic in your textbook.

Definition of convection and the buoyancy force	1.1-1.2
Boussinesq and anelastic approximations	1.3
Review of thermodynamics, skew-Ts, and stability	Ch. 4-6
Local convection: Thermals and plumes	Ch. 2
Rayleigh-Benard (dry) convection	Ch. 3
Cumulus clouds and entrainment	Ch. 7-8
Ordinary convection and convective storm environments	9.1-9.2.0; 11.1-11.3; 11.6
Multicellular convection and mesoscale convective systems	9.2.1; 9.3-9.4; 11.4
Supercellular convection	9.2.2; 11.5
Tornadoes	
Numerical simulations of deep moist convection	Ch. 10

COURSE POLICIES

Email: I will strive to answer all emails in a timely matter. Email should be reserved for quick questions, especially after hours. If you have a more significant question or other problem, do not hesitate to stop by my or office during office hours or to make an appointment. Please include "ATMS-491" in the subject line when emailing me.

Respect: You will treat other students and me with respect and will ensure that the classroom is a good learning environment free from disruptions such as extraneous conversation and *the ringing of cell phones*. The use of classroom computers and cellular phones for non-class related activities, **including Facebook**, is not permitted during class time. Please come to class on time. If you must come to class late or leave early, please do so without disrupting the class. Each class will start and end on time.

Academic Integrity: You are permitted work together on homework assignments, but the final product must be your own; students turning in assignments that are blatantly copied will receive no credit. You are expected to complete your exams independently. Failure to do so will result in strict disciplinary action. Please see http://www.uiuc.edu/admin_manual/code/rule_33.html for more information.

Special Needs: To insure that disability-related concerns are properly addressed from the beginning of the course, students with disabilities who require reasonable accommodations to participate in this class are asked to see the instructor as soon as possible in accordance with university policy. For more information, please visit http://www.uiuc.edu/admin_manual/code/rule_4.html