SIOC 217A - Atmospheric & Climate Sci I - Russell [FA17]
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Syllabus

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Course Syllabus

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DESCRIPTION

The course goal is to provide knowledge of atmospheric structure, composition and processes. This course is designed to provide an enduring understanding of: energy content and transfers, water saturation, and climate forcings and feedbacks. The essential questions that will focus, guide, and sustain learning during the course are:

- What does energy content and transfer reveal about the Earth's temperature?
- How does water saturation link clouds, temperature, and stability in the atmosphere?
- How do forcings and feedbacks shape my views of human role in the Earth system?

This course is designed to provide first-year graduate students with climate-relevant knowledge of the atmosp some students are focused on this area specifically for future research and others just want some introd knowledge. The course is designed to address both of these interests.

LEARNING OBJECTIVES

After completing this course, students will know how to apply thermodynamic principles to understa atmospheric processes and students will be able to explain the role of thermodynamic relationships in atmos processes. Specific objectives of this course are listed by chapter below.

Chapter 1: Identify fundamental thermodynamic concepts.

1. Relate pressure, temperature and energy to define the state of a fluid.
2. Quantify the kinetic theory of gases using the ideal gas equation of state.
3. Apply the hydrostatic balance to idealized conditions.

Chapter 2: Describe heat-work cycles, including the Carnot cycle.

1. Evaluate the heat and work associated with specific adiabatic or isothermal state changes.
2. Distinguish between states and pathways.
3. Use the first and second laws of thermodynamics to quantify energy, heat, and work.
4. Distinguish between enthalpy, entropy, and Gibbs free energy.
5. Evaluate hurricanes as Carnot cycles.

Chapter 3: Describe optical properties and radiative balance of the atmosphere.

1. Define optical properties of the atmosphere and use them to describe radiative transfer.
2. Distinguish between diffuse and direct, irradiance and radiance, absorption and reflection.
3. Define radiative transfer laws: Kirchoff, Wien, Stefan-Boltzman, Planck
4. Use the principles of blackbody radiation to describe Earth's radiative balance (Ch. 12).

Chapter 4: Identify what controls water phase transition.

1. Sketch the phase diagram of water and explain the meaning of its lines and spaces.
2. Apply the Clausius-Clapeyron equation to calculate the change in saturation pressure.
3. Define the variables used to track atmospheric water and energy.
4. Identify and explain the unique properties of water and its role in cloud formation.

Chapter 5: Learn aerosol-cloud transition processes.

1. Explain the role of nucleation (activation) in forming new phases.
2. Describe what controls the role of particles in forming clouds using the Kohler equation.
3. Review the history of advances in our understanding of cloud formation processes.

Chapter 6: Quantify processes associated with cloud formation.

1. Identify the causes of cloud formation and the processes that are relevant.
2. Evaluate the amount of water that will condense when a cloud forms.
3. Use dew point temperatures as a metric of relative humidity.

Chapter 7: Evaluate atmospheric stability and describe its role in vertical circulation.

1. Describe how water vapor and liquid affect the degree (and sign) of stability.
2. Define convective available potential energy and apply it to describing changes in clouds.

Chapter 8: Describe cloud characteristics for types of low, middle, and high clouds.

1. Distinguish optical properties for different cloud types.
2. Distinguish likelihood for precipitation for different cloud types.

Chapter 12: Relate Earth's radiation budget to large-scale circulation.

1. Use simple climate model to evaluate the components that affect global mean temperature.
2. Describe the different energy streams that affect the Earth's radiative balance.
3. Identify the consequences of radiation for driving circulation poleward and longitudinally.

Chapter 13: Explain three examples of climate feedbacks.

1. Distinguish between climate forcings and feedbacks.
2. Explain three important feedback loops in the Earth system.

REQUIRED MATERIALS

The required text is *Thermodynamics of Atmospheres and Oceans*, J. A. Curry & P. J. Webster (1999). It is available for purchase at the Bookstore and is also available as pdf on the course website. Supplementary reading material and handouts (or links to them) are posted on the TritonEd course site.

Course Schedule

Date	Dy	Ch	Skip:	**Hmwk**	Topics
2-Oct	M	1	1.2, 1.8-9		What is thermodynamics? What do thermodynamics contro class?
4-Oct	W	1			What is required for hydrostatic balance and how does it de ideal gas law relevant?
6-Oct	F	2			What are the First and Second Laws of Thermodynamics? Processes?
9-Oct	M	2	2.11		How does energy drive a hurricane? How is this energy cyc energy in each step?
11-Oct	W	3	3.4-6		What equations govern radiative energy? What are the type radiation?
13-Oct	F			**1+2**	Group Project Assignments.
16-Oct	M				No Class (rescheduled to 10/6/17).
18-Oct	W			**EXAM**	Optional Pre-Assessment Exam.
20-Oct	F			**Pick2ndPub**	Group Project Work Time (no Office Hour).
23-Oct	M	12.1			How can the radiative equations be applied to a planet? Wh changed?
25-Oct	W	4	4.5-6		What makes water unique? How does its molecular structu used to track water?
27-Oct	F			**3+4**	Office Hour and Group Project Work Time.
30-Oct	M	5	5.5-7		How does a new phase form? How does size and composi in a cloud?
1-Nov	W	8			What conditions are needed to form a cloud? What causes precipitation will form?
3-Nov	F			**Fig&Pnt**	Office Hour and Group Project Work Time.
6-Nov	M	8			What are the basic types of low and high clouds? Which ar cooling?
8-Nov	W				Review for Midterm (Ch. 1-4 plus 12erb - Energy Balance).
10-Nov	F				Holiday: Veteran's Day.
13-Nov	M			**EXAM**	Midterm (Ch. 1-4 plus Ch. 12erb - Energy Balance)
15-Nov	W	6			How does latent heat contribute to cloud development? Ho diagrams tell us?
17-Nov	F			**5+8**	Ofice Hour and Group Project Work Time.
20-Nov	M	7	(skim eq'ns)		When does air rise and when does it fall? What do we nee
					How is energy transferred around the Earth? What human

22-Nov	W	12		**SubmitMS**	changes amplified?
24-Nov	F				Holiday: Thanksgiving.
27-Nov	M	13	13.6-7	**ReviewDue**	What three feedbacks have the biggest known effects on E
29-Nov	W	13			Why are climate models uncertain? What parts of climate n
1-Dec	F			**6+7**	Office Hour and Group Project Work Time.
4-Dec	M			**SubmitPPT**	Project Presentations (submit presentations by noon on 12/
6-Dec	W				Project Presentations (submit presentations by noon on 12/
8-Dec	F			**SubmitFnl**	Final Exam Review (Ch. 1-8, 12, 13, Projects).
14-Dec	Th			**EXAM**	Final Exam (Ch. 1-8, 12, 13, Projects) at 11:30-2:30, Locati

Course Information

This course is part of an integrated 3-quarter series (SIO 217 a, b, c). Although it is formally a lecture course, we will incorporate student participation and student projects as integral parts of class. This form of teaching recognizes that students come to class with prior knowledge on the topics to be studied. Sometimes this knowledge is profound and accurate. Sometimes it isn't. Learning involves first confronting our prior knowledge. This form of teaching also stresses the similarity between the learning experience and the research experience. We learn by actively engaging in formulating questions and discovering the answers to them. This is very different from rote memorization of facts, lecture notes and pages of text.

This class will involve intensive student participation in interactive learning exercises, as well as a group term project to be presented in class and in reports. I will use class time for interactive learning exercises that

- reinforce key terms, definitions, and equations or
- explore challenging concepts with additional information and different perspectives.

I will generally not simply repeat the material in the text. Here are my expectations:

Participate fully in every class that you attend. Read the text before class. Always bring the text and your laptop to class. Take your own notes in addition to the posted slides. Study the assigned material in advance, especially by viewing the podcasts and reading the chapters before class. Be an active participant in class; do not just sit and listen.

There are 10 weeks in the quarter, and we will try to cover 10 chapters of the text, thus about a chapter per week. The ten chapters we will study are 1, 2, 3, 4, 5, 6, 7, 8, 12, and 13. In several chapters, I will specify some of the material to skip. The homework provides practice in key concepts; you are encouraged to get help from me or other students, but the answers you turn in must be in your words with answers that you can explain and defend.

Expect frequent questions about the readings and in-class assignments that test or document your understanding. I will give guidance in advance on which material is most important. In particular, always know the meaning of every word in the assigned portions of the text because learning the "jargon" of the atmosphere is an important part of this class. Quizzes and the mid-term and final exams will include definitions.

IMPORTANT: In this course, you must not remain silent. You must speak as well as listen. If English is not your first language, make use of this opportunity to practice your English.

Course Policies

Basis for Final Grade: The goal of the quizzes will be to help the student to learn various nomenclature and background of education. Exams are announced in advance and cannot be rescheduled (except with a letter from a "dean, divinity, doctor, or DoD"). Grading will be as follows:

Assessment	Grade	Learning Purpose
Quizzes and Discussion/Surveys	10%	Aid memory, practice terms,
Participation or Pre-Assessment	10%	Develop and demonstrate c

Homework	20%	Check mastery of basic calc
Midterm (and Optional Correction)	20%	Assess mastery of core con
Group Term Project	10%	Demonstrate application of
Final Exam	30%	Assess mastery of all course

Grading Scale:

- 90 – 100% A
- 80 – 89% B
- 70 – 79% C
- 60 – 69% D
- 0 – 59% F

Grade Dissemination: Graded tests and materials in this course will be returned individually. You can access your scores at any time on TritonEd.

Late Work Policy: There are no make-ups for quizzes or exams. I do not accept late work. TritonEd is configured to accept completed assignments up to the midnight of the due date and then it will not accept submissions. I will share complete information on assignments to allow ample time for completion if you do not procrastinate. Please respect the time of your instructors and your colleagues; plan ahead and submit on time so that we can all progress through this learning experience together.

Grades of "Incomplete": The current university policy concerning incomplete grades will be followed in this course. Incomplete grades are given only in situations where unexpected emergencies prevent a student from completing the course and the remaining work can be completed the next semester. Your instructor is the final authority on whether you qualify for an incomplete. Incomplete work must be finished by the end of the subsequent quarter or the "I" will automatically be recorded as an "F" on your transcript.

Group Work Policy: Everyone must take part in a group project. All members of a group will receive the same score; that is, the project is assessed and everyone receives this score. However, that number is only 90% of your grade for this project. The final 10% is individual, and refers to your teamwork. Once formed, groups cannot be altered or switched, except for reasons of extended hospitalization.

Disability Access: Students requesting accommodations for this course due to a disability must provide a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD), which is located in University Center 202 behind Center Hall. Students are required to present their AFA letters to Faculty (please make arrangements to contact me privately) and to the OSD Liaison in the department in advance so that accommodations may be arranged. Contact the OSD for further information: 858.534.4382 (phone); osd@ucsd.edu(email); http://disabilities.ucsd.edu (website).

Title IX Compliance: The University recognizes the inherent dignity of all individuals and promotes respect for all people. Sexual misconduct, physical and/or psychological abuse will NOT be tolerated. If you have been the victim of sexual misconduct, physical and/or psychological abuse, we encourage you to report this matter promptly. As a faculty member, I am interested in promoting a safe and healthy environment, and should I learn of any sexual misconduct, physical and/or psychological abuse, I must report the matter to the Title IX Coordinator. Should you want to speak to a confidential source you may contact the Counseling Center. The Office for the Prevention of Harassment & Discrimination (OPHD) provides assistance to students, faculty, and staff regarding reports of bias, harassment, and discrimination. OPHD is the UC San Diego Title IX office. Title IX of the Education Amendments of 1972 is the federal law that prohibits sex discrimination in educational institutions that are recipients of federal funds. Students have the right to an educational environment that is free from harassment and discrimination. Students have options for reporting incidents of sexual violence and sexual harassment. Sexual violence includes sexual assault, dating violence, domestic violence, and stalking. Information about reporting options may be obtained at OPHD at (858) 534-8298, ophd@ucsd.edu orhttp://ophd.ucsd.edu. Students may receive confidential assistance at CARE at the Sexual Assault Resource Center at (858) 534-5793, sarc@ucsd.edu orhttp://care.ucsd.edu or Counseling and Psychological Services (CAPS) at (858) 534-3755 orhttp://caps.ucsd.edu. Students may feel more comfortable discussing their particular concern with a trusted employee. This may be a student affairs staff member, a department Chair, a faculty member or other University official. These individuals have an obligation to report incidents of sexual violence and sexual harassment to OPHD. This does not necessarily mean that a formal complaint will be filed. If you find yourself in an uncomfortable situation, ask for help.

Attendance Policy: All students are responsible for all information and updates provided in all scheduled lectures. My expectations for your physical and mental attendance of class and project times is that you be prepared, engaged, and "present" for all discussions or activities. Illness and unforeseen circumstances may prevent you from attending one or two classes during the quarter, and as a matter of courtesy please let instructors and team members know when you will be missing and how you will make up the missed time. Automated podcasts have been scheduled, but they do not always work and do not necessarily include all information given in class (since they do not record what is written on the board). Attendance for the interactive learning modules during class is optional, but if you are not going to attend then provide the written approval of your degree program advisor. Attendance at scheduled group project work times (Fridays starting third week) is required, unless a schedule for alternative meeting times is approved by all members of the group and submitted to the instructor by the second group meeting.

Professionalism Policy: I expect the classroom to be an active, open environment, which encourages diverse

thought and comments. Please attend to all university policy and classroom etiquette procedures. Those not heeding the policies will be asked to leave the classroom/lab immediately so as to not disrupt the learning environment. Please arrive on time, be attentive, and respectful for all class meetings. Students who habitually disturb the class by talking, arriving late or other unprofessional behavior may suffer a reduction in their final class grade. Active, positive, engaging, participation in class activities is essential. As pre-professionals, you should be at the point in your career where you have learned to ask and answer these questions:

1. How do I know when I know something? What is the evidence and how reliable is it?
2. How are things, events, theories, models or people connected? What is the cause and effect?
3. What is new and what is old - have I run across this idea before? When, where, what did it mean to me then, and how I can expand and further connect the concept now?
4. So what? Why does it matter? What does it all mean?

Academic Conduct Policy: The Policy on Integrity of Scholarship aims to encourage and maintain the highest ethical standards in research. The policy reaffirms the University's commitment to integrity: Integrity is essential for an academic community. The University expects that both faculty and students will honor this principle and in so doing protect the validity of University intellectual work. For students, this means that all academic work will be done by the individual to whom it is assigned, without unauthorized aid of any kind. Instructors, for their part, will exercise care in planning and supervising academic work, so that honest effort will be upheld. It is against policy to submit the same paper for credit in more than one course (http://senate.ucsd.edu/manual/appendices/appendix2.pdf).

Instructor Goals. At a minimum, I hope to pursue the following goals and solicit your open and timely feedback on how well we are meeting these goals:

- Communicate effectively and frequently;
- Be an enthusiastic, active and involved;
- Demonstrate a mastery of the discipline;
- Relate material to current practice and research;
- Clearly explain complex concepts and ideas;
- Provide a framework for lifelong learning;
- Strive to involve participants in class activities;
- Be available to assist participants in or out of class; and
- Have respect and concern for all participants.