ATS 601: Atmospheric Dynamics I
Course Syllabus for Fall 2017

Class: 09:00AM - 09:50AM WF, ATS 101

http://barnes.atmos.colostate.edu/COURSES/AT601_F17/index.html

1 Instructor

Prof. Elizabeth A. Barnes

Office:	ATS 402
email:	eabarnes@atmos.colostate.edu
Office Hours:	W 15:00 - 16:45, or by appointment

2 Teaching Assistant

Andrea Jenney

Office:	ATS West 212
email:	andrea@atmos.colostate.edu
Office Hours:	W 11:00 - 13:00, or by appointment

3 Course Focus

Atmospheric dynamics constitutes a branch of the larger field of geophysical fluid dynamics which it-self is embedded in the general field of fluid mechanics. Geophysical fluid dynamics aims at understanding the underlying mechanisms of atmospheric and oceanic motion over a vast range of spatial and temporal scales. Although much of the study of geophysical fluid dynamics requires simplifications to the underlying physics, much can be gained by studying such simplified systems. In fact, many of the conclusions drawn from these simplified systems carry-over directly to the real atmosphere/ocean. This course covers the first fundamentals of geophysical fluid dynamics with an emphasis on the atmospheric component.

During this course you will:

- become more comfortable with basic vector mathematics and how to physically interpret the equations of motion,
- become familiar with atmospheric dynamics jargon,
- learn the fundamental physics of geophysical fluid mechanics,
- run and analyze output from a simple atmospheric circulation model,
- practice writing-up scientific results in a professional manner.

4 Scheduling

Lectures will typically be taught on WF from 9:00-9:50 in ATS 101. However, there will be multiple occasions when lectures will need to be rescheduled. The dates and times of the canceled and rescheduled lectures will be posted on the course website and discussed in class.

5 Course Expectations

The following list presents the minimum requirements for passing this course:

- show-up to class <u>on time</u> and ask questions,
- keep up with the reading (when applicable),
- submit all assignments on time and at an acceptable level of quality (it is expected that you will spend *at least* 2 hours of effort outside of class for each hour of class time),
- satisfactorily complete all exams

6 Course Prerequisites

You are expected to be familiar with basic high-school and college-level mathematical concepts. Minimal time will be spent in lecture reviewing these topics:

- algebra
- basic calculus (e.g. how to take a derivative and an integral)
- vector calculus (e.g. dot products, cross products)

If you are concerned about your background in these areas, please speak with me. While the concepts, tools, and techniques explored in this course will be taught within the context of atmospheric science, there are no atmospheric science prerequisites.

You will be expected to write and implement computer code throughout this course. I do not care what software you use, but note, I will not spend office hours debugging your code for you.

7 Course Web Page

The course web site will be used for posting notes and homework assignments and providing additional resources. The course web site is available through the instructors webpage and is listed at the top of this syllabus.

8 Grading

The overall course grade will be made up of two different components: homeworks and exams, with homeworks covering 70% of your grade, and exams covering the other 30%.

8.1 Homework

There will be approximately 1 homework per week throughout this course (although I maintain the right to increase or decrease this number), with homeworks typically due on Fridays.

If you need help in completing the assignment, first ask your peers for assistance and request help from your TA and instructor second. You are *encouraged* to interact with your classmates by sharing ideas and discussing the specifics of the material and homeworks. You are, however, expected to hand-in your own homework assignment, and it should not be a direct copy of your classmate's.

Your homework assignments must be clear and legible (see discussion below on LaTeX). All variables should be defined, all steps described, and all figures and sketches of good quality. By doing this, you are not only being nice to me and the TA who have to read your work, but you will gain practice in presenting your results clearly and professionally as required for your careers as scientists.

8.2 Exams

There will be four in-class exams throughout the semester. There will be no "pop" quizzes. The exams will cover lectures, assigned reading, and previous homework problems. Exams will be closed notes. There will not be a final exam in this course.

9 Texts & Resources

There is no required textbook for this course, however, for those of you interested in dynamics I highly recommend G. Vallis' textbook (see below). The lecture material will rely mostly on the my lecture notes (to be distributed during the course). There is one required resource in this course - **the internet**. Google is amazing - use it. One of the most important things to learn in graduate school is "how to look it up." If the the approach from class isn't clear to you, odds are that someone else has come up with an alternative method of explaining the concept that jives with your learning style. So Google it!

Many of the materials including notes and homeworks in this course are borrowed from the course materials of Prof. Wayne Schubert and Prof. Thomas Birner. You can access these notes through the course webpage. Additionally, there are three highly recommended texts that, while not required, are fantastic resources for this course and beyond:

- Vallis, G. K., 2017: Atmospheric and Oceanic Fluid Dynamics, Cambridge University Press, (Chapters 1-4); (also see http://empslocal.ex.ac.uk/people/staff/gv219/aofd/index.html)

- Holton, J. R., 2004: An Introduction to Dynamic Meteorology, 4th Edition, Academic Press (or 5th Edition by Holton and Hakim, 2012)

- Marshall, J. and R. A. Plumb, 2008: Atmosphere, Ocean, and Climate Dynamics, An Introductory Text, Academic Press (Chapter 6-7)

10 Software

10.1 Analysis & Plotting Software

You are required to have an analysis and plotting software package (often they are one in the same) with which you can do the homeworks. I do not care what you use, but I recommend you talk with your advisor to determine what will be most useful for you and your future research.

10.2 *Optional: LaTeX*

LaTeX[1] is a type-set program that takes macro code and formats it into a final (often pdf) document. For example, this syllabus was written with LaTeX. The end result is a clean, consistently formatted document. More and more scientists are using LaTeX to write-up their research, and journals are increasingly preferring LaTeX files to Mircrosoft Word files for manuscript submission.

A main reason to use LaTeX is the ease with which mathematical symbols, equations, etc. are formatted. In addition, including figures is efficient: the user does not "cut and paste" the figure into the text, but rather places the actual document path of the figure in the LaTeX code. Thus, whenever the figure is changed, it is automatically updated in the manuscript file. LaTeX is free and can be used on all common operating systems (e.g. Linux, Mac, Windows).

---

[1]pronounced "LAY-tek" or "LAH-tek".

I will not require that you use *LaTeX* for your homeworks, however, I highly encourage you to do so, and a handout will be provided at the beginning of the semester to get you up and running. While the initial learning curve is rather steep, I think that the payoff is worth it. Equation type-setting is easy and always neat, figures will be easily updated, and references are straight-forward to handle with *BibTeX*[2].
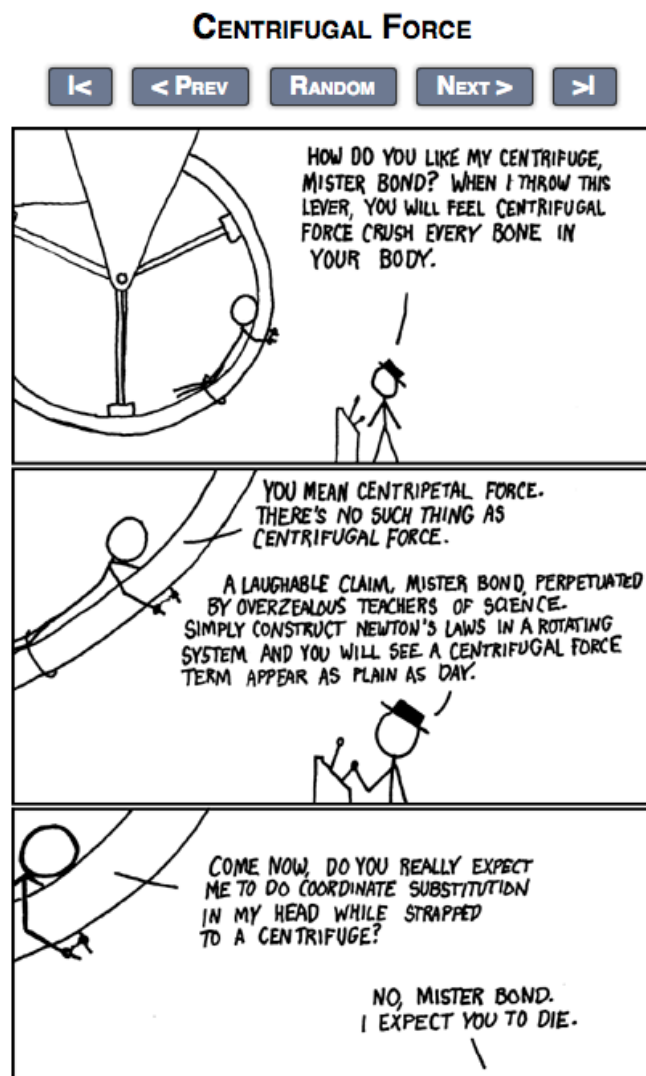
11   CSU Honor Pledge

This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity) and the Student Conduct Code (http://www.conflictresolution.colostate.edu/conduct-code). At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

12   Tentative Outline

The following is a tentative outline for the class. Reality will almost surely deviate from this outline.

1. **General Mathematical Concepts**
2. **The Equations of Motion**
3. **Earth's Rotation**
4. **The Primitive Equations**
5. **Balanced Motion**
6. **Rotational Flow**
7. **Rossby Waves**
8. **Shallow Water Models**
9. **Potential Vorticity**

---

[2] *LaTeX*'s bibliography manager.