ATS 601: Atmospheric Dynamics I
Course Syllabus for Fall 2019

Class: 10:00AM - 10:50AM TTh, ATSW 121

1 Instructor

Prof. David W. J. Thompson

Office:	ATS 430
email:	davet.colostate.edu
Office Hours:	W 14:00 - 15:00, or by appointment

2 Teaching Assistant

Simchan Yook

Office:	ATS 428
email:	Simchan.Yook@colostate.edu
Office Hours:	Tuesday 15:00 - 16:00, or by appointment

3 Course Focus

Atmospheric dynamics constitutes a branch of the larger field of geophysical fluid dynamics which itself is embedded in the general field of fluid mechanics. Geophysical fluid dynamics is focused on understanding the underlying mechanisms of atmospheric and oceanic motion over a vast range of spatial and temporal scales. Much of the study of geophysical fluid dynamics requires simplifications to the underlying physics, but 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,
- download and analyze output from atmospheric Reanalyses,
- practice scientific writing.

4 Scheduling

Lectures will typically be taught on TTh from 10:00-10:50 in ATSW 121. 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:

- attend class 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 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)

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

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 Canvas.

8 Grading

The overall course grade will be made up of three different components: 1) homeworks (60%), 2) exams (30%), and 3) the final project (10%).

8.1 Homework and Final Project

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 Thursdays.

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.

The Final Project will be handed out during the latter half of the class and will be due during finals week. It will include analyses of observations.

8.2 Exams

There will be four in-class exams throughout the semester. 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**. 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. The course website lists three highly recommended texts that, while not required, are fantastic resources for this course and beyond.

The original materials for this course were developed by Prof. Wayne Schubert and Prof. Thomas Birner. The course notes in their current form were developed by Prof. Elizabeth Barnes, but have been edited by me in places.

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 Microsoft 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).

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].

[1] pronounced "LAY-tek" or "LAH-tek".
[2] *LaTeX*'s bibliography manager.

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**