ATM 651: Introduction to Atmospheric Dynamics

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Brief Description for UM Bulletin: This course surveys the dynamics of atmospheric flow and weather phenomena, aiming at the first-year graduate level.

Course Description: This course surveys the dynamics of atmospheric flow and the physically-grounded description and depiction of weather phenomena. It is intended to serve as core preparation for incoming PhD students whose research will be dynamical, while also serving as an accessible overview for students in other subdisciplines. For these reasons, it stresses phenomena and the essentials of our physical discourses about them (emphasizing useful approximations), with enough exposure to the underlying full-complexity fundamentals to facilitate more advanced study, and to at least appreciate dynamical research seminars in the future.

Texts (optional; on reserve):

<u>Atmospheric Science: An Introductory Survey</u> (second edition), by Wallace & Hobbs.

<u>An Introduction to Dynamical Meteorology</u> (fifth edition) by Hakim and Holton.

<u>Essentials of Atmospheric and Oceanic Dynamics</u> by Vallis.

<u>Atmospheric Convection: The Short Course</u>, Mapes (book in preparation; handouts).

Learning Objectives:

1) Students will be familiar with the *physical/mathematical framing* of discourse about atmospheric flow, the main *dynamical phenomena* of weather and climate science, the and the *words in common use for all these concepts*.
2) Students will memorize and understand the meaning of the 5-6 differential equations in 5-6 unknowns that "govern" atmospheric dynamics, and how additional processes (like physical heating/cooling and interchanges among scales of motion and phases/habits of water) plug into those equations.
3) Students will be able to access, manipulate, display, and speak and write meaningfully about atmospheric data in light of the above.
4) Students will be able to access, parse, and paraphrase or summarize scientific literature.

Prerequisites:
College physics and math (up to multivariate calculus), or permission of instructor.

<u>Course Policies</u>
Class Attendance:

Attendance is essential for learning the material taught in class. Absences must be communicated, preferably in advance, and students will be assigned to summarize the session they missed (synthesizing the notes of others).

Honor Code:
Collaboration and peer learning are actively encouraged, but students are expected to follow the University of Miami's honor code (https://www.grad.miami.edu/_assets/pdf/graduate_student_honor_code_2016_2017.pdf).

Course Structure:

1. Socratic participation in class will be elicited by random draw, mostly on matters of pure logic and thought to keep everyone's brains engaged, but occasionally on the facts or results of reading or prior teaching. Good sportsmanship is appreciated, and a participation score is part of evaluation.
2. Homeworks will be assigned, to make students touch and modify the equations and words and concepts. Some assignments utilizing visualizations with The IDV software and Python computations (in Jupyter notebooks) will require computer access and use.
3. Two exams will be given (early-mid and late-mid term), with the aim of spurring synthesis and retention. These will center on homework material; any shortcomings may be partly redeemed through extra homework.
4. Final project: You will present some weather phenomenon case study with emphasis on some course-related academic aspect; or a computational or other elucidation of course principles; or a critical summary of >3 interrelated literature papers. The level can match students' experience and skill levels: there is plenty of room for elementary lessons to be appreciated more deeply and shared, as well as for advanced topics to be explained well to peers. The main goal will be finding the proper voice in these expressions (not overconfident nor underconfident; not too general nor too specific) in light of the complexities of particular situations and the limits of specific and general knowledge.

Grading:

1. 40% Attendance, class participation, homework assignments
2. 30% Two exams (15% each)
3. 30% Final presentation

<u>Three main blocks:</u> (detailed plan after we get to know each other)

The course will have 3 main blocks of about 4-5 weeks, with exams after I and II.

Block I: The math and physics: equation sets, derived results, concepts, words for all
Block II: Classical idealizations (waves, cyclones, fronts, clouds, storms)
Block III: Applications: real situations, recent literature, project related material