Atmospheric Dynamics or Dynamics and Synoptic Meteorology
EAS 4655 or EAS 6502 (3 Credit Hours)
Fall 2023

Lecture Meeting Times: MW 11:00 AM – 12:15 PM
Lecture Location: L1116 Ford ES&T

Instructor: Dr. Zachary Handlos
Office: 1251 Ford ES&T Building
Office Hours: 10:30 AM – 12 PM Mondays, 1-3 PM Wednesdays or via appointment – in-person or virtual appointments both OK!
Email: zachary.handlos@eas.gatech.edu

TA: Faria Panwala
Office Hours: By appointment
Email: fpanwala3@gatech.edu

Course Prerequisites:
- MATH 2551
- MATH 2552

******It is strongly recommended that you have completed or concurrently enroll in EAS 2750: Physics of the Weather while taking this course******

Required Textbooks
- Holton, J. R. and G. J. Hakim (2012), *An Introduction to Dynamic Meteorology*; ISBN-13: 978-0123848666.
- Martin, J. E. (2006), *Mid-Latitude Atmospheric Dynamics: A First Course*; ISBN-13: 9780470864654.

Course Description
At the heart of all weather, climate and other atmospheric phenomena on Earth is that of fluid dynamics. It is dynamical theory that can describe the complexity of the atmosphere, how to best observe atmospheric motions and how to best predict such motion. It is vital that an atmospheric scientist develops an appreciation and sufficient understanding of the fluid atmosphere for their career, whether they pursue an academic path, work within the government sector focusing on protecting citizens from inclement weather and climate events or even that of the private sector, where an understanding of atmospheric motion can dictate the company and corporate logistics.

If you are enrolled within this course, you will likely have had some experience with weather and climate, whether it be from taking an introductory atmospheric science course or simply experiencing such phenomena within your daily life. This course will take your understanding of the atmosphere to the "next level" by helping you learn how to apply calculus and physics towards understanding of the fundamental laws and principles that govern the Earth's atmosphere. While not the primary focus of this course, such dynamical concepts can readily be applied to Earth's oceans as well as similar atmospheric and oceanic fluid bodies on other planets, moons and exoplanets.

Learning Outcomes

The following learning outcomes will be accomplished as a result of successful completion of this course (i.e., passing this course):

1) Answer questions on course problem sets and knowledge checks accurately, demonstrating successful application of math and physics theory toward atmospheric dynamics theory
2) Improve scientific communication skills through course participation assignments
3) Reflect on one's own understanding and knowledge growth through self-reflection and self-assessment
4) Increase confidence in defending one's accomplishments within the course through mid-semester and final course assessments

Course Topics

1) Calculus review, including Lagrangian vs. Eulerian derivatives
2) Flow Kinematics
3) Fundamental forces
4) Mass, Momentum and Energy
5) Scale Analysis
6) Vertical Coordinate Systems
7) Circulation and Vorticity

Ungrading for Grading

This semester, an "ungrading" approach will be used to determine your grade within this course (adopted from Dr. Janel Hanrahan's dynamics course at Northern Vermont University). Below is an explanation of the "ungrading" grading system as well as likely questions about this method:

How will this work?

- After completion of any course assignments, the course instructor will provide feedback on the assignments but NOT a score or letter grade. The feedback will provide information about your successes within the assignments as well as what needs to be corrected or improved.
- You will have one week after each assignment to resubmit based on the feedback provided to improve your performance on the assignment.
- There will be two mid-semester evaluation periods in which you will evaluate your performance in the course and assign yourself a letter grade. This letter grade must be supported by evidence from your performance in the class and also supported by evidence observed from the course instructor. Rubrics will be provided to help assess yourself during these checkpoints during the semester.
- At the end of the semester, you will evaluate your performance in the course one last time, and this evaluation will require you to assign a letter grade for the course. Again, evidence of your performance from the semester will be used, along with confirmation from the course instructor, to determine your final grade.

What assignments will you work on?

- Participation – weekly assignments that are some combination of pre-class reading assignments and reflections on learning outcomes
- Problem sets – practice problems within atmospheric dynamics along with determining the learning outcomes associated with each assignment

- Knowledge checks – assessments to check in periodically throughout the semester regarding student understanding of course material
- Synoptic labs (EAS 6502 Students Only) – graduate students will complete 4 lab assignments (adapted from EAS 4656: Atmospheric Dynamics Practicum) that will teach students skills related to meteorological data analysis, Python programming and the use of MetPy tools and case study analysis

Why are you doing this to us Dr. Handlos? This feels very uncomfortable given that everything is based on grades at GT!
Oh this is definitely going to feel uncomfortable relative to your other courses! Below explains my justification for trying this out (list a mix of my thoughts and that of Dr. Hanrahan):

- It allows me to provide you with formative rather than summative feedback.
- It allows you to focus on **learning** instead of your grade (which is more like that of the "real world").
- Ungrading encourages a growth mindset instead of a fixed mindset.
- This will allow you to take risks and experiment and not be concerned about getting a bad grade.
- This will allow you to have more freedom with our curriculum, including more active learning.
- Grades are subjective, reduce the depth and quality of student thinking, encourage cheating, and get in the way of healthy relationships with your peers.
- This will help you take ownership of your learning.

Academic Honesty
The best way to learn in this course is to participate in all aspects of the course, celebrate one's accomplishments throughout and to learn from one's mistakes, even at the risk of one's grade not being perfect on every assignment. Participation in activities such as copying answers from another student, using unauthorized resources, including the use of electronic devices or AI tools such as ChatGPT, posting solutions to course assignments and quizzes on the Internet, and/or any other activity that would be considered a method for shortcutting this course will prevent you from truly enjoying the experience that is Atmospheric Dynamics. Such methods above also lead to the development of habits that are hard to break and may reduce your success beyond class and in the "real world."

Academic Honor Code
The instructor and students are expected to follow Georgia Tech's Academic Honor Code:
https://policylibrary.gatech.edu/student-affairs/academic-honor-code

Access and Accommodations:
If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Office of Disability Services to explore reasonable accommodations.

The Office of Disability Services can be contacted by:
Phone: **404-894-2563**
Email: dsinfo@gatech.edu
Website: https://disabilityservices.gatech.edu/

Resources:
Academic Support

- Center for Academic Success
  - 1-to-1 tutoring

    - Peer-Led Undergraduate Study (PLUS)
    - Academic coaching
- Residence Life's Learning Assistance Program
- OMED Educational Services - Group study sessions and tutoring programs
- Communication Center - Individualized help with writing and multimedia projects
- Academic advisors for your major

Personal Support

Georgia Tech Resources

- The Office of the Dean of Students | **404-894-6367** | 2nd floor, Smithgall Student Services Building; You also may request assistance here
- Counseling Center | **404-894-2575** | Smithgall Student Services Building 2nd floor
    - Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, referral services, and crisis intervention.
    - *Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at **404-894-2204**.*
- Students' Temporary Assistance and Resources (STAR)
    - Can assist with interview clothing, food, and housing needs.
- Stamps Health Services | **404-894-1420**
- OMED Educational Services| **404-894-3959**
- Women's Resource Center | **404-385-0230**
- LGBTQIA Resource Center | **404 385 4780**
- Veteran's Resource Center | **404-385-2067**
- Georgia Tech Police | **404-894-2500**

National Resources

- The National Suicide Prevention Lifeline | 1-800-273-8255
    - Free and confidential support 24/7 to those in suicidal or emotional distress
- The Trevor Project
    - Crisis intervention and suicide prevention support to members of the LGBTQ+ community and their friends
    - Telephone | **1-866-488-7386** | 24 hours a day, 7 days a week
    - Online chat | 24 hours a day, 7 days a week
    - Text message | Text "START" to **687687** | 24hrs day, 7 days a week

List of Course Topics*

Week	Topics	Course Readings and Due Dates
Week 1 (8/21/23 – 8/25/23)	Calculus, Vectors, Taylor Series Expansion, Other Math Review	Martin: Ch. 1 Holton: Ch. 1.1 and 1.2 Beginning Assessment Due
Week 2 (8/28/23 – 9/1/23)	Lagrangian vs. Eulerian derivatives; Advection	Martin: Ch. 1.2.4 Holton: Ch. 2.1 Problem Set 1 Due
Week 3 (9/4/23 – 9/8/23)	2D Flow Kinematics	Martin: Ch. 1.4 Holton: n/a
Week 4 (9/11/23 – 9/15/23)	Fundamental Forces – Gravity, PGF; Apparent Gravity	Martin: Ch. 2.1, 2.2 Holton: Ch. 1.4 EAS 6502 ONLY – Lab 1 Due Problem Set 2 Due
Week 5 (9/18/23 – 9/22/23)	Fundamental Forces – PGF, Friction; Apparent Forces – Centrifugal, Coriolis	Martin: Ch. 2.1, 2.2 Holton: Ch. 1.4, 1.5 Knowledge Check 1
Week 6 (9/25/23 – 9/29/23)	Atmospheric Mass; Hydrostatic Balance; Thickness Equation; Mass Continuity	Martin: Ch. 3.1, 3.2.2 Holton: Ch. 1.6 Problem Set 3 Due
Week 7 (10/2/23 – 10/6/23)	Introduction to Isobaric Coordinates; Mass Continuity in Isobaric Coordinates; Start Equations of Motion	Martin: Ch. 3.1, 3.2, 4.1 Holton: Ch. 1.6, 2.5, 3.1 EAS 6502 ONLY – Lab 2 Due
Week 8 (10/9/23 – 10/13/23)	FALL BREAK (10/9-10/10); Equations of Motion Continued	Martin: Ch. 3.2, 4.1 Holton: Ch. 3.1 Problem Set 4 Due
Week 9 (10/16/23 – 10/20/23)	Equations of Motion – Spherical Coordinates; Scale Analysis	Martin: Ch. 3.2 Holton: Ch. 2.2, 1.3 Midterm Assessment Due Knowledge Check 2
Week 10 (10/23/23 – 10/27/23)	Geostrophic Balance; Geostrophic vs. Ageostrophic Wind	Martin: Ch. 3.2 Holton: Ch. 2.4 EAS 6502 ONLY – Lab 3 Due Problem Set 5 Due

Week 11 (10/30/23 – 11/3/23)	Thermal Wind	Martin: Ch. 4.3 Holton: Ch. 3.4
Week 12 (11/6/23 – 11/10/23)	Natural Coordinates	Martin: Ch .4.4 Holton: Ch. 3.2 Problem Set 6 Due
Week 13 (11/13/23 – 11/17/23)	Circulation and Vorticity	Martin: Ch. 5 (specific sections TBD) Holton: Ch. 4 (specific sections TBD) Knowledge Check 3
Week 14 (11/20/23 – 11/24/23)	THANKSGIVING BREAK (11/22-11/24); Circulation and Vorticity	Martin: Ch. 5 (specific sections TBD) Holton: Ch. 4 (specific sections TBD)
Week 15 (11/27/23 – 12/1/23)	Atmospheric Waves	Martin: n/a Holton: Ch. 7 Knowledge Check 4 (Take-Home due at end of semester)
Week 16 (12/4/23)	TBD	Martin: TBD Holton: TBD EAS 6502 ONLY – Lab 4 Due
FINAL ASSESSMENT – FRIDAY, DECEMBER 8TH, 2023; 11:20-2:10 PM	**FINAL ASSESSMENT – FRIDAY, DECEMBER 8TH, 2023; 11:20-2:10 PM**	**FINAL ASSESSMENT – FRIDAY, DECEMBER 8TH, 2023; 11:20-2:10 PM**

*Course topics, readings and due dates subject to change