

**Mesoscale Meteorology
EAS 4813/8813 (3 Credit Hours)
Fall 2021**

Lecture Meeting Times: MW 12:30 – 1:20 PM
Lecture Location: Room L1116 ES&T

Lab Meeting Time: T 12:30 – 3:15 PM
Lab Location: Room L1116 ES&T

Instructor: Dr. Zachary Handlos
Office: 1251 Ford ES&T Building
Office Hours: 3:15-4:15 PM TR and 2-3 PM W or via appointment (in-person or virtual)
Email: zachary.handlos@eas.gatech.edu

*****Statement about Wearing Masks*****

You are **strongly encouraged** to wear a mask within campus buildings **regardless of your vaccination status**.

*****COVID-19 Statement*****

The best way to protect yourself from COVID-19 is to get vaccinated; more information about vaccination opportunities on campus can be found here: <https://health.gatech.edu/coronavirus/vaccine>

If you are experiencing a fever (i.e., temperature over 100°F), cold-like symptoms, sore throat, dry cough, flu or any other type of illness, **DO NOT COME TO CLASS IN-PERSON**. Please inform the course instructor ASAP if you will miss class due to illness.

COVID-19 campus guidelines: <http://health.gatech.edu/coronavirus/campus-guidelines>

Please consider participating in asymptomatic COVID-19 testing: <https://mytest.gatech.edu/>

Undergraduate students are strongly recommended to have completed the following:

- EAS 2750: Physics of the Weather
- EAS 4655: Atmospheric Dynamics (could take this course same semester as mesoscale)

Graduate students are strongly recommended to have completed the following:

- EAS 6502: Introductory Fluid Dynamics and Synoptic Meteorology

Required Text

Markowski, P. and Y. Richardson (2010), *Mesoscale Meteorology in Midlatitudes*; ISBN-13: 9780470742136.

Recommended Text

Rauber, R. M., J. E. Walsh and D. J. Charlevoix (2013), *Severe and Hazardous Weather: An Introduction to High Impact Meteorology*; ISBN-13: 9780757597725.

Course Description

Mesoscale Meteorology focuses on the study of weather phenomena on spatial and temporal scales that are smaller than synoptic meteorology features but generally larger than cumulus-scale phenomena. These events last on the order of seconds to minutes, hours, and days, with their spatial scales usually ranging between 1 km to 1000 km. While most meteorologists often associate midlatitude severe weather with mesoscale meteorology, several other phenomena also occur within this scale. This includes orographic (i.e., mountain) weather, boundary layer events, fog, lake and sea breezes, lake-effect snow, and across-front phenomena.

Significant progress has been made regarding meteorologists' accuracy in forecasting the location and magnitude of mesoscale meteorology events. We are now able to use numerical weather prediction to often accurately forecast the timing of severe weather outbreak events as well as the development and location of many of the weather phenomena listed earlier.

Why do such meteorological features occur? How do meteorologists go about analyzing such features? What theory has been discovered that can be utilized to understand, diagnose and forecast such phenomena? Is there actually a purpose to all of this calculus material that I have to learn for this major? All of these questions (and many, many more) will be answered throughout this course.

Course Topics

- 1) Atmospheric Dynamics Refresher
- 2) Mesoscale Instabilities
- 3) Mesoscale Frontal Dynamics
- 4) Boundary Layer Meteorology and Hazards (e.g., Lake-Effect Convection)
- 5) Orographic Meteorology (e.g., Downslope Windstorms)
- 6) Deep Moist Convection (e.g., Severe Weather)

Earth and Atmospheric Science Core Skill Development

The School of Earth and Atmospheric Sciences at Georgia Tech strives to meet several learning standards for all students within the undergraduate program. These standards, and how they will be achieved in this course, are listed below:

- 1) Demonstrate **quantitative understanding** of mesoscale meteorology theory and real-time mesoscale weather events
- 2) Develop **critical analysis** and **problem-solving skills** through course exercises and case study projects
- 3) Gain **practical experience** with **analyzing, interpreting and communicating** mesoscale meteorology events orally (e.g., weather discussion events) and through written assignments (e.g., case study projects, WxChallenge reflection assignments)
- 4) Gain appreciation of the **interdisciplinary** nature of meteorology through course exercises, theoretical problems, course projects and participation in WxChallenge competition
- 5) **Increase breadth of knowledge** within meteorology by developing foundational understanding of atmospheric physics and dynamics on the mesoscale as well as other scales that tie to mesoscale meteorology (e.g., synoptic, planetary scale)

- 6) Develop **comprehensive and cohesive understanding** of mesoscale meteorology through consideration of several diagnostic tools (e.g., PV perspective, Semi-Geostrophic Theory, z- vs. p- vs. natural coordinates)

Grading

Your grade in this course will be based on your performance within the following categories:

- Lab Assignments (6 labs/problem sets; keep top 5) – 30% of grade
- Quizzes (5 quizzes; keep top 4) and Practice Quizzes – 25% of grade
- 2 Weather Discussions and 2 Blog Posts – 20% of grade
- Case Study Project – 20% of grade
- WxChallenge Forecasting and Reflection – 5% of grade

Lab Assignments (30% of grade)

See course schedule for lab assignment due dates. These assignments will require you to apply course reading material and course theory to solving a variety of mesoscale meteorological problems, both in traditional “problem set” format as well as using programming. Your lowest lab score will be dropped. Due to this drop policy, there will be no makeup assignments; a missed assignment will result in a "0" score and be considered your "dropped" assignment.

****Graduate Students: You will be expected to complete additional problems on assignments that are at a graduate-level difficulty. These questions will be specified on the assignment.****

Quizzes (25% of Grade)

Quizzes will assess your understanding of recently discussed course material. Your lowest quiz grade will be dropped. The actual quizzes make up 20% of your total grade, while “practice quizzes” one week prior to your actual quiz make up 5% of your total grade.

Due to the drop policy described above, there will be no makeup quizzes; a missed quiz will result in a "0" score and be considered your "dropped" quiz.

****Graduate Students: You will be expected to complete additional problems on quizzes that are at a graduate-level difficulty. These questions will be specified on the assignment.****

Weather Discussion and Blog (20% of grade)

You and one or more classmates will facilitate a weather discussion during 2 of the lab periods this semester. This weather discussion will require you to provide an in-depth analysis of the current (and recent past) weather as well as short-term forecasted weather using mesoscale tools learned from this course. This will allow you an opportunity to practice applying course material to weather observational analysis and forecasting.

You and your classmates will also contribute mesoscale meteorology discussions to the Georgia Tech synoptic and mesoscale meteorology blog. More details about this will be revealed in class.

Case Study Project (20% of Grade)

You will write a scientific paper describing in rigorous detail the physical mechanisms responsible for the development of a mesoscale event of interest. This paper will require you to perform a literature review, develop a “hypothesis” or “research question” about your case, present detailed results and discussion of

your results and summarize your findings within a “Conclusions” section. You will also give a presentation to the class summarizing your findings and conclusions in a presentation format analogous to that of presenting at a conference. Your paper and presentation will be expected to follow AMS paper and presentation guidelines (more on this during class). I expect the final product that you produce to reflect your ability to critically analyze scientific data, provide correct physical reasoning and present scientific material in a clear, concise and accurate manner.

WxChallenge Forecasting and Reflection (5% of grade)

You will participate within the WxChallenge forecasting competition this semester. This is a national forecasting competition, where participants enter maximum/minimum temperature, maximum wind speed and precipitation values for a forecast city over a two-week period. Prizes are awarded for forecasters that receive the least number of error points.

In this course, you will be required to submit forecasts for all forecasting days for all cities during the competition this semester. At the completion of all 5 forecast cities for this semester, you will write a short reflection summarizing how well you did at forecasting, including discussion of your forecast strategies and how well they worked (or did not work).

Grading Scale

The **grading** for the course is as follows:

Grade	Percentage
A	100 – 90
B	89.99 – 80
C	79.99 – 70
D	69.99 – 60
F	<60

Depending on the distribution of student scores at the end of the course, the scores may be curved to reflect the scale described above (**up to the instructor’s discretion**).

Late Work Policy

An assignment turned in late will be deducted 20% of its total grade for each day it is late after submitted. This policy will only be waived in extreme circumstances (e.g., serious illness, family emergency, COVID-19). **You must contact me at least 24 hours prior to the due date of any assignment** if you anticipate any issues with submitting it on time.

Lecture Notes

A significant portion of course theory will be written on Google Jamboard slides during class; it is your responsibility to take notes while listening.

Cheating

Cheating will not be tolerated in this course. Cheating includes the following: 1) copying answers from another student, 2) using unauthorized resources to study for course quizzes and assessments, which includes the use of electronic devices, 3) posting solutions to course quizzes and assessments on the Internet, and/or 4) any other activity that would be considered “academic misconduct”.

To summarize, do not cheat; it is not worth jeopardizing your future because you wanted to look good doing something that you need to improve upon.

Academic Honor Code

The instructor and students are expected to abide by Georgia Tech's Academic Honor Code. Plagiarism of any kind (including the reproduction of materials found on the internet) is strictly prohibited and will be reported to the Office of Dean of Students for academic misconduct. The complete text of the Academic Honor Code may be found at:

<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 Reading (from Markowski and Richardson text) – <u>Read Before Class</u> (Starting for Week 2; Review Ch. 1 and 2 during Week 1)
Week 1 (8/23/21 – 8/27/21)	Mesoscale vs. Synoptic meteorology; Atmospheric dynamics review; mesoscale web resources	Ch. 1 and 2
Week 2 (8/30/21 – 9/3/21)	Thermodynamic Diagrams and Hodographs; Start Mesoscale Instabilities	Ch. 2 and 3
Week 3 (9/6/21 – 9/10/21)	Finish Mesoscale Instabilities; Synoptic Fronts	Ch. 3 and 5
Week 4 (9/13/21 – 9/17/21)	Continue Synoptic Fronts, Mesoscale Boundaries (Drylines, Outflow Boundaries, etc...)	Ch. 5
Week 5 (9/20/21 – 9/24/21)	Continue Synoptic Fronts, Start Mesoscale Boundaries (Drylines, Outflow Boundaries, etc...)	Ch. 5
Week 6 (9/27/21 – 10/1/21)	Finish Mesoscale Boundaries; Sea/Lake Breezes	Ch. 5
Week 7 (10/4/21 – 10/8/21)	CSI and Drylines	Ch. 5
Week 8 (10/11/21 – 10/15/21)	Drylines, Outflow Boundaries and Convection Initiation	Ch. 5 and Ch. 7
Week 9 (10/18/21 – 10/22/21)	Convection Initiation; Organization of Isolated Convection	Ch. 8
Week 10 (10/25/21 – 10/29/21)	Organization of Isolated Convection – Supercells; MCS's	Ch. 8 and 9
Week 11 (11/1/21 – 11/5/21)	Organization of Isolated Convection – Supercells; MCS's	Ch. 8 and 9

Week 12 (11/8/21 – 11/12/21)	MCS's; Deep Moist Convection Hazards: Tornadoes	Ch. 9 and 10
Week 13 (11/15/21 – 11/19/21)	Deep Moist Convection Hazards: Straight-Line Winds, Hail, Flash Flooding	Ch. 10
Week 14 (11/22/21 – 11/26/21)	Cold Air Damming; Lake-Effect Convection	Ch. 4.5 and Ch. 13
Week 15 (11/29/21 – 12/3/21)	Tropical Cyclones	TBD
Week 16 (12/6/21)	Tropical Cyclones/Finish Course	TBD
FINAL QUIZ – TBD	FINAL QUIZ – TBD	FINAL QUIZ – TBD

*Course topics subject to change depending on how much time is needed to get through each topic of the course; we may also rearrange topics depending on the types of weather events occurring in real-time throughout the semester. Note that other readings will be assigned that complement the lecture material as necessary; this potentially includes later chapters in the course textbook not listed above.