

ATS 641: Mesoscale Meteorology
Spring 2024
Mondays/Wednesdays, 1:00-2:15 pm (2 credits)

Course Description and Prerequisites

This course will cover the theory and application of mesoscale meteorology, and how mesoscale phenomena relate to features and processes on larger and smaller scales. The course is listed as a lab course, with a total of 150 minutes of class time per week, which will include lectures, weather discussions, and time for working on class assignments and projects.

Prerequisite: ATS640 or previous undergraduate coursework in meteorology, or consent of the instructor

Learning Outcomes

Upon completion of this course, students will be able to:

- Describe the basic theories describing mesoscale weather phenomena
- Understand the techniques used in mesoanalysis and mesoscale numerical modeling
- Apply the theories to observed mesoscale phenomena through analysis of recent and historical weather events

Instructor Information

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Materials will also be shared on Microsoft OneDrive

Teaching Assistant

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Textbook

Required textbook: Paul M. Markowski and Yvette P. Richardson, *Mesoscale Meteorology in Midlatitudes*, Wiley-Blackwell, 2010. [Note: an online version is available from the CSU library: <http://ebookcentral.proquest.com/lib/csu/detail.action?docID=514430>]

Other useful texts (not required):

Severe Convective Storms, AMS Monograph, 2001.

Robert J. Trapp, *Mesoscale-Convective Processes in the Atmosphere*, Cambridge University Press, 2013.

I will also be making use of notes written by Professor Emeritus Richard Johnson, which I will make available as the semester goes along. He has been kind enough to give permission to use them, and I would appreciate it if you do not redistribute them without permission (see also copyright policy below). Additionally, copies of Powerpoint slides used in class and other supplemental material will be made available either on Canvas, Microsoft OneDrive, or via e-mail.

Grading Policies

Course grading will be based on a combination of lab exercises, a midterm exam, and a final research project and presentation. The lab assignments will be worth 45%, the midterm exam will be worth 25%, and the final project will be worth 30% of your final grade. Plus/minus grading will be used. Details regarding the final project will be discussed and distributed in class, including the timeline and potential topics.

Lab exercises

There will be 4-6 lab exercises over the course of the semester. These will involve applying the concepts discussed in class, and will often involve analyzing interesting recent mesoscale weather events. One or more will also involve processing output from a numerical model (more on this will be provided in class).

Class forecast contest

A class forecast contest will be conducted this semester, with two separate “tournaments” separated by Spring Break. Your forecasting performance will not affect your grade, but participation is expected. Forecasts will be made each day of class starting in week 2. More details will be provided in class.

Weather discussions

The last 15-20 minutes of each Monday class period will be devoted to a class discussion of current or recent mesoscale weather, focusing on physical/dynamical processes. Most weeks, the discussion will be led by one of the students in the class. Each student will be responsible for preparing and leading the discussion in class twice over the course of the semester. All students are also expected to participate in the discussions by asking questions or suggesting items of interest. Sign-ups will take place the first week of class.

Expectations

At least 2 hours of effort are expected to complete readings and lab assignments outside of class for each hour of class time.

Special needs

If you have special learning needs that should be accommodated in this class, please see the instructor during the first two weeks of the semester, and refer to <https://disabilitycenter.colostate.edu/> for more information.

Copyright policy

All materials used in this class are copyrighted. These materials include but are not limited to syllabi, quizzes, exams, lab problems, in-class materials, review sheets, and additional problem

sets. Because these materials are copyrighted, you do not have the right to copy the handouts, unless permission is expressly granted.

Academic Integrity and Plagiarism

Academic integrity is a crucial part of the vibrant learning community at Colorado State University and in the Department of Atmospheric Science. We expect all students to conduct their academic work with integrity, and particularly to avoid plagiarism. As commonly defined, plagiarism consists of passing off as one's own the ideas, words, writings, etc., which belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you should have the permission of that person. Plagiarism is a violation of the University rules on academic integrity. If you plagiarize in your work you could lose credit for the plagiarized work, fail the assignment, or fail the course. Plagiarism could result in expulsion from the university. Each instance of plagiarism, classroom cheating, and other types of academic dishonesty will be addressed according to the principles published in the CSU General Catalog (see, <http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity>)

In this course, students are generally allowed (and encouraged!) to discuss the lab assignments with each other, but each student is expected to do their own work and turn in their own assignment.

Tentative Schedule for ATS641 (MW 1:00-2:15pm)

Dates	Topic	Reading
17, 22 January	Syllabus; Introduction; Definitions of Mesoscale;	Chapter 1 of MMM, Chapters 1-2 of Johnson notes
24, 29 January	Fort Collins & Colorado climatology; Mesoanalysis techniques, synoptic meteorology review;	Chapter 2 MMM, Chapters 2-4, 9 of Johnson notes
31 January, 5 February	Potential vorticity; Fronts and frontogenesis	Chapter 2 MMM, Chapters 3-4 of Johnson notes
7, 12 February	Low-level jets; instabilities	Chapters 3, 4.7 and 5 of MMM
14, 19 February	Instabilities, continued Orographic flows	Chapter 3, 11-13 of MMM, Chapters 7,8,10 of Johnson notes
21, 26 February	Orographic flows, continued	Chapter 3, 11-13 of MMM, Chapters 7,8,10 of Johnson notes
28 February	Orographic flows, continued	Chapter 7 of MMM, Chapter 11 of Johnson notes
4, 6 March	Convective processes Midterm exam (specific date TBD)	Chapters 8, 10 of MMM
11, 13 March	SPRING BREAK: NO CLASS	
18, 20 March	Convective processes (continued)	

25, 27 March	Convective processes (continued)	
1, 3 April	Mesoscale convective systems	Chapter 9 of MMM, Chapter 12 of Johnson notes
8, 10 April	Mesoscale convective systems (continued)	
15, 17 April	Mesoscale convective systems (continued)	
22, 24 April	Flash floods; microbursts; derechoes	
29 April, 1, 4 May	Other unfinished topics and miscellaneous mesoscale phenomena	Chapter 10 of MMM; Chapters 13-14 of Johnson notes
6-10 May	Final exam period (final project presentations; time TBD)	