ATS 641: Mesoscale Meteorology
Spring 2025
MW, 1:00-2:15 PM, ATS Room 101 (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: ATS 640 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

Name	Dr. Russ S. Schumacher
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Office hours	By appointment; please send e-mail or Teams message to set up time
Office location	ATS Room 413 (or the Annex)
Course website	http://schumacher.atmos.colostate.edu/teaching/ats641/
	Materials will be shared on Canvas, OneDrive and Teams

Teaching assistant

Name	Jacob Escobedo
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Office hours	Monday and Wednesday, 2:30-3:30pm
Office location	ATS Room 411

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 at https://onlinelibrary-wiley-com.ezproxy2.library.colostate.edu/doi/book/10.1002/9780470682104]

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 Prof. 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, OneDrive, Teams, 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 running and processing output from a numerical model (more on this will be provided in class).

Class forecast contest

A class forecast contest will be conducted, 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. 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 on will be led by one of the students in the class. Each student will be responsible for preparing and leading the discussion in class once 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
20, 22 January	**NO CLASS MONDAY 20 JANUARY, MLK HOLIDAY** Syllabus; Introduction; Definitions of mesoscale	Chapter 1 of MMM, Chapters 1-2 of Johnson notes
27, 29 January	Synoptic meteorology review; Mesoanalysis techniques, Fort Collins & Colorado climatology;	Chapter 2 MMM, Chapters 2-4,9 of Johnson notes
3, 5 February	Potential vorticity; Fronts and frontogenesis	Chapter 2 MMM, Chapters 3-4 of Johnson notes
10, 12 February	Low-level jets; instabilities	Chapters 3, 4.7 and 5 of MMM
17,19 February	Instabilities, continued Orographic flows	Chapter 3, 11-13 of MMM, Chapters 7,8,10 of Johnson notes
24, 26 February	**RUSS ON TRAVEL 26 FEB, WILL RESCHEDULE** Orographic flows, continued	Chapter 3, 11-13 of MMM, Chapters 7,8,10 of Johnson notes
3, 5 March	Orographic flows, continued Convective processes (introduction)	Chapter 7 of MMM, Chapter 11 of Johnson notes
10, 12 March	Convective processes (continued) **Midterm exam (specific date TBD)**	
17, 19 March	**SPRING BREAK: NO CLASS**	
24, 26 March	Convective processes (continued)	Chapters 8, 10 of MMM
31 March, 2 April	Convective processes (continued)	
7, 9 April	**RUSS ON TRAVEL 9 APRIL, WILL RESCHEDULE** Mesoscale convective systems	Chapter 9 of MMM, Chapter 12 of Johnson notes
14, 16 April	Mesoscale convective systems (continued)	
21, 23 April	Mesoscale convective systems (continued)	
28, 30 April	Flash floods; microbursts; derechos	Chapter 10 of MMM; Chapters 13-14 of Johnson notes
5, 7 May	Mesoscale processes and climate change; other unfinished topics and miscellaneous mesoscale phenomena	
Finals week (12-15 May)	**Final project presentations "mini conference": will be scheduled at a time that mutually works for the class**	

*Other topics may also be inserted into the schedule as time and student interest allow. It is also possible that topics will be rearranged if a particularly interesting weather event occurs that relates to one of the topics. If major changes are to be made during the semester, an updated version of the schedule will be provided.