ATS 735: Mesoscale Dynamics
Fall 2023
TR, 10:00-11:15am, ACRC 212B

Course Description and Prerequisites

This course will involve investigating the mesoscale processes that occur in a variety of atmospheric phenomena. The fundamental dynamics of mesoscale processes, important past research findings, and current research frontiers will all be addressed and discussed.

A typical week in the course will include one day of lecture, and one day with a presentation and discussion of a paper or papers from the literature. There will be several guest lectures from leading researchers throughout the semester as well, some in-person and some virtual. The amount of “work” expected of students will be relatively small, but the amount of reading and thinking will be large.

Prerequisite: ATS641 or consent of the instructor

Learning Outcomes

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

- Understand and assess the theories describing mesoscale weather phenomena; particularly convective and orographic processes
- Critically read and examine the key literature in the field of mesoscale meteorology
- Describe how observations and numerical models are used to understand mesoscale processes
- Apply theories to observed mesoscale phenomena through analysis of recent and historical weather events

Instructor Information

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Office hours	By appointment; please send e-mail to set up time
Office location	ATS Room 413
Course websites	http://schumacher.atmos.colostate.edu/teaching/ats735
	Microsoft Teams channel and OneDrive for the class

Textbook

Recommended textbook: Paul M. Markowski and Yvette P. Richardson, *Mesoscale Meteorology in Midlatitudes,* Wiley-Blackwell, 2010. [Available online for “check-out” through the CSU libraries.]

Other useful texts:
Robert J. Trapp, *Mesoscale-Convective Processes in the Atmosphere*, Cambridge University Press, 2013.
Yuh-Lang Lin, *Mesoscale Dynamics*, Cambridge University Press, 2010.

Additionally, copies of Powerpoint slides used in class and other supplemental material will be made available either on OneDrive or via e-mail.

Grading Policies

Course grading will be based on a combination of homework assignments, in-class presentations and discussions, and a final project. The assignments will be worth 15% of your final grade, in-class presentations will be worth 30%, the final project will be worth 45% of your final grade, and participation in discussions of mesoscale weather and of the literature will be worth 10%.

Homework assignments

There will be 1 homework assignment during the course, that will involve running and processing output from a numerical model (more on this will be provided in class).

In-class presentations

Each student will be responsible for presenting and leading a discussion of a paper (or set of related papers) from the literature in mesoscale meteorology. (Some will be "classic" papers, and some will be relevant recent papers, and on some topics your presentation will cover a single paper, but on others it may be more than one, or an article-comment-reply series.) The list of papers will be provided during the first week of class and will correspond to the topics covered throughout the semester. Sign-up will take place during the first week of class. If there is an alternate paper on a topic that you would like to present instead, please ask me; this may be accommodated if appropriate. You will be responsible for providing an introduction to the paper and its relevance, outlining its primary findings, revealing limitations to the study, summarizing the influence that the paper has had on subsequent research in the field, and initiating discussion within the class. You should aim for about 30 minutes for your presentation, and then we can aim to spend the rest of the class time with discussion. All students are responsible for reading the paper being presented and coming prepared to participate in discussion.

Final project

Your final project may take one of three forms:

1) Observational and/or modeling analysis of a mesoscale weather event (or events) using operational or research datasets, or model simulation.
2) An idealized numerical modeling experiment to investigate mesoscale phenomena.
3) A critical re-examination of a key paper from the literature (not including one of the ones already presented in class)

The project will involve a ~10-page paper and a 15-minute conference-style presentation to the class. By the end of September, please think of a possible topic and turn in a paragraph describing your idea. Then, by late October, I will meet with you individually to discuss your proposed topic. The paper will be due on Wednesday, December 13, and the presentations will be given during the final exam period. More details on the format of the project will be given in class.

Expectations

At least 2 hours of effort are expected to complete readings, assignments, and projects 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 assignments with each other, but each student is expected to do his or her own work and turn in his or her own assignment.

Tentative* Schedule for ATS735 (TR 10:00-11:15am)

Dates	Topic
22, 24 August	Syllabus; Introduction; Definitions of mesoscale; review/introduction of pertinent equations **NO CLASS ON 24 AUGUST – WILL BE RESCHEDULED**
29, 31 August	Instabilities; parcel theory
5, 7 September	Convective dynamics
12, 14 September	Convective dynamics
19, 21 September	Mesoscale convective systems
26, 28 September	Mesoscale convective systems
3, 5 October	Mesoscale observations and field campaigns
10, 12 October	Mesoscale numerical modeling
17, 19 October	Mesoscale vortices
24, 26 October	Mesoscale vortices
31 Oct, 2 November	Scale interactions between mesoscale & larger/smaller scales
7, 9 November	Mesoscale gravity waves
14, 16 November	Orographic flows
21, 23 November	**NO CLASS – Thanksgiving week**
28, 30 November	Mesoscale prediction and predictability
5, 7 December	Mesoscale processes and climate change
Thursday 14 December	**Final project presentations during final exam period 2-4 pm**

*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.

Schedule for student-led discussions of mesoscale meteorology literature

	Tentative date*	**Topic**	**Possible papers (choose one)**
1	Thurs. 31 August	Instabilities	Combination of [Schultz and Schumacher (1999); Sherwood (2000); Schultz et al. (2000)] [**led by Russ]**
2	Thurs. 7 Sept.	Instabilities	Doswell and Markowski (2004)
3	Thurs. 14 September	Convective dynamics	Markowski and Richardson (2014)
4	Thurs. 21 September	MCSs	Combination of: [Weisman and Rotunno 2004; comments by Stensrud et al. (2005); reply by Weisman and Rotunno (2005)]
5	Thurs. 28 Sept	MCSs	Alfaro and Coniglio (2018)
6	Thurs. 5 October	Mesoscale observations	Choose from Miller et al. (2019) or Grasmick et al. (2018)
7	Tues. 10 October	Mesoscale numerical modeling	Bryan et al. (2003)
8	Thurs. 19 October	Mesoscale vortices	Combination of: [Raymond and Jiang (1990); Trier et al. (2000)]
9	Tues. 24 October	Mesoscale vortices	Zhang et al. (2018)
10	Thurs. 26 October	Scale interactions	Chasteen and Koch (2022a)
11	Thurs. 2 November	Mesoscale gravity waves	Adams-Selin (2020)
12	Thurs. 9 November	Orographic flows	Lott (2016)
13	Thurs. 30 November	Mesoscale prediction/predictability	Combination of [Durran and Gingrich 2014; Sun and Zhang 2016]
14	Thurs. 7 December	Mesoscale processes and climate change	Combination of [Prein et al. 2017; Haberlie and Ashley 2019]

*** Based on the availability of a couple additional guest speakers, it's possible that these dates will be shifted by 1-2 class sessions.**

Confirmed guest lecturers	**Date**	**Topic**
John Peters	Thursday 12 October	convective updraft dynamics
Manda Chasteen	Tuesday 31 October	scale interactions
Becky Adams-Selin	Tuesday 7 November	gravity waves
Neil Lareau	Tuesday 28 November	mesoscale dynamics of wildfires