ATS712
Dynamics of Clouds
Spring 2025

Meeting Times:
Tues/Thurs: 8:45-10:00am
Make up classes: Mon: 2:45-4:00pm
Room: ATS 101

Instructor:
Susan C. van den Heever
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Graduate Teaching Assistant:
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Office Hours: Tues: 12:00-2:00pm
Room: ATS Main 209

Course Description:
This class focuses on the general dynamics of cloud systems. Conceptual models of fog, stratocumuli, cumuli, cumulonimbi, and mesoscale convective systems will be presented. In addition to presenting what is known about these cloud systems, we will also discuss what is not well understood with a view to enhancing our research efforts in this regard.

Classes will be held for 75 minutes twice a week, and will primarily be comprised of lectures by the instructor. Material covered in class will be supplemented by several homework assignments throughout the semester. The class will conclude with student presentations on a cloud dynamics topic of their selection.

Grading:
No exams will be held for this class. Homework assignments (40%) and a final presentation (60%) will constitute your grade.

Recommended Reading and other Tools / Skills
Cotton, W.R., G.H. Bryan, and S.C. van den Heever, 2010: *Storm and Cloud Dynamics*, 2nd Edition. Academic Press.
Basic coding abilities.

Class Webpage
The webpage for this class may be found at:
https://vandenheever.atmos.colostate.edu/vdhpage/ats712/ats712.php
Class notes, homework sets and general announcements can be found on this site.

Science Questions
As the primary goal of this 700-level class is to provide a strong cloud dynamics background for your current and future research, class discussions focused on developing science questions will be held at the end of each topic or main subsection. Each student is expected to have thought about such questions independently and should be able to present these ideas in class if called on.

Potential Topics
Possible topics and the class time spent on them are shown in the next table. Please note that this class is intended to be somewhat flexible and driven in part by class interests. We may therefore decide to cover one topic in more detail than is shown in the table or to introduce a new topic that is not shown here, both of which could lead to changes in the table below. Please let me know if there is a specific topic you would be interested in covering that is not shown here.

Academic Integrity:
All students are subject to the policies regarding academic integrity found in the 2024 – 2025 General Catalog, found at http://catalog.colostate.edu/general-catalog/policies/, and the student conduct code (https://resolutioncenter.colostate.edu/conduct/code/). Examples of academic dishonesty can be found in these sources. At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

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

Course Outline:

Chapter	Topic	Subtopics	~# Classes
Chapter 1	**Cloud Characteristics**	Classification of clouds; cloud time scales, vertical velocities, and liquid water contents	2
Chapter 2	**Fog**	Types of fog and formation mechanisms; radiation fog; valley fog; marine fog	5
Chapter 3	**Stratocumulus Clouds**	Morphologies; stratocumulus-topped BL; CTEI; transitions to trade-wind cumuli; role of drizzle, wind shear, large-scale subsidence, diurnal cycle and mid- to upper-level clouds	4
Chapter 4	**Cumulus Clouds**	Boundary layer cumuli from an ensemble point of view; theories of entrainment and detrainment; downdraft initiation; the role of precipitation; cloud mergers; large-scale convergence	5
Chapter 5	**Cumulonimbus Clouds and Severe Convective Storms**	Descriptive storm models and storm types; updrafts magnitudes and profiles; turbulence; origin and intensity of downdrafts; low-level outflows and gust fronts; theories of storm movement and propagation; mesocyclones and tornadoes; hailstorm models and formation processes; rainfall processes and properties; aerosol impacts on convective dynamics	8
Chapter 6	**Mesoscale Convective Systems**	Definition of mesoscale convective systems; conceptual models of MCSs; climatology of MCSs; MCVs and Tropical Cyclone Genesis; impacts of MCSs	4
Chapter 7	**Clouds, Storms and Climate**	Clouds and the global radiation budget; hot towers and tropical circulations; clouds and global hydrological cycle; cloud venting	2
Total Number of Classes			30