

ATS 724, Fall 2023

Cloud Microphysics

Tuesday and Thursday: 1 – 1:50, 121ATS West

Instructor: Prof. Sonia Kreidenweis
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Course Objectives:

- To expose students to cloud microphysical processes at an advanced level;
- To assess what we as a community do not know about cloud microphysical processes;
- To investigate how cloud processes are represented in a variety of numerical models;
- To learn about some of the instrumentation used for cloud microphysics observations, and interpretation of data;
- To critique current theories through literature analysis.

Prerequisites:

- ATS620 (or equivalent class)
- PhD students, or MS students with written consent of the instructor

Required Texts and Course Materials:

There is no required textbook for this class. There is a CSU Canvas site for this class. All course notes and reading materials will be posted there. Please note that course notes are courtesy of Prof. Sue van den Heever and used with her permission. I will be closely following the topics and design of this course as she taught it in Fall 2020, with the addition of some sessions on instrumentation used for cloud microphysics observations and interpretation of those data

Course Description:

This class will combine an advanced theoretical analysis of cloud microphysical processes with an examination of how these processes are represented within numerical models across the scales. The cloud processes that will be discussed include nucleation, condensation, collision-coalescence, aggregation, riming, freezing, melting, and precipitation. Microphysical-dynamical feedbacks and aerosol-cloud interactions will also be examined. Bin and bulk approaches to the parameterization of microphysical processes in cloud models will be presented. Some instrumentation used will be introduced with discussion of the data and its use in developing and improving parameterizations.

Course Outline:

1. Introduction, Definitions and Assumptions (2 classes)
2. Adiabaticity, Parcel Theory and Saturation Adjustment (1 class)
3. Size Distributions (1 class)
4. Condensation (~3 classes)
5. Warm Phase Nucleation (~2 classes)
6. Collision and Coalescence (~4 classes)
7. Ice Nucleation (~3 classes)
8. Precipitation (1 class)
9. Ice Processes (~5 classes)
10. Graupel and Hail (~2 classes)
11. Aerosol-Cloud Interactions (~5 classes)

Course Structure, Contact Hours, Expectations, and Grading Criteria:

- The class will meet in person for two 50-minute periods each week as indicated above.
- The course material will be delivered through instructor lectures, student analysis and presentation of assigned literature papers, and in-class discussions.
- At least 4 hours of effort (2 hours per each hour of class time) outside of class each week are expected to complete readings and homework assignments.
- The literature analysis and presentations, together with your participation in the class discussions, comprise your grade as shown below.
- There are no exams in this course.
- *Audit expectations:* Audits will be allowed at the discretion of the instructor. All students formally auditing the course will be required to actively participate in the discussions, therefore, they will be expected to complete at least some of the readings. They will not be required to prepare a presentation.

Final Grades are weighted as follows:

Literature analysis and Presentations: 90% Class Participation: 10%

Statement on Academic Integrity:

This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (<https://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity>) and the Student Conduct Code (<https://resolutioncenter.colostate.edu/wp-content/uploads/sites/32/2018/08/Student-Conduct-Code-v2018.pdf>). 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.

Inclusion Statement:

CSU Atmospheric Science is a leading global institution, and as such, all members of our community regardless of race, ethnicity, culture, religion, sexual orientation, gender identity and expression, physical ability, age, socioeconomic status or nationality are welcome as equal contributors. We value and appreciate diversity, and we believe that diversity on our campus strengthens our entire scientific community. It is my intent that students from all backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that the students bring to this class be viewed as a resource, strength and benefit. Your suggestions are encouraged and appreciated.

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/accommodations-process/> for more information.

Public Health Information:

Updated information on CSU policies and resources related to public health can be found at: <https://covid.colostate.edu>