ATS 724
Cloud Microphysics
Spring 2016

Course Objectives:

- To expose students to cloud microphysical processes at a more advanced level than is presented in ATS620;
- To address how these cloud processes are represented in a variety of parameterization schemes and numerical models; and
- To provide students with practical experience in the design and development of microphysical parameterization schemes by requiring them to build and work with simple models utilizing several different parameterization approaches.

Instructor:

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Graduate Teaching Assistant

Leah Grant
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Office Hours: times and locations to be determined within the first week of class

Meeting Times:

Mondays and Wednesdays: 10-10:50 AM, 212B ACRC

Prerequisites:

- ATS620
- PhD level, or MS level with written consent of the instructor
- A working knowledge of Fortran and Linux, as the course will involve building and working with simple cloud microphysical models.

Texts / Outside Reading:

There is no required text for this class.
Course notes will be distributed for the class via the website:
http://vandenheever.atmos.colostate.edu/vdhpage/ats724/ats724.php
Username is 724notes. The password will be distributed in class.

Course Description:

This class will combine an advanced theoretical analysis of cloud processes with a practical approach to representing these processes through student-designed and -built cloud models. The cloud processes that will be examined include nucleation, condensation, collision and coalescence, and precipitation processes, for liquid cloud systems. Feedbacks between these microphysical processes and cloud dynamics will also be examined, as will the role of entrainment. Bin and bulk approaches to the parameterization of microphysical processes in cloud models will be presented. Students will explore parameterization schemes in more detail through appropriately constructed homework assignments.

Course Structure, Expectations, and Grading Criteria:

- Course material will be delivered in a lecture format, meeting for two 50-minute periods each week as indicated above. Lectures (.pptx or .pdf format) are posted on the class website. 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.
- Regular homework is assigned and is due at the start of the class indicated. No late homework assignments will be accepted without prior approval by the instructor.
- There are no exams in this course.
- Each student is to prepare an oral presentation on the final homework assignment. The last homework assignment will be more extensive than the previous homework assignments, and will provide the student some freedom to explore the sensitivity to various parameters and / or microphysical schemes within the numerical models being used this semester. The results of these sensitivity tests should form the basis of the oral presentation.

Final grades are weighted as follows:

Homework: 80% Presentation: 20%

Academic Integrity:

This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (http://www.catalog.colostate.edu/Content/files/2012/FrontPDF/1.6POLICIES.pdf) and the Student Conduct Code (http://www.conflictresolution.colostate.edu/conduct-code). 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 http://rds.colostate.edu/csuinfo/accommodations.asp for more information.

TENTATIVE CLASS SCHEDULE

WEEK	MONTH	DATE	DAY	TOPICS	DETAILS	HOMEWORKS DUE
	January	16	M	MLK	NO CLASS	
1		18	W	Chapter 1: Introduction to Microphysical Modeling	Importance of microphysical schemes Basic concepts and terminology Cloud microphysics-dynamics feedbacks	
		23	M	NO CLASS		
2		25	W	NO CLASS		
		30	M	Chapter 2: Parcel Theory	Adiabatic air parcels Thermodynamic and water properties Modeling frameworks to be used in class	
MAKEUP		30	M		Saturation adjustment Trajectories and parcels	
3	February	1	W	Chapter 3: Hydrometeor size distributions	Log normal and gamma distributions	
		6	M	Chapter 4: Condensation	Theory of condensational growth	HW1: Parcel and Cloud Models
MAKEUP		6	M		Theory of condensational growth	
4		8	W		Condensational growth in numerical models	
		13	M		Condensational growth in numerical models	
MAKEUP		13	M	Chapter 5: Nucleation	Theory of nucleation	
5		15	W		Theory of nucleation	
		20	M		Nucleation in models	
6		22	W		Nucleation in models	
		27	M		Discussion	HW2: Condensation and nucleation
MAKEUP		27	M	Chapter 6: Collision and Coalescence	Theory of collision and coalescence	
7	March	1	W		Theory of collision and coalescence	
		6	M		Collision coalescence in numerical models	
8		8	W		Collision coalescence in numerical models	
		13-15	M-W	SPRING BREAK		
		20	M		Discussion	HW3: Collision and Coalescence
9		22	W	Chapter 7: Entrainment	Homogeneous mixing	
		27	M		Heterogeneous mixing	
MAKEUP		27	M	Chapter 8: Precipitation Processes	Ventilation and terminal velocity	
10		29	W		Droplet breakup	
	April	3	M	NO CLASS		
11		5	W	NO CLASS		
		10	M		Shedding and Sedimentation	
12		12	W		Discussion	HW4: Precipitation Processes
		17	M	Chapter 9: Ice Processes	Theory of ice processes	
MAKEUP		17	M		Theory of ice processes	
13		19	W		Ice processes in numerical models	
		24	M	NO CLASS		
14		26	W	NO CLASS		
	May	1	M		Ice processes in numerical models	
15		3	W		Ice processs in numerical models	
16		8-10	M-W	FINAL PRESENTATION OF HW 5: MICROPHYSICAL PARAMETERIZATION SCHEMES		

MAKEUP Classes: 1:00 - 1:50 pm on Mon