ATS724
Cloud Microphysics

(2-0-0)
Spring 2013 **odd years?**

Prerequisites:
ATS620, ATS621; PhD students or with written consent of the instructor; a working knowledge of Fortran, C++ or IDL, and Linux, as the class will involve designing and building a simple cloud microphysical model.

Course Description: **Sue and Sonia, please complete**
(no limit, could include mode of delivery)
Advanced analysis of the theories and observations of nucleation, mechanisms of cloud droplet-spectra broadening, precipitation particle growth mechanisms, ice multiplication processes, precipitation particle breakup mechanisms, and cloud electrification theories.

Instructors:
Sonia Kreidenweis, Professor, Department of Atmosphic Science
Sue van den Heever, Assistant Professor, Department of Atmospheric Science

Text(s): **Sonia and Sue, please complete**

Additional Class Material: **Sonia and Sue, please complete if applicable**

Course Objective(s):
The primary goals of this class are:
1. to expose students to cloud microphysical processes at a more advanced level than is presented in ATS620;
2. to address how these cloud processes are represented in a variety of parameterization schemes and numerical models; and
3. to provide students with practical experience in the design and development of microphysical parameterization schemes by requiring them to design and build a simple parcel model utilizing several different parameterization approaches.

Course Topics/Weekly Schedule: **Sonia and Sue, please include breakdown of how much time will be devoted to each topic**
- Parcel thermodynamics and basic cumuli storm dynamics
- Condensation
- Nucleation of cloud droplets and ice particles
- Collision and Coalescence
- Precipitation growth and breakup
- Ice processes

- Entrainment
- Parameterization approaches and assumptions including multiple moment bulk assumptions and bin modeling techniques

Instructional Methodology: The first class of the week will be used to discuss theoretical aspects of cloud microphysical processes, while parameterization assumptions and programming elements will be covered in the second class. Weekly homework assignments will focus on building the model and analyzing the output.

Mode of Delivery:
Lecture format, classroom instruction.

Methods of Evaluation: Graded homework assignments, primarily composed of problems solved using the model they are designing and building, will constitute 70% of the grade. Each student will also be required to deliver a final presentation on a topic of their choice that is investigated through the use of the model that they have built. This will constitute 30% of their grade.

Relevant ABET criteria: n/a

Meeting times: Twice per week

Course Title Abbreviated: Cloud Microphysics

Request for 2013:
ATS724 was last taught in Spring 2011 by Bill Cotton. The class was taught as a survey class of the various microphysical schemes in a range of different cloud and mesoscale models that addresses aerosol indirect effects, and relied heavily on discussion of published studies. The class proposed by Kreidenweis and van den Heever, while still focusing on advanced aspects of cloud microphysics, will utilize a significantly different approach to that of Cotton, including having the students design and build their own microphysical parameterization schemes. A brief survey of students has indicated great interest in obtaining such modeling skills, however, a number of students we questioned had already taken ATS724 when Bill Cotton taught the class. We are therefore requesting the opportunity to teach this class as ATS680 in SP2013, in order to allow those students to obtain credit for both the survey and modeling approaches to this class. This would only be for 2013. The next time we teach the class (proposed for 2015), it would be as ATS724 as there will be few students enrolled at that time who will have taken the survey approach.