**ATS712**
**Dynamics of Clouds**
**Fall 2018**

**Meeting Times:**
T/Th: 9-10:15am
Room: ATS 101
Make up classes: M/W: 1-2:15pm

**Instructor:**
Susan C. van den Heever
Room 425
Phone: 1-8501
Email: sue@atmos.colostate.edu

**Graduate Teaching Assistant:**
Peter Marinescu
Room 415
Email: Peter.Marinescu@colostate.edu

**Course Description:**
This class focuses on the general dynamics of cloud systems. Conceptual models of fog, stratocumuli, cumuli, cumulonimbi, mesoscale convective systems and orographic 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 include presentations by the instructor and students. Material covered in class will be supplemented by several homework assignments throughout the semester. The class will conclude with student presentations on a topic of their selection. These presentations will be held during finals week.

**Grading:**
No exams will be held for this class. A number of homework assignments 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 this is a 700 level class that is focused on providing a background for research, class discussions will be held at the end of each topic or main subsection to discuss science questions arising from the material just presented. Each student is expected to have thought about such questions independently and should be able to present these 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 shown in the table or to introduce a topic that is not shown here, both of which would 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 and behavior found in the 2018-2019 General Catalog found at http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity. Violations will result at a minimum 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.

**Class Outline**

| Topics | Subtopics | SCD Chapter | Approx Classes |
|---|---|---|---|
| Clouds – Introduction | • Classification of clouds<br>• Cloud time scales, vertical velocities, and liquid water contents | 1 | 2 |
| Fogs and Stratocumulus Clouds | • Types of fog and formation mechanisms<br>• Radiation fog and physics and dynamics<br>• Valley fog<br>• Marine fog<br>• Stratocumulus clouds | 6 | 4 |
| Thermodynamic Variables | • Various forms of potential temperature<br>• Dry and moist static energy etc | | 2 |
| Cumulus Clouds | • Boundary layer cumuli – an ensemble view<br>• Theories of entrainment, detrainment, and downdraft initiation in cumuli<br>• The role of precipitation<br>• Cloud merger and larger scale convergence | 7 | 6 |
| Cumulonimbus Clouds and Severe Convective Storms | • Descriptive storm models and storm types<br>• Updrafts and turbulence in cumulonimbi<br>• Updraft magnitudes and profiles<br>• Turbulence<br>• Downdrafts: origin and intensity<br>• Low-level outflows and gust fronts<br>• Theories of storm movement and propagation<br>• Mesocyclones and tornadoes<br>• Hailstorms<br>• Models of hailstorms and hail formation processes<br>• Rainfall from cumulonimbus clouds<br>• Aerosol impacts on convective precipitation | 8 | 7 |
| MCSs | • Definition of mesoscale convective systems<br>• Conceptual models of MCSs<br>• Climatology of MCSs<br>• MCVs and Tropical Cyclone Genesis<br>• Impacts of MCSs | 9 | 4 |
| Orographic Systems | • Theory of flow over hills and mountains<br>• Effects of clouds on orographic flow<br>• Orogenic precipitation<br>• Turbulence eddies and embedded convection in orographic clouds<br>• Blocking impacts on orographic precipitation | 11 | 3 |

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| | • Distribution of supercooled liquid-water in orographic clouds<br>• Efficiency of orographic precipitation and diurnal variability<br>• Aerosol influences on orographic precipitation | | |
| Clouds, Storms and Climate | • Clouds and the global radiation budget<br>• Hot towers and tropical circulations<br>• Clouds and global hydrological cycle<br>• Cloud Venting<br>• Aerosol pollution impacts on global climate<br>• Representing clouds in GCMs | 12 | 2 |
| **TOTAL CLASSES** | | | 30 |