

## **Climate System Physics-GEO 387P/347P**

**Spring 2011**

*Prerequisites: Two semesters of calculus and one of calculus-based physics  
3 credits.*

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### **What can you expect from this course?**

Earth's climate state and variability are fundamentally controlled by the energy balance of its climate system, which is largely determined by the physical properties and chemical composition of the Earth's climate system. These physical processes, through their control on energy and water, drive winds and ocean currents, and actively interact with the dynamic, chemical, biological and geological processes of the climate system. The purpose of this course is to understand and quantify these physical processes. The applications of these processes to climate variability and change issues and their interaction with dynamic, chemical, biological and geological processes will be discussed.

At the end of this course, I hope you will be able to take home the principles and formulations for a few fundamental processes that control the thermodynamic, radiative and hydrological properties of the Earth's climate system, and understand how they can be applied to explain and predict the climate state and changes.

**Text Book:** "Atmospheric Science-an introductory survey" by Wallace and Hobbs, the 2<sup>nd</sup> edition, published by Elsevier Inc.

**References (not required):** An introduction to atmospheric radiation by K. N. Liou; Physics of climate by Peixoto and Oort; Microphysics of clouds and precipitation by Pruppacher and Klett

### **Where?**

|                      |   |
|----------------------|---|
| Location:            | JGB 2.202   |
| Class Meeting Times: | Tuesday, Thursday 2:00 - 3:30pm,  |
| Office hours:        | Thursday: 1-2pm or by appointment. Emails will be replied within 24 hours unless the instructor is on travel. |

All class materials will be posted at Blackboard.

### **What do you expected to do?**

**Three in-class exams (open-book):** count 20% each, 60% total towards the course grade

**Assignments:**

Read research papers for relevant topics (most of these papers are written for general geoscience readers).

Exercises (informal homeworks):

Materials of the assignments will be tested by the three exams.

**Research Project (presentation and report):** 30% of the total grade

**Class-Participation:** 10%

**Outline of the topics and tentative schedule:**

1. Components of the Climate System and their impacts on climate system physical properties at different temporal and spatial scales (Weeks 1-2)
2. Atmospheric Composition (weeks 3-4)
3. Radiation in the atmosphere and surface ocean (weeks 3-4)
4. Thermodynamics of the atmosphere and ocean (weeks 5-6)
5. Physics of the water cycle (weeks 6-10)
  - A. Evaporation and evapotranspiration
  - B. Formation and development of the cloud and precipitation
  - C. Role of aerosols on clouds, precipitation and plant transpiration
  - D. Impact of atmospheric water cycle on ocean surface temperature and salinity
6. Synthesis of the outstanding topics of current climate research (weeks 11-14)
  - A. cloud/precipitation process
  - B. aerosols
  - C. biogeochemical cycle: carbon/CH<sub>4</sub>
  - D. Ocean convection and thermohaline circulation
  - F. Vegetation/land use
7. Project presentations (Week 15) - AGU style (totally 15 minutes, 12 minutes presentation + 3 minutes question/answer)