Climate Dynamics - Geography (GEOG) 142 [4 units]

Instructor: John Chiang, 547 McCone, jchiang@atmos.berkeley.edu, 2-3900
Office hours: by appointment; set hours TBA
Time and location: MW 9:30a-11a, 575 McCone

Midterm: provisionally Wed Oct 10, in class (will confirm)
Final exam date: TBA

Grades (approximate, subject to change): Homeworks/class project ~35%; Midterm ~25%; Final ~40%

Course home page: Please subscribe this course on your bspace account **https://bspace.berkeley.edu/**

Lecture slides: will be posted on bspace the night before the lecture. It'll usually be late at night, so best that you check in the morning prior to coming to class.

Goal: a *conceptual* basis for understanding of how earth's present climate comes about and how the various components of the climate system (atmosphere, land, ocean, cryosphere) interact to do so. The hope is that the student would be able to apply this knowledge to understand how change to the climate system can come about.

Prerequisites: concepts in physics are used in the text, so knowledge at the level of first course in undergraduate physics is highly recommended. Basic calculus will be helpful. ***Please read the separate note on prerequisites.***

Text: I require Hartmann (below), but it only covers about half of what I want to do, so I will supplement it with additional notes/text (I'll provide them). I also list references that may be helpful to you.

Required Global Physical Climatology **(aka GPC)** (Dennis Hartmann, Academic Press (1994)). Copies will be on reserve at the Earth Science and Map Library. The ASUC bookstore has copies for sale.

Helpful references (available in Earth Sci & Map Library):

Barry RG and RJ Chorley, "Atmosphere, Weather, and Climate".
Open University Course Team Staff: "Ocean circulation"
Wallace, J. M. and P.V. Hobbs, "Atmospheric Science: An Introductory Survey" Academic Press, 1977.

Outline of course (subject to change). The chapters refer to GPC

1. ***Introduction & observations of the climate system*** (Chapter 1): Atmospheric temperature. Atmospheric composition. Hydrostatic balance. Atmospheric humidity. Ocean, land, cryosphere.
2. ***The earth's energy balance*** (Chapter 2): orbital characteristics of the earth and distribution of insolation. Concept of energy balance as applied to the earth: first law of thermodynamics; emission temperature, greenhouse effects, distribution of insolation, top of atmosphere energy balance, poleward heat transport.
3. ***Atmospheric radiative transfer*** (Chapter 3): physics of electromagnetic radiation; Planck's law. Absorption and emission of radiation by gases. Radiative transfer. Radiative and radiative-convective equilibrium. Role of clouds and cloud feedback.
4. ***Surface energy balance*** (Chapter 4): Surface energy budget: radiative, latent and sensible fluxes. Heat storage at the surface. The atmospheric boundary layer. Fluxes and its dependence on surface characteristics. Diurnal and seasonal variations.
5. ***Atmospheric circulation*** (Chapter 6): how the circulation is set up and how it is related to the global energy balance. Equations of motion. Hydrostatic and geostrophic balance. The zonal mean circulation and meridional heat transport. Large scale circulation patterns. (Here I'll deviate somewhat from Hartmann and include more detail on the general circulation of the atmosphere).
6. ***Ocean circulation and its relationship to climate*** (Chapter 7): Properties of seawater. Processes in the ocean mixed layer that determines its temperature and circulation. Its relationship to deeper waters and the thermohaline circulation. Meridional heat transport in the ocean.
7. ***The cryosphere***. Observed characteristics and relationship to the energy balance. Ice sheets and glaciers, sea ice, snow, permafrost. Ice-albedo feedback.

As time permits, we will cover one or more of these topics:

- ***Climate sensitivity and feedback***
- ***Natural climate change***: examples of interannual and decadal variability of climate (e.g. El Nino-Southern Oscillation, and the North Atlantic Oscillation). Paleoclimate change (e.g. Climate of the last glacial maximum).
- ***Anthropogenic climate change***