

SYLLABUS

OCEA90 : Fundamentals of Climate

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Office hours: Wed. 12-2pm; Thurs 1:30-3:30pm. Earth & Marine Science A312

OVERVIEW

Duration: 5 weeks, 2 lectures per week (10 classes)

Meeting time: TuTh, 9:00AM-12:30PM

The climate of the Earth is undeniably changing. In this course we will explore how interactions between the atmosphere, ocean, cryosphere, biosphere and land surface shape the very nature of the Earth's climate. The course will comprise five modules that introduce important ideas and concepts about the circulation of the atmosphere and ocean (week 1), atmospheric teleconnection patterns (week 2), the El-Niño Southern Oscillation (week 3), the Pacific Decadal Oscillation and other low frequency modes of natural climate variations (week 4), and greenhouse gas emissions and global warming (week 5). The analysis of climate is inherently statistical in nature – that is, there is no “control experiment” on which we can base the interpretation of Earth observations, so by necessity we are forced to view climate in terms of probabilities. Therefore, in addition to learning about how the climate system works, this course will explore some of the statistical methods that underpin much of what is known about how climate is changing. This class satisfies the Statistical Reasoning (SR) General Education requirement.

SCHEDULE

- Week 1 - Module #1: Atmospheric Circulation and the Basics of Probability and Statistics

Reading:

-module1.pdf

-Reader, Mackenzie, “The Fluid Earth: Atmosphere,” chapter 3, page 3-26;

Concepts:

- Random numbers; probability density functions; cumulative probabilities

-Earth energy balance; distribution of atmospheric pressure; Pressure gradient force; Coriolis force; geostrophic balance;

- Week 2 - Module #2: Atmospheric Teleconnection Patterns

Reading:

-module2.pdf

-Reader, “An Overview of the North Atlantic Oscillation” by Hurrell et al, pages 69-103;

Concepts:

-The general circulation of the atmosphere; more on probability density functions

-Storm tracks; teleconnection patterns; the Pacific North American (PNA) pattern and the North Atlantic Oscillation (NAO)

- Week 3 - Module #3: The El Niño Southern Oscillation (ENSO)

Reading:

- module3.pdf
- Reader, Mackenzie, "The Fluid Earth: Hydrosphere," chapter 4, page 31-66;

Concepts:

- The ocean circulation; gyres and western boundary currents; correlation
- The Bjerknes feedback; El Niño and La Niña; probabilistic forecasting

- Week 4 - Module #4: Climate Variability

Reading:

- module4.pdf

Concepts:

- Covariance; principal components
- Principal components and climate modes; the Pacific Decadal Oscillation (PDO); the North Pacific Gyre Oscillation (NPGO); annular modes; the Indian Ocean Zonal Mode (IOZM)

- Week 5 - Module #5: Climate Change

Reading:

- module5.pdf
- Reader, Kump et al., chapter 16, pages 109-145;

Week 5:

- The greenhouse effect revisited; climate change; linear regression
- Attribution of climate change; climate model forecasts

ASSIGNMENTS

Student assignments are based on the open source statistical software package called R. R is freely available for both Mac and PC, and is also available in most of the computer laboratories on campus. You should install R on your own personal computer as soon as possible, or locate a convenient computer lab where R is available for you to use. For information on how to download and install R, see <http://its.ucsc.edu/software/list.html> under the tab "R – Statistics." For basic instructions on R see the document R_introduction.pdf which can be found in the R folder on the class web site.

The approximate schedule of assignments is as follows:

- (1) Assignment #1: out on 7/26; due on 8/2
- (2) Assignment #2: out on 8/2; due on 8/9
- (3) Assignment #3: out on 8/9; due on 8/16
- (4) Assignment #4: out on 8/16; due on 8/23
- (5) Assignment #5: out on 8/23; due on 8/26 (Friday)

NOTE: Students are required to work on assignments alone. There are no group assignments, and the work you submit for grading must be your own work. Only hard copies of your assignments are accepted.

-Electronic copies of student work will not be accepted.

-Assignments are due by 4pm on the date indicated.

-10% will be deducted from your grade for everyday that an assignment is overdue.

EXAMINATIONS

There will be two exams during the quarter: a mid-term exam scheduled for 8/11 and a final exam scheduled for 8/25. Both will be during the class period.

STUDENT EVALUATION

Students will be evaluated based on their performance in five homework assignments (75% of final grade) and two examinations (25% of final grade).

CLASS TEXT

There is no textbook for this class. Instead a customized reader is available at the bookstore, though it is optional and in no way required for the class. In addition, the instructor will make notes available online that cover the statistical material that is covered during lectures.

The instructor will do everything possible to accommodate students with learning or physical disabilities. However, such disabilities must be brought to the attention of the instructor at the start of the quarter.

The instructor will make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please notify the instructor regarding any anticipated scheduling conflicts arising from observance of religious holidays or festivals as early in the quarter as possible so that there is adequate time to make necessary alternative arrangements.