EESS 146B/246B
Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation
http://pangea.stanford.edu/~leift/EESS146Bweb/index.html
Spring Quarter 2010
Version 3/4/10

CLASS HOURS & LOCATION:
Monday, Wednesday, and Friday 2:15pm – 3:05pm.
Monday, Wednesday: McCullough 115; Friday: Y2E2 111

INSTRUCTOR: Leif Thomas leift@stanford.edu Y2E2 Bldg, Room 181
Office hours: TBA.

TEACHING ASSISTANT: TBA
Office hours: TBA

TEXT:
Atmosphere, Ocean, and Climate Dynamics: An Introductory Text, by J. Marshall and R. A. Plumb. Academic Press.

GRADING:
There will be no mid-term or final exam. Grades will be based on four homeworks (80%) and a lab notebook (20%).
Students will be required to participate in laboratory demonstrations used to illustrate the key fluid dynamics of the ocean circulation and document what they observe in a lab notebook to be turned in on the Monday after the lab at the beginning of the class period. Problem sets should be turned in at the beginning of the class period. ***Late assignments will receive a point deduction of 50% of the total.***

COURSE DESCRIPTION:
Introduction to the physics governing the circulation of the atmosphere and ocean and their control on climate with emphasis on the large-scale ocean circulation. This course will give an overview of the structure and dynamics of the major ocean current systems that contribute to the meridional overturning circulation, the transport of heat, salt, and biogeochemical tracers, and the regulation of climate. Topics include the tropical ocean circulation, the wind-driven gyres and western boundary currents, the thermohaline circulation, the Antarctic Circumpolar Current, water mass formation, atmosphere-ocean coupling, and climate variability.

PREREQUISITES:
MATH 51 and PHYSICS 41 (or equivalent math and physics) and some familiarity with the Navier-Stokes equations; **-OR-** CEE 164/262D.

Course Schedule and Reading

29-March Introduction and motivation

31-March Physical characteristics of the ocean (9.1)

2-April LAB: Constraints imposed by rotation and stratification; *HW1 out*

5-April Coriolis force, geostrophy, and the thermal wind balance (6.6, 7.1, 7.3)

7-April Observed mean circulation and distributions of temperature and salinity. (9.1, 9.2)

9-April LAB: Taylor-Proudman effect; geostrophic balance

12-April Wind-stress and Ekman layers (10.1)

14-April Ekman pumping and suction and the Taylor-Proudman effect on a sphere (10.1, 10.2)

16-April LAB: Ekman pumping/suction, vortex stretching; *HW1 due; HW2 out*

19-April Wind-driven gyres and the Sverdrup balance (10.3)

21-April Western boundary currents, vorticity balance, and Rossby waves. (10.3,11.3.2)

23-April LAB: Wind-driven ocean gyres

26-April Taylor-Proudman in a layered ocean and recirculation gyres (10.4)

28-April Air-sea fluxes, the ocean mixed layer, and water mass formation (11.1)

30-April LAB: Thermal-wind balance; *HW 2 due; HW 3 out*

3-May Three-dimensional structure of the gyres, water masses, and subduction

5-May Antarctic Circumpolar Current and Antarctic Intermediate Water (10.5, 8.3)

7-May LAB: Eddies in the ocean: baroclinic instability

10-May Deep water formation and the global density budget (11.1, 11.2)

12-May Dynamical models of the abyssal, meridional overturning circulation (11.3)

14-May Observations of the abyssal circulation and its water masses (11.4); *HW 3 due; HW 4 out*

17-May Energetics of the ocean circulation

19-May Ocean heat, freshwater, and carbon transport and budget (11.5,11.6)

21-May LAB: Abyssal circulation

24-May Equatorial circulation (12.2)

26-May ENSO/El Niño (12.2)

28-May Course review. *HW 4 due*