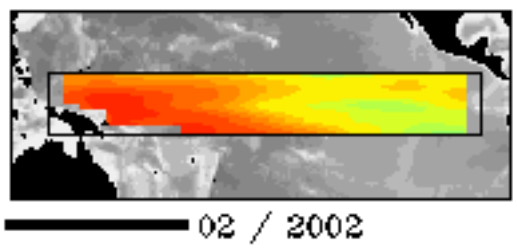
SIO 210: Introduction to Physical Oceanography

[Scripps Institution of Oceanography]
[University of California San Diego]

Fall 2015	*Instructors:* Lynne Talley and Myrl Hendershott *TAs:* Jessica Masich and Jose 'Alfredo' Giron Nava (course TAs), Jonathan Eliashiv (Math tutorial) *Time:* Monday (All), Wednesday (Section 1), Friday (Section 2) 2:00-3:20 *Location:* Vaughan 100	SCRIPPS INSTITUTION OF OCEANOGRAPHY



Equatorial Pacific SST, courtesy of NOAA

UCSD TED site for SIO 210

Course Overview

Physical description of the sea; physical properties of seawater, methods and measurements, boundary processes, regional oceanography. Prerequisites: the mathematics and physics required for admission to the graduate curriculum in the Scripps Institution of Oceanography, or consent of the instructor. Since math courses might have been taken many years ago for some students, please check this math concept link, and attend the math tutorials if you want a refresher.

The course url is http://www-pord.ucsd.edu/~ltalley/sio210. The notes and figures are background for the coursework. They are evolving and informal. They may not be used for other purposes without permission. Figures from copyrighted sources include the reference.

The class is divided into two sections: Section 1 (more descriptive approach), and Section 2 (more dynamical approach). Students should attend two lectures per week: Monday (for all) and either Wednesday (Section 1) or Friday (Section 2), which will cover the same material as Wednesday but with a more dynamical approach if appropriate. All students are welcome to attend all lectures. All graded work will be the same for both sections.

Lecture links: until just prior to lecture, the link is likely to be the 2014 content

Sep. 28: Introduction, scales of motion and Physical Properties of Seawater I
Sep. 30, Oct. 2: Physical Properties of Seawater II and III
Oct. 19 [originally Oct. 5]: Dynamics I Advection/Transports/Budgets and Typical distributions I
Oct. 21, 23 [originally Oct. 7,9]: Typical distributions II; and Dynamics II Equations of motion, non-rotating
Oct. 12 (all students): Waves [Myrl Hendershott]
Oct. 14 (all students): Tsunamis [Myrl Hendershott]
Oct. 16 (all students): Tides [Myrl Hendershott]
Oct. 26 [originally Oct. 19]: Observational tools and Data analysis methods
Oct. 28, 30 [originally Oct. 21, 23]: Data analysis methods; and Dynamics III: Rotation
Nov. 2: Mid-term (in-class, in Sumner auditorium)
Nov. 4, 6 [originally Oct. 26]: Atmospheric circulation; and Dynamics IV: Geostrophy
Nov. 9 [originally Oct. 28, 30]: Dynamics IV (continued) Geostrophy; and Dynamics V: Friction, Ekman layers
Nov. 11, 13 [originally Nov. 4, 6]: Eddies, Rossby waves; and Dynamics VI: Potential vorticity, beta effect
DATES NOT CORRECTED HEREAFTER
Nov. 9: Pacific Ocean - wind-driven circulation
Nov. 11, 13: Atlantic, Indian upper ocean circulation; Dynamics VII: Sverdrup balance, western boundary currents
Nov. 16: Eastern boundary currents; and Dynamics VIII: eastern boundary currents
Nov. 18, 20: Equatorial circulation and ENSO; and Dynamics IX: Equatorial circulation and ocean-atmosphere feedbacks
Nov. 23: Southern Ocean circulation; and Dynamics X: Southern Ocean wind-driven circulation
Nov. 25 (both sections): Atlantic Ocean deep circulation; and Dynamics XI: Thermohaline circulation
Nov. 27 (Thanksgiving holiday)
Nov. 30: Global circulation
Dec. 2, 4: Climate and the oceans (draft)
Dec. 9: Final exam (3-6 PM)

Assignments

Problem Set 1, Due Oct. 19

Problem Set 2, Due Oct. 30

Short paper, data project or tank experiment.

Topic due Oct. 26, JOA project or paper due Nov. 23, tank experiments ongoing.
Choose between:

- (1) critique of a published paper (written report),
- (2) data project using Java Ocean Atlas, with Jim Swift and Jessica Masich (individual or group presentation, written report). Letter from Jim Swift regarding JOA
- (3) tank experiment (group presentation, written report),

Read this: Guidelines (2015) for tank experiments

http://paoc.mit.edu/labguide/projects.html
The accompanying textbook is
Marshall, J. and Plumb, R. A., 2007. Atmosphere, Ocean, and Climate Dynamics: An Introductory Text, Elsevier

Tutorials: times suggested, to be finalized on first day of class

Course material tutorials (alternating Jess Masich, Alfredo Giron and Lynne Talley)
Section 1 (less mathematical): Thursday's 2:00-3:00 Hubbs 4500 (Alfredo Giron)
Section 2 (more mathematical): Friday's 11-12 Vaughan 300 (Jess Masich)

Math tutorial (click this link to look at list of math concepts): Monday's 11-12, Ritter 229. (Jonathan Eliashiv)
Useful math link: Wolfram MathWorld
Any basic calculus textbook is helpful. Wikipedia is surprisingly good for calculus as well.

Grading

Percentages: Final exam (40), mid-term exam (20), paper (12), each of 4 assignments (7)

Previous exams

Primary texts - online

- *Descriptive Physical Oceanography: An Introduction, 6th edition* by L. Talley, G. Pickard, W. Emery, J. Swift
- *Java Ocean Atlas exercises for Descriptive Physical Oceanography (part of the text)*

To reach SIO 210 eReserves: NOT YET OPERATIONAL 28 SEPT 2015

Other relevant texts (* = hard copy reserves available at SIO department)

Most useful for everyone:

- **Atmosphere, Ocean, and Climate Dynamics: an Introductory Text* by John Marshall and R. Alan Plumb, Elsevier, 2007. (For all tank experiment groups.)
- *Introduction to Physical Oceanography.* by Robert Stewart. This is an open source, online text only, which includes a printable pdf and cover. The pdf version is the most up-to-date.
- *Regional Oceanography: An Introduction.* by Matthias Tomczak and Stuart Godfrey.

Introductory level:

- *Ocean Circulation*. Open University Press, Pergamon.
- *Invitation to Oceanography* by Paul Pinet, Jones and Bartlett Learning, 2011. Online study tools.
- UCAR MetEd online course, including unit on currents. You will have to register, but it's free.

More advanced dynamical treatments:

- *Introduction to Geophysical Fluid Dynamics* by Benoit Cushman-Roisin, Elsevier, 2011.
- **Atmospheric and Oceanic Fluid Dynamics* by Geoff Vallis, Cambridge University Press, 2006.
- *Fluid Mechanics (5th edition)* by P. Kundu, I.M. Cohen, D. R. Dowling, Elsevier, 2012.

Atmosphere-Ocean Dynamics by Adrian Gill, Academic Press, 1982. pdf of Appendix 2 (properties of seawater)
- *Introduction to Physical Oceanography* by John Knauss
- *Ocean Circulation and Climate: observing and modelling the global ocean.* Ed. G. Siedler, J. Church and J. Gould, Academic Press, 2001.
- *Ocean Circulation and Climate - A 21st Century Perspective.* Ed. G. Siedler, S.M. Griffies, J. Gould and J.A. Church, Elsevier, 2013.

Other online resources

- Properties of seawater from the UNESCO tables, in fortran, matlab and c
- Hendershott, M. C., 2004. Lectures on tides, from Geophysical Fluid Dynamics 2004. Woods Hole Oceanog. Inst. Tech. Rept., WHOI-2005-08.E
- Waves notes (Hendershott) 11/05
- A nice collection of classic papers on large-scale ocean circulation and related topics (Geoff Vallis, Princeton University)

Contact Information

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