SIO 210: Introduction to Physical Oceanography

Scripps Institution of Oceanography
University of California San Diego

Fall 2017	*Instructors:* Jennifer Mackinnon and Sarah Purkey *TAs:* Benjamin Birner and Savannah Lewis *Time:* Monday, Wednesday 2:00-3:20 *Location:* Vaughan 100 *Tutorials:* Friday at TBD

Course Overview

Physical description of the sea; physical properties of seawater, methods and measurements, boundary processes, regional oceanography.

Prerequisites: The mathematics (calculus) 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.

UCSD TritonEd site for SIO 210

Lectures

Oct. 2: Introduction, scales of motion and start Physcial prop of sea water
Oct. 4: Physical Properties of Seawater II and III
Oct 9: Dynamics 1 (Advection/mixing, isopycnals surfaces)
Oct 11: Dynamics 2 (Momentum, velocity, energy)
Oct. 16: Observational Tools and Data Analysis
Oct. 18: Typical distributions
Oct. 23: Forcings and Atmospheric circulation
Oct. 25: Coriolis effects and Ekman layers
Oct. 30: Upper ocean circulation
Nov 1: Variation of Coriolis and circulation (Sverdrup balance, western boundary currents)
Nov 6: Mid-term (in-class)
Nov. 8: Eastern boundary currents
Nov. 13: Equatorial circulation and ENSO
Nov. 15: Waves
Nov. 20: Tides
Nov. 22: Atlantic Ocean deep circulation; Thermohaline circulation

Nov. 27: Southern Ocean circulation
Nov. 29: Global circulation
Dec 4: Natural climate variability and the oceans
Dec 6: Climate change and the oceans, using IPCC WGI chapter readings and figures.
Dec. 13: Final exam

Assignments

Links will be available when Problem Sets are assigned

Problem Set 1, Due TBD
Problem Set 1 Answer Key

Problem Set 2, Due TBD
Problem Set 2 Answer Key

Problem Set 3, Due TBD
Problem Set 3 Answer Key

Problem Set 4, Due TBD
Problem Set 4 Answer Key

Short paper, data project or tank experiment

Oct. 11: Pick project type (paper, data project, or tank experiment - see below). Sign up in class.

Oct. 25: Short topic description due (very short)

Nov. 29: Data project or paper due

Tank experiments are ongoing

Choose between:
- (1) Review of a pair of published papers (written report),

Guidelines for paper.
- (2) Data project using Java Ocean Atlas, with Jim Swift (individual or group presentation, written report).

Letter from Jim Swift regarding JOA.
- (3) Tank experiment (group presentation, written report).

Guidelines (2016) 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

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Tutorials:

Course material tutorials
SIO210 CSP Students: Friday TBD, Location TBD
SIO210 All Students: Friday TBD, Location TBD

Math tutorial (click this link to look at list of math concepts):
Friday TBD, Location TBD
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), project/paper (12), each of 4 assignments (7)

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)*

Other relevant texts

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 (copyright 2008). This is an open source, online text only, which is currently hosted only as a pdf of entire text. The link may be ephemeral as it is no longer supported by TAMU.
- *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 TEOS-10 (Thermodynamic Equation of State 2010)
- Properties of seawater from the UNESCO tables (pre-2010 EOS), 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, University of Exeter)

Contact Information

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