Physical-Biogeochemical Coupling in Oceans and Lakes

AOS/ZOO/GEOSCI/IES 750: Problems in Oceanography
Spring 2016

Instructor	Galen A. McKinley, 1511 AOS&S, gamckinley@wisc.edu; *Office hrs: TBD*
Class Time	TTh 11-12:15
Location	1411 AO&SS, 1225 W. Dayton St.
Credits	3
Course website	Learn@UW, https://learnuw.wisc.edu

Course Description:
In this new course, we will explore the mechanisms of physical-biogeochemical coupling in the oceans and lakes. We will address 1-dimensional coupling, 3-dimensional coupling, high frequency variability, and net effects on large-scale carbon and nutrient cycles. Laboratory exercises will be drawn from observations and models across small lakes, large lakes and the open ocean.

Course meetings will be used for 50% Lecture and 50% Lab/Discussion. The Lab/Discussion will vary in content over the semester as appropriate to the material, focusing on data analysis, modeling exercises, and discussion of peer-reviewed publications. Lab/Discussion will be structured to create opportunities for students of different backgrounds (e.g. physics, ecology, chemistry) to practice interdisciplinary collaboration.

Grading: Labs will conclude with a write-ups and presentations. For discussion, students will take turns leading, and all will be expected to fully participate. There will be an open-book take-home final exam.

Text:
Required:

Williams, R.G. and M.J. Follows. 2011. Ocean Dynamics and the Carbon Cycle, Cambridge, 404pp.
(Electronically at UW-Madison: https://search.library.wisc.edu/catalog/9910137653802121)

Supplementary readings will also be assigned and posted on Learn@UW.

Week-by-week overview (more detail on last page):

Week 1-4: 1-D coupling in oceans and lakes - Understanding the seasonal cycle of surface productivity
Labs: Lake Mendota data
Bermuda Atlantic Timeseries data
Two layer coupled model

Week 5-8: 3-D coupling in oceans and lakes under the influence of Earth's rotation
Labs: Geostrophic balance in the thermal bar
Wind-driven upwelling in large lakes and the equatorial Pacific

Week 9-10: Mechanisms of high frequency variability – Eddies, fronts and waves
Lab: TBD

Week 11-14: Carbon and nutrient cycles
Labs: Ocean nutrient and carbon distributions
Great Lakes carbon budgets
Terrestrial influences

Week 15: Anthropogenic change

Grading:

Lab reports (5 x 10% = total 50%)
Lab presentations (10%)
Participation (20%)
Take home final (20%)

Expected final Scale:

100-93%=A
92-88%=AB
83-97% = B
78-82% = BC
70-77% = C
60-69% = D

Exam:

The final exam will be take-home and open-book. Collaboration will not be allowed. Any evidence of collaboration will be considered a breach of academic integrity standards and will not be tolerated. See "Academic integrity" below for more detail.

Attendance:

Class attendance is critical, and this is your responsibility. In accordance with UW-Madison policy, I will avoid scheduling mandatory course requirements on dates of key religious holidays. If you will miss class for required fieldwork, a conference, or personal reasons, you must provide adequate and reasonable advance notice (>72 hrs notice). If illness will prevent your attendance, please make every effort to let me know in advance of the class meeting. Both excused and unexcused absences may negatively impact your final grade.

Academic integrity:

Academic integrity is expected from all students. Please make you are familiar with the expectations as outlined at https://www.students.wisc.edu/doso/academic-integrity/. Failure of the course will result if these standards are not respected.

Daily Schedule for AOS/ZOO/GEOSCI/IES 750 - Spring 2016
Problems in Oceanography:
Physical - Biogeochemical Coupling in the Oceans and Great Lakes

Week	Date		Topic	Reading, ***Assignment Due***
1	19-Jan	1	Introduction	
	21-Jan	2	Lecture 1: Surface forcing for large aquatic systems	Williams and Follows Ch 1,5
2	26-Jan	3	Lecture 2: 1D physical-biogeochemical coupling	Williams and Follows Ch 7
	28-Jan	4	Lab / discussion 1: Seasonal coupling of physics and ecosystems: data	
3	2-Feb	5	Lab / discussion 1: Seasonal coupling of physics and ecosystems: data	Fahnenstiel et al. 2010
	4-Feb	6	Lab / discussion 2: Seasonal coupling: model	
4	9-Feb	7	Lab / discussion 2: Seasonal coupling: model	
	11-Feb	8	Lecture 3: 3D Circulation - Transport by advection and diffusion	Williams and Follows Ch 2,3
5	16-Feb	9	Lecture 4: 3D Circulation - Advection with Earth's rotation	Williams and Follows Ch 4
	18-Feb	10	Lab / discussion 3: Geostrophic balance	
6	23-Feb	11	Lab / discussion 3: Geostrophic balance	
	25-Feb	12	Guest Lecture: TBD	
7	1-Mar	13	Lecture 5: 3D Circulation - Advection with Earth's rotation	Williams and Follows Ch 4
	3-Mar	14	Lab / discussion 4: Wind-driven upwelling, oceans and Great Lakes	
8	8-Mar	15	Lab / discussion 4: Wind-driven upwelling, oceans and Great Lakes	
	10-Mar	16	Lecture 6: Gyre circulations and aquatic productivity	Williams and Follows Ch 8
9	15-Mar	17	Lecture 7: Fronts and eddies	Williams and Follows Ch 9
	17-Mar	18	Lab / discussion 5: Fronts and eddies	
10	29-Mar	19	Lecture 8: Waves and turbulence	Wetzel Ch 7
	31-Mar	20	Guest Lecture: TBD	
11	5-Apr	21	Lecture 9: Carbon chemistry	Williams and Follows Ch 6
	7-Apr	22	Lecture 10: Carbon and nutrient cycles of the upper ocean	Williams and Follows Ch 10,11
12	12-Apr	23	Lecture 11: Carbon and nutrient cycles of the deep ocean	Williams and Follows Ch 12
	14-Apr	24	Lab / discussion 6: Carbon and nutrient cycles	
13	19-Apr	25	Lab / discussion 6: Carbon and nutrient cycles	
	21-Apr	26	Lecture 12: Terrestrial influences	
14	26-Apr	27	Lab / discussion 7: Terrestrial influences	
	28-Apr	28	Lab / discussion 7: Terrestrial influences	
15	3-May	29	Lab / discussion 8: Anthropogenic change	
	5-May	30	Wrap up	
	12-May		***Take home final exam due***	