OCN 310L: Global Environmental Change Laboratory
(cross-listed as MET 310L and OEST 310L)

Instructor: Richard E. Zeebe

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Grading:
Weekly homework assignments: 30%
Homework presentation and class participation: 40%
Draft, paper and oral presentation: 30%

No midterm! No final!

Rules:
In fairness to other students, draft or paper turned in 1 and 2 days late will receive a grade corresponding to 2/3 and 1/3 of the points scored, respectively. After 2 days, zero credit will be given. Homework not turned in before class receives 0 points. These rules apply unless there is a documented reason such as medical emergency or funeral.

In this class you will develop and improve skills in working out strategies and ideas how to quantitatively solve problems. The topics will focus on Earth’s environment. Your challenge will be to develop concepts and approaches to various problems and finally provide useful solutions to them (calculating sophisticated, highly accurate answers will not be the goal, rather useful approaches and reasonable values will be required). This is sometimes not a trivial task and you should anticipate to spend a considerable amount of time on your homework, but — as the famous physicist Richard Feynman has put it — you will have “the pleasure of finding things out”!

If necessary, contact Adam regarding your homework — but only after in-depth consideration of the problem and with a preliminary idea or a precise question.
The first part of the class will be concerned with problems and exercises of the textbook. Every week homework will be assigned and turned in before class the week after. The homework will be discussed in class and every week some of you will present their solutions to the other students. The presentation will rotate and at the end of the semester each student will have presented approximately the same number of exercises.

The second part of the class will be concerned with developing and using numerical tools for quantitative problem solving. The scientific topic will focus on phosphorus cycling in the ocean. You will develop a numerical algorithm (in groups of two) to solve the equations of a box model of the ocean’s phosphorus cycle (Toggweiler, 1999). The software used for this application will be MATLAB (bring a memory key to every class in order to save your files!). After development of the base model, you will choose a project which will serve as the subject of your paper and oral presentation. A typical project will require changes to the existing numerical code in order to perform a sensitivity study or tackle a related/advanced problem.

Tentative Schedule

Aug 23
- Introduction
- Chapter I.1—I.6
- Homework (due Aug 30):
  - Related exercises, to be assigned
  - Read p. 21–33, Chapter II.1—II.4

Aug 30
- Chapter II.1—II.4
- Homework (due Sep 06):
  - Related exercises, to be assigned
  - Read p. 34–44, Chapter II.5—II.7

Sep 06
- Chapter II.5—II.7
- Homework (due Sep 13):
  - Related exercises, to be assigned
  - Read p. 45–58, Chapter II.8—II.10

Sep 13
- Chapter II.8—II.10
Homework (due Sep 20):
   Related exercises, to be assigned
   Read p. 95–108, Chapter IIC (II.19–II.20)

Sep 20
Introduction to chemical equilibria
Chapter II.19–II.20
Homework (due Sep 27):
   Related exercises, to be assigned
   Read p. 111–113, 138–149, Chapter (II.22, III.4)

Sep 27
Non-steady state box models and carbonate chemistry
Chapter II.22, III.4
Homework (due Oct 04):
   Related exercises, to be assigned
   Read MATLAB Intro

Oct 04
Introduction to MATLAB
Homework (due Oct 11):
   Solve analytically $\frac{dy}{dt} = \lambda \, y, \, y(0) = y_0$

Oct 11
Solve numerically $\frac{dy}{dt} = \lambda \, y, \, y(0) = y_0$
Develop routines for base model (PO$_4$ in 3-box model)
Homework:
   Work on model/draft paper

Oct 18
Develop routines for base model (PO$_4$ in 3-box model)
Discussion/assignment of projects
Homework:
   Work on model/draft paper

Oct 25
Finalize routines for base model (PO$_4$ in 3-box model)
Project model experiments
Homework:
   Work on model/draft paper
Nov 01
  Project model experiments
  Work on draft paper
  Homework:
  Draft paper

Nov 08
  Project model experiments
  Work on draft paper
  Homework:
  Draft paper

Thursday, Nov 10, 01:00 pm: Draft paper due for review
→ Mailbox, MSB 502

Nov 15
  Discussion of reviewed draft paper
  Work on model/final paper in class
  Homework:
  Work on model/final paper
  Prepare oral presentation

Tuesday, Nov 22, 01:30 pm: Final paper due

Nov 22
  Oral presentations
  Homework (due Nov 29):
  Read p. 59–73, Chapter II.11–II.13

Nov 29
  Chapter II.11–II.13
  Homework (due Dec 06):
  Related exercises, to be assigned.

Dec 06
  Homework Presentation
  Chapter II.11–II.13