AOSC 680: Introduction to Earth System Science

Instructor: Ross Salawitch (301-405-5396; rsalawit@umd.edu)

Fall 2022: Tues – Thurs 2:00 to 3:15 pm, Atlantic 2316

Websites: http://www.atmos.umd.edu/~rjs/class/fall2022 & https://umd.instructure.com/courses/1327017

Required Text:

Chemistry in Context: Applying Chemistry to Society **7th Edition** American Chemical Society
(You can either purchase, rent a used copy from me for $20 refundable upon return of the book, or use a password protected PDF file I'll provide to registered students)

Paris Climate Agreement: Beacon of Hope by Ross J. Salawitch *et al*. (available for free via open access)

Atmospheres, Clouds, and Climate by David Randall

Climate and Oceans by Geoffrey Vallis

Climate and Ecosystems by David Schimel

The Cryosphere by Shawn J. Marshall

These four Princeton Primers in Climate books, available in various formats including paperback for less than $30 each, will be the primary source for the student led discussions, which will take place from 13 Oct until 2 Dec. We will almost certainly read multiple chapters from the first three of these books, and will delve into the fourth if there is student interest in reading about the cryosphere.

Supplemental Text (selected readings will be provided):

Global Warming: The Complete Briefing **5th Edition** by John Houghton (selected readings will be provided)

Course Description. An introduction to the study of the earth as a system: atmosphere, oceans, land, cryosphere, solid earth, and humans. Cycling of materials and energy in the earth system: the energy cycle, the hydrologic cycle, the carbon cycle, the nitrogen cycle. Climate processes and variability: land-atmosphere, ocean-atmosphere, biosphere-climate, and human interactions, short- and long-term variability in climate. Thus class will be taught at a level appropriate for first year graduate students in Atmospheric and Oceanic Science.

Prerequisites: AOSC graduate student *OR* being advised by an AOSC Faculty Member *OR* permission of instructor.

Class Philosophy: We'll begin in traditional format, consisting of 9 lectures designed to provide a broad background to Earth System Science. This portion of the class will make use of equations, at a level considerably simpler than you will see in the other AOSC Core Classes. We will then transition to the student led discussion part of class, which will make use of either three or perhaps all four of the most excellent Princeton Primers In Climate series. These readings, which consist of light equations, emphasize **fundamental understanding of concepts in Earth System Science**, which is the mantra of this class. Each book is available in a variety of formats, including paperback for less than $30 each.

Grades: Grades will be based on the problems set (10%), admission tickets (30%), one in class exam (20%), the student led presentation (20%), and the final project (10%) and final paper (10%). All students are required to write a research paper that is 6 to 8 pages long (single-spaced; length does not include figures or references) on a topic of their choosing related to the material covered in class. All students will make deliver two in class presentations: one based on a chapter or two selected from one of the required books in the Princeton Primers in Climate Series (this will be an hour long discussion) and the second based on a research project (this will be a 10 minute presentation).

Course Topics

- How to Build a Habitable Planet: Geological Evolution of Earth's Atmosphere
- Overview of Global Warming
- The Greenhouse Effect: Radiative Transfer; Cloud and Water Vapor Feedbacks
- Climates of the Past
- Modeling of Earth's Climate
- The Global Carbon Cycle
- Biogeochemical Cycles of Methane and Nitrous Oxide
- Selected readings from:
  - *Atmosphere, Clouds and Climate* by David Randall
  - *Climate and Oceans* by Geoffrey Vallis
  - *Climate and Ecosystems* by David Schimel
  - *The Cryosphere* by Shawn J. Marshall