

Climate Modeling (METEO 523, 3 credits)

Course Syllabus for Fall 2006

Instructor: Michael E. Mann, Department of Meteorology, 523 Walker Building,
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Meeting Time/Place: T R 2:30-3:45P (218A HOSLER)

Office Hours: You are encouraged to use email for questions when possible. You are welcome to visit my office for questions during scheduled office hours (Wed, 1:30-2:45 PM), or by appointment.

Motivation:

In order to understand and model the climate system, we need to understand the dynamics of the underlying components, including the atmosphere and ocean, and the mechanisms by which they are coupled.

In this course, we will model the dynamics and thermodynamics governing the ocean and atmosphere on spatial and temporal scales appropriate for climate studies. We will investigate the processes by which the dynamics of the ocean and atmosphere are coupled on these timescales, with the goal of understanding the basic mechanisms of climate variability.

Topics to be covered:

- *Averaging of the Governing Equations for Climate Studies*
- *Coupled ocean-atmosphere interactions*
- *The Thermohaline and Wind-Driven Ocean Circulation*
- *The El Nino/Southern Oscillation*
- *Internal Climate Variability*
- *Energy Balance Models*

Webpage

We will regularly draw upon the course homepage as a resource for the course:

<http://www.meteo.psu.edu/~mann/Mann/courses/METEO523FAI>

Aside from links to the course syllabus, there will be links to the readings, problem sets, slides from the lectures, and other course-related materials.

Lectures

Attendance of all lectures is expected. You are strongly encouraged to ask questions and participate constructively in class. Copies of slides from the lectures will usually be made available electronically through the course website (see above) within 2-3 days following the lecture.

Textbook

The course textbook is:

Peixoto and Oort (1992), *Physics of Climate*, 2nd Edition, American Institute of Physics Press, 564pp.

Where appropriate, supplementary readings taken from various sources will be posted on the course website.

Grading

Problem Sets (60%): There will be several (4-5) problem sets assigned that will involve applications of topics covered in class.

Mid-Term (40%): There will a mid-term examination during class on Tuesday Oct 31.

LECTURE SCHEDULE (tentative and subject to change)

	DATE	LECTURE TOPIC	READING	ASSIGNMENT
1	T Sep 5	Introduction	1; 2	
2	R Sep 7	Equations of Motion	3.1-3.2.1	
3	T Sep 12	Equations of Motion (cont); Energy Equation	3.1-3.2.1; 3.4.1	<i>PS #1 Assigned</i>
4	R Sep 14	Equation of State for Atmosphere	3.5;3.5.1	
5	T Sep 19	Filtering of the equations for Atmosphere	3.2.2	
6	R Sep 21	Filtering of the equations for Atmosphere (cont)	3.2.2	
7	T Sep 26	Large-scale Atmospheric Circulation	3.2.2; 7	<i>PS #1 Due</i>
8	R Sep 28	Large-scale Atmospheric Circulation (cont)	3.2.2; 7	
9	T Oct 3	Hydrological cycle; Salinity; Equation of State for Ocean	3.5.2;12;12.1.1-12.5.2	<i>PS #2 Assigned</i>
10	R Oct 5	Filtering of the equations for Ocean	3.2.3	
11	T Oct 10	Large-scale Ocean Circulation—Ekman (transport and circulation)	3.2.3;8	

12	R Oct 12	Large-scale Ocean Circulation—Sverdrup transport	Supplemental Readings	
13	T Oct 17	Large-scale Ocean Circulation—gyre circulation	Supplemental Readings	
14	R Oct 19	Large-scale Ocean Circulation—thermohaline circulation	Supplemental Readings	<i>PS #2 Due</i>
	T Oct 24	<i>No Class</i>		
	R Oct 26	<i>No Class</i>		
	T Oct 31	<i>Mid-term</i>		
15	R Nov 2	Energy Balance; Energy Balance Models (EBMs)	6-6.3; 6.6-6.8; 10-10.7	<i>PS #3 Assigned</i>
16	T Nov 7	EBMs (continued); Upwelling-Diffusion Models	Supplemental Readings	
17	R Nov 9	Earth System Models of Intermediate Complexity (EMICs)	Supplemental Readings	
18	T Nov 14	Atmospheric General Circulation Models (GCMs)	Supplemental Readings	<i>PS #3 Due</i>
19	R Nov 16	Atmospheric General Circulation Models (GCMs)	Supplemental Readings	<i>PS #4 Assigned</i>
	T Nov 21	<i>No Class [Thanksgiving Break]</i>		
	R Nov 23	<i>No Class [Thanksgiving Break]</i>		
20	T Nov 28	Tropical Ocean-Atmosphere Dynamics; ENSO	Supplemental Readings	
21	R Nov 30	Tropical Ocean-Atmosphere Dynamics; ENSO	Supplemental Readings	
22	T Dec 5	ENSO (continued)	Supplemental Readings	
23	R Dec 7	Coupled Atmosphere-Ocean Models (AOGCMs)	Supplemental Readings	<i>PS #4 Due</i>
	T Dec 12	<i>Course evaluations</i>		