University of Maryland College Park
AOSC 401
"Climate Dynamics and Earth System Science"
Spring 2016

Instructor:	Prof. Menglin S. Jin
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Office Hours:	Thursday 1:15-2:00 PM, or on appointment
Class Days/Time:	Tue, Thur 2:00 -3:15 PM
Classroom:	CSS2428

- In addition to my regular office hours, I am available by email daily.
- Additional office hour is possible with appointment.

Prerequisite: AOSC 200- Weather and Climate **or** AOSC 400- Physical Meteorology of the Atmosphere

Faculty Web Page

Copies of the course materials such as the syllabus, major assignment handouts, etc. can be found at elms.umd.edu **https://myelms.umd.edu/courses/1190902**. You are responsible for regularly checking class website (or other communication system as indicated by the instructor).

My personal website is at https://www.atmos.umd.edu/people/faculty.php?view=140
I have put additional teaching video there.

Course Description

AOSC401 discusses the evolving structures of the Earth System (land, ocean, biosphere, atmosphere components and cryosphere). This course is designed for majors and will cover the background of remote sensing, the current status of sensors and platforms, and the recent satellite-based results on climate change.

Scope of the course and description

This is an introductory course on the climate and the earth system. The emphasis is on scientific understanding on the principle climate elements and processes, the spatial and

temporal variability of the Earth's climate and the climate changes. Topics include the global weather and climate system; climate change; earth's radiation budget; clouds and aerosols; energy balance, the hydrologic cycle, and general circulation of the atmosphere and oceans; the natural variability of the atmosphere-ocean-biosphere; carbon cycle and biogeochemistry, atmosphere-ocean coupling and ENSO variability; potential human effects on climate: greenhouse effects, deforestation, nuclear winter.

Studies Learning Outcomes (LO)

Upon successful completion of this course, students will be able to:

LO1 articulate a basic understanding of the theory of Remote Sensing

LO2 Understand sensor, orbit, and retrieval terminology

LO3 Interpret satellite observations well

LO4 Satellite data analysis

LO5 Oral presenting and writing skills

Text and Reference Books

Title: **The Earth System (3rd Edition)**
Authors: Lee R. Kump, J. F. Kasting, R.G. Crane
Publisher: Prentice-Hull Inc. 2009
ISBN: 0-13-177387

Title: **Atmospheric Science**
Authors: Wallace and Hobbs
Publisher: Academic Press 2006

Inter-governmental Panel on Climate Change (IPCC), Climate Change 2013: The Scientific Basis, Working Group I Report.
Freely downloadable from
http://www.climatechange2013.org/report/review-drafts/

Other Readings

Other materials will be assigned for reading during the class.

Classroom Protocol

Students must attend class on time. Participate in class activity, and behave respectfully to the instructor and other students. Cell phone use in class room is not allowed.

Assignments and Grading Policy

Course Requirements	% of Grade	Points
Homework	15	100
Midterm-1	15	100
Midterm -2	15	100
Class Project	15	100
Class Participation	10	100
Final Exam	30	100
Total	**100**	**500**

Homework
About *10* homework assignments will be given during the semester. Homework will be assigned in class and be collected two weeks later. Total homework is worth 15% of final grade.

Late homework will be taken off 10 points/per day.

Start on the project assignments early and come see me if you are stuck. If you start on it early, it is not that hard. **Do not wait until the last minute.**

Research Project (details will be finalized after the class begins)

Students will work as a 2-person-team to discuss a research topic on remote sensing related to climate change. The topic will be decided at the first part of course, with guidance from the professor. A 10-page paper will be required from each research project at the end of the semester (this might change depending on research needs), and a 15-minute oral presentation will be given by each student to the class at the last part of semester.

Exams:
If one exam is missed, then a zero will be given. If you must miss an exam, then see me in advance. The format of the exams will be similar to the homework and will consist mainly of multiple-choice problems or short answer questions. Obviously, cheating on the exam will not be tolerated and will result in a zero being given for that exam.

Class Participation:
While class participation is graded as 5%, you are expected to be prepared for class and to take active part in the class discussions. Use the class time to get your questions answered on the homework or concepts that you did not understand.

a. Grading information:
Grading Percentage Breakdown

93% and above	A
92% - 90%	A-
89% - 88%	B+
87% - 83%	B
82% - 80%	B-
79% - 78%	C+
77% - 73%	C
72% - 70%	C-
69% - 68%	D+
67% - 63%	D
62% - 60%	D-
below 60%	**F**

b. Extra credit options, if available:
Some extra credit assignments will be given during the semester.

c. Penalty (if any) for late or missed work:
Late work will be penalized 10% per day or part of a day late for any project.

University Policies

Academic integrity

Your commitment as a student to learning is evidenced by your enrollment at University of Maryland College Park. The University's Academic Integrity policy requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sa.sjsu.edu/judicial_affairs/index.html.

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours.

Calendar:

First Day of Class	January 25 (Tuesday)
Mid-Exam 1	Feb 25 (Thursday)
Spring Break	March 15-20
Mid-Exam 2	March 24 (Thursday)
Last day of Class	May 10 (Tuesday)
Final Exam	TBD

Themes covered by the course

Theme 1: Course outline and introduction

Theme 2: Earth & climate observations

Theme 3: Radiation and climate

Theme 4: Greenhouse Effect & Carbon Cycle

Theme 5: Global warming

Theme 6: Cloud and climate

Theme 7: Aerosol and climate

Theme 8: Atmospheric dynamics & general circulation

Theme 9: Land and Climate

Theme 10: Oceanic dynamics & circulation

Theme 11: Ocean-atmosphere interactions and climate (ENSO, NAO and MJO)

Theme 12: Cryosphere and Climate

Theme 13: Sea-level Change

Theme 14: Climate change frontier –IPCC

Specific Schedule

The lecture schedule indicates the intended scope and timing of materials presented in the course. It is likely that we will deviate from this schedule over the semester.

	Date	Class times	Topics	Deadlines	Assignments
1	1/26	Lecture 1	Overview of this course, "Getting Acquainted" class activity		
2	1/28	Lecture 2	Earth and Climate Observations		HW1 assign
3	2/2	Lecture 3			
4	2/4	Lecture 4	Radiation and climate	HW1 due	HW2 assign
5	2/9	Lecture 5			
6	2/11	Lecture 6	Greenhouse Effect & Carbon Cycle	HW2 due	HW3 assign

7	2/16	Lecture 7			
8	2/18	Lecture 8	Global Warming	HW3 due	
9	2/23	Lecture 9			
10	2/25	Lecture 10	Mid-Term1		
11	3/1	Lecture 11	Cloud and climate		HW4
12	3/3	Lecture 12			
13	3/8	Lecture 13	Aerosol and climate		HW5
14	3/10	Lecture 14			
15	3/15	Lecture 15	Spring Break		
16	3/17	Lecture 16	Spring Break		
17	3/22	Lecture 17	Atmospheric dynamics & general circulation		HW6
18	3/24	Lecture 18	Mid-term2		
19	3/29	Lecture 19	Land and Climate		HW7
20	3/30	Lecture 20			
21	4/5	Lecture 21	Oceanic dynamics & circulation		HW8
22	4/7	Lecture 22			
23	4/12	Lecture 23	Ocean-atmosphere interactions and climate ENSO, NAO and MJO		HW9
24	4/14	Lecture 24			
25	4/19	Lecture 25	Cryosphere and Climate		HW10
26	4/21	Lecture 26			
27	4/26	No Class	Sea-level Change		
28	4/28	Lecture 27	Climate change frontier – IPCC		HW11
29	5/3	Lecture 28	Research Project Presentation, Final Review		
30	5/5	Lecture 29	Research Project		
31	5/10	Lecture 30	Final Review	Last Class	
	5/11-5/118		TBD		

The trajectory of the Earth System through the Late Quaternary, particularly the Holocene, provides the context for exploring the human-driven changes of the Anthropocene and the future trajectories of the system (SI Appendix has more detail). Fig. 1 shows a simplified representation of complex Earth System dynamics, where the physical climate system is subjected to the effects of slow changes in Earthâ€™s orbit and inclination. What is the most important part of our planet, the main reason Earth is different from all the other planets in the solar system? If 10 different environmental scientists were asked this question, they would probably give 10 different answers. Each scientist might start with their favorite topic, from plate tectonics to rainforests and beyond. Eventually, however, their collective description would probably touch on all the major features and systems of our home planet. On a macro level, the Earth system maintains its existence and functions as a whole through the interactions of its parts, called components. At a lower level or micro level, it is helpful to think of the Earth system in terms of four central components known as the subsystems â€“ the hydrosphere, geosphere, atmosphere and biosphere.Â Systems can be complex and dynamic, stable and unstable. Systems can range in complexity, and Earthâ€™s subsystems are all dynamic.