

Master of Science in Sustainability Science

SUSC PS5030 Observing and Understanding Sea Level Change

Thursdays, 4:10–6:00 PM

3 credits

Instructor:	James L. Davis, Lamont Research Professor in the Lamont-Doherty Earth Observatory of Columbia University, jdavis@ldeo.columbia.edu
Office Hours:	Zoom by appointment.
Response Policy:	Instructor is available for discussions on e-mail or Zoom, with response within 1–2 business days.
Teaching Assistant:	Tyler Zorn, tbz2105@columbia.edu
Prerequisites:	N/A

Course Overview

This course provides an overview of the science related to observing and understanding sea-level change, which has an important place in the Sustainability Science Masters curriculum through its profound impact on the sustainability of coastal cities and ecosystems. In modern research, sea-level rise is viewed as a complex response of the Earth “system of systems” to climate change. Measuring ongoing sea-level change is challenging due to the great natural variability of sea level on short time scales caused by tides, weather, and ocean currents. Interpreting measurements so that one can assess (and mitigate against) potential economic and societal impacts of sea-level rise is crucial but can be complicated, since so many Earth-system processes play a role. Some of these processes are related and others are unrelated to climate change; some of the latter are natural and others are of anthropogenic origin. Students enrolled in this course will through lectures and class discussions address the following topics related to the underlying observational basis for sea-level rise:

1. Definitions and scientific language describing sea-level change.
2. Survey of satellite, airborne, ground-based, and in situ observations relevant to sea-level change.
3. Interpretation of observations in terms of processes within and interactions among Earth systems (cryosphere, ocean, atmosphere, and solid Earth).
4. Sea-level change budgets.
5. Using observations of sea-level change to distinguish between anthropogenic and natural contributions.
6. Contrast between global mean sea-level change and local sea-level change.
7. Major community-wide efforts to synthesize a wide range of observations to make conclusions regarding the impact of climate change on sea level.
8. Introduction to the problem of predicting sea-level change.

Learning Objectives

By the end of this course, students will be able to:

- L1: Describe the major observational systems on which our understanding of sea-level change is based.
- L2: Identify the primary Earth-system processes that contribute to present-day sea-level change and explain how they are used to interpret the observations.
- L3: Distinguish between global mean sea-level change and local/regional sea-level change.
- L4: Assess scenarios for future sea-level rise at a location based on a sea-level change budget.
- L5: Critically evaluate synthesis reports on sea-level rise such as those from the Intergovernmental Panel on Climate Change.
- L6: Evaluate scientific and non-scientific communications regarding sea-level change and identify strengths and weaknesses in the communication.

Readings

There is no required textbook. Some papers will be assigned for readings for individual classes.

Assignments and Assessments

Class Participation (10%) (L1, L2, L3, L4, L5, L6)

Class participation, including oral and written communication, exercises important job and life skills. Students will be expected to participate in class discussions and demonstrate their increasing understanding of sea-level change.

Homework (60%) (L1, L2, L3, L6)

Students will have four written take-home assignments, each worth 15% of the total grade. Each problem will consist of specific questions that must be addressed by analysis and interpretation of sea-level data sets obtained from public web sites or provided by the instructor, including use of on-line tools described in class.

Class Presentation (30%) (L1, L2, L3, L4, L5, L6)

Students will analyze a “popular” communication in the public domain and present their analysis during class.

Grading

The final grade will be calculated as described below:

Grade	Percentage	ASSIGNMENT	% Weight
A+	98–100 %	Homework: Melting ice and sea level change	15
A	93–97.9 %	Homework: Silly Putty as an Earth analog	15
A-	90–92.9 %	Class presentation	30
B+	87–89.9 %	Homework: Sea-level change budgets and climate scenarios	15
B	83–86.9 %	Homework: Science response to denialism	15
B-	80–82.9 %	Class participation	10
C+	77–79.9 %		
C	73–76.9 %		
C-	70–72.9 %		
D	60–69.9 %		
F	59.9% and below		

Course Policies

Participation and Attendance

You will be expected to come to class on time and prepared. It is understandable that new concepts to which you are introduced in the readings may not be fully absorbed; you will not be judged by having an imperfect understanding of the concepts in the readings but you will be expected to ask questions during class discussion. Attendance is thus very important, and more than one absence will affect your grade. Lecture notes will be made available on the day after class.

Late work

Work that is not submitted on the due date noted in the course syllabus without advance notice and permission from the instructor will be graded down 1/3 of a grade for every day it is late (e.g., from a B+ to a B).

Citation & Submission

All written assignments must cite sources using a consistent citation format and be submitted to the course website (not via email).

Homework

Homework must be completed outside of class. Collaboration on homework is encouraged, but students must turn in their own assignments.

School and University Policies and Resources

Copyright Policy

Please note—Due to copyright restrictions, online access to this material is limited to instructors and students currently registered for this course. Please be advised that by clicking the link to the electronic materials in this course, you have read and accept the following:

The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted materials. Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specified conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement.

Academic Integrity

Columbia University expects its students to act with honesty and propriety at all times and to respect the rights of others. It is fundamental University policy that academic dishonesty in any guise or personal conduct of any sort that disrupts the life of the University or denigrates or endangers members of the University community is unacceptable and will be dealt with severely. It is essential to the academic integrity and vitality of this community that individuals do their own work and properly acknowledge the circumstances, ideas, sources, and assistance upon which that work is based. Academic honesty in class assignments and exams is expected of all students at all times.

SPS holds each member of its community responsible for understanding and abiding by the SPS Academic Integrity and Community Standards posted at <https://sps.columbia.edu/students/student-support/academic-integrity-community-standards>. You are required to read these standards within the first few days of class. Ignorance of the School's policy concerning academic dishonesty shall not be a defense in any disciplinary proceedings.

Diversity Statement

It is our intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that the students bring to this class be viewed as a resource, strength and benefit. It is our intent to present materials and activities that are respectful of diversity: gender identity, sexuality, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture.

Accessibility

Columbia is committed to providing equal access to qualified students with documented disabilities. A student's disability status and reasonable accommodations are individually determined based upon disability documentation and related information gathered through the intake process. For more information regarding this service, please visit the University's Health Services website: <https://health.columbia.edu/content/disability-services>.

Class Recordings

All or portions of the class may be recorded at the discretion of the Instructor to support your learning. At any point, the Instructor has the right to discontinue the recording if it is deemed to be obstructive to the learning process. If the recording is posted, it is confidential and it is prohibited to share the recording outside of the class.

SPS Academic Resources

The Division of Student Affairs provides students with academic counseling and support services such as online tutoring and career coaching: <https://sps.columbia.edu/students/student-support/student-support-resources>.

Columbia University Information Technology

[Columbia University Information Technology](#) (CUIT) provides Columbia University students, faculty and staff with central computing and communications services. Students, faculty and staff may access [University-provided and discounted software downloads](#).

Columbia University Library

[Columbia's extensive library system](#) ranks in the top five academic libraries in the nation, with many of its services and resources available online.

The Writing Center

The Writing Center provides writing support to undergraduate and graduate students through one-on-one consultations and workshops. They provide support at every stage of your writing, from brainstorming to final drafts. If you would like writing support, please visit the following site to learn about services offered and steps for scheduling an appointment. This resource is open to Columbia graduate students at no additional charge. Visit <http://www.college.columbia.edu/core/uwp/writing-center>.

Career Design Lab

The Career Design Lab supports current students and alumni with individualized career coaching including career assessment, resume & cover letter writing, agile internship job search strategy, personal branding, interview skills, career transitions, salary negotiations, and much more. Wherever you are in your career journey, the Career Design Lab team is here to support you. Link to <https://careerdesignlab.sps.columbia.edu/>

Spring 2024 Course Schedule/Course Calendar

Date/ Lecture	Topics and Activities	Readings (to be completed before class)	Assignments
1/18 Class 1	Course overview; Introduction to sea level; Overview of observational evidence for sea-level change		
1/25 Class 2	Background: Physics relevant to sea-level change		Homework: Melting ice and sea level change (due 2/11)
2/1 Class 3	Measuring relative sea level at one location: tide gauges		
2/8 Class 4	Overview of processes impacting sea level change		
2/15 Class 5	Observation of vertical land motion: Postglacial rebound, crustal loading, earthquakes, plate tectonics, and local subsidence		Homework: Silly Putty as a viscoelastic Earth analog (due 2/25)
2/22 Class 6	Satellite radar altimetry; Ocean density and circulation; in situ measurements of ocean temperature and salinity; atmospheric pressure		
2/29 Class 7	Satellite measurement of ice sheet and ocean mass		Homework: Scientific response to opinion: This or this (due 3/24)
3/7 Class 8	Visiting presentations (Emily Torem and Dr. Evelyn Powell)		
3/14	Spring Recess		
3/21 Class 9	Sea-level fingerprints; Sea-level change budgets	Love et al. (2016)	Class Presentations (submissions due 3/31)
3/28 Class 10	Communicating sea-level change		
4/4 Class 11	Class presentations		Homework: Calculating sea-level budgets (due 4/28)
4/11 Class 12	Class presentations		
4/18 Class 13	Sixth IPCC Assessment Report	Selections from IPCC 6 th Assessment (2022)	
4/25 Class 14	Predicting and mitigating impact of sea-level change	New York State Sea Level Rise Task Force (2011)	