Course Description

Synopsis
Today there is a quasi-absolute scientific consensus that human activities are warming the planet, despite fierce denial from sectors of the public sphere. How did we go from the idea that Earth was too vast and powerful for humans to possibly change, even comprehend, to the recognition that Earth’s surface is a collection of fragile ecosystems that humanity must manage and preserve for its own survival? This class will survey the discovery of global warming. Its 200-year history mirrors the fundamental progress of science: quantum physics, electromagnetism, fluid dynamics, biogeochemistry, radioisotope chemistry, chaos theory, ecology, supercomputing, state estimation, and the theory of complex adaptive systems. The journey will teach us much about the nature of scientific inquiry, the culture of “organized skepticism”, and the emergence of scientific consensus based on a consilience of evidence involving theory, direct and indirect observations, as well as experiments in silico.

Requirements
An open mind

General Information

Professor: Julien Emile-Geay ZHS 275 julieneg@usc.edu
Teaching Assistant: Alexander James ZHS 275 ?@usc.edu

Instructors

Office Hours M-W 13:30-15:00 in ZHS 275, or by appointment.

Where/When

Class meets Mon/Wed, 10:00–11:50 in LVL13.

Discussions meet Fri at 9:00 in WPH201 or 10:00 in WPH202 (register separately).

Lab will meet once or twice during the semester, 5-8pm Wed, usually for a guest speaker or movie (date TBD).

Field trips are scheduled on Fridays, 10am – 5pm (pandemic-pending). Three amazing trips:
1. Mount Wilson Observatory in the scenic San Gabriel mountains. This is where galaxies, and the expansion of the Universe, were first observed.
2. the urban swamp of the La Brea Tar Pits, for a look behind the scenes at their unique collections.
3. NASA’s Jet Propulsion Laboratory, sending robots to Mars and Starshades to the edge of the solar system. And keeping eyes on Earth, too.
Books

Required Books


Supplemental Reading


Grade

The class is worth 4 units, which means that it requires substantial work. Attendance to discussion sections is mandatory (register separately, please). You will write two papers: a midterm and a final. At each week’s discussion (13 total), short written assignments will be given, graded out of 2. The remaining 4% of the grade will be based on participation.

Table 1: Numeric to letter grade conversion (cutoffs)

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Schedule

I Light & Matter

Week 1 — 08/24/20 — What is there to discover?
Reading: Weart, Chapter 1. No discussion Aug 20
Monday A brief history of global warming. Climate’s Three Big Questions.
Wednesday Earth’s temperature: Fourier’s Footing and Forays

Week 2 — 08/31/20 — What is temperature?
Reading: WP, Chapter 1 + Pierrehumbert, [2004].
Monday Energy and the First Law.
Wednesday “The kind of motion we call heat”. Entropy and the Second Law.

Week 3 — 09/07/20 — Radiant Energy
Reading WP, Chapters 2 & 3. Simple Climate, Arrhenius.
Monday No class (Labor Day)

Week 4 — 09/14/20 — Planetary Energy Balance
Reading: Pierrehumbert [2011]. WP, Chap 4; The CO₂ theory of Gilbert Plass.
Monday The Greenhouse Effect
Wednesday Climate Feedbacks

Week 5 — 09/21/20 — Taking Earth’s temperature
Reading WP, Chapter 12. A vast Machine, Chap 1. The modern temperature record
Monday Instrumental (in-situ and remote) observations.
Wednesday Data infrastructure: Callendar’s Quest

Week 6 — 09/28/20 — The Carbon Cycle
Reading WP, Chapter 13. Simple Climate: Suess; Broecker; Keeling.
Monday Short-term carbon cycle
Wednesday Long-term carbon cycle

II From Atoms to Planets

Week 7 — 10/05/20 — Atomic Science, Cold War Science
Reading: Atoms in trees; World’s loneliest tree records the Anthropocene; The age of the Earth; Simple Climate, Dansgaard
Monday Cold War Science (A. Lakoff)
Wednesday Nuclear Physics: isotopes and atomic bombs
Week 8 — 10/12/20— Climate modeling
Reading WP, Chapter 5 (Manabe & Wetherald 1967). Schmidt: the physics that we know; Simple Climate: Manabe; Weart: GCMs.
Wednesday Richardson’s “Forecast Factory”. The Attribution of Climate Change.
Assignment Midterm Paper due.

Fall Recess Oct 15–16

Week 9 — 10/19/20— Paleoclimatology
Reading Weart: Ice Age Cycles; Simple Climate: Milankovitch; Broecker, part II.
Monday Quaternary Ice Ages
Wednesday Abrupt climate change

Week 10 — 10/26/20— Space and Time
Reading Weart: Venus & Mars; The Sixth Extinction
Monday A journey in space: Mars, Earth, Venus and the solar system (guest)
Wednesday A journey in time: from the Big Bang to the Anthropocene (F. Corsetti)

Week 11 — 11/02/20— Chaos and Order
Monday Laplace and Lorenz: living on a butterfly’s wings
Wednesday Climate Prediction

Week 12 — 11/09/20— Experiments in silico
Reading Oreskes & Conway: The Collapse of Western Civilization; Weart: Impacts
Monday Climate Impacts
Wednesday Climate, Collapse & Capitalism

III SCIENCE: FROM WAR WINNER TO CULTURE WAR
Week 13 — 11/16/20— On the shoulder of giants
Reading How do you know a paper is legit?; Schermer: Why Climate Skeptics Are Wrong.
Monday Scientific progress, scientific consensus
Wednesday Good Science, Bad Science, and Ugly Science

Week 14 — 11/23/20— The Psychology of Flawed Reasoning
Assignments Podcast: tribal psychology; Hoffmann: Climate Science as Culture War;
Monday motivated reasoning, confirmation bias, identify-protective cognition
Thanksgiving Break Nov 25–29

Week 15 — 11/30/20— Climate Science in the Public Sphere

Reading Weart, Climate and the Public, part 1 & part 2; Podcast: How we almost stopped climate change.

Monday The American Denial of Global Warming

Wednesday Movie night: Merchants of Doubt

Wednesday The Science Denial Pandemic

Dec 14 – Final Paper due

IV Participation
Class participation is a critical aspect of this course. The first way to participate in class is to come to class. However, active participation is what we’re after: ask questions, offer comments. You are not required to know much science to take this class, so there is no such thing as a stupid question; also, we will encounter many controversial topics, in which your opinion matters – it would be too bad to keep it for yourself.

V Final Paper
Develop your own topic, or choose from one of the following: From Stasis to Crisis; From Biosphere to Noosphere; Science & Agnotology; Civilization as a geosystem; Natural Laws vs Human Nature; Anthropocentrism & Anthropocene; Revolutions in Earth Science;

VI Technology

Blackboard
BlackBoard is our primary medium of communication outside the classroom. It is where I post class notes, announcements, and assignments. Is is where you access that content, participate in discussions, and check your grades. It is your responsibility to ensure that you receive BlackBoard announcements. Make sure you enable email notifications, and importantly, make sure your inbox is not full; every year I get emails bounced from students too neglectful to clean up their inbox. If you have a doubt about when an assignment is due, go check it on BlackBoard. Also note that BlackBoard messages are richer than the email notifications they generate. Frequently, the announcements contain links to content archived on BlackBoard – those links will not appear in the emails. If the email digest you read does not make sense, please check it on BlackBoard; it might have the answer you need. If it still doesn’t, please email me.

Email etiquette
If you can spare the time, please come to office hours or see me after class. I’d much rather talk to a human than a computer, and I have yet to bite a student. Other email etiquette tips may be found here.

Laptops & Tablets
Laptops and tablets look way cool, but they have proven far less effective than good old pen&paper at information retention. Moreover, their use in the classroom can be disruptive to you and people around you if you use them for activities unrelated to the class. Please exercise best judgment and be considerate of others around you.

VII Academic Conduct

Plagiarism
Presenting someone else’s ideas as your own, either verbatim or recast in your own words, is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Section 11, Behavior Violating University Standards.
Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct.

**Discrimination**
Difficulty, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity or to the Department of Public Safety. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men provides 24/7 confidential support, and the sexual assault resource center webpage describes reporting options and other resources.

**Support Systems**
- **Student Counseling Services (SCS)** (213) 740-7711 – 24/7 on call
  Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.
  https://engemannshc.usc.edu/counseling/
- **National Suicide Prevention Lifeline** –1-800-273-8255
  Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.
  http://www.suicidepreventionlifeline.org
- **Relationship & Sexual Violence Prevention Services (RSVP)** – (213) 740-4900 – 24/7 on call
  Free and confidential therapy services, workshops, and training for situations related to gender-based harm.
  https://engemannshc.usc.edu/rsvp/
- **Sexual Assault Resource Center** For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/
- **Office of Equity and Diversity (OED)** (Title IX compliance) – (213) 740-5086
  Works with faculty, staff, visitors, applicants, and students around issues of protected class.
  https://equity.usc.edu/
- **Bias Assessment Response and Support** Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response.
  https://studentaffairs.usc.edu/bias-assessment-response-support/
- **Student Support & Advocacy** – (213) 821-4710
  Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic.
  https://studentaffairs.usc.edu/ssa/
- **Diversity at USC** Tabs for Events, Programs and Training, Task Force (including representatives for each school), Chronology, Participate, Resources for Students.
  https://diversity.usc.edu/