SIOC 217C: Atmospheric and Climate Sciences III

Spring 2024

Instructor:	Nick Lutsko nlutsko@ucsd.edu	**Time:**	Tu/Th 3:30pm–5pm
Location:	Keck 101		

This course covers the essential processes required to understand Earth's past, present and future climate. We will largely focus on infrared radiative transfer, building towards an understanding of the greenhouse effect and of the forcing/feedback framework for climate change. We will also cover the surface energy balance, insolation and its variations over time, and, briefly, the essential dynamical processes by which the atmosphere transports heat.

Grading Criteria: 60% homeworks/30% project/10% class participation.

Lectures: Lectures will be given in person and will be a mixture of blackboard derivations, lecture slides and plotting sessions using Jupyter notebooks (hosted on Google Colab). Lecture notes will take the form of Jupyter notebooks and will be posted after each lecture.

Attendance Expectations: Students are expected to attend every class. Please let me know if you will be absent or require accomodations. The UCSD Office for Students with Disabilities has resources at `https://osd.ucsd.edu/students/index.html`. This includes information on how to request accomodations and what kinds of accomodations are available.

Office Hours: Please email me if you would like to meet.

Homeworks: Homework assignments will be posted on Canvas and should be turned in through Canvas. They may be turned in one class later than they are due without penalty, but they will be accepted later than this only in exceptional circumstances.

Projects: Each students will conduct a literature review of a major climate feature (e.g., the ENSO cycle) and its expected changes under global warming. Each student will meet with Nick to come up with a project topic. Further details will be provided in class.

Collaboration: Students may collaborate on homework exercises, but it is expected that each student will pursue their academic goals honestly and be personally accountable for all submitted work. The UCSD Academic Integrity Policy is available at: `https://academicintegrity.ucsd.edu/process/policy.html`.

Course Textbook:
Raymond Pierrehumbert (2010) *Principles of Planetary Climate.* Cambridge: Cambridge University Press.
Also useful:
Dennis L. Hartmann (1994) *Global Physical Climatology.* Academic Press, 1st Edition.

Course Schedule:

04/02 — Introduction, set-up Google Colab, climate overview (PPC 1)
04/04 — Blackbody radiation/Intro to radiation (PPC 3.2)
04/09 — Planck's Law, Stefan-Boltzmann Law (PPC 3.2)
04/11 — Planetary Energy Balance, Ice-Albedo feedback (PPC 3.3, 3.4)
04/16 — Partially-absorbing atmospheres (PPC 3.5)
04/18 — Intro to climate feedbacks and forcing (PPC 3.3)
HW1 due: 04/24
04/23 — Plane-parallel radiative transfer (PPC 4.1)
04/25 — Gray gas model (PPC 4.2)
04/30 — Real gas radiation 1 (PPC 4.3)
05/02 — Real gas radiation 2 (PPC 4.3)
05/07 — Climate forcings and feedbacks redux
05/09 — Surface Energy Balance 1 (PPC 6.1-6.3)
HW2 due: 05/12
05/14 — Surface Energy Balance 2 (PPC 6.5-6.9)
05/16 — Insolation 1 (PPC 7.2, 7.3)
05/21 — Thermal Inertia (PPC 7.4)
05/23 — Insolation and orbital variations (PPC 7.5-7.7)
Project Titles due: 05/26
05/28 — Dynamics 1: Horizontal heat transport (PPC 9.2)
05/30 — Dynamics 2: Hadley circulation
HW3 due: 05/29
06/04 — Dynamics 3: Mid-latitude dynamics
06/06 — Review Session

Final Project due: 06/14