Atmospheric Radiation and Energetics

ATS 722, Department of Atmospheric Science

10:00 – 10:50 Mondays, Wednesdays and Fridays, ACRC 212B

Instructor Contact Information

Prof Christine Chiu
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ACRC 203
Office hours: To be arranged with the instructor

Teaching Assistant Contact Information

N/A

Course Description

This is a graduate level course on radiative transfer in the atmosphere, and their implications on energetics. Specifically, this class focuses on the role of radiative processes in the Earth's climate systems, and is concerned with topics of Earth radiation and energy balance, radiative and radiative-convective equilibrium, climate thermodynamics, and climate feedbacks.

Course materials

Lecture slides and detailed notes will be available on google drive (see the following link) in due course.

https://drive.google.com/drive/folders/1clZY0BEFpjIOaX9aCh5iFYFqJkWs35fi?usp=sharing

There is no textbook for this course.

Class Participation

Students' participation and engagement are strongly encouraged. Students will be expected to present recent papers and lead class discussions.

Grading

Course grade will be based on **two** short presentations in class (40%) plus a small mid-term project (20%) and a final project due at the end of the semester (40%).

Statement on Academic Integrity

This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (http://www.catalog.colostate.edu/FrontPDF/1.6POLICIES1112f.pdf) and the Student Conduct Code (http://www.conflictresolution.colostate.edu/conduct-code). At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

Disclaimer

The instructor reserves the right to make modifications to this information throughout the semester.

Preliminary Schedule

Week	Topics / Learning outcomes	Remark
1–2	***Logistics & Introduction*** • Radiometry • Basic Laws • Elementary radiative transfer	
2–3	***The Earth's Radiation Budget (ERB)*** • ERBE, CERES and GERB • Cloud radiative effects • Aerosol direct effects • The greenhouse effect • Atmospheric radiative cooling • ERB trends and other topics	
3–5	***Radiative Forcing of Climate*** • Greenhouse gas forcing • Aerosol direct forcing • Aerosol indirect forcing • Contrail climate forcing • Land-surface climate forcing	*Student-led presentation/discussion*
6–8	***Radiative Equilibrium*** • Radiative equilibrium climate models • Radiative equilibrium with convective adjustment • Radiative-convective equilibrium (RCE) with semi-explicit convection • RCE with cloud resolving models	*Student-led presentation/discussion*
9–11	***Energy Balance Theory*** • Energy balance climate models (EBM) • Ice-albedo feedback and ice catastrophe • The faint young sun paradox • Climate-biosphere feedbacks • Time dependent EBM • Stochastically forced EBM	*Student-led presentation/discussion*

Week	Topics / Learning outcomes	Remark
12–13	***Climate feedbacks*** • Water vapor feedbacks • Ice albedo feedbacks • Cloud feedback • Sea surface regulation • Approaches and tools	*Student-led presentation/discussion*
15–16	***Thermodynamical principles of climate*** • Entropy of Radiation • Entropy as a governing principle of climate • Entropy and Climate • Ziegler's principle of maximum dissipation	