SIO 217a Atmospheric and Climate Sciences I: Atmospheric Thermodynamics

Fall 2014 Peer-Reviewed Term Projects

Concept: Although peer review has long been a central feature of the working lives of research scientists, it has rarely found its way into the classroom. In our term projects, just as in the case of real research journals, you will be asked to respond to criticisms of reviewers and then revise your work accordingly. The peer review mechanism allows the student authors to address the defects in their reviews, as pointed out not by an authority figure or an examination but by their own peers. As an important side benefit, you will gain experience with the peer review process itself and come to appreciate its strengths and weaknesses in evaluating scientific papers.

In addition, each project will complete detailed calculations that illustrate the quantitative behavior of three aspects of the class: cloud nucleation, radiative transfer, and air parcel motion. Each group will consider a different sensitivity study expanding on a result shown in the book. The format of your paper will be 3 pages (excluding references, figures, tables) that include:

1) Introduction: a brief summary of how your topic affects atmospheric thermodynamics.
2) Description of the model, its assumptions, and its possible shortcomings.
3) Physical significance of the model parameters you are calculating and varying.
4) Conclusions you draw from your modeling study, with as much physical insight as the modeling results allow. (For example, "As the initial water vapor content of the parcel is increased, more latent heat is available and a more vertical development is observed".)

Suggested points to include in your discussion:

- What are the assumptions of the model about the process(es) you are studying? How does this affect your conclusions?
- What is the physical significance of the changes you are making to the code? Are the model results consistent with your expectations?

You and your readers will find it helpful if your discussion uses the relevant concepts you have learned in class. Your discussion can make reference to the figures that show the results of your model in variables relevant to your topic. These figures should be designed to be easy to understand, and they may require additional labels and formatting beyond what is in your programming language, so you may want to use a different graphics package for the figures.

Your paper will be submitted for evaluation by peers, followed by preparing a presentation and submitting a revised manuscript. Final manuscripts will be posted to the class website, so please make sure that you leave time for careful proof-reading. For both submissions of the manuscript, each team will email a single PDF file including all text, figures, and references for the written report to the class and the instructors (max. length: 3 pages of single-spaced text) reviewing your modeling results. Include page and line numbers. Your manuscript should be understandable by scientists who are non-specialists, i.e. not just other members of the class. The reports will be handed out for review on the same day they are handed in. Written reviews will be due as a pdf listing comments (do not mark on the submitted paper). Do not include your name in the review file (text or embedded), so that your review comments are anonymous. Each team will give an in-class, oral presentation of approximately 8 min/person (maximum). Each member of the team should give part of the presentation. Please prepare and submit your presentation as a

Powerpoint or PDF file. INCLUDE YOUR TEAM NUMBER IN THE FILENAME for project submissions.

DUE DATES:
Topic assignments: Oct 29
Construct and test model on assigned problems: Nov 3-7
Email pdf of plots of your problem solution for instructor feedback: Nov 7 (11:00am)
Email selected case study for instructor feedback: Nov 14 (11:00 am)
Email pdf of plots of your sensitivity study for instructor feedback: Nov 21 (11:00am)
Revise sensitivity studies and explain/write results: Nov 15-21
Email pdf of completed projects (with text) due for peer review: Nov 26 (11:00am)
Peer review comments due: Dec 1 (11:00am)
Oral presentations with audience participation: Dec 8 and 10 (12:30-1:50pm IN CLASS)
Email 2 pdfs to editor: final paper and responses to peer comments: Dec 12 (5:30pm)

Grades will be based on submitted plots, oral presentations, peer comments, responses to review, and the final revised manuscript. Peer comments are provided and graded individually, manuscript and responses are graded as a team, and presentations are graded both individually and as a team. Participation in team assignments is a privilege, so please take your group assignments seriously. For the final exam, all students are responsible for knowing the material in all the papers presented.

The starting point for research is the text (Curry and Webster, Ch. 5, 6, 7, 8, 12); additional insight is also provided in corresponding chapters of Pruppacher and Klett and Seinfeld and Pandis (posted on the course website). The first step is for you to write a code in the programming language that you have selected that implements the model equation(s) needed to solve the problem. The projects differ in the physical processes and cloud types that each group will study. The first step for each project is to check if your model reproduces a result in the book. As soon as your code passes this sanity check, you are ready to start your modeling study!

Topics for ROAST 2014 (More Details Available at Office Hours and By Appointment):

- Cloud Radiative Transfer (Ch. 3, 8.3, 12.1): Stratus Brightening vs. Cirrus Thinning
  - Start by solving Ch. 8 Problems 5+6 using Matlab or other code; check your answer.
  - Identify another cloud type/region in the published literature and repeat problem.
  - Holding T, w_l constant, halve and double the measured drop/crystal concentration; calculate the change in SW and LW fluxes; then "design" a change in drop/crystals to maximize net cooling.
  - Discuss your results in the context of the effectiveness of changing drop/crystal number concentrations for climate engineering ("geoengineering").
- Precipitation Processes (Ch. 5.4, 5.5, 8.2, 12.4): Condensation vs. Aggregation
  - Start by solving Problem 5-5 and 8-2 using Matlab or other code; check your answer.
  - Identify of another cloud type/region in the published literature and repeat problem.
  - Holding T, w_l constant, halve and double the initial drop/crystal size; calculate the change in growth time; then "design" a change in drop/crystals to minimize growth time.
  - Discuss your results in the context of the effectiveness of seeding clouds for modifying the hydrological cycle ("weather modification").