Syllabus of ATOC 531: Dynamics of Current Climates

This course introduces graduate students and upper level undergraduate students to the basic features of the Earth climate and the physics that is behind these features. The course includes lectures on climate theories and computer lab sessions for the students to learn to analyze climate data. Students' class learning will be verified and reinforced by in-class quizzes, homework assignments and a term project that focuses on the analysis of one climate variable field, designed in consultation with the instructor.

Objective

Learn the basic theories, models and analysis methods to describe the mean climate of the Earth, its natural variability and anthropogenic changes.

Pre-requisites

MATH 315, ATOC 312/512, or equivalent

Course Outline

1. Mean climate
   Energy, water, momentum budgets
   General circulation
   Lab: Observation and modeling data

2. Natural climate variations
   Externally forced cycles
   Interval variabilities
   Lab: Temporal and spatial pattern

3. Anthropogenic climate changes
   Global warming
   Radiative forcing and feedback
   Lab: Climate trend

Evaluation Scheme

1. In-class quizzes (20%)

These are tests to verify students' knowledge and comprehension, based on preceding lectures, readings and lab materials.
2. Homework assignments (30%)
Analytical and numerical problems.
3. Course Project (50%),
A proposal, a mid-term presentation and a final report. See the appendix for detailed requirements.

References

- Lecture notes
  Available on myCourses
- Textbooks
  Hartmann, Global Physical Climatology
  Wallace and Hobbs, Atmospheric science: an introduction

Disclaimer Concerning Integrity

- McGILL UNIVERSITY VALUES ACADEMIC INTEGRITY. THEREFORE ALL STUDENTS MUST UNDERSTAND THE MEANING AND CONSEQUENCES OF CHEATING, PLAGIARISM AND OTHER ACADEMIC OFFENCES UNDER THE CODE OF STUDENT CONDUCT AND DISCIPLINARY PROCEDURES
  (see www.mcgill.ca/integrity for more information).

Requirements of the course project

During the course of the semester, you will complete these components for your course project:

1) Proposal
You will discuss and design your course project over a consultation meeting with the instructor. Email him early to set up a time for this meeting. You will then write and submit this proposal. In this document, you shall describe:
a) Objective
Describe what is the variable field you choose to examine, what is the main feature(s), based on literature reading or your knowledge, that you aim to verify, and why it matters for climate and/or relates to your own research interests.
b) Method
Describe what is the dataset, or model if you choose to do a modeling project, that you will use to obtain the variable field of interest, what is the spatial domain and time period that you will analyze, how you anticipate to process the data field (e.g., what averaging is required, how to derive the value of the variable if it is not directly available from the dataset or model outputs, etc.), what analysis method(s) (e.g., time series analysis, correlation, EOF, etc.) you will apply to produce the feature that you aim to verify.
c) References
If applicable, copy and describe the key contents (figure or table) that are pertinent to the feature(s) of the variable field you aim to reproduce or verify.

The length limit of your proposal is 1-page, excluding the references.

2) Presentation:
Midway in the semester, you will each give an oral presentation on the topic of your project based on relevant lecture(s), literature reading, and optionally your own analysis if you have obtained any relevant results. In your talk, you will cover:
a) what topic and variable field you have chosen to analyze and what is the key feature or relationship you aim to examine,
b) why the chosen topic is of interest and what are the relevant science questions and findings in the literature,
c) how you conduct your analysis, i.e., your method.
In essence, you will present to the class similar contents to your proposal, refined and substantiated after relevant lectures, more literature reading, and, if applicable, your own analyses.

The length limit of your presentation is 15-minute (tentative, subject to revision depending on the class size). As a rule of thumb, prepare no more than 1 slide per minute when making your presentation slides.

Your presentation will be followed by questions from your classmates and the instructor. There is no time limit for the question period (typically ~5 minutes). The questions from the instructor

may be based on your presentation contents as well as relevant course contents, to test your knowledge as well as reasoning (you may consider this a mini oral exam).

The grading of your presentation will be based on the clarify and quality of your presentation as well as how you answer the questions. See the appendix for the rubric of the presentation part.

We will schedule your presentation based on the course schedule. Ideally, your presentation will occur shortly after the lecture of relevant topic. The schedule will be announced after your proposal is reviewed (about one month into the semester). You shall email the instructor your presentation before your presentation date.

3) Final Report
The final report is essentially a summary of your project. It should consist of these sections: Introduction, Methodology, Results, Discussion, and References. The length, including all these sections, should be within 6 pages, with up to 4 figures and up to 3000 words (excluding the references).

Include in the digital submission of your report a supplementary information . This file or folder should include your program scripts (those you generated instead source codes of the RT models), input file (e.g., Tape5) for radiation model, etc. – in essence, all the materials needed to reproduce your results, except for the original data files and RT models. It would be helpful to include a readme file in the folder to document what is in each file. You can simply put these files into a folder, zip it and send together with your report by email or preferably a Dropbox/OneDrive link.

Your report is due the last day of the semester (the day the classes end, prior to the start of the final exam period). You shall submit a digital copy of your project report by email.

Appendix

1. Oral Presentation Rubric

Structure of presentation:
Unacceptable 0-2 points (disorganized contents, missing any of these key elements: Introduction, Method and Result), Acceptable 3 points (includes all key elements, but the description of some element is unclear), Good 4 points (clear description of all elements, insufficient discussion of result), Excellent 5 points (complete and balanced presentation of all elements, including good explanation of the results)

Graphical contents:
Unacceptable 0-2 points (small fonts, cluttered slides, unlabeled, inadequate references), Acceptable 3 points (generally adequate font size and labelling, but some slides are unclear and in need of improvement), Good 4 points (generally good graphical presentation, could be improvements in student generated figures or tables), Excellent 5 points (very good use of layout, figures, and fonts, including student generated figures that are publication-level quality)

Oral communication:
Unacceptable 0-2 points (long pauses, reading, poor audience engagement), Acceptable 3 points (fluent delivery, but reading or awkward delivery but not reading), Good 4 points (generally good delivery, but audience engagement could be improved), Excellent 5 points (clearly delivered, smooth without reading)

2. Final Report Rubric

Quality of the research (50/100):
Clearly identified objectives (as described in Proposal)?
Objective(s) met; question(s) posted answered?
Research plan fully executed?
Methods correctly applied?

Understanding of the results (30/100):
Results validated?
Main features in the results identified and described?
Correctly interpreted and/or related to radiation knowledge and theory?
Conclusions properly stated and supported by the results?

Quality of presentation (20/100):
Report properly structured (Intro/Method/Result/Discussion)?
Clarity of the method? Equations, model inputs/outputs and analytical programs explained?
Figures/tables sufficiently, logically and legibly included?
References included?