Large-Scale Atmospheric Circulations

EAS - 4470/6532
Spring 2012
Lectures: Tuesday and Thursday; 3:05-4:25
Location: ES&T L1116

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Textbook

None required

Office Hours

By appointment (e-mail recommended)

Course Overview

The course is designed to provide an introduction to the phenomenology and dynamics of large-scale atmospheric variations having time scales of a week and longer. Using papers from the recent scientific literature and real-time analyses, we will overview the basic characteristics, underlying physics, and current status of a number of large-scale atmospheric phenomena. Topics will include weather regimes, storm track variability, stratospheric polar vortex variability, El Niño-Southern Oscillation, teleconnections, monsoon circulations, the Arctic and Quasi-Biennial Oscillations, and stratosphere-troposphere coupling. The class format will include reading assignments and student presentations.

Outline

Week:

1-2 Tools of the Trade

-> Basic state and eddy decomposition, time filters, harmonic analysis, zonal averaging, pattern identification, linear regression and compositing techniques, wave properties, review of dynamical equations, dynamical diagnostic methods.

3 Basic state characteristics

-> Seasonal mean circulations: jet streams and polar vortex, forced stationary waves, transient eddies, power spectra, heat and momentum fluxes, storm tracks, (contrast winter and summer, NH and SH, midlatitude and tropics, etc)

4-5. Midlatitude tropospheric variability

-> Weather regimes, teleconnections, atmospheric blocking, storm track variability, Rossby waves and baroclinic instability

6-7. El Nino Southern Oscillation

-> Atmospheric and oceanic evolution, atmosphere-ocean coupling, remote effects, tropical-extratropical interactions

8-9. Other tropical tropospheric variability

-> Tropical waves, Monsoon circulations, Madden-Julian Oscillation

10-11. Stratospheric variability

-> Stratospheric circulation, Annular modes, stratospheric warmings, Quasi-biennial oscillation, wave-mean flow interaction

12-13. Stratosphere-troposphere coupling

-> Tropospheric planetary wave propagation, the Arctic Oscillation, direct and indirect feedback mechanisms, seasonal transitions.

14-15. Long-term circulation trends

-> Volcanic emissions, ozone trends, and solar cycle variability.

Course Evaluation

Class Participation:	10%
Problem Sets (3-4):	25%
Presentations (2-3):	25%
Final:	40%

As for all Georgia Tech classes, EAS 4470/6532 is governed by the Georgia Tech Honor Code (www.deanofstudents.gatech.edu/Honor/). In particular, unauthorized use of materials from previous semesters and plagiarism is strictly prohibited. Problem sets are expected to be turned in at the beginning of class on the day they are due. Students in the class may work together on solving problem sets, but must turn in separate writeups. There will be no class on Jan 24 or during the week of March 19-23 (Spring Break).

General format (after first 3-4 weeks)

Thursday (or earlier): Background and theory for particular topic (by me)

Tuesday: Topical presentations (by students)

(**All students are expected to read topical papers; visit websites, & prepare questions**)

a) Instructor presentation (me): Brief intro and/or phenomenological examples

b) Student presentation A:

   20 minute overview of the current/recent past state of phenomenon in question

   -> Use online resources; tech memos; reports; journals, etc.

   -> Try to frame in larger context (regional impacts, trends, other phenomena, etc.)

   -> ~20 slides/frames (overheads, web links, powerpoint slides, etc.)

   -> Overview followed by 10 minute question/answer/discussion period

c) Student presentation B:

   20 minute overview of assigned topical research paper regarding phenomenon

   -> Papers assigned from recent issues of Science or Nature (I have pdf files)

   -> Overviews should expand upon subject and place in context with other topics

   -> ~20 slides/frames (overheads, web links, powerpoint slides, etc.)

   -> Overview followed by 10 minute question/answer/discussion period