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ATS 602
Atmospheric Dynamics II
Course Syllabus for Spring 2020

Instructor:
David W. J. Thompson
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room: ATS 430
Office hours: W 14:00-15:00 or by appointment

TA:

Meeting times:
Monday, Wednesday 11:00-11:50 AM, ATSW 121
(some classes may be rescheduled due to travel)

Resources

Primary

- Holton, J. R. and G. J. Hakim, 2013: An Introduction to Dynamic Meteorology, 5th Edition, Academic Press
  Available electronically via CSU libraries. Can be downloaded at:
  https://www.sciencedirect.com/book/9780123848666/an-introduction-to-dynamic-meteorology

Recommended

- Vallis, G. K., 2017: Atmospheric and Oceanic Fluid Dynamics, Cambridge University Press. 2nd edition.
  http://empslocal.ex.ac.uk/people/staff/gv219/aofd/
- Hoskins, B. J. and James, I. N., 2014: Fluid Dynamics of the Mid-Latitude Atmosphere. Wiley.
  https://www.wiley.com/en-us/Fluid+Dynamics+of+the+Mid+Latitude+Atmosphere-p-9780470795194

Evaluation:

Homework (4 total): 40%
Exam 1 (synoptic scale dynamics): 20%
Exam 2 (large scale dynamics): 20%
Final project: 20%

Focus:

Atmospheric dynamics constitutes a branch of the larger field of geophysical fluid dynamics which itself is embedded in the general field of fluid mechanics. Geophysical fluid dynamics is focused on understanding the underlying mechanisms of atmospheric and oceanic motion over a vast range of spatial and temporal scales. Much of the study of geophysical fluid dynamics requires simplifications to the underlying physics, but much can be gained by studying such simplified systems. In fact, many of the conclusions

drawn from these simplified systems carry-over directly to the real atmosphere/ocean.

This course follows from ATS601. It is divided into two primary parts. Each part will include two homework assignments and one exam. In Part One we will focus on synoptic scale dynamics; in Part Two we will focus on large-scale dynamics.

Course Web Page:
The course web site is available through Canvas.

General course outline:

Part One: Synoptic-scale dynamics

Holton/Hakim Chs. 6 and 7

1. The QG approximation
2. QG potential vorticity
   - The QG PV equation
   - PV inversion, conservation, and the height tendency equation
   - The QG omega equation
3. Baroclinic instability
   - The two-layer model
   - The Eady model
4. Frontogenesis

Part Two: Large-scale dynamics

Holton/Hakim Chs. 10-12

5. The conventional Eulerian mean
6. The transform Eulerian mean
   - The Eliassen-Palm flux
7. Equatorial wave theory
8. Eulerian and TEM perspectives of large-scale extratropical dynamics
   - The climatological mean circulation
   - Tropospheric variability
   - Sudden stratospheric warmings
   - The QBO
9. The high frequency extratropical transients
   - Frequency dependence and anisotropy
   - The extended Eliassen-Palm flux
   - Baroclinic lifecycles