

Version: Wednesday, August 27, 2025

ATS 602
Atmospheric Dynamics II
Course Syllabus for Fall 2025

Instructor:

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Room: ATS 430

Meeting times:

Tuesday, Thursday 11:10-12:00, ACRC 212B

Office hours:

Tuesday 1:00-2:00 PM (or really anytime my door is open)

Overview:

Atmospheric dynamics constitutes a branch of the larger field of geophysical fluid dynamics which itself is embedded in the general field of fluid mechanics. ATS602 follows from ATS601 and is focused on large-scale geophysical fluid dynamics, with an emphasis on atmospheric dynamics. The first half of the class will review the "quasi geostrophic" approximation, QG potential vorticity and its applications, and large-scale atmospheric dynamics. It will cover the Eulerian and transformed Eulerian mean equations, and how they can be used to physically interpret observed phenomena. The second half of the class will focus on the use of the tools developed in the first half to inform and guide analyses of observational data. We will consider research focused on large-scale extratropical dynamic variability and also the dynamical response to climate change.

Resources (all are available free via CSU libraries and the links below):

- Holton, J. R. and G. J. Hakim, 2013: An Introduction to Dynamic Meteorology, 5th Edition, Academic Press
<https://www.sciencedirect.com/book/9780123848666/an-introduction-to-dynamic-meteorology>

- 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>

- Held, I. M., 2000: The general circulation of the atmosphere
https://www.gfdl.noaa.gov/wp-content/uploads/files/user_files/ih/lectures/woods_hole.pdf

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Evaluation:

Evaluation consists of ~5-6 homeworks. Each homework will be worth roughly the same number of points.

General course outline:

Review of the primitive equations

The QG approximation and equations

Potential vorticity

- The QG PV equation
- PV inversion and conservation

The conventional Eulerian mean

The transform Eulerian mean

- The Eliassen-Palm flux

Eulerian and TEM perspectives of large-scale extratropical dynamics

- The climatological mean circulation
- Tropospheric variability

Applications to observed aspects of large-scale dynamic variability

- Annular modes
- Stratospheric variability
- Wave/mean flow interactions in the tropics and extratropics
- Atmospheric dynamical response to climate change