

ATMOSPHERIC DYNAMICS I (ATS 601, 3 credits)

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Office Hours: quick questions right after class
for longer questions Mondays 1–3 pm, or by appointment

Graduate teaching assistants:

Alex Gonzalez (gonzalez 'at' atmos.colostate.edu), Office: 312 Main Bldg
TA Office Hours: Tue/Thu 2–4

Main Text: Lecture Notes (largely based on Vallis, G. K., 2006: Atmospheric and Oceanic Fluid Dynamics, Cambridge University Press, Chapters 1–4)

Highly Recommended Texts:

Prof. Schubert's class notes (password protected) at

http://schubert.atmos.colostate.edu/teaching/at601-2/at601-2_notes.html

Gill, A. E., 1982: Atmosphere-Ocean Dynamics, Academic Press

Holton, J. R., 2004: An Introduction to Dynamic Meteorology, 4th Edition,
Academic Press (or 5th Ed. Holton & Hakim 2012)

Marshall, J. and R. A. Plumb, 2008: Atmosphere, Ocean, and Climate Dynamics,
An Introductory Text, Academic Press (Chapters 6 & 7)

Other Texts:

Cushman-Roisin, B., and J.-M. Beckers, 2011: Introduction to Geophysical Fluid
Dynamics, 2nd Ed., International Geophysics Series, Academic Press

James, I. N., 1994: Introduction to Circulating Atmospheres,
Cambridge University Press

Landau, L. D., and E. M. Lifshitz, 1959: Fluid Mechanics, Pergamon Press

Pedlosky, J., 1987: Geophysical Fluid Dynamics, 2nd Edition, Springer-Verlag

Salmon, R., 1998: Lectures on Geophysical Fluid Dynamics,
Oxford University Press

Classroom: ATS 101, Mon/Wed/Fri @ 10:00 am - 10:50 am

Class Website: <http://birner.atmos.colostate.edu/ats601.html>

Grading: Homework 55% (lowest HW score will be dropped)
Three In-Class Midterms 15% each (~9/26, ~10/31, ~12/5)
No Final, but optional oral exam to improve final grade

At least 2 hours of effort are expected to complete readings and homework assignments outside of class for each hour of class time.

This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (<http://www.catalog.colostate.edu/FrontPDF/1.6POLICIES1112f.pdf>) and the Student Conduct Code (<http://www.conflictresolution.colostate.edu/conduct-code>). At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

Course Description

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 aims at understanding the underlying mechanisms of atmospheric and oceanic motion. This involves processes on a vast range of spatial and temporal scales. In almost all cases one has to strongly simplify the underlying physics using appropriate assumptions in order to be able to arrive at an understanding of particular types of motion. Yet, much can be gained by studying such strongly simplified systems, in fact some of the conclusions drawn from simplified systems carry over directly to the real atmosphere/ocean. This course, part I of a two-semester sequence on atmospheric dynamics, covers the fundamentals of geophysical fluid dynamics with a slight emphasis on the atmospheric component.

Rough Course Outline:

xEquations of motion (2–3 weeks):

- Material derivative
- Momentum Equations (Navier-Stokes), Mass Conservation, Equation of State, Thermodynamic Equation
- Energy Budget
- Hydrostatic Balance

xRotation; Balanced Motion; Vorticity & Circulation; Rossby Waves (4-5 weeks)

- Rotating Framework
- Balanced Motion
- Vorticity & Circulation
- Rossby Waves

xNearly Incompressible Fluids; Sound-proofing (~1 week)

- Nearly Incompressible Fluids: Boussinesq Approximation
- Sound-proofing: Anelastic Approximation

xShallow Water Models (4-5 weeks):

- Single Layer, Multi-Layer Models
- Shallow Water Gravity Waves
- Shallow Water Potential Vorticity, Rossby Waves
- Potential Vorticity generalized
- Geostrophic Adjustment
- (possibly) Shallow Water Quasi-Geostrophic Theory
- Energetics and Available Potential Energy

xPrimitive Equations (~1 week):

- Spherical Coordinates
- Approximations to the Primitive Equations