Atmospheric Sciences 435
Dynamic and Synoptic Meteorology
Spring 2008

Time and Place: 9:10–10:00 MWF, 203 O&M
Instructor: Prof. Craig Epifanio, 1017B O&M Building, 845-9224, cepi@tamu.edu
Office Hours: 1:00–2:00 MW, 3:00–4:00 R

Description: ATMO 435 is the second of a two-course sequence presenting an introduction to fluid motions in the atmosphere. The present course is divided roughly into three main parts. The first part explores wave motions in the atmosphere, with hydrostatic surface waves, internal gravity waves and barotropic Rossby waves used as examples. Part 2 is an introduction to atmospheric turbulence, with particular application to the atmospheric boundary layer. The final part explores the large-scale baroclinic motions that modulate our day-to-day weather.

Homework: Problem sets will be assigned roughly weekly. You are encouraged to work together in groups to solve the problems. However, please make sure that your presentation of the problem reflects *your* understanding of the solution. Plagiarism–mindlessly adopting another's words or ideas as if they were your own–will be penalized.

Grading: Roughly weekly problem assignments (20%), two in-class exams (25% each), and a final exam (30%)

Texts: The course loosely follows the required text:
An Introduction to Dynamic Meteorology, by James R. Holton.

Course Outline:

Section numbers from Holton are given in brackets.

I. Review and other preliminaries

A. The equations of motion in local coordinates
B. Scaling the continuity equation: the anelastic and incompressibility approximations
C. The Boussinesq approximation [5.1.1]

II. Waves in geophysical systems

A. Review: waves and wave parameters
B. Surface gravity waves
  1. Shallow-water gravity waves with rotation [7.3.2 + rotation]
     Basic states and linearization
  2. Fourier decomposition [7.2.1]
  3. Dispersion and group velocity [7.2.2]
B. Internal gravity waves [7.4,7.5]
C. Barotropic Rossby waves [7.7]

III. The atmospheric boundary layer

A. Basic turbulence concepts
   1. Reynolds averaging [5.1]
   2. Energy conversions in turbulent flows [5.2]

B. Models of turbulence in the atmospheric boundary layer [5.3]

C Effects on the free atmosphere: Ekman pumping [5.4]

IV. Quasi-geostrophic analysis for large-scale flows

A. The observed structure of baroclinic waves [6.1]

B. Equations of motion in isobaric coordinates [3.1]

C. The quasi-geostrophic approximation
   1. Approximate equations for large-scale flows [6.2.1]
   2. Quasi-geostrophic vorticity and wave propagation [6.2.2]
   3. Geopotential tendency and quasi-geostrophic potential vorticity [6.3]
   4. Diagnosis of vertical motion: the omega equation and **Q** vectors [6.4]

D. Conceptual model of a baroclinic wave [6.5]

V. Further topics

A. Frontogenesis and the semi-geostrophic approximation [9.2]

B. Baroclinic instability: the two-layer model [8.2]
   1. Linear instability theory and complex phase speeds

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