ASP 5952: Dynamical Meteorology II
Fall, 2018

Instructor Prof. Zhengyu Liu,
Class Time TR 12:45-2:05pm
Location Derby Hall, room 1116
Credits 3
Course website
Prerequisites ASP 5951 or consult instructor

Instructor Information:
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Office Hour: Tuesday: 2:30-3:30pm

Text Book
Handout to be emailed

Course Description
This course discusses advanced dynamic theories for large-scale atmospheric motion in the framework of quasi-geostrophic dynamics. The course studies the shallow water system in the first half and the stratified flow in the second half. The major concepts to be discussed are: scaling analysis, the shallow water system, vorticity, circulation and potential vorticity, the quasi-geostrophic system, Rossby waves and baroclinic instability.

The course is designed as the last dynamic course for senior undergraduate and graduate students in Geography Department, but also applies to students in other departments interested in theories of rotating fluid dynamics.

The course chapters are as follows:
The sections with "*" are additional materials for your reference and will not be discussed in the class.

Part I: Dynamics of Shallow Water System

Chapter 1: Basics (3 weeks)
Sec.1.0: Introduction
Sec.1.1: Basic equations,
Sec.1.2: Conservation laws
Sec.1.3: Circulation, vorticity and Kelvin's Theorem
Sec.1.4: Potential vorticity conservation
Sec.1.5: Shallow water waves on f-plane
*Sec.1.6: Geostrophic adjustment

Chapter 2: Shallow Water Rossby Wave Dynamics (3 weeks)
Sec.2.1: Quasi-geostrophic equation
Sec.2.2: Rossby waves
Sec.2.3: Group velocity and energy propagation
Sec.2.4: Reflection and normal modes
Sec.2.5: Forced waves
*Sec.2.6: Non-plane waves

Chapter 3: Forced Circulation (1 week)

*Sec.3.1: Atmospheric circulation
Sec.3.2: Ekman dynamics
*Sec.3.3: Sverdrup flow
*Sec.3.4: Rossby wave and ocean circulatioin

Part II: Dynamics of Stratified Flow

Chapter 4: Basics of Stratified Fluid (1 weeks)
Sec.4.1: Basic equations
*Sec.4.2: Vorticity equation
*Sec.4.3: Ertel potential vorticity

Chapter 5: Rossby Wave Dynamics (2 weeks)
Sec.5.1: Quasi-geostrophic equation for stratified flow
Sec.5.2: Rossby waves in stratified fluid
Sec.5.3: Vertical normal modes
*Sec.5.4: The Elliassan-Palm theorem

Chapter 6: Instability Theory (2 weeks)
Sec.6.1: Instability problem
Sec.6.2: Baroclinic instability in a two-layer QG model
Sec.6.3: Energetics
*Sec.6.2: Charney-Stearn theorem
*Sec.6.4: The Eady problem.
*Sec.6.6: Barotropic instability

Grading:
40 % homework+quiz, 30% mid-term exam, 30% final exam

References:
1: Pedlosky, J. Geophysical Fluid Dynamics (2nd ed, 1987)**,** *Springer-Verlag***.**
2: Gill, A. E., Atmosphere-Ocean Dynamics, 1981, *Academic Press*.
3: Holton, J. R., An Introduction to Dynamic Meteorology (3rd ed), *Academic Press*.