Syllabus - MAE578 Geophysical & Environmental Fluid Dynamics - Spring 2015

Lectures and short lab demonstrations on the dynamics of geophysical and environmental fluid flows. Prerequisites: Familiarity with basic fluid mechanics and thermodynamics

Instructor: Huei-Ping Huang, hp.huang@asu.edu Office: ERC359
Office hours: 3-5 PM Tuesdays/Thursdays, or by appointment
Course website: **http://www.public.asu.edu/~hhuang38/MAE578.html**

Textbook: *"Atmosphere, ocean, and climate dynamics, an introductory text", J. Marshall and R. A. Plumb, Academic Press,* **Required**. This book covers the basic material for the first half of this course. Lecture notes will be provided to supplement the textbook.

Other recommended textbooks:

For GFD of large-scale flows:
(1) "*Atmospheric and oceanic fluid dynamics", G. K. Vallis, Cambridge University Press*
(2) *"Atmosphere-ocean dynamics", A. E. Gill, Academic Press*
(3) *"Geophysical fluid dynamics", J. Pedlosky, Springer-Verlag*
(4) *"An introduction to dynamic meteorology", J. R. Holton, Elsevier-Academic Press*

All are excellent and slightly more advanced than Marshall & Plumb.

For environmental flows at smaller scales:
(1) *An introduction to boundary layer meteorology, R. B. Stull, Springer*
(2) *Turbulence and diffusion in the atmosphere, A. K. Blackadar, Springer*

They are among the few textbooks on the subject that are friendly to beginners. Unfortunately, (2) is out of print (except for Kindle edition); Try to borrow a copy from the library.

Course outline

Expect some revision as the course progresses. We also plan to conduct 1-2 laboratory sessions outside regular class time (likely using office hours), pending resolution of some logistic issues.

1. Overview (1 lecture)
2. Energy balance of large-scale atmospheric circulation (3 lectures)
3. Stratified flow: vertical structure, static stability, and convection (4 lectures)
4. Water vapor, moist convection, and precipitation (2 lectures)
5. Survey of 3-D momentum and energy equations of fluid flows (2 lectures)
6. The effect of earth rotation (5 lectures)
7. Atmospheric boundary layer & near-surface processes (4 lectures)
8. Effect of topography and gravity waves (1 lecture)
9. Global-scale circulation of the atmosphere and oceans (4 lectures)
10. Issues related to numerical weather prediction (2 lectures)
11. Issues related to observation/measurement (2 lectures)

Grade will be based on homework assignments (60%), a term paper (30%), and an oral exam (10%). Depending on availability of time, the oral exam might be replaced by an extra homework assignment, a bonus task for the term project, or a final presentation.