Syllabus - MAE578 Geophysical & Environmental Fluid Dynamics - Fall 2011

Lectures and short lab demonstrations on the dynamics of geophysical and environmental fluid flows. Prerequisites: Familiarity with basic fluid mechanics is desirable but not absolutely necessary.

Instructor: Huei-Ping Huang, hp.huang@asu.edu
Office:ERC359 Office hours: 3-5 PM Tuesday, 2-3 PM Wednesday, or by appointment
Course website: **http://www.public.asu.edu/~hhuang38/MAE578.html**

Textbooks:

(1) *"Atmosphere, ocean, and climate dynamics, an introductory text", J. Marshall and R. A. Plumb, Academic Press,* **Required**. This book covers the basic material for at least the first half of this course. Lecture notes will be provided to supplement the textbook.
(2)*"Atmospheric and oceanic fluid dynamics: fundamentals and large-scale circulation, G. K. Vallis, Cambridge University Press,* **Recommended**. This book is slightly more advanced than Marshall & Plumb and is highly recommended for anyone who is seriously considering pursuing research in GEFD.

Other recommended books:

For large-scale flows related to weather and climate:
(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, (1) is very expensive and (2) is out of print; Interested students may try to first borrow a copy from the library.

Topographic effects, stratified flows, etc.:
(1) "*Topographic effects in stratified flows*", *P. G. Baines, Cambridge University Press*

Course outline

The listed number of lectures is approximate. In addition to regular lectures, we also plan to conduct a few laboratory sessions outside the regular class schedule (likely using office hours)

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 and precipitation (1 lecture)
5. Survey of the momentum and energy equations of fluid flows (4 lectures)
6. The effect of earth rotation (4 lectures)
7. Atmospheric boundary layer & near-surface processes (3 lectures)
8. Effect of topography and gravity waves (1 lecture)
9. Global-scale circulation of the atmosphere and oceans (4 lectures)
10. Issues with numerical simulation and prediction (1 lecture)

Grade will be based on homework assignments and a term paper. No exams.