ATM S 547, Spring Quarter 2013

Boundary Layer Meteorology

Instructor: Professor Chris Bretherton
704 Atmospheric Sciences Bldg., 685-7414
breth@washington.edu (office hours 1:30-2:30 MW or by appointment)

Lectures: Tu Th 11:30-12:50; ATG 406

Prerequisites: 505 (fluids) or permission of instructor

Recommended Text: The Atmospheric Boundary Layer, by J. R. Garratt, 1992, Cambridge University Press, 316 pp. (available at University Bookstore)

Course Description:

Turbulence and turbulent fluxes, averaging. Convection and shear instability. Monin-Obukhov similarity theory, surface roughness. Wind profiles. Organized large eddies. Convective and stably stratified boundary layers. Measurement technologies. Large-eddy simulation. Boundary-layer parameterization. Energy fluxes at ocean and land surfaces (including soil and vegetation interactions), diurnal cycle. Cloud-topped boundary layers.

Grading

- Homework (50%): you may collaborate on this, though I ask that you write your own Matlab scripts and description of results. To minimize paper use, please email me any supporting Matlab scripts as attachments when you submit your assignment.
- Term project (50%) on some topic of your choice related to the class (please see me for approval of your proposed topic). Each student will do a 15-20 minute oral presentation on their topic during one of the last two class sessions (5 and 7 June) and email me a 5-10 page written report by 5 pm on We 12 June.

Lecture notes (pdf). Some lectures take more than one period to complete. I plan to update some lectures as we go along, so you might not want to print them out more than a day in advance. The overall structure will not change, however.

- Lecture 1 Introduction; instabilities
- Lecture 2 Turbulent flow
- Lecture 3 Turbulent fluxes and TKE budgets
- Lecture 4 Boundary layer turbulence and mean wind profiles
- Lecture 5 Surface roughness and the logarithmic sublayer
- Lecture 6 Monin-Obukhov similarity theory
- Lecture 7 BL wind profiles and large eddy structure in convective and neutral BLs
- Lecture 8 Mixed layer and K-theory parameterizations of BL turbulence
- Lecture 9 Nonlocal parameterizations of BL turbulence
- Lecture 10 Surface energy balance
- Lecture 11 Surface evaporation and soil moisture
- Lecture 12 Diurnal cycle over land
- Lecture 13 Lecture 13 - Stable boundary layers - only present highlights
- Lecture 14 notes and slides Oceanic and cloud-topped BLs - observations
- Lecture 15 Cloud-topped physical processes and mixed layer modeling. Figures (ppt)
- Lecture 16 Cloud-topped mixed-layers II
- Lecture 17 Shallow cumulus convection

Class Schedule Notes

- No class Tu-Th 9-11 Apr - Instructor travel.

These lectures will be made up after students' schedule constraints are known.

Homeworks

- Homework 1 (Due Th 2 May)
- rf18L1.txt for HW1, p3.
- psduw.m for HW1, p3b.
- highpassw.m for HW1, p3c.
- Homework 2 (Due Fr 17 May)

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