Atm. Sci. 547 Boundary Layer Meteorology (Spring quarter, 3 credits; alternate years)
http://www.atmos.washington.edu/2004Q2/547

This course is a general survey of boundary layer meteorology. The atmospheric boundary layer (ABL) is the part of the atmosphere affected by turbulence induced by the flow of air over an underlying surface. The ABL is important as the part of the atmosphere in which we live, with direct effects on our daily life and work. It also plays a central role in the exchange of heat, moisture, momentum, trace gasses and aerosols between land, ocean, and ice surfaces, in cloud formation, and in the general circulation of the atmosphere. Boundary layer processes are important for interpreting remotely sensing data such as scatterometer winds or surface skin temperatureand the atmosphere occurs within the boundary layer. Skillful parameterizations of the energy balance of underlying surfaces over the diurnal and annual cycles and of turbulent transports in the ABL are vital to numerical forecast and climate models. In this course, we will try to explore some of these connections of the boundary layer to other atmospheric processes as well as the diverse internal dynamics that can be found in different types of boundary layers. We will also try to explain the boundary layer parameterizations that are used in current climate and forecast models (e. g. CCM3 and MM5). Prerequisite: Introductory fluid dynamics (Atm S/Amath 505/Ocean 511).

Professor:

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Grading

- Homework (60%); you may collaborate on this. Will include some simple computer modelling.
- Term project (40%) on some topic of your choice related to the class, 5-10 page written report due by Wednesday of finals week (June 9). Each student will do a 15-20 minute oral presentation in the last week on their term project.

Syllabus

Introduction to turbulence. Convection and shear instability. Turbulence, Reynolds averaging, turbulent fluxes. Observational tools and remote sensing.

Organized large eddies. Boundary layer wind and thermodynamic profiles. Convective and stably stratified boundary layers.

The surface layer. Monin-Obukhov similarity theory, surface roughness.

Surface energy fluxes over ocean and land. Land surface models. Diurnal cycle. Terrain effects.

Parameterizations and models of turbulent transport in dry boundary layers

Cloud-topped boundary layers and their parameterization.

Student presentations

Text

J. R. Garratt, 1992: *The Atmospheric Boundary Layer.* Cambridge University Press, 316 pp.

Contains a list of other relevant books at the end of the first chapter, including historically important texts.

Some other relevant current texts

Stull, R. B., 1988: *An Introduction to Boundary Layer Meteorology*, Kluwer Publishers, 666 pp. - idiosyncratic discussion of physics, but nice discussion of the methods, observational and computational tools used in boundary layer meteorology.

Arya, S. P. S., 1988: *Micrometeorology*, Academic Press, 307 pp. - a very accessible advanced undergrad introduction to the subject, mostly focussing on surface layer.

Sorbjan, Z., 1989: *Structure of the Atmospheric Boundary Layer.* Prentice-Hall, 317 pp.