Boundary Layer Meteorology

(METR 5103)

Spring 2012 Syllabus

General information:
Fundamentals of the atmospheric boundary layer dynamics and thermodynamics will be taught. Basic concepts of turbulence theory will be discussed and analyzed. Applications of this theory in the atmospheric boundary layer and mesoscale modeling will be considered. Emphasis will be placed on the state-of-the-art approaches towards parameterization and simulation of turbulent flows in atmospheric boundary layers under different meteorological conditions and above different underlying surface types.

Time and place: Mon, Wed, Fri; 1:00 - 1:50 p.m.; Room NWC 5930.

Instructor: Dr. Evgeni Fedorovich (http://weather.ou.edu/~fedorovi/fedorovich.html)
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Office hours: by appointment.

Prerequisites: METR 3113 and/or 5113, or permission of instructor.

Textbook: Garratt, J. R., 1994: *The Atmospheric Boundary Layer*, Cambridge University Press, 316 pp.

Recommended additional texts:
Stull, R. B., 1988: *An Introduction to Boundary Layer Meteorology*. Kluwer, 666 pp.
Sorbjan, Z., 1989: *Structure of the Atmospheric Boundary Layer*, Prentice Hall, 317 pp.
Wyngaard, J. C., 2010: *Turbulence in the Atmosphere*, Cambridge University Press, New York, 393 pp.

Proposed grading:
Midterm exam (March): 30%. Course project: 30%. Final exam (May): 40%. Grade cutoffs: A − ≥85%, B − ≥70%, C − ≥50%, D − ≥30%, F − <30%.

Course outline:
Place of the planetary boundary layer (PBL) in the Earth's atmosphere. Role of density/temperature stratification in the PBL. Observational and model data on the structure of convective, neutral, and stably stratified atmospheric boundary layers. Diurnal cycle of the PBL. Interaction between the PBL and larger-scale atmospheric processes.

Governing equations of the PBL dynamics and thermodynamics. Mean and turbulent motion in the PBL. Reynolds decomposition and averaging. Problem of turbulence closure. Interaction of PBL flow with underlying surfaces of different kinds. Surface energy balance. Turbulence regime in the atmospheric surface layer (ASL). Monin-Obukhov similarity. Flux-profile relationships in the ASL.

Hierarchy of PBL turbulent flow models. Balance of turbulence kinetic energy (TKE) in the PBL. The TKE dissipation rate and its parameterization. Parameterization of turbulent transport in atmospheric models. Large eddy simulation of the PBL turbulence regime. Subgrid closure schemes.

Note: *Any student in this course who has a disability that may prevent him or her from fully demonstrating his or her abilities should contact Dr. Evgeni Fedorovich personally to discuss accommodations necessary to ensure full participation and facilitation of educational opportunities.*