

AOS 773

Spring 2015

3 credits

**BOUNDARY LAYERS, MICROMETEOROLOGY, & TURBULENCE**

TTh 1:00-2:15 pm AOSS 811

Professor Ankur Desai

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Office Hours: by appointment

Web page: <https://learnuw.wisc.edu/> (login with your NetID to access course)

**Course Materials**

*Required:*

Stull, R.B. 1988/1997. *An Introduction to Boundary Layer Meteorology*, Kluwer Academic, ISBN 90-277-2769-4

*Others:*

Wyngaard, J.C. 2010. *Turbulence in the Atmosphere*, Cambridge Univ. Press, ISBN 978-0521887694

Arya, S. Pal. 2001. *Introduction to Micrometeorology, 2nd Edition*, Academic Press, ISBN 0120593548

Garratt, J.R. 1992. *The Atmospheric Boundary Layer*, Cambridge Univ Press, ISBN 0521467454

Van Dyke, M. 1982. *An Album of Fluid Motion*, Parabolic Press, ISBN 0915760037

All books are on reserve at the SSEC Library (3<sup>rd</sup> floor AOSS building).

**Course content**

The atmospheric boundary layer is a) where you live, b) where weather impacts society the most, c) where turbulence happens, and d) where land/ocean friction and energy exchange are first and most directly felt by the atmosphere. A number of research problems in meteorology from air pollution dispersion to mesoscale modeling to land-ocean-atmosphere interaction require thorough understanding of boundary layer meteorology. This understanding is primarily gained by exploration of theories in micrometeorology (meteorology at the smallest of scales) and turbulence (high Reynolds number chaotic flow). This course will expose you to empirical and theoretical understanding of the atmospheric boundary layer and its connections to Earth systems' sciences.

**Grading**

50% Problem sets and paper reviews (one approx. every week) / 30% Exams / 20% Research project

**Course Structure**

Tuesday and Thursday classes will consist of standard lectures, and interactive discussion is encouraged. On most Thursdays, in addition to lecture, student groups will take turns orally presenting reviews to the most recent problem set or reading. Students are encouraged to work on the problem sets together and assist the presenter during the solution discussion. For the final research project, students will analyze data from existing boundary layer field studies and write a short (4-8) page research paper and present a short (5 minute) presentation of their findings.

## Course Calendar

Week 1	1/20 & 1/22	Introduction to boundary layer meteorology
Week 2	1/27 & 1/29	Viscous and turbulent flow
Week 3	2/3 & 2/5	Ensemble and Reynolds averaging, fluxes
Week 4	2/10 & 2/12	TKE, energy cascades, closure, parameterization
Week 5	2/17 & 2/19	Surface energy balance and boundary conditions
Week 6	2/24 & 2/26	Dimensional analysis and similarity theory
Week 7	3/3 & 3/5	Modeling and observing boundary layer turbulent flows
	TUE 3/3	Exam I
Week 8	3/10 & 3/12	Atmospheric surface layer, Monin-Obhukov similarity
Week 9	3/17 & 3/19	Near-neutral mixed layer
Week 10	3/24 & 3/26	Convective and stable boundary layers
	THU 3/26	Research proposal due
Week X	3/31 & 4/2	SPRING BREAK
Week 11	4/7 & 4/9	Convective and stable boundary layers, entrainment
Week 12	4/14 & 4/16	Cloud-topped boundary layers
Week 13	4/21 & 4/23	Marine boundary layers and geographic effects
Week 14	4/28 & 4/30	Geographic effects (terrain, land-ocean contrast, urban areas)
	THU 4/30	Exam II
Week 15	5/5 & 5/7	Research presentations
	THU 5/7	Research paper due

NO FINAL

## Accommodation Policy

Campus policy: "We believe in the right of all students who are enrolled at the University of Wisconsin-Madison to full and equal educational opportunity. Disability should not be the basis for exclusion from educational programs. All students are entitled to an accessible, accommodating, and supportive teaching and learning environment. ... Students are expected to inform faculty, in a timely manner, of their need for special instructional accommodations."

Students requiring class accommodations due to a learning or physical disability must present documentation from the McBurney Disability Resource Center (<http://www.mcburney.wisc.edu/> ; 608-263-2741, Middleton Bldg, 1305 Linden Dr) in the first week of class. Accommodations will be made in consultation with the McBurney Center.

Students who require temporary accommodations due to medical or psychological reasons should acquire documentation from University Health Services. Counseling is available from Counseling Services, University Health Services (<http://www.uhs.wisc.edu/> ; 608-265-5600, 115 N Orchard St).