

AOS 773

Spring 2010

3 credits

BOUNDARY LAYERS, MICROMETEOROLOGY, & TURBULENCE

TTh 9:30-10:45 am AOSS 811

Professor Ankur Desai

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1549 AOSS

Email: desai@aos.wisc.edu

Office Hours: by appointment or whenever my door is open

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:

Arya, S. Pal. 2001. *Introduction to Micrometeorology, 2nd Edition*, Academic Press, ISBN 0-12-059354-8

Garratt, J.R. 1992. *The Atmospheric Boundary Layer*, Cambridge Univ Press, ISBN 0 521 46745 4 (paper)

Wallace, J.M. and P.V. Hobbs. 2006. *Atmospheric Science: An Introductory Survey, 2nd Edition*, Elsevier, ISBN 978-0-12-732951-2.

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

All books are on reserve at the SSEC Library (3rd 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 paper

Course Structure

Tuesday and Thursday classes will consist of standard lectures, and interactive discussion is encouraged. On most Thursdays, in addition to lecture, students will take turns orally presenting reviews to the most recent problem set or reading. Given the small class size, students are encouraged to work on the problem sets together and assist the presenter during the solution discussion. Since there is not enough time to cover all topics in the field, students will conduct independent research on a topic of their choosing related to boundary layer meteorology, write a short (5-10) page research paper and present a short (10 minute) presentation of their findings.

Course Calendar

Week 1	1/19 & 1/21	Introduction to boundary layer meteorology
Week 2	1/26 & 1/28	Viscous and turbulent flow
Week 3	2/2 & 2/4	Ensemble and Reynolds averaging, fluxes, TKE
Week 4	2/9 & 2/11	TKE, energy cascades, closure, parameterization
Week 5	2/16 & 2/18	Surface energy balance and boundary conditions
Week 6	2/23 & 2/25	Monin-Obhukov similarity theory
Week 7	3/2 & 3/4	Modeling and observing boundary layer turbulent flows
	THU 3/4	Exam I
Week 8	3/9 & 3/11	Atmospheric surface layer
Week X	3/16 & 3/18	Near-neutral boundary layers, static and dynamic stability
Week 9	3/23 & 3/25	Convective boundary layers
Week 10	3/30 & 4/1	SPRING BREAK
Week 11	4/6 & 4/8	Stable boundary layers
Week 12	4/13 & 4/15	Cloud-topped boundary layers
Week 13	4/20 & 4/22	Marine boundary layers and geographic effects
Week 14	4/27 & 4/29	Geographic effects (terrain, land-ocean contrast, urban areas)
	THU 4/29	Exam II, Research paper due
Week 15	5/4 & 5/9	Research presentations

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).