

California State University, Chico  
Department of Geological and Environmental Sciences

## **GEOS 435: Boundary Layer Meteorology, Section 01, Spring 2020**

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<b>Office hours:</b>	Mondays from 1:30 – 4:30 PM or by appointment
<b>Class days and times</b>	Tuesdays and Thursdays from 12:30 – 1:45 PM
<b>Classroom:</b>	PHSC 130
<b>Prerequisites:</b>	GEOS 170, PHYS 202A or 204A, MA 109 or 120

### **Course Usage of Blackboard Learn**

Copies of the course syllabus and major assignments may be found on Blackboard Learn. You are responsible for regularly checking the online resources, which is accessed through the [Chico State Portal](#).

### **Course Description and Goals**

The atmospheric boundary layer (ABL) is the lowest part of the Earth's atmosphere (generally less than 1 km altitude) that is in constant contact with the surface of the Earth and responds quickly to thermal and mechanical forcing. Air motion within the ABL modulates the vertical fluxes of heat, momentum, and trace gases. Turbulence is the main physical process by which those fluxes occur, and hence statistical descriptions are the norm. Therefore, this course will tend to focus on small-scale meteorology (also known as *micrometeorology*), turbulence, and the behavior of the atmosphere near the surface. The goals of the course are to provide students with (1) an understanding of how the atmosphere is coupled to the surface of the Earth, (2) awareness of the types of ABLs and their mean structure, and (3) an overview of phenomena that occur within the ABL.

### **Student Learning Objectives**

Students will learn why boundary layers form and why they play critical roles in controlling fluxes of heat, momentum, and trace gases across interfaces. Students will learn to distinguish various types of atmospheric boundary layers and the critical roles they play in controlling surface climate, air quality, and weather. Students will learn the physical and mathematical basis for various formulations that allow us to model and predict the state of the atmospheric boundary layer.

### **Course Content Learning Outcomes**

Upon successful completion of this course, students will be able to:

1. Define the atmospheric boundary layer (ABL), be able to identify it in observations, and be aware of the physical processes that control its depth.
2. Describe why the atmospheric boundary layer is of critical importance in environmental science and many human enterprises.
3. Understand how static stability and the surface energy budget influence turbulence characteristics, fluxes, and idealized theoretical models of boundary layer turbulent transport.
4. Describe some canonical boundary layers over flat surfaces such as the Ekman BL, convective BL, mixed layer, stable BL, cloud-capped marine BL, trade wind BL, etc.
5. Be able to describe important boundary layer flow phenomena such as convection cells, streets, gravity waves and KH billows, upslope and downslope winds, land- and sea-breezes, low-level jets, density current fronts, and deep convection initiation.
6. Interpret some nomenclature, jargon, and mathematical ideas that are used to describe boundary layers in quantitative ways.
7. Understand how vegetation and forest canopies influence surface layer structure and fluxes.
8. Describe some basic statistical characteristics and importance of boundary layer turbulence and how turbulence controls fluxes and the transport heat, momentum, and trace gases.

### **Required Texts/Readings (note where available)**

#### **Textbooks**

*Introduction to Boundary Layer Meteorology*, 1988, Kluwer Academic Publishers, by [Roland B. Stull](#). ISBN-13: 978-9027727695

*Practical Meteorology*, 2018, by [Roland Stull](#). ISBN: 978-0-88865-283-6

Freely available from the following link:

[https://www.eoas.ubc.ca/books/Practical\\_Meteorology/](https://www.eoas.ubc.ca/books/Practical_Meteorology/)

#### **Other fine boundary layer books (not required)**

*Fundamentals of Boundary-Layer Meteorology*, 1st edition, 2018, Springer, by [Xuhui Lee](#). ISBN-13: 978-3319608518

*Disclaimer: All links open in a new window.*

*Atmospheric Boundary Layer Flows*, 1994, Oxford University Press, by J. C. Kaimal and [J. J. Finnigan](#). ISBN-13: 978-0195062397

*Atmospheric Boundary Layer*, 2015, Cambridge University Press, by [J. Vila-Guerau de Arellano](#) et al. ISBN-13: 978-1107090941

*Footprints in Micrometeorology and Ecology*, 2014, Springer, by M. Y. Leclerc and [T. Foken](#). ISBN-13: 978-3642545443

*Eddy Covariance*, 2012, Springer, edited by M. Aubinet, T. Vesala, and D. Papale. ISBN-13: 978-9400723504

*Micrometeorology*, 2nd edition, 2017, Springer, [T. Foken](#). ISBN-13: 978-3642254390

### **Classroom Protocol**

Attendance is an important part of the course. A sign-in sheet will be circulated at the beginning of class. Please sign the sign-in sheet for attendance credit.

Please do not eat in lecture. The noises and smells may be a distraction for your peers. Plan your day so that you have adequate nourishment before class. Please come to class on time. Walking in several minutes late is a distraction for everyone. We understand if it happens rarely due to extraordinary circumstances, but chronic lateness projects lack of maturity and respect and may be taken into account for your course grade.

Please silence mobile phones and avoid texting during lectures.

Please do not chat with your neighbor during lecture. It is very distracting for others in the course who are trying to listen to the instructor.

Use of phones is strictly prohibited during quizzes and exams.

### **Dropping and Adding**

You are responsible for understanding the policies and procedures about add/drops, academic renewal, etc., found in the [CSU Chico University Catalog](#). You should be aware of the new deadlines and penalties for adding and dropping classes.

### **Assignments and Grading Policy**

In addition to attendance, quizzes, exams, and homeworks, course grades will probably be influenced by one or more special assignments. For example, students may be required to select an area of environmental science involving boundary layer meteorology that is of special interest to them and prepare a written report and/or oral presentation.

Grades will be determined based upon some combination of points earned through attendance, quizzes, exams, homeworks and special assignments.

## **University Policies and Campus Resources**

### **Academic Integrity**

Students are expected to be familiar with the University's Academic Integrity Policy. Your own commitment to learning, as evidenced by your enrollment at California State University, Chico, and the University's Academic Integrity Policy requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the Office of Student Judicial Affairs. The policy on academic integrity and other resources related to student conduct can be found on the [Student Judicial Affairs web site](#).

### **IT Support Services (Optional)**

Computer labs for student use are located on the first and fourth floor of the Meriam Library, Room 116 and 450, Tehama Hall Room 131, and the Bell Memorial Union (BMU) basement. You can get help using your computer from IT Support Services; contact them through the [ITSS web site](#). Additional labs may be available to students in your department or college.

### **Student Services (Optional)**

Student services are designed to assist students in the development of their full academic potential and to motivate them to become self-directed learners. Students can find support for services such as skills assessment, individual or group tutorials, subject advising, learning assistance, summer academic preparation and basic skills development. Student services information can be found on the [current students page of the CSU Chico web site](#).

*Disclaimer: All links open in a new window.*

### **Americans with Disabilities Act**

If you need course adaptations or accommodations because of a disability or chronic illness, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Please also contact Accessibility Resource Center (ARC) as they are the designated department responsible for approving and coordinating reasonable accommodations and services for students with disabilities. ARC will help you understand your rights and responsibilities under the Americans with Disabilities Act and provide you further assistance with requesting and arranging accommodations.

#### **[Accessibility Resource Center](#)**

530-898-5959

Student Services Center 170

[arcdept@csuchico.edu](mailto:arcdept@csuchico.edu)

### **Student Learning Center (Optional)**

The mission of the Student Learning Center (SLC) is to provide services that will assist CSU, Chico students to become independent learners. The SLC prepares and supports students in their college course work by offering a variety of programs and resources to meet student needs. The SLC facilitates the academic transition and retention of students from high schools and community colleges by providing study strategy information, content subject tutoring, and supplemental instruction. The University Writing Center has been combined with the Student Learning Center. You can also visit the [Student Learning Center web site](#).

### **Blackboard ALLY**

Chico State is committed to providing you the best learning experience possible. With this goal we have activated Blackboard ALLY in your courses. ALLY is a revolutionary product that focuses on making digital course content more accessible to all students. You will now be able to download any content in this course in the format that fits best with your learning style. PDF, HTML, .EPUB and Audio files are now available for most content items. Here is a link to more [information on formats available](#) as well as what each format offers. Should you have any questions or experience issues while using ALLY please contact the Office of Accessible Technology and Services at [oats@csuchico.edu](mailto:oats@csuchico.edu) or 530-898-6532.

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## **GEOS 435 (Boundary Layer Meteorology) Tentative Schedule**

*(Note: subject to change with fair notice.)*

<b>Week</b>	<b>Date</b>	<b>Topics, Readings, Assignments, Deadlines</b>
1	1/21, 1/23	Mean CBL structure
2	1/28, 1/30	Types of boundary layers
3	2/04, 2/06	
4	2/11, 2/13	
5	2/18, 2/20	Instructor gone.
6	2/25, 2/27	Time-series analysis
7	3/03, 3/05	
8	3/10, 3/12	Surface layer and similarity theory
9	3/17, 3/19	Spring break. No classes
10	3/24, 3/26	
11	3/31, 4/02	Effects of vegetation
12	4/07, 4/09	
13	4/14, 4/16	Terrain-induced flows
14	4/21, 4/23	
15	4/28, 4/30	Severe weather
16	5/05, 5/07	
17	5/11-5/17	Final exam week