CLIM301-001 Weather Analysis and Prediction (Lecture)

Semester: Fall 2022
Lecture Time: 12:00 pm - 1:15 pm, Tuesday and Thursday
Location: Enterprise Hall 174

Instructor: Dr. Bohua Huang
Email: bhuang@gmu.edu
Office Hour: 9:30 am – 11:00 am, Tuesday

Office: 269 Research Hall
Office Phone: 703-993-6084

Students should have Mason COVID Health Check "green" prior to attending in person classes.

Blackboard Login Instructions

Access to MyMason and GMU email are required to participate successfully in this course. Please make sure to update your computer and prepare yourself to begin using the online format BEFORE the first day of class. Check the IT Support Center website. Navigate to the Student Support page for help and information about Blackboard. In the menu bar to the left you will find all the tools you need to become familiar with for this course. Take time to learn each. Make sure you run a system check a few days before class. Become familiar with the attributes of Blackboard and online learning.

Course Description

CLIM-301 studies the basic properties of various weather systems and phenomena and applies physical principles to explain their processes. This course also introduces students to the basic weather analysis and forecasting techniques. In this course, students will view various meteorological observations, learn how to read and interpret surface and upper air weather maps, and get familiar with basic procedure and products of numerical weather prediction.

Course Learning Outcomes

After taking this course, students will be able to

- Know general properties of typical weather phenomena influencing the US
- Read standard weather maps and charts constructed from observations
- Apply some physical principles to interpret weather phenomena qualitatively
- Be familiar with basic meteorological tools and products for weather forecast

Required Textbook:

Aguado E. and J. E. Burt: Understanding Weather and Climate, 7th edition, plus online access to Pearson MasteringMeteorology
(You may get online access to Pearson MasteringMeteorology and eText of the textbook through Blackboard Course; see instruction in the "Student_Registration_Handout" in the Syllabus directory)

Reading Materials:

Wallace, J. M., and P. V. Hobbs, 2006: Atmospheric Science: An Introductory Survey. Second edition. (ISBN-10: 0-12-732951-X), Chapters 3 and 7 (provided as reserved online materials)

Milrad, S. 2018: Synoptic analysis and forecasting: An introductory toolkit. (ISBN: 978-0-12-809247-7) Chapters 11 and 12 (provided as reserved online materials)

Class notes will be available on Blackboard after each lecture. Please note that the class notes are for your study. Please don't share them outside the class and/or post them online.

Grade breakdown:

Homework	40% Homework assignments are given every Thursday (due next Thursday), except for the first week and the weeks of the midterms. The weekly homework includes the online assignment from "MasteringMeteorology" (Part A) and a calculation assignment (Part B).
Test	50% quizzes, Mid-term I, Mid-term II, Final exam
Online Discussion	10%
Final Grade for CLIM301	
Lectures (CLIM301-001)	60%
Lab (CLIM301-002)	40% (see lab instructor's syllabus for details)

Grading Scale

A+ 97%-100% A 93%-97% A- 90%-93%
B+ 87% - 90% B 83%-87% B- 80%-83%
C+ 77% - 80% C 73%-77% C- 70%-73%
D 60% - 70% F below 60%

Technology Requirements

Hardware: You will need access to a Windows or Macintosh computer and access to a fast and reliable broadband internet connection. You will need speakers or headphones to hear recorded content.

Software: We use Blackboard as the learning management system. You will need a browser and operating system that are listed compatible or certified with the Blackboard version available on the myMason Portal. See supported browsers and operating systems. Also, make sure your computer is protected from viruses by downloading the latest version of Symantec Endpoint Protection/Anti-Virus software for free here.

Note: If you are using an employer-provided computer or corporate office for class attendance, please verify with your systems administrators that you will be able to install the necessary applications and that system or corporate firewalls do not block access to any sites or media types.

Course Schedule:

Section I Large-scale weather systems, synoptic analysis

Week 1 Course requirement and introduction (08/22-8/26)
(Textbook, Chapter 13; Milrad, Chapter 1)
Aug. 23 Tuesday
course requirement
a brief history of synoptic meteorology
Aug. 25 Thursday
Global observing system
Concept of pressure
Meteorological equation of state, virtual temperature

Week 2 Atmospheric pressure (08/29-09/02)
(Textbook, Chapter 4; Wallace and Hobbs, Chapters 3)
Aug. 30 Tuesday
Pressure gradient force
Hydrostatic balance
Sep 01 Thursday
Surface pressure: definition and measurement
Surface analysis, sea-level pressure, contouring
Upper air analysis, isobaric surface, geopotential height

Week 3 Wind (09/05-09/09) (09/05, Labor Day, no class)
(Textbook, Chapter 4; Wallace and Hobbs, Chapter 7)
Sep 06 Tuesday
Wind measurement and representation on weather map
Coriolis force and concept of geostrophic wind
Gradient wind: effect of curvature

Effect of friction
Subgeostrophic and supergeostrophic flows

Sep 08 Thursday

Vertical change of wind
Geopotential height thickness
Hypsometric equation
Thermal wind

Week 4 Air mass and front (09/12-09/16)

(Textbook, Chapter 9; Wallace and Hobbs, Chapter 8)

Sep 13 Tuesday

Concept of air mass,
source regions
formation

Sep 15 Thursday

Concept of front,
Characteristics of cold, warm, stationary, and occluded fronts
Dry lines

Week 5 Mid-latitude cyclone (09/19-09/23)

(Textbook, Chapter 10; Wallace and Hobbs, Chapter 8)

Sep 20 Tuesday

Life cycle of mid-latitude cyclones, polar front theory
Vorticity, relative vorticity, planetary vorticity, absolute vorticity
Divergence and convergence, confluence and diffluence

Sep 22 Thursday

Vorticity and temperature advection
Connection of surface cyclone/ front and upper level trough and ridge

Week 6 Review of Section I and Mid-Term I (09/26-09/30)

Sep 27 Tuesday

Section review

Sep 29 Thursday

Mid-Term 1 (12:00 pm – 1:15 pm)

Section II Atmospheric physical properties, thermodynamic chart analysis

Week 7 Atmospheric moisture (10/03-10/07)

(Textbook, Chapter 5; Wallace and Hobbs, Chapter 3)

Oct 4 Tuesday

Hydroloigical cycle, water vapor in atmosphere
Vapor pressure, saturation vapor pressure
Mixing ratio, specific mixing ratio, relative humidity, dew point
Measuring humidity, wet-ball temperature
Dew point and nighttime minimum temperature
Processes affecting saturation, condensation, dew and fog

Oct 6 Thursday

SkewT-logP diagram
Adiabatic and diabatic processes
Potential temperature
Dry and moist adiabatic lapse rates
Environmental lase rate

Week 8 NWS SKYWARN class (10/10-10/14)
(Textbook, Chapter 6; Wallace and Hobbs, Chapter 3)
Oct 11 Tuesday
Fall break, no class
Oct 13 Thursday
NWS SKYWARN class (12:00 pm – 2:45 pm)
Johnson Center, 336, Meeting Room F

Week 9 Static stability, cloud and precipitation (10/17-10/21)
(Textbook, Chapters 6 & 7; Wallace and Hobbs, Chapter 3)
Oct 18 Tuesday
Static stability (absolutely stable and unstable, conditionally unstable) potential instability
Lifting condensation level
Level of free convection
Inversion
Oct 20 Thursday
Formation of cloud
Growth of cloud droplets to raindrops
Warm clouds, Collision–coalescence process
Cool cloud and cold cloud, Bergeron process
rain, graupel, hail
Measuring cloud amount
Measuring precipitation

Week 10 Satellite and Radar (10/24-10/28)
(Milrad: Chapters 11 and 12)
Oct 25 Tuesday
Polar-orbiting and geostationary satellites and their characteristics
Using different types of satellite imagery to identify weather features
Oct 27 Thursday
Introduction to weather radar
Common types of radar imagery and feature identification

Week 11 Review of Section II and mid-term II (10/31-11/04)
Nov 01 Tuesday
Review of Section II
Nov 03 Thursday
Mid-term II

Section III Mesoscale and tropical weather systems, weather prediction

Week 12 Thunderstorm and tornado (11/07-11/11)
(Textbook, Chapter 11)
Nov 08 Tuesday
Basics of lightning
Air mass thunderstorms
Multicell
Downbursts
Nov 10 Thursday
Supercell
Tornado formation, distribution, damage and forecast

Week 13 Tropical storm and hurricane (11/14-11/18)
(Textbook, Chapter 12)
Nov 15 Tuesday
Structure and characteristics of tropical storms
Conditions and steps in the formation of hurricanes
Nov 17 Thursday
Hurricane movement, landfall and dissipation
Hurricane prediction

Week 14 Winter Weather (11/21-11/25) (Thanksgiving Recess, 11/23-11/27)
(Textbook, Chapter 7)
Nov 22 Tuesday
Snow, sleet and freezing rain
Lake-enhanced snow
Nov 24 Thursday
No class

Week 15 Weather prediction (11/28-12/02)
(Textbook, Chapter 13)
Nov 29 Tuesday
NWS, NCEP, regional weather forecast offices
General weather forecasting procedure and products
Basics of numerical weather prediction
model products
Dec 01 Thursday
Review for final exam

Final Exam (12/08, 10:30am-1:15pm)

Homework Description: For each week (except for the first week and the review weeks), homework is posted on Thursday. The homework includes two parts. Homework-Part A is from the Pearson MasteringMeteorology with multiple-choice questions and mini-essays. Homework-Part B is about calculation, usually with two

to four questions. The homeworks are due in one week on Thursday at 11:59 pm. There is no homework due on review weeks. Late homework will not be accepted.

Online quizzes: An online quiz is given at the end of each lesson except for the review weeks. Each quiz has five multiple-choice questions. You will have 20 minutes to complete the quiz. Quizzes are open book.

Online Discussion Board Posts. Your discussion will be graded based upon completion in time and the quality of discussion. I will post the weekly discussion questions on Tuesdays and you will be expected to post your initial response by Friday 11:59 pm and your comments to peers' posts by Monday 11:59 pm. Late posts will not be accepted.

Mid-terms and Final. The two mid-term exams will be on Sep. 29 and Nov. 3 and the final exam will be on Dec. 8. The formats of the exams will be close book. Students can bring one page of reviewing notes on a 11 x 8.5 paper to the exam.

University Policies and Resources

a. Academic Honesty: You are expected to be familiar with and abide by the University's Honor Code. The Code can be found here. It is your responsibility to see me if you have questions about these policies. George Mason University has an honor code that states the following:

To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the University Community have set forth this:

b. Students must follow the university policy for Responsible Use of Computing
c. Student services: The University provides range of services to help you succeed academically and you should make use of these if you think they could benefit you. I also invite you to speak to me (the earlier the better).
d. Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account.
e. The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance. Counseling Center: Student Union I, Room 364, 703-993-2380.
f. Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester. All academic accommodations must be arranged through that

office. Please note that accommodations MUST BE MADE BEFORE assignments or exams are due. I cannot adjust your grade after the fact.

g. Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
h. The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. University Writing Center: Robinson Hall Room A114, 703-993-1200. The writing center includes assistance for students for whom English is a second language.
i. Diversity: George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.