CLIM301-001 Weather Analysis and Prediction (Lecture)

Semester: Fall 2023
Credit: 4 (including lab)
Time: 12:00 pm - 1:15 pm, Tuesday and Thursday (Research Hall 202)

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

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)

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 (08/21-8/25)

Aug 22 Tuesday

course requirement
a brief history of synoptic meteorology

Aug 24 Thursday

Global observing system
Concept of pressure
Meteorological equation of state, virtual temperature

Week 2 Atmospheric pressure (08/28-09/01)

Aug 29 Tuesday

Pressure gradient force
Hydrostatic balance

Aug 31 Thursday

Surface pressure: definition and measurement
Surface analysis, sea-level pressure, contouring
Upper air analysis, isobaric surface, geopotential height

(Textbook, Chapter 4; Wallace and Hobbs, Chapters 3, 7)

Week 3 Wind (09/04-09/08) (09/04, Labor Day, no class)

Sep 05 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 07 Thursday

Vertical change of wind
Geopotential height thickness
Hypsometric equation
Thermal wind

(Textbook, Chapter 4; Wallace and Hobbs, Chapter 7)

Week 4 Air mass and front (09/11-09/15)

Sep 12 Tuesday

Concept of air mass
source regions
formation

Sep 14 Thursday

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

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

Week 5 Mid-latitude cyclone (09/18-09/22)

Sep 19 Tuesday

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

Sep 21 Thursday

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

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

Week 6 Review of Section I and Mid-Term I (09/25-09/29)

Sep 26 Tuesday

Section review

Sep 28 Thursday

Mid-Term 1 (12:00 pm – 1:15 pm)

Section II Atmospheric physical properties, thermodynamic chart analysis

Week 7 Atmospheric moisture and thermodynamics (10/02-10/06)

Oct 3 Tuesday

Vapor pressure, saturation vapor pressure
Mixing ratio, specific mixing ratio, relative humidity, dew point
Measuring humidity, wet-bulb temperature
Dew point and nighttime minimum temperature

Oct 5 Thursday

SkewT-logP diagram
Adiabatic and diabatic processes
Potential temperature
Dry and moist adiabatic lapse rates
Environmental lase rate
Lifting condensation level
Level of free convection

(Textbook, Chapters 5 and 6; Wallace and Hobbs, Chapter 3)

Week 8 NWS SKYWARN class (10/9-10/13)

Oct 10 Tuesday

Fall break, no class

Oct 12 Thursday

NWS SKYWARN class (12:00 pm – 2:45 pm)
classroom to be determined.

Week 9 Static stability, cloud, and precipitation (10/16-10/20)

Oct 17 Tuesday

Static stability (absolutely stable and unstable, conditionally unstable) potential instability
Inversion
Formation of cloud
Cloud types
Measuring cloud amount

Oct 19 Thursday

Growth of cloud droplets to raindrops
Warm clouds, Collision–coalescence process
Cool cloud and cold cloud, Bergeron process
Snow, rain, graupel, hail, sleet and freezing rain
Measuring precipitation

(Textbook, Chapters 6 & 7; Wallace and Hobbs, Chapter 3)

Week 10 Satellite and Radar (10/23-10/27)

Oct 24 Tuesday

Polar-orbiting and geostationary satellites and their characteristics
Using different types of satellite imagery to identify weather features
Introduction to weather radar

Oct 26 Thursday

Common types of radar imagery and feature identification
(Milrad: Chapters 11 and 12)

Week 11 Review of Section II and mid-term II (10/30-11/03)

Oct 31 Tuesday

Review of Section II

Nov 02 Thursday

Mid-term II

Section III Mesoscale and tropical weather systems, weather prediction

Week 12 Thunderstorm and tornado (11/06-11/10)

Nov 07 Tuesday

Air mass thunderstorms
Multicell
Downbursts

Nov 09 Thursday

Supercell
Tornado formation, distribution, damage and forecast
(Textbook, Chapter 11)

Week 13 Tropical storm and hurricane (11/13-11/17)
Nov 14 Tuesday
Structure and characteristics of tropical storms
Conditions and steps in the formation of hurricanes
Nov 16 Thursday
Hurricane movement, landfall and dissipation
Hurricane prediction
(Textbook, Chapter 12)

Week 14 Weather prediction (11/20-11/24) (Thanksgiving Recess, 11/22-11/26)
Nov 21 Tuesday
NWS, NCEP, regional weather forecast offices
General weather forecasting procedure and products
Nov 23 Thursday
No class
(Textbook, Chapter 13)

Week 15 Weather prediction (continued) and final review (11/28-12/02)
(Textbook, Chapter 13)
Nov 29 Tuesday
Basics of numerical weather prediction
models, procedures, and products
Dec 01 Thursday
Review for final exam

Final Exam (12/07, 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.

Policy for late assignments: Late homework submitted within one week after the due date is still accepted with a 3% reduction of the assigned points after each day. Homework late for more than one week is not accepted.

Quizzes: A 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. 28 and Nov. 2 and the final exam will be on Dec. 7. The formats of the exams will be announced. If you cannot attend any of these exams at the given dates and times, you should get approval from in advance. You should also arrange the next closest time to take the exam.

University Policies and Resources

a. Academic Honesty: You are expected to be familiar with and abide by the University's Honor Code (https://oai.gmu.edu/full-honor-code-document/). Essentially, it includes the following: (1) Homework and projects submitted should be your own work, without the use of inappropriate assistance or resources. (2) When you refer to the work of others in these tasks, you must give full credit through accurate citations. (3) In creating your work, you should not take materials you are not authorized to use. It is your responsibility to see me if you have questions about these policies.
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. Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process. Disability

Services is located in Student Union Building I (SUB I), Suite 2500. Email:ods@gmu.edu | Phone: (703) 993-2474. All academic accommodations must be arranged through that office. Then please discuss your approved accommodations with me. Please note that accommodations must be made before assignments or exams are due.

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.