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:


Grade breakdown:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>40%</td>
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<tr>
<td>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).</td>
<td></td>
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<tr>
<td>Test</td>
<td>50%</td>
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<tr>
<td>Online Discussion</td>
<td>10%</td>
</tr>
<tr>
<td>quizzes, Mid-term I, Mid-term II, Final exam</td>
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<tr>
<td>Final Grade for CLIM301 Lectures (CLIM301-001)</td>
<td>60%</td>
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<tr>
<td>Lab (CLIM301-002)</td>
<td>40%</td>
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<td>(see lab instructor’s syllabus for details)</td>
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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 lapse 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.