# CLIM301 Weather Analysis and Prediction

***Instructors:*** Dr. Bohua Huang (Lecture)
Dr. Long Chiu (Lab)
***Semester:*** Fall 2019
***Credit:*** 4
***Time:*** Lecture: 12:00 pm - 1:15 pm, Tuesday and Thursday
Lab: 1:30 pm - 2:45 pm, Tuesday and Thursday
***Location:*** Research Hall 121

***Content:***

CLIM-301 examines the basic properties of various large-scale weather systems and phenomena and applies physical principles to understand their processes. This course also introduces students to the basic weather analysis and forecasting techniques. Students will learn the methods of meteorological observations, analysis and interpretation of surface and upper air weather maps, as well as basic procedure and products of numerical weather prediction.

***Textbook:***

For lectures:

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

For lab:

Carbone, G.: Exercises for Weather and Climate. 9th edition
(see Dr. Chiu's lab instruction)

***References:***

Vasquez, T.: Weather Analysis and Forecasting Handbook. (ISBN 978-0-9832533-8-9)

Wallace, J. M., and P. V. Hobbs: Atmospheric Science: An Introductory Survey. Second edition. (ISBN-10: 0-12-732951-X)

(Copies of both references are reserved in the classroom)

***Grade breakdown:***

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|---|---|---|
| Lab | 40% | |
| Lectures | 60% | |
| | Homework | 20%, given every Thursday (due next Thursday), except for the first week and the weeks before the midterms. The homework includes the online assignments from "MasteringMeteorology" and supplemental calculation questions I give. |
| | Mid-term I | 10% |
| | Mid-term II | 10% |
| | Final | 20%) |

(All exams are closed book)

***Lecture schedule:***

(Lecture slides will be available on Blackboard "course content" after each class)

8/27 *Introduction (course requirement, a brief history of synoptic meteorology, observational networks)*

8/29 *Atmospheric pressure and wind* (Concept of pressure, equation of state, virtual temperature, atmospheric pressure, horizontal and vertical pressure gradient force) (Chapter 4, textbook; Wallace and Hobbs, Chapter 3; Vasquez, Chapter 1)

9/03 *Vertical pressure gradient and hydrostatic balance* (hydrostatic balance, surface pressure, pressure measurement, sea-level pressure, surface analysis, pressure tendency, upper air analysis, isobaric surface, geopotential height, thickness, hypsometric equation) (Chapter 4, textbook; Wallace and Hobbs, Chapter 7; Vasquez, Chapter 1)

9/05 *Wind and geostrophic balance* (wind representation on weather map, Coriolis force, concept of geostrophic wind) (Chapter 4, textbook; Wallace and Hobbs, Chapter 7; Vasquez, Chapter 1)

9/10 *Gradient wind and thermal wind* (geostrophic wind in natural coordinate, effect of friction, effect of curvature, gradient flow, subgeostrophic and supergeostrophic flows) (Chapter 4, textbook; Wallace and Hobbs, Chapter 7; Vasquez Chapter 1)

9/12 *Homework help*

9/17 *Air masses and fronts I* (concept of air mass, source regions, formation, fronts, cold front, warm front, stationary front) (Chapter 9, textbook; Wallace and Hobbs, Chapter 8; Vasquez Chapters 4-5)

9/19 *Air masses and fronts II* (occluded front, dry lines) (Chapter 9, textbook; Wallace and Hobbs, Chapter 8; Vasquez Chapter 5)

9/24 *Mid-latitude cyclone I* (life cycle of mid-latitude cyclones, polar front theory) (Chapter 10, textbook; Wallace and Hobbs, Chapter 8; Vasquez Chapter 6)

9/26 *Mid-latitude cyclone II* (concept of vorticity, relative vorticity, planetary vorticity, absolute vorticity, divergence and convergence, confluence and diffluence, vorticity equation, advection, surface front and upper level patterns) (Chapter 10, textbook; Wallace and Hobbs, Chapter 8; Vasquez Chapter 1)

10/01 *Review for Section 1*
10/03 **Mid-term I**

10/08 *Atmospheric moisture I* (hydroloigical cycle, water vapor in atmosphere, vapor pressure, saturation vapor pressure, mixing ratio, specific mixing ratio, relative humidity, dew point) (Chapter 5, textbook; Wallace and Hobbs, Chapter 3)
10/10 *Atmospheric moisture II* (measuring humidity, *wet-ball temperature, dew point and nighttime minimum temperature, processes affecting saturation, adiabatic and diabatic processes, potential temperature*) (Chapter 5, textbook; Wallace and Hobbs, Chapter 3)
10/15 Fall Break (no class)
10/17 *Atmospheric stability I* (dry and moist adiabatic lapse rates, environmental lase rate, lifting condensation level, static stability, absolutely stable and unstable, conditional instability, potential instability) (Chapter 6, textbook; Wallace and Hobbs, Chapter 3)
10/22 *Atmospheric stability II* (Inversion, condensation, dew and fog, etc)
10/24 *Clouds* (formation of cloud, cloud types: High, middle, low clouds, cirrus, stratus, cumulus, nimbus, etc) (Chapter 6, textbook)
10/29 *Precipitation I* (Growth of cloud droplets, warm clouds, Collision–coalescence process, cold cloud, Bergoren process) (Chapter 7, textbook; Wallace and Hobbs, Chapter 3)
10/31 *Precipitation* II (snow, rain, graupel, hail, sleet and freezing rain, measuring precipitation) (Chapter 7, textbook; Wallace and Hobbs, Chapter 3)
11/05 *Review for Section II*
11/07 **Mid-term II**

11/12 *Thunderstorms and tornados I* (basics of lightning; air mass thunderstorms) (Chapter 11, textbook; Vasquez, Chapter 9)
11/14 *Thunderstorms and tornados II* (multicell and supercell thunderstorms, downbursts, tornado formation, distribution, damage and forecast) (Chapter 11, textbook; Vasquez, Chapter 9)
11/19 *Tropical storms and hurricanes I* (structure and general characteristics) (Chapter 12, textbook; Vasquez, Chapter 9)
11/21 *Tropical storms and hurricanes II* (Conditions and steps in the formation of hurricanes, hurricane movement, landfall and dissipation, hurricane prediction) (Chapter 12, textbook; Vasquez, Chapter 9)
11/26 *Numerical weather prediction I* (Introduction to US meteorological centers, NWS, NCEP, regional weather forecast offices; general weather forecasting procedure and products) (Chapter 13, textbook; Vasquez, Chapter 10)
11/28 Thanksgiving recess (no class)
12/03 *Numerical weather prediction II* (Basics of numerical weather prediction models, procedures and products) (Chapter 13, textbook; Vasquez, Chapter 10)
12/05 *Review for final exam*
12/12 **Final Exam** (Thursday, 10:30am-1:15pm, Research Hall 121)

***Students with Disabilities***:
If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474, http://ods.gmu.edu. All academic accommodations must be arranged through the ODS.

***GMU Email***:
All George Mason students are issued an e-mail account. Students must use their MasonLive email account to receive important University information, including messages related to this class. See http://masonlive.gmu.edu for more information.

**HONOR CODE:**
Mason is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. The AOES Department strongly enforces the GMU Honor Code. Students are expected to read and adhere to the George Mason University Honor Code. **Ignorance of the Honor Code is no excuse for infractions thereof.** The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind), please ask for guidance and clarification.

**MASON DIVERSITY STATEMENT:**
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.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

The reflection of Mason's commitment to diversity and inclusion goes beyond policies and procedures to focus on behavior at the individual, group and organizational level. The implementation of this commitment to diversity and

inclusion is found in all settings, including individual work units and groups, student organizations and groups, and classroom settings; it is also found with the delivery of services and activities, including, but not limited to, curriculum, teaching, events, advising, research, service, and community outreach.

Acknowledging that the attainment of diversity and inclusion are dynamic and continuous processes, and that the larger societal setting has an evolving socio-cultural understanding of diversity and inclusion, Mason seeks to continuously improve its environment. To this end, the University promotes continuous monitoring and self-assessment regarding diversity. The aim is to incorporate diversity and inclusion within the philosophies and actions of the individual, group and organization, and to make improvements as needed.

**WHERE TO GET HELP**:
If you encounter any difficulties in this course, first contact your research advisor **immediately!** Do not wait until the end of the semester to ask for help in understanding the material in order to improve your grade - by then, it may be too late. Do not be afraid to ask for help - that is our job!

The Counseling Center is committed to improving academic and personal skills, and offers many workshops and counseling groups throughout the semester.

Make use of the many rich academic and personal opportunities available at Mason!