Atm Sci 470/470G – Tropical Meteorology
MW 11:00a-12:15p, EMS E140
Spring 2020

Instructor:	Prof. Clark Evans
Contact:	(414) 229-4469, evans36@uwm.edu, EMS W401
Office Hours:	TR 9:30-10:45a or by appointment
Prerequisites:	Passing grades in Atm Sci 351 and/or Atm Sci 360
Course Website:	https://sites.uwm.edu/evans36/atmsci470/, with grades posted to Canvas
Required Text:	None. The instructor will provide all lecture materials. I expect that you will read the relevant course material *prior* to the class when it is covered. Wrestle with the material and come to class prepared to ask questions and participate in discussions!

Course Overview

In this course, we will discuss two major themes: meteorology of the tropics and tropical cyclone meteorology. Major topics of discussion, as taken from the course description in the UWM Course Catalog, include but are not limited to the dynamics and energetics of tropical circulations; the origins and evolution of equatorial disturbances and easterly waves; the structure and dynamics of tropical cyclones; and hurricane modeling and prediction.

Learning Objectives

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

- Qualitatively *and* quantitatively describe how diabatic heating gives rise to the primary synoptic- and larger-scale tropical circulations, including but not necessarily limited to the Hadley and Walker cells, equatorial waves, monsoons, and tropical cyclones.
- Conceptually describe the physical processes responsible for tropical cyclone climatology, genesis, intensity change, structural evolution, and motion, and apply this understanding to observations and/or forecasts of observed tropical cyclone events.

Grading

For undergraduate students, your grade will be based on your performance on the following:

20% Mid-Term Exam
20% Final Exam
42% Homework (seven in total, 6% each)
18% Quizzes (six in total, 3% each)

For graduate students, your grade will be based on your performance on the following:

20% Mid-Term Exam
20% Final Exam
13% Lecture
35% Homework (seven in total, 5% each)
12% Quizzes (six in total, 2% each)

You are encouraged to discuss homework assignments with other students, *but the completed assignments must reflect your own work*! Copying answers, in whole or in part, will result in no credit. Late assignments will only be accepted if late due to an excused absence. All homework assignments are due three class meetings after the one in which they are assigned. For example, the first assignment is given on Monday, February 3 and is due in-class on Wednesday, February 12. Typically, assignments will be given on a Monday and will be due the following Wednesday.

The final exam *is not* cumulative and will cover only material discussed in class beyond that which is covered on the mid-term exam. Note, though, that fundamental concepts covered in the first half of the class are still relevant in the second half of the class, and these are fair game to be addressed on the final exam. Make-up exams are only permissible in the event of an excused absence from class, including absences for university-recognized personal matters. If you are in doubt about if your absence will qualify, please ask me ahead of time for clarification.

Six quizzes (some in-class, some take-home) of five-ten minutes in length will be given during the semester without prior announcement. Quizzes are generally not cumulative except to the extent that material later in the semester builds on material from earlier in the semester. Make-up quizzes are only permissible in the event of an excused absence. These quizzes are intended to provide you with feedback relative to your mastery of the course material and encourage the development of higher levels of learning (apply, analyze, evaluate, and create). Quizzes are graded on a "*good faith*" basis. Thus, you will receive full credit if you score ≥70% on a quiz or your actual grade if you score <70% on a quiz.

Graduate students enrolled in this course are required to prepare and deliver a short lecture on an approved topic related to the course. More details are provided at the end of this syllabus.

Grades will be assigned based on the following scale:

A 92.5-100%	**A-** 90-92.49%	**B+** 87.5-89.99%	**B** 82.5-87.49%
B- 80-82.49%	**C+** 77.5-79.99%	**C** 72.5-77.49%	**C-** 70-72.49%
D+ 67.5-69.99%	**D** 62.5-67.49%	**D-** 60-62.49%	**F** 0-59.99%

A grade of an "A" is intended to reflect *mastery* of the presented material. Grades of "B" and "C" are intended to reflect minor and major deficiencies, respectively, in your mastery of the presented

material. Grades of "D" and "F" reflect no mastery of the presented material. Minor deficiencies include incomplete attribution while major deficiencies include incorrect attribution.

Course Outline

The following outline is tentative and subject to change. The dates listed with each assignment are those on which the assignment will be *given*.

Week	Dates	Topic(s) To Be Covered
1	Jan. 22	Course Introduction
2	Jan. 27, 29	Tropical Climatology; Hadley Cell
3	Feb. 3, 5	Hadley Cell, cont.; Equatorial Waves
4	Feb. 10, 12	Equatorial Waves, cont.; Walker Circulation
5	Feb. 17, 19	El Niño-Southern Oscillation; Madden-Julian Oscillation
6	Feb. 24, 26	**Clark Travel – No Class**
7	Mar. 2, 4	Monsoons
8	Mar. 9, 11	Trade Wind Inversions; **Mid-Term Exam**
9	Mar. 16, 18	**Spring Break – No Class**
10	Mar. 23, 25	Trade Wind Inversions, cont.; Tropical Jets and Disturbances
11	Mar. 30, Apr. 1	Tropical Cyclone Climatology
12	Apr. 6, 8	Tropical Cyclone Formation
13	Apr. 13, 15	Tropical Cyclone Intensity Change
14	Apr. 20, 22	Tropical Cyclone Structure
15	Apr. 27, 29	Tropical Cyclone Motion
16	May 4, 6	**Final Exam**; Graduate Student Lectures & Course Evaluations

Mid-Term: 11 March, in class **Final:** 4 May, in class

HW #1: Kuo-Eliassen Model of the Hadley Circulation (3 February)
HW #2: Equatorial Waves (17 February)
HW #3: Madden-Julian Oscillation (2 March)
HW #4: Developing vs. Non-Developing Tropical Disturbances (23 March)
HW #5: Tropical Cyclone Genesis Forecasting (6 April)
HW #6: Maximum Potential Intensity of Tropical Cyclones (20 April)
HW #7: Sawyer-Eliassen Model of the TC Secondary Circulation (4 May; due via e-mail 13 May)

I will be absent during week 6 (24-28 February) and finals week (11-15 May) due to conference travel. I do not anticipate us making up the two missed February classes.

A Note on Course Organization and Student Success

To give yourself the best chance of success in this course, I recommend the following:

- Take detailed notes in class.

- Give yourself a day to let the concepts covered in class sit in your mind, then review your notes. Take stock of what you do not understand and formulate questions for the next class.
- Ask your questions. We develop new understanding by scaffolding it on top of our existing knowledge, using the latter to provide a frame of reference for understanding the former. Inevitably, this prior knowledge is different for each of you, just as mine differs from yours. I can best help you if let me know where you struggle when it first arises.
- Review the posted lecture notes and supplemental materials once they are posted online.
- Use low-stakes quizzes, both those given in class and those you give to yourself, to help in deepening your understanding. It particularly helps if you quiz yourself on material covered in earlier weeks – or that which you might have more difficulty with – rather than material we are currently covering or have recently covered in class.
- Homework assignments emphasize applying what you are learning to real-world scenarios, whereas exam questions emphasize extending what you have learned in new directions. As a result, I encourage you to move beyond memorizing information to deeper understanding.

Inevitably, no matter which teaching style I adopt for a given class, the information presented will be from the perspective in which either (a) I understand it best or (b) I think you will understand it best. If there's something you don't understand, that's okay! Please let me know so that I can try a different approach to best help you understand it from the best perspective for you.

Course Credit Hour Statement

This course is a three credit course. This means that this class represents an investment of time of at least 144 hours by the average student. Of these 144 hours, 45 are associated with in-class instruction and 32 are associated with the completion of course assignments. For undergraduate students, the remaining 67 hours are associated with each student's study of the course materials. For graduate students, twenty hours are associated with completion of the course project, while the remaining 47 hours are associated with each student's study of the course materials.

Departmental Regulations

Any room changes and/or course cancellations will be posted on departmental letterhead only.

University Regulations

University-Wide Rights and Regulations

The University of Wisconsin-Milwaukee has established a series of policies relating to student rights and regulations in this and all UWM-offered courses. You are encouraged to read through these policies at https://uwm.edu/secu/wp-content/uploads/sites/122/2016/12/Syllabus-Links.pdf at your earliest convenience. Please notify me if you need special accommodations in order to meet any course requirements.

Statement of Academic Misconduct

The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonestly. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors. Further information can be found at:

https://uwm.edu/deanofstudents/conduct/academic-misconduct/

Statement of Sexual Harassment

Sexual harassment is reprehensible and will not be tolerated by the University. It subverts the mission of the University and threatens the careers, educational experience, and well-being of students, faculty and staff. The University will not tolerate behavior between or among members of the University community which creates an unacceptable working environment. The policy on sexual harassment and sexual violence can be found at:

https://apps.uwm.edu/secu-policies/storage/other/SAAP%205-2.%20Sexual%20Violence%20and%20Sexual%20Harassment%20Policy.pdf

Likewise, discrimination is not tolerated by the University. The policy on discriminatory conduct can be found at:

https://apps.uwm.edu/secu-policies/storage/faculty/2847_S_47_Discr_olicy_clean.pdf

Graduate Student Lecture

In order to receive graduate credit for this course, you must prepare and deliver a lecture of up to 20 min on an approved topic related to the course. The primary deliverable from this project is the lecture, which may take any form (traditional lecture, flipped classroom, hybrid, etc.) and use any medium (whiteboard, PowerPoint, etc.) of your choosing. In addition to the lecture, you are also responsible for preparing an abstract (500-word maximum) synthesizing the key concepts covered within your lecture.

This class is designed as an introduction to fundamental concepts of tropical meteorology. In your lecture, you will go deeper into a *specific* topic (of your choosing) related to one of these concepts. I do not expect that you will become an expert capable of conducting independent research in this area, but I do expect that you will become generally knowledgeable in the topic at a level sufficient to explain it to your classmates.

Sample topics include but are not necessarily limited to:

- Self-aggregation and radiative-convective instability
- Gross moist stability in the context of tropical convection
- Normal modes and equatorial waves
- Theories of El Niño-Southern Oscillation formation
- Theories of Madden-Julian Oscillation formation
- Tropical-cyclone intensity change in moderate vertical wind shear
- Vortex Rossby waves
- Tropical cyclones and climate change
- Downstream development in response to extratropical transition

If you wish to choose a topic not listed above, please discuss it with me first. All topics are first-come, first-served, and the deadline for notifying me of your chosen topic is ***26 February***.

Preparing your lecture will involve becoming familiar with at least a subset of the literature on that topic. I recommend starting with a review paper – or, in the absence thereof, a recently published paper – on the topic and working backward from there as necessary. This does not mean that you will need to review twenty papers, as that is beyond the scope of this class and lecture. When you notify me of your chosen topic, I will help you to identify a couple of papers from which you can begin your study. By ***11 March***, you should have identified all resources that you wish to consider; please notify me of these by this date so I can provide any feedback that may be necessary.

After identifying and initially reviewing your source materials, you should draft a lecture outline, including core learning objectives, anticipated mode of delivery, and anticipated material covered. Once this outline is complete, please contact me to schedule a meeting of 30-60 minutes to discuss

this outline and any questions that may have arisen as you have reviewed your source materials. This meeting should be completed by ***1 April***.

The lecture will be given on the Wednesday of the last week of classes (***6 May***). The lecture order will be determined by a random draw in mid-April. Your abstract is due at the time of your lecture. As noted above, this abstract should succinctly synthesize the key concepts covered in your lecture. It should be written at a level that someone who has completed a tropical meteorology course but did not attend your lecture can understand, and it should be written in the style of an abstract that is found within a published manuscript.

Your lecture and abstract will be graded according to the following rubric:

- **Lecture quality (30%):** To what extent was the lecture engaging? Was the presenter well-prepared? Were they able to address students' questions clearly and effectively? Were all lecture materials of high technical quality (e.g., legible, fully explained, etc.)?

- **Abstract quality (20%):** Did the abstract adhere to the stated length, focus, and technical level guidelines? Is the writing of high quality for a scientific work?

- **Scientific content (35%):** Were the lecture and abstract scientifically accurate? If someone broadly knowledgeable in tropical meteorology were to have attended the lecture and read the abstract, would they have accurately understood the material?

- **Peer evaluation (10%):** How well did the class understand the lecture's key concepts? The class will also be asked to provide anonymous feedback about the lecture's structure and delivery; these will not factor into your grade except in extreme instances (good/bad).

- **Deadlines (5%):** Did the student adhere to all stated deadlines for the lecture and abstract?