Atm Sci 470 – Tropical Meteorology
TR 9:30-10:45a, EMS E170
Spring 2016

Instructor:	Prof. Clark Evans
Contact:	(414) 229-4469, evans36@uwm.edu, EMS W401
Office Hours:	TR 11:00a-12:15p or by appointment
Prerequisites:	Passing grades in Atm Sci 351 and/or Atm Sci 360
Course Website:	http://derecho.math.uwm.edu/classes/AtmSci470.html
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.

Grading

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

20% Mid-Term Exam
20% Final Exam
48% Homework (eight in total, 6% each)
12% Quizzes (six in total, 2% each)

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

20% Mid-Term Exam
20% Final Exam
22% Project
32% Homework (eight in total, 4% each)
6% Quizzes (six in total, 1% each)

You are encouraged to discuss homework assignments with other students, *but the actual 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, an assignment given on Tuesday, February 2 is due in-class on Thursday, February 11. Typically, assignments will be given on a Tuesday and will thus be due the following Thursday.

The final exam *is not* cumulative and will cover only material discussed in class after spring break. 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 whether your absence will qualify, please ask me ahead of time for clarification.

Six in-class quizzes of five-ten minutes in length will be given during the semester without prior announcement. As with exams, quizzes *are* cumulative. Make-up quizzes are only permissible in the event of an excused absence from class. 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). Note that 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. The benefit to learning of such a quizzing strategy is highlighted in the book *Make it Stick*, and I encourage everyone to read this book at least once.

Graduate students enrolled in this course are required to complete a short project on an approved topic related to the course. A full description of the project is 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.

Week	Dates	Topic(s) To Be Covered
1	Jan. 26, 28	Introduction, Tropical Climatology
2	Feb. 2, 4	Hadley Cell
3	Feb. 9, 11	Equatorial Waves
4	Feb. 16, 18	Walker Circulation and El Niño Southern Oscillation
5	Feb. 23, 25	Madden-Julian Oscillation and Tropical Variability
6	Mar. 1, 3	Monsoons; Trade Wind Inversions

7	Mar. 8, 10	Trade Wind Inversions; Mid-Term Exam
8	Mar. 15, 17	**Spring Break – No Class**
9	Mar. 22, 24	Tropical Jets and Disturbances
10	Mar. 29, 31	Tropical Cyclone Climatology
11	Apr. 5, 7	Tropical Cyclone Formation
12	Apr. 12, 14	Tropical Cyclone Intensity Change
13	Apr. 19, 21	Tropical Cyclone Structure
14	Apr. 26, 28	Tropical Cyclone Motion
15	May 3, 5	Extratropical Transition, Tropical Cyclone Monitoring
16	May 10	Graduate Student Presentations, Course Evaluations

Mid-Term: 10 March, in class **Final:** 16 May, 10:00-noon

HW #1: Kuo-Eliassen Model of the Hadley Circulation (2 February)
HW #2: Equatorial Waves and the Walker Circulation (16 February)
HW #3: Madden-Julian Oscillation (23 February)
HW #4: Developing vs. Non-Developing Tropical Disturbances (22 March)
HW #5: Tropical Cyclone Genesis Forecasting (29 March)
HW #6: Maximum Potential Intensity of Tropical Cyclones (12 April)
HW #7: Sawyer-Eliassen Model of the Tropical Cyclone Secondary Circulation (19 April)
HW #8: Tropical Cyclone Motion (26 April)

I will be absent during week 13 of the semester (18-22 April) due to conference travel. Missed classes will be made up at mutually agreed-upon dates and times to be announced at a later date.

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 http://www.uwm.edu/Dept/SecU/SyllabusLinks.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 http://www4.uwm.edu/acad_aff/policy/academicmisconduct.cfm.

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 discriminatory conduct, including sexual harassment, can be found at http://www4.uwm.edu/secu/docs/faculty/2847_S_47_Discr_olicy_clean.pdf.

Graduate Student Project

In order to receive graduate credit for this course, you must complete a project on an approved topic related to the course. There exist two deliverables from this project: an oral presentation and written report. In this project, you are to conduct some form of data analysis on a topic that is of interest to you that is related to the material covered within the course. Sample project ideas are provided below, although numerous other topics exist. Please note that your project may be related to but cannot duplicate work that you conduct for another class or your thesis.

The oral presentation will be given in class during the last regularly-scheduled class meeting on 10 May. The order of presentations will be determined randomly at the start of this class. The oral presentation should be of fifteen minutes in length and given in the format of that given at American Meteorological Society and American Geophysical Union conferences. Typically, this involves ~12 minutes for your presentation and ~3 minutes for questions from the audience.

The presentation should describe the key question motivating your analysis, the chosen analysis methods, key findings, and how those findings relate to previous research. Each slide should be clearly explained and legible from the back of the room. A good pacing estimate is one slide per minute. Large tables are not recommended. Figures are preferable to text, though there exist instances where several bullet points' worth of text on a slide are unavoidable. I recommend that you practice your presentation prior to giving it in class.

The written report will be due at the start of class on 10 May. Either a hard-copy or electronic version of your report are acceptable. It must be no more than eight double-spaced pages, with 10-12 pt font and 1" margins. References, figures, and tables do not count against this limit. As with the presentation, the written report should describe the key question motivating your analysis, the chosen analysis methods, key findings, and how those findings relate to previous research. I will be happy to provide feedback on your draft report if given a copy by 28 April.

Given the relatively limited contribution of the course project to your course grade, the project should be of appropriately limited scope. In other words, I do not expect publishable research to result from this project, nor do I expect it to approach the scope of the course project for my Numerical Weather Prediction class for those who have taken that course. To ensure that your project is of appropriately limited scope, please schedule a meeting with me prior to 19 February to discuss your project idea.

Your project will be graded according to the following rubric:

- **Quality of oral presentation (20%):** Did the oral presentation adhere to guidelines? How well were questions from the audience handled?

- **Quality of written report (20%):** Did the written report adhere to guidelines? Is the report of high technical quality?

- **Experimental design (20%):** Is the key question motivating the analysis clearly stated and well-posed? What data analysis methods are used to address this question? Are they appropriate to the study of the chosen topic?

- **Data analysis (40%):** Are the chosen data analysis methods applied appropriately? What are the key findings that result from the analysis? Is physically- and/or dynamically-based insight provided to connect the results of the analysis to theory? Where appropriate, are connections drawn between the findings and those obtained by previous investigators?

Sample project ideas include, but are by no means limited to, the following:

- Why did El Niño not develop during 2014 but did during 2015?

- Identifying possible connections between equatorial wave modes and tropical cyclones.

- Why did Tropical Storm Erin (2007) reintensify over land while Tropical Storm Bill (2015), despite passing over similarly moist soils, did not reintensify over land?

- What factors enabled Hurricane Alex (2016) to form well outside of hurricane season?

- Evaluation of atmospheric and oceanic predictors for seasonal tropical cyclone activity.

- Is sea surface temperature or upper oceanic heat content more closely related to tropical cyclone intensity change?

- How does tropical cyclone size relate to the rate at which it changes intensity?

- Why are annular hurricanes less common in the Atlantic than in other basins?

- Why do some tropical cyclones that strongly interact with the mid-latitude flow not exert a strong influence upon the downstream pattern relative to other such tropical cyclones?

- How accurate are satellite-derived intensity estimates of subtropical cyclones?

- How does tropical cyclone forecast intensity error vary with forecast track error?

- How reliable are SHIPS-based probabilistic predictions of rapid intensification?

- How reliable are SHIPS-based probabilistic predictions of concentric eyewalls?