ATS 742 Tropical Meteorology- Spring 2019

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Web: Class webpage is available on CSU's educational platform Canvas. Please let me know if you have trouble accessing anything on this page. Discussion papers will be posted on this site.

Class meets in ATS West 121 at 11 am-11:50 am MonWed.

Maloney Office Hours: By appointment

Contact hours: 2 (*At least 2 hours of effort are expected to complete homework and reading assignments outside of class for each hour of class time.)*

Student Learning Goals and Objectives: The successful student will gain a professional level understanding of tropical meteorology. The course material will provide a strong foundation from which students can build to make contributions to the peer-reviewed scientific literature.

Text: None. The course materials will be drawn from journal articles and lecture notes. This course will approach tropical meteorology from a decidedly large-scale perspective, with less emphasis on mesoscale aspects of tropical meteorology, although these will by necessity be brought in at points. We have a mesoscale meteorology course at the 600 level (ATS 641) and mesoscale dynamics course at the 700 level (ATS 735) that cover mesoscale aspects of tropical convective systems. Further, ATS 712 also covers tropical mesoscale systems. Hence, covering these topics here would be redundant.

The format of the class will be lecture/paper discussion. I intend to follow the outline included here. We will also spend time reading papers from the recent and seminal scientific literature and discussing them in class.

Grading: The course requirements and grading will be approximately as follows:

Participation in Paper/ Classroom Discussions: 50%
Final Paper: 40%
Broader Class Participation: 10%

Paper Discussion: Students will be expected to lead discussion of a journal article. Papers assignments will be discussed during the second week of class, as well as a list of journal articles we will cover during the semester.

Final Paper/Project: A final paper or project description of no more than 10 double-spaced pages is required. This will deal with a review of some topic of current interest in tropical meteorology, or some independent research if you prefer. Topics need to be defined and committed to by April 1. If desired, a first draft can be handed to me by April 29, during which I will make suggestions on style and content. This step is purely optional although some might find it of benefit. The final version is due at the end of finals week.

Course Outline:

Week 1: Overview: Mean distribution of meteorological variables, the seasonal cycle of the tropical atmosphere, phenomenology of the tropics

Week 2: Tropical budgets: heat, moisture, moist static energy, kinetic/potential energy

Week 3: Weak tropical temperature gradients.

Week 4: Modes of tropical convective heating and associated vertical velocity

Week 5: Modeling tropical precipitation with the moist static energy (MSE) budget

Week 6: Applications of the MSE budget to the tropical atmosphere

Week 7: Moisture and tropical convection: Observations and implications for parameterization.

Week 8: Equatorial wave dynamics.

Week 9: The Madden-Julian oscillation (MJO): observations and modeling

Week 10: MJO theory and diagnosis

Week 11: Moisture modes: Balanced disturbances and the weak temperature gradient

Week 12: MJO teleconnections

Week 13: Easterly waves: Observations

Week 14: Easterly waves: Theory

Week 15: Tropical variability and climate change

Statement on Academic Integrity
This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity) and the Student Conduct Code

(https://resolutioncenter.colostate.edu/student-conduct/code/). At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

Discussion Papers:

Week 3:

Chiang, J. C. H., and A. H. Sobel, 2002: Tropical Tropospheric Temperature Variations Caused by ENSO and Their Influence on the Remote Tropical Climate. *J. Climate*, **15**, 2616–2631.

Week 4:

Schumacher, C., R. A. Houze, I. Kraucunas, 2004: The Tropical Dynamical Response to Latent Heating Estimates Derived from the TRMM Precipitation Radar. *J. Atmos. Sci.*, **61**, 1341–1358.

Week 7:

Holloway, C. E., and J. D. Neelin, 2009: Moisture vertical structure, column water vapor, and tropical deep convection. *J. Atmos. Sci.*, **66**, 1665–1683

Week 8:

Wheeler, M., G. N. Kiladis, 1999: Convectively Coupled Equatorial Waves: Analysis of Clouds and Temperature in the Wavenumber–Frequency Domain. *J. Atmos. Sci.*, **56**, 374–399. [look at the figures on the AMS website. The PDF reproduction is poor].

Week 10:

Wolding, B. O, E. D. Maloney, and M. Branson, 2016: Vertically Resolved Weak Temperature Gradient Analysis of the Madden-Julian Oscillation in SP-CESM. *J. Adv. Modeling. Earth. Sys.*, 8, doi:10.1002/2016MS000724.

Week 12:

Henderson, S. A., E. D. Maloney, and E. A. Barnes, 2016: The influence of the Madden-Julian oscillation on Northern Hemisphere winter blocking. *J. Climate*, **29**, 4597–4616.

Week 13:

Thorncroft, C. D., N. M. J. Hall, and G. N. Kiladis, 2008: Three-dimensional structure and dynamics of African easterly waves. Part III: Genesis. *J. Atmos. Sci.*, **65**, 3596–3607.

Week 15:

Maloney, E. D., A. F. Adames, and H. X. Bui, 2018: Madden-Julian Oscillation Changes under Anthropogenic Warming. *Nature Clim. Change*, **9**, 26-33.