SYLLABUS

MET 416: TROPICAL ANALYSIS AND FORECASTING
Spring Semester 2019
Location: HIG room 310 13:30-17:30 T & R

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The purpose of this class is to acquaint you with various forecasting techniques applicable to tropical and mesoscale phenomena. For the Tropics we will discuss forecasting issues for the various planetary, synoptic, mesoscale, and convective scale features that impact society. We will also look at the southernmost U.S. because of the large amount of data available. You will learn how to apply the information from a wide range of web sites to make a forecast. You should all have had MET 302 and MET 303 or the equivalent.

A typical class will start with a lecture lasting about 60+ minutes that will provide some background for the lab. This will be followed by a preparation time (20-30 min) for the map discussions that will be conducted by a few students, with an often-animated critique by the professor. The teaching assistant will run the forecast contest. Typical locations to forecast for are Honolulu and Miami.

This course has two foci: writing intensive and oral intensive. The approximately dozen labs will constitute over 5000 words. There will be ~4 short quizzes that will have essays that will be graded on presentation as well as content. Feedback on writing style will be given for each of the labs. The lab reports (save for hand analyses) should be done on a computer and it will be necessary to provide links to the maps that you used for your analyses.

Each student will make several map briefings throughout the semester with each map briefing lasting 20 to 30 minutes. Early in the semester there will be plenty of feedback on both the scientific as well as the presentation portion of the map briefings. The last map briefing near the end of the semester will have written feedback after the entire map briefing is complete. Here we assume that you have developed a much-improved technique compared to your initial presentations.

WFO weather briefings occur downstairs at 10:30 AM each Tuesday and Friday. Please plan to attend these briefings unless you have a class conflict. Field trips to the North Shore (conditions permitting) and to a local TV station will be arranged. Guest speakers from the WFO will give special insights into forecast problems facing operational forecasters in Hawaii.

Preliminary Lecture Outline

Introduction to forecasting in the tropics

Introduction to the course	1/15
Atmospheric circulations in the tropics – scale analysis	1/17
ENSO	1/22
Atmospheric circulations in Midlatitudes –Rossby Waves and Jet streams	1/24
Overview of synoptic scale – Jet streaks & QG	1/29
Kona Lows	1/31
Ocean hazards and surf forecasting	2/5
Field Trip to North Shore	2/7
Subtropical Fronts	2/12
Heavy Rain	2/14
Flash Flooding	2/19
Downslope Windstorms	2/21
Orographic lift	2/26
Field trip to Koko Head	**2/28**

Tropical Cyclones

Radar – WSR-88d reflectivity and Doppler theory and interpretation	3/5
Environmental prerequisites for formation, synoptic climatology	3/7
Life cycle and energetics, contrast with midlatitude cyclones	3/12
Hurricane track and intensity forecasting	3/14
Hurricane structure, impacts on land, social issues in forecasts	3/28
Review and **Third Exam**	**4/2**

Tropical mesoscale phenomena

Review of mesoscale dynamics	4/4
Thermodynamic diagrams	4/9
Convection and instability	4/11
Summer trade-wind weather based on HaRP	4/16
Tornados and water spouts in Hawaii	4/18
MCS's in the deep tropics	4/23
Review and **Fourth Exam**	**4/25**

Grading

Oral Weather Briefings	25%	O
Written Lab Assignments	30%	W
Forecast Contest	15%	W
Four Short Exams	30%	W
Total	100%	

This class is *Oral Intensive*. See www.hawaii.edu/gened/oc/oc.htm. Oral weather briefings will be presented at the end of each lab period. The weather briefings and an oral research paper presentation will be critiqued and graded based on how clear, correct, and well enunciated the English is. Students must adequately complete all oral communication assignments to pass the course with a D grade or better. Forty percent of the grade depends on the oral component of this class. Students who do not complete all oral communication assignments will not earn O Focus credit.

This class is also *Writing Intensive*. See manoa.hawaii.edu/mwp/. The writing assignments fall into three categories, (i) written lab assignments (14 labs x 2 pages per lab), (ii) written sections in exams, (8 pages). Each of these will be graded for the quality of the technical writing (content and clarity), with drafts returned for revisions. Grades for each step are logged and used to determine a final writing grade for the course. Students must adequately complete all writing assignments to pass the course with a D grade or better. Students who do not complete all writing assignments will get a D- or an F and will not earn W Focus credit.

Reference Texts

1. Forecaster's Guide to Tropical Meteorology by Ramage 1995
2. Midlatitude and Synoptic Meteorology by Gary Lackmann 2012
3. Weather Analysis - Dusan Djuric, 1994
4. Atmospheric Science: An Introductory Survey, Wallace and Hobbs, 2006.
5. Severe Local Storms in the Tropics (AMS Monograph) – Gary Barnes, 2001.
6. AMS Journals online: http://ams.allenpress.com/amsonline/?request=index-html

Student Learning Objectives (SLOs): This is a capstone class in which many fundamental concepts in atmospheric physics and dynamics are reviewed to give the student a solid overview of the field of meteorology. Upon completion of ATMO 416, the student should be able to:

1. Understand weather map analysis at the surface and aloft.
2. Understand the satellite products, including the use of enhancement curves.
3. Explain the application of visible vs infrared vs water-vapor channel imagery in forecasting.
4. Understand the steps involved in creating a numerical weather forecast.
5. Explain the advantages of global models and regional models.
6. Understand the limitations and challenges of numerical weather prediction.
7. Conduct a scale analysis of the equations of motion for the tropics and contrast the result with that for midlatitudes.
8. Understand various force balances and their application in describing winds in the tropical atmosphere.
9. Explain the general circulation of the atmosphere.
10. Understand the dynamics of Rossby waves and Baroclinic instability and the interplay between the two.
11. Understand the terms in the quasi-geostrophic omega equation and it's limitation in the tropics.
12. Explain the energetics and evolution of a kona low.
13. Understand the fundamentals of wave and swell forecasting.
14. Understand frontogenesis and the structure and morphology of cold fronts and shear lines in the subtropics.
15. Understand the ingredients involved in and hazards associated with heavy rainfall and flash flooding.
16. Explain the data resources and their application in heavy rain flash flood forecasting
17. Understand the dynamics and conditions conducive for downslope windstorms in the subtropics.
18. Understand the role of orography in creating clouds, enhancing rainfall, and producing anchored thunderstorms.
19. Explain the basics of radars and the utility of radar reflectivity in weather forecasting.
20. Understand the basics of radar velocity data in weather forecasting.
21. Understand the life cycle and energetics of tropical cyclones.
22. Explain hurricane track and intensity forecasting.
23. Understand mesoscale dynamics in the tropics.
24. Understand the basics of convection and instability in the atmosphere and the use of radiosonde data to document atmospheric vertical motions and thunderstorm potential.

25. Understand summer trade-wind weather in Hawaii based on HaRP.
26. Understand the conditions conducive to water spouts and tornados in Hawaii
27. Understand MCS's in the deep tropics.

Title XI Statement:

The University of Hawai'i is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources that are in the community. Here are some of your options:

As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the campus Title IX Coordinator. Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.

If you wish to remain ANONYMOUS, speak with someone CONFIDENTIALLY, or would like to receive information and support in a CONFIDENTIAL setting, use the **confidential resources available here**:

http://www.manoa.hawaii.edu/titleix/resources.html#confidential

If you wish to directly REPORT an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence or stalking as well as receive information and support,

contact: Dee Uwono Title IX Coordinator (808) 956-2299 t9uhm@hawaii.edu.