Instructor: Sen Chiao  
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schiao@fit.edu

Course Description:  
The application of the basic laws of thermodynamics and geophysical fluid dynamics to the behavior and circulation in the atmosphere and their interaction with the ocean.

Credits: 3 hours

Weekly Class Meeting Pattern: Tu/Th lecture and discussion per week.  
Office hour: Tu/Th 1:00 to 3:00 pm. I will also try to answer emailed questions promptly.

Texts Required:  

References:
2. NAS: Coastal Meteorology, 1992  
7. Global Perspectives on Tropical Cyclones, WMO, No. TCP-38, 1995  
9. Papers in AMS journals

Lecture materials:  
The class website posts the topics and reading assignments for each lecture. Please do the reading before class. The homework assignments and labs due dates will be posted. The following list is a tentative schedule. I reserve the right to change this schedule if there is a need.

Week 1: How the ocean-atmosphere system is driven
- Introduction
- The Amount of Energy Received by the Earth
- Radiative Equilibrium Models
- The Greenhouse Effects
- Effects of Convection
- Effects of Horizontal Gradients
- Variability in Radiative Driving of the Earth
Week 2: Conservation of Thermodynamic Energy
- Equation of State
- Thermodynamic equation
- The specific Entropy
- Aspects of Moist Air
- Atmospheric and Oceanic Stability

Week 3: Mass and Moisture Conservation
- The Continuity Equation
- The Equation of Motion
- Horizontal Motion under Balances of Forces
- The Equation of Motion in Turbulent Flow

Week 4: Boundary Layer Processes and Marine boundary layer
- Current Understanding and Challenges
- The Generic Atmospheric boundary layer
- Surface interaction
- Internal boundary layers
- The inhomogeneous atmospheric boundary layer
- Boundary layer clouds

Week 5: Atmospheric Boundary Layers and Air-Sea Interactions
- The Surface Boundary Layer
- The logarithmic Wind Profile
- The Nonadiabatic Wind Profile
- The Ekman Layer
- Surface Fluxes of Momentum, heat and Moisture
- Wind Stress (Drag) coefficient over the Water Surfaces

Week 6: Thermally driven effects (Ch7 Coastal Met; Nation Coastal Data Center)
- Coastal Upwelling
- Coastal Fog
- Coastal Jets

Week 7: Tropical Dynamics
- CISK and cumulus parameterization
- Equatorial trough zone (Ramage)

Week 8: Tropical Wind systems, trade winds (Ramage) and Midterm. Turn in one page abstract of your research project.

Week 9: Regional Climate and Atlantic Hurricanes
- Exploring relationships between regional climate and Atlantic Hurricanes
- Caribbean Climate Variability
Week 10: Tropical Cyclones (WMO)
  • Structure
  • intensification and
  • dynamics

Week 11: Tropical Cyclones
  • Formation and movement
  • Convective Processes

Week 12: Monsoon
  • Monsoon Convection,
  • easterly waves
  • squall and non-squall lines

Week 13: Ocean and Climate
  • El Nino south Oscillation
  • Atmospheric Response to EL Nino heating

Week 14: Large-scale air-sea interaction
  • ENSO, MJO; teleconnections
  • Marine in situ measurements

Week 15: Final Presentations and review for final exam.

Week 16: Final exam.

**Method of Grading:**

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<th>Component</th>
<th>Percentage</th>
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<tr>
<td>Final exam</td>
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<tr>
<td>Final Project (written)</td>
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<tr>
<td>Final Project (Presentation)</td>
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<td>Paper discussion (class participation)</td>
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<tr>
<td>Homework problems</td>
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<tr>
<td>Labs</td>
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Research Project:
Each of you will conduct an independent research project on tropical atmospheric and/or oceanic phenomenon of your choice. You will present the results in a paper (minimum of 6 pages not including figures) worth 20% and an oral presentation (~ 25 minutes) worth 20% of your final grade. The paper format must follow American Meteorological Society publication guidelines. More specific guidelines will be forthcoming.

Homework:
3 to 4 homework problems will be given including computer programming exercises. All assignments are due by the end of the day on the due date. Late assignments will not be accepted unless prior arrangements have been made.

Paper discussion:
Each of you will be required to lead paper discussion throughout the semester. More specific paper lists will be forthcoming. Participating in discussion is de rigueur (15% of grade). So if you want to sit quietly or use your laptop, then don’t take this class.

Labs:
Five labs from the UCAR COMET will be given periodically.