SYLLABUS

MET 305 Meteorological Instrumentation and Observations Spring Semester 2015

Professor: Michael Bell
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Time and Location: MW 10:30-11:20 PM and F 10:30-1:30 PM in HIG 310
Office Hours: M,W 1:00 - 3:00 PM, or by appointment
First day of instruction 1/12/15, last day of instruction 5/6/15.

Student Outcomes: Understand the history, operation, and use of meteorological instruments that monitor the atmosphere, with emphasis on practical applications. Instructor will provide hands-on experience with instrumentation where possible. Modern meteorology includes a wide variety of in situ and remote sensing instruments that are designed to observe aspects of our atmospheric environment. During this course students will develop skills in meteorological instrumentation, electronics, experimental design and logistics, computer-aided data analysis, and presentation of results.

Lecture Outline
By Week
1. Introduction/Lab Reports/Course expectations
Why observations are important; the utility of practical experience; the importance of calibration, response time, and error estimation in observations. The structure of a scientific report. History of early meteorological instruments. Instrument performance.
Lab 1: Introductory lab

2. Temperature: Direct Measurement
What is temperature? How is temperature measured? Calibration; time response; ventilation.
Lab 2: Calibration of several different temperature sensors.

3. Temperature: Indirect Measurement
Introduction to radiation – radiance, black body, IR temperature sensors. Solar and Earth radiation measurements.
Lab 3: Documenting IR radiation in the environment.

4. Pressure
What is pressure? Barometer concepts and instruments. Importance of calibration.
Lab 4: Calibration and comparison of pressure sensors, analysis of data.

5. Humidity
Water, changes of state, relative and absolute humidity measurement.
Lab 5: Calibration and comparison of humidity sensors, analysis of data.

6. GPS in Atmospheric Monitoring
Ground-based and spaced based approaches and resulting data sets.
Lab 6: Statistics, calculation of variance (standard deviation), correlations, log normal dist.

7. Rainfall
Rain gauges, rain rate, placement of rain gauges.
Lab 7: Extreme value analysis and Rainstorm recurrence interval.

8. Near Surface Wind Measurement
Wind-field measurement; vector measurement; different types of anemometer and physical principles involved. Importance of time response; distance constant; sonic anemometry. Calibration and comparison of anemometers in the field, data logging, analysis of time series.
Lab 8: Variation of wind with exposure and height. Wind data analysis – wind rose plots.

9. Renewable energy
Wind and solar power.
Mid-term Take-home Exam

10. Radiosondes
Radiosonde instrumentation, calibration, deployment, ascent rates.
Lab 9: Sounding analysis – lapse rates, stability indices, wind shear.

11. Wind Profilers, Radio Acoustic Sounding Systems (RASS), Sodars, lidars.
Basic principals of remote sensing of winds and temperature aloft.
Lab 10: Geometry of profiler data

12. Radar Remote Sensing of Precipitation and Wind
Basic principles; instrumental set-up; sensitivity; wavelengths used; antenna types/sizes; radar indicators (RHI, PPI, CAPPI); approximate radar equation and what it tells us. Importance of phase (ice/liquid), particle size and shape.
Lab 11: Doppler radar – practical analysis of radar imagery.

13-14. Designing a Field Experiment. Site selection and field set-up logistics, data retrieval and analysis.
Lab 12: Field Experiment

15. Aerosols and Fugitive Dust.
Final Take-Home Exam

16. Review and Class Presentations

Instructor may modify this schedule to discuss subjects relevant to current weather events (like hurricanes) or to shuffle the order in which material is presented. The department has a limited amount of instrumentation available. Every opportunity will be made to integrate these instruments into the course with practical (hands-on) labs or demonstrations.

This class is *Writing Intensive* and uses writing to promote the learning of course materials. The hallmarks of a 'W" focus class are:

W1. The class uses writing to promote the learning of course materials.

W2. The class provides interaction between the instructor and students while students do assigned writing.

W3. Written assignments contribute significantly to each student's course grade.

W4. The class requires students to do a substantial amount of writing—a minimum of 4,000 words, or about 16 pages.

W5. To allow for meaningful professor-student interaction on each student's writing, the class is restricted to 20 students.

The writing assignments for this class fall into three categories, (i) written lab assignments, (ii) written sections in take-home exams, and (iii) written research paper. 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.

Text: Course materials will be provided for each lecture. The references below will be used by the instructor to supplement lectures.

References:
Meteorological Measurement Systems, by Fred V. Brock and Scott J. Richardson, Oxford University Press, 2001.
Instructor's Handbook on Meteorological Instrumentation, by Fred V. Brock (Editor) and Carol E. Nicholaidas (Assistant Editor), NCAR/TN-237+IA, 1984.
Federal Meteorological Handbook No. 1 (FMH-1), by OFCM, 1995.

Grading

Written Lab Assignments	50% W
Research Paper & Oral Presentation	30% W
Take-home Exams	20% W
Total	100%

Final Presentation Schedule: Monday, May 11 9:45 - 11:45 AM