ATS 650 Measurement Systems and Theory Syllabus Spring Semester 2025

Professor: Michael M. Bell
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Time and Location: MW 11:00-11:50 AM in ATS 121 West
Office Hours: By appointment
First day of instruction 1/22/2025, last day of instruction 5/7/2025.

Student Outcomes: Understand the history, operation, and use of meteorological instruments that monitor the atmosphere, with emphasis on practical applications and field experiments. During this course students will develop skills in meteorological instrumentation, remote sensing, and field experimental design and logistics. Students will obtain a theoretical and practical understanding of in situ and remote sensing instruments that are designed to observe key physical characteristics of our atmospheric environment.

Lecture Topics
The course will consist of material on in situ instrumentation, remote sensing instrumentation, and field experiment design. The final project will integrate all the material in a 'virtual' field experiment to test hypotheses and experiment design.

1. Introduction/Course expectations
Why observations are important; the utility of practical experience; the importance of calibration, response time, and error estimation in observations. History of early meteorological instruments. Instrument performance.

2. Introduction to Field Experiments and Analysis
Hypothesis development and experimental design. Data retrieval and analysis.

3. Temperature: Direct and Indirect Measurements
Thermometer concepts and instruments. Calibration; time response; ventilation.
Radiance, black body, IR temperature sensors. Solar and Earth radiation measurements.

4. Pressure
Barometer concepts and instruments. Importance of calibration and comparison of pressure sensors.

5. Humidity
Water, changes of state, relative and absolute humidity measurement.

6. Rainfall and microphysics
Rain gauges, rain rate, disdrometers, optical probes.

7. Winds
Anemometers from surface and aircraft; vector measurement; Importance of time response; distance constant; sonic anemometry.

8. GPS applications for winds and thermodynamics
Ground-based and spaced based approaches.

9. Radiosondes and dropsondes
Sounding instrumentation, calibration, deployment, ascent and descent rates.

10. Research Aircraft
Aircraft specific measurement issues

11. Passive Remote Sensing
Microwave radiometers, basics of satellite instrumentation

12. Active Remote Sensing
Wind Profilers, Radio Acoustic Sounding Systems (RASS), Sodars, lidars, and radars.

13. Field Experiments Revisited
Site selection and field set-up logistics, other considerations.

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

Class Participation	20% W
Homework	50% W
Final Project	30% W
Total	100%

We want you to be able to fully participate in the learning experience. Student resources for food, financial, and housing security; transportation; child care; health care; violence; and immigration issues are compiled at basicneeds.colostate.edu.

An additional list of student resources, which includes information on learning/accommodation resources, mental-health resources, student case management, and religious observances is at the following link and QR code: https://col.st/2FA2g