ATMOSPHERIC SCIENCES 360 Spring 2013
ATMOSPHERIC INSTRUMENTATION

Taught by: Pat Arnott. Office hours Wed 1 pm - 3 pm, RM 213 Leifson Physics.

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Course Administration: http://www.patarnott.com/atms360/ and webct.unr.edu.

Course Deliverables:
see http://www.patarnott/com/atms360/homework.html.
see http://www.patarnott/com/atms360/notes2013.htm.

Time and Place: Tues / Thurs 4:00 pm until 5:15 pm, Room 113 Leifson Physics.

Textbooks: Specific online reading material will be assigned.
1. Getting Started in Electronics by F. Mims.
2. Science and communication circuits and projects by F. Mims.

Supplementary Texts:
3. Meteorological Measurement Systems by Brock and Richardson, Oxford Univ Press.

OUTLINE:

The three objectives of this practical, hands-on course are:
1. To learn about instruments used in Atmospheric Sciences by studying and using them.
2. To learn about Atmospheric Science laboratories in Northern Nevada.
3. To unleash your creativity with respect to Atmospheric Instrumentation development.

GRADING:

Attendance and participation: 1/4th
Notebook at Midterm: 1/4th.
Notebook at Final: 1/4th.
Final Project: 1/4th.

WORK TOGETHER:

I *strongly* suggest that you work together with other students on projects and homework. Find a lab partner or group and take advantage of the synergy provided by group brainstorms.

Special Needs:

Any student with a disability needing academic adjustments or accommodations is requested to contact the instructor as well as the Disability Resource Center in Thompson Student Services107 as soon as possible to allow for appropriate arrangements.

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The general topics for this course are discussed in turn below.

1. Atmospheric instruments are needed to study climate, air quality, air motion, clouds, sunlight and infrared radiation, and interfaces such as the atmosphere with the ocean and land. These instruments measure phenomena over a very wide range of sizes from the molecular level, to the planetary scale. Measurements that are used to monitor climate must be very stable and accurate over many years so that subtle changes can be inferred. Economic and sociological decisions are likely to be made in the future based at least somewhat on the story brought forth by these instruments. We will discuss broad categories of instruments in this class covering most of these length and time scales and will also discuss remote sensing, for example, from satellites.

2. Suppose you wanted to build an instrument today. What sort of resources are available to you? Do you need to have a Ph.D. in instrument design to measure something with a tool you make yourself? Do you need a Ph.D. in computer science and electrical engineering? Well, of course it probably wouldn't hurt to have a Ph.D. in Physics and Chemistry as well. But that all takes a lot of time, and sometimes direct experience can be a helpful guide when choosing what problems you really want to work on in detail. We will go through a pathway towards instrument development and will pick a particular topic to study. For example, suppose we wanted to know how much ozone is above our heads to the top of the atmosphere. How sophisticated must we get to do this analysis? We will look at four tools to use in instrument design, mechanical layout software, electrical circuit board software, data acquisition hardware, and data acquistion software. We will also go through a basic introduction to electronics. Electronics and software are at the heart of instruments, so some familiarity with these basic building blocks will act as a spring board to learning and comfort when you someday need to look 'under the hood' of an instrument to fix it, or need to make one yourself.

3. Major instruments we will likely discuss.
a. FTIR spectrometer for measuring downwelling IR from the atmosphere.
b. Cimel sunphotometer for measuring atmospheric optical depth and aerosol size distribution.
c. MFRSR radiometer for measuring spectral direct and diffuse radiation and for retrieving aerosol and cloud optical depth.
d. Ultrasonic Anemometer.
e. NEXRAD radar.
f. ‘Standard’ weather stations like the one at the UNR farm.
g. Photoacoustic instruments for measuring in situ light absorption and scattering.
h. Become aware with the EPA criteria pollutant measurements in Reno and Sparks.