Students and observationally based research
start small, think big, and everyone wins

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Overview of observational (in-situ) education at the University of Oklahoma
Introduction

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- Highlight issues and current solutions duck tape
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- Highlight issues and current solutions duck tape
- Provide examples of links between education and research
- Touch on the future direction of our endeavors
Students

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Instructor
The benefits of using observational data in the class room can be achieved by combining course materials and personal research aspects, when appropriate, without sacrificing course goals.
Hands-on labs are the oldest component of observational education at OU (METR 3613)
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Arrived at current system of labs after decades of iteration and at least four course instructors
Lab 1

Goal

To gain familiarity with the most common circuits encountered with in-situ observational systems and the tools used to diagnose and troubleshoot them.
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- Circuits - resistors in series and parallel, and bridge circuits
- Use a digital multimeter to sample resistance, current, and voltage
- Verify Ohms and Kirchhoff’s circuitry laws
Lab 2

Goal

To gain familiarity with and address the subjective nature of the process of static calibration

- Basics of circular potentiometers
Lab 2

Goal

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- Static calibration of a wind vane
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  - Hold vane in steady position, wait for voltage output to stabilize
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To gain familiarity with and address the subjective nature of the process of static calibration

- Static calibration of a wind vane
  - Hold vane in steady position, wait for voltage output to stabilize
- Each student calculates the calibration coefficients
  - direction is related to voltage via linear regression
Lab 3

Goal

Determine if a thermistor needs to be recalibrated

- Statically compare output from two sensors (one ‘reference’, one ‘questionable’)

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Lab 3

Goal

Determine if a thermistor needs to be recalibrated

- Statically compare output from two sensors (one 'reference', one 'questionable')
- Determine errors
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Goal

Determine if a thermistor needs to be recalibrated

- Statically compare output from two sensors (one 'reference', one 'questionable')
- Determine errors
- Decide if 'questionable' sensor needs to be recalibrated
Lab 4

Goal

Investigate the response time of a thermistor

- Compare two thermistors while input is changing
Lab 4

Goal

Investigate the response time of a thermistor

- Compare two thermistors while input is changing
- Alter the time constant of one thermistor with a balloon
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Goal
Investigate the response time of a thermistor

- Compare two thermistors while input is changing
- Alter the time constant of one thermistor with a balloon
- Estimate the time constant of each thermistor
Lab 5

Goal

Determine how ‘good’ a tipping bucket rain gauge is under the best possible environmental conditions

- Compute ‘single tip’ errors
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Determine how 'good' a tipping bucket rain gauge is under the best possible environmental conditions

- Compute 'single tip' errors
- Investigate errors associated with steady rain rates
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Goal

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- Compute 'single tip' errors
- Investigate errors associated with steady rain rates
- Comment on other possible errors not addressed in the lab
Introduction
Labs
Long term projects
The next step - ILREUM
Questions

Basic electronics
Static calibration
Calibration check
Dynamic characteristics
Rain Gauges

Student Reaction

Student reaction

What's the point?
Too much work

Each lab results in a 20 page (give-or-take 5) lab report, AMS style

Great, now what? I can troubleshoot a circuit and check the calibration of a potentiometer...and?
Student reaction

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Instructor reaction

- Tweak labs

Requires students to believe us for an entire year - they are very much a now, now, now group of individuals.

Conclusion - even with 'hands-on' approach, lack of 'hear-and-now' motivation is a show-stopper.

Solution - at the risk of overloading the students, add semester long projects that include the planning, collection, and analysis of data.
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Long term projects
Long term project 1 - Sunshine

- Focus on shortwave radiation
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- 'Exposure errors' - reflection
Long term project 1 - Sunshine

- Focus on shortwave radiation
- ’Exposure errors’ - reflection
- ’Exposure errors’ - shade
Long term project 2 - Upper air

- Investigate upper air measurements
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- Calculation of basic skew–t parameters in light of sensor errors
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- Investigate upper air measurements
- Calculation of basic skew–t parameters in light of sensor errors
- Highlight open questions with regards to the radiosonde platform
Long term project 3 - Thermo/Hydro

- Focus on Temperature and Relative Humidity
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- Full deployment of sensors
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  - Assembly, Datalogger
  - Programming, deployment, data collection, take-down
- Spatial variability

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- Prompted investigation of cold pool phenomena at LTM
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- Has resulted in a conference poster, two conference talks, and a publication!
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- Has resulted in a conference poster, two conference talks, and a publication!
- Proposal in the works.
Long term project 4 - Anemometry

- Investigate exposure 'errors' in vegetation
Long term project 4 - Anemometry

- Investigate exposure 'errors' in vegetation
- ...in an urban setting
Long term project 4 - Anemometry

- Investigate exposure 'errors' in vegetation
- ...in an urban setting
- Become familiar with sonic anemometry
Long term project 4 - Anemometry

- Prompted investigation of rotor-like motions
Long term project 4 - Anemometry

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- Construction of the 'Sonic Beast'
Long term project 4 - Anemometry

- Prompted investigation of rotor-like motions
- Construction of the 'Sonic Beast'
- Interesting results
Student reaction

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- Really, really fun to get outside!
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However, the workload is perhaps a bit much ...currently taping that one, MacGyver style
ILREUM - the basics

- ILREUM - Innovative Laboratory for Research and Education in Urban Meteorology
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**Educational Applications**

- **Thunderbird Micronet**
  - Rural site with inhomogeneous terrain. Located on a slope with vegetation, and close to a lake.

- **NWC Lab**
  - Suburban site, upwind roughness depends strongly on wind direction. BL transitions can be studied.

- **MobUrb**
  - Mobile urban measurement platform that can be easily deployed in urban areas. A long-term IOP in OKC is an important component of ILREUM

**Research Applications**

- **Oklahoma Mesonet**
  - Statewide network of 115 surface meteorological stations.

- **OKC Urban Micronet**
  - Planned network of ~20 surface meteorological stations in the OKC metro area.

- **Wind-Tunnel Lab**
  - Large boundary-layer wind tunnel at the University of Hamburg, Germany. Allows studies with different idealized urban roughness configurations and realistic city models (e.g., OKC).
ILREUM - The next step
Questions?

- Innovative Laboratory for Research and Education in Urban Meteorology (ILREUM)
- Career award funded by the National Science Foundation (NSF Grant ATM054788)
- http://micronet.ou.edu/ilreum/