Teaching Wintertime Mountain Meteorology in The Mountains: An Experiential Learning Field Course in Colorado's San Juan Mountains

19th AMS Conference on Mountain Meteorology

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UCCS University of Colorado Colorado Springs

Center for Snow & Avalanche Studies

The Course:

> Wintertime mountain meteorology / microclimate
> Applied, experiential, research project-focused
> Lectures given at CSAS building; Silverton

Learning Objectives:

> To instill a fundamental understanding of the science of snowpack dynamics and assessment, as measured through snow density, structure, stability, and microclimate

> To develop an appreciation of mountain climate and weather

> To develop skills in field observation, data collection, data interpretation, writing, and public speaking.

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Course Content:

> Cold season mountain weather

> Microclimate

> Energy budget in snowpack

> Snow / snowpack properties

> Hydrology

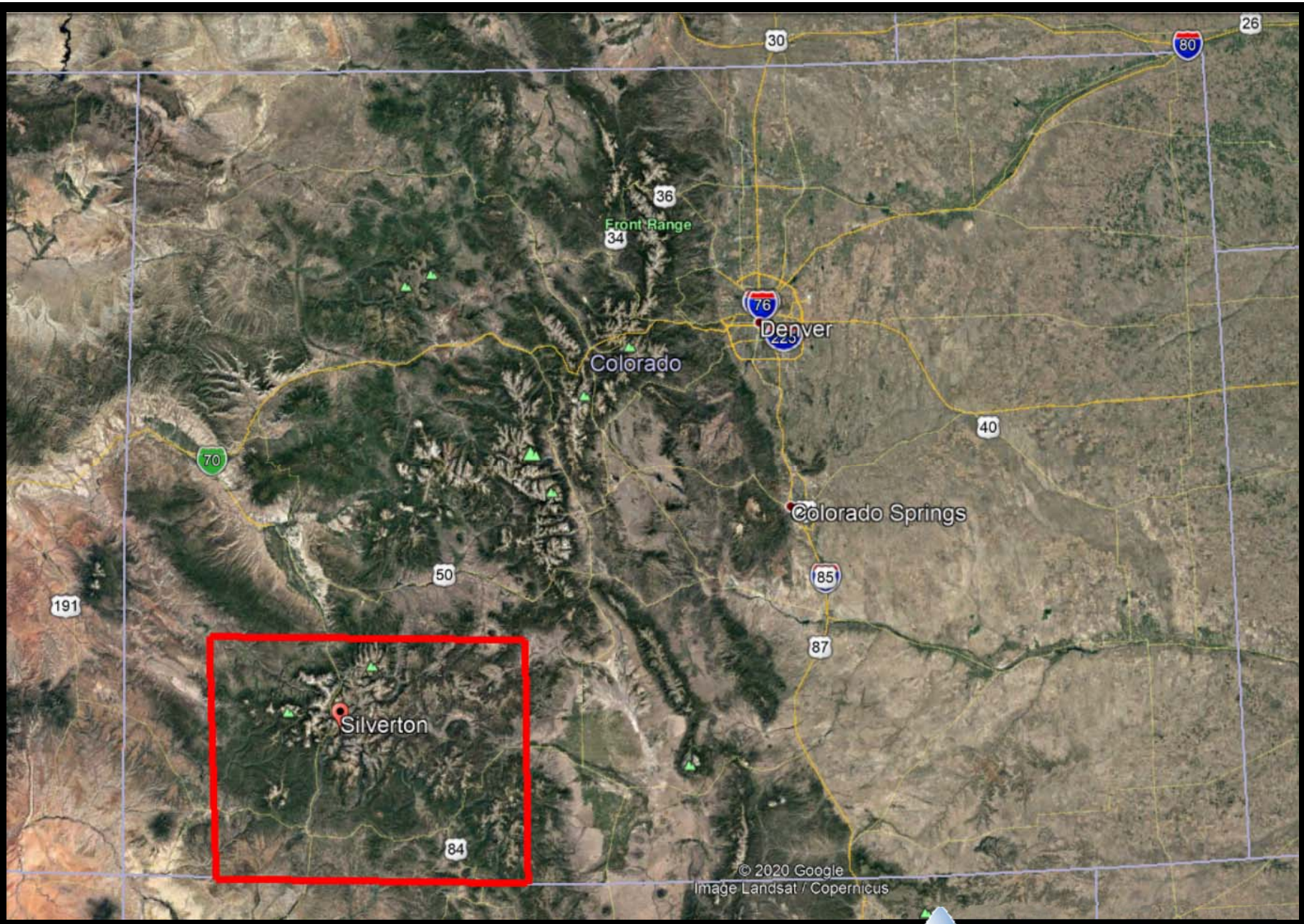
> Data collection / field methods

> Western water management

> Local environmental problems

> Hazards – avalanche / hwy maintenance

> Climate change in SW



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History of field courses in taught in Silverton, CO

- Mel Marcus, 1974 - 1997 (ASU)
- Tony Brazel, 1977 - 1999 (ASU)
- Don Friend, 1990 - 2014 (-3) (ASU > MNSU)
- Mark Hildebrandt, 2000 - 2013 (-2) (ASU > SIUE)
- Mark Fonstad, 2001 - 2003, 2005, 2010 (ASU > TX STATE > U OR)
- Collen Garrity, 2018, 2019 (ASU > SUNY)
- Me + Emily Skop, 1998 – 2003 (ASU > UCCS)
- Me, 2008 - 2020 (ASU > UCCS)

I hear and I forget, I see and I remember, I do and I understand.
Confucius, 450 BC

Tell me and I forget, teach me and I remember, involve me and I will learn. *Benjamin Franklin, 1750*

High-Impact Educational Practices (HEPs)

The Association of American Colleges & Universities (AAC&U) defines HEPs as:

1) Common Intellectual Experiences
2) Learning Communities
3) INQUIRY-BASED COLLABORATIVE ACTIVITIES
4) UNDERGRADUATE RESEARCH
5) Diversity / Global Learning (Study Abroad)
6) Capstone Courses & Projects
7) EXPERIENTIAL LEARNING
8) First-Year Seminars & Experiences
9) Writing-Intensive Course
10) Internships

From: High-Impact Educational Practices: What They Are, Who Has Access to Them, and Why They Matter, by George D. Kuh (AAC&U, 2008)

Deep Learning

... occurs when students understand the material provided, and are interested in or even passionate about extending their depth of knowledge beyond what is provided (Ramsden 1987)

... is an approach in which the student's intention is to understand the meaning (Haggis 2003)

... connects concepts and topics and spawns new ideas (Webb 1997)

The Silverton Field Experience

The course:

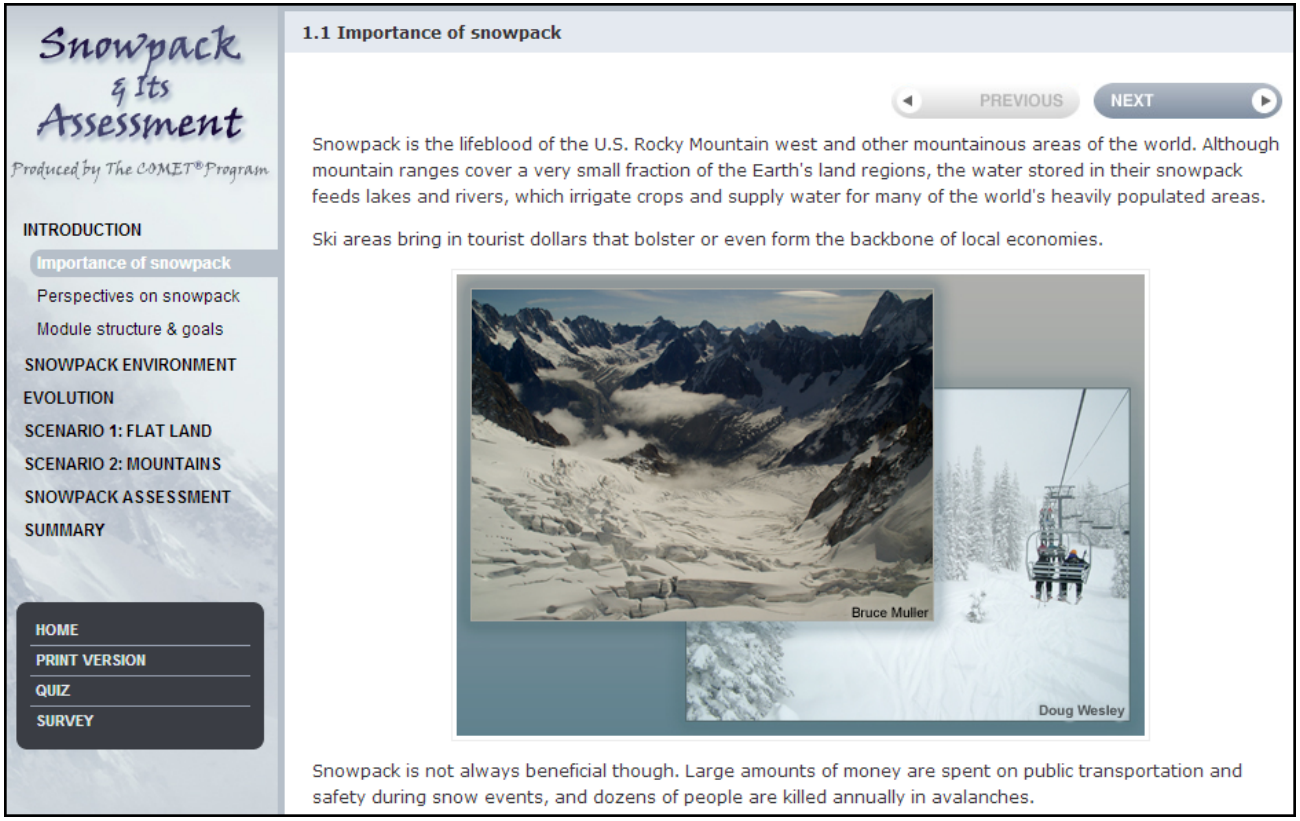
- 8 days, 7 nights
- Mid-winter / early spring
- Upper-level undergrad / graduate
- Capped at 12
- Highly structured

Course components

1. Pre-trip meeting, one month prior to departure
   - Introductions
   - **Distribute syllabus and readings**
   - **Provide research question options**
   - Collect money
   - Safety, risks, waivers, physical requirements, cold weather gear, limited medical services

Course components

2. Pre-trip online module centered on snowpack assessment



http://www.meted.ucar.edu/afwa/snowpack/

Course components

2. Pre-trip online module centered on snowpack assessment

http://www.meted.ucar.edu/afwa/snowpack/

Course components

3. Four half-days of lecture

Chris Landry, Center for Snow and Avalanche Studies (CSAS)

Jeff Derry, CSAS

Course components

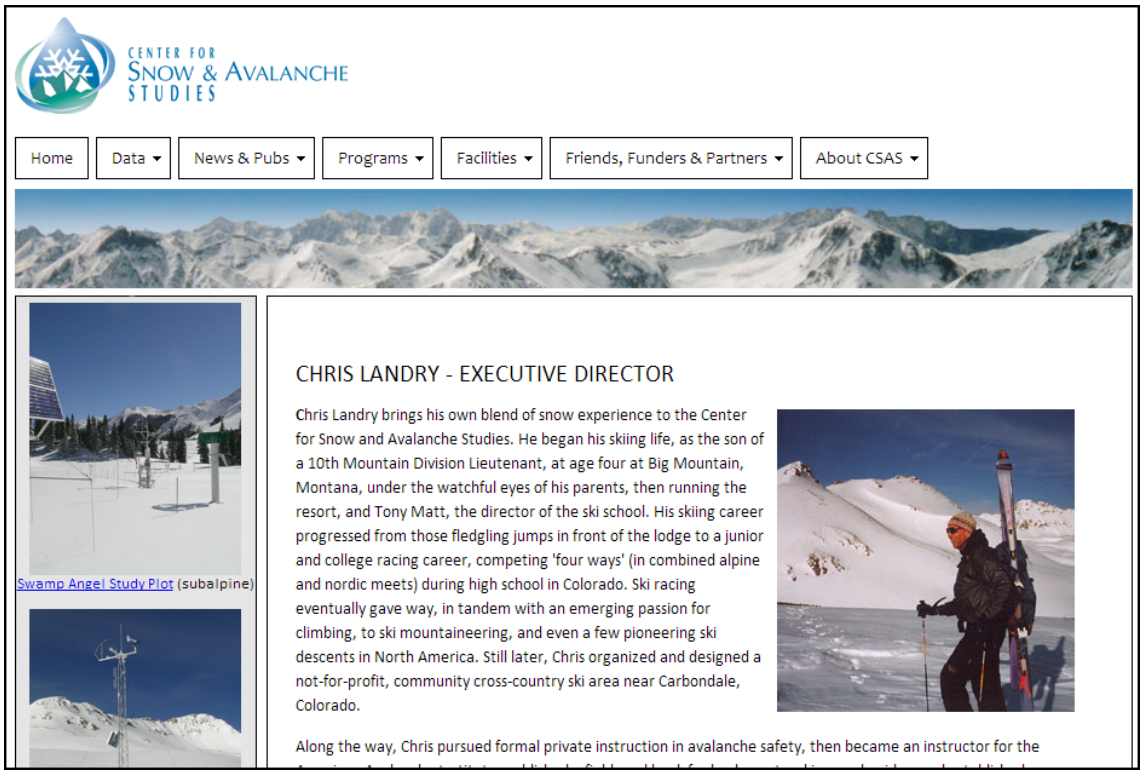
3. Four half-days of lecture

Faculty from YOUR university

Faculty from ANOTHER university

Course components

4. Four half-days of in-field data collection



Course components

5. Field excursions / lectures with local experts

Leigh Gillette, Colo. Parks and Wildlife

Chris Schultz, US Forest Service

San Juan Mountains Association

Mountain Studies Institute
SAN JUAN MOUNTAINS, COLORADO

Silverton Area Chamber of Commerce

UCCS University of Colorado Colorado Springs

Course components

5. Field excursions / lectures with local experts

Jeff Davis, Colo. Avalanche Info. Center

Kevin deKay, Silverton School

Course components

6. Hand-written 4 – 6 pg. research paper centered on single research question

Central Question - Pick One:

Human-Environment: ***What hazards, obstacles, and opportunities do avalanches and extreme weather conditions create for the town of Silverton?***

Physical: ***Why are avalanches so difficult to forecast?***

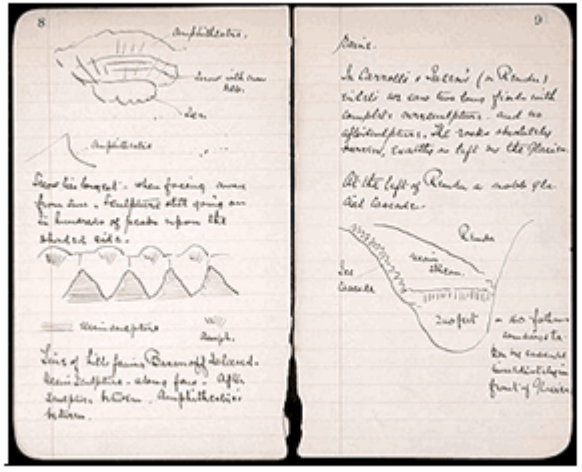
Physical: ***Focusing on climate and/or geology as driving process(es), interpret the physical landscape of the Silverton area.***

Physical: ***Using HOBO / TidBit data, SNOTEL data, personal observation, and (optionally) GIS, discuss the relationship between topography and microclimate in the Silverton area.***

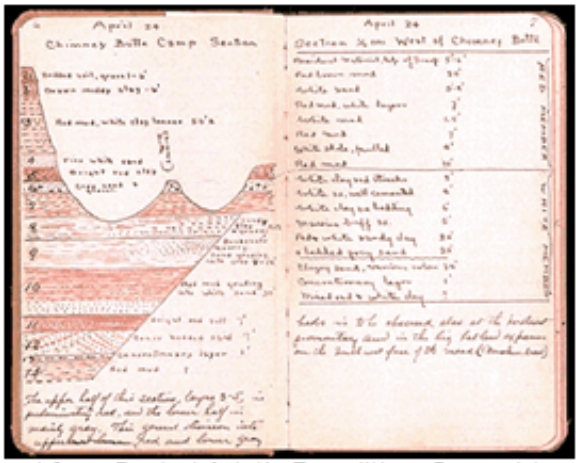
Course components

7. Daily entries into field journal, broken into
   - i) personal reflection
   - ii) data collection
   - iii) sketches, notes, from readings, lectures, activities…

Examples of How to Use Sketching in a Field Journal (www.amnh.org)



Field journal of Henry Fairfield Osborn, Alaska Trip, 1896



Field journal from Central Asiatic Expedition. Opened to page with color sketch of stratigraphy, "Chimney Butte Camp Section"

Course components

8. Journal article summary with instructor

Learning Objectives: To gain experience interpreting and summarizing relevant information from professional papers.

Task: Pick a favorite paper from Section 1 of your readings list. Read the material carefully and critically and be prepared to summarize its contents to your instructor. Also, be prepared to answer specific questions about the material, such as:

- What is the main message of this paper?
- How can this paper help you answer your research question?
- What is the research question?
- What are the research methods used?
- What are the results?
- What are the conclusions?

The brief (5 min. or so) discussion between you and your instructor represents **5%** of the course grade. You will be graded on how well you summarize your reading and on how you answer the instructor's questions about the various research components of the paper.

Course components

9. Build and sleep in Quinzee, a three-day process

Course components

10. Daily readings (reinforce / support daily activities)
    - journal articles
    - book chapters
    - newspaper excerpts
    - Silverton area climate summaries, weather forecasts, NWS discussions
    - CAIC weather summaries / avalanche forecasts
    - Review CSAS current meteorological data

Course components

2019 Required Readings

Section 1: Journal Articles and Book Excerpts

Barry, R. C. 2008. *Mountain Weather and Climate*. Cambridge U Press, New York, NY. 401–407.

Benedict, A.D. 1991. *A Sierra Club Naturalist's Guide: The Southern Rockies*. San Francisco: Sierra Club, 1-8, 18-21, 132-148.

Guido, Z.S., D J. Ward, and R.S. Anderson. 2007. Pacing the post-Last Glacial Maximum demise of the Animas Valley glacier and the San Juan Mountain ice cap, Colorado. *Geology*, 35(8): 739-742.

Marsh, B. 1987. Continuity and Decline in the Anthracite Towns of Pennsylvania, *Annals of the Association of American Geographers,* 77(3): 337-352.

Painter, T., A. Barrett, C. Landry, J. Neff, M. Cassidy, C. Lawrence, K. McBride, and G. Farmer, 2007. Impact of disturbed desert soils on duration of mountain snow cover, *Geophysical Research Letters,* 34.

Reifsnyder, W.E. 1980. *Weathering the Wilderness.* Sierra Club Books, San Francisco, CA. 60-69, 90-98.

Steenburgh, W., K. Redmond, K. Kunkel, N. Doesken, R. Gillies, J. Horel, M. Hoerling, and T. Painter. 2013. "Present Weather and Climate: Average Conditions." In Assessment of Climate Change in the Southwest U.S.: A Report Prepared for the National Climate Assessment, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 56–73. A report by the Southwest Climate Alliance. Wash., DC: Island Press. ***(in Canvas)***

Section 2: Data, Brochures, and Technical Reports

Colorado Avalanche Information Center (CAIC) website: https://avalanche.state.co.us/

CensusViewer.com (Moonshadow Mobile, Inc.). 2010. Silverton, CO Population: Census 2010 & 2000 Interactive Map, Demographics, Statistics, Quick Facts. /city/CO/Silverton (13 Dec. 2012).

Derry, J., M. Lilly, G. Schultz, and J. Cherry. 2009. Snow Data Collection Methods Related to Tundra Travel, North Slope, Alaska: 2009. National Energy Technology Lab, Arctic Transportation Networks Project Report GWS.TR.09.05. **(*in Canvas*)**

Logan, N. 2004. Snow Metamorphism: The Force Behind our Ever-Changing Snowpack. Colorado Geological Survey *Rock Talk* (excerpt), 7:3.

Tremper, B. 1994. Simple Snow Stability Tests. *The Avalanche Review*, 13:2. ***(optional - in Canvas)***

US Department of Agriculture. 2003. Natural Resources Conservation Service National Water and Climate Center SNOTEL (SNOwpack TELemetry) Brochure.

US Department of Agriculture. 1959. Snow Survey Sampling Guide, Handbook No. 169. **(*in Canvas*)**

Western Regional Climate Center. 2010. Silverton, Colorado 1981 - 2010 period of record general climate summary – temperature and precipitation.

Section 3: Newspaper and Magazine Articles

Best, A. 2010. The Cost of Dusty Snow. *Mountain Town News*, 13 November.

Maye, R. 2014. Highway Linking Ouray, Silverton Reopens After Rockfall. *The Gazette*. June.

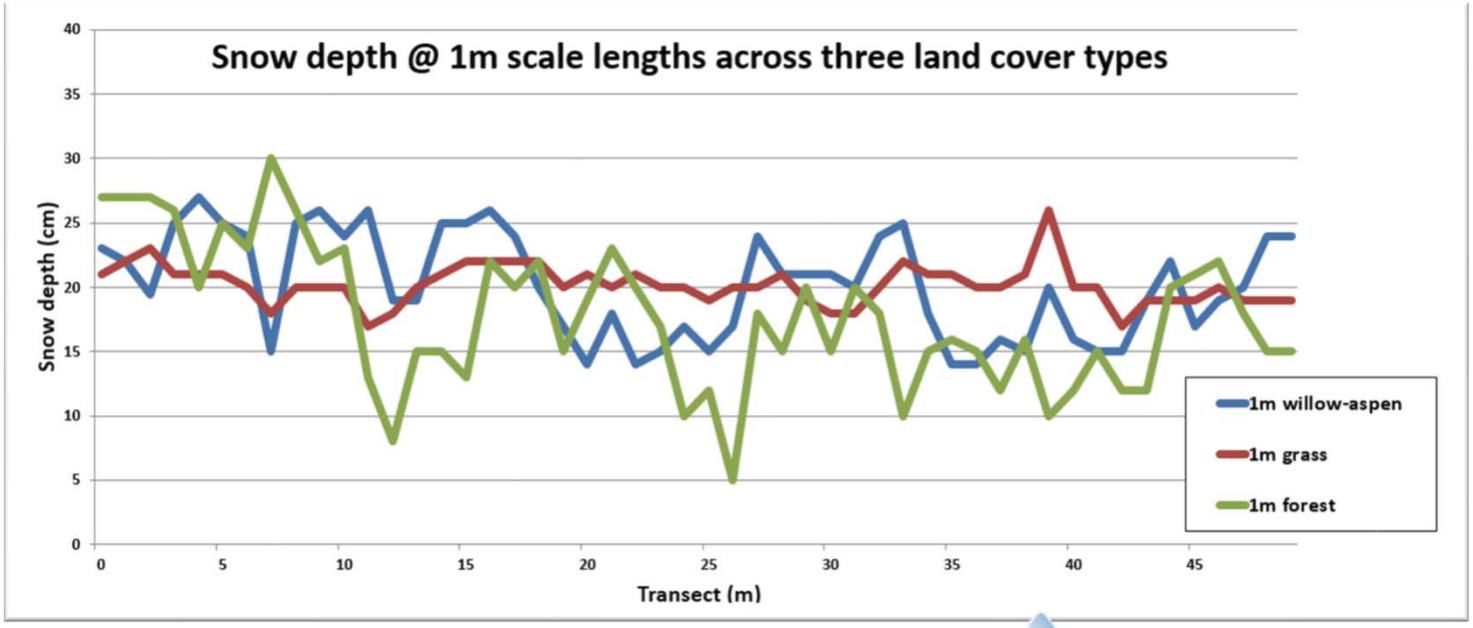
Odell, R. 2008. Go Sell it on the Mountain. *5280*. January.

End of document

Course components

11. Labs

– Variation of snow properties across three different landcover types at different scale-lengths; HOBO temp. / RH data along transects; snow depth vs. ground complexity; SWE results by core sampler: Federal vs. Adirondack, snowpack temp. at varying depth



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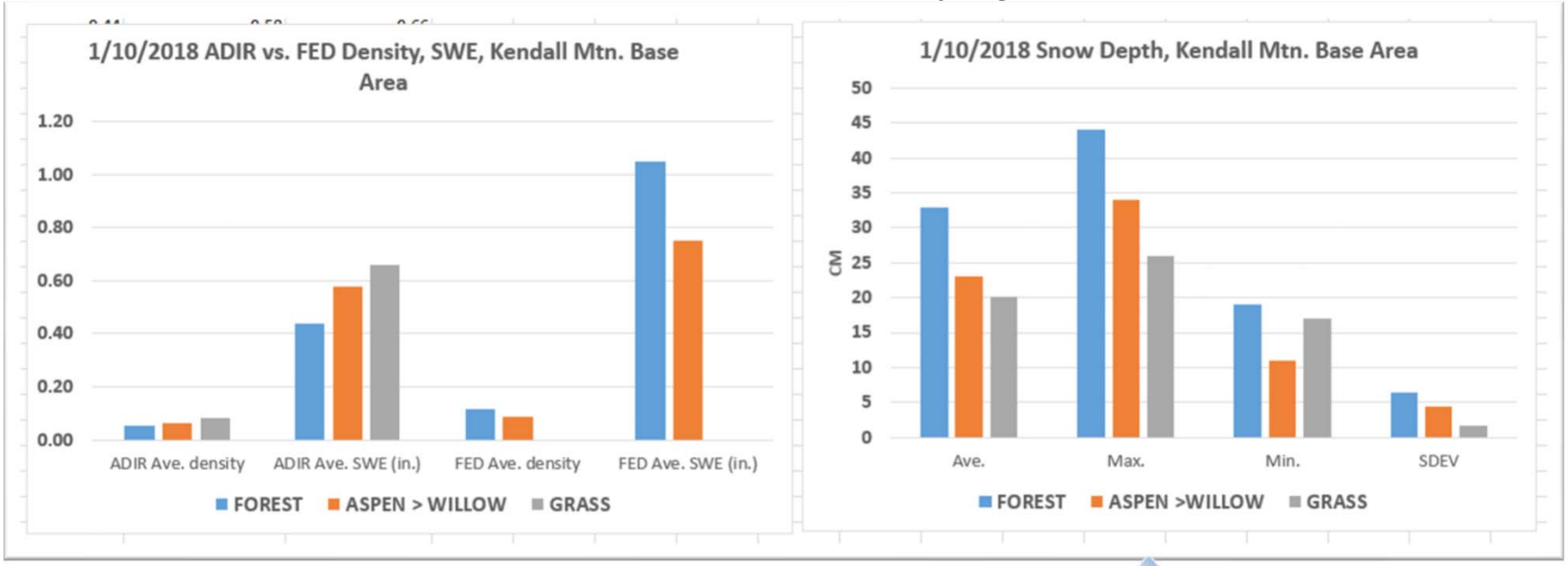

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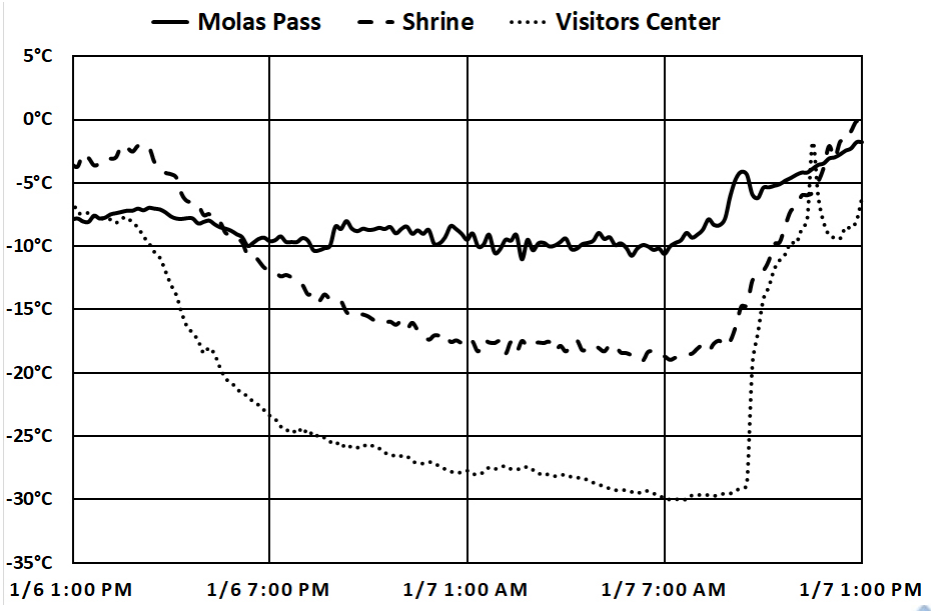

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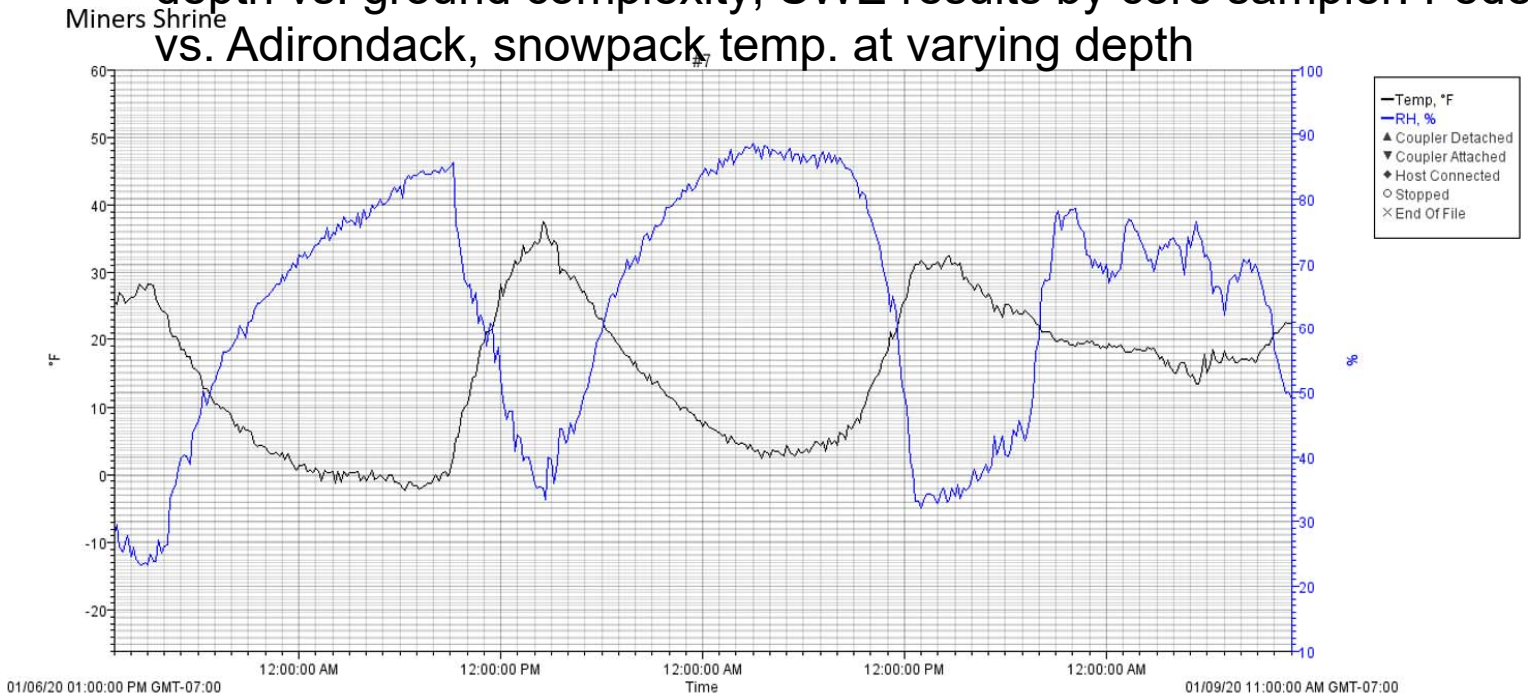

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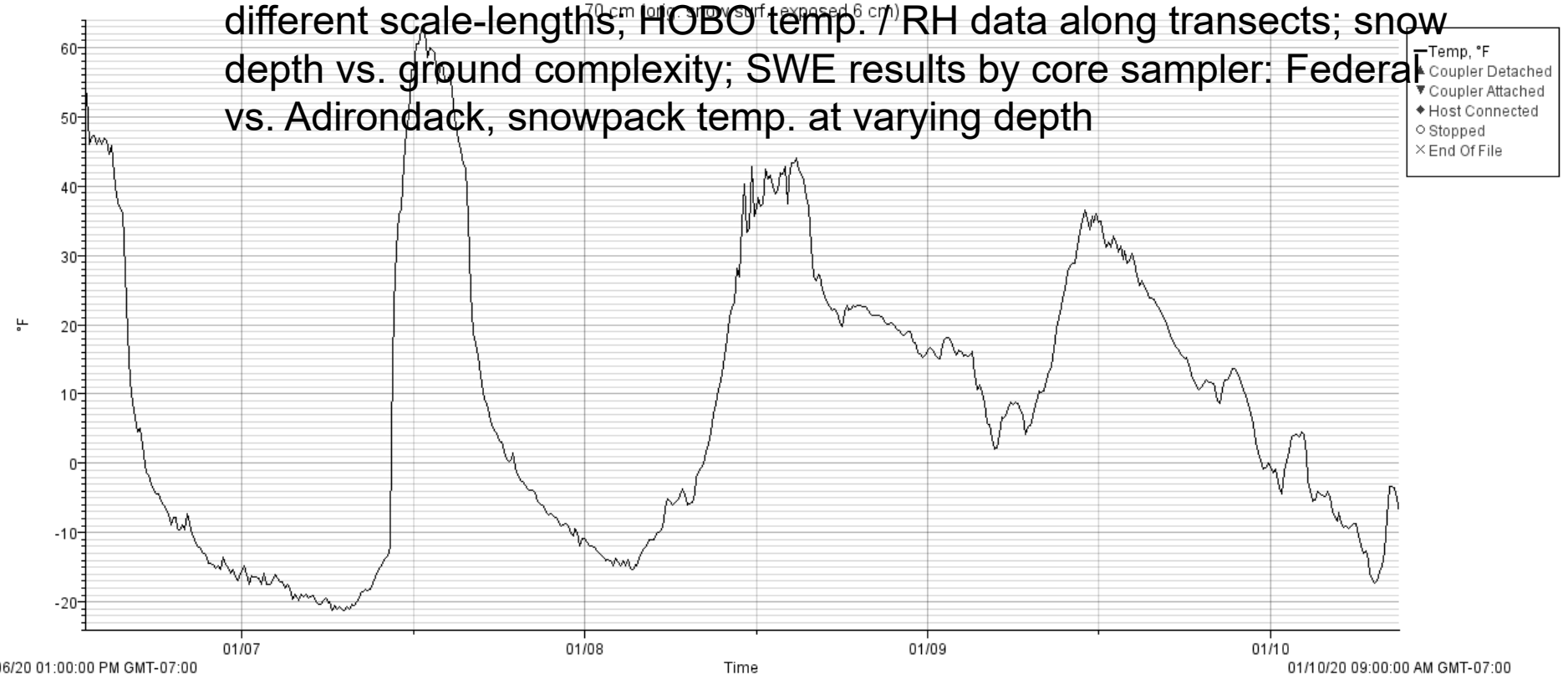

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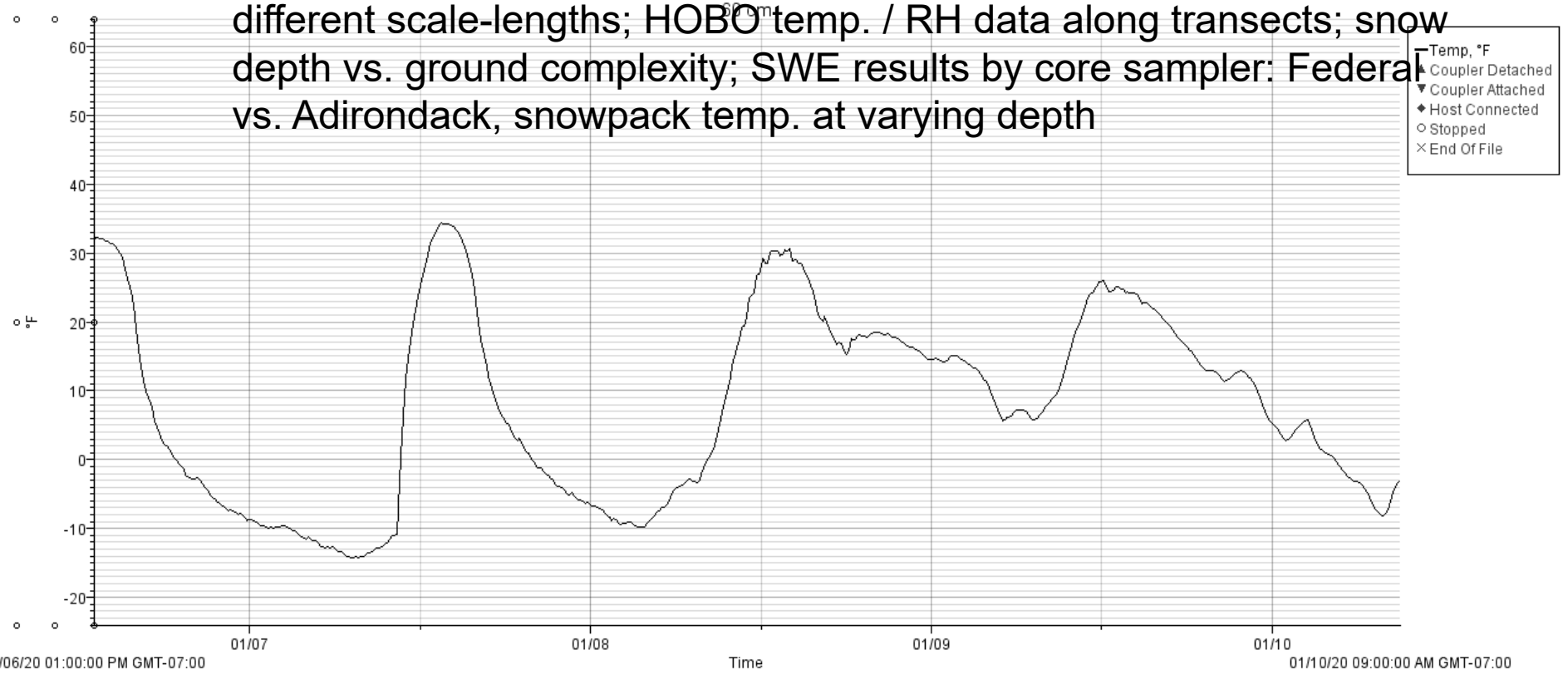

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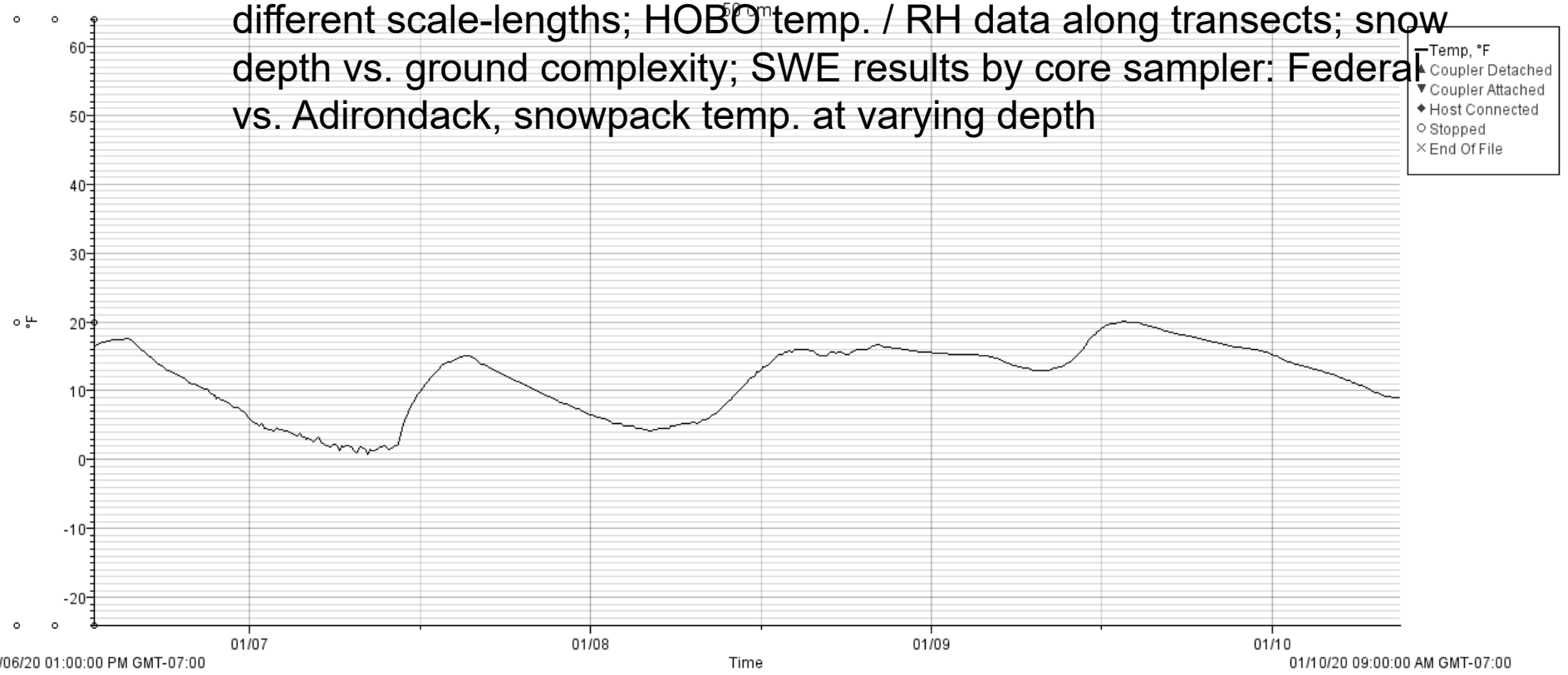

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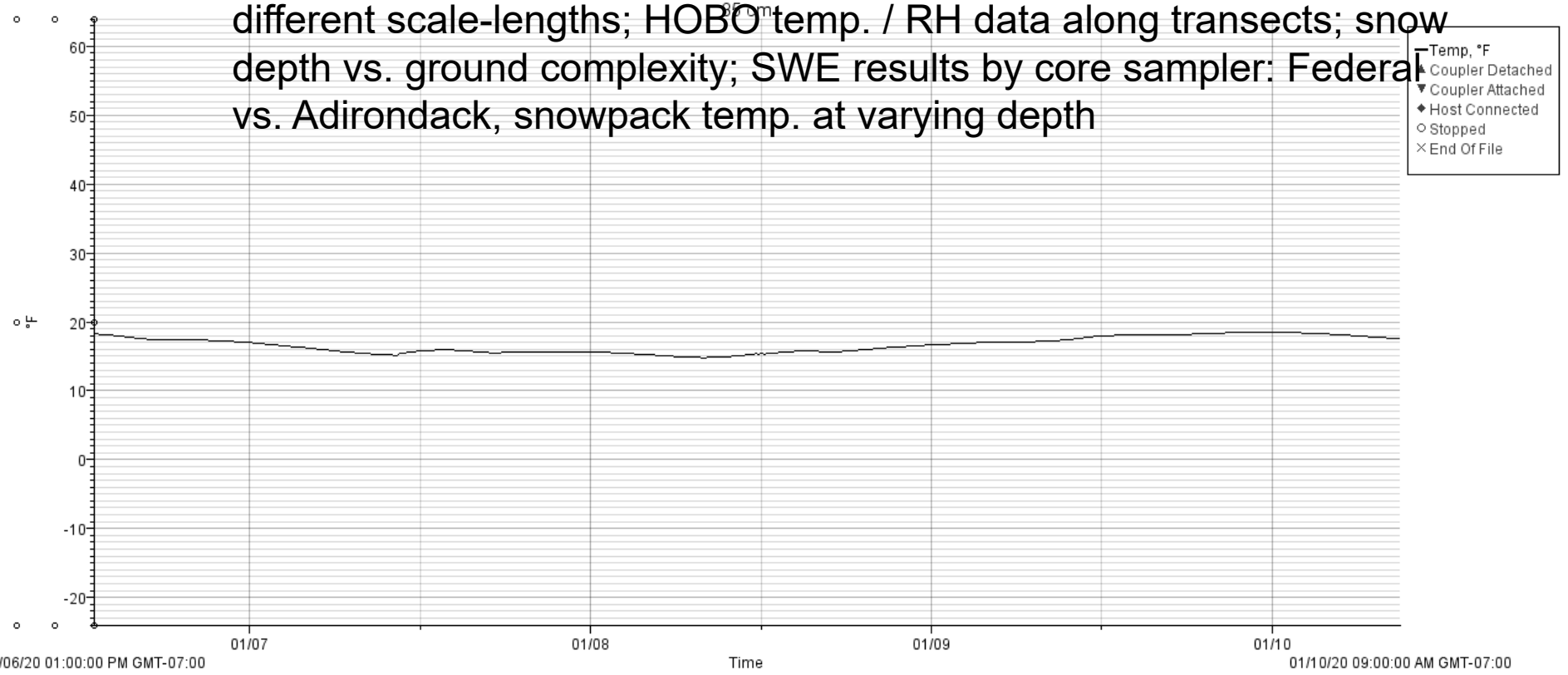

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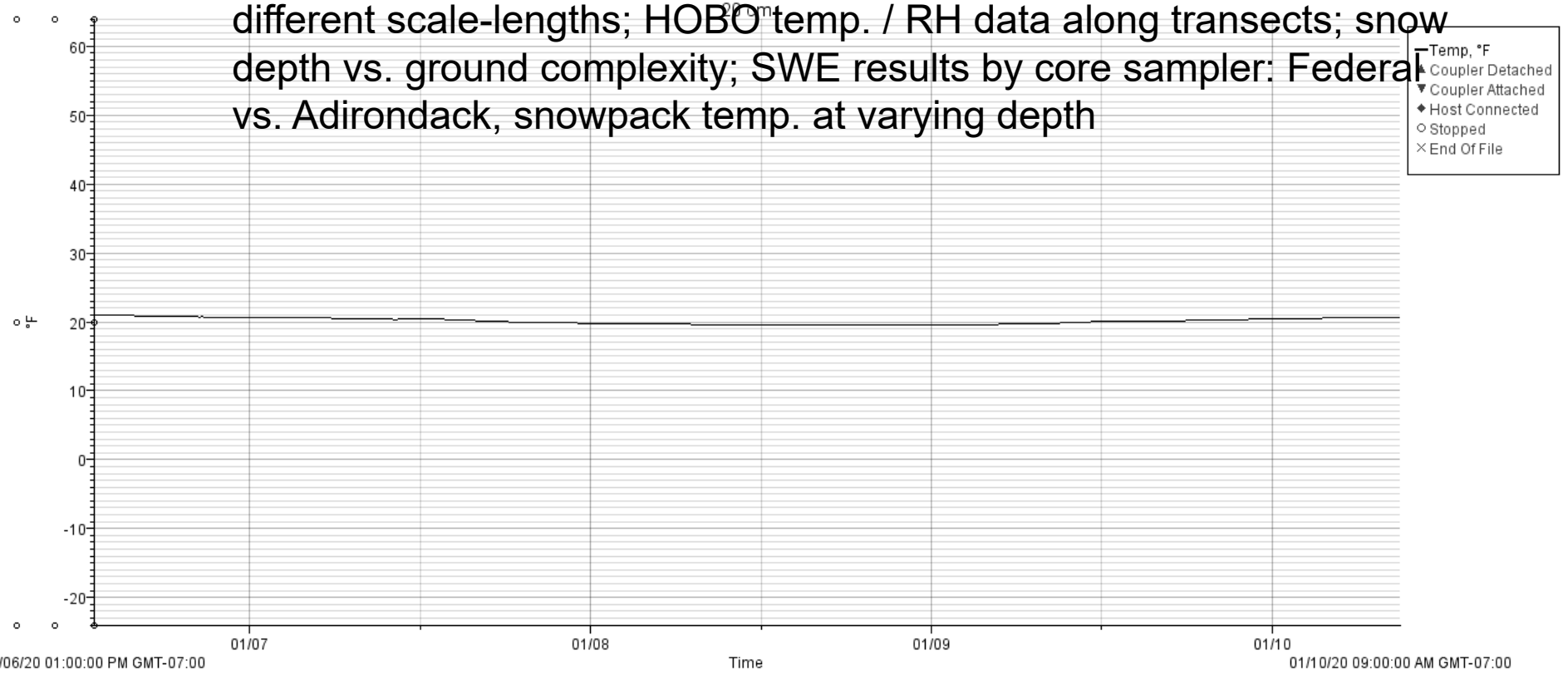

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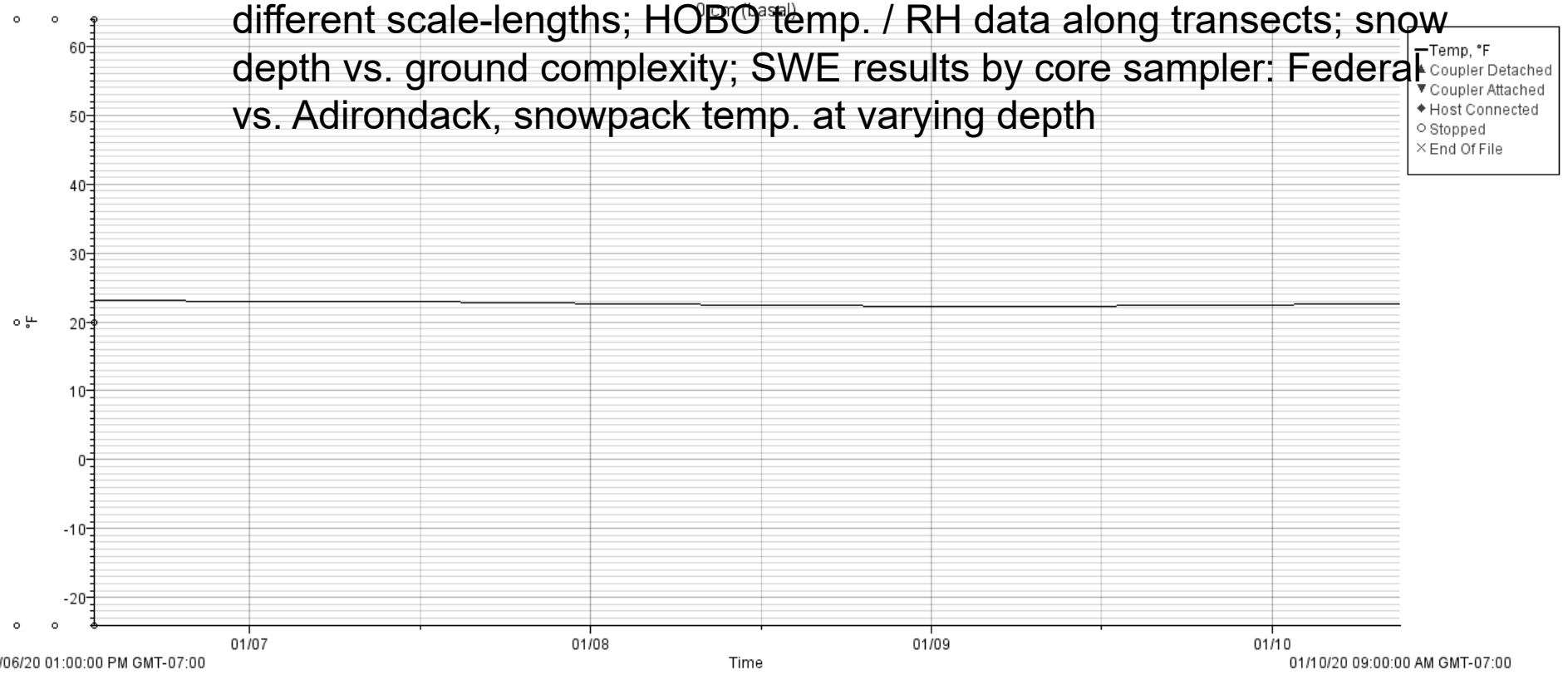

Course components

12. Oral presentation to the class *and to members of the Silverton community*
    - students present the answer to their research question

Course components

Grading

- Central Question Essay and Presentation (50%): Each student will answer a central question in 1) a 5-6 page handwritten essay and 2) a 5 minute oral presentation.

- Field Journal (40%): Daily entries will include field observations, definitions and interpretations from readings, notes from speakers, questions for speakers, and drawings/diagrams

- Journal Article, Report, or Book Excerpt Synopsis (5%): Each student will summarize one-on-one with the instructor any paper from Section 1 of the readings list.

- Course Participation (5%): Students who actively participate, regularly ask questions, are well-involved in the group dynamic, follow the 'Safety and Behavior' conditions earn these points.

Course fees

$800 / student

- 7 breakfasts / 7 dinners
- Lodging in Silverton 7 nights
- Transport. / fuel – 3 rental vehicles / one week
- Speaker fees / field support services
- Course materials

Course evaluations

How much learned (1 – 6)	Course Overall (1 – 6)
Silverton Field Studies ave. = 5.9	Silverton Field Studies ave. = 6.0
Geography Dept. ave. = 5.2	Geography Dept. ave. = 5.2
School (LAS) ave. = 5.2	School (LAS) ave. = 5.1
UCCS ave. = 5.0	UCCS ave. = 5.0

To be clear

This type of course may not always enhance education positively:

> reinforce stereotypes of a place
> course fees + equipment
> physical disability = difficulty
> personality conflicts
> Univ. liability issues
> miss work, family responsibilities

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