

**AOS 401**

**Spring 2013**

**2 credits**

**Topics in Meteorology: Orographic Storms Laboratory**

M 2:25-3:15 pm AOSS 1411

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Office Hours: TTh 1:15-2:15 pm or by appointment

Web page: <https://learnuw.wisc.edu/> (login with your NetID to access course)

**Course Materials**

*None required for purchase, but books are on reserve at the SSEC Library (3<sup>rd</sup> floor AOSS)*

*\$150 course participation fee*

**Course content**

The objective of this course is to gain hands-on experience in observation of atmospheric phenomena related to orography (mountain meteorology). You will gain practical experience in preparing a project proposal, conducting research in the field, and reporting on results. The field experience takes place at the Storm Peak Laboratory (SPL) in Steamboat Springs, CO from the Friday morning before Spring Break (Mar 22, 2011) through Saturday evening during Spring Break (Mar 31, 2011).

**Grading**

Proposal presentation and review – 20%

Participation – 60%

Final report and presentation – 20%

**Course Structure**

There are three components to this course: preparation of a proposal prior to the trip, conducting research at SPL, and reporting your findings. Prior to Spring Break, class time is devoted primarily to an overview of the logistics of the field experience, the instrumentation available at SPL, and to brainstorming research ideas. The instructor will provide advice and assistance with fine-tuning research ideas, though the primary responsibility for coming up with a project rests with you.

First-draft research proposals are due about one month before departure to SPL. Each student's proposal will be peer-reviewed by three other students and also by the instructor. The comments received back from the reviewers (due back one week later) will be used to improve the proposal. The second-draft proposals, due one week after the first-draft, will then be emailed to SPL staff for additional review and comments, usually with respect to the availability or capabilities of the instruments the student proposes to use. Final proposals are due about one week before departure, at which time students will each give an informal 8-minute presentation of their proposed research to their classmates. Students are encouraged to develop plans for assisting each other on mutually complementary projects.

Upon return to Madison, class meetings will be by arrangement. Your primary remaining responsibilities will be to complete the analysis of your data, prepare a research paper in journal format, and make a conference-style 10-minute oral presentation of your findings. Details on the format and due date of the paper and presentation will be provided.

## Course Calendar

Week 1	1/28	Introduction to SPL
Week 2	2/4	NO CLASS (possible guest lecture, TBD)
Week 3	2/11	Instrumentation at SPL
Week 4	2/18	Mountain meteorology lecture
Week 5	2/25	Proposal writing
DRAFT PROPOSAL DUE FRI 2/29		
Week 6	3/4	Proposal revision
REVIEWS DUE FRI 3/8		
Week 7	3/11	Trip preparation
REVISED PROPOSAL DUE FRI 3/15		
Week 8	3/18	Proposal presentations, depart for SPL FRI 3/22
Week 9	3/22-3/30	FIELD PROJECT!
Week 10	4/1	NO CLASS
Week 11	4/8	Post-trip discussion
Week 12	4/15	Data analysis
Week 13	4/22	Work on papers and presentations
Week 14	4/29	Paper review
DRAFT PAPER DUE FRI 5/3		
Week 15	5/6	Presentations
FINAL PAPER DUE FRI 5/10		
NO FINAL		

## Accommodation Policy

Campus policy: "We believe in the right of all students who are enrolled at the University of Wisconsin-Madison to full and equal educational opportunity. Disability should not be the basis for exclusion from educational programs. All students are entitled to an accessible, accommodating, and supportive teaching and learning environment. ... Students are expected to inform faculty, in a timely manner, of their need for special instructional accommodations."

Students requiring class accommodations due to a learning or physical disability must present documentation from the McBurney Disability Resource Center (<http://www.mcburney.wisc.edu/>) in the first week of class. Accommodations will be made in consultation with the McBurney Center.

Students who require temporary accommodations due to medical or psychological reasons should acquire documentation from University Health Services. Counseling is available from Counseling Services, University Health Services (<http://www.uhs.wisc.edu/>).

## **Logistics (adapted from Dr. Grant Petty's AOS 401 wiki)**

### **About Storm Peak Laboratory**

The Storm Peak Laboratory (SPL) was established as a cloud physics research facility in 1981 by Randy Borys of Colorado State University. In 1995, the ad hoc system of trailers was replaced with a permanent facility located not on Storm Peak itself but rather on nearby Mt. Werner. After Prof. Borys accepted a position at the Desert Research Institute (DRI), management of the facility transferred to DRI as well. SPL is staffed by Dr. Gannet Hallar (SPL Director) and Ian McCubbin (Site Manager).

SPL is located at an elevation of 10,500 feet (3,200 meters) above sea level and within the boundaries of the world-class Steamboat ski resort. Wintertime access to SPL is via three successive ski lifts, starting near the base of the ski area at an elevation of about 6,900 feet. Most visitors and SPL staff return to the base by skiing down, though transport by snowmobile is possible when needed. There is power and internet (including WiFi) in the lab, but no external water supply. Water for washing is obtained from melted snow during the winter and is trucked up in the summer. Potable water is always carried up.

A wide variety of research instruments operate either continuously or intermittently at the lab. Most are devoted to aerosol measurements, atmospheric chemistry, cloud physics, and solar radiation. More details can be found at:

[http://www.stormpeak.dri.edu/SPL\\_home\\_page.html](http://www.stormpeak.dri.edu/SPL_home_page.html)

One of the important missions of SPL has been educational outreach. Each year, SPL hosts a number of small groups of students ranging from 5th grade to graduate level, exposing them to the process of taking and analyzing scientific measurements of the atmosphere.

### **Costs**

Beyond the \$150 course participation fee, additional costs to students for the trip include:

- Ski equipment rental, around \$100
- Meals during travel to and from Madison and SPL
- Incidentals, such as offsite meals, snacks for the road, sunscreen, etc.

Costs covered by AOS include:

- Hotel for overnight stay on the way to SPL
- SPL usage fees, lodging, meals during stay at SPL, and lift tickets
- Vehicles and fuel

### **Pre-Departure**

Early in the semester, each student who plans to help with driving must submit a Driver Authorization Form to the AOS Main Office. It takes time to process these, so they **MUST** be submitted several weeks prior to departure. Students with out-of-state drivers licenses must have their forms notarized prior to turning them in. Once the authorization has been granted, each driver's name should turn up in the data base accessed at:

<http://riskinfo.bussvc.wisc.edu/DrAuth/DriverAuth.aspx>

## **Things to bring from Madison**

Note that all of your items will have to be transported to SPL via a snowmobile. Please be considerate and pack as light as possible.

- Snow boots
- Thermal socks
- Wind- and water-resistant insulated jacket
- Wind- and water-resistant insulated snow pants
- Sweater (wool or other insulating material such as fleece)
- Warm hat, neck covering, very warm gloves
- Ski goggles and/or good sunglasses
- Thermal underwear top and bottom (not cotton)
- Long-sleeved shirts
- Comfortable long pants
- Indoor warm slippers
- Pajamas, underwear, etc
- Towel and washcloth
- Basic toiletries (shampoo, toothbrush, toothpaste)
- Swimsuit (if you want to visit the Hot Springs Pool in town)
- Notebook and pen
- Any additional instrumentation and spare parts you will need
- Your research planning documents and any supporting information you need (instrument or software instructions, etc)
- Optional -- Ski, snowboard or snowshoe equipment
- Money for Incidentals
- Water Bottle
- Tennis Shoes
- Cell Phones – numbers will be collected by the instructor and forwarded to Dr. Hallar

Bedding will be provided at the Laboratory - do not bring sleeping bags.

If needed, there is a pharmacy at the same supermarket (City Market) where we will shop for groceries on arrival.

## **Departure**

Departure is usually at approximately 7am on the Friday morning prior to Spring Break. Students and instructor meet at the AOSS loading dock. Typically, we take two vehicles with about four passengers in each one; unneeded seats are removed to make room for luggage. We drive from Madison to Colorado on Friday, arriving around 9-10 PM, and staying in a hotel that is paid for by AOS. The following morning, we leave for Steamboat Springs and arrive early afternoon. Because driving conditions can deteriorate severely in bad weather at high altitude, it is advisable to monitor conditions and be ready to take an alternate route if needed.

The first order of business on arrival is rent ski equipment before meeting SPL staff in the afternoon. We will stay in a hotel in downtown Steamboat Springs that day to help acclimate. The next day, cargo and groceries will be transported to SPL via snowcat; students, instructor, and SPL staff will don skis and proceed to the nearby lift to ascend to SPL.

## **Living and Working at SPL**

Space is quite limited for sleeping and storage. Do not expect much privacy. There are two bunk rooms, one with three bunks, the other with six. When possible, one room will be used for female residents, the other for male, but mixing may be necessary depending on the ratio. There are two bathrooms, each equipped with a sink and a toilet. The sink uses water obtained from melted snow and pumped out of canisters. Water must be regularly replenished.

There is a small commons area with modest kitchen and dining table. The kitchen includes a refrigerator, microwave, stove/oven, toaster oven, and latte machine.

There is very good WiFi access. Students are encouraged to bring laptops to aid in acquiring and analyzing data.

## **Altitude**

SPL is located at 10,500 feet altitude, where ambient air pressure is approximately 70% of that at sea level. Almost everyone feels at least minor effects of the altitude shortly after arrival, especially when combined with fatigue from the long drive. Typical symptoms on the first and second day can include lethargy, headache, lightheadedness, and even minor nausea. Some of these symptoms are intensified by dehydration, which occurs very rapidly in the thin, extremely dry air at SPL -- be prepared to drink about one-half ounce of water per day for every pound of body weight. For example, someone weighing 180 lbs should plan on drinking 90 ozs., or a little less than three quarts of water (or equivalent), per day.

If you feel any of the above symptoms, your first action should probably be to drink a glass or two of water, followed by aspirin or other pain reliever as needed. Don't be afraid to go to bed early, but expect to sleep somewhat poorly the first night.

For most people, symptoms of altitude will subside after the first day. Very occasionally, someone might experience acute altitude sickness requiring medical attention and removal to a lower altitude -- please don't ignore severe symptoms!

Another consequence of the altitude is that the boiling point of water is reduced to about 89 deg. C, or 192 deg. F. Cooking of some foods will take noticeable longer because of this difference.

## **Skiing**

Skiing is the preferred mode of transportation, both to reach SPL between lift runs and to return to town as needed. Many students are not proficient skiers when they arrive at Steamboat Springs but nevertheless manage to get around well enough. Some students may choose to get some ski practice in at one of the local ski hills such as Cascade Mountain, Tyrol Basin or Devils Head before leaving for Steamboat. We may try to arrange a class ski day.

Upon arrival, SPL staff will help identify ski routes that are more forgiving of beginners. If you find that you cannot confidently and safely ski well enough to get to and from SPL and other critical locations, then SPL staff will provide snowmobile transport as needed, usually limited to one or two passengers maximum per trip.

To reach SPL from the base, three lifts are required. In each case, you must ski a fair distance from the exit of one lift to reach the beginning of the next. The topmost lift shuts down early in the

afternoon (around 3:30), so it is essential to plan your arrival at that lift with plenty of time to spare, otherwise you may be forced to hike the long final stretch to reach SPL! Details on the closing times of the essential lifts will be given by SPL staff upon arrival.

### **Meals**

Typically, visitors are responsible for preparing breakfast and lunch individually. Dinners are usually prepared by one visitor for the whole group (see chore list, below). It is important to work out menus for all meals in advance so that ingredients can be purchased on arrival.

### **Rules**

The following rules of conduct (safety, collegiality, etc.) apply

1. Obey all rules of the ski area (e.g. do not ski out of bounds or too fast; observe "rules of the road" -- e.g., downhill skiers have the right of way).
2. Students **MUST** return to the lab by 3pm (last lift). Otherwise it is a **LONG** hike back up to SPL!
3. Any alcohol consumption by those over 21 must be done responsibly and in moderation.
4. Perform all assigned chores (see below)
5. Noise should be kept down after 10 PM.
6. Always wear proper shoes when climbing the ladder to the deck.

### **Chores**

There are seven chores that will be rotated among the visitors on a daily basis:

- cooking dinner
- washup and cleaning after dinner
- toilet cleaning
- water replenishment
- breakfast and lunch dishes
- emptying trash
- evening weather briefing

Details of these chores will be explained by SPL staff on arrival.

### **Laundry and hygiene**

The group can travel to town via skis or snowmobile to the parked vans and then drive to a local gym with hot springs where we can enjoy the pools and take a shower -- bring swimwear and personal items. Admission is around \$11, and a towel can be rented for about a dollar. There is also a laundromat near the gym. We will probably go to town on Tuesday or Wednesday and then shower again on Saturday morning prior to departure from Steamboat. It takes a lot of time, so it cannot be an everyday event or they will not be able to finish their research project.

In between trips to town and during lulls in bathroom use (e.g., when fellow students are outside working on their projects), you might want to take advantage of opportunities to sponge down with your washcloth to help keep you feeling reasonably fresh.

### **Evening activities**

In the evening after the weather briefing, board games and movies are always popular. Students may want to bring DVDs. There are quite a few already at the lab. The lab also has decks of cards.

## **Sleeping**

Bunks are small and closely spaced. Bedding is provided in the form of two sheets, a blanket, and a pillow case. Storage for personal effects is extremely limited. Foam earplugs may be helpful for those who are easily disturbed by snoring and/or by the sounds of people coming and going.

## **Research**

The primary purpose of the SPL field experience is of course to undertake a research project. You will likely discover that the conditions and equipment capabilities you planned for are not quite the ones that you actually find when you arrive, so it is quite normal to revise, sometimes quite substantially, your research plans to adapt to the new reality. The important thing is to have made *substantial* headway on a *non-trivial* research project by the time you leave. The instructor will not "ride herd" on you -- how you organize your time while there is up to you, as long as you achieve that goal.

Your instructor will be available to advise on science objectives and methods as needed. SPL staff will provide assistance with specific instruments and with obtaining current and/or historical data.

## **Weather Briefings**

One of the evening activities will be a weather briefing given by one of the students. These briefings will help the group plan for the next day's activities. In addition, a systematic daily record of the weather conditions compiled and distributed to the group will assist students in their research writeups after their return to Madison.

The student preparing the briefing should provide a written weather summary, following a standard template in Word format, to the instructor, who will compile them into a single weather summary document after SPL.

## **Tentative Field Schedule**

FRI 3/22	6:30 am	Depart Madison from AOSS building loading dock
	8 pm	Arrive Boulder, CO
SAT 3/23	8 am	Tour NCAR Mesa Lab
	11 am	Depart Boulder, CO
	2 pm	Arrive Steamboat Springs, rent skis, purchase items
	3 pm	Meet SPL staff
	evening	Stay in town
SUN 3/24	8 am	Depart for SPL, SPL tour/orientation, instrumentation usage
MON 3/25		Conduct research at SPL
TUE 3/26		Conduct research at SPL
WED 3/27		Conduct research at SPL
THU 3/28		Conduct research at SPL
FRI 3/30		Wrap up final research at SPL, clean up
	3 pm	Depart SPL
SAT 3/31	12 pm	Arrive in Madison, unload