

Juneau Icefield Research Program 2016 ENVS 496: Earth System Field Science

Dates: June 24 – August 20, 2016
Locations: Juneau, AK - permanent research camps across the Juneau Icefield - Atlin, BC
Website: JuneauIcefield.com

Format: Eight-week, seven-days a week, intensive field course
Credits: 6 semester credit hours
Faculty: 24 visiting and resident faculty from North American and European Colleges and universities

Contacts:

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This eight-week, intensive field course is co-offered by the University of Alaska – Southeast (UAS) and the Juneau Icefield Research Program (JIRP).

COURSE DESCRIPTION

This is an upper-division, **8-week field course** in Earth system science, with emphasis on field science, concepts in glaciology, and the integrated systems of the northern Coast Mountains. Students will conduct original research and learn safe expeditionary practices while traversing the extreme environment of the Juneau Icefield. This course emphasizes field observations, research project design and participation, use of a variety of instruments for data collection, and learning through relevant demonstrations, problem sets, pertinent lectures and discussions led by JIRP faculty at nunatak camps and research sites across the Juneau Icefield. Disciplinary academic areas include: glaciology, geophysics, geochemistry, alpine ecology, geomorphology, science communication, remote sensing, atmospheric science, bedrock geology, hydrology, glacier travel, and training in expeditionary organization and leadership.

LEARNER CHARACTERISTICS

Participants who will gain most from JIRP and ENVS 496 are those who dedicate themselves fully to the expedition and embrace JIRP's three foci of learning. Co-founder and long-time director Dr. Maynard M. Miller began each season with a simple equation:

$$S = xy^2$$

Where *S* is success, *x* is innate talent and *y* is effort. Dr. Miller's point was that it is the *effort* we put into tasks that determines success. So it is with the JIRP experience, and with life in general.

JIRP academics have long been built on the three points of the Emersonian Triangle: 1) Books, 2) Nature and 3) Action. *Books* represent learning from those who have come before us, *Nature* is our greatest teacher, but it takes *Action* (Involvement) to learn. At JIRP we believe strongly – and now have 70 years to back this up – that it is involvement, integration in research, immersion in Nature, and collaboration in a wilderness, expeditionary setting that brings about a transformative educational experience. While on the Juneau Icefield, different day-to-day activities often bring about foci on the *Experience*, the *Curriculum*, and/or the *Research* of JIRP. Each of these components is equally important, and the participants who embrace each will gain the largest rewards from their summer.

PREREQUISITES

The most important prerequisite is a demonstrated desire to broaden one's scope of academic interest in the sciences, to achieve an understanding of Earth systems, and to participate fully in an expeditionary field course. The JIRP curriculum primarily targets upper-level undergraduate students, but is appropriate for recent graduates, students beginning graduate school and high-achieving and older high-school students. Crossing the Juneau Icefield, and carrying out field studies in an extreme environment requires a significant physical effort. Participants must be fit enough to carry heavy loads across rough surfaces on foot and skis. While some ability on skis is preferred, it is not a prerequisite.

EQUIPMENT

To safely cross the Juneau Icefield and to enable full participation in JIRP, participants must come with all items on an extensive equipment list: <http://juneauicefield.com/program-details/>. Upon arrival in Juneau, equipment checks will be completed for each participant. This equipment list has been developed and continually refined over many decades of experience on the Juneau Icefield, and as such is tailored to help the participant successfully and comfortably cross the Juneau Icefield and fully participate in JIRP. If you have questions regarding the JIRP equipment list, please be in touch with JIRP Program Manager, Deb Gregoire: deb.jirp@gmail.com.

COURSE DETAILS

The academics of the JIRP focuses on three components, each with an equal emphasis: **1) Experience, 2) Curriculum** and **3) Research**. The JIRP experience – an eight-week traverse of the Juneau Icefield and all its component parts – is a transformative experience and as such is a key component of the field course. This includes less-quantifiable, but no less important educational experiences such as collaboration with a group in a wilderness setting, full-time access to faculty and graduate student mentors, and an immersive experience in a challenging and inspiring landscape. The JIRP curriculum includes the series of field activities, lectures, problem sets, and group activities focused generally on the natural systems of the northern Coast Mountains and specifically on the role of glaciers within it. Each year, curriculum content is shaped in part by core research areas in which

each participant will be embedded. In 2016, JIRP will have six core research areas. Each of these core research areas includes a number of specific group projects that will be further developed with respect to student interest. Each participant will collaborate on the design and help conduct a project in one of these core research areas, but can expect to have exposure to each project area.

1. Experience: The JIRP experience of traversing the northern Coast Mountains across the Juneau Icefield, while engaging in a rigorous academic program, and collaborating with fellow expedition members is a primary focus. On any given day this might include traversing on skis to the next camp, exploring a nearby ridge in assistance of a botanical research team, serving as an assistant camp manager, taking part in a camp-based group project, practicing advanced crevasse rescue techniques, or perhaps washing laundry and catching up on some academic reading. The day-to-day experience of JIRP includes the challenges, the excitement, the realities, the strain, and the camaraderie of living and working in a wilderness environment. Participants will gain much from the richness of JIRP life; upon returning home, this is what you will miss most. Immerse yourself in the JIRP experience!

2. Curriculum: The JIRP curriculum focuses on the glaciers of the Juneau Icefield within the integrated Earth systems of the northern Coast Mountains. The content of the curriculum is guided by and helps to support the core research areas (see below). As JIRP is a field-based course, much of the curriculum delivery is hands on and in the field. Other delivery methods – particularly when faced with inclement weather – include camp-based lectures, group exercises, discussions, and problem sets. The JIRP faculty strives to make the curriculum as immersive as possible, meaning that participants are learning by doing as much as possible.

- *Core topics to be included in the JIRP 2016 curriculum:*
 - Glacier Mass Balance
 - Geophysics
 - Geobotany and Ecology
 - Isotope Geochemistry
 - Biogeochemistry
 - GPS Surveying
 - Science Communication
 - Satellite Remote Sensing
 - Photogrammetry
 - Glacial Geomorphology
 - Meteorology
 - Climatology
 - Bedrock Geology
 - Hydrology
 - Expedition Logistics and Leadership
 - Glacier Travel and Crevasse Rescue
- *Science communication:* A growing component of the JIRP curriculum – and of vital importance in science in general – is science communication. Science communication in the context of JIRP should be understood to address and span a wide array of audiences (the research community, your peers, and the general public) and media (scientific papers, publically accessible blogs, public presentations, and posters for scientific conferences). A focus early in the summer will be increasing proficiency in reading, understanding, and evaluating scientific

literature. Participants will be involved in a series of science communication lectures and activities that will lead to the following deliverables:

1. **The JIRP Blog:** Each participant will be required to contribute **at least two blog posts** during the Program. At least one of these must have a science focus, while the other may have a focus on expedition life.
 2. **Public Presentations in Atlin:** Each research team will be required to deliver a public presentation in Atlin, BC. These are short-format (~6-8 minutes), oral presentations completed as a team.
 3. **Open House in Juneau:** Upon return to Juneau at the end of the Program, each research team will organize a display for an informal, public event at the Mendenhall Glacier Visitor Center.
 4. **Final Paper or Poster:** Group projects will be synthesized into either a final, short-format paper or poster intended for an academic audience.
- **Final Exam:** In the months following JIRP 2016, but before the culmination of the Fall 2016 semester, each participant will be required to complete a final, written, open-book exam.

3. Research: Each JIRP participant will be a member of one of six core research groups. For 2016 these include 1) Glacier Mass Balance, 2) GPS Surveying, 3) Geophysics, 4) Geobotany and Ecology, 5) Isotope Geochemistry and 6) Biogeochemistry. While participants will be fully involved in one research area, every participant will have the opportunity to gain exposure to each. All research is done in groups and with the guidance of two to four faculty leaders. Participants will receive further information on these project areas upon arrival in Juneau. To become familiar with the 2016 research possibilities, *please read the six, one-page overviews of these research areas that accompany this syllabus.*

In addition to these six core research projects, participants will have the opportunity to be involved with a number of additional “*demonstration level*” projects. These will afford hands-on learning opportunities, and the potential for working on mini-projects with JIRP faculty. For JIRP 2016, these projects will include terrestrial and aerial photogrammetry, repeat photography, surface reflectance, bedrock geology, and dendrochronology activities.

- **Primary deliverables for the research component of JIRP:**
 1. **Public presentations** in Atlin and Juneau
 2. Completion of either a **group paper or poster**

In recent years, a majority of JIRP research groups have co-authored poster presentations at the Fall Meeting of the American Geophysical Union (AGU). Indeed, in 2015, most of the JIRP participants were co-authors, and over half attended AGU! While not required as a JIRP “assignment”, this is a fantastic opportunity and one we highly encourage participants to be involved in. We plan to once again target AGU, or other relevant conferences, for poster presentations of JIRP research. The faculty leads of the six research projects will spearhead this effort. **To be listed as a co-author, however, you must be a member of AGU. If you would like to take advantage of this opportunity, please join as a student**

member prior to arriving in Juneau: <https://membership.agu.org/students/>

ASSESSMENT OF STUDENT PERFORMANCE AND GRADING

Students are evaluated on criteria that measure academic and expeditionary participation and performance. Of significance are group collaboration, project design contributions, curriculum participation, data collection and organization, analysis of data, and quality of presentations. Teamwork is fundamental to successful project completion; participants typically must maintain contact and interaction after the field season to complete project reports, and conference presentations if applicable. The overall course mark will be determined as follows:

- Participation in the JIRP field program 50%
- Evaluation of group report or poster of independent research 30%
- Evaluation of final examination 20%

FACULTY

JIRP faculty members participate in the program on a number of different levels. *Academic leads* (of which there will always be one) guide the overall trajectory of JIRP academics and research in the field, but also contribute as lecturers and research mentors; they are present for two to three weeks each. *Visiting Faculty* members contribute as project leads, research mentors and lecturers; they are also present for two to three weeks each. *Guest Lecturers* join the team for one to three days, and contribute as lecturers and research mentors. *Research Assistants* are present for the entire program and have a joint role as staff members. JIRP 2016 faculty members, along with their roles, research areas and institution affiliations are listed in alphabetical order below.

- Dr. Jason Amundson (*Guest Lecturer, Geophysics, U. Alaska - Southeast*)
- Billy Armstrong (*Visiting Faculty, Glaciology, U. Colorado*)
- Dr. Polly Bass (*Faculty, Geobotany and Ecology, Alaska Pacific University*)
- Dr. Matthew Beedle (*Academic Lead, Glaciology, U. Northern BC/Northwest Community College*)
- Dr. Lucas Beem (*Visiting Faculty, Geophysics, U. Texas*)
- Annie Boucher (*Research Assistant, Science Communication, U. Maine*)
- Dr. Megan Buzby (*Visiting Faculty, Data Analysis, U. Alaska - Southeast*)
- Dr. Catharine White (*Visiting Faculty, Geobotany and Ecology, Northwest Community College*)
- Dr. Cathy Connor (*Guest Lecturer, Geology, U. Alaska - Southeast*)
- Dr. Alison Criscitiello (*Visiting Faculty, Geochemistry, U. Calgary*)
- Dr. Sarah Fortner (*Visiting Faculty, Biogeochemistry, Wittenberg U.*)
- Kate Harris (*Guest Lecturer, Expedition Planning, KateHarris.ca*)
- Uwe Hoffmann (*Research Assistant, GPS Surveying, U. Applied Sci. - Berlin*)
- Dr. Eran Hood (*Guest Lecturer, Hydrology, U. Alaska - Southeast*)
- Lara Hughes-Allen (*Research Assistant, GPS Surveying, U. Southern California*)
- Paul Illsley (*Visiting Faculty, Remote Sensing, Nova Scotia Community College*)
- Dr. Natalie Kehrwald (*Visiting Faculty, Biogeochemistry, US Geological Survey*)
- Kiya Riverman (*Visiting Faculty, Geophysics, Penn State*)

- Dr. Eric Klein (*Visiting Faculty, Isotope Geochemistry, U. Alaska Anchorage*)
- Dr. Jeremy Littell (*Visiting Faculty, Geobotany and Ecology, US Geological Survey*)
- Bradley Markle (*Visiting Faculty, Isotope Geochemistry, U. Washington*)
- Chris McNeil (*Visiting Faculty, Glaciology, US Geological Survey*)
- Dr. Sonia Nagorski (*Guest Lecturer, Geology, U. Alaska - Southeast*)
- Paul Neiman (*Visiting Faculty, Meteorology, Nat. Oceanic and Atmos. Assoc.*)
- Dr. Lindsey Nicholson (*Academic Lead, Glaciology, U. Innsbruck*)
- Dr. Allen Pope (*Academic Lead, Glaciology, Nat. Snow and Ice Data Center*)
- Dr. Shad O'Neil (*Visiting Faculty, Glaciology, US Geological Survey*)
- Dr. Martin Truffer (*Guest Lecturer, Geophysics, U. Alaska - Fairbanks*)
- Dr. Don Voigt (*Visiting Faculty, Geophysics, Penn State*)
- Gordon Weary (*Visiting Faculty, Geomorphology, Northwest Community College*)
- Dr. Erin Whitney (*Academic Lead, Geochemistry, U. Alaska - Fairbanks*)
- Dr. Jen Witter (*Visiting Faculty, Geology, Alaska Pacific U.*)

CALENDAR

Please note that the following calendar is tentative. Our beginning and ending dates are firm, but all other dates are subject to change due to weather and other logistical constraints. The purpose of this calendar is to provide an understanding of the general arc of the summer as we cross the Juneau Icefield. Different portions of the summer are broken up into imprecise 'weeks'.

Week 1: Welcome, Orientation, and Training in Juneau (June 24 – 30)

- During week one we welcome JIRP participants and provide foundational academic and safety-training content while based out of the University of Alaska – Southeast.
- Orientation and introduction to JIRP, team building, expeditionary responsibilities, safety training, and introductory curriculum content
- Safety training includes: Knots, prussik practice, bear safety, emergency protocol, hypothermia, blister prevention, crampon and ice axe use
- Curriculum content includes: JIRP history, environmental systems of the northern Coast Mountains, geological context, introduction to the Juneau Icefield, glacier geomorphology, plant succession, geochemistry, introduction to science communication
- Field Trip to Mendenhall Glacier. Topics include glacier geomorphology, glacier recession and thinning, crampon and ice axe use, and ablation zone characteristics.
- Field Trip to Herbert Glacier. Topics include plant succession, glacier geomorphology, and northern Coast Mountains ecology.

Week 2: Ascent to Camp 17, Safety Training and Introductory Field Science (July 1 – 11)

- In week two participants ascend to Camp 17 from Juneau. Upon arrival at C17 the first four days will be dedicated almost completely to safety training. After completion of safety training we will begin field research on Lemon Creek Glacier.
- Camp safety and expeditionary protocols: Learning how the JIRP expedition functions in the field, both for safety and efficiency

- Safety training: knots, glacier travel, self arrest, ascending and descending snow slopes, crevasse rescue, skiing
- Field studies: Lemon Creek Glacier mass balance and GPS surveying, alpine botany, glacial geomorphology
- Curriculum content: GPS surveying, mass balance methods and concepts, mountain meteorology, introduction to Taku Glacier, geophysics, reading science, field notes
- Begin to develop research project ideas with mentors

Weeks 3-4: Two-day traverse to Camp 10, Academic Program, Begin Research Projects (July 12 - 29)

- During weeks three and four the academics and research of JIRP take precedence. After the two-day traverse to C10, groups present proposed research, initiate research efforts, and participate in camp- and field-based curriculum.
- Curriculum content: geophysics, local geology, advanced mass-balance methods, isotope geochemistry, biogeochemistry, nunatak biology, photogrammetry, energy balance, writing research proposals
- Research: Groups refine and present their research hypotheses and methods, field data collection, literature review in camp, collaboration with faculty mentors

Weeks 5-6: Traverse to Camp 18, Academic Program, Research Projects Continue, Prepare for Atlin Presentations (July 30 - August 10)

- During weeks five and six the expedition transitions from Camp 10 to Camp 18. More advanced topics are included in the academic program, research projects continue, data analysis and preparation for presentations in Atlin.
- Curriculum content: advanced glaciology, geophysics and geochemistry topics, presenting science, expedition leadership and organization, surface reflectance
- Research: Group research projects continue and field research completion, first-order data analysis, begin organization of Atlin presentations

Week 7: Final Traverse from Camp 18 to Atlin, Research Project Presentations, Complete Academic Program (August 11 - 17)

- During week seven we complete the crossing of the Juneau Icefield, complete the academic program and groups present their projects in Atlin.
- The multi-day traverse from Camp 18, through Camp 26, to Atlin Lake and on to Atlin, BC affords numerous opportunities to observe the more continental climate, different geology, and ablation zone of the Llewellyn Glacier.
- Curriculum content: glacier hydrology, expedition planning, oral and written science communication, open-house presentations
- Research: Groups research project synthesis, completion of project presentations

Week 8: Bus and Ferry to Juneau, Open House, Closing (August 18 - 20)

- The final days of JIRP begin with a bus and ferry transfer through Skagway, AK back to Juneau. Upon arrival back in Juneau, participants finalize their open-house format presentations. Wrap up of the JIRP 2016 expedition.
- Research: Open-house style presentations.

- Depart Juneau on August 20.

Weeks 9-15: Participants Complete Group Research Projects and Exam

- Upon returning from JIRP, groups complete their final projects in either short-format paper or poster form. This is done from afar, but know that your continued participation in this process is required for success of the research effort and that JIRP mentors will continue to be available.
- Participants complete the written, open-book exam.

RECOMMENDED PRE-JIRP READING

Listed below are a few recommended readings to be reviewed prior to arriving in Juneau. Additionally, each project overview also has pre-JIRP recommended readings. Please do your best to familiarize yourself with these papers, blog posts and additional online materials.

A note on reading scientific papers: Don't be discouraged if these readings are your first foray into the world of academic literature. These papers can be daunting, even for experts in the field! As part of JIRP we will discuss and have sessions on reading scientific literature within the science communication portion of our curriculum. To get you started, however, please refer here:

- *How to read a scientific paper:* A humorous take on the wild world of academic writing, <http://www.sciencemag.org/careers/2016/01/how-read-scientific-paper>
- *Infographic: How to read a scientific paper:* <https://www.elsevier.com/connect/infographic-how-to-read-a-scientific-paper>

Recommended, general pre-JIRP readings: Listed by preferred order

Field, W. O. and Miller, M. M. 1950. The Juneau Ice Field Research Project. *Geographical Review*, 40, 2, 179-190.

O'Neel, S., et al. 2015. Icefield-to-Ocean Linkages across the Northern Pacific Coastal Temperate Rainforest Ecosystem, *BioScience*, 65, 5, 499-512.

Barry, R. 2006. The status of research on glaciers and global glacier recession: a review. *Progress in Physical Geography*, 30, 3, 285-306.