

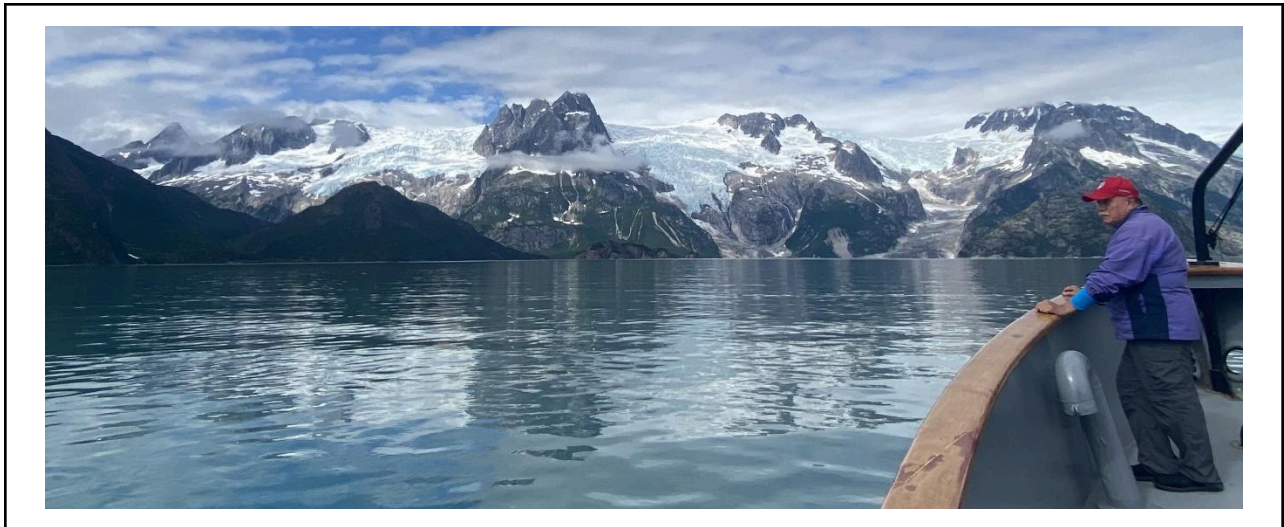


# GLACIER CHANGE AND LANDSCAPE EVOLUTION OF THE LOST COAST OF ALASKA

*July 7 – 13 online, July 14 – 27 onsite*  
Academic Credits: 6 Semester Credit Units

## FIELD SCHOOL DIRECTOR(S)

Bruce Molnia, PhD, US Geological Survey



## OVERVIEW

Glaciers shape the Earth's surface as they advance and retreat, forming valleys, modifying and mountains, and leaving deposits that form a geologic record. The processes of glaciation and deglaciation have influenced the formation of much of Alaska's landscape for at least the past four million years. Glaciers cover approximately 5% of Alaska's land surface. By area, Alaska's glaciers represent approximately 13% of Earth's mountain glaciers. However, Like temperate glaciers everywhere else on Earth, Alaska's glaciers are in decline. From 1985 to 2020, glacier-covered land in Alaska decreased by ~13%.

This program will document Alaskan glacier change and landscape evolution. The program will be led by Dr. Bruce Molnia, a glacial scientist who has studied Alaska's glaciers for over 50 years. One of the primary techniques we'll use is repeat photography, which compares newly collected photographs with historical photographs taken from the same location, sometimes more than a century before. Finding the exact spot where the historic photographs were taken can be a

challenge, but there is no evidence of climate change more compelling than these then-and-now photographic pairs.

The program includes one week of online preparation with Dr. Molnia and two weeks on board the research vessel **Endeavour** exploring glaciers of the Lost Coast in Alaska. The online portion will include an introduction to Earth systems and processes with an emphasis on glacier geology and glaciology. Following the online session, students will board the **Endeavour** for the hands-on, up-close look at and analysis of dozens of Alaska's glaciers, located in some of the world's most spectacular mountains and fiords. While collecting important photographic evidence of glacial change, students will experience glaciers firsthand, and observe their importance to Alaskan environments, including today's flora and fauna. In the field, students will use historical ground photographs, aerial photographs, satellite images, topographic maps, and the historical literature to 'read' landscape features, to identify locations from which photographs have previously been taken, and to identify new locations from which they can document present day glacier change and landscape evolution. Photographic pairs that students produce will be used in a journal article that the students will co-author, and which will be shared with the National Snow and Ice Data Center where they will become publicly available documentation of Alaskan glacial change.

The Lost Coast is that almost-uninhabited, glacier-rich stretch of the Gulf of Alaska coastline from Cape Spencer north to Prince William Sound. The expedition will leave from Gustavus, Alaska, stop in Glacier Bay, and then head up the Lost Coast to Lituya Bay (site of a 1,720-foot glacier-related tidal wave in 1958), Yakutat Bay (where the giant Malaspina Glacier ends), and Icy Bay (site of a 500-foot glacier-related tidal wave in 2015), and end in Cordova. In all, we'll be investigating more than 50 glaciers. The **Endeavour** is a 72-foot US Coast Guard designated research vessel with a professional captain and crew.

Dr. Molnia will be assisted by Ben Molnia, a geospatial analyst /data scientist, who will oversee documenting field data and locations. The expedition team will fly into Gustavus and depart from Cordova, both airports served by Alaska Airlines.

#### ACADEMIC CREDIT UNITS & TRANSCRIPTS

**Credit Units:** Attending students will be awarded 6 semester credit through our academic partner, Connecticut College. Connecticut College is a highly ranked liberal arts institution with a deep commitment to undergraduate education. Students will receive a letter grade for attending this field school (see assessment, below). Students are encouraged to discuss the transferability of credit units with faculty and registrars at their home institution prior to attending this field school.

**Transcripts:** An official copy of transcripts will be mailed to the permanent address listed by students on their online application. One more transcript may be sent to the student's home institution at no cost. Additional transcripts may be ordered at any time through the [National Student Clearinghouse](#).

## **PREREQUISITES**

None

## **COURSE OBJECTIVES**

This program builds on more than a century of research exploring Alaska glacier advance and retreat. In recent years, glacier changes have been very dramatic, with very few glaciers advancing. Most are in retreat, especially those situated at lower elevations. The most easily and frequently measured glacier-fluctuation parameter is the geographic position of the glacier's terminus and how it has changed. Maps, charts, satellite images, vertical and oblique aerial photographs, ground photographs, and field surveys are all used to determine terminus position. Charts and exploration maps from early navigators and explorers and "traditional knowledge" stories from the oral histories of Alaska's indigenous peoples also yield information about the past extent of glaciers. Proxy methods, such as tree coring and carbon dating, yield approximate ages for terminus position, up to several millennia ago. Together, these methods play an important role in documenting the location and changes in the position of the termini of Alaskan glaciers over time. Participants will be introduced to these and other tools.

This program will provide new ground photographic evidence of terminus positions changes and landscape evolution at the more than 50 Lost Coast glaciers we will visit. Students will learn to use satellite images, aerial photographs, maps, and historical ground-based photographs taken as early as the 1880s, to help determine the extent of glacial change in these areas. Using these data in the field, students will relocate the sites from which the historical photographs were made and will take new photographs capturing the identical fields of view. If a glacier is no longer visible from the historical photo location, the team will establish and document new locations from which the glacier's terminus can be photographed, now and in the future. The primary data collection method is digital repeat photography.

## **LEARNING OUTCOMES**

Students will learn to use the tools needed to understand the changing landscapes and glaciers in the areas we will visit. Tools and skills include:

- Map reading;
- Interpreting satellite imagery and aerial photography;
- Using GPS;
- Using digital photography to document landscape changes
- Understanding and using field surveys
- The application of indigenous knowledge and oral histories.

Additionally, students will learn how to read landscapes based on geological features. Through the application of material covered in lectures and readings, students will learn how to interpret the landscape, including the role of glaciers in shaping the landscapes we will encounter.

## **ASSESSMENT**

Students will be evaluated on their participation in group discussions and activities, as well as performance on assignments.

Students will record observations, questions and reflections in a field journal. Students will be asked to read the landscape at each glacier we visit, using the known history of the area and applying principles and processes covered in lectures and readings to interpret the landscapes around them. Field journals will be collected periodically for evaluation.

Students will prepare a storyboard about one or more of the glaciers we visit, including photographs and illustrations of the site, its known or probable geologic history, features and changes over time.

Finally, students will contribute to writing a journal article about the glacial changes we document, which will be submitted for publication with students as co-authors.

## **COURSE SCHEDULE**

All IFR field schools begin with an orientation that addresses local and program protocols concerning student behavior, appropriate attire, local practices and sensibilities that may be unfamiliar, potential fauna and flora hazards, IFR harassment and discrimination policies, and the student Code of Conduct.

### Online Component

During the one-week online portion of the course, students will be expected to complete all readings and attend daily online lectures and discussions. A typical day during the online phase of the program includes 20-40 pages of reading, preparation for class discussions, and participating in a 90-minute lecture and discussion online.

Lecture topics will include:

July 7 Introduction to the Earth System

July 8 Climate and weather

July 9 Geography and geology of Alaska

July 10 Introduction to glaciers, including the vocabulary needed to 'talk' glaciers

July 11 Glacier dynamics, including glacier flow, erosion, and deposition

Required readings will be available to enrolled students approximately two weeks prior to the start of the online course.

### Field Research component

Students will fly to Gustavus, Alaska and transfer to our research vessel, the ***Endeavour***. Activities for the next two weeks will take place on the ship. Important note: As we are conducting field research, changing conditions, including weather, can dictate our exact schedule. We will follow the following schedule to the extent possible, but we must all be prepared for changes to the itinerary due to weather, unexpected findings, or other conditions.

### July 14

Orientation; safety onboard the research vessel, including safety drills; shared duties and responsibilities onboard; safety in the field.

Lecture: Alaska exploration  
Skills training: GPS, map reading

### July 15

Glacier Bay. First explorations of Alaska's glaciers.

Lectures: Behavior of Alaska's glaciers since the Little Ice Age, Introduction to remote sensing  
Skills training: Repeat photography, using aerial, satellite and ground photographs

### July 16 – 26

Exploring glaciers of Alaska's Lost Coast

Our days will typically begin early in the morning with observations and discussions on the *Endeavour*. We will use observation, field reports, GPS, maps and aerial and satellite imagery to locate the site of historical photographs. We will use repeat photography to document changes in glacial position and extent. We will use the *Endeavour*'s shore boats to bring us to land for exploration, and/or to approach tidewater glaciers.

Students will be expected to document each day's exploration in their field journal and to take digital photographs. These photographs are important documentation of Alaskan glacial change. All expedition participants are expected to share their photography with the National Snow and Ice Data Center (NSIDC), the National Park Service (Glacier Bay and Wrangell-St. Elias National Parks), and each other. Through the NSIDC, images and repeat photographs will be freely available to anyone.

Students will participate in evening discussions on the *Endeavour*, reflecting on the day's work and relating required readings to our findings. Evening sessions will allow students to present their findings and all of us to explore how our explorations can be applied to future work. We will prepare for the following day's expeditions. Additional readings and resources will be available on the vessel to supplement your learning.

### July 27

Final program day, Cordova

Our field work concludes with final discussions and wrap up. We will discuss our next steps for sharing our findings, including creating the outline of the co-authored journal article and assigning tasks related to its writing.

### Post program

Students will complete their assigned sections of the journal article. Dr. Molnia will edit and submit it for publication. Dr Molnia will also be available to assist participants with storyboards or other post-expedition activities.

## **REQUIRED READINGS**

PDF files of all mandatory readings will be provided to enrolled students. Students are encouraged to download and/or print readings prior to traveling. Course participants are expected to be prepared to engage the discussions led by facilitators, all of whom will be looking for compelling evidence that students have read and thought about the assigned readings prior to the scheduled day on which they are first discussed.

## **PART II: TRAVEL, SAFETY & LOGISTICS**

### **NOTICE OF INHERENT RISK**

Traveling and conducting field research can involve risk. The IFR engages in intensive review of each field school location and programming prior to approval. Once a program is accepted, the IFR reviews each program annually to make sure it still complies with all our standards and policies, including those pertaining to student safety. Participants should also take every reasonable step to reduce risk while on IFR programs, including following the safety advice and guidelines of your program director, being alert to your surroundings and conditions, letting someone know where you will be at all times, and assessing your personal security.

The IFR does not provide trip or travel cancellation insurance. We strongly encourage participants to consider purchasing this insurance, as unexpected events may prevent your participation or cause the program to be canceled. Insurance is a relatively small cost to protect your educational investment in an IFR program. When comparing trip cancellation insurance policies, make sure the policy covers the cost of both airfare and tuition.

Please note that the schedule outlined in this syllabus can be disrupted by unforeseen circumstances, including weather, revisions by local permitting agencies, or conditions onsite. While this schedule represents the intentions of the program, adaptability is an intrinsic part of all field research, and necessary alterations to the schedule may happen at any time.

If you have any medical concerns, please consult with your doctor. For all other concerns, please consult with the program director and staff.

### **PROGRAM SPECIFIC FIELD CONDITIONS**

Alaska in July brings warm weather with frequent showers. Be prepared for rain with appropriate clothing and footwear. Good footwear with grippy soles to wear on the ship is very important, as the deck of the ship can get slippery. You will need rubber boots or equivalent rugged footwear for exploring on shore (see packing list). We will explore glaciers in any weather. The ship will anchor in protected areas along the coast, though some rocking of the boat is to be expected at anchor and when underway.

### **ACTIVITY LEVEL**

Students should expect to walk and hike along the coast as we explore the glaciers, which can include uneven and slippery surfaces, crossing streams and marshes, and climbing over downed trees and rocks. There will be a moderate amount of such physical activity daily. You will move from the research vessel to shore boats to land frequently. You will also move around the ship and participate in shared duties such as food preparation, cleaning, and watch duties.

### **VISA REQUIREMENTS**

No visa required for US citizens

## STUDENT HEALTH

An IFR field school is designed to provide safe, positive, and constructive experiences for participating communities, students, and researchers. We are committed to protocols and practices that support the health and well-being of all involved in our field school projects, including the members of the community in which these projects take place.

We recommend that students adopt best-practices for arriving in a good state of health to protect themselves and their peers' readiness to set about the work of the field school. A thriving field camp environment is a constant exchange of energy, patience, effort, respect, and service. Arriving healthy is every student's first act of service — their first opportunity to behave in a way that respects the safety and wellness of one another.

## TRAVEL (TO AND DURING THE PROGRAM)

Natural disasters, political changes, weather conditions and various other factors may force the cancellation or alteration of a field school. IFR recommends students only purchase airline tickets that are fully refundable and consider travel insurance in case a program or travel plans must change for any reason. General information for this program is below, but keep in mind we will discuss any updated travel information during the program orientation.

Our program will begin in Gustavus, Alaska and end in Cordova, Alaska. Both of these airports are served by Alaska Airlines, however, flights are limited and may be difficult to book during the busy summer season. We will therefore try to arrange a charter flight from Juneau on July 14. Please wait to buy your airline ticket until this is confirmed. Students will be met at the airport and transfer to the *Endeavor*.

Students will spend the next two weeks onboard the ship, transferring to shore boats to explore the coast. Students should plan to fly out of Cordova, Alaska, departing no earlier than 11 AM on July 27. Students will be brought to the airport in Cordova if desired. There are also ferries that depart from Cordova to Whittier, where there is regular bus service to Anchorage. Check the [Alaska Marine Highway System](#) website for schedules. Note that it is often less expensive, and much faster, to fly.

If you missed your connection or your flight is delayed, please call, text or email the field school director immediately. A local emergency mobile phone number will be provided to all enrolled students.

## ACCOMMODATIONS

Everyone lives aboard the Endeavor during the field research component of the program. The ship is 72 feet long with three bunk rooms and two heads, both with showers. Given the limited water the ship can carry, students will not be able to shower every day and will be able to do one load of laundry during the expedition. Students will all share one bunk room, accommodating 6. Each student will have a drawer and space around their bed for storage, but space is limited on the ship and students are strongly encouraged to pack lightly. There is a



salon and galley for food preparation, and an open-air deck for observing, relaxing and group discussions. There is a small dog who shares the ship with us. You can learn more about the ship at: <https://www.alaskaendeavour.org/ship>

## EQUIPMENT LIST

1. 11" - 15" rubber/PVC boots or similar sturdy footwear.

We recommend 11-15" high rubber boots from Xtratuf, Grunden or similar. Lower, leather hiking boots will get wet and stay wet. Wool hiking socks are a good choice to pair with your boots. Please break the boots in before attending the field study portion of the program. These boots will be worn daily during the expedition.

2. Waterproof jacket and pants.

Please make sure these are waterproof and not just water repellent. Jackets that have ventilation (such as "pit zips") will allow you to regulate your body temperature better than those without. Jackets should have hoods, or you should bring a waterproof hat. Rain pants are worn over other lightweight pants or long johns. Examples of good rain gear:

<https://www.rei.com/product/227570/rei-co-op-rainier-rain-jacket-mens>

<https://www.rei.com/product/227614/rei-co-op-rainier-rain-jacket-womens>

<https://www.rei.com/product/227615/rei-co-op-rainier-rain-pants-womens>

<https://www.rei.com/product/227731/rei-co-op-rainier-rain-pants-mens>

3. Digital camera with GPS encoding (cell phone with good camera resolution is fine).

## RECOMMENDED PACKING LIST

Due to limited space on board the ship, students are encouraged to pack lightly and bring quick drying clothing. Cotton dries slowly, so heavy cotton fabrics, such as denim, should be avoided. Bring clothing that you can layer so you will be able to regulate your body temperature as the weather changes.

- 3-4 Short sleeve T-shirts
- 2-3 Long sleeve shirts/layers that can be worn over T-shirts. Consider a warmer layer, such as a fleece jacket or thermal top as one of your choices.
- 2-3 pairs of long pants. Nylon or other quick dry fabrics are good choices.
- Leggings or long johns.
- 6 days worth of underwear and socks.

- If you get cold easily, bring a thermal layer, such as long underwear.
- A pair of sneakers or boat shoes.
- Modest pajamas or loungewear.
- Polarized sunglasses.
- Toiletries (the ship has soap and shampoo).
- Prescription medication - bring enough for the whole voyage.
- Day pack (bring a waterproof cover or sufficient zip top plastic bags to protect your gear).

Pack in a duffle bag, not a hardsided suitcase.

**Note:** the Ship will provide:

- Bedding
- Pillow
- Towels
- Soap and shampoo
- Sunscreen
- Fishing gear