U.S. Geological Survey—Department of the Interior, Region 11, Alaska—2023–24 Biennial Science Report

Circular 1554

U.S. Department of the Interior
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Cover.
Top left. A bull caribou grazes in autumn at the Lake Clark National Park and Preserve in Alaska. Photograph by U.S. Geological Survey.

Middle left. Fire in a boreal forest in Alaska. Photograph by U.S. Geological Survey.

Bottom left. Crumbling blocks of permafrost along the Beaufort Coast. Photograph by U.S. Geological Survey.

Top right. *Rubus chamaemorus* L. (cloudberry) is an important subsistence resource for many Alaska residents. Photograph by U.S. Geological Survey.

Middle right. Mount Cleveland summit with Carlisle Island beyond. Photograph taken May 31, 2023, by Dane Ketner, U.S. Geological Survey.

Bottom right. *Vulpes lagopus* (arctic fox) in the summer on the northern coast of Alaska. Photograph by Ryan Askren, U.S. Geological Survey.

U.S. Geological Survey—Department of the Interior, Region 11, Alaska—2023–24 Biennial Science Report

Edited by Elizabeth M. Powers and Dee M. Williams

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U.S. Geological Survey

U.S. Geological Survey, Reston, Virginia: 2025

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Contents

Abbreviations

°C	degrees Celsius
3D	three-dimensional
AK CASC	U.S. Geological Survey Alaska Climate Adaptation Science Center
AKRO	U.S. Geological Survey Alaska Regional Office
AMEC	Alaska Mapping Executive Committee
ANSEP	Alaska Native Science and Engineering Program
AON	Arctic Observing Network
ARDF	Alaska Resource Data File
ASC	U.S. Geological Survey Alaska Science Center
AVO	U.S. Geological Survey Alaska Volcano Observatory
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
C	carbon
CVO	U.S. Geological Survey Cascades Volcano Observatory
DOI	U.S. Department of the Interior
eDNA	environmental DNA
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GIS	geographic information system
IARPC	Interagency Arctic Research Policy Committee
IERP	Integrated Ecosystem Research Program
km	kilometers
lidar	light detection and ranging
NHD	National Hydrography Dataset
no.	number
NPRB	North Pacific Research Board
NPS	National Park Service
NSAR	National Strategy for the Arctic Region
NVEWS	National Volcano Early Warning System
PIV	particle image velocimetry
UAF	University of Alaska Fairbanks
USGS	U.S. Geological Survey
v.	volume
VSC	U.S. Geological Survey Volcano Science Center
VTWG	Vegetation Technical Working Group
WBD	Watershed Boundary Dataset
YVO	U.S. Geological Survey Yellowstone Volcano Observatory

U.S. Geological Survey—Department of the Interior, Region 11, Alaska—2023–24 Biennial Science Report

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Alaska Organizational Overview

U.S. Geological Survey (USGS) Mission—The USGS national mission is to monitor, analyze, and predict the current and evolving dynamics of complex human and natural Earth-system interactions and to deliver actionable information at scales and timeframes relevant to decision makers. Consistent with the national mission, the USGS in Alaska provides timely and objective scientific information to help address issues and inform management decisions across five interconnected focus areas:

- Energy and Minerals;
- Geospatial Mapping;
- Natural Hazards;
- Water Quality, Streamflow, and Ice Dynamics; and
- Ecosystems.

The USGS in Alaska consists of approximately 350 scientists and support staff working in 3 Alaska-based science centers. USGS science activities are also initiated by the Cooperative Research Unit and USGS centers outside Alaska. In the last 5 years, USGS research in Alaska has produced many scientific benefits resulting from more than 900 publications. Publications relevant to Alaska can be conveniently searched by keyword through the USGS Publications Warehouse at https://pubs.usgs.gov/.

Regional Office

The USGS Alaska Regional Office (AKRO) provides strategic leadership for the region's science programs while facilitating growth of USGS science capacity in Arctic and Subarctic systems. The AKRO maintains relations with other Federal and State agencies, Tribes, Alaska Native organizations, and the academic community to advance the goals and objectives of the U.S. Department of the Interior (DOI) and the White House Administration, representing a single interface point for the entire breadth of USGS science and its capabilities. The AKRO works in close coordination with local USGS science centers to gather, synthesize, and deliver scientific information that is timely, relevant, and impartial concerning Alaska's geology, geography, hydrology, diverse physical and biological resources, and natural hazards.

The AKRO provides management and strategic coordination with the USGS Alaska Science Center (ASC), the USGS Volcano Science Center (VSC), the USGS Alaska Climate Adaptation Science Center (AK CASC), USGS scientists from other regions, and external partner operating in Alaska. At the end of fiscal year (FY) 2024, Alaska Regional personnel include the Regional Director (Aimee Devaris), Deputy Regional Director of Science (Dr. Dee Williams), Deputy Regional Director of Operations (Durelle Smith), Science Coordinator (Dr. Elizabeth Powers), Safety Manager (Daniel Morgan), Regional Management Officer (Karlene Crawford), Regional Tribal Liaison (Tess Hostetter), and Budget Analyst (Brian Hudgins). Additional information about the Alaska Region is available at https://www.usgs.gov/unified-interior-regions/region-11.

The AKRO maintains a distinctive organizational and operational status in the USGS by virtue of several key factors:

1. Alaska is prone to multiple natural and climate-related hazards, including earthquakes, volcanoes, landslides, coastal storms, tsunamis, flooding, fire, and permafrost degradation.
2. The Federal government manages about 65 percent of Alaska as public lands, including numerous national forests, national parks, and national wildlife refuges.
3. Alaska Native subsistence activities and legal protections shape the planning and direction of scientific research throughout the State.
4. The ASC currently operates one of the largest and most scientifically integrated centers in the USGS, but a large volume of Alaskan and Arctic research activities are done by staff from centers outside the State.
5. The AKRO, by virtue of its hosting of the VSC with its five volcano observatories and responsibilities in the American West, Hawaii, and Pacific territories, maintains awareness and partnerhips well beyond Alaskan borders.

For these reasons, Alaska constitutes a dynamic area for USGS activities.

Alaska Science Center

The ASC, led by Dr. Christian Zimmerman, consists of about 135 science and support personnel representing the full suite of disciplines at the USGS. Research and activities in support of all the USGS mission areas are managed collectively with a vision to achieve an integrated landscape-level understanding of the highly diverse and complex ecosystems of Alaska. The ASC delivered 353 science information products in FY 2023–24, including 141 journal articles, 15 USGS series reports, 4 book chapters, 174 data releases, and 19 software releases. More information about specific research initiatives in Alaska is available in this report and on the ASC website at https://www.usgs.gov/centers/asc.

Volcano Science Center

The VSC, led by Tina Neal, is under the Alaska Region and is responsible for the 5 United Sates regionally based volcano observatories and about 175 employees on the west coast and in Hawaii. The VSC encompasses the Alaska Volcano Observatory (AVO) in Anchorage and the observatories outside the Alaska Region; the Cascades Volcano Observatory (CVO); the virtual Yellowstone Volcano Observatory (YVO) in Vancouver, Washington; the Hawaiian Volcano Observatory (HVO) in Hilo, Hawai'i; and the California Volcano Observatory (CalVO) in Moffett Field, California, as well as the internationally scoped Volcano Disaster Assistance Program, a joint USGS-U.S. Agency for International Development program, based at CVO. Their common mission is to enhance public safety and minimize social and economic disruption from eruptions through the delivery of effective forecasts, warnings, and information on volcano hazards based on scientific understanding of volcanic processes. The volcanically active U.S. territories of American Samoa and the Commonwealth of the Northern Mariana Islands are remotely served by HVO and AVO, respectively. VSC scientists are engaged with the public through social media, official website, and frequent outreach appearances to schools, interagency partners, and other stakeholders. VSC authors produced more than 150 scholarly publications in FY 2023–24, an additional 29 USGS series publications, 67 data releases, and 326 abstracts. Follow news from the AVO (which is a 36-year-old cooperative program of the USGS, the State of Alaska Department of Geological and Geophysical Surveys [ADDGS], and the University of Alaska Fairbanks [UAF]) Geophysical Institute at https://www.avo.alaska.edu/.

Alaska Climate Adaptation Science Center

The AK CASC, led by Dr. Stephen Gray, is one of nine regional climate adaption centers that provide managers with the tools and information they need to develop and execute management strategies that address the effects of the climate on natural and cultural resources. The Center is hosted by the UAF, but staff are also physically located at the USGS campus at Alaska Pacific University in Anchorage, as well as other locations throughout the State.

Various program partners provide expertise in climate science, ecology, environmental impact assessments, modeling, and advanced information technology. New AK CASC efforts and initiatives include the launch of the Northern Climate Reports (https://northernclimatereports.org) tool and the development of a multiyear partnerhip with the Native American Fish and Wildlife Society (https://www.nafws.org/). The AK CASC continues to develop its Alaska Tribal Resilience Learning Network to bring together climate researchers, traditional knowledge experts, and Tribal resilience staff to create a community of learning, sharing, technical assistance, and training in support of Alaska Tribes. The AK CASC continues to collaborate with the Pacific Islands Climate Adaptation Science Center to promote joint research in "Icefield to Ocean" and "Ridge to Reef" systems, but also provides opportunities for undergraduate and graduate student exchange between Alaska and Hawaii. AK CASC researchers produced more than 40 peer-reviewed publications in FY 2023–24, as well as a variety of datasets, public-outreach materials, and other informational products. More information is available at https://akcasc.org.

External Partners

To meet the Nation's most pressing science needs and to deliver timely and relevant information, USGS scientists routinely work with other Federal, State, and local government agencies; Tribal nations; academic institutions; international colleagues; and nongovernmental and private organizations.

For the purposes of this report, we define a partner as any entity that actively works with the USGS to co-fund or co-produce scientific research or natural hazard messaging activities.

External partners include more than 20 Federal agencies, 25 State agencies, 5 Alaska Native Organizations, 20 non-governmental organizations, 10 industry partner, and more than 50 academic institutions. USGS regional managers collaborate actively with the DOI Alaska bureaus and State and regional groups, especially through the DOI Alaska Cooperative Planning Group, the Interagency Arctic Research Policy Committee (IARPC), Arctic Council Working Groups, and numerous bilateral interagency agreements with the DOI bureaus of the U.S. Fish and Wildlife Service (FWS), National Park Service (NPS), Bureau of Ocean Energy Management (BOEM), and Bureau of Land Management (BLM).

One formal partnerhip worth a special mention is the Alaska Cooperative Fish and Wildlife Research Unit hosted at the UAF campus. This unit is part of a nationwide program intended to foster college-level research and graduate student training in support of science-based management of fish and wildlife and their habitats. The Alaska Unit exists by cooperative agreement among the USGS, Alaska Department of Fish and Game, the UAF, the FWS, and the Wildlife Management Institute. The unit mission is aimed at understanding the ecology of Alaska fish and wildlife, evaluating effects of land use and development on these resources, and relating the effects of social and economic needs to production and harvest of natural populations. Shawn Crimmins is the current acting lead while a search is underway for a permanent unit leader. The Alaska Cooperative Fish and Wildlife Research Unit website is https://www.akcfwru.uaf.edu/.

Employee Spotlights

Patrick Lemons

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Photograph by Mike Delue, U.S. Geological Survey

Patrick Lemons is the Assistant Regional Administrator of the AK CASC. Before joining the AK CASC in 2023, Patrick worked for FWS's Marine Mammals Management Program where he served as a quantitative population ecologist from 2010 to 2016 and served as the Chief of the Marine Mammals Management program from 2016 to 2023. Much of his past work has included the use of novel quantitative approaches to address a variety of wildlife management needs. This includes the development of the first comprehensive estimate of the *Odobenus rosmarus divergens* (Pacific walrus) population using a genetics-based, capture-mark-recapture approach. He also specializes in program management and working with managing agencies to identify high priority science needs for numerous northern species including *Ursus maritimus Phipps* (polar bear), Pacific walruses, *Enhydra lutris* (sea otter), and migratory birds such as geese and loons. In his current position with the AK CASC, Patrick is working with agencies, communities, and Tribal representatives to develop the next AK CASC 5-year research plan. He received his Ph.D. from the University of Nevada, Reno, in quantitative population estimation of migratory birds and also holds a Master of Science from Texas Tech University and an undergraduate from Kansas State University.

Rob Witter

Research Geologist, ASC
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Rob Witter pointing to a geologic contact on Montague Island that records tectonic uplift during the Great Alaska Earthquake in 1964 that had a magnitude of 9.2. Photograph by the U.S. Geological Survey.

Rob Witter joined the USGS ASC in 2011. He is an earthquake and tsunami geologist who does geological detective work to uncover clues about the location, size, and frequency of ancient earthquakes and tsunamis. Rob specializes in field-based studies of plate-boundary faults that generate destructive earthquakes, like the Alaska-Aleutian Subduction Zone and the Queen Charlotte-Fairweather Fault system. When plate-boundary faults rupture under the ocean, they can launch tsunamis that affect communities along Alaska's coastline and across the Pacific Ocean. Rob uses methods in geomorphology, paleo seismology, geodesy, and sea-level studies to decipher the history of ancient earthquakes. From 2011 to 2021, Rob led a team doing research in Alaska's Aleutian Islands, and their findings offered new insights into the Aleutian earthquakes that generate dangerous, trans-Pacific tsunamis. The research Rob does contributes to seismic and tsunami hazards assessments used to strengthen building codes and reduce tsunami risk. Most recently, he contributed new earthquake data used in the FY 2023 Alaska National Seismic Hazards Model. Rob aspires to carry out research that builds societal resilience in the face of earthquake and tsunami hazards with the goal of preparedness to help prevent future earthquakes and tsunamis from becoming disasters.

Emily Weiser

Wildlife Biologist, ASC
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Emily Weiser doing a local bird survey by bike. Photograph by Emily Weiser, U.S. Geological Survey.

Emily Weiser has been working as a wildlife biologist at the USGS ASC since 2019. Her work has a quantitative focus, applying complex analytical methods or developing new models for projects whose datasets are large, complicated, or sometimes messy. Emily is particularly interested in researching how scientists study things, including how scientists improve methods and reveal caveats or biases that can arise when we apply models to imperfect field data. Some of her recent work has involved developing an aerial photographic survey for fall-staging geese on the Alaska Peninsula, evaluating flight altitude of migrating geese in relation to planned offshore windfarms, and demonstrating biases that can arise in nest-survival analysis when nests are found later in the nesting cycle. By improving how we monitor populations and analyze data, Emily's work helps ensure that our State, Federal, and indigenous partner and decision makers have the best possible information to manage wildlife.

Dawn Ruth

Research Geologist, Lab Manager, CalVO
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Left, Dawn Ruth doing fieldwork at the Mayon volcano (Philippines) for her postdoctoral research, and right, Dawn Ruth prepping samples for analysis on the scanning electron microscope. Photographs by U.S. Geological Survey.

Dawn Ruth joined the VSC in 2019 as a research geologist. She investigates the dynamics of magmatic plumbing systems using a variety of geochemical and petrological techniques. Specifically, Dawn focuses on determining the nature and timing of magmatic processes that happen before an eruption. She focuses on volcanoes that erupt frequently (for example, Mayon Volcano, Philippines and Kilauea, Hawai'i) or over a large area, for example Newberry Volcano, Oregon and Clear Lake Volcanic Field, California. The results of her work help us understand precursor magmatic processes that may be linked to geophysical signals that, in turn, may help with eruption forecasting in the future.

Dawn also manages the USGS Menlo Park/Moffett Field Electron Microbeams Lab, which hosts a scanning electron microscope and an electron microprobe. She is a subject matter expert on electron microscopy, often interfacing with other electron microscope users from different science centers, in addition to her own research in the VSC. Dawn's electron microbeam expertise aided diverse projects investigating topics such as: the abundance of chromium in groundwater, the morphology of biofilms, and the orientation of halite crystals from fault scarps. She has expanded the capabilities of the Electron Microbeams Lab by her introduction of new analytical detectors (for example, electron backscatter diffraction [EBSD], and a Keyence automated digital microscope with laser induced breakdown spectrometer, which allow users to collect even more diverse geochemical and crystallographic datasets). Finally, Dawn successfully networked the electron microprobe, allowing users to collect data remotely from different USGS locations.

Michael Poland

Research Geophysicist, YVO
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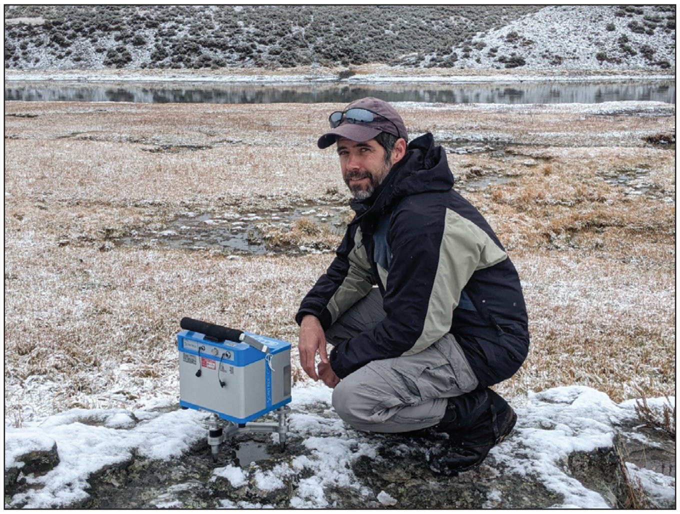


Mike Poland collecting gravity data at the Yellowstone National Park. Photograph by Charles Wicks, U.S. Geological Survey.

Mike Poland has been a research geophysicist with the VSC since 2002. His work focuses on measuring and interpreting deformation and gravity change at volcanoes as a means of better understanding subsurface magmatic processes and forecasting hazardous eruptive activity. He began his career at the CVO, developing his capability to utilize Interferometric Synthetic Aperture Radar data for volcano monitoring and participating in the response to the 2004 to 2008 eruption of Mount Saint Helens. Mike moved to the HVO in 2005 to study volcanic eruptions and magmatic plumbing systems at Kilauea and Mauna Loa, and he identified changes in magma supply to Kilauea that had a direct effect on eruptive activity. In 2015, he returned to the CVO, and in 2017 became the scientist-in-charge of the YVO, leading that diverse consortium of institutions to better understand how Yellowstone's magmatic, tectonic, and hydrothermal systems work and the effects of their associated hazards. In addition to research, Mike has developed an interest in public communication, and he is involved in outreach efforts to promote a better appreciation for volcanology using social media, informational videos, weekly web articles, and comprehensive reports about volcanic, tectonic, and hydrothermal activity in the Yellowstone region.

Structure of Report

The research in this biennial report is organized primarily by the five major focus areas (energy and minerals; geospatial mapping; natural hazards; water quality, streamflow, and ice dynamics; and ecosystems). The focus areas are then subdivided into subsections. However, each project description could be sorted into other categories of reader interest, such as geographic location or association with established DOI research priorities. To facilitate search and discovery, this report uses various icons, which are embedded immediately below the title of each project description. Different icons are used to represent the six different categories of topics, four different geographic locations, and eight different established DOI priorities. All 18 icons are illustrated in a legend at the conclusion of this section.

This report uses broad ecoregions as a convenient means to establish categories of geographic location. An ecoregion is an area defined by its ecology and geography that covers large expanses of land or water and contains distinct assemblages of natural communities and species. Within each ecoregion, there is substantial, but not absolute, spatial correlation among the characteristic assemblages. The three broad Alaska ecoregions are the (1) Arctic, (2) Boreal Forest, and (3) Subarctic Coastal (Maritime). The fourth icon is used to represent work that generally spans across the entire State of Alaska.

Arctic Ecoregion (Including Bering Tundra)

The Arctic Ecoregion of Alaska encompasses the area north of the Arctic Circle and consists of the flat and treeless coastal plains and the rolling foothills and rugged peaks of the Brooks Range. The Arctic Research Policy Act of 1984 (Public Law 98–373, amended as Public Law 101–609) expands the definition to include “the territory north and west of the Porcupine, Yukon, and Kuskokwim Rivers (including North Slope and Northwest hydrologic zones), and all contiguous seas (including the Bering, Beaufort, Chukchi, and Arctic Seas).” The climate of the ecoregion is primarily cold and dry; freezing temperatures dominate most of the year. The Arctic Ecoregion also includes the Bristol Bay region, Bering Sea islands, and parts of the Seward Peninsula and Yukon-Kuskokwim Delta. The climate in the Arctic transitions between maritime and continental in the Bristol Bay area and shifts to moist polar in the north.

Boreal Forest Ecoregion

The Boreal Forest Ecoregion encompasses interior Alaska, stretching from the southern side of the Brooks Range in the north to the Alaska Range in the south. This region covers a wide geographic area and, thus, has considerable variation in temperature and precipitation, yet the climate is considered continental with short, warm summers and long, cold winters.

Subarctic Coastal Ecoregion

The Subarctic Coastal Ecoregion is the most diverse ecoregion in Alaska, consisting of subarctic coastal regions stretching from southeast Alaska to the tip of the Aleutian Island chain. Various landscapes include fjords, beaches, rocky intertidal zones, kelp forests, underwater seamounts, and seafloor sediment. The subarctic mainland includes the Chugach Mountains, the Copper River Basin, and the Talkeetna Mountains and is characterized by forest, bogs, wetlands, and alpine tundra. Southeast Alaska is characterized by its maritime climate, temperate rainforests, abundant islands, and long fjords. The Aleutian Islands are a chain of volcanic islands covered in rugged mountain peaks with carved fjords, high cliffs, rocky and wave-battered beaches, and small dune fields. This part of the region has a cool maritime climate but varies greatly in terms of precipitation amounts, although high winds and intense ocean storms are common across the region.

U.S. Department of the Interior Priorities

DOI plays a central role in how the United States stewards its public lands, increases understanding of human-environmental interactions, studies historical and present-day natural processes, and honors our nation-to-nation relationship with Tribes. This report links USGS program/project descriptions with DOI priorities and goals established in FY 2021. These DOI priorities are illustrated by the distinct icons that appear in the legend in the following section. Although the programs and projects described can demonstrate connection before established priorities, they can provide data and analysis to inform efforts to improve public safety, critical infrastructure resilience, resource management, and industry planning and decision making.

Icon Legend

Topical Areas:

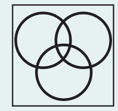

Energy and Minerals


Water Quality, Streamflow, and Ice Dynamics

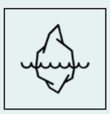

Alaska Mapping

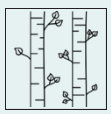

Natural Hazards


Ecosystems


Cross-Cutting Programs

Ecoregions:


Arctic


Boreal Forest


Subarctic Coastal


Statewide

DOI Priorities in 2023–24 Most Relevant to U.S. Geological Survey Work in Alaska:


Create a Conservation Stewardship Legacy


Clean Energy


Strengthening Tribal Relations


Centering Equity and Environmental Justice


Economic Vitality


Climate Science Research

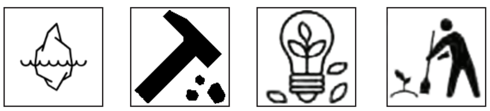

Public Health and Safety


Protecting Biodiversity

Energy and Minerals

Energy Resources

Alaska Basins and Petroleum Systems



The Alaska Basins and Petroleum Systems Project assesses undiscovered energy resources and investigates ancient climate excursions to predict future affects in Alaska. The focus of this research is primarily Arctic Alaska, with additional investigations in the North Chukchi Basin, Cook Inlet, and other sedimentary basins with energy resource potential. Primary objectives include (1) understanding the geologic framework of Arctic Alaska and its energy systems, (2) assessing undiscovered oil and gas resources, (3) investigating relations between petroleum source rocks and carbon burial during peak global greenhouse climate conditions, and (4) delivering energy resource information to land and resource managers, policy makers, and the public. This research uses multiple methods and data types (seismic, outcrop, core, petrophysics, thermal maturity, geochronology, thermochronology, geochemistry, biostratigraphy, etc.) to accomplish its mission. Outcomes include the documentation of ancient high-latitude climate excursions in Arctic Alaska and the evaluation of petroleum resource potential in the National Petroleum Reserve in Alaska, as well as other Federal, State, and Native lands.

Photograph showing a helicopter-mobilized drill rig preparing to retrieve a research core of middle Cretaceous strata on Slope Mountain about 160 kilometers south of Prudhoe Bay. The rig is operated by the U.S. Geological Survey Research Drilling Program in cooperation with the Alaska Department of Geological and Geophysical Surveys. Sandstone intervals in the shallow marine lower Nanushuk Formation are direct analogs for reservoirs in giant oil discoveries in the National Petroleum Reserve in Alaska and nearby State lands about 185 kilometers northwest of this exposure. Photograph by Jared Gooley, U.S. Geological Survey.

Contacts

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Project Link

https://www.usgs.gov/programs/energy-resources-program/science/alaska-petroleum-systems

Recent Publications

Counts, J.W., Vickers, M.L., Stokes, M.R., Spivey, W., Gardner, K.F., Self-Trail, J.M., Gooley, J.T., McAleer, R.J., Jubb, A.M., Houseknecht, D.W., Lease, R.O., Griffis, N.P., Vickers, M., Śliwińska, K., Tompkins, H.G.D., and Hudson, A.M., 2024, Insights into glendonite formation from the Upper Oligocene Sagavanirktok Formation, North Slope, Alaska: Journal of Sedimentary Research, v. 94, no. 2, p. 179–206, https://doi.org/10.2110/jsr.2023.060.

Hutchinson, D.R., Houseknecht, D.W., and Mosher, D.C., 2025, Canada Basin Tectono-Sedimentary Element, Arctic Ocean, *in* Drachev, S.S., Brekke, H., Henriksen, E., and Moore, T.E., eds., Sedimentary successions of the Arctic region and their hydrocarbon prospectivity: London, Geological Society, Memoir 57, https://doi.org/10.1144/M57-2022-49.

Amato, J.M., Dumoulin, J.A., Gottlieb, E.S., and Moore, T.E., 2022, Detrital zircon ages from upper Paleozoic–Triassic clastic strata on St. Lawrence Island, Alaska—An enigmatic component of the Arctic Alaska–Chukotka microplate: Geosphere, v. 18, no. 5, p. 1492–1523, https://doi.org/10.1130/GES02490.1.

Northern Alaska Gas Hydrate Resource Characterization

Gas hydrates could be a vast untapped source of energy, with the total amount of gas in the gas hydrate accumulations of the world possibly surpassing the volume of known conventional gas reserves. The USGS gas hydrate resource assessment efforts include the analysis of the potential environmental and climate effects of gas production from Arctic permafrost and marine gas hydrate accumulations. The USGS, U.S. Department of Energy, and the Japan Oil, Gas and Metals National Corporation are leading an effort to do an extended gas hydrate production test in the Alaska North Slope. The primary goal of this project is to do scientific field production tests of gas hydrate-bearing reservoirs using conventional production technology. The project included the drilling of a stratigraphic test well in 2018 and the drilling and completion of a geodata well and two production test wells in February 2023. The Hydrate-P1 Production Test Well has been tested through a series of pressure drawdown experiments, and the production testing phase of this project was completed in June 2024.

Photograph showing the Alaska North Slope gas hydrate production test site in the Prudhoe Bay Unit. Photograph by the Alaska North Slope Gas Hydrate Production Testing Project.

Time frame	Project Partners
Fiscal years 2018–24	U.S. Department of Energy—National Energy Technology Laboratory; Japan Oil, Gas and Metals National Corporation; State of Alaska Department of Natural Resources; Arctic Slope Regional Corporation—Energy Services

Contacts

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Carolyn Ruppel, Woods Hole Coastal and Marine Science Center, cruppel@usgs.gov, 617–806–6768

Program Link

https://www.usgs.gov/centers/central-energy-resources-science-center/science/gas-hydrates

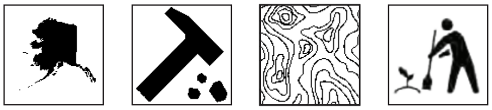
Recent Publications

Garcia, A., Jin, G., Collett, T.S., Haines, S., and Merey, S., 2023, Monitoring a gas hydrate field with distributed temperature sensing for long-term well integrity, *in* Annual International Meeting for Applied Geoscience and Energy, Houston, Tex., 2023, Proceedings: Houston, Tex., 12 p.

Garcia, A., Jin, G., Collett, T.S., Haines, S., and Merey, S., 2023, Long-term well integrity monitoring at a gas hydrate study site with distributed temperature sensing, *in* The Society of Petroleum Engineers Workshop; Fiber-Optic Sensing Applications for Well, Reservoir and Asset Management, Westminster, Colo., August 8–9, 2023, Proceedings: Westminster, Colo., Society of Petroleum Engineers, 12 p.

Mineral Resources

Maintenance of Alaska Geologic Map and Mineral Deposit Databases



Geologic map of Alaska showing the generalized geology of the State, with each color representing a different type or age of rock.

The USGS collects data on the geology and mineral resources in Alaska and maintains this information in the Alaska Geologic Map and Mineral Deposit Databases. The USGS tracks and updates the (1) Alaska Geologic Map and the (2) Alaska Resource Data File (ARDF).

1. Alaska Geologic Map—The Alaska geologic mapping project entails the maintenance and updating of the Alaska geologic map database created in 2015, incorporating newly available data and releasing these new data in episodic updates. The 2015 compilation also involved creating text and spatial databases of available information and data. The dataset was then integrated statewide to produce, in addition to the new State map, several other derivative maps. As a digital database, it is an analytical tool that can continually be updated. The project also involves integrating the Alaska data with datasets covering parts of Canada, Russia, and the conterminous United States. Mineral and energy resource assessments drive demand for the geologic map, but the map (and associated spatial and attribute datasets that were used to create it) also has potential for use in addressing regional environmental issues.

2. ARDF—The ARDF is a mission-critical database of mines, prospects, and minerals in the State of Alaska that is continually updated as new information becomes available. The project entails (1) providing complete, up-to-date, and user-friendly and user-accessible information on metallic and selected non-metallic minerals in Alaska; (2) tracking mineral industry activity in the State; and (3) systematically releasing updated records on the internet. The information collected and maintained by the project can be useful for mineral resource assessments, mineral deposit modeling, and mineral environmental studies, as well as land-use decisions.

Time frame
Fiscal year 2007–ongoing

Contact

Frederic H. Wilson, ASC, fwilson@usgs.gov, 907–786–7448

Project Links

https://ardf.wr.usgs.gov/

https://alaska.usgs.gov/portal/project.php?project_id=212

https://alaska.usgs.gov/portal/project.php?project_id=214

Recent Publication

Blodgett, R.B., Wilson, F.H., Shew, N.B., and Clough, J.G., 2020, Bedrock geologic map of the 15’ Sleetmute A-2 quadrangle, southwestern Alaska: U.S. Geological Survey Scientific Investigations Map 3450, 18 p., 1 map sheet, scale 1:63,360, https://doi.org/10.3133/sim3450.

Improving Understanding of Critical Mineral Potential in the Alaska Outer Continental Shelf

The United States relies on certain mineral commodities, known as critical minerals, that are essential to its economy and national security. The USGS seeks to improve knowledge of critical mineral potential in the United States. The objectives of this study are to improve knowledge of marine minerals, including critical marine minerals in the Alaska Outer Continental Shelf, Exclusive Economic Zone, which has been found to contain several types of marine minerals and meets prospective criteria for several others. To accomplish these objectives, methods such as data synthesis and updating prospective criteria for mineral resource extraction relevant to the Alaska region are used by the USGS. Products include a data-integrated prospective map, a USGS Professional Paper, and a recommendation of fieldwork by the USGS and collaborators. Additional products include data relevant to the outcome of any potential extraction on other co-located natural resources.

Image showing ferromanganese crust from the Chukchi Plateau and Borderland in the Arctic Ocean. Photograph by the U.S. Geological Survey.

Time frame	Project Partner
Fiscal years 2019–24	Bureau of Ocean Energy Management

Contacts

Amy Gartman, Pacific Coastal and Marine Science Center, agartman@usgs.gov, 831–460–7562

Douglas Kreiner, ASC, dkreiner@usgs.gov, 907–786–7190

Tectonic and Metallogenic Evolution of the Broader Yukon-Tanana Upland

USGS ASC research staff lead a multi-investigator, field-based project focused on the geologic framework and mineral resources of the Yukon-Tanana upland region from Fairbanks, Alaska, southeast to the Alaska-Yukon border. This 5-year project is funded by the USGS Mineral Resources Program, and major funding was provided in FY 2020–21 by the National Cooperative Geologic Mapping Program to improve digital geologic map compilations. This project is coordinated with new geological, geophysical, and geochemical studies by the Alaska Division of Geological and Geophysical Surveys run by the USGS Earth Mapping Resource Initiative (https://www.usgs.gov/special-topic/earthmri). USGS research priorities include (1) new geological mapping, bedrock sampling, and tectonic interpretation of the regional geologic framework; (2) focused ore deposit and placer studies and regional characterization of mineralized systems; (3) studies of major fault networks and Cenozoic landscape evolution; and (4) interpretation and modeling of airborne geophysical data.

Geologic fieldwork in FY 2020–21 focused on a broad regional transect fromYukon-Charley Rivers National Preserve and the Good-paster mining district in the east to the Fairbanks mining district and Manley Basin to the west. The core objective of the project is to develop a comprehensive, modern geologic, metallogenic, and geophysical framework of eastern interior Alaska.

Photograph showing U.S. Geological Survey Alaska Science Center research geologist Jamey Jones working on geologic mapping and sampling in the West Crazy Mountains of the eastern interior of Alaska. Photograph by Adrian Bender, U.S. Geologic Survey.

Time frame	Project Partners
Fiscal years 2020–24	Alaska Department of Geological and Geophysical Surveys, Yukon Geological Survey, Geological Survey of Canada

Contact

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Project Link

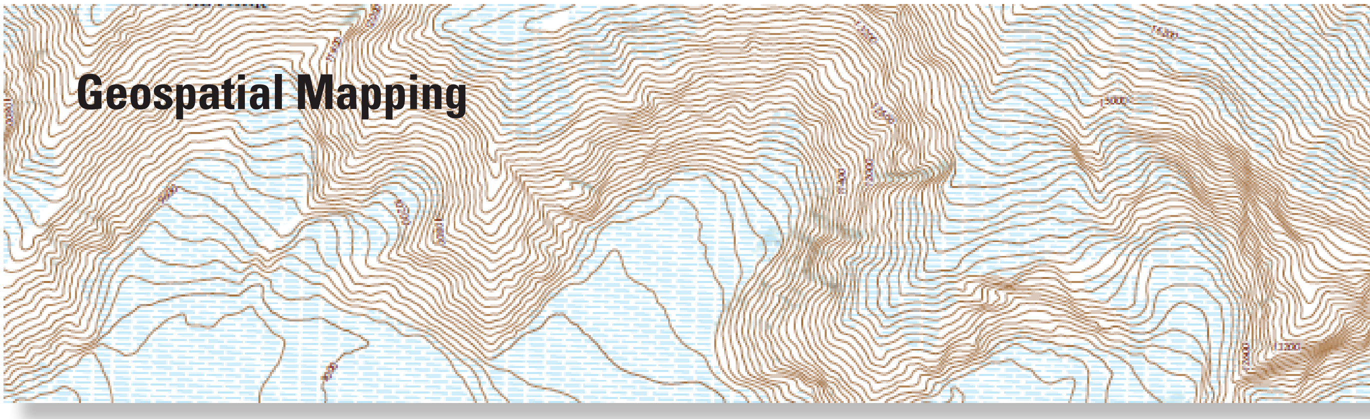
https://www.usgs.gov/centers/asc/science/tectonic-and-metallogenic-evolution-yukon-tanana-upland-alaska

Recent Publications

Kreiner, D.C., Hammarstrom, J., and Day, W., 2023, Critical minerals for a carbon-neutral future: Washington, D.C., Eos, v. 104, https://doi.org/10.1029/2023EO230403.

Bender, A.M., Lease, R.O., Corbett, L.B., Bierman, P.R., Caffee, M.W., and Rittenour, T.M., 2020, Late Cenozoic climate change paces landscape adjustments to Yukon River capture: Nature Geoscience, v. 13, p. 571–575, https://doi.org/10.1038/s41561-020-0611-4.

Kreiner, D.C., Jones, J.V., III, Kelley, K.D., and Graham, G.E., 2020, Tectonic and magmatic controls on the metallogenesis of porphyry deposits in Alaska, *in* Sharman, E.R., Lang, J.R., and Chapman, J.B., eds., Porphyry deposits of the Northwestern Cordillera of North America—A 25-year update v. 57: Montreal, Quebec, Canadian Institute of Mining and Metallurgy Special, p. 134–175.



Geospatial Mapping

Acquisition of Light Detection and Ranging (Lidar) Data

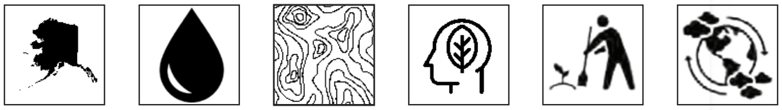
The USGS partners with Federal, State, and academic/private entities to collect high-quality, three-dimensional (3D) mapping data of the United States. The partnership 3D Elevation Program presents a unique opportunity for collaboration between all levels of government and private organizations to leverage the services and expertise of private-sector mapping firms that acquire 3D elevation data. Federal funds to support this opportunity are provided by the USGS, the Federal Emergency Management Agency (FEMA), and the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). The USGS facilitates planning and acquisition for the broader community using government contracts and partnerhip agreements. All data (digital elevation models) are made publicly available on the USGS's “The National Map” https://www.usgs.gov/tools/national-map-viewer.

Time frame	Project Partners
Fiscal year 2018–ongoing	Federal Emergency Management Agency, Natural Resources Conservation Service, National Park Service, Ahtna Native Regional Corporation, U.S. Forest Service

Contact

Brian Wright, National Geospatial Program, bwright@usgs.gov, 907–201–0113

Alaska Hydrography Map



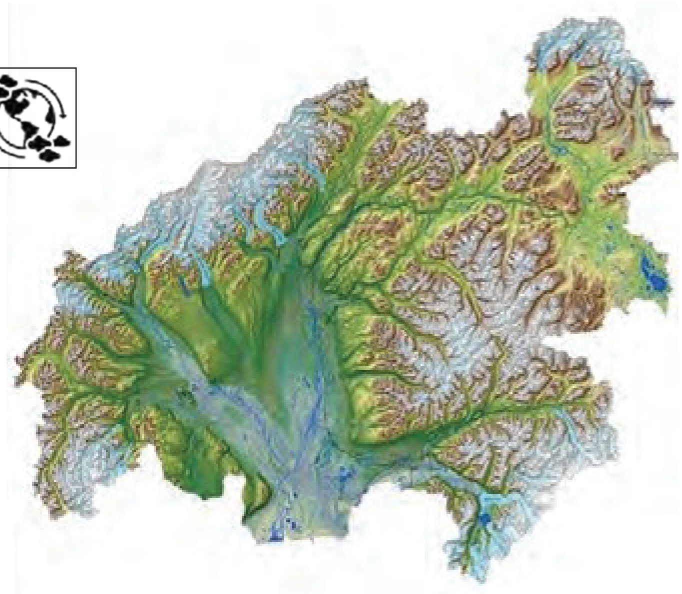


Image showing the terrain and hydrography of the Matanuska-Susitna watershed, south-central Alaska. Photograph by Kacy Krieger, University of Alaska Anchorage. Used with permission.

In Alaska, most mapping of water features is based on 1950s-era USGS historical topographic maps at a broad 1:63,360-scale. Numerous partners are engaged to remap Alaska waters to meet national high-resolution, 1:24,000-scale standards. This work is overseen by the Alaska Geospatial Council of Alaska Hydrography Technical Working Group, which has two goals: (1) update the National Hydrography Dataset (NHD) to national standards and (2) meet specific hydrography mapping needs of agencies in Alaska. As a result of this collaborative effort, 47 percent of the NHD in Alaska has been updated to the 1:24,000 scale national standard, and these data are available to the public. The updates also include updates to the Watershed Boundary Dataset (WBD).

The NHD, WBD, and NHDPlus High Resolution (NHDPlus HR) are geospatial datasets that map and model the surface water of the United States. Together, the NHD and WBD form a rich data suite that maps the Nation's surface-water network and hydrologic unit areas. The NHD, at 1:24,000 scale or better, represents the Nation's hydrologic drainage networks and related features, including rivers, streams, canals, lakes, ponds, glaciers, coastlines, dams, and streamgages. The WBD represents drainage areas of the country at eight nested levels. The NHD and WBD are the most up-to-date and geographically inclusive hydrography datasets for the Nation. In FY 2024, the USGS completed the transition to the new 3D Hydrography Program (3DHP). Currently, 3DHP surface-water data are available or are in progress for about 50 percent (295,100 square miles) of Alaska, and an additional 64,000 square miles are planned to be mapped.

Time frame	Project Partners
Fiscal year 2012–ongoing	State, Federal, and private partner engaged in the Alaska Geospatial Council

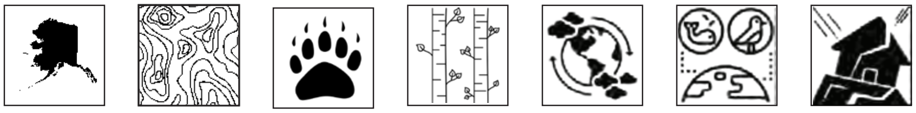
Contact

Brian Wright, National Geospatial Program, bwright@usgs.gov, 907–201–0113

Project Link

https://www.usgs.gov/core-science-systems/ngp/user-engagement-office/alaska-mapping-initiative

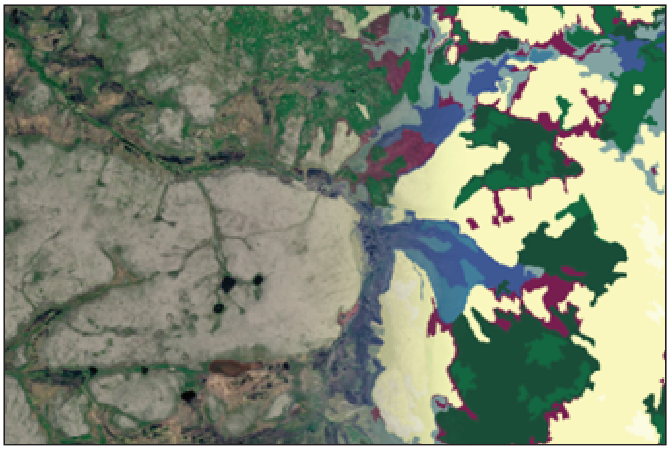
Alaska Statewide Vegetation Mapping



The Alaska Geospatial Council Vegetation Technical Working Group (VTWG) is comprised of Federal, State, and academic and private entities that address vegetation inventory and mapping needs in Alaska. USGS staff have been members of the VTWG since 2017. The purpose of VTWG is to develop a suite of vegetation inventory and mapping standards to coordinate the development of statewide vegetation mapping products. The VTWG is a collaborative effort that is responsive to stakeholder needs. For example, decision makers and natural resource managers use vegetation maps for land-use planning, for managing wildlife and habitat, and for managing fire and other hazards such as permafrost degradation.

VTWG products include:

1. A statewide database of field observations. VTWG developed a single data repository that stores field data from multiple entities. To date, 16 entities have contributed field vegetation data, and the database has approximately 30,000 field observations.



Categorical map showing vegetation types. Photograph by Alaska Geospatial Council Vegetation Technical Working Group. Used with permission.

2. Updates to the U.S. National Vegetation Classification System, which is the Federal Geographic Data Committee standard for vegetation classification.

3. Categorical map of vegetation types.

4. Continuous percent cover maps of characteristics: including, for example, species of management interest, narrow aggregates of species within the same genera (such as willow for moose browse), or percent cover plant functional types (such as deciduous shrubs).

Time frame	Project Partners
Fiscal year 2017–ongoing	National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, University of Alaska Anchorage, University of Alaska Fairbanks, ABR, Inc., Aecom, Ducks Unlimited, The Nature Conservancy, Natural Resources Conservation Service, Alaska Department of Fish and Game, State of Alaska, Environment Yukon

Contact

Elizabeth Powers, AKRO, epowers@usgs.gov, 907–229–5089

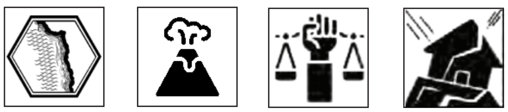
Project Link

https://agc-vegetation-soa-dnr.hub.arcgis.com/

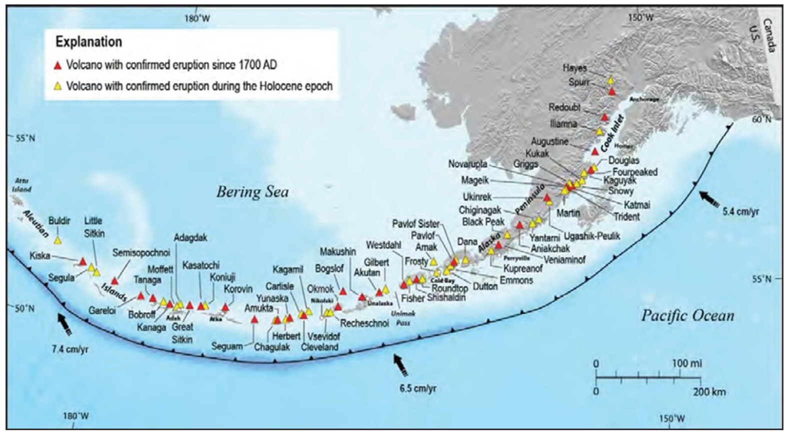
Natural Hazards

Volcanoes

Alaska Volcano Observatory



Alaska has 54 historically active volcanoes and about 100 volcanoes that were active in the past 11,000 years. The primary hazard from eruptions is airborne ash, though several communities are vulnerable to ashfall, mudflow, and pyroclastic flow hazards. AVO is a joint program of the USGS, the Geophysical Institute of the UAF, and the State of ADDGS. AVO was formed in 1988 to (1) monitor and study Alaska's hazardous volcanoes, (2) forecast and record eruptive activity, and (3) mitigate affects of volcanic hazards to life and property. AVO uses several monitoring methods including seismic stations at 32 volcanoes, continuous Global Positioning System stations at 8 volcanoes, regional and local infrasound sensors, and web cameras. In addition to ground-based monitoring, AVO relies on satellite data and other remote data streams to detect volcanic unrest and eruptions. AVO has robust basic and applied research programs that include topical and place-based studies using geophysics, petrology, geology, geochemistry, remote sensing, and numerical modeling. AVO produces formal information products regarding volcanic activity and hazards (https://volcanoes.usgs.gov/vns2/); journal articles; USGS publications on volcanic processes, methods, and hazards; and hazards assessments and geologic maps.



Map showing the volcanoes of the Aleutian Arc in Alaska. The U.S. Geological Survey Alaska Volcano Observatory uses various methods, including real-time geophysical networks and satellite imagery, to monitor activity at Alaskan volcanoes. This map shows the volcanoes stretching from Mount Hayes to Kiska. For more information about Alaska's volcanoes, please visit https://www.avo.alaska.edu.

Time frame	Project Partners
Fiscal year 1988–ongoing	University of Alaska Fairbanks, Alaska Division of Geological and Geophysical Surveys

Contact

Matthew M. Haney, AVO, mhaney@usgs.gov, 907–786–7111

Project Link

https://www.avo.alaska.edu/

Recent Publications

Kupres, C.A., Yang, X., Haney, M., and Roman, D.C., 2024, Sustained co-eruptive increase in seismic velocity below Great Sitkin Volcano due to magma extrusion: Geophysical Research Letters, v. 51, no. 15, https://doi.org/https://doi.org/10.1029/2024GL108991.

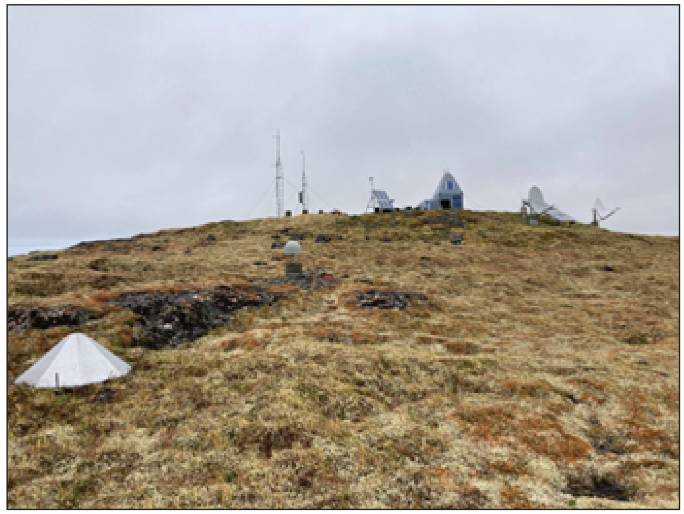
Mitchell, M.A., Peacock, J.R., and Burgess, S.D., 2023, Imaging the magmatic plumbing of the Clear Lake Volcanic Field using 3-D gravity inversions: Journal of Volcanology and Geothermal Research, v. 435, p. 107758, https://doi.org/10.1016/j.jvolgeores.2023.107758.

Ball, J.L., 2022, Stratigraphy and eruption history of maars in the Clear Lake Volcanic Field, California: Frontiers in Earth Science (Lausanne), v. 10, p. 911129, https://doi.org/10.3389/feart.2022.911129.

Alaska Volcano Observatory Network Hardening with Typhoon Merbok Disaster Supplemental Funds

Typhoon Merbok affected coastal communities and critical infrastructure in Alaska with high winds, rain, and storm surge in FY 2022. The resulting loss of power, data communications, and structural damage at remote sites hampered the AVO's ability to monitor active volcanoes. The Typhoon Merbok Disaster Supplemental provides funding to improve monitoring capabilities through the design, testing, and implementation of resilient power, data communication, and data acquisition systems. These objectives can be achieved through the following methods:

- repair damage to stations and regional receive facilities;
- harden communication infrastructure at receive facilities and major repeater sites;
- enhance and augment power systems at individual stations and provide back-up power systems at regional receive facilities;
- develop and employ back-up or failover internet connections (satellite, terrestrial) at regional receive facilities; and
- improve existing IT networking and data acquisition systems.



Station AMKA on the highpoint near the eastern end of the remote, uninhabited Amchitka Island. This site hosts local instrumentation, including seismic broadband and strong-motion sensors, a geodetic receiver, an infrasound array, and a camera pointing toward Semisopochnoi Island (volcanic island to the north). In addition to these local instruments, remote data from a tide gage in nearby Constantine Harbor and from volcano monitoring networks on both Semisopochnoi and Little Sitkin Islands are received and telemetered via satellite links to receiver facilities in Anchorage and the cloud. This site has received initial power enhancements and a redundant satellite link to improve system resiliency and data reliability. Additional work along these lines was performed during the fiscal year 2024 field season. Photograph by Steven M. Botnick, U.S. Geological Survey.

Most of the engineering, design, and testing of hardened systems and approaches are complete; remote acquisition systems have been developed; remote low-power data communication nodes are designed; remote power system designs are being finalized; and data communications at remote nodes can be accomplished through a combination of satellite, cellular, and utility telco circuits as appropriate. FY 2024–25 are the key field implementation years of this project, with FY 2026 being mostly devoted to completing project documentation, including the systems and approaches used to carry it out. The expected outcomes of this project are to reduce data loss, particularly loss resulting from severe weather, and increase real-time data availability for the entire AVO monitoring network. These advances can improve AVO's monitoring capabilities and allow it to always be operationally vigilant at all monitored volcanoes.

Time frame	Project Partners
Fiscal years 2023–26	Alaska Division of Geological and Geophysical Surveys, University of Alaska Geophysical Institute

Contact

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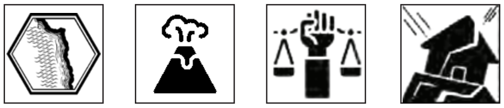
Mount Edgecumbe Volcano Monitoring Network



Detecting unrest at long dormant volcanoes is particularly challenging in Alaska because not all historically active volcanoes (eruptions in past 300 years) can be monitored with ground-based instrumentation because of the difficult logistical situation. Additional complications are Alaska's size and that volcanoes are in several distinct parts of the State. The most recent eruptive activity at Mount Edgecumbe, a 976-meter-high stratovolcano west of Sitka, Alaska, was at least 800 years ago, according to Tlingit oral history. Unrest was detected at the volcano in April 2022, and retrospective analysis revealed a magmatic intrusion beneath the volcano beginning in 2018. After this detection of unrest, AVO installed four seismometers and four geodetic sensors during FY 2022–23 at Mount Edgecumbe. As shown in the figure, the local network enabled much smaller (magnitude <1) earthquakes to be reliably detected and located, including a swarm of small volcanic earthquakes in January–February 2024. The local network has dramatically improved AVO's ability to forecast the possibility of future eruptive activity at the volcano.

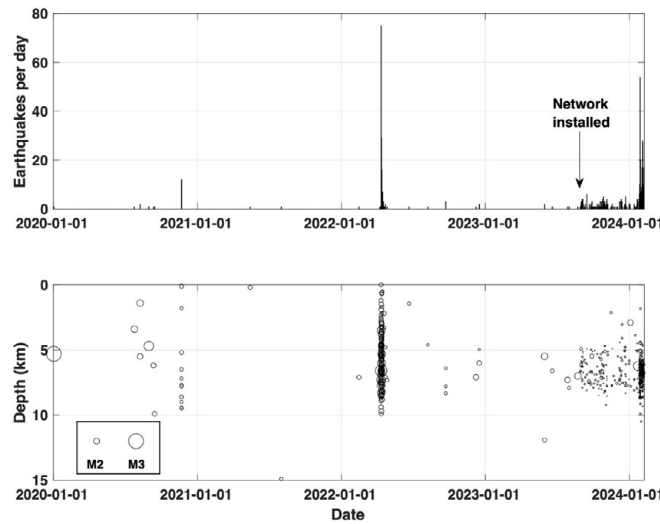
Time frame	Project Partners
Fiscal year 2022–ongoing	U.S. Forest Service, Sitka Sound Science Center

Contact

Matthew M. Haney, AVO, mhaney@usgs.gov, 907–786–7111

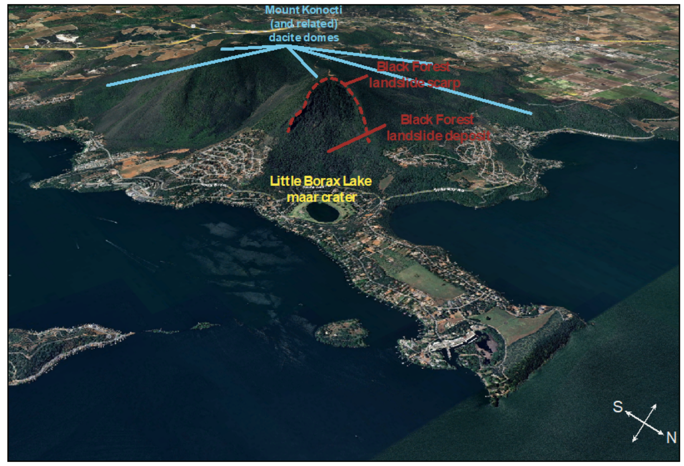
Recent Publication

Grapenthin, R., Cheng, Y., Angarita, M., Tan, D., Meyer, F.J., Fee, D., Wech, A., 2022, Return from dormancy—Rapid inflation and seismic unrest driven by transcrustal magma transfer at Mt. Edgecumbe (L'úx Shaa) Volcano, Alaska: Geophysical Research Letters, vol. 49, no. 20, https://doi.org/10.1029/2022GL099464.



Daily rate, depth, and magnitude (M2 and M3) of earthquakes in the vicinity of Mount Edgecumbe between January 1, 2020, and February 8, 2024. Earthquake information obtained from the Advanced National Seismic System Comprehensive Earthquake Catalog (https://earthquake.usgs.gov/data/comcat/). The time when U.S. Geological Survey Alaska Volcano Observatory finished installing a local seismic network at Mount Edgecumbe is indicated in the plot, and from that point forward, smaller earthquakes could be more reliably located. The largest earthquake swarm at Mount Edgecumbe during this period, in terms of daily rate and earthquake magnitude, was during April 2022. Graphs from the U.S. Geological Survey Alaska Volcano Observatory.

California Coast Range Volcanic Fields—The Clear Lake Volcanic Field



Oblique image showing Mount Konocti and related dacite domes adjacent to Clear Lake, California. Roughly a third of the total erupted volume of the Clear Lake volcanic field is represented by the approximately 35 cubic kilometers of rock comprising Mt. Konocti and nearby hills. A few of the dacite domes that form the mountain are labeled, as are the scarp and deposits of the Black Forest landslide. Imagery from Google Earth with U.S. Geological Survey annotations.

The California Coast Range mountains host several volcanic fields active during the past 30 million years. The most recently active is the Clear Lake Volcanic Field, close to the densely populated California Bay Area. With a 3-million-year record of volcanism as recent as approximately 8 kiloannum (Holocene), it is important to understand the threat of future volcano-related hazards to the regional population and infrastructure. The objectives of this project are to understand the Clear Lake Volcanic Field and its associated hazards from the bottom up using geophysical methods such as gravity and magnetotellurics to image the magmatic plumbing system. With physical volcanology, analysis of rock chemistry, and radiometric dating, the goal is to determine the timing and conditions of melt generation that resulted in past eruptions. This approach aims to construct a comprehensive picture of the volcanic system through space and time, which can inform an updated hazard assessment of the Clear Lake Volcanic Field. Since FY 2022, this project has hosted 2 science sessions at professional meetings, submitted 10 abstracts, and published 2 peer-reviewed manuscripts and one topical fact sheet. Project scientists and partner have also spent significant time in the field and laboratory collecting and generating various datasets and have participated in outreach with Lake and Mendocino County stakeholders, including members of the public, local landowners, the CALPINE power generation company, Lake County Winegrape Commission, Blue Ribbon Committee for the Rehabilitation of Clear Lake, and the Clear Lake Environmental Research Center.

Time frame	Project Partners
Ongoing	Geothermal Resource Investigations Project, University of California Davis, University of British Columbia

Contact

Seth Burgess, CalVO, sburgess@usgs.gov, 650–329–5220

Project Link

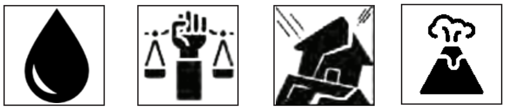
https://www.usgs.gov/volcanoes/clear-lake-volcanic-field

Recent Publications

Mitchell, M.A., Peacock, J.R., and Burgess, S.D., 2023, Imaging the magmatic plumbing of the Clear Lake Volcanic Field using 3-D gravity inversions: Journal of Volcanology and Geothermal Research, v. 435, p. 107758, https://doi.org/10.1016/j.jvolgeores.2023.107758.

Ball, J.L., 2022, Stratigraphy and eruption history of maars in the Clear Lake Volcanic Field, California: Frontiers in Earth Science (Lausanne), v. 10, p. 911129, https://doi.org/10.3389/feart.2022.911129.

Mount Shasta Volcanic Lahar (Volcanic Mudflows) Monitoring



The VSC is part of the Alaska Region that includes five U.S. regionally based volcano observatories, including the CalVO. CalVO was formed in 2012 and is headquartered at Menlo Park and Moffett Field, Calif. Sixteen young volcanoes designated as “Low Threat” to “Very High Threat” are dispersed throughout the State. Partially molten rock (magma) resides beneath at least seven of these—producing volcanic earthquakes (seismicity), toxic gas emissions, hot springs, ground movement, and lahars. Lahars (volcanic mudflows) are one of the most persistent and far-traveling volcanic hazards, extending tens of kilometers beyond a volcano’s flanks. Because they require only water and a source of volcanic debris, lahars may flow even when a volcano is not active or experiencing unrest, including because of seasonal weather events. Mount Shasta, a large stratovolcano in Shasta and Trinity Counties in northern California, has produced dozens of non-eruptive lahars in the last 150 years, most recently from 2014 to 2015 and again from 2021 to 2022. Effects of these flows have included damage to roads and water supply pipes, closures of major transportation routes, and disruptions to recreation in the Shasta-Trinity National Forest. The objectives of the CalVO project are to document, monitor, and assess the hazards of non-eruptive and eruptive lahars at Mount Shasta by combining methods of historical research, simulating hazard scenarios through numerical modeling, hazard product co-production with stakeholders, and seismic/infrasound/visual monitoring campaigns. Between FY 2022–24, the results of lahar modeling scenarios were shared with the U.S. Forest Service and other stakeholders as part of a hazard design workshop. In FY 2022, campaign-style seismic, infrasound, and video instruments were also deployed on Mount Shasta to collect data about the onset, timing, and characteristics of non-eruptive lahars. A co-analysis of historical records and weather and climate data was started in FY 2023 and is still underway. These ongoing efforts can help CalVO and our partner anticipate, prepare for, and mitigate lahar hazards at Mount Shasta.

Photograph showing the Mud Creek drainage on Mount Shasta’s southwest flank, which is the site of frequent non-eruptive lahars. In June 2022, these flows of mud and boulders posed a serious threat to the water supply pipe for the town of McCloud, California, necessitating the temporary installation of seismic, infrasound, and video monitoring equipment by California Volcano Observatory scientists. Photograph by Jessica L. Ball, U.S. Geological Survey.

Contact

Jessica L. Ball, CalVO, jlball@usgs.gov, 650–439–2597

Time frame	Project Partner
Fiscal years 2023–24	U.S. Forest Service

Project Link

https://www.usgs.gov/volcanoes/mount-shasta

Recent Publication

Ball, J.L., Hotovec-Ellis, A., and Dawson, P., 2023, Muddy waters—Are weather-related lahars the new norm at Mount Shasta?: International Association of Volcanology and Chemistry of the Earth's Interior, 2023 Scientific Assembly Book of Abstracts, p. 55, https://www.iavceivolcano.org/content/uploads/2021/03/iavcei-2023-book-of-abstracts.pdf.

Cascade Volcano Observatory Lahar (Volcanic Mudflows) Monitoring

The VSC is managed under the Alaska Region and includes five U.S. regionally based volcano observatories, including the CVO. CVO monitors a variety of volcanic related hazards, including eruptions of tephra and lava, pyroclastic flows, and lahars (volcanic mudflows), which pose a substantial hazard at Cascade Range volcanoes in Washington and Oregon. At Mount Rainier, Washington, lahars have occurred in association with and in the absence of volcanic activity. There, the CVO has built and maintains a lahar detection system. The objective is to provide earliest feasible notice of lahars sweeping down valleys where communities at risk could be affected within as little as tens of minutes to an hour of event onset. The system integrates seismometers, infrasound sensors, and tripwires into a comprehensive detection network. Scientists are exploring methods for developing automated, robust, event-detection algorithms that can swiftly notify emergency management authorities, providing them maximum time to alert communities at risk. CVO is actively engaged in community education and outreach and in FY 2023 developed agreements with stakeholders to codify and periodically test alert notification procedures. To aid interpretations of network data, recent modeling studies have assessed the behavior, speed, arrival times, and flow depths of hypothetical but realistic lahars, providing authorities with actionable information on potential hazards faced by their communities.

Photographs showing U.S. Geological Survey scientists installing a lahar detection system site at Mount Rainier, Washington. The secure box houses batteries, radio, and other equipment to detect lahars, power instruments, and return data to the U.S. Geological Survey Cascades Volcano Observatory. Detection algorithms automatically send alerts to emergency management centers in the Puget lowlands of Washington State. Photographs by Elizabeth Westby, U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2020–ongoing	Mount Rainier National Park, Washington State Emergency Management Division, Pierce County Department of Emergency Management

Contact

Jon Major, CVO, jjmajor@usgs.gov, 360–993–8927

Project Link

https://www.usgs.gov/volcanoes/mount-rainier

Recent Publication

George, D.L., Iverson, R.M., and Cannon, C.M., 2022, Modeling the dynamics of lahars that originate as landslides on the west side of Mount Rainier, Washington: U.S. Geological Survey Open-File Report 2021–1118, 54 p., https://doi.org/10.3133/ofr20211118.

Yellowstone Volcano Observatory

The VSC is managed from Anchorage, Alaska, and it oversees five volcano observatories, including the YVO. Small hydrothermal explosions are an underappreciated geologic hazard in Yellowstone National Park and happen almost annually, but usually in backcountry locations. In July 2024, a plume of hot water, mud, and rock exploded and rose 400–600 feet at Yellowstone National Park. People in the vicinity ran for safety and no one was injured. The YVO monitoring plan for the Yellowstone volcanic system provides a framework for a hydrothermal monitoring system, with the objectives of tracking changes and forecasting hazardous hydrothermal activity. To accomplish these objectives, seismic, Global Navigation Satellite Systems, and infrasound sensors are installed in hydrothermal areas. The first such multiparameter station was installed in the middle of Norris Geyser Basin during FY 2023. Almost immediately, the new data streams paid dividends, providing additional indicators on locating small earthquakes in the region and detecting eruptions of Steamboat Geyser, the tallest geyser in the world, via the 3-element infrasound array. YVO anticipates that the data from their multiparameter stations will be used for researching the dynamics of hydrothermal activity and for monitoring changes that might otherwise go unobserved.

Photograph showing the largest boulder confirmed to have been part of the July 23, 2024, hydrothermal explosion from Black Diamond Pool, Biscuit Basin, Yellowstone National Park. The tape measure is 20 inches long. Black Diamond Pool and a boardwalk are in the background, and the foreground is scattered with smaller rocks that were part of the explosion. Photograph by Lauren Harrison, Colorado State University, on July 25, 2024.

Time frame	Project Partners
Fiscal year 2020–ongoing	University of Utah, Yellowstone National Park, EarthScope Consortium

Contact

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Project Link

https://www.usgs.gov/observatories/yvo/news/a-new-monitoring-site-track-hydrothermal-activity-norris-geyser-basin

Recent Publication

Yellowstone Volcano Observatory, 2022, Volcano and earthquake monitoring plan for the Yellowstone Caldera system, 2022–2032: U.S. Geological Survey Scientific Investigations Report 2022–5032, 23 p., https://doi.org/https://doi.org/10.3133/sir20225032.

Volcano Disaster Assistance Program

In FY 2024, the USGS co-organized and co-funded the 5th Volcano Observatory Best Practices meeting in Pucón, Chile. Funds to the USGS were made available from the former U.S. Agency for International Development through the Volcano Disaster Assistance Program and its interagency agreement. About 70 people from 23 countries attended the meeting, which this year was focused on Volcano Observatory Communications. Observatory staff, social science researchers, and volcanologists joined together to discuss this critical theme. Key topics included (1) roles and responsibilities of observatories and civil protection authorities in communicating volcano hazards; (2) building relationships with stakeholders; (3) social media; (4) communicating during unrest and crises; (5) worst-case scenarios; and (6) volcano data. Logistics for the meeting were organized principally by SERNAGEOMIN (Chile) and their partner at the Universidad de la Frontera. Besides the Volcano Disaster Assistance Program, funding also came from the Instituto Nazionale di Geofisica e Vulcanogia. More than half of the participants received partial to full travel support to attend the meeting. Instituto Nazionale di Geofisica e Vulcanogia and the USGS are now planning the next meeting for FY 2027 that will be in Catania, Sicily.

Photograph showing the 5th Volcano Observatory Best Practices participants at Pucón, Chile; the conference focused on the topic of Volcano Observatory Communications. Photograph by SERNAGEOMIN.

Time frame	Project Partners
Fiscal years 2023–24	U.S. Agency for International Development, U.S. Geological Survey Volcano Hazards Program

Contact

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Project Link

https://volcanoes.usgs.gov/vdap/

National Volcano Early Warning System

The objective of USGS's National Volcano Early Warning System (NVEWS) is to develop and maintain a fully integrated national-scale volcano monitoring system to monitor U.S. volcanoes. Key components of NVEWS, when fully implemented, include volcano monitoring networks, interoperability across all five U.S. volcano observatories, the National Volcano Information Service, a 24/7 national watch office capability, and an external grants program. Project efforts focused on targeted hiring of key personnel (including National Volcano Information Service and NVEWS project managers, a data scientist, and other critical technical support), a pilot project to move a key VSC service into the cloud, developing the first-ever inventory of all data pathways at each observatory, maintaining and upgrading existing monitoring networks, adding new stations at targeted, high-priority volcanoes (for example, Mount Edgecumbe, Mount Rainier), developing the first center-wide response plan, and facilitating VSC-wide discussions about achieving greater interoperability across the VSC.

Photograph showing one of Alaska Volcano Observatory's three new seismic and Global Navigation Satellite System stations in a small network around the Mount Edgecumbe volcano in late fiscal year 2023. Shown is station EDES with Mount Edgecumbe in the background. Max Enders (U.S. Geological Survey) is pictured. Photograph by Max Kaufman, University of Alaska Fairbanks Geophysical Institute.

Time frame	Project Partners
Fiscal year 2022–ongoing	University of Alaska Fairbanks, Alaska Division of Geological and Geophysical Surveys, University of Washington, University of Oregon, University of Hawaii

Contact

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Project Link

https://www.usgs.gov/programs/VHP/national-volcano-early-warning-system-monitoring-volcanoes-according-their-threat

Recent Publication

Wilkins, A., Mandeville, C., Power, J., and Given, D., 2023, Comparison of earthquake early warning systems and the national volcano early warning system at the U.S. Geological Survey: U.S. Geological Survey Fact Sheet 2023–3033, 4 p., https://doi.org/10.3133/fs20233033.

Hawaii Volcano Observatory

Image of a webcam deployed to monitor the 2022 eruption of Mauna Loa. Photograph by K. Mulliken, U.S. Geological Survey.

Hawaii's two very high-threat volcanoes frequently erupt. Kīlauea has erupted 5 times at the summit since 2020 and Mauna Loa erupted for the first time in 38 years in 2022. Real-time views of a volcanic eruption site are a vital source of information for emergency managers, and webcams have become one of the most important tools in an eruption crisis. The USGS HVO maintains a network of approximately 30 continuously operating webcams across Mauna Loa and Kīlauea that have provided views of recent eruptions at these volcanoes. During eruptions or periods of unrest, additional cameras are deployed near areas of activity to provide additional coverage, transmitting data over cellular or satellite networks to provide situational awareness. Many of these cameras and their supporting network infrastructure were funded by the Additional Supplemental Appropriations for Disaster Relief Act of 2019 (H.R. 2157) as part of HVO's efforts to rebuild and harden the monitoring network after the 2018 Kīlauea eruption and summit collapse.

During the 2022 Mauna Loa eruption, multiple cellular cameras were deployed at locations near the high-elevation vents, along the channelized lava flows, and at the flow front that was encroaching on the Daniel K. Inouye Highway. Additionally, a live-stream camera provided a real-time view of the lava fountains at the vent, allowing remote monitoring of effusion changes. During the 2020 to 2023 Kīlauea summit eruptions, network monitoring cameras recorded dramatic images associated with the onset of new eruptions, including more than 300 tall lava fountains, as well as long-term dynamic processes like endogenous growth of the Halemaʻumaʻu lava lake because of magma accumulation below. Monitoring cameras are also positioned along the southeast and southwest rift zones. In addition to high-resolution visual cameras, HVO also operates thermal cameras at Kīlauea and Mauna Loa summits to facilitate monitoring and mapping of active regions within the caldera. An increasing number of controllable pan-tilt-zoom cameras are also being deployed so that specific features at the summits can be imaged for situational awareness, scientific analysis, and hazard assessment.

Contact

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Earthquakes, Landslides, and Tsunamis

Landslide and Tsunami Hazards in Glacier Bay National Park and Preserve

The Glacier Bay National Park and Preserve has a history of earthquake- and climate-induced landslides. When these landslides initiate underwater or rapidly enter the water, they can generate waves that can be hazardous to marine vessels. In FY 2022, about 520,000 people visited Glacier Bay National Park and Preserve on cruise ships and tour boats. The objectives of this project are to evaluate landslide and landslide-generated tsunami hazards within the park. The evaluation methods being used include rock mass quality and structural characterization; landslide inventory mapping from lidar, Interferometric Synthetic Aperture Radar, and bathymetric data; modeling to determine spatially variable landslide susceptibility; and numerical simulations of landslide runout and landslide-generated tsunamis. Since the publication of the FY 2021–22 biennial science report for the Alaska region, we have published results summarizing landslide inventory and susceptibility mapping and observations important for evaluating the possible affects that mountain permafrost degradation, glacier thinning, and retreat will have on landslide magnitudes and frequencies. We are actively sharing our results with the NPS leadership team for Glacier Bay National Park and Preserve.

U.S. Geological Survey and National Park Service staff inspect rocks in Glacier Bay National Park and Preserve, and the captain of the National Park Service research vessel, Capelin, waits nearby. Photograph by Jeff Coe, U.S. Geological Survey.

Time frame	Project Partner
Fiscal year 2020–ongoing	National Park Service

Contact

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Project Links

https://www.usgs.gov/natural-hazards/landslide-hazards/science/mountain-permafrost-climate-change-and-rock-avalanches

https://www.usgs.gov/natural-hazards/landslide-hazards/science/potential-landslide-paths-and-implications-tsunami-hazards

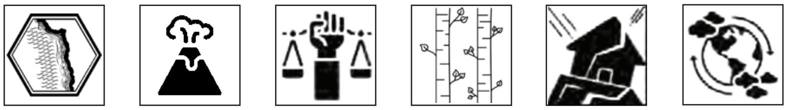
Recent Publications

Hults, C.P., Coe, J.A., and Avdievitch, N.N., 2023, Fractures, scarps, faults, and landslides mapped using LiDAR—Glacier Bay National Park and Preserve, Alaska: Fort Collins, Colo., NPS, Natural Resource Report NPS/GLBA/NRR—2023/2605, https://doi.org/10.36967/2300706.

Kim, J., Coe, J.A., Lu, Z., Avdievitch, N.N., and Hults, C.P., 2022, Spaceborne InSAR mapping of landslides and subsidence in rapidly deglaciating terrain, Glacier Bay National Park and Preserve and vicinity, Alaska and British Columbia: Remote Sensing of Environment, v. 281, p. 113231, https://doi.org/10.1016/j.rse.2022.113231.

Smith, W.D., Dunning, S.A., Ross, N., Telling, J., Jensen, E.K., Shugar, D.H., Coe, J.A., and Geertsema, M., 2023, Revising supraglacial rock avalanche magnitudes and frequencies in Glacier Bay National Park, Alaska: Geomorphology, v. 425, 15 p., https://doi.org/10.1016/j.geomorph.2023.108591.

Prince William Sound Landslide Hazards



Landslides and landslide-generated tsunami hazards are prevalent in the steep, seismically active, and deglaciated mountains and fiords of the Prince William Sound. In addition to the submarine landslides and tsunami that were initiated during the March 1964 magnitude 9.2 (M9.2) earthquake in PWS that resulted in region-wide devastation and loss of life, more recent analysis has revealed other large, slow-moving landslides that represent significant hazard should they fall rapidly and catastrophically into adjacent waterbodies.

Core objectives of the Prince William Sound Landslide Hazards Project are intended to advance our understanding of landslide hazard and risk in the region and include (1) developing a regional landslide hazard assessment, (2) defining a strategy for long-term surveillance of unstable slopes in the region, and (3) partnering with other Federal, State, and local agencies to develop a warning system to alert for a landslide-generated tsunami. Methods used to accomplish these objectives include geologic and geomorphic mapping, remote sensing, geophysical monitoring, and modeling of slope stability, tsunami generation, and wave propagation.

We have published subaerial and submarine landslide inventories from northwestern Prince William Sound, used remote sensing to identify slow-moving landslides in the region, released maps showing the tsunamigenic potential for several landslide failure scenarios at the Barry Arm landslide, and documented the multiplatform and interdisciplinary methods being used to surveil the Barry Arm landslide. We are actively coordinating with other Federal, State, and local agencies to provide actionable scientific information on landslide hazards that can be used to inform community planning, resource management, emergency response operations, and risk reduction efforts. Furthermore, science and monitoring results from this project can directly inform warning operations at the National Tsunami Warning Center in Palmer, Alaska.

Photograph showing a ground-based synthetic aperture radar unit installed on the east side of Barry Arm, Prince William Sound, Alaska. This instrument is designed to capture high spatiotemporal resolution data by characterizing the motion of the Barry Arm landslide. Photograph by Dennis Staley, U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2020–ongoing	Alaska Department of Geological and Geophysical Surveys, National Oceanic and Atmospheric Administration National Tsunami Warning Center, Alaska Earthquake Center

Contact

Jeffrey Coe, Geologic Hazards Science Center, jcoe@usgs.gov, 303–273–8606

Project Links

https://www.usgs.gov/natural-hazards/landslide-hazards/science/barry-arm-alaska-landslide-and-tsunami-monitoring

https://dggs.alaska.gov/hazards/barry-arm-landslide.html

Recent Publications

Barnhart, K.R., Jones, R.P., George, D.L., Coe, J.A., and Staley, D.M., 2021, Preliminary assessment of the wave generating potential from landslides at Barry Arm, Prince William Sound, Alaska: U.S. Geological Survey Open-File Report 2021–1071, 28 p., https://doi.org/10.3133/ofr20211071.

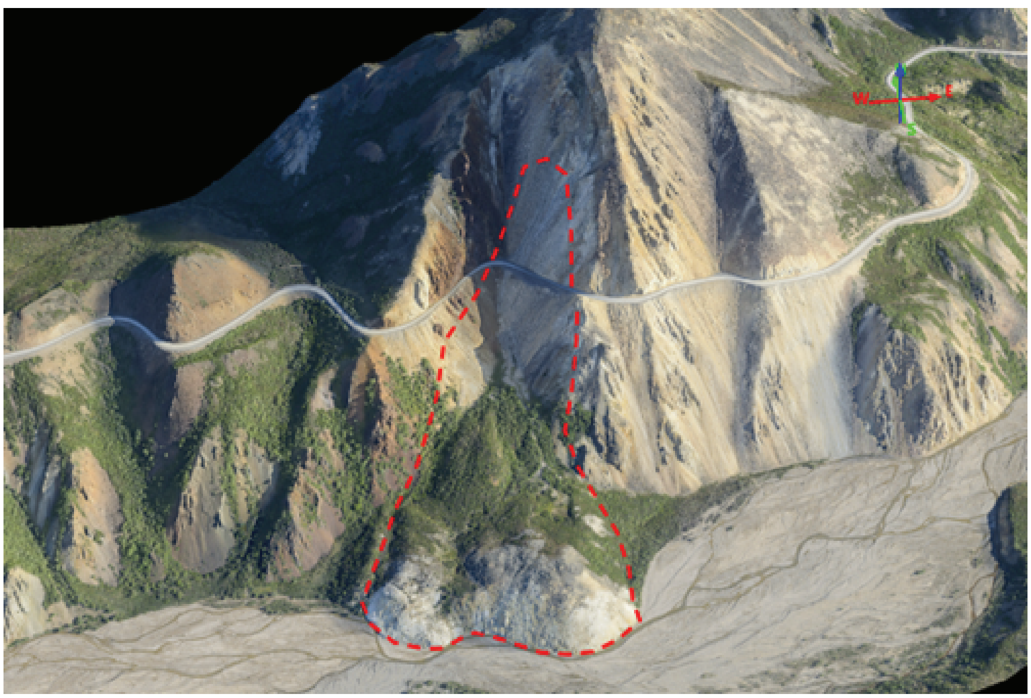
Schaefer, L.N., Coe, J.A., Jones, K.W., Collins, B.D., Staley, D.M., West, M., Karasozen, E., Miles, C., Wolken, G.J., Daannen, R.P., Baxstrom, K.W., 2023, Kinematic evolution of a large paraglacial landslide in the Barry Arm fjord of Alaska: Journal of Geophysical Research: Earth Surface, v. 128, no. 11, https://doi.org/10.1029/2023JF007119.

Schaefer, L.N., Kim, J., Staley, D.M., Lu, Z., and Barnhart, K.R., 2024, Satellite interferometry landslide detection and preliminary tsunamigenic plausibility assessment in Prince William Sound, southcentral Alaska: U.S. Geological Survey Open-File Report 2023–1099, 22 p., https://doi.org/10.3133/ofr20231099.

Assessing the Risk to National Park Service Lands in Alaska Imposed by Rapidly Warming Temperatures

The observed rate of warming in many NPS lands in Alaska has accelerated soil subsidence and increased landslide frequency, thereby threatening public access, subsistence activities, and infrastructure. Areas most affected by this change are along the Denali Park Road, the proposed Ambler Road through Gates of the Arctic National Park & Preserve should be inserted here, and the McCarthy Road in Wrangell-St. Elias National Park & Preserve should be added here. Resource managers need accurate, localized climate information to assess and plan for future landslide hazards. This project addresses concerns and management implications of warming in these focus areas with an overarching goal to minimize and mitigate resulting affects.

Methods of doing this include using high-resolution climate data available from the AK CASC and the NPS Inventory and Monitoring Weather Station, park-level assessments of ground instability, and landslide vulnerability data from the three focus areas that can aid in the decision-making process for resource managers. Resulting project information will also be disseminated to the three parks for use in resource management planning, infrastructure stability assessments, and other park planning. Additionally, future climate-based decisions have the potential to go beyond resource management to inform infrastructure planning, including the new NPS Strategic Facility Investment Planning Initiative.



Composite photograph of the Pretty Rocks landslide. Photograph by National Park Service.

Contact

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Time frame	Project Partner
Fiscal years 2022–23	National Park Service

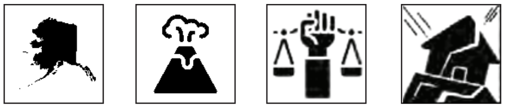
Project Link

https://www.usgs.gov/programs/climate-adaptation-science-centers/science/assessing-risk-national-park-service-lands

Recent Publication

Lader, R., Sousanes, P., Bhatt, U.S., Walsh, J.E., and Bieniek, P.A., 2022, Climate indicators of landslide risks on Alaska National Park Road Corridors: Atmosphere, v. 14, no. 1, 34 p., https://doi.org/10.3390/atmos14010034.

Alaska Earthquake Hazards



The major active fault systems in Alaska include the Denali and Queen Charlotte-Fairweather Faults and the Alaska-Aleutian Subduction Zone, both of which can produce large earthquakes that may threaten lives and property. Many active faults, especially along the subduction zone, can generate large tsunamis that threaten Alaskan coastal communities and propagate across the Pacific Ocean causing widespread affects. The main objective of the Alaska Earthquake Hazards Project is to focus on more accurately defining the location, magnitude, and frequency of prehistoric earthquakes and tsunamis, which inform probabilistic assessments of future hazards. Using methods from paleoseismology, geochronology, and quantitative geomorphology, the research team completes field-based studies to understand how, where, and why earthquakes and tsunamis happen in Alaska. Expected outcomes of these studies include the gathering of seismic and tsunami source parameters that are used to update the National Seismic Hazard Map for Alaska. Research results inform tsunami hazard assessments completed by States and territories with support from the National Oceanic and Atmospheric Administration National Tsunami Hazard Mitigation Program.

Photograph showing a U.S. Geological Survey geologist surveying a trace of the 1958 Fairweather Fault earthquake surface rupture at Crillon Lake, Glacier Bay National Park and Preserve, southeast Alaska. Trace forms a linear, uphill-facing, 1–2-meter-tall escarpment flanked by trees that likely were tilted during the 1958 earthquake. Photograph by Rob Witter, U.S. Geological Survey.

Time frame	Project Partners
Fiscal years 2007–25	U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory, Alaska Department of Geological and Geophysical Surveys, University of Durham, Virginia Polytechnic Institute and State University, University of Washington, Boise State University, Ghent University, Cortland State University, Michigan State University, University of Alaska Fairbanks, Oregon State University

Contact

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Project Link

https://www.usgs.gov/centers/asc/science/alaska-earthquake-and-tsunami-hazards

Recent Publications

Witter, R., Briggs, R., Dura, T., Engelhart, S., and Nelson, A., 2022, Seismic sources in the Aleutian cradle of tsunamis: Eos, v. 103, https://eos.org/features/seismic-sources-in-the-aleutian-cradle-of-tsunamis.

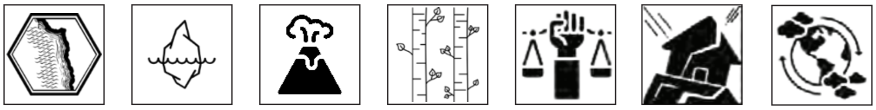
Grant, A.R.R., Jibson, R.W., Witter, R.C., Allstadt, K.E., Thompson, E.M., and Bender, A.M., 2020, Ground failure triggered by shaking during the November 30, 2018, magnitude 7.1 Anchorage, Alaska, earthquake: U.S. Geological Survey Open-File Report 2020–1043, 21 p., https://doi.org/10.3133/ofr20201043.

Jibson, R.W., Grant, A.R.R., Witter, R.C., Allstadt, K.E., Thompson, E.M., and Bender, A.M., 2019, Ground failure from the Anchorage, Alaska, earthquake of 30 November 2018: Seismological Research Letters, v. 91, no. 1, p. 19–32, https://doi.org/10.1785/0220190187.

Witter, R., Briggs, R., Engelhart, S.E., Gelfenbaum, G., Koehler, R.D., Nelson, A., La Selle, S.P., Corbett, R., and Wallace, K., 2019, Evidence for frequent, large tsunamis spanning locked and creeping parts of the Aleutian megathrust: Geological Society of America Bulletin, v. 131, no. 5–6, p. 707–729, https://doi.org/10.1130/B32031.1.

Sea-Ice Loss, Coastal Flooding, and Erosion

Alaska Coastal Processes and Hazards



Erosion along the Beaufort Sea coast mobilizes large quantities of organic matter to the Arctic Ocean where it may be remineralized, releasing greenhouse gases and fueling marine primary production. Terrestrially derived organic carbon also accumulates in nearshore food webs along this coastline, reflecting its use as an energy subsidy. The objective of this project is to examine the relative contributions of eroding permafrost soils, river particulates, and marine production to organic matter in lagoon sediments along the Alaska Beaufort Sea coast. We use various geochemical methods, such as dual-carbon isotopic mixing models and lipid biomarkers, to characterize organic matter and track eroded material in the marine environment. These characterizations should provide insights about how varying erosion rates, river inputs, and other factors affect benthic habitats in lagoons and regional carbon cycling.

Photograph showing a high ice content permafrost bluff erosion following a series of coastal storms and a prolonged time of anomalously high air temperatures on Barter Island in Beaufort Sea, northern Alaska, fiscal year 2019. Photograph by U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2020–ongoing	U.S. Geological Survey Alaska Climate Adaptation Science Center, Alaska Department of Geological and Geophysical Surveys, National Oceanic and Atmospheric Administration, National Weather Service, University of Alaska Fairbanks

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Ann Gibbs, Pacific Coastal and Marine Science Center, agibbs@usgs.gov, 831–460–7540

Ferdinand Oberle, Pacific Coastal and Marine Science Center, foberle@usgs.gov, 831–460–7589

Project Links

https://www.usgs.gov/centers/pcmsc/science/climate-impacts-arctic-coasts

https://www.usgs.gov/natural-hazards/coastal-marine-hazards-and-resources/science/climate-change-us-arctic-ocean-margins

Recent Publications

Erikson, L.H., Nederhoff, K., Engelstad, A., Kasper, J., and Bieniek, P, 2022, Central Beaufort Sea wave and hydrodynamic modeling study—Report 2—Modeled waves, hydrodynamics, and sediment transport in Foggy Island Bay: Anchorage, Alaska, U.S. Department of the Interior, Bureau of Ocean Energy Management, prepared by the U.S. Geological Survey, Santa Cruz, Calif., under interagency agreement M17PG00046 and by the Alaska Center for Energy and Power, Fairbanks, Alaska, under cooperative agreement M17AC00020, 64 p.

Gibbs, A.E., Erikson, L.H., and Hamilton, A.I., 2023, Barrier islands and spits of northern Alaska—Decadal scale morphological change, *in*: The Proceedings of the Coastal Sediments 2023, New Orleans, LA, April 2023, P. Wang, E. Royer, J.D. Rosati (Eds). Singapore, World Scientific Publishing, p. 36–43, https://doi.org/10.1142/9789811275135_0004.

Building a Coastal Flood Hazard Assessment Tool with At-Risk Alaska Communities

Logo of the Coastal Storm Modeling System (CoSMoS). Image by U.S. Geological Survey.

Coastal flooding and erosion are increasingly threatening infrastructure and public safety in Alaskan Native communities. Although many scientists and projects are attentive to the problem, there are still very limited coastal flood hazard vulnerability assessment tools that use cutting-edge modeling approaches that can also be customized to specific community needs in a manner that easily supports local adaptation planning. The Coastal Storm Modeling System (CoSMoS) is a dynamic modeling approach developed by the USGS in collaboration with partner to achieve detailed scenario projections of coastal flooding caused by the combination of coastal storm events (waves and storm tides) and sea-level rise scenarios. CoSMoS is already used in California, but variants are also applied along the East Coast and the Pacific Islands, and now the model is being adapted for Arctic conditions so it can be used by Alaska communities along the Beaufort, Chukchi, and Bering Sea coastlines where storm threats are highest. The model projections include the effects of large-scale patterns such as diminishing sea-ice cover, permafrost thaw, and shoreline change that are scaled down to local flood projections for use in community-level planning and decision making.

The main goal of this project is to use the CoSMoS platform to inform and help co-produce locally customized flood hazard maps and online tools to support the development of culturally appropriate and cost-efficient adaptation strategies. The project team works with Federal, State, and local community representatives to understand the priority tools and output products deemed most relevant for local use. The model system integrates topographic elevation data and the highest resolution atmospheric and sea-ice data available from the latest generation global climate models to map plausible coastal flood hazards until the mid-21st century.

Time frame	Project Partners
Fiscal years 2022–25	Alaska Division of Geological and Geophysical Surveys, Coastal Analytics LLC, University of California Santa Cruz

Contact

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Project Link

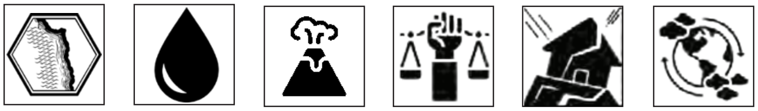
https://www.usgs.gov/programs/climate-adaptation-science-centers/science/building-a-coastal-flood-hazard-assessment-and

Recent Publications

Buzard, R.M., Maio, C.V., Erikson, L.H., Overbeck, J.R., Kinsman, N.E.M., and Jones, B.M., 2024, Current and projected flood exposure for Alaska coastal communities: Scientific Reports, v. 14, no. 1, p. 7765, https://doi.org/10.1038/s41598-024-58270-w.

Williams, D.M., and Erikson, L.H., 2021, Knowledge gaps update to the 2019 IPCC special report on the ocean and cryosphere—Prospects to refine coastal flood hazard assessments and adaptation strategies with at-risk communities of Alaska: Frontiers in Climate, v. 3, 11 p., https://doi.org/10.3389/fclim.2021.761439.

Building an Operational System to Forecast Potential Flood Hazards in Unalakleet, Alaska



Like many coastal communities in Alaska, the village of Unalakleet is vulnerable to marine flooding during large storms. Norton Sound typically has storm surges in the fall and winter months when the coastline is covered with shorefast ice. However, warming trends in the Arctic have resulted in reduced ice coverage at the sound and increased development of wave events affecting coasts. Two video cameras were installed by the USGS in collaboration with the Alaska Division of Geological and Geophysical Surveys and village authorities to better document and understand wave and water-level dynamics in Norton Sound.

Every 30 minutes, during daylight hours, the cameras collect snapshots and videos for 10 minutes, which are posted online. These and other images are then used to observe and quantify coastal processes such as wave runup, development of rip channels, bluff erosion, and movement of sandbars and ice floes. The USGS plans to install similar systems in other U.S. locations (two video cameras temporarily overlooked the Beaufort Sea coast from atop the coastal bluff of Barter Island near Kaktovik in FY 2018). The knowledge gained from this imagery can improve computer-derived simulations of shoreline change that communities can use to plan for sea-level rise, changing storm patterns, and other threats to coasts. In collaboration with National Oceanic and Atmospheric Administration, the overriding USGS goal is to develop a real-time system that provides approximate 6-day forecasts of total water level and flood potentials from the analysis of astronomic tides, storm surge, and wave runup. Toward that end, about 90 kilometers (km) of bathymetry track-line data were collected in the inlet and estuary and along the open coast extending about 1.2 km north and south of the inlet and about 1.5 km offshore.

Photograph showing a view looking westward over Norton Sound from U.S. Geological Survey-operated video camera atop a windmill tower in Unalakleet, western Alaska. Photograph by U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2019–ongoing	Alaska Division of Geological and Geophysical Surveys, Native Village of Unalakleet, City of Unalakleet, National Oceanic and Atmospheric Administration

Contacts

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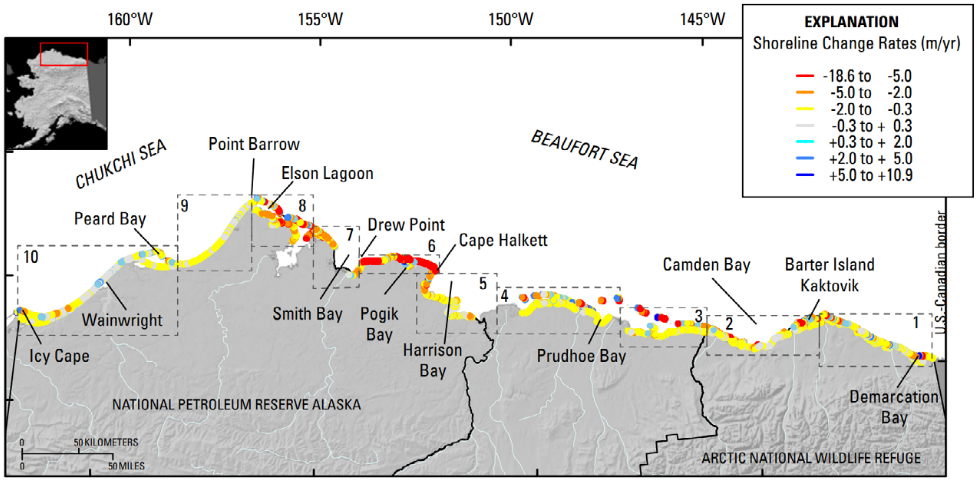
Ann Gibbs, Pacific Coastal and Marine Science Center, agibbs@usgs.gov, 831–460–7540

Project Link

https://www.usgs.gov/centers/pcmsc/science/using-video-imagery-study-wave-dynamics-unalakleet

National Assessment of Shoreline Change on the Coast of Alaska

Rates and patterns of historical shoreline change are quantified along Alaska's coast as part of the USGS Coastal Change Hazards focus area and the Alaska Coastal Processes and Hazards projects. Consistent methods used across the projects allows for systematic and objective comparisons of change along all U.S. coastlines. By understanding the causal relationship between shoreline change and sediment movement with forcings, such as coastal storms and atmospheric conditions, the USGS can develop better models for understanding long-term vulnerability from coastal hazards and help coastal managers and communities plan for a changing climate. Objectives of this project include developing and improving coastal-change assessments, quantifying rates of change, and supporting long-term planning and decision making to ensure sustainable coastal economies, infrastructure, and ecosystems. Initial assessments are complete for the coast north of the Bering Strait to the U.S. Canadian border. The next phase of analysis extends the study area south to the Yukon-Kuskokwim Delta. Updated rates will be calculated as new shoreline datasets become available.



Map showing color-coded shoreline change rates and key geographic locations on the north coast of Alaska.

Contact

Ann Gibbs, Pacific Coastal and Marine Science Center,
agibbs@usgs.gov, 831– 460–7540

Time frame	Project Partner
Fiscal year 2006–ongoing	Alaska Department of Geological and Geophysical Surveys

Project Links

https://www.usgs.gov/natural-hazards/coastal-marine-hazards-and-resources/science/climate-change-us-arctic-ocean-margins

https://www.usgs.gov/centers/pcmsc/science/climate-impacts-arctic-coasts

https://www.usgs.gov/natural-hazards/coastal-marine-hazards-and-resources/science/national-assessment-coastal-change

Recent Publications

Gibbs, A.E., Erikson, L.H., and Hamilton, A.I., 2023, Barrier islands and spits of northern Alaska—Decadal scale morphological change, *in* The Proceedings of the Coastal Sediments 2023, New Orleans, LA, April 2023, P. Wang, E. Royer, J.D. Rosati (Eds). Singapore, World Scientific Publishing, p. 36–43, https://doi.org/10.1142/9789811275135_0004.

Piliouras, A., Jones, B.M., Clevenger, T., Gibbs, A.E., and Rowland, J.C., 2023, Variability in terrestrial characteristics and erosion rates on the Alaskan Beaufort Sea coast: Environmental Research Letters, v. 18, no. 11, p. 114050, https://doi.org/10.1088/1748-9326/ad04b8.

Zimmermann, M., Erikson, L.H., Gibbs, A.E., Prescott, M.M., Escarzaga, S.M., Tweedie, C.E., Kasper, J.L., and Duvoy, P.X., 2022, Nearshore bathymetric changes along the Alaska Beaufort Sea coast and possible physical drivers: Continental Shelf Research, v. 242, p. 10475, https://doi.org/10.1016/j.csr.2022.104745.

Other Hazards

Using Dendrochronology to Understand the Frequency and Magnitude of Snow Avalanches in Southeast Alaska

Photograph showing a U.S. Geological Survey researcher holding a cross section of a tree to look for irregular rings. Photograph by Molly Tankersley, U.S. Geological Survey.

Snow avalanches affect transportation corridors and settlements throughout western North America. The city and Borough of Juneau (CBJ), Alaska, and surrounding region has the highest urban avalanche danger in the United States, with regular effects on people, property, critical infrastructure, and natural resources. The objectives of this project are: (1) to reconstruct a chronology of large-magnitude avalanches within the CBJ and the surrounding areas of concern, (2) to characterize specific synoptic weather and climate patterns associated with broad-scale avalanche incidence clusters, and (3) to identify relationships between avalanche incidence and specific ocean-atmosphere teleconnections. The methods used to accomplish these objectives combine classical dendrochronological techniques with a novel nested spatial sampling design to develop a time series of large-magnitude avalanche events. When combined with a lidar-derived, high-resolution, comprehensive avalanche runout model, the results from this project inform stakeholders and partner of the frequency of avalanches that affect public safety and infrastructure. Products of this project include a temporal and spatial dataset of large-magnitude avalanches in the region, reports to CBJ, a high-resolution map of maximum runout distances in areas at risk, and numerous public outreach products.

Project Partners
University of Alaska Southeast, University of Alaska Fairbanks, Alaska Department of Natural Resources, Alaska Division of Geological and Geophysical Surveys, City and Borough of Juneau, Alaska Electric Light and Power, Kensington Gold Mine

Contact

Erich Peitzsch, Northern Rocky Mountain Science Center, epeitzsch@usgs.gov, 406–599–9970

Project Links

https://www.usgs.gov/centers/norock/science/examining-snow-avalanche-frequency-and-magnitude

https://www.usgs.gov/center-news/between-lines-tree-rings-reveal-avalanche-history

Recent Publication

Peitzsch, E.H., Hendrikx, J., Stahle, D.K., Pederson, G.T., Birkeland, K.W., and Fagre, D.B., 2021, A regional spatiotemporal analysis of large magnitude snow avalanches using tree rings: Natural Hazards and Earth System Sciences, v. 21, no. 2, p. 533–557, https://doi.org/10.5194/nhess-21-533-2021.

USGS Geomagnetism Program—Preparing the Nation for Intense Space Weather

Although major geomagnetic storms are rare, there is significant potential for large-scale affects when they happen. When a large sunspot emerges, the likelihood of an abrupt emission of radiation and intense solar wind increases. As these winds reach the Earth, electrically charged particles enter the Earth's magnetosphere, ionosphere, and the interior of the planet, inducing a geomagnetic storm. The storm can interfere with utilities, infrastructure, and technologies essential to modern society, endangering the economy and national security. The USGS Geomagnetism Program monitors the Earth's geomagnetic field variations through the operation of a network of 14 observatories across the United States and its territories (including 5 in Alaska) and pursues scientific research to estimate and assess geomagnetic and geoelectric hazards. Methods used integrate accurate, high-resolution measurements of the geomagnetic signals, Earth surface impedance from magnetotelluric surveys, and statistical geoelectric hazard information. Products include time series that are used for space-weather monitoring and prediction and publications and maps of potential hazards to the U.S. electric grid.

Photograph showing the Sand Point, Alaska, magnetic observatory, Popof Island, Shumagin Island group, Alaska. Photograph by Jeff Fox, U.S. Geological Survey.

Time frame	Project Partners
Ongoing	National Oceanic and Atmospheric Administration, U.S. Forest Service, National Park Service, Schlumberger Technology Corporation Shumagin Corporation

Contact

Krissy Lewis, Geologic Hazards Science Center, klewis@usgs.gov, 303–273–8471

Project Link

https://www.usgs.gov/natural-hazards/geomagnetism

Recent Publication

Ringler, A.T., Anthony, R.E., Wilson, D.C., Claycomb, A.E., and Spritzer, J., 2020, Magnetic field variations in Alaska—Recording space weather events on seismic stations in Alaska: Bulletin of the Seismological Society of America, v. 110, no. 5, p. 530–2540, https://doi.org/10.1785/0120200019.

Water Quality, Streamflow, and Ice Dynamics

Hydrologic Monitoring

Streamflow and Groundwater Monitoring

Nationwide, the USGS Groundwater and Streamflow Information Program supports the collection and delivery of streamflow and water-level information for more than 8,500 sites. Data are served online—most in near real-time—to meet many diverse needs of stakeholders. The streamgages are operated and maintained by the USGS, but most are funded in partnerhip with one or more of about 1,400 Federal, State, local, and Tribal agencies or organizations. This unique cooperation results in nationally consistent and impartial water data that aids in local decision making. Alaska has the lowest density of streamflow information stations in the Nation (122 streamflow sites in FY 2024). Streamgages are concentrated along the road system and near population centers, leaving many areas of the State devoid of any hydrologic information. Operating streamgages in Alaska is expensive, owing to complex logistics, amount of labor and access to remote sites, all contributing to high costs. The average cost to measure year-round discharge and water temperature in Alaska can be twice the cost of streamgaging in the lower 48 states. Provisional data are relayed to USGS offices by satellite, telephone, and radio telemetry where they receive an automated quality-assurance check and are available for public viewing within minutes. All real-time data are provisional and subject to revision after a formal review process that includes the computation of annual statistics.

Time frame	Project Partners
Ongoing	Alaska Department of Transportation; Alaska Department of Fish and Game; Alaska Energy Authority; U.S. Forest Service; U.S. Fish and Wildlife Service; U.S. Army Corps of Engineers; and several municipalities and boroughs, hydropower operators, and operating mines

Contact

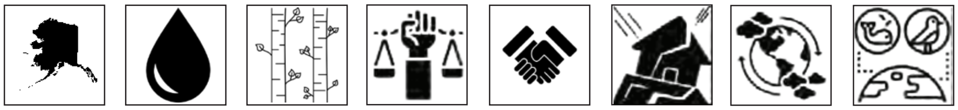
Jeff Conaway, ASC, jconaway@usgs.gov, 907–786–7041

Project Link

https://waterdata.usgs.gov/ak/nwis/rt

Photograph showing a U.S. Geological Survey technician measuring discharge during high flow at June Creek near Clear, Alaska. Photograph by Heather Best, U.S. Geological Survey.

Continuous Monitoring and Baseline Assessment of Water Quality of Transboundary Alaskan Rivers



Multiple rivers, including the Salmon, Unuk, Stikine, Taku, and Alsek Rivers, originate in Canada and flow into southeast Alaska. All five rivers support traditional, recreational, and commercial salmon fisheries as well as recreation. Active and proposed large-scale mining activity in the Canadian parts of these watersheds poses a potential threat to the fisheries and traditional lifestyles downstream in Alaska. The objectives of monitoring and assessing the water quality of Transboundary Alaskan Rivers are to (1) assess the geology and mineralization potential of study area watersheds; (2) analyze retrospectively and collect new data to characterize the water, sediment, and biological quality of the rivers; and (3) establish partnerhips with Tribes and government agencies to ensure that assessments meet the needs of Tribes and local stakeholders. Methods of accomplishing these objectives include updated geologic mapping and geologic sample reanalysis, biological sampling, and discrete water-quality sampling. The goal is for information on streamflow and water-quality conditions collected hourly at downstream monitoring sites to be paired with periodically collected samples that are analyzed for concentrations of metals, nutrients, and major ions. In combination, these data enable analysts to quantify loads of important water-quality constituents at daily, monthly, and annual time-steps. These data are the basis for identifying potential changes in water-quality conditions resulting from future upstream mining activities.

Photograph showing a U.S. Geological Survey technician doing water-quality sampling on the Unuk River, Alaska. Photograph by Randy Host, U.S. Geological Survey.

Time frame	Project Partner
Fiscal years 2019–24	Water Resources Mission Area

Contact

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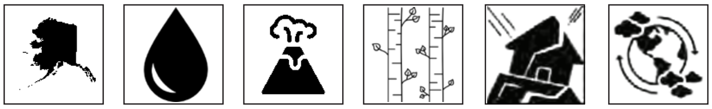
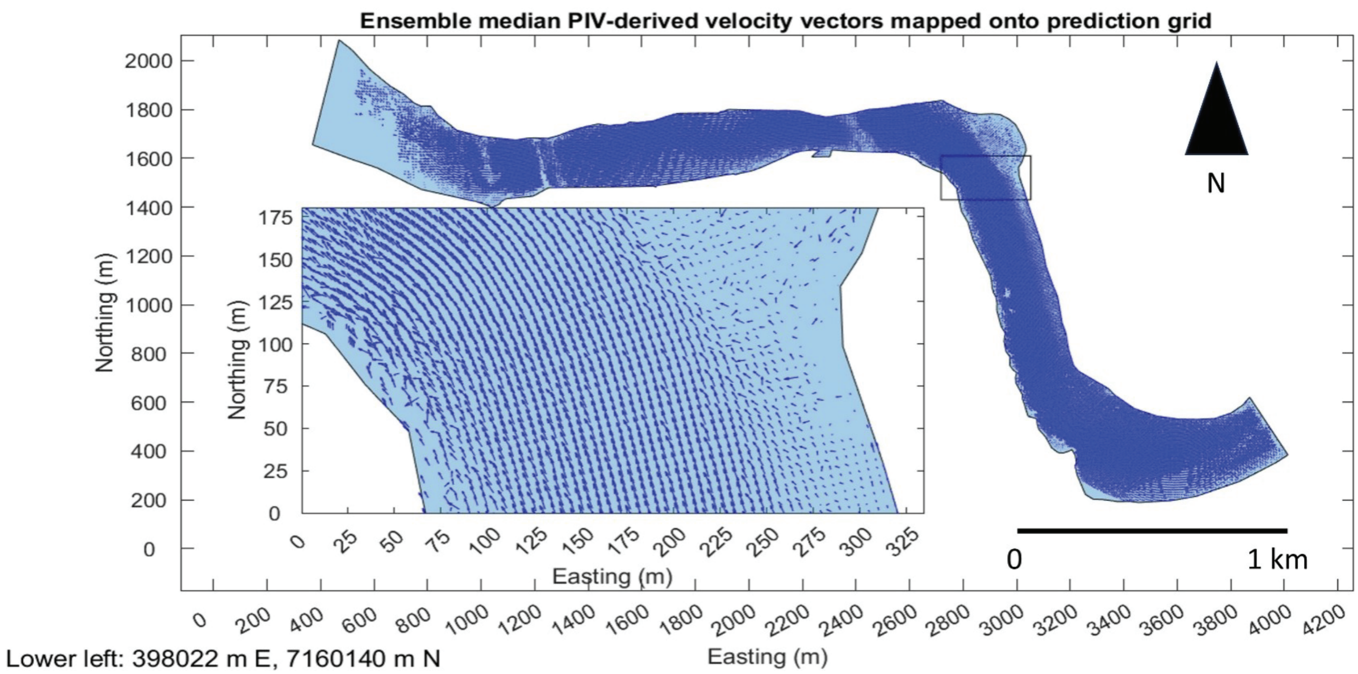
Project Link

https://www.usgs.gov/centers/asc/science/usgs-transboundary-river-monitoring-southeast-alaska

Developing Remote Sensing Methods to Measure Streamflow in Alaska Rivers



As part of our ongoing objective to estimate river surface velocities from remotely sensed data, we developed a new method for using images acquired from a fixed-wing aircraft. We call this technique Moving Aircraft River Velocimetry, or MARV. MARV takes overlapping image sequences as a airplane flies along a river and tracks the motion of water surface features in those images using a particle image velocimetry (PIV) algorithm. Relative to existing approaches that rely on hovering or stationary platforms, MARV increases the spatial coverage of river velocity mapping from single, isolated locations to much longer, continuous river segments. Initial testing of MARV focused on a 4-km reach of the Tanana River and involved comparing image-derived velocities to boat-based field measurements (Legleiter and Kinzel 2023a). The core PIV algorithm used for MARV has also been incorporated into a USGS software package. The Toolbox for River Velocimetry using Images from Aircraft (TRiVIA) is a standalone tool that allows end users to easily implement a PIV-based workflow (Legleiter and Kinzel 2023b).



Graph showing a velocity vector field (blue arrows) for a part of the Tanana River in Alaska derived from images acquired by an airplane flying 1,204 meters above the channel using a particle image velocimetry-based workflow. Graph by U.S. Geological Survey.

Time frame
Fiscal year 2016–ongoing

Contacts

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Carl Legleiter, Geomorphology and Sediment Transport Laboratory, cjl@usgs.gov, 307–760–8369

Recent Publications

Legleiter, C.J., Kinzel, P.J., Laker, M., Conaway, J.S., 2023a, Moving aircraft river velocimetry (MARV)—Framework and proof-of-concept on the Tanana River: Water Resources Research, v. 59, no. 2, https://doi.org/10.1029/2022WR033822.

Legleiter, C.J., and Kinzel, P.J., 2023b, The toolbox for river velocimetry using images from aircraft (TRiVIA): River Research and Applications, v. 39, no. 8, p. 1457–1468, https://doi.org/10.1002/rra.4147.

Alaska Streambed Scour Monitoring and Modeling

More than 60 percent of all bridge failures in the United States are caused by streambed scour, which is a result of complex hydraulic forces acting on streambeds during major flooding events. Costs associated with restoring damaged structures are substantial, but the indirect costs associated with the disruption of traffic often are even greater, especially in Alaska, where alternate travel routes between many cities do not exist. In cooperation with the Alaska Department of Transportation and Public Facilities (AKDOT&PF), the U.S. Geological Survey has been researching streambed scour through scour monitoring, hydrodynamic modeling, and data collection during high flows for several decades. Objectives of the streambed scour project are two-fold. The first objective is to monitor streambed elevations in real time at bridges coded as scour-critical and provide warnings to AKDOT&PF during scour events. Methods used include instrumenting bridges with sonars, stage sensors and cameras, multibeam and lidar surveys of bridge reaches, and collecting hydrologic data during floods. The second objective is to predict hydraulic conditions that could lead to scour at bridges during floods using hydrodynamic models. This work enables State and Federal agencies to identify infrastructure that requires stream scour mitigation and (or) annual monitoring for potential damage to infrastructure.

Photograph showing U.S. Geological Survey staff doing a multibeam and lidar survey at Tanana River at Big Delta, Alaska, to access scour conditions at the Richardson Highway Bridge in July 2023. Photograph by Hiram Henry, Alaska Department of Transportation and Public Facilities.

Time frame	Project Partner
Fiscal year 2017–ongoing	Alaska Department of Transportation and Public Facilities

Contact

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Project Link

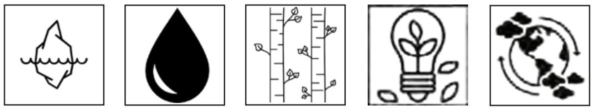
https://www.usgs.gov/centers/alaska-science-center/science/streambed-scour-bridges-alaska

Recent Publications

Beebee, R.A., 2022, Recent history of glacial lake outburst floods, analysis of channel changes, and development of a two-dimensional flow and sediment transport model of the Snow River near Seward, Alaska: U.S. Geological Survey Scientific Investigations Report 2022–5099, 39 p, https://doi.org/10.3133/sir20225099.

Dudunake, T.J., and Schauer, P.V., 2023, Bathymetric and topographic surveys at select Alaska highway bridges, 2023 (ver 1.1, September 2023): U.S. Geological Survey data release, https://doi.org/10.5066/P9X8TZLY.

Quantifying Groundwater and Aufeis and Their Contribution to Surface-Water Availability and Habitat in the Arctic National Wildlife Refuge, Alaska



The North Slope of Alaska is a unique environment defined by continuous permafrost, abundant wildlife, and substantial industrial activity. Liquid water is a limited resource in this cold environment, and rivers provide important habitat and connections between terrestrial, freshwater, and marine ecosystems. Little is known about the relative contribution of precipitation and groundwater to rivers in this region, limiting the ability to properly use water resources.

Project objectives include quantifying water sources, aquifer size, and groundwater ages on Alaska's North Slope and particularly in the coastal plain, also known as the 1002 Area and is the northernmost area of the Arctic National Wildlife Refuge along the Beaufort Sea. Methods of completing these objectives include geochemical and remote sensing-based determinations of water sources and contributions to Arctic rivers, hydrological investigations of soil water and permafrost thaw potential, and isotopic age dating to determine aquifer properties and source areas. Results can provide quantification of water resources, aiding managers in balancing ecological and industrial requirements in this extreme, water-limited environment.

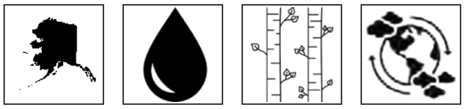
Permafrost-rich bluff of the Canning River in the 1002 Region of the Arctic National Wildlife Refuge, North Slope of Alaska. Water samples and thermal imagery collected from an Unoccupied Arial System are being used to determine water sources to the river and to quantify water resources and fish habitat in this region. Photograph by Joshua Koch, U.S. Geological Survey.

Time frame	Project Partners
Fiscal years 2019–22	U.S. Fish and Wildlife Service, National Science Foundation

Contact

Joshua Koch, ASC, jkoch@usgs.gov, 303–817–5595

Glaciers



Glaciers are defining features of the physical landscapes in the high mountains of western North America, including Alaska. Mountain glaciers profoundly affect the quality, quantity, and timing of runoff, local and regional ecosystems, global sea level, and land use. The primary objective of this project is to understand glacier mass change through time. Climate forcing has an immediate response in the form of seasonal mass gains and losses and causes a delayed response of the glacier flow field that results in cumulative changes to glacier thickness and area. Methods used to quantify these changes include field-based measurements of winter snow accumulation, summer melt, surface velocities, local weather stations, and remotely sensed changes in area and thickness. Reanalysis of legacy data increases our confidence in the conclusion that all five of the benchmark glaciers are losing mass, and the rate at which they are losing mass is increasing with time. Products include publicly available USGS data releases, summary data releases with the World Glacier Monitoring Service, and peer-reviewed publications.

Map showing locations of the five U.S. Geological Survey benchmark glaciers.

Time frame	Project Partner
Fiscal year 2016–ongoing	U.S. Army Corps of Engineers Cold Regions Research and Engineering Lab

Contact

Louis Sass, ASC, lsass@usgs.gov, 907–786–7460

Project Link

https://www.usgs.gov/programs/ecosystems-land-change-science-program/science/glaciers-and-landscape-change

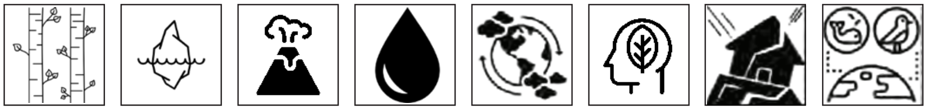
Recent Publications

McNeil, C., O’Neel, S., Loso, M., Pelto, M., Sass, L., Baker, E.H., and Campbell, S., 2020, Explaining mass balance and retreat dichotomies at Taku and Lemon Creek Glaciers, Alaska: Journal of Glaciology, v. 66, no. 258, p. 530–542, https://doi.org/10.1017/jog.2020.22.

O’Neel, S., McNeil, C., Sass, L.C., Florentine, C., Baker, E.H., Peitzsch, E., McGrath, D., Fountain, A.G., and Fagre, D., 2019, Reanalysis of the USGS benchmark glaciers—Long-term insight into climate forcing of glacier mass balance: Journal of Glaciology, v. 65, no. 253, p. 850–866, https://doi.org/10.1017/jog.2019.66.

Permafrost

Arctic Biogeochemical Response to Permafrost Thaw



Warming and thawing of permafrost soils in the Arctic are expected to become widespread over the coming decades. Permafrost thaw changes ecosystem structure and function, affects resource availability for wildlife and society, and decreases ground stability, which affects human infrastructure. Since permafrost soils contain about half of the global soil carbon pool, defining the magnitude of soil carbon losses from permafrost thaw is critically important to understanding the global carbon cycle, known as the permafrost carbon feedback. Recently, wintertime processes have been shown to be a critical yet understudied component of the permafrost carbon feedback. Therefore, our objective is to understand wintertime processes controlling greenhouse gas fluxes (carbon dioxide and methane) that thaw permafrost soils in Alaska using isotopic, geophysical, microbial, and biogeochemical methods. Our published products improve understanding of permafrost thaw processes and the permafrost carbon feedback.

Time frame	Project Partner
Fiscal year 2015–ongoing	University of Alaska Fairbanks

Photograph showing an eddy covariance tower at sunset continuously measuring the carbon balance of thawing permafrost ecosystems at the Alaska Peatland Experiment in the interior of Alaska. Photograph by Jack McFarland, U.S. Geological Survey.

Contact

Mark Waldrop, Geologic, Minerals, Energy, and Geophysics Science Center, mwaldrop@usgs.gov, 650–714–9294

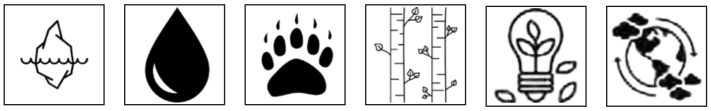
Recent Publications

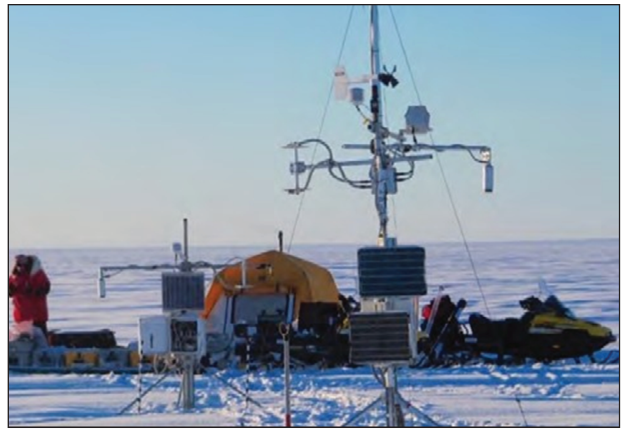
Manies, K.L., Dieleman, C., Douglas, T.A., James, S., McFarland, J., Minsley, B., Turetsky, M., and Waldrop, M.P., 2023, Depth to frozen soil measurements at APEX, 2008-2023: U.S. Geological Survey data release, https://doi.org/10.5066/P92MAA6Z.

Euskirchen, E.S., Edgar, C.W., Kane, E.S., Waldrop, M.P., Neumann, R.B., Manies, K.L., Douglas, T.A., Dieleman, C., Jones, M.C., and Turetsky, M.R., 2024, Persistent net release of carbon dioxide and methane from an Alaskan lowland boreal peatland complex: Global Change Biology, v. 30, no. 1, p. e17139, https://doi.org/10.1111/gcb.17139.

Manies, K.L., Dieleman, C., Douglas, T.A., James, S., McFarland, J., Minsley, B., Turetsky, M., and Waldrop, M.P., 2023, Depth to frozen soil measurements at APEX, 2008-2023: U.S. Geological Survey data release, https://doi.org/10.5066/P92MAA6Z.

USGS Climate and Permafrost Observing Network





Photograph showing a U.S. Geological Survey technician doing climate station maintenance in spring near Teshekpuk Lake, northern Alaska. Photograph by Frank Urban, U.S. Geological Survey.

The USGS, BLM, and FWS each have an interest in tracking long-term climate patterns in the National Petroleum Reserve in Alaska and the Arctic National Wildlife Refuge, where oil and gas exploration and development/potential development are actively happening. This project maintains the collection and interpretation of long-term climate and permafrost data from an existing network of observing stations, which the USGS has operated since the late 1990s with the support of the BLM and FWS. The network includes air temperature, soil temperature, relative humidity, precipitation, wind speed, wind direction, barometric pressure, snow depth, and solar radiation sensors. In-season and long-term time series datasets from this program are essential to understanding natural environmental trends and variability in the Arctic, which informs land-use planning, permitting, and monitoring. Additionally, many of the parameters observed at these stations are drivers of regional water balance and strongly influence storage and runoff patterns, information that is critical for the interpretation of hydrologic and biologic datasets. Fieldwork and data management are completed by the USGS. Finalized data series are released annually and archived within the Global Terrestrial Network for Permafrost under the Global Climate Observing System.

Time frame	Project Partners
Fiscal years 2019–23	Bureau of Land Management and U.S. Fish and Wildlife Service

Contact

Frank Urban, Geosciences and Environmental Change Science Center, furban@usgs.gov, 303–236–4790

Geophysical Imaging of Alaska Permafrost

Accelerated warming, extreme precipitation, and other disturbances at high latitudes have substantial effects on boreal and arctic ecosystems that influence hydrologic processes, biogeochemical cycling, and carbon emissions. Subsurface zones of deep thaw, as well as warm permafrost near 0 degrees Celsius (°C) that can contain significant liquid water, may be hotspots for the production and mobilization of greenhouse gases such as methane and carbon dioxide. The objectives of this project are to characterize and monitor belowground permafrost conditions, understand how permafrost is changing in response to warming and disturbance, and better predict the consequences of permafrost change. To accomplish these objectives, methods used include novel geophysical measurements and monitoring experiments to characterize subsurface permafrost and liquid water content with high spatial resolution using electrical, electromagnetic, seismic, and nuclear magnetic resonance instruments. Geophysical inferences are linked with remote sensing observations and in situ biogeochemical datasets to create a robust understanding of the consequences of changing water and ice content on carbon cycling in permafrost domains.

Photograph showing electrical resistivity imaging across a bog and a surrounding permafrost plateau near Coldfoot, Alaska. National Association of Geoscience Teachers intern with the U.S. Geological Survey Geology, Geophysics, and Geochemistry Science Center is helping to deploy the resistivity array. Photograph by Burke Minsley, U.S. Geological Survey.

Time frame
Fiscal years 2023–24

Contact

Burke Minsley, Geology, Geophysics, and Geochemistry Science Center, bminsley@usgs.gov, 303–236–5718

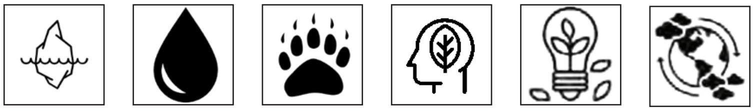
Recent Publications

Minsley, B.J., Pastick, N.J., James, S.R., Brown, D.R.N., Wylie, B.K., Kass, M.A., and Romanovsky, V.E., 2022, Rapid and gradual permafrost thaw—A tale of two sites; Geophysical Research Letters, v. 49, no. 21, https://doi.org/10.1029/2022GL100285.

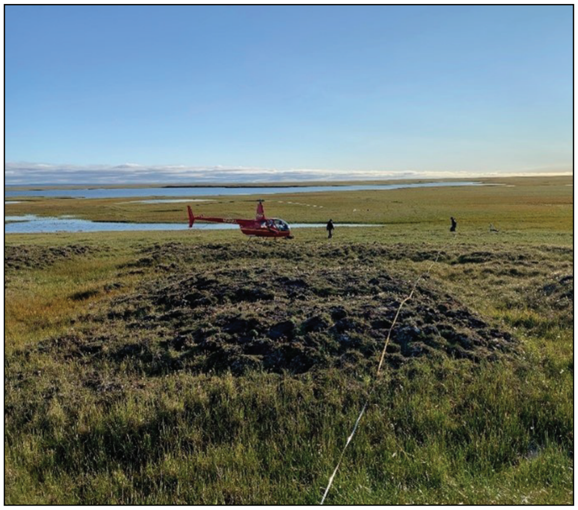
Minsley, B.J., James, S.R., and Pastick, N.J., 2022, Alaska permafrost characterization—Geophysical and related field data collected in 2021: U.S. Geological Survey data release, https://doi.org/10.5066/P9XEMDE1.

James, S.R., Minsley, B.J., McFarland, J.W., Euskirchen, E.S., Edgar, C.W., and Waldrop, M.P., 2021, The biophysical role of water and ice within permafrost nearing collapse—Insights from novel geophysical observations: Journal of Geophysical Research, Earth Surface, v. 126, no. 6, https://doi.org/10.1029/2021JF006104.

An Assessment of the Critical Landscape Conditions and Potential Change in the 1002 Area of the Arctic National Wildlife Refuge to Support Habitat Management Decision Making



The areas along the Arctic coast are changing the fastest among all of Earth's habitats because of climate change. In this area, permafrost is thawing rapidly, changing how much and when water reaches rivers, ponds, lakes, wetlands, and groundwater. Improving understanding of the area can help inform studies of ongoing permafrost thaw and future warming and interests in oil and gas extraction in the coastal plain (also known as the 1002 area) of the Arctic National Wildlife Refuge. This 3-year project plans to develop detailed maps of the 1002 area, document soil temperature and moisture change, and measure surface-water flow and routes to rivers, lakes, and ponds and measure carbon stocks, carbon gas fluxes, and water chemistry. We use (1) field surveys to assess vegetation, topography, permafrost conditions, river discharge, carbon gas fluxes, and water chemistry; (2) airborne and satellite imagery to document surface conditions and water flow through time and in unprecedented detail; and (3) advanced modeling to simulate historical (1950–2020) and future (2021–2100) land cover, permafrost, and water flow dynamics, assuming changes in climate and development. The resulting data and deliverables can help identify areas vulnerable to change, allow managers to better understand risks, and guide potential oil and gas development.



Photograph showing scientists establishing a transect at a field site on the coastal plain of Alaska for measurements of thaw depth, organic layer thickness, and aboveground biomass. The uneven ground is called "patterned ground" or "polygonal tundra" and is caused by massive ice wedges under the surface. Photograph by Zhiliang Zhu, U.S. Geological Survey.

Time frame	Project Partner
Fiscal years 2019–23	University of Alaska Fairbanks

Contact

Neal Pastick, Earth Resources Observation and Science Center, npastick@usgs.gov, 605–594–2652

Project Link

https://www.usgs.gov/programs/climate-adaptation-science-centers/science/assessment-critical-landscape-conditions-and

Recent Publications

Gay, B.A., Pastick, N.J., Züfle, A.E., Armstrong, A.H., Miner, K.R., and Qu, J.J., 2023, Investigating permafrost carbon dynamics in Alaska with artificial intelligence: Environmental Research Letters, v. 18, no. 12, p. 125001, https://doi.org/10.1088/1748-9326/ad0607.

Gay, B.A., Pastick, N.J., Watts, J., Armstrong, A.H., Miner, K.R., and Miller, C., 2024, Forecasting permafrost carbon dynamics in Alaska with GeoCryoAI, *in* EGU General Assembly 2024, Vienna, Austria, April 14–19, 2024.

The Rusting of Arctic Rivers—Freshwater Ecosystems Responding Rapidly to Up-Taking Metals

Permafrost thaw, thaw-induced erosion, and wildfires have altered the concentration and flux of organic carbon, nutrients, and trace metals in Arctic streams. Recent observations indicate that waters draining permafrost landscapes may be susceptible to iron and carbon mobilization following thaw. One consequence of these altered iron-cycling processes is the abrupt change in the color of streams to orange, reflecting a dramatic shift in water quality. The project objective is to document the effects of iron mobilization on water quality and the consequences to stream ecosystems. The methods used to accomplish the objective are to map the spatial distribution of orange streams and the onset of color change; quantify the effects on water quality and determine landscape controls on metal mobilization; and assess consequences of shifts in stream water quality on stream biota, including resident and anadromous fish. The data collected from these methods can provide a comprehensive examination of the physical, chemical, and biological consequences of metal seeps and provide knowledge relevant to forecasting future changes in the Arctic.

Time frame	Project Partners
Fiscal year 2023–ongoing	National Park Service, Arctic Network, University of California, Davis

Contact

Michael P. Carey, ASC, mcarey@usgs.gov, 907–786–7197

Photograph showing the north fork of the Agashashok River in the NPS website has Noatak National Preserve, Alaska. Recent observations from Arctic Alaska indicate that waters draining permafrost landscapes may be susceptible to iron and carbon mobilization following thaw. One consequence of these altered iron-cycling processes is the abrupt change in color (orange) of stream and river reaches, reflecting a dramatic shift in water quality. Photograph by Mike Carey, U.S. Geological Survey.

Assessing the Characteristics and Fate of Organic Matter Eroding into Lagoons Along the Alaska Beaufort Sea Coast

Erosion along the Beaufort Sea coast mobilizes large quantities of organic matter to the Arctic Ocean where it may be remineralized, releasing greenhouse gases and fueling marine primary production. Terrestrially derived organic carbon also accumulates in nearshore food webs along this coastline, reflecting its use as an energy subsidy. The objective of this project is to examine the relative contributions of eroding permafrost soils, river particulates, and marine production to organic matter in lagoon sediments along the Alaska Beaufort Sea coast. We use various geochemical methods, such as dual-carbon isotopic mixing models and lipid biomarkers, to characterize organic matter and track eroded material in the marine environment. The results from these methods can provide insight about how varying erosion rates, river inputs, and other factors affect lagoon benthic habitats and regional carbon cycling.

Time frame	Project Partner
Fiscal year 2020–ongoing	Mendenhall Program

Photograph showing high ice content permafrost bluff erosion at Barter Island, Alaska, in 2019 following a series of coastal storms and a prolonged time of anomalously high air temperatures. Cordell Johnson of the U.S. Geological Survey Pacific Coastal and Marine Science Center is seated on the all-terrain vehicle. Photograph by U.S. Geological Survey.

Contact

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Mammals

Polar Bear Distribution, Population Dynamics, Health, and Energetics Research

The *Ursus maritimus* (polar bear) is recognized worldwide as a species vulnerable to changing climate because its required sea-ice habitats are being lost. USGS science played a central role in informing the decision to list the polar bear as threatened under the Endangered Species Act in 2008. This science was based on an understanding gained from long-term studies of the southern Beaufort Sea population, 1 of 19 worldwide, and 1 of only 2 polar bear populations with long-term data. In these studies, the USGS documented a negative relation between the length of the open water season over the continental shelf and the population growth rate. Applying future sea-ice conditions to the relation between sea-ice availability and population growth rate enabled us to project a future trajectory of the population. We are monitoring the survival and habitat use of the Beaufort Sea population to determine whether the habitat base for this population changes as projected and whether the population responds to those habitat changes as projected in 2007. Information about how polar bears in this population respond to sea-ice loss informs management of the subsistence harvest, permitting of oil and gas activities in Alaska's coastal plain, and projections for the worldwide population.

Photograph showing a polar bear on ice in the southern Beaufort Sea, off northern Alaska. Photograph by Mike Lockhart, U.S. Geological Survey.

Time frame	Project Partners
1980s–ongoing	U.S. Fish and Wildlife Service, Bureau of Land Management, Canadian Wildlife Service, North Slope Borough, Inuvialuit-Inupiat Commission, Alaska Nannut Co-Management Council, Alaska Eskimo Whaling Commission, North Slope Communities, Industry

Contact

Todd Atwood, ASC, tatwood@usgs.gov, 907–786–7061

Project Link

https://www.usgs.gov/centers/asc/science/polar-bear-research

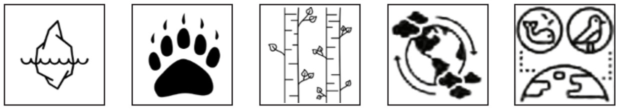
Recent Publications

Andersen, E.M., Wilson, R.R., Rode, K.D., Durner, G.M., Atwood, T.C., and Gustine, D.D., 2024, The post-emergence period for denning polar bears—Phenology and influence on cub survival: Journal of Mammalogy, v. 105, no. 3, p. 490–501, https://doi.org/10.1093/jmammal/gyae010.

Wilson, R.R., French-McCay, D.P., Perham, C., Woodruff, S.P., Atwood, T.C., and Durner, G.M., 2024, Potential impacts of an autumn oil spill on polar bears summering on land in northern Alaska: Biological Conservation, v. 292, p. 110558, https://doi.org/10.1016/j.biocon.2024.110558.

Bromaghin, J.F., Douglas, D.C., Durner, G.M., Simac, K.S., and Atwood, T.C., 2021, Survival and abundance of polar bears in Alaska's Beaufort Sea, 2001–2016: Ecology and Evolution, v. 11, no. 20, p. 14250–14267, https://doi.org/10.1002/ece3.8139.

Pacific Walrus Research



The *Odobenus rosmarus divergens* (Pacific walrus) is one of four marine mammal species managed by the DOI. The ASC of the USGS (a bureau of the DOI) does long–term research on Pacific walruses to inform local, State, national, and international policymakers regarding the conservation of the species and its habitat. The goal of current research is to refine and enhance models to forecast future walrus abundance and distribution in response to changing Arctic conditions and human activities.

Photographs showing scientists preparing to radio-tag walruses in the Chukchi Sea, northern Alaska, to track movements as sea ice is reduced in the region. Photograph by U.S. Geological Survey.

The initial phase of this research began with the collection of population age structure data from three consecutive years (FY 2013–15) from the Chukchi Sea during ship-based research cruises in collaboration with the FWS and Alaska Department of Fish and Game. These field efforts provided updated estimates of walrus population age structure and, together with data from surveys repeated over the past four decades, provided current information on population status and trends. Current collaborations between the USGS and the FWS aim to use these data to develop new statistical techniques that combine traditional mark-recapture with kinship data to provide more robust estimates of walrus population size. Ongoing and planned work includes Unoccupied Aircraft System population surveys of hauled out walruses in northwestern Alaska, assessments of walrus' behavioral responses to marine vessel interactions, and modeled linkages among future sea-ice availability, walrus energy requirements, and population vitality rates.

Time frame	Project Partners
Fiscal year 2013–ongoing	Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, Bureau of Ocean Energy Management, Eskimo Walrus Commission, North Slope Borough

Contact

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Project Link

https://www.usgs.gov/centers/asc/science/walrus-research

Recent Publications

Johnson, D.L., Eisaguirre, J.M., Taylor, R.L., and Garlich-Miller, J.L., 2024, Assessing the population consequences of disturbance and climate change for the Pacific walrus: Marine Ecology Progress Series, v. 740, p. 193–211, at https://doi.org/10.3354/meps14635.

Fischbach, A.S., 2023, Pacific walrus coastal haulout images from remote camera stations: U.S. Geological Survey data release, at https://doi.org/10.5066/F7XW4H88.

Battaile, B.C., and Jay, C.V., 2020, Walrus haulout photographs near Pt. Lay Alaska, September 2014: U.S. Geological Survey data release, at https://doi.org/10.5066/F7B27SB2.

Birds

Seabirds and Forage Fish Ecology Program

Photograph showing *Uria aalge* (common murres) in a colony at Cook Inlet, south-central Alaska, 2017. Photograph by Sarah Schoen, U.S. Geological Survey.

Seabirds serve as practical indicators of change in the marine environment—natural or human-induced—because they can be readily monitored at their colonies and at sea. The USGS studies seabird population dynamics and feeding ecology for a variety of seabird species to better understand why seabird populations fluctuate over time and how natural and anthropogenic factors influence population biology. Findings from these studies are provided to DOI management agencies and other stakeholders to inform decisions. Long-term tasks that form the core of the ASC's forage fish, seabird, and ecosystem studies include (1) compiling and analyzing the pelagic distribution data of marine birds in the North Pacific relative to biological oceanography and changes in climate; developing methods for censusing and monitoring trends in seabird populations on land and at sea; (2) studying the oceanography, plankton, forage fish, and seabirds around major seabird colonies in Alaska; and (3) measuring the possible effect of algal toxins on seabird mortality.

Contacts

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Time frame	Project Partners
Fiscal year 2022–ongoing	U.S. Fish and Wildlife Service, National Park Service, Bureau of Ocean Energy Management, Exxon Valdez Oil Spill Trustee Council

Project Link

https://www.usgs.gov/centers/asc/science/seabirds-and-forage-fish-ecology

Recent Publications

Arimitsu, M.L., and Piatt, J.F., 2019, Monitoring long-term changes in forage fish distribution, abundance, and body condition in Prince William Sound: Gulf Watch Alaska, 2 p., https://pubs.er.usgs.gov/publication/70203368.

McGowan, D.W., Goldstein, E.D., Arimitsu, M.L., Deary, A.L., Ormseth, O., De Robertis, A., Horne, J.K., Rogers, L.A., Wilson, M.T., Coyle, K.O., Holderied, K., Piatt, J.F., Stockhausen, W.T., and Zador, S., 2020, Spatial and temporal dynamics of Pacific capelin (*Mallotus catervarius*) in the Gulf of Alaska—Implications for ecosystem-based fishery management: Marine Ecology Progress Series, v. 637, p. 117–140, https://www.gulfwatchalaska.org/wp-content/uploads/2015/06/P-ForageFish_press2.pdf.

Piatt, J.F., Parrish, J.K., Renner, H.M., Schoen, S.K., Jones, T.T., Arimitsu, M.L., Kuletz, K.J., Bodenstein, B., García-Reyes, M., Duerr, R.S., Corcoran, R.M., Kaler, R.S.A., McChesney, G.J., Sydeman, W.J.2020, Extreme mortality and reproductive failure of common murres resulting from the northeast Pacific marine heatwave of 2014–2016: PLoS One, v. 15, no. 1, 32 p., https://doi.org/10.1371/journal.pone.0226087.

Population Ecology of Waterfowl and Loons

The Population Ecology of Waterfowl and Loons Project at the ASC includes a variety of research directions and methods that inform our partner. In FY 2020, research objectives included (1) quantifying and mapping abundance and distribution of waterbird species in western and northern Alaska; (2) mapping to determine population structure among North American sea duck species; (3) demographic analyses and trends for species of management concern, such as *Somateria fischeri* (spectacled eider); (4) surveys and assessments of avian influenza in loon species; and (5) general ecology of waterfowl and loons that may inform management agency decisions.

Photograph showing a pair of spectacled eiders flying near the Colville River, northern Alaska, 2013. Photograph by Ryan Askren, U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2005–ongoing	Bureau of Land Management, U.S. Fish and Wildlife Service, Bureau of Ocean Energy Management

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Project Links

https://www.usgs.gov/centers/asc/science/waterfowl-research

https://www.usgs.gov/centers/asc/science/loon-research

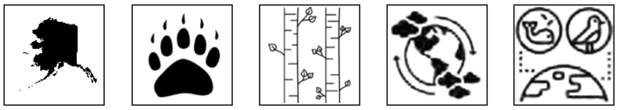
Recent Publications

Menning, D.M., Uher-Koch, B.D., Flamme, M.J., Simmons, T., Schmutz, J.A., and Talbot, S.L., 2023, eDNA metabarcoding analyses of diet in yellow-billed loons of northern Alaska: Waterbirds, v. 45, no. 2, p. 159–166, https://doi.org/10.1675/063.045.0206.

Amundson, C.L., Flint, P.L., Stehn, R.A., Platte, R.M., Wilson, H.M., Larned, W.W., and Fischer, J.B., 2019, Spatio-temporal population change of Arctic-breeding waterbirds on the Arctic Coastal Plain of Alaska: Avian Conservation and Ecology, v. 14, no.1, 198 p., https://doi.org/10.5751/ACE-01383-140118.

Flint, P.L., Patil, V.P., Shults, B.S., and Thompson, S.J., 2020, Prioritizing habitats based on abundance and distribution of molting waterfowl, in the Teshekpuk Lake Special Area of the National Petroleum Reserve, Alaska: U.S. Geological Survey Open-File Report 2020–1034, 16 p., https://doi.org/10.3133/ofr20201034.

Population Ecology and Habitats of Alaska Land Birds



Alaska supports more than 130 species of breeding land birds, including many that migrate to neotropical wintering areas. Population declines have been documented for several species over the past few decades, and land managers in Alaska use information on possible drivers of population change, such as *Dendroctonus rufipennis* (spruce beetle) epidemics, fire, and disease to inform decision making. There is little information on the status of Alaskan landbird populations in relation to those of temperate regions. Objectives of this project are to (1) coordinate a cooperative, regional program to monitor population trends of landbirds breeding in northern ecoregions; (2) investigate relations between the distribution of breeding landbirds and terrestrial habitats at the landscape level; and (3) examine population dynamics governing population trends. Methods used to accomplish these objectives include annual ground surveys and banding, which helps researchers understand changes in population size and demography over time.

Photograph showing a U.S. Geological Survey biologist doing a bird survey on Alaska's Seward Peninsula. Photograph by Lance McNew, U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2001–ongoing	Canadian Wildlife Service, U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Alaska Department of Fish and Game, University of Alaska Fairbanks

Contacts

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Steve Matsuoka, ASC, smatsuoka@usgs.gov, 907–786–7075

Project Link

https://www.usgs.gov/centers/asc/science/boreal-partner-flight

Recent Publications

Robinson, B.W., Withrow, J.J., Richardson, R.M., Matsuoka, S.M., Gill, R.E., Jr., Johnson, A.S., Lovette, I.J., Johnson, J.A., DeGange, A.R., and Romano, M.D., 2020, Further information on the avifauna of St. Matthew and Hall Islands, Bering Sea, Alaska: California Birds, v. 51, no. 2, p. 78–91, at https://doi.org/10.21199/WB51.2.1.

Roy, C., Michel, N.L., Handel, C.M., Van Wilgenburg, S.L., Burkhalter, J.C., Gurney, K.E.B., Messmer, N.L., Princé, K., Rushing, C.S., Saracco, J.F., Schuster, R., Smith, A.C., Smith, P.A., Sólymos, P., Venier, L.A., and Zuckerberg, B., 2019, Monitoring boreal avian populations—How can we estimate trends and trajectories from noisy data?: Avian Conservation and Ecology, v. 14, no. 2, 26 p., https://doi.org/10.5751/ACE-01397-140208.

Slager, D.L., Epperly, K.L., Ha, R.R., Rohwer, S., Wood, C., Van Hemert, C., and Klicka, J., 2020, Cryptic and extensive hybridization between ancient lineages of American crows: Molecular Ecology, v. 29, no. 5, p. 956–969, https://doi.org/10.1111/mec.15377.

Harmful Algal Bloom Toxins and Alaska Seabirds

Alaska is widely recognized as a global center for breeding shorebirds, as 90 percent of the migratory species in the Western Hemisphere have breeding populations in Alaska. Research objectives of this project are to (1) provide information used by management agencies, such as the current distribution and abundance of shorebird species in Alaska; (2) understand factors involved in driving population changes in Alaska and throughout the broad non-breeding distribution of these species; and (3) evaluate new and emerging topics with this species group. Methods of accomplishing these objectives involve using population genetics, satellite telemetry and other tagging, and ground surveys.

Photograph showing *Rissa tridactyla* (black-legged Kittiwake) forage on Pacific sand lance and capelin near their colony on Gull Island, Cook Inlet. Photograph by Sarah Schoen, U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2020–ongoing	Alaska Sealife Center: in kind, National Wildlife Health Center: in kind, U.S. Fish and Wildlife Service: in kind

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Project Link

https://www.usgs.gov/centers/alaska-science-center/science/harmful-algal-bloom-toxins-alaska-seabirds

Recent Publications

Van Hemert, C., Ballweber, L.R., Sinnett, D.R., Atwood, T.C., Fischbach, A., Gustine, D.D., Pabilonia, K.L., 2023, Giardia and cryptosporidium in resident wildlife species in Arctic Alaska: Food and Waterborne Parasitology, v. 32, https://doi.org/10.1016/j.fawpar.2023.e00206.

Anderson, D.M., Fachon, E., Hubbard, K., Lefebvre, K.A., Lin, P., Pickart, R., Richlen, M., Sheffield, G., and Van Hemert, C., 2022, Harmful algal blooms in the Alaskan Arctic—An emerging threat as the ocean warms: Oceanography, v. 35, nos. 3–4, p. 130–139, https://doi.org/ 10.5670/ oceanog.2022.121.

Dusek, R.J., Smith, M.M., Van Hemert, C., Shearn-Bochsler, V.I., Hall, S., Ridge, C.D., Hardison, D.R., Kaler, R.S.A., Bodenstein, B.L., Hofmeister, E.K., and Hall, J.S., 2021, Acute oral toxicity and tissue residues of saxitoxin in the mallard (*Anas platyrhynchos*): Harmful Algae, v. 109, https://doi.org/10.1016/j.hal.2021.102109.

Fish

Heat Stress in Alaska's Pacific Salmon

Pacific salmon are cold-water fishes that have historically been limited in range by cold temperatures in Alaska. Rapid warming at northern latitudes have increased freshwater temperatures and raised the possibility that summer water temperatures in some of Alaska's freshwaters are now stressful for migrating adult Pacific salmon. The objective of this study is to understand whether contemporary water temperatures induce stress in Alaskan *Oncorhynchus tshawytscha* (Chinook salmon) as inferred by the widespread population declines. The methods used to accomplish this objective include an experiment that integrates muscle tissue samples collected from the field for laboratory analysis of heat stress biomarkers (gene transcription and heat shock proteins) through collaborations with researchers from the Western Ecological Research Center and Eastern Ecological Science Center. In the experiment, two contemporary summer water temperatures (18 and 21 °C) induced heat stress. In field collections, about half of the field-caught Chinook salmon in the Yukon River had biomarkers consistent with heat stress. Additional experiments for juvenile Chinook salmon and *Oncorhynchus kisutch* (coho salmon) at five treatment temperatures (15, 17, 19, 21, and 23 °C) were recently done to further investigate the effects of heat stress. Analysis and interpretation of field-collected adult and juvenile Pacific salmon from other western and southcentral Alaska rivers is underway. Given that heat stress increases the risk of in-river mortality before spawning and that salmon are managed by in-river counts of spawning adults, our findings suggest the potential for in-river abundance counts (escapement) to overestimate the true number of spawning fish, which results in overharvest. Observations of in-river mortality among adult Pacific salmon during Alaska's record heat and drought in 2019 brought public attention to the heat stress affecting Pacific salmon.

Photograph showing a spawning Yukon River Chinook salmon captured as part of an experimental temperature manipulation study to validate heat stress biomarkers near Pilot Station, Alaska, June 2018. A muscle tissue sample required for the study fits in the small white plastic vial next to the fish. Photograph by Shannon Waters, U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2016–ongoing	Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative, U.S. Fish and Wildlife Service, Alaska Department of Fish and Game

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Project Link

https://www.usgs.gov/centers/asc/science/assessing-heat-stress-migrating-yukon-river-chinook-salmon

Recent Publications

von Biela, V.R., Regish, A.M., Bowen, L., Stanek, A.E., Waters, S., Carey, M.P., Zimmerman, C.E., Gerken, J., Rinella, D., and McCormick, S.D., 2023, Differential heat shock protein responses in two species of Pacific salmon and their utility in identifying heat stress: Conservation Physiology, v. 11, no. 1, https://doi.org/10.1093/conphys/coad092.

Bowen, L, von Biela, V.R., McCormick, S.D, Regish, A.M., Waters, S.C., Durbin-Johnson, B., Britton, M., Settles, M.L., Donnelly, D.S., Laske, S.M., Carey, M.P., Brown. R.J., and Zimmerman, C.E., 2020, Transcriptomic response to elevated water temperatures in adult migrating Yukon River Chinook salmon (*Oncorhynchus tshawytscha*): Conservation Physiology, v. 8, no. 1, 22 p., https://doi.org/10.1093/conphys/coaa084.

von Biela, V.R., Bowen, L., McCormick, S.D., Carey, M.P., Donnelly, D.S., Waters, S., Regish, A.M., Laske, S.M., Brown, R.J., Larson, S., Zuray, S., and Zimmerman, C.E., 2020, Evidence of prevalent heat stress in Yukon River Chinook salmon: Canadian Journal of Fisheries and Aquatic Sciences, v. 77, no. 12, p. 1878–1892, https://doi.org/10.1139/cjfas-2020-0209.

Tracing Mercury Through Lake Food Webs in Alaska's National Parks

Mercury is a toxic contaminant that threatens the health of aquatic ecosystems and species. Mercury concentrations in *Salvelinus namaycush* (lake trout), an important subsistence species and sportfish, were among the highest measured in western U.S. national parks, exceeded ecological and human health benchmarks. Our main objective is to reveal trophic pathways (food/energy sources) that may reduce or enhance mercury biomagnification with successive trophic levels among lake trout and determine whether concentrations vary with lake limnology, morphology, or biogeochemistry. Our methods of accomplishing this include sampling aquatic food web components (such as macroinvertebrates, prey fishes) from 10 lakes across 4 of Alaska's National Parks and Preserves for mercury concentrations and trophic relationships (via stable isotopes). A detailed food web approach across multiple parks with lakes of differing morphologies can improve understanding of the biological mechanisms that promote mercury biomagnification in fish and lake ecosystems and provide information on the health and safety of subsistence and sportfish resources.

Photograph showing a lake trout with its stomach contents caught at Wrangell-St. Elias National Park. Dorsal muscle collection and stomach content analysis are used to evaluate the biomagnification of mercury in lake trout. Stomach contents visible below the fish consist primarily of *Cottus cognatus* (slimy sculpin). Photograph by U.S. Geological Survey.

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Project Link

https://www.usgs.gov/centers/alaska-science-center/science/tracing-mercury-through-lake-food-webs

Time frame	Project Partners
Fiscal year 2016–ongoing	Gates of the Arctic National Park and Preserve, Lake Clark National Park and Preserve, Noatak National Preserve

Nearshore Fish Surveys in the Beaufort Sea

In the Arctic, rapid changes in temperature and salinity have led to changes in locations where fish are commonly found. Recent offshore survey efforts provide an opportunity to detect these changes and to compare fish abundance between offshore and nearshore habitats to understand whether nearshore habitats are used for specific life stages (such as juvenile rearing, feeding, or reproduction). Updated information on fish communities in the Arctic and the use of their nearshore habitats can provide management agencies with improved understanding of the risks of natural resource development and production in Federal waters. For example, information from this study can support BOEM in assessing whether red-throated loons are behaviorally affected by industrial activities and whether nearshore fish communities are large enough and have adequate nutrition for reproductive success.

Osmerus dentex (Arctic smelt) captured along the Beaufort Sea coastline in Alaska.

Time frame	Project Partner
Fiscal year 2017–ongoing	Bureau of Ocean Energy Management

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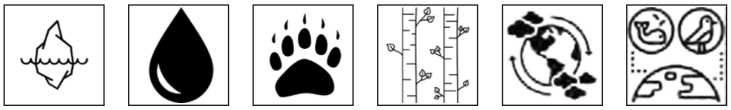
Project Link

https://www.usgs.gov/centers/alaska-science-center/science/nearshore-fish-surveys-beaufort-sea

Habitat

Beavers Affecting Tundra Ecosystems—Quantifying Effects on Hydrology, Permafrost, Water Quality, and Fish Habitat in Noatak Wild and Scenic River Basin, Alaska



The *Castor canadensis* (North American beaver) has expanded beyond its historical range into tundra ecosystems, potentially affecting the water quality, hydrology, and food webs of Arctic streams. Beaver dams create impoundments, flooding permafrost soils in tundra catchments and causing abrupt thaw. Our objective is to predict the consequences of beaver range expansion on the hydrology, water quality, and food webs of tundra ecosystems. Our methods (1) quantify the local and downstream effects of beaver ponds on water quality and hydrologic conditions and (2) assess how beaver-induced changes affect fish growth and bioaccumulation of mercury. The data from our study can provide a comprehensive examination of the physical, chemical, and biological consequences of beaver dams at the riverscape level and provide knowledge relevant to forecasting future changes in the Arctic. Scientific findings are planned to be published in peer-reviewed journals and via a NPS resource brief to highlight the effects of beavers on arctic ecosystems to promote public education.

Photograph showing a beaver dam on Rabbit Creek at Cape Krusenstern National Monument in northwestern Alaska. Photograph by Mike Carey, U.S. Geological Survey.

Contact

Michael P. Carey, ASC, mcarey@usgs.gov, 907–786–7197

Time frame	Project Partners
Fiscal year 2019–ongoing	National Park Service, University of Alaska Fairbanks

Project Link

https://www.usgs.gov/centers/asc/science/beavers-impacting-tundra-ecosystems-bite

Recent Publications

Shannon, K.C., Christman, N.R., Crump, B.C., Carey, M.P., Koch, J., Lapham, L.L., O'Donnell, J, Poulin, B.A., Tape, K.D., Clark, J.A., Colwell, F.S., 2023, Comparing sediment microbial communities of Arctic beaver ponds to tundra lakes and streams: Journal of Geophysical Research: Biogeosciences, v. 128, no. 8., https://doi.org/10.1029/2023JG007408.

O'Donnell, J.A., Carey, M.P., Poulin, B.A., Tape, K.D., and Koch, J.C., 2022, How beavers are changing arctic landscapes and Earth's climate: Frontiers for Young Minds, v. 10, p. 719051, https://doi.org/10.3389/frym.2022.719051.

Assessing the Dissemination of Antimicrobial Resistance Through Surface Waters of National Parks in Alaska

Antimicrobial resistance is an increasing global public health threat and environmental health challenge. In this project, our objective is to develop and optimize new tools to evaluate the occurrence and dissemination of antimicrobial resistance genes in surface waters on NPS-managed lands. Researchers in the Molecular Ecology Lab use quantitative polymerase chain reaction and genomic sequencing methods to detect and characterize antimicrobial resistance genes of clinical relevance from filtered surface-water samples. Resulting data products and summaries are available to the NPS and the public to provide information on potential contaminants that may be in surface waters on public lands.

Time frame	Project Partners
Fiscal years 2023–24	National Park Service; Region Kalmar County, Sweden; Linköping University, Sweden

Photograph showing scientists sampling surface waters for antimicrobial resistant bacteria at Exit Creek in Kenai Fjords National Park in Alaska. Antimicrobial resistance of clinical relevance may have important implications for human and animal health. The U.S. Geological Survey has partnered with the National Park Service to develop and optimize new tools to evaluate the occurrence and dissemination of antimicrobial resistance genes in surface waters. Photograph by U.S. Geological Survey.

Contact

Andy Ramey, ASC, aramey@usgs.gov, 907–786–7174

Project Link

https://www.usgs.gov/programs/environmental-health-program/science/antibiotic-resistant-bacteria-acquired-wild-birds

Recent Publications

Ahlstrom, C.A., Scott, L.C., Woksepp, H., Bonnedahl, J., and Ramey, A.M., 2023, Environmental antimicrobial resistance gene detection from wild bird habitats using two methods—A commercially available culture-independent qPCR assay and culture of indicator bacteria followed by whole genome sequencing: Journal of Global Antimicrobial Resistance, v. 33, p. 186–193, https://doi.org/10.1016/j.jgar.2023.03.009.

Habitat Dynamics—Using Satellite Remote Sensing in Landscape-Scale Wildlife and Ecological Process Studies

The Habitat Dynamics Project examines how short- and long-term changes in the environment affect the distribution and survival of wildlife populations. Understanding linkages between the physical and biological environment can help to inform management decisions. This project focuses on integrating remote sensing, satellite telemetry, and geographic information systems (GIS). Working collaboratively with other principal investigators, project participants use satellite and software technologies to study spatial and temporal interactions between wildlife populations and their environment. The three primary objectives of this project are to develop (1) wildlife distribution databases with emphasis on satellite tracking data, (2) environmental databases with emphasis on Arctic regions, and (3) GIS algorithms for integrated data analyses of habitat dynamics.

Photograph showing an adult female walrus with a behavior monitoring satellite-linked radio tag placed on it by U.S. Geological Survey personnel.

Contact

David C. Douglas, ASC, ddouglas@usgs.gov, 907–364–1576

Project Link

https://alaska.usgs.gov/portal/project.php?project_id=8

Time frame	Project Partners
1990s–ongoing	U.S. Fish and Wildlife Service, North Slope Borough

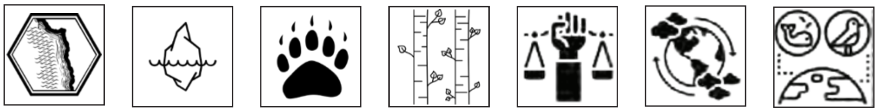
Recent Publications

Durner, G.M., Amstrup, S.C., Atwood, T.C., Douglas, D.C., Fischbach, A.S., Olson, J.W., Rode, K.D., and Wilson, R.H., 2020, Catalogue of polar bear (*Ursus maritimus*) maternal den locations in the Beaufort and Chukchi Seas and nearby areas, 1910–2018: U.S. Geological Survey Data Series 1121, 12 p., including appendixes, https://doi.org/10.3133/ds1121. [Supersedes USGS Data Series 568.]

Poessel, S.A., Uher-Koch, B.D., Pearce, J.M., Schmutz, J.A., Harrison, A.-L., Douglas, D.C., von Biela, V.R., and Katzner, T.E., 2020, Movements and habitat use of loons for assessment of conservation buffer zones in the Arctic Coastal Plain of northern Alaska: Global Ecology and Conservation, v. 22, 15 p., https://doi.org/10.1016/j.gecco.2020.e00980.

Von Duyke, A.L., Douglas, D.C., Herreman, J., and Crawford, J.A., 2020, Ringed seal (*Pusa hispida*) seasonal movements, diving, and haul-out behavior in the Beaufort, Chukchi, and Bering Seas (2011–2017): Ecology and Evolution, v. 10, no. 12, p. 5595–5616, https://doi.org/10.1002/ece3.6302.

Rapid Ecosystem Changes in Tundra Biomes—Implications for Landscapes and Humans



The Yukon Kuskokwim Delta encompasses the southernmost, warmest parts of the Arctic tundra biome and is renowned for its high biological productivity and subsistence-based communities, which are isolated from the statewide road system. Recent and rapid environmental changes in this region include significant winter and spring warming, decreased sea-ice extent, loss of snow cover, warming permafrost, and recurrent tundra fires, all of which cause significant changes in plant communities and primary ecosystem productivity. This project combines ecological ethnography with the monitoring of key coastal resources and elements vulnerable to the effects of climate changes. This project was developed in response to the growing awareness of rapid and potentially persistent climate change effects on subarctic coastal ecosystems and the need to document effects on Alaska Native villages and subsistence resources. The Yukon Kuskokwim Delta has been underrepresented in past studies of Arctic environmental change. In collaboration with the FWS and others, the USGS has developed a long-term monitoring project to detect recent ecosystem changes in tundra biomes and provide our partner with predictions of when, where, and how future changes may happen.

Photograph showing U.S. Geological Survey researchers and project partner documenting changes in permafrost, land surfaces, and vegetation communities in the Yukon-Kuskokwim Delta, western Alaska. Photograph by Rachel Loehman, U.S. Geological Survey.

Contacts

Rachel Loehman, ASC, rloehman@usgs.gov, 505–724–3664

Elizabeth Powers, AKRO, epowers@usgs.gov, 907–786–7085

Time frame	Project Partners
Fiscal year 2016–ongoing	U.S. Fish and Wildlife Service, Bureau of Indian Affairs, Alaska Native Villages of Chevak and Kotlik, Western Alaska Landscape Conservation Cooperative, U.S. Forest Service

Project Link

https://www.usgs.gov/centers/gecsc/science/terrestrial-records-holocene-climate-change-fire-climate-and-humans

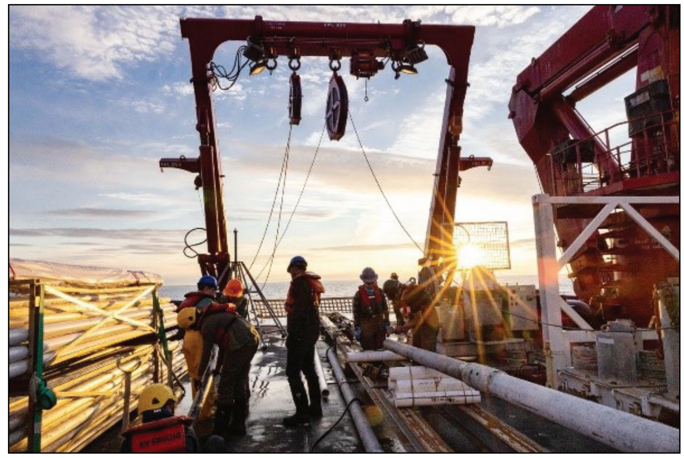
Recent Publications

Herman-Mercer, N.M., Loehman, R.A., Toohey, R.C., and Paniyak, C., 2019, Yukon-Kuskokwim Delta berry outlook—Results from local expert surveys: U.S. Geological Survey data release, https://doi.org/10.5066/P9HDXE32.

Herman-Mercer, N.M., Loehman, R.A., Toohey, R.C., and Paniyak, C., 2020, Climate- and disturbance-driven changes in subsistence berries in coastal Alaska—Indigenous knowledge to inform ecological inference: Human Ecology: An Interdisciplinary Journal, v. 48, no. 1, p. 85–99, https://doi.org/10.1007/s10745-020-00138-4.

Submarine Basins, Steppe, and Sea Ice—Paleoclimate and Paleoecology of the Late Pleistocene and Holocene Bering Sea Shelf

A dearth of scientific coring on the Bering Sea shelf limits an understanding of land bridge paleoecology and the ability to reconstruct regional paleoceanography during the Holocene. We plan to collect and analyze sediment cores from five submarine sedimentary basins on the Bering Sea shelf that may have been occupied by freshwater lakes during the last glacial maximum. Our objectives include reconstructing the vegetation of the emergent Bering Land Bridge and evaluating the relation between sea-ice extent during the Pleistocene and Holocene. To date, efforts to reconstruct conditions on the Bering Land Bridge have focused on more proximal and accessible terrestrial sites, whereas reconstructions of sea ice and marine productivity are based on data from deeper sites off the shelf edge. Our methods of reconstruction include using Chirp sub-bottom profiling to identify appropriate sediment coring locations and then using a variety of coring methods (multicores, gravity cores, jumbo piston cores, and [or] vibracores) to retrieve as much as 16-meter-long sediment cores. Later our team plans to analyze the cores using methods from diatom micropaleontology, palynology, organic geochemistry, sedimentology, and ancient deoxyribonucleic acid (DNA).



Photograph showing scientists collecting sediment cores on the Bering Land Bridge. Photograph by U.S. Geological Survey.

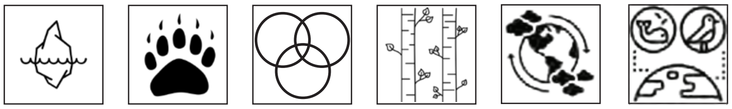
Time frame	Project Partner
Ongoing	University of Alaska Fairbanks

Contact

Beth Caissie, Geology, Minerals, Energy and Geophysics Science Center, bcaissie@usgs.gov, 650–329–5274

Cross-Cutting Programs

USGS Changing Arctic Ecosystems Initiative



The objectives of the USGS Changing Arctic Ecosystems Initiative are to (1) quantify the responses (positive, negative, and stable) of wildlife species and their habitats to ecosystem change in the Arctic, (2) make information on these responses publicly available to inform management decisions related to the development of oil and gas resources on BLM lands and on the Outer Continental Shelf managed by BOEM, and (3) provide projections of likely future wildlife and habitat responses to inform DOI actions related to regulation or policy, Alaska Native subsistence and co-management actions, and new monitoring protocols and adaptive management strategies.

Photograph showing an *Vulpes lagopus* (Arctic fox) in the summer on the northern coast of Alaska. Photograph by Ryan Askren, U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2010–ongoing	U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Ocean Energy Management, National Oceanic and Atmospheric Administration, North Slope Borough Co-Management Councils

Contact

John Pearce, ASC, jpearce@usgs.gov, 907–786–7094

Project Link

https://www.usgs.gov/centers/asc/science/changing-arctic-ecosystems

Recent Publications

Severson, J.P., Vosburgh, T.C., and Johnson, H.E., 2023, Hourly vehicle traffic data associated with industrial activity on the North Slope of Alaska during summers 2019–2020: U.S. Geological Survey data release, https://doi.org/10.5066/P9HXW3N5.

USGS ASC, Polar Bear Research Program, and U.S. Fish Wildlife Service, 2024, Estimated post-emergence period for denning polar bears of the Chukchi and Beaufort Seas: U.S. Geological Survey data release, https://doi.org/10.5066/F7G73BTD.

Johnson, H.E., Golden, T.S., Adams, L.G., Gustine, D.D., and Lenart, E.A., 2020, Caribou use of habitat near energy development in Arctic Alaska: The Journal of Wildlife Management, v. 84, no. 3, p. 401–412, https://doi.org/10.1002/jwmg.21809.

Pagano, A.M., Atwood, T.C., Durner, G.M., and Williams, T.M., 2020, The seasonal energetic landscape of an apex marine carnivore, the polar bear: Ecology, v. 101, no. 3, 16 p., https://doi.org/10.1002/ecy.2959.

Poessel, S.A., Uher-Koch, B.D., Pearce, J.M., Schmutz, J.A., Harrison, A.-L., Douglas, D.C., von Biela, V.R., and Katzner, T.E., 2020, Movements and habitat use of loons for assessment of conservation buffer zones in the Arctic Coastal Plain of northern Alaska: Global Ecology and Conservation, v. 22, 15 p., https://doi.org/10.1016/j.gecco.2020.e00980.

Alaska Native Science and Engineering Program Partnerhip

The USGS Alaska Region partner with the University of Alaska Anchorage Alaska Native Science and Engineering Program (ANSEP), a comprehensive science, technology, engineering, and math program beginning with students in sixth grade and continuing through high school and into science and engineering undergraduate and graduate degree programs, possibly through to the Ph.D. degree. ANSEP's objective is to create systemic change in the hiring patterns of Alaska Natives in science and engineering by placing students on a career path to leadership. The USGS partner with ANSEP through a cooperative agreement since FY 2012.

The USGS provides ANSEP students with opportunities to (1) work in a multidisciplinary natural science environment that examines fish, wildlife, and lands in an ecosystem context; (2) do water and mineral resource assessments; (3) acquire a better understanding of natural hazards facing Alaska; and (4) use state-of-the-art tools, from the latest molecular genetics techniques to geospatial information technologies.

Photograph of an Alaska Native Science and Engineering Program student working in the U.S. Geological Survey Alaska Science Center genetics laboratory. Photograph by U.S. Geological Survey.

Time frame	Project Partner
Fiscal year 2006–ongoing	Alaska Native Science and Engineering Program

Contact

Durelle Smith, AKRO, dpsmith@usgs.gov, 907–786–7104

Project Link

https://www.ansep.net/

Ecosystems Analytics

As analytical techniques have become more powerful, many scientists may find it challenging to maintain fluency in emerging statistical methods, GIS software, or data visualization. Expert data analysts may be needed to complete parts of projects or better design novel studies that can incorporate recently developed methods. The Ecosystems Analytics Group at the ASC provides analytical support ranging from answering specific coding questions to providing general analysis assistance. Our goal is to save the time spent analyzing data by those less familiar with certain techniques or to improve inference by using novel or emerging techniques with existing data. The group helps with software coding, spatial analyses, regression, mixed-effects and hierarchical models, power analyses, sampling design, Bayesian models, web-based data applications, and web- and publication-quality figures. Projects are based on analyst ability and experience; time investment; and concordance with DOI, USGS, and ASC priorities.

Photograph of a large polar bear. Photograph by Mike Lockhart, U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2020–ongoing	U.S. Fish and Wildlife Service, Bureau of Land Management, North Slope Borough

Contacts

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Emily Weiser, ASC, eweiser@usgs.gov, 907–786–7089

Jeffrey Bromaghin, ASC, jbromaghin@usgs.gov, 907–786–7086

Rebecca Taylor, ASC, rebeccataylor@usgs.gov, 907–786–7000

Project Link

https://www.usgs.gov/centers/asc/science/ecosystems-analytics

Recent Publications

Flint, P.L., Patil, V.P., Shults, B., and Thompson, S.J., 2020, Prioritizing habitats based on abundance and distribution of molting waterfowl, in the Teshekpuk Lake Special Area of the National Petroleum Reserve, Alaska: U.S. Geological Survey Open-File Report 2020–1034, 16 p., https://doi.org/10.3133/ofr20201034.

Wang, B., Ellefson, K.J., Granitto, M., Kelley, K.D., Karl, S.M., Case, G.N.D., Kreiner, D.C., and Amundson, C.L., 2020, Evaluation of the analytical methods used to determine the elemental concentrations found in the stream geochemical dataset compiled for Alaska: U.S Geological Survey Open-File Report 2020–1038, 66 p., https://doi.org/10.3133/ofr20201038.

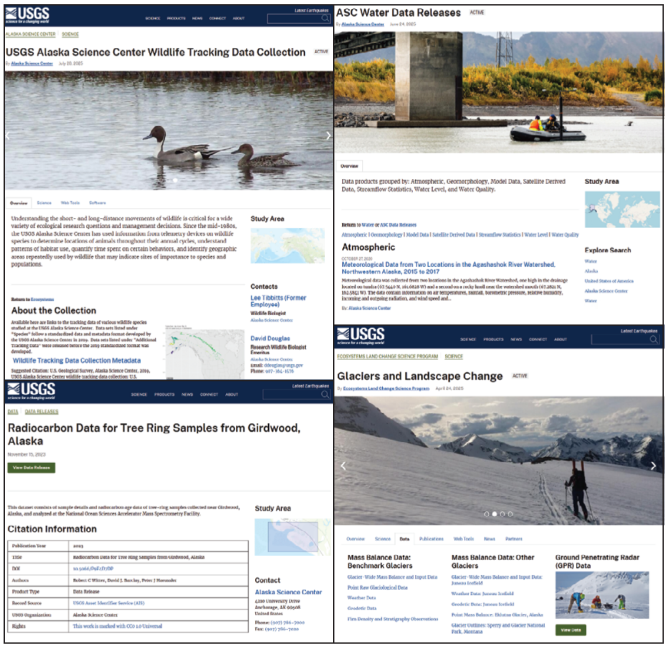
Weiser, E.L., 2020, Sample-size considerations for a study of shorebird nest survival in the 1002 Area, Arctic National Wildlife Refuge, Alaska: U.S. Geological Survey Open-File Report 2020–1066, 18 p., https://doi.org/10.3133/ofr20201066.

Data Management

Providing no-cost, easy access to federally funded scientific data is a legal requirement and a rapidly expanding expectation in the scientific community. All staff and contractors working for, or funded by, the USGS ASC comply with all Federal laws and DOI and USGS policies, directives, and standards regarding the access and archive of data. The ASC Data Management Group provides support for scientific staff in all USGS ASC Programs (Ecosystems, Geology, Water Ice and Landscape Dynamics [WILD], and Natural Hazards).

The objectives of the ASC Data Management Group are: (1) to help support and guide researchers to document and publish their scientific data, (2) to develop and refine efficient methods of data delivery to the public, while adhering to best practices for scientific data and software management, and (3) to provide public access to current and legacy USGS data and software.

Time frame
Fiscal year 2015–ongoing



Screenshots of data releases from the U.S. Geological Survey Alaska Science Center.

Contact

John Reed, ASC, jareed@usgs.gov, 907–786–7406

Project Link

https://www.usgs.gov/centers/alaska-science-center/data

Recent Publications

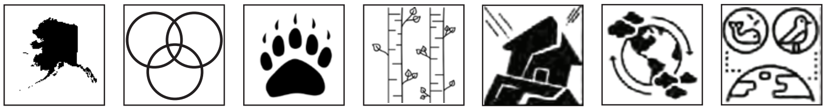
U.S. Geological Survey Alaska Science Center-Polar Bear Research Program and U.S. Fish Wildlife Service, 2024, Estimated post-emergence period for denning polar bears of the Chukchi and Beaufort Seas: U.S. Geological Survey data release, https://doi.org/10.5066/F7G73BTD.

Koch, J.C., Poulin, B.A., O'Donnell, J.A., Carey, M.P., and Evinger, T., 2023, Chemistry of orange and reference streams in northwestern Alaska: U.S. Geological Survey data release, https://doi.org/10.5066/P9DZSQ43.

Dumoulin, J.A., Whidden, K.J., Rouse, W.A., and DeVera, C.A., 2023, Geochemical data from selected Triassic rock samples in northeastern Alaska: U.S. Geological Survey data release, https://doi.org/10.5066/P9FAGE8O.

Bender, A.M., Haeussler, P.J., and Powers, P.M., 2021, Geologic inputs for the 2023 Alaska update to the U.S. National Seismic Hazard Model (NSHM) (ver. 2.0, February 2023): U.S. Geological Survey data release, https://doi.org/10.5066/P97NRR0F.

Molecular Ecology Laboratory



The Molecular Ecology Lab at the ASC provides genetic information on the health and status of biological resources for diverse local, State, and Federal partner. The objective of the Molecular Ecology Lab research program is to identify and fill gaps in our knowledge about species and population status, biodiversity, and the health of wildlife and their habitats to inform decisions on federally managed or co-managed biological resources. The Molecular Ecology Lab applies diverse methods, including next-generation sequencing, whole genome sequencing, quantitative polymerase chain reaction, and metabarcoding to complete research projects pertaining to wildlife health and disease, population genetics, and environmental DNA (eDNA). The lab's data products and summaries are provided to partner agencies and the public to inform decision making.

Photograph showing the staff of the U.S. Geological Survey Alaska Science Center Molecular Ecology Lab, September 2022. From left to right: Ann Riddle-Bernsten (biologist), Bobbi Pierson (lab manager and geneticist), Laura Scott (geneticist), Eleni Petrou (geneticist), Christina Ahlstrom (geneticist), Cherie McKeeman (geneticist), Damian Menning (research geneticist), and Andy Ramey (lab director and research geneticist). Photograph by U.S. Geological Survey.

Time frame	Project Partners
Fiscal year 2020–ongoing	Alaska Department of U.S. Fish and Game, Department of Defense, National Park Service, U.S. Department of Agriculture, U.S. Fish and Wildlife Service, University of Georgia

Contact

Andy Ramey, ASC, aramey@usgs.gov, 907–786–7174

Project Link

https://www.usgs.gov/labs/molecular-ecology-laboratory

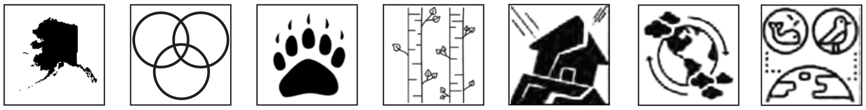
Recent Publications

Ramey, A.M., Scott, L.C., Ahlstrom, C.A., Buck, E.J., Williams, A.R., Kim Torchetti, M., Stallknecht, D.E., and Poulson, R.L., 2024, Molecular detection and characterization of highly pathogenic H5N1 clade 2.3.4.4b avian influenza viruses among hunter-harvested wild birds provides evidence for three independent introductions into Alaska: Virology, v. 589, p. 109938, https://doi.org/10.1016/j.virol.2023.109938.

Ahlstrom, C.A., Woksepp, H., Sandegren, L., Ramey, A.M., and Bonnedahl, J., 2023, Exchange of carbapenem-resistant *Escherichia coli* Sequence Type 38 intercontinentally and among wild bird, human, and environmental niches: Applied and Environmental Microbiology, v. 89, no. 6, p. e00319–e00323, https://journals.asm.org/doi/10.1128/aem.00319-23.

Ramey, A.M., McKeeman, C.M., Petrou, E.L., Menning, D.M., Russ, O.L., and López, J.A., 2024, Environmental DNA as a tool for better understanding the distribution, abundance, and health of Atlantic and Pacific salmon: Bethesda, Md., Fisheries, v. 49, no. 4, p. 169–180, https://doi.org/10.1002/fsh.11038.

Emerging Wildlife Disease



Environmental health is defined by connections between the physical environment, ecological health, and human health. Current research within the USGS recognizes the importance of this integrated research philosophy, which includes study of disease and pollutants as they pertain to wildlife and humans. Alaska is an important area to study environmental health because of its significant wildlife resources. Within the USGS, the Emerging Wildlife Disease Project supports USGS scientists nationwide to address wildlife diseases of high concern to the United States. This project focuses on important wildlife disease topics prevalent in Alaska such as avian influenza, bacterial and parasitic infections in wildlife, and Avian Keratin Disorder in landbirds and responds to new topics as they arise.

Photograph of a common murre on the water near its colony in Kachemak Bay, Alaska. Photograph by Sara Schoen, U.S. Geological Survey.

Contacts

Andy Ramey, ASC, aramey@usgs.gov, 907–786–7174

Caroline Van Hemert, ASC, cvanhemert@usgs.gov, 907–786–7167

Time frame	Project Partners
Fiscal year 2005–ongoing	Alaska Department of Fish and Game, National Park Service, U.S. Department of Agriculture, U.S. Fish and Wildlife Service, University of Georgia

Project Link

https://www.usgs.gov/centers/asc/science/wildlife-disease-and-environmental-health-alaska

Recent Publications

Ramey, A.M., Hill, N.J., DeLiberto, T.J., Gibbs, S.E.J., Hopkins, M.C., Lang, A.S., Poulson, R.L., Prosser, D.J., Sleeman, J.M., Stallknecht, D.E., and Wan, X.F., 2022, Highly pathogenic avian influenza is an emerging disease threat to wild birds in North America: The Journal of Wildlife Management, v. 86, no. 2, p. e22171, https://doi.org/10.1002/jwmg.22171.

Van Hemert, C., Ballweber, L.R., Sinnett, D.R., Atwood, T.C., Fischbach, A., Gustine, D.D., and Pabilonia, K.L., 2023, Giardia and Cryptosporidium in resident wildlife species in Arctic Alaska: Food and Waterborne Parasitology, v. 32, p. e00206, https://doi.org/10.1016/j.fawpar.2023.e00206.

Smith, M.M., Van Hemert, C., Atwood, T.C., Sinnett, D.R., Hupp, J., Meixell, B.W., Gustine, D., Adams, L., and Ramey, A.M., 2022, A serological survey of Francisella tularensis exposure in wildlife on the Arctic Coastal Plain of Alaska, USA: Journal of Wildlife Diseases, v. 58, no. 4, p. 746–755, https://doi.org/10.7589/JWD-D-21-00162.

The Sensitivity of Alaskan and Yukon Rivers, Fish, and Communities to Climate

Climate change is transforming Arctic hydrology. Changes including permafrost thaw, altered runoff hydrology, and river temperatures pose serious threats to Indigenous communities who rely on rivers for subsistence fishing; for access to supplies and fuel; and for transportation corridors (especially during the winter months) for overland access to reach subsistence resources, to transport goods, and to visit neighboring villages. The objective of this project is to converge Indigenous knowledge and Western science to strengthen collective understanding of terrestrial hydrologic change in the Arctic and its potential effects on rivers, fish, and Indigenous communities. A large interdisciplinary team, including an Indigenous Advisory Council, has been formed to meet this objective. Methods used to accomplish the objective include enhanced river monitoring using continuous collection of river temperatures and solute tracers at USGS gages in Alaska and communities participating in the Indigenous Observation Network. These data can inform a new state-of-the-art climate model that predicts hydrology and river ice across Alaska and the Yukon River Basin. These data can also be used in fish bioenergetic models that can help predict fish resources in the changing Arctic. Indigenous knowledge can be combined with modeling results to develop storylines of change that support resilience in Indigenous communities.

Photograph showing the Ambler River flowing south. The Ambler River originates in the Brooks Range. Photograph by Josh Koch, U.S. Geological Survey.

Time frame	Project Partners
Fiscal years 2019–24	University of Colorado, Boulder; National Center for Atmospheric Research; Institute for Tribal Environmental Professionals; Yukon River Intertribal Watershed Council; University of Saskatchewan; University of Waterloo

Contacts

Nicole Herman-Mercer, Water Resources Mission Area–Integrated Information Dissemination Division, nhmercer@usgs.gov, 303–236–5031

Josh Koch, ASC, jkoch@usgs.gov, 303–817–5595

Project Link

https://www.colorado.edu/research/arctic-rivers/

Recent Publications

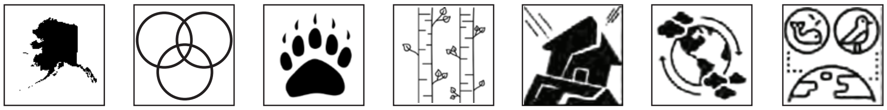
Musselman, K.N., Addor, N., Vano, J.A., and Molotch, N.P., 2021, Winter melt trends portend widespread declines in snow water resources: Nature Climate Change, v. 11, no. 5, p. 418–424, https://doi.org/10.1038/s41558-021-01014-9.

Newman, A.J., Monaghan, A.J., Clark, M.P., Ikeda, K., Xue, L., Gutmann, E.D., and Arnold, J.R., 2021, Hydroclimatic changes in Alaska portrayed by a high-resolution regional climate simulation: Climatic Change, v. 164, no. 17, p. 1–21, https://doi.org/10.1007/s10584-021-02956-x.

Newman, A.J., Clark, M.P., Wood, A.W., and Arnold, J.R., 2020, Probabilistic spatial meteorological estimates for Alaska and the Yukon: Journal of Geophysical Research: Atmospheres, v. 125, no. 22, p. 1–21, https://doi.org/10.1029/2020JD032696.

Poujol, B., Prein, A.F., and Newman, A.J., 2020, Kilometer-scale modeling projects a tripling of Alaskan convective storms in future climate: Climate Dynamics, v. 55, no. 11–12, p. 3543–3564, https://doi.org/10.1007/s00382-020-05466-1.

Northern Climate Reports



The AK CASK objectives have long included providing access to actionable climate projections and climate futures derived from prior research like the Alaska Integrated Ecosystem Modelling project. Alaska rightsholders and stakeholders use these projections for vulnerability assessments, adaptation plans, and other planning efforts. The objective of this project is to meet the rapid increase in need for climate information. AK CASC scientists collaborated with Scenarios Network for Alaska + Arctic Planning to develop the Northern Climate Reports webtool. This tool serves climate futures by management unit, ethnolinguistic region, community, or other areas of interest across the region while appropriately conveying uncertainty. The tool relies on methods developed over the history of the AK CASC to characterize Alaska-relevant changes, including best practices for communicating climate scenarios. It provides access to location-specific model outputs for climate, fire, vegetation, *Dendroctonus rufipennis* (spruce beetle), and permafrost. This innovative webtool (https://northernclimatereports.org/) is being continually updated with new decision-relevant climate science information.

Photograph of the Wolverine Glacier weather station (U.S. Geological site number 15236895) on the Kenai Peninsula, with a weighing type precipitation gage with a large wind screen on the left, a radar-based precipitation sensor on the pole in the middle, and a new power system in the shack on the right. In the background are unnamed peaks on the edge of the Sargent Icefield.

Time frame	Project partner
Fiscal year 2021–ongoing	University of Alaska Fairbanks Scenarios Network for Alaska + Arctic Planning

Contacts

Jeremy Littell, AK CASC, jlittell@usgs.gov, 907–360–9416

Project Link

https://northernclimatereports.org/

Recent Publication

Littell, J.S., 2024 Alaska climate futures (mid and late 21st century) and historical references (20th century): U.S. Geological Survey data release, https://doi.org/10.5066/P9DHBMZ5.

Alaska Tribal Resilience Learning Network

The Alaska Tribal Resilience Learning Network is a community of learning, sharing, technical assistance, training, and support for Alaska Tribes, the leadership of these Tribes, and Indigenous communities as they respond and adapt to the current and future effects of climate change. Through a cooperative agreement with the Native American Fish and Wildlife Society, the Learning Network works to build collaborative and meaningful relationships with Alaska Native Tribes and other entities to address management and climate adaptation needs across the State.

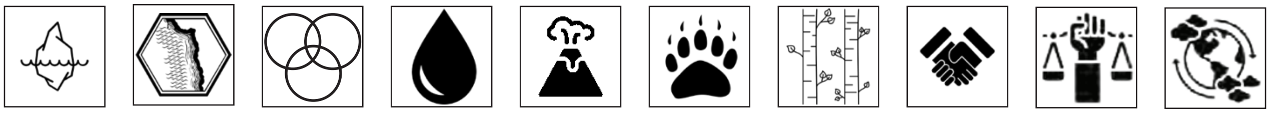
Time frame	Project Partners
Fiscal year 2021–ongoing	International Arctic Research Center, University of Alaska Fairbanks, Aleutian Pribilof Islands Association

Photograph showing a storage tank overturned because of flooding in western Alaska. Photograph by Ryan Toohey, U.S. Geological Survey.

Contact

Steve Gray, AK CASC, sgray@usgs.gov, 907–301–7830

Looking Forward, Looking Back—Strengthening Resilience Today



The first Strengthening Resilience Today training was held in Fairbanks, Alaska, in May 2023 for Tribal members to learn about and develop climate adaptation strategies for their communities. It was attended by 23 Tribal members from the Tribes of Igiugig Village, Native Village of Hooper Bay, Native Village of Paimiut, Klawock, Kokhanok Village, and Native Village of Unalakleet. The second training was held in Anchorage, Alaska, in February 2024. Community site visits during the second training took place in the first six months of 2024 the winter to summer of FY 2024 and included community gatherings and talks about climate adaptation from AK CASC scientists. Five baseline syntheses, one for each community, were finalized at a work session in FY 2024 with a representative from each community.

Photograph showing the Strengthening Resilience Today participants at the University of Alaska Fairbanks. Photograph by Michael Delue, University of Alaska Fairbanks.

Time frame	Project Partners
Fiscal years 2018–24	U.S. Bureau of Indian Affairs, Native Movement, Native American Fish and Wildlife Society, University of Alaska Fairbanks

Contact

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Alaska's Berry Future—Planning for Changing Resources in an Altered Climate

Berries are a crucial nutritional and cultural resource for communities and ecosystems in Alaska. However, berry abundance and the timing of their lifecycle are becoming more variable because of climate change. Climate adaptation plans across the State identify climate change effects on berry timing and availability as primary concerns. Although there is a large body of work on plants that produce berries, much of that information is not accessible to land managers and communities. The first objective of this project is to bring scientists, land managers, and community observers together to synthesize what is known about berry plants and how they are responding to climate change. One goal of this coordination is to produce a publicly accessible report aimed at informing communities about how to plan for changing berry resources. Second, the project aims to identify information gaps on berry abundance and timing to inform future research. A third goal is to address "rotten berries" by piloting a new citizen science component that focuses on berry quality and decomposition. Finally, the project team plans to work with Alaska Native educators in four communities to develop protocols and lesson plans for multiple age groups to bring an exciting new dimension to youth and provide training opportunities to rural communities.

Time frame	Project Partners
Fiscal years 2023–24	U.S. Fish and Wildlife Service, Sun'aq Tribe of Kodiak, U.S. Department of Agriculture, Metlakatla Indian Community, Metlakatla Boys and Girls Club, Innoko River School, Sitka 4–H Club

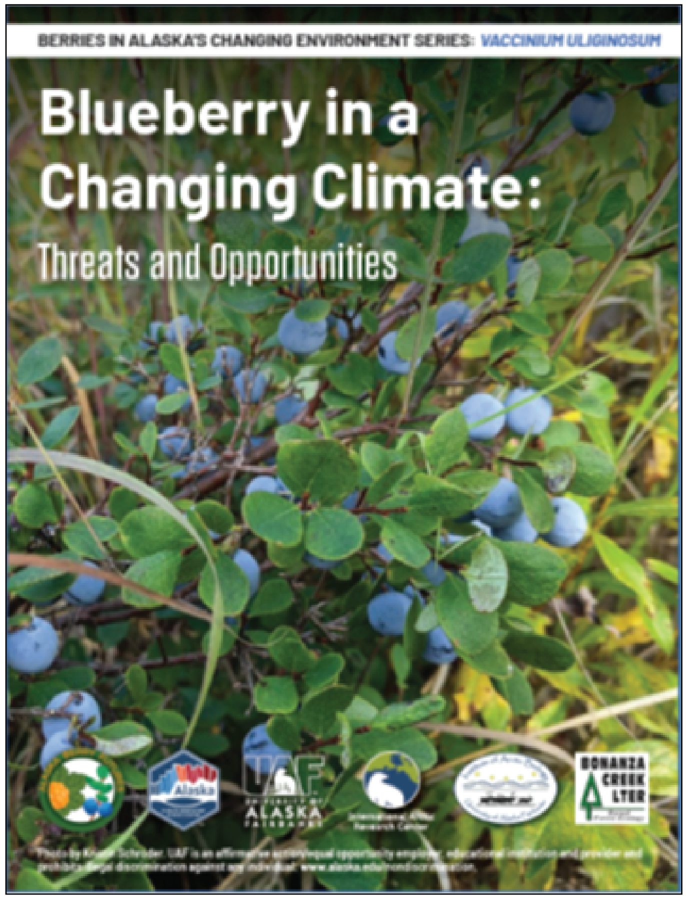

Image showing the publication "Blueberry in a Changing Climate: Threats and Opportunities" in the Berries in Alaska's Changing Environment Series: *Vaccinium Uliginosum*. Photograph by Kristin Schroder, University of Alaska Fairbanks (Mulder and others, 2023).

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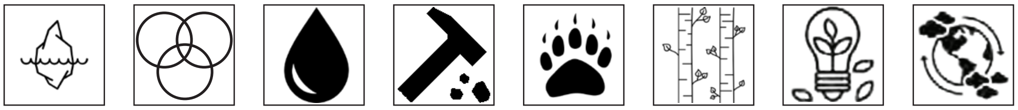
Project Link

https://www.usgs.gov/programs/climate-adaptation-science-centers/science/alaskas-berry-future-planning-changing

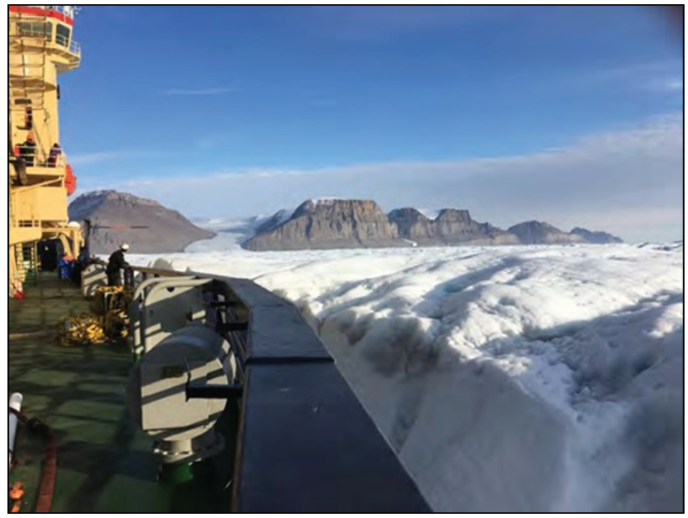
Recent Publications

Mulder, C.P.H., Weingartner, L., Parkinson, L.V., Bird, L., Putman, M., Sousa, E., Diggle, P., Spellman, K.V., and Smyth, A., 2023, Blueberry in a changing climate—Threats and opportunities, *in* Berries in Alaska's Changing Environment Series—*Vaccinium Uliginosum*: Fairbanks, Alaska, University of Alaska, 20 p.

Land-Sea Linkages in the Arctic Global Change Research and Development—Climate History and Past Environmental Change



Paleoclimate records in Arctic Ocean sediments (1) improve understanding of patterns and causes of Arctic climate change; (2) determine possible future climate change and effects of Arctic Sea ice on mid-latitude weather; and (3) help decision makers address issues of ecosystem health, endangered species, energy policy, national security, and transportation. The goal of this project is to investigate the changing Arctic using instrumental records of environmental conditions and sediment cores, over short (50-year) and long (about 400,000-year) time frames. Marine sediment samples and cores can be used to document paleo-oceanographic changes during periods of glacial-interglacial climate variability. Pollen assemblages can be used to compare ocean and land-based changes. Primary research objectives include (1) evaluation of sea ice and climate variability in the Arctic using sediment cores as proxy records to support models projecting future ice, temperature, and circulation; (2) connection of ocean, climate, and land-cover changes in Alaska during past interglacial periods; and (3) determination of baseline ocean temperature, sea ice, pH, and marine ecosystems before the instrumental period of the last few decades.



Photograph showing the research vessel Oden near the ice tongue of the Ryder Glacier, northwestern Greenland. During summer 2019, U.S. Geological Survey scientists participated in the Ryder Expedition to investigate the cryosphere's dynamic history and response to climate change. Photograph by Laura Gemery, U.S. Geological Survey.

Time frame	Project Partners
Fiscal years 2019–23	Stockholm University, Princeton University, Columbia University, Aarhus University (Denmark), GEOMAR, Kiel (Germany), University of Arizona, University of Maryland, National Oceanic and Atmospheric Administration, U.S. Coast Guard

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Project Link

https://www.usgs.gov/land-resources/land-change-science-program/science/land-sea-linkages-arctic

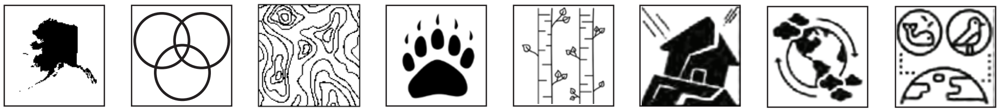
Recent Publications

Cronin, T.M., and Zabel, I.H., 2022, Abrupt climate change—Paleontological Research Institution blog series on geological records: Paleontological Research Institution blog, https://www.priweb.org/blog-post/what-is-abrupt-climate-change?rq=abrupt%20climate%20change.

Gemery, L., T. M. Cronin, W.M. Briggs, Jr., E.M. Brouwers, E.I. Schornikov, A. Stepanova, A. Wood, and M. Yasuhara, 2017, An Arctic and subarctic ostracode database—Biogeographic and paleoceanographic applications: Hydrobiologia, v. 786, p. 59–95, https://doi.org/10.1007/s10750-015-2587-4.

Cronin, T.M., 2020, The paleoclimatic and paleobiogeographic significance of the Tjörnes Basin, northern Iceland, *in* Eiríksson, J., and Símonarson, L.A., eds., Pacific–Atlantic mollusc migration—Ocean Gateway Archives on Tjörnes, North Iceland: Springer, Topics in Geobiology, v. 52, p. 5–6.

Alaska Mapping Executive Committee



The Alaska Mapping Executive Committee (AMEC) coordinates the modernization of Alaska map layers. Executives from multiple Federal agencies and the State meet to prioritize and coordinate mapping objectives. AMEC currently promotes acquisition of several digital map layers, including imagery, elevation, terrestrial hydrography, wetlands, coastal shorelines, and bathymetry. Since the May 2023 AMEC meeting, the AMEC Technical Subcommittee has continued meeting monthly to coordinate and track six mapping themes. In FY 2024, AMEC added vegetation mapping as a tracked theme.

Contact

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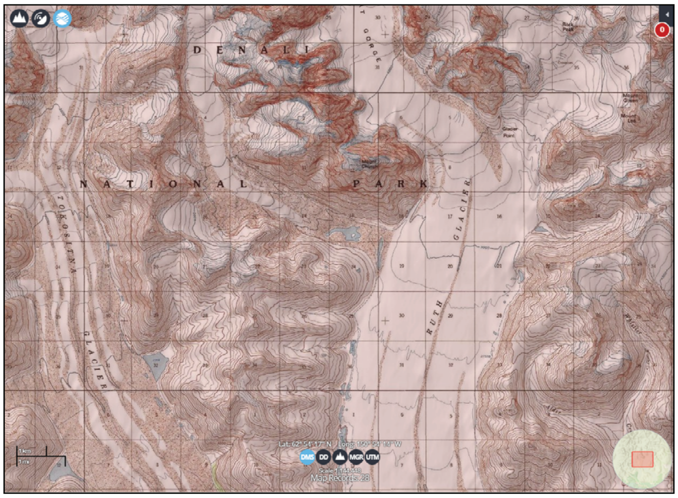
Project Link

https://www.usgs.gov/ngp-user-engagement-office/alaska-mapping-executive-committee



Screenshot from the U.S. Geological Survey TopoView website (https://ngmdb.usgs.gov/topoview/) showing part of a topographic map within Denali National Park, Alaska.

Time frame	Project Partners
Fiscal year 2012–ongoing	U.S. Department of Agriculture, Department of Commerce, Department of Defense, Department of Homeland Security, U.S. Department of the Interior, Department of Transportation, Environmental Protection Agency, Executive of Office of the President, Office of Management and Budget, Executive of Office of the President, Office of Science and Technology Policy, Federal Aviation Administration, Federal Emergency Management Agency, National Geospatial-Intelligence Agency, National Oceanic and Atmospheric Administration, National Reconnaissance Office, Natural Resources Conservation Service, National Science Foundation, U.S. Army Corps of Engineers, Board of Indian Affairs, Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forestry Service, National Park Service, U.S. Northern Command, State of Alaska

Collaboration with the Interagency Arctic Research Policy Committee

IARPC was established in 1984 under the Arctic Research and Policy Act Public Law 98–373 as a collaborative platform among Federal agencies to enhance scientific research and monitoring in the Arctic by connecting government researchers, non-Federal researchers, and Arctic communities to work together on pressing issues. Every 5 years, IARPC is required by law to develop and implement an Arctic Research Plan with input from the Federal research community, Alaska State agencies, Tribal and non-governmental organizations, and the public. The USGS is actively engaged with the current 2022–26 Arctic Research Plan, assuming a lead role on 13 deliverables and contributing to 46 deliverables in support of the Biennial Implementation. The USGS also serves as the lead bureau for DOI in other IARPC activities, with the USGS Director serving as DOI Principal on the Committee and many USGS staff serving a leadership role on IARPC work groups and collaboration teams.

Time frame	Project Partners
Fiscal year 1984–ongoing	Department of Energy, U.S. Department of Interior, Department of Homeland Security, National Oceanic and Atmospheric Administration, Marine Mammal Commission, Smithsonian Institute, Department of Agriculture, U.S. Geological Survey National Science Foundation, National Aeronautical Space Administration, Environmental Protection Agency, Department of Transportation, Department of Defense, Department of Health and Human Services, Denali Commission, Department of Housing and Urban Development, Universities

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Project Link

https://www.iarpccollaborations.org/about.html

Collaboration with the U.S. Arctic Observing Network

The U.S. Arctic Observing Network (AON) is a collaborative initiative, guided by a Federal board, with representatives from a range of agencies coordinating together to improve the Arctic observing system. It operates as a recognized sub-body of the IARPC, and the USGS AKRO plays an active role in supporting its work. In FY 2022, AON's Federal board responded to a request from Congress about its report "On the Need to Establish and Maintain a Sustained AON." In addition to articulating issues with the current state of Arctic observing, the board put forward a vision for more effective and inclusive observing and data systems. The report recommends: supporting coordinated, integrated, and sustained critical observations and infrastructure with an emphasis on furthering the development of a shared data management system, prioritizing human and technological capacity building, and closing gaps in climate resilience and national security concerns.

Contact

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Project Link

https://www.usaon.org/sites/default/files/2024-03/USAON_Accomplishments%20Report_2024.pdf

Collaboration with the Arctic Executive Steering Committee at the White House

The Arctic Executive Steering Committee (AESC), established by executive order on January 21, 2015, works to provide guidance to Federal departments and agencies and to enhance coordination of Federal Arctic policies across agencies and offices. In FY 2023, the AESC and National Security Council released an implementation plan—the National Strategy for the Arctic Region (NSAR). This is a public document intended to provide a multiagency commitment to action as a follow up to the FY 2022 NSAR. The plan identifies 48 “commitments” from 13 “strategic objectives” based on the NSAR’s 4 “pillars”: (1) Security; (2) Climate Change; (3) Sustainable Economic Development; (4) International Cooperation. As the AESC plans over the coming decade, the newest NSAR is of shorter focus, with quarterly progress updates and annual formal reporting. Each of the 48 commitments has one or two lead agencies coordinating the drafting and supporting the lines of effort, and multiple supporting agencies contribute to the drafting and execution. DOI is a lead or supporting agency in 24 of the 48 commitments, and the USGS has a lead role in 13 actions and a supporting role in 8. The Special Assistant to the Secretary in Alaska has previously served as DOI Principal.

Time frame	Project Partners
Fiscal year 2005–ongoing	Alaska Department of Fish and Game, National Park Service, U.S. Department of Agriculture, U.S. Fish and Wildlife Service, University of Georgia

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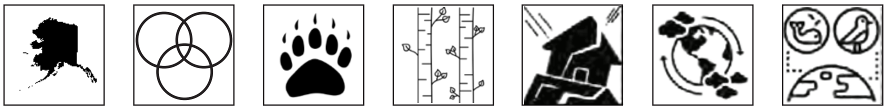
Project Link

https://arcticsecurity.org/national-strategy-for-the-arctic-region-implementation-plan/

USGS Contributes to the Arctic Report Card



Issued annually since FY 2006, the National Oceanic and Atmospheric Administration "Arctic Report Card" is a timely and peer-reviewed source for clear, reliable, and concise environmental information on the current state of different components of the Arctic environmental system relative to historical records. Two essays from the Arctic Report Card stand out because of their critical topics and their USGS authorship. The USGS ASC research fish biologist Vanessa von Biela is a coauthor on an essay in the FY 2023 Arctic Report Card, "Divergent Responses of Western Alaska Salmon to a Changing Climate." This essay summarizes how record-high abundance of Bristol Bay *Oncorhynchus nerka* (sockeye salmon) can co-occur with historic lows of Chinook and *Oncorhynchus keta* (chum salmon) and the implications of both extremes for fisheries and Alaskan communities. Gas Hydrates Project Chief Carolyn Ruppel coauthored the invited essay on "Permafrost Beneath Arctic Ocean Margins." The essay summarizes pan-Arctic observations that constrain the contemporary extent of subsea permafrost, highlighting modern USGS studies on the U.S. Beaufort margin. The FY 2023 Arctic Report Card was released to the public during a press conference at the American Geophysical Union conference in San Francisco, California. Read more about the Arctic Report Card at https://arctic.noaa.gov/Report-Card.

Cover of the fiscal year 2023 National Oceanic and Atmospheric Administration Arctic Report Card.

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Time frame
Fiscal year 2006–ongoing

Project Link

https://arctic.noaa.gov/Report-Card/

Recent Publications

Thoman, R.L., Moon, T.A., and Drukenmiller, M.L., eds., 2023, NOAA Arctic report card 2023—Executive summary: National Oceanic and Atmospheric Administration web page, https://doi.org/10.25923/5vfa-k694.

Humphreys, J.M., Ramey, A.M., Douglas, D.C., Mullinax, J.M., Soos, C., Link, P., Walther, P., and Prosser, D.J., 2020, Waterfowl occurrence and residence time as indicators of H5 and H7 avian influenza in North American poultry: Scientific Reports, v. 10, 16 p., https://doi.org/10.1038/s41598-020-59077-1.

Ramey, A.M., Cleveland, C.A., Hilderbrand, G.V., Joly, K., Gustine, D.D., Mangipane, B., Leacock, W.B., Crupi, A.P., Hill, D.E., Dubey, J.P., and Yabsley, M.J., 2019, Exposure of Alaska brown bears (*Ursus arctos*) to bacterial, viral, and parasitic agents varies spatiotemporally and may be influenced by age: Journal of Wildlife Diseases, v. 55, no. 3, p. 576–588, https://doi.org/10.7589/2018-07-173.

Ramey, A.M., and Reeves, A.B., 2020, Ecology of influenza A viruses in wild birds and wetlands of Alaska: Avian Diseases, v. 64, no. 2, p. 109–122, https://doi.org/10.1637/0005-2086-64.2.109.

North Pacific Research Board Collaboration

The North Pacific Research Board (NPRB) was created by Congress in 1997 to recommend priority coastal and marine research in the Gulf of Alaska, Bering Sea, and Arctic Ocean to the Secretary of Commerce for funding through an annual competitive and peer-reviewed grant program—known as the "core program"—derived primarily from National Oceanic and Atmospheric Administration sources. The USGS AKRO represents DOI interests on the 20-member Board since its creation in 2001, serving in an advisory capacity on numerous strategic initiatives, including annual funding decisions, as well as long-term funding allocation strategies and options for improving the vitality and relevance of an integrated marine science program.

Since its inception, NPRB has been a sponsor and one of the leading organizers of the Alaska Marine Science Symposium, Alaska's premier marine research conference. In most years, more than 700 people attend this 4-day conference held annually during January.

Image showing the logo of the North Pacific Research Board.

In addition to the annual core program, NPRB also allocates resources to long-term monitoring and an Integrated Ecosystem Research Program (IERP) to support multidisciplinary collaboration for a greater understanding of the complex interactions among the physical, chemical, biological, and social processes that influence the structure and function of Alaska's large marine ecosystems. The products of these programs are highly relevant to communities and industries that rely upon these ecosystems. IERPs generally involve 50–100 individuals, including students, early-career researchers, senior scientists, and Alaska community members. NPRB implements IERPs in three phases: assessment, field research, and synthesis. To date, NPRB has funded three IERPs, and recently committed to a fourth. The first IERP (2007–14), done in partnerhip with the NSF, provided research funding to improve the scientific community's understanding of the Bering Sea in the context of a changing climate. The Gulf of Alaska IERP (2010–16) provided research funding to investigate environmental processes and biological interactions that influence the survival, transport, settlement, and recruitment of larval and juvenile stages of commercially and ecologically important groundfish. The Arctic IERP (2016–21) provided research funding to advance understanding of the linkages between the northern Bering Sea and the Arctic and to examine how productivity and biological rate processes established during spring in the Bering Strait region influence the ecology of the Chukchi Sea during summer and fall, with implications for food security among Arctic residents. The forthcoming IERP (2025–30) aims to document significant changes in the physical and biological environment of the Northern Bering and Chukchi Seas. Areas of interest include how shifts in environmental conditions and processes may influence species of commercial, ecological, and subsistence importance and implications for State and Federal fisheries management and communities that depend on these resources.

Time frame	Project Partners
Fiscal year 2010–ongoing	North Pacific Research Board, National Oceanic and Atmospheric Administration, Alaska Department of Fish and Game Oil Spill Recovery Institute, University of Alaska Fairbanks, Alaska Sea Life Center, U.S. Arctic Research Commission, U.S. Coast Guard, Ocean Conservancy

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Project Link

https://nprb.org/

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