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U.S. Geological Survey—Department of the Interior Region 11, Alaska—2021–22 Biennial Science Report

Circular 1497

U.S. Department of the Interior
U.S. Geological Survey

Cover.

Top left. Permafrost forming a grid-like pattern in the National Petroleum Reserve, North Slope, Alaska, approximately 2017. Photograph by David Houseknecht, U.S. Geological Survey.

Middle left. Gas plume rising from Augustine Volcano during its eruptive phase, Augustine Island, Alaska, January 24, 2006. Photograph by Cyrus Whitney Read, U.S. Geological Survey

Bottom left. Alaska Native Science and Engineer Program student helping to band molting snow geese and black brant on the Colville River Delta, Alaska, August 1, 2018. Photograph by U.S. Geological Survey.

Top right. Walruses socializing during U.S. Geological Survey research efforts permitted under U.S. Fish and Wildlife Service Permit No. MA801652-3, September 19, 2013. Photograph by Ryan Kinsbery, U.S. Geological Survey.

Middle right. Close up of Common Murre sitting on egg at breeding colony on Gull Island in Kachemak Bay, Alaska, November 28, 2018. Photograph by Sarah Schoen, U.S. Geological Survey.

Bottom right. Scientist preparing to extract a snow core from a Benchmark Glacier, September 8, 2018. Photograph by U.S. Geological Survey.

U.S. Geological Survey—Department of the Interior Region 11, Alaska—2021–22 Biennial Science Report

Edited by Elizabeth M. Powers and Dee M. Williams

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U.S. Department of the Interior
U.S. Geological Survey

U.S. Geological Survey, Reston, Virginia: 2022

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Suggested citation:
Powers, E.M., and Williams, D.M., eds., 2022, U.S. Geological Survey—Department of the Interior Region 11, Alaska—2021–22 biennial science report: U.S. Geological Survey Circular 1497, 83 p., https://doi.org/10.3133/cir1497.

ISSN 2331-1258 (online)

Regional Director's Message


Aimee Devaris

Dear Stakeholders and Partners:

2021 has been another year marked by both profound challenges and incredible opportunities. We have transitioned to a new Administration with newly defined research priorities and budget projections, while maintaining our established expertise and enriching our strong network of research partners. We have lived through another year of COVID-19 resurgence with ongoing disruptions to our workplace routines and fieldwork activities, calmly adjusting to updated guidance and fulfilling the duties of our mission. As I think about select highlights of partnership and collaboration over the past year, I reflect with great admiration and pride upon the resilience, hard work, and dedication of all U.S. Geological Survey (USGS) staff who contribute to our work in Alaska.

We found creative ways to respond to new challenges. Despite most of the staff still teleworking and spending far less time traveling or in the field, our three Alaska Region Science Centers—the Alaska Science Center, the Volcano Science Center, and the Alaska Climate Adaptation Science Center (AK CASC)—maintained high productivity in terms of data releases and publications. During fiscal year 2021, the Alaska Science Center delivered 75 data releases through its data repository. In addition, the Alaska Science Center delivered over 185 peer-reviewed publications including USGS Series and manuscripts published through external journals, books, and monographs. The Volcano Science Center delivered over 195. The AK CASC delivered over fifty peer-reviewed publications in fiscal year (FY) 2021, as well as a variety of data sets, public-outreach materials, and other informational products.

A key highlight of FY2021 was the USGS Landslide Program and Alaska Regional Office coordinated an intergovernmental response to the discovery of a potential landslide into the Barry Arm of Prince William Sound that threatens the town of Whittier and regional mariners with tsunamis. The USGS quickly pivoted resources and staff to address public concern with this new threat through a partnership involving the State, the National Oceanic Atmospheric Administration, the University of Alaska, and the Alaska Volcano Observatory. USGS led the effort to deploy instrumentation to monitor the landslide area for signs of instability and characterize the nature of the threat. Using more detailed bathymetric surveys of the area and improved tsunami modeling, USGS demonstrated that the maximum wave height resulting from a landslide into Barry Arm was less than previously described in an initial report; thus lowering (though not limiting) the risk to Whittier.

Another FY2021 highlight is the expanding partnership between the USGS Mineral Resources Program, through its Earth Mapping Resources Initiative, with the State of Alaska's Division of Geological and Geophysical Surveys to acquire geoscientific data in the Yukon-Tanana (YT) Uplands in east-central Alaska. Airborne geophysical surveys over the YT Uplands are nearing completion with the first data expected to be publicly available in early FY2022. Meanwhile, the USGS Energy Program continues its research into the geology of Alaska's North Slope. This work is vital for better quantifying and discerning oil and natural gas resources that could help advance a pathway toward lower-carbon energy production.

Mapping has also been a consistent highlight, as the Alaska Mapping Executive Committee (AMEC) celebrated the completed collection of elevation data covering the entire state of Alaska as a priority focus of the nation's Three-Dimensional Elevation Program. Since 2010, multiple federal agencies and the State of Alaska contributed over $68 million to complete the project. All the data are now fully processed and can be available through USGS and State of Alaska public websites. The new elevation data have been used to create a new statewide series of accurate digital topographic maps for Alaska. The final 75 of the 11,278 maps, that are required to achieve statewide coverage of Alaska, are currently in production and are expected to be completed before the end of FY2021. AMEC established a Coastal Mapping Subcommittee to prioritize and advance a statewide coastal-topography and nearshore bathymetric-mapping program. This program will be critical as new shipping lanes open and ocean transfer of people and goods expands commerce in regional, state, and federal waters.

Another highlight of collaboration was the consensual production of the next 5-year Arctic Research Plan, 2022–26, due to be published by the Interagency Arctic Research Policy Committee (IARPC) before year's end. Many USGS personnel played key roles to help achieve this successful outcome so that Acting Director Applegate, as the Department of the Interior (DOI) Principal to IARPC, could ratify the new plan on behalf of all DOI bureaus. The new plan facilitates more comprehensive coverage of relevant DOI Arctic research, such as land conservation, protecting biodiversity, public health and safety, and economic vitality. Looking forward, the USGS remains committed to maintain a leadership role in Arctic science and technology by delivering accurate study of relevant resources or hazards, and by promoting integration of these activities through an increasingly holistic and service-oriented approach.

A final highlight of collaboration centers upon our ongoing work to ensure inclusive and equitable workforce strategies to increase participation in science for underrepresented groups living in Alaska and the Arctic. For example, I am happy to report the Unlearning Racism in the Geosciences pod in the Volcano Science Center developed a 2-year Action Plan and the regional office chartered the Alaska Region Diversity, Equity, Inclusion, and Access Steering Committee to see this work through to completion. The committee is currently undertaking work in the following areas: removing barriers in recruitment and hiring processes, establishing an accessible mentoring program, mainstreaming inclusive habits and behaviors in the workplace, improving field and lab plans to include safety protocols related to anti-harassment, and promoting access to educational/awareness materials regarding racism. In July 2021, the Alaska Region established a new Memorandum of Understanding between USGS and Alaska Pacific University (APU) for a period of five years to support APU as an Alaska Native Serving Institution. We continue to participate annually in the Alaska Native Science and Engineering Program to support systematic change in the hiring patterns of Alaska Natives in science and engineering by placing students on a career path to leadership.

The public has come to expect a deeper engagement with scientists and science agencies; co-production is the new collaborative model of research that includes stakeholders, the public, donors, and policy makers. This Biennial Report is one means of providing more transparent and straightforward information about our diverse work as a deliberate step to facilitate external co-production processes. I am pleased to share this Biennial Report, on behalf of the USGS Alaska Region and U.S. Department of the Interior Region 11.

Aimee M. Devaris

USGS DOI Region 11 Director

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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 inter-connected themes:

- 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 three Alaska-based science centers, a Cooperative Research Unit, and USGS centers outside Alaska, with a combined annual science budget of about $60 million. In the last 5 years, USGS research in Alaska has produced many scientific benefits resulting from more than 1,050 publications. Publications relevant to Alaska can be conveniently searched by keyword through the USGS Publications Warehouse at https://pubs.er.usgs.gov/search?q=Alaska.

Regional Office

The Office of the Alaska Regional Director provides strategic leadership for the region's science programs while facilitating growth of USGS science capacity centering on Arctic and Subarctic systems. The office 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 regional office works in close coordination with local 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 Alaska Regional Office maintains a distinctive organizational and operational status in the USGS by virtue of several key factors:

1. Alaska's size, extensive coastline, geographic separation, Arctic and circumpolar nexus, and complex tectonic history and dynamism bestow it a unique geology and geography and hazard exposure compared to the rest of the Nation;
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 conduct of scientific research throughout the State;
4. The USGS Alaska Science Center (ASC) currently operates one of the largest and most scientifically integrated centers in the USGS, and a large volume of Alaskan and Arctic research activities are accomplished by staff from centers outside the State; and
5. The regional office, by virtue of its hosting of the Volcano Science Center with its 5 volcano observatories and responsibilities in the American west, Hawaii, and Pacific territories, maintains awareness and partnerships well beyond Alaska borders.
6. For these reasons, Alaska constitutes a dynamic area for USGS activities.

The Alaska Regional Office provides management and strategic coordination with the ASC, the Volcano Science Center (VSC), the Alaska Climate Adaptation Science Center (AK CASC), USGS scientists from other regions, and external partners operating in Alaska. Current Alaska Regional personnel include the Regional Director (Aimee Devaris), Deputy Regional Director of Science (Dr. Dee Williams), Deputy Regional Director of Operations (Durelle Smith), Senior Science Advisor (Thomas Murray), Science Coordinator (Dr. Elizabeth Powers), Safety Manager (Daniel Morgan), and Budget Analyst (Marnelli Cordero). More information about the Alaska Region is available at https://www.usgs.gov/unified-interior-regions/region-11.

Alaska Science Center

The ASC, led by Dr. Christian Zimmerman, is composed of about 150 science and support personnel representing the full suite of disciplines at 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 more than 270 science information products in Fiscal Year (FY) 2021, including 95 journal articles, 11 USGS series reports, 76 abstracts, 9 book chapters, 78 data releases, and 1 software release. More information about specific research initiatives in Alaska is available in this volume and on the ASC web portal at https://www.usgs.gov/centers/asc.

Volcano Science Center

The VSC, led by Tina Neal, is under the Alaska Region, and manages the five U.S. regionally based volcano observatories and about 175 employees on the West Coast, in Washington DC, Reston, VA, and in Hawaii. The VSC encompasses the Alaska Volcano Observatory (AVO) in Anchorage and the observatories outside the Alaska Region; Cascades Volcano Observatory (CVO), Yellowstone Volcano Observatory in Vancouver, WA, Hawaiian Volcano Observatory in Hilo, HI, and California Volcano Observatory in Menlo Park and Santa Clara, CA; 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 delivery of effective forecasts, warnings, and information on volcano hazards based on scientific understanding of volcanic processes. VSC scientists are highly engaged with the public through social media, official web sites, and frequent outreach appearances to schools, interagency partners, and other stakeholders. Follow news from the AVO (which is a 31-year-old cooperative program of USGS, the State of Alaska Department of Geological and Geophysical Surveys, and the University of Alaska Geophysical Institute) at https://www.avo.alaska.edu/.

Alaska Climate Adaptation Science Center

The AK CASC, led by Dr. Stephen Gray, is one of eight regional centers that provide managers with the tools and information they need to develop and execute management strategies that address the impacts of the climate on natural and cultural resources. The Center is hosted by the University of Alaska Fairbanks but is physically housed within the USGS campus at Alaska Pacific University in Anchorage. Various program partners provide expertise in climate science, ecology, environmental impact assessments, modeling, and advanced information technology. Despite limitations related to COVID-19, the AK CASC made significant strides to connect climate adaptation research with communities, managers, and partners in 2021. The launch of the Alaska Tribal Resilience Learning Network in January brought together climate researchers, traditional knowledge experts, and tribal resilience staff to create a community of learning, sharing, technical assistance, training, and support for Alaska Tribes as they respond and adapt to the current and future impacts of climate change. The AK CASC continues to collaborate with the Pacific Islands Climate Adaptation Science Center in Hawaii to promote joint research in “Icefield to Ocean” and “Ridge to Reef” systems, while providing opportunities for undergraduate and graduate student exchange. The AK CASC, with about 30 staff, yielded over 50 peer-reviewed publications in FY2021, as well as a variety of data sets, 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 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 partners, and more than 50 academic institutions. USGS Regional Managers collaborate actively with Department of the Interior (DOI) Alaska Bureaus and State and regional groups, especially through the Alaska Cooperative Planning Group, the Interagency Arctic Research Policy Committee, 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 partnership worth an explicit mention is the Alaska Cooperative Fish and Wildlife Research Unit hosted at the University of Alaska Fairbanks campus. This unit is part of a nationwide program 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 (ADF&G), University of Alaska Fairbanks, FWS, and the Wildlife Management Institute. The unit mission is aimed at understanding the ecology of Alaska fish and wildlife, evaluating impacts of land use and development on these resources, and relating effects of social and economic needs to production and harvest of natural populations. The Alaska Unit is led by Dr. Jeffrey Falke, Assistant Professor of Fisheries, and the Alaska Unit website address is https://www.akcfwru.uaf.edu/.

Structure of Report

The research presented in this biennial report is organized primarily by the five major topical areas (energy and minerals; geospatial mapping; natural hazards; water quality, streamflow, and ice dynamics; and ecosystems). The topical areas are then subdivided into relevant 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 this type of 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 five different categories of topics, four different geographic locations, and five different established DOI priorities. All 17 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 ecologically and geographically defined area that covers large areas of land or water and contains distinct assemblages of natural communities and species. Within each ecoregion, there exists substantial, but not absolute spatial correlation among the characteristic assemblages. The three broad Alaska ecoregions include (1) Arctic, (2) Boreal Forest, and (3) Subarctic Coastal (Maritime). A 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 primarily is cold and dry, where 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 is transitional between maritime and continental in the Bristol Bay area and shifts to a moist polar climate to the north.

Boreal Forest Ecoregion

The Boreal Forest ecoregion encompasses interior Alaska, stretching from the southern side of the Brooks Range in the north and 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

This is the most diverse ecoregion in Alaska, consisting of subarctic coastal regions stretching from Southeast Alaska to the tip of the Aleutian Island chain. Variable landscapes include fjords, beaches, rocky intertidal zones, kelp forests, underwater seamounts, and seafloor sediment. 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

This report links USGS program/project descriptions with established DOI priorities and goals. The DOI plays a central role in how the United States stewards its public lands, increases environmental protections, pursues environmental justice, and honors our nation-to-nation relationship with Tribes. In 2021, DOI identified the following thematic priorities that intersect most closely with USGS activities in Alaska:

- Climate Science Research,
- Clean Energy,
- Public Health and Safety,
- Economic Vitality,
- Conserving Public Lands and Waters,
- Protecting Biodiversity,
- Centering Equity and Environmental Justice, and
- Strengthening Tribal Relations.

These DOI priorities are illustrated by the distinct icons that appear in the legend in the following section.

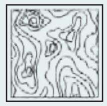
U.S. Geological Survey map showing the three major ecoregions (arctic, boreal, maritime) and six major hydrologic zones of Alaska (Southeast, South Central, Southwest, Yukon, Northwest, and North Slope). Source: Figure 1, Stackpoole, S.M., and others, 2017, Inland waters and their role in the carbon cycle of Alaska: Ecological Applications, v. 27, no. 5, p. 1403–1420, https://doi.org/10.1002/eap.1552.

Icon Legend

Topical Areas:

Energy and Minerals

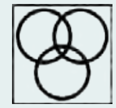
Water Quality, Streamflow, and Ice Dynamics



Alaska Mapping

Natural Hazards

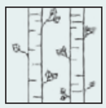
Wildlife, Fish, and Habitat



Cross-Cutting Programs

Ecoregions:

Arctic



Boreal Forest

Subarctic Coastal

Statewide

Current DOI Priorities Most Relevant to USGS 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 & Safety

Protecting Biodiversity

Note: All maps, illustrations, and photographs in the report have a USGS source that is in the public domain, unless otherwise noted.

Employee Spotlight

Heather Johnson

Research Wildlife Biologist
Alaska Science Center
Professional Page: https://www.usgs.gov/staff-profiles/heather-johnson?qt-staff_profile_science_products=0#qt-staff_profile_science_products
Email: heatherjohnson@usgs.gov

Heather Johnson handling bear cubs. Photograph by U.S. Geological Survey.

Heather Johnson has been working as a Research Wildlife Biologist at the USGS Alaska Science Center since 2017. She is a terrestrial, large mammal ecologist who investigates the influence of changing habitat conditions on animal behavior and population dynamics to address the management needs of government agencies. Her research program focuses on understanding the influence of climate change and energy development on the behaviors, distributions, and demography of migratory caribou in the Arctic. In collaboration with state, federal and international partners, Heather's research determined that Arctic caribou strongly select for high-quality forage during the early summer, particularly forage protein, which is only available at the beginning of the growing season. Because the spatial distribution of high-quality, early summer forage varies each year based on the timing of snowmelt and vegetation growth, the location of caribou summer ranges can exhibit dramatic annual shifts and were predicted to move in response to warming climate conditions. Predicting such range shifts is important for identifying habitat areas likely to be used by caribou in the future, particularly given interest in expanding energy development in the Arctic.

Cyrus Read

Geophysicist
Alaska Volcano Observatory
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Cyrus Read working in the field. Photograph by Fiona Eberhardt, Department of Natural Resources.

Cyrus Read is a USGS Geophysicist for the Alaska Volcano Observatory (AVO). He has worked for the AVO since 2004, first as a contractor, then as a USGS employee. His work at AVO involves building, installing and maintaining volcano monitoring systems in Alaska and in the Commonwealth of the Northern Mariana Islands. The systems collect data from a variety of instruments including seismic, geodetic, infrasonic and cameras, which are telemetered via terrestrial and satellite networks in real time. The logistics of powering and operating the equipment in difficult environments, combined with boat and helicopter access in remote and occassionally volcanically active locations, provide varied and challenging work. In the last couple years, Cyrus has been working with the Geophysical field team at AVO to implement larger scale communication sites powered by wind and solar systems that have been able to maintain operation through the Alaskan winter weather. Information generated from these monitoring systems is used to monitor and forecast eruptions and issue warnings of volcano hazards.

Hanna Dietterich

Research Geophysicist
Alaska Volcano Observatory
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Hanna Dietterich working at the Little Sitkin, Aleutian Islands. Photograph by Matt Loewen, U.S. Geological Survey.

Hannah Dietterich is a USGS Research Geophysicist at the Alaska Volcano Observatory (AVO). Hannah joined the AVO staff in 2018 after three years as a postdoctoral researcher at the USGS California Volcano Observatory in Menlo Park. Her work focuses on lava flow dynamics, remote sensing of volcanic activity, numerical modeling of volcanic hazards, and probabilistic volcanic hazard assessment. Her research integrates geologic mapping, physical volcanology, remote sensing, and modeling with observations of ongoing eruptions to better understand volcanic hazards. This research has developed new tools for volcanic eruption monitoring and response in Alaska, where frequent and distant eruptions require remote sensing characterization of activity. Hannah's work on lava flow dynamics, remote sensing, and hazard modeling informed monitoring and hazard assessment during the 2018 Kīlauea eruption crisis in Hawaii. Data collected in 2018 by Hannah and colleagues have increased our understanding of lava flow physics and hazards.

Karyn Rode

Research Wildlife Biologist
Alaska Science Center
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Email: krode@usgs.gov

Karyn Rode working on a black bear study along the coast in southcentral Alaska in collaboration with Alaska Department of Fish and Game, May 2019. Photograph by U.S. Geological Survey

Karyn Rode has been a Research Wildlife Biologist at the Alaska Science Center since 2012. She has been studying the ecology and behavior of bears as a biologist with the Alaska Department of Fish and Game, the US Fish and Wildlife Service, several universities, and the USGS since 1997, and she has studied other large mammals in Africa and Alaska. As a USGS Research Wildlife Biologist, she focuses on understanding the response of polar bears and walrus to sea ice loss and ecosystem change associated with a rapidly warming Arctic in order to mitigate interactions between these species and humans. Studying these marine mammals has become increasingly difficult because the rapid loss of sea ice in Coastal Alaska limits access to handle and take the physical measurements needed to track individual health and population vitality rates. To address this problem, she undertook a study to identify ecological and environmental metrics that can serve as indicators of reproduction and cub survival in polar bears that live in the Chukchi Sea, publishing her results this year. With collaborators, she is currently publishing a study that will provide the first ever estimates of the energetic costs of walrus swimming, which will aid in determining the impacts of increased travel to foraging sites associated with recent sea ice loss.

Kristi Wallace

Geologist
Alaska Volcano Observatory
Professional Page: https://www.avo.alaska.edu/about/staff.php?view=Tephra&mode=research&dirid=35
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Kristi Wallace at the summit of Vesuvius volcano, Italy. Photograph by Tina Neal, U.S. Geological Survey.

Kristi Wallace is a USGS geologist with the Alaska Volcano Observatory (AVO). She has specialized in volcanic ash research and eruption response since 2001. Kristi is the head of the Alaska Tephra Laboratory and Data Center, an interdisciplinary center for the study of volcanic ash in Alaska. Her work focuses on understanding the frequency, distribution, and character of ashfall in Alaska, specifically from Cook Inlet volcanoes because of their risk posed to major population centers in Alaska. Kristi plays a significant role in science and outreach during eruption responses, documenting ashfall events, working with agency partners and the community, and communicating hazards to partners and the public. In recent years, Kristi has fostered interagency collaborations to better inform the public about hazards associated with volcanic ash. She is a founding member and is current U.S. leader of the International Association of Vocanology and Chemistry of the Earth's Interior Volcanic Ashfall Impacts Working Group, which is focused on ashfall hazard mitigation. She is a leader in the international tephra-community working group, establishing best practice guidelines for tephra studies from collection through analysis to improve data sharing and collaboration among tephra scientists.

Jeremy Littell

Research Ecologist
Alaska Climate Adaptation Science Center
Professional Page: https://www.usgs.gov/staff-profiles/jeremy-littell?qt-staff_profile_science_products=0#qt-staff_profile_science_products
Email: jlittell@usgs.gov

Jeremy Littell sampling the snow with his daughter. Photograph by Siiri Bigalke, Utah State University.

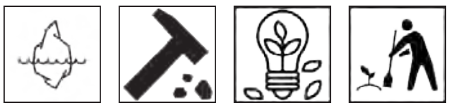
Jeremy Littell has been a Research Ecologist with the Alaska Climate Adaptation Science Center for 9 years. Prior to that, he worked as a graduate student, postdoc, and then research scientist for 10 years at the University of Washington. His research background is in climate impacts on mountain and forest ecosystems, including climatic limitations on wildfire, tree growth, and tree establishment, as well as paleoclimate and paleoecological reconstruction. Recently, Jeremy has been studying hydroclimatic variability in the western U.S. over the last millennium through tree-ring chronologies that are uniquely sensitive to snowpack because snow limits their growth, and this has helped to reconstruct streamflow in snow dominated river systems and to understand recent snow-droughts in a longer climate context. Jeremy has over 15 years of experience translating climate impacts science for use in a wide range of resource management, climate adaptation, and vulnerability assessment initiatives. He has tailored climate projections for land management units in Alaska, which includes custom climate projections of future changes in climate, fire, and vegetation for all the National Park Service, U.S. Fish and Wildlife Service, and U.S. Forest Service units in Alaska and, in partnership with Alaska Native Tribal Health Consortium and the Alaska Tribal Climate Science Liaison, several regions important to Alaska Native communities.

Project Descriptions

Energy and Minerals

Energy Resources

Alaska Petroleum Systems



The Alaska Petroleum Systems project entails assessment oil resources, evaluation natural gas potential, and investigation ancient climate excursions in the Arctic to predict future climate impacts. The focus of this research is Arctic Alaska. Core objectives include (1) understanding of the Arctic geologic framework, Alaska petroleum systems; (2) assessing undiscovered oil and gas resources; and (3) delivering energy resource information to land and resource managers, policy makers, and the public. This research integrates and analyzes multiple types of data (seismic, outcrop, core, petrophysics, thermal maturity, geochronology, thermochronology, geochemistry, biostratigraphy, etc.) to accomplish its mission. Outcomes include evaluation of petroleum resource potential on leased and unleased tracts of the National Petroleum Reserve in Alaska (contributes to Executive Order 14008) and documentation of ancient climate excursions in Arctic Alaska.

Mid-Cretaceous strata on Slope Mountain, about 160 kilometers (km) (100 miles) south of Prudhoe Bay, with Trans-Alaska Pipeline System in foreground. Sandstone benches in lower Nanushuk Formation are direct analogs for reservoirs in recent, giant oil discoveries in the National Petroleum Reserve in Alaska and nearby State lands about 185 km (150 miles) northwest of this exposure. Photograph by David W. Houseknecht, U.S. Geological Survey.

Time frame	Budget
2017–22	>$1,000,000

Contact

David Houseknecht, USGS Eastern Energy Resources Science Center, Reston, Virginia, dhouse@usgs.gov, (703) 648-6466

Project Link

https://www.usgs.gov/energy-and-minerals/energy-resources-program/science/alaska-petroleum-systems?qt-science_center_objects=0#qt-science_center_objects

Recent Publications

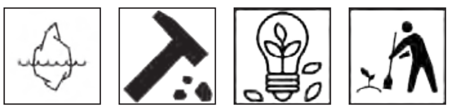
Botterell, P. J., Houseknecht, D. W., Lillis, P. G, Barbanti, S. M., Dahl, J. E., and Moldowan, J. M., 2021, Geochemical advances in Arctic Alaska oil typing—North Slope oil correlation and charge history: Marine and Petroleum Geology, v. 127, p. 1–2, https://www.sciencedirect.com/science/article/abs/pii/S0264817220306619?via%3Dihub.

Houseknecht, D.W., Mercier, T.J., Schenk, C.J., Moore, T.E., Rouse, W.A., Dumoulin, J.A., Craddock, W.H., Lease, R.O., Botterell, P.J., Sanders, M.M., Smith, R.A., Connors, C.D., Garrity, C.P., Whidden, K.J., Gooley, J.T., Counts, J.W., Long, J.H., and DeVera, C.A., 2021, Assessment of undiscovered gas resources in Upper Devonian to Lower Cretaceous strata of the western North Slope, Alaska, 2021: U.S. Geological Survey Fact Sheet 2021–3003, 4 p., https://pubs.usgs.gov/fs/2021/3003/fs20213003.pdf.

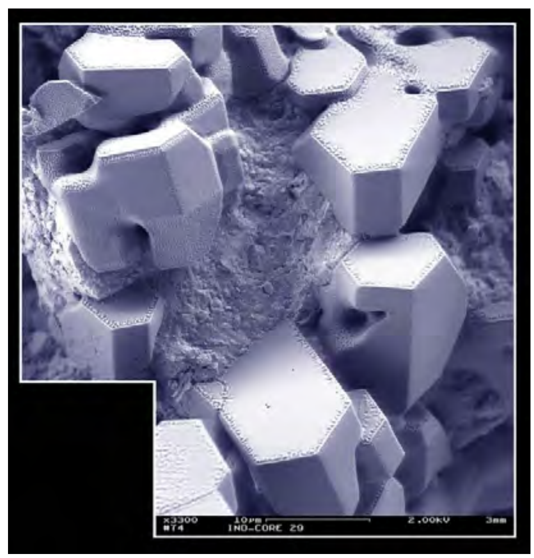
Houseknecht, D.W., Whidden, K.J., Connors, C.D., Lease, R.O., Schenk, C.J., Mercier, T.J., Rouse, W.A., Botterell, P.J., Smith, R.A., Sanders, M.M., Craddock, W.H., DeVera, C.A., Garrity, C.P., Buursink, M.L., Karacan, C.O., Heller, S.J., Moore, T.E., Dumoulin, J.A., Tennyson, M.E., French, K.L., Woodall, C.A., Drake, R.M., II, Marra, K.R., Finn, T.M., Kinney, S.A., and Shorten, C.M., 2020, Assessment of undiscovered oil and gas resources in the central North Slope of Alaska, 2020: U.S. Geological Survey Fact Sheet 2020–3001, 4 p., https://pubs.usgs.gov/fs/2020/3001/fs20203001.pdf.

Rouse, W.A., Whidden, K.J., Dumoulin, J.A., and Houseknecht, D.W., 2020, Surface to subsurface correlation of the Middle–Upper Triassic Shublik Formation within a revised sequence stratigraphic framework: Interpretation, v. 8, p. SJ1–SJ16, https://doi.org/10.1190/int-2019-0195.1.

Gas Hydrate Resource Characterization



Gas hydrates are naturally gathering crystalline solids that form from water and gas in permafrost regions and in marine sediments. Gas hydrates contain large amounts of methane and may represent an important future source of energy; however, much remains to be learned about their prevalence in nature. Gas hydrates are known to exist in numerous sedimentary basins in Arctic permafrost settings and in marine sediments of outer continental margins. Short term production tests in northern Canada and Alaska have demonstrated that natural gas can be produced from hydrates. The USGS; U.S. Department of Energy; and the Japan Oil, Gas and Metals National Corporation are leading an extended gas hydrate production test in the Alaska North Slope. The primary goal of this project is to complete a scientific field production test of gas hydrate-bearing reservoirs using conventional production technology. The project included the drilling of a stratigraphic test well (completed in December 2018); this will be followed in 2022 by the drilling of a geologic data well and two production test wells, and then the testing of the reservoir response to pressure reduction over a period of about 12 months.



Scanning electron microscope image of gas hydrate crystals in a sediment sample. The scale is 10 micrometers or approximately 0.0004 inches. Photograph by Laura Stern, U.S. Geological Survey.

Time frame	Budget	Project partners
2018–24	$500,000–$1,000,000	U.S. Department of Energy, Japan Oil, Gas and Metals National Corporation

Contact

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Program Links

https://www.usgs.gov/centers/cersc/science/gas-hydrates?qt-science_center_objects=0#qt-science_center_objects

https://www.usgs.gov/centers/cersc/science/alaska-north-slope-2018-hydrate-01-stratigraphic-test-well?qt-science_center_objects=0#qt-science_center_objects

Recent Publications

Collett, T.S., Boswell, R., and Zyrianova, M., 2022, Alaska North Slope terrestrial gas hydrate systems—Insights from Scientific drilling. In: Mienert, J., Berndt, C., Tréhu, A.M., Camerlenghi, A., Liu, C.S., eds., World atlas of submarine gas hydrates in continental margins: Springer, Cham., 21 p., https://doi.org/10.1007/978-3-030-81186-0_16.

Collett, T., Okinaka, N., Wakatsuki, M., Boswell, R., Marsteller, S., Minge, D., Crumley, S., Itter, D., and Hunter, R., 2020, Design and operations of the Hydrate-01 Stratigraphic Test Well, Alaska North Slope—Proceedings of the 10th International Conference on Gas Hydrates, Singapore, June 21–26, 2021: Singapore, National Energy Technology Laboratory, 8 p, https://www.netl.doe.gov/sites/default/files/2020-08/Collett-et-al-Design-and-Operations.pdf.

Haines, S., Collett, T., Boswell, R., Lim, T-K., Okinaka, N., Suzuki, K., and Fujimoto, A., 2020, Gas hydrate saturation estimation from acoustic log data in the 2018 Alaska North Slope Hydrate-01 Stratigraphic Test Well—Proceedings of the 10th International Conference on Gas Hydrates (ICGH10), Singapore, June 21-26, 2021: Singapore, National Energy Technology Laboratory, 5 p., https://www.netl.doe.gov/sites/default/files/2020-08/Haines-et-al-Sgh-from-Acoustic-Log-Data.pdf.

Kurvits, T., Dallimore, S., Melling, H., and others, 2020, Northern issues, science gaps and recommendations, *in* Rapid response assessment of coastal and offshore permafrost: United Nations Environmental Program, story map, 8 p., https://storymaps.arcgis.com/stories/74bf8d1540c542b7a444a5a2ba1559e2.

White, M.D., Kneafsey, T.J., Seol, Y., Waite, William F., Uchida, S., Lin, J.S., Myshakin, E.M., Gai, X., Gupta, S., Reagan, M.T., Queiruga, A.F., and Kimoto, S., 2020, An international code comparison study on coupled thermal, hydrologic and geomechanical processes of natural gas hydrate-bearing sediments: Journal of Marine and Petroleum Geology, v. 120, 55 p., https://www.sciencedirect.com/journal/marine-and-petroleum-geology/vol/120/suppl/C.

Yoneda, J., Jin, Y., Muraoka, M., Oshima, M., Suzuki, K., Walker, M., Westacott, D., Otsuki, S., Kumagai, K., Collett, T.S., Boswell, R., and Okinaka, N., 2020, Multiple physical properties of gas hydrate-bearing sediments recovered from Alaska North Slope 2018 Hydrate-01 Stratigraphic Test Well: Journal of Marine and Petroleum Geology, v. 123, 43 p., https://doi.org/10.1016/j.marpetgeo.2020.104748.

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. Source: Wilson (2008) (see “Recent Publications” at the end of this section).

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 (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 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 a valuable 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 behind it) have tremendous potential for use in addressing regional environmental issues.

2. ARDF

The ARDF is a mission-critical database of mines, prospects, and mineral occurrences 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 mineral occurrences 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 is valuable for mineral resource assessments, mineral deposit modeling, and mineral environmental studies, as well as land-use decisions.

Contact

Frederic H. Wilson, ASC, fwilson@usgs.gov, (907) 786-7448

Time frame	Budget
2007–ongoing	$100,000–$499,000

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 Publications

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.

Goldfarb, R.J., Meighan, C., Meinert, L., and Wilson, F.H., 2016, Mineral deposits and metallogeny of Alaska, chap. 1 *of* Boyd, R., Bjerkgard, T., Nordahl, B., and Schiellerup, H., eds., Mineral resources in the Arctic: Geological Survey of Norway Special Publication, p. 12–20, https://pubs.er.usgs.gov/publication/70188828.

Koeneman, L.L., and Wilson, F.H., comps., 2018, Legacy K/Ar and $^{40}Ar/^{39}Ar$ geochronologic data from the Alaska—Aleutian Range batholith of south-central Alaska: U.S. Geological Survey Open-File Report 2018–1033, 8 p., 1 plate, https://doi.org/10.3133/ofr20181033.

Wilson, F.H., 2018, Surficial geologic map of the Dillingham quadrangle, southwestern Alaska: U.S. Geological Survey Scientific Investigations Map 3388, 1 sheet, 15 p., scale 1:250,000, https://doi.org/10.3133/sim3388.

Geographic Information System Prospectivity Analysis for Critical Minerals in Ore-Forming Systems in Alaska

Rare earth element-mineralized dikes on Dotson Ridge, Southeast Alaska. Black bands are dikes that are rich in rare earth element-bearing minerals and oxides. White band is an aplite dike composed of quartz and feldspar. Host rock to these dikes is quartz diorite. Hammer is for scale. Photograph by Susan Karl, U.S. Geological Survey.

The primary objective of the Geographic Information System Prospectivity Analysis for Critical Minerals in Ore-Forming Systems in Alaska project is to quantify and understand the distribution of critical elements—elements needed for technological, economic, and military applications—in ore-forming systems in Alaska. This is accomplished using data-driven geographic information system (GIS)-based methods that systematically and simultaneously analyze geospatially referenced datasets and provide an unbiased, quantitative product for large areas that are characterized by diverse types of geological, geochemical, and geophysical data. Our products are high-resolution prospectivity analyses and maps for critical elements at the scale of about 100-square-kilometer (62-square-mile) drainage basins. Project objectives include (1) providing statewide mineral prospectivity maps for specified critical minerals, (2) identifying new areas in Alaska that have resource potential for specified minerals, (3) identifying understudied areas that warrant further investigation for these minerals, (4) identifying areas where data coverage is insufficient and requires future sampling, (5) acquiring new data for areas for which data coverage is poor, (6) augmenting datasets, and (7) acquiring or constructing new appropriate datasets. Current investigations address tungsten in granite, skarns, and orogenic gold deposits; cobalt and germanium in sediment-hosted base metal deposits; rhenium and platinum group elements in porphyry systems; and graphite in metamorphic and igneous hydrothermal systems.

Time frame	Budget	Project partners
2018–21	$100,000–$499,000	Alaska Division of Geological and Geophysical Surveys, Bureau of Land Management, Colorado School of Mines

Contact

Susan Karl, ASC, skarl@usgs.gov, (907) 786-7428

Recent Publications

Granitto, M., Wang, B., Shew, N.B., Karl, S.M., Labay, K.A., Werdon, M.B., Seitz, S.S., and Hoppe, J.E., 2019, Alaska Geochemical Database Version 3.0 (AGDB3)—Including “best value” data compilations for rock, sediment, soil, mineral, and concentrate sample media: U.S. Geological Survey Data Series 1117, 33 p., https://doi.org/10.3133/ds1117.

Jones, J.V., III, Karl, S.M., Labay, K.A., Shew, N.S., Granitto, M., Hayes, T.S., Mauk, J.L., Schmidt, J.M., Todd, E., Wang, B., Werdon, M.B., and Yager, D.B., 2015, GIS-based identification of areas with mineral resource potential for six selected deposit groups, Bureau of Land Management Central Yukon Planning Area, Alaska: U.S. Geological Survey Open-File Report 2015–1021, 78 p., 2 app., 12 pls., http://dx.doi.org/10.3133/ofr20151021.

Karl, S.M., Jones, J.V., III, and Hayes, T.S., eds., 2016, GIS-based identification of areas that have resource potential for critical minerals in six selected groups of deposit types in Alaska: U.S. Geological Survey Open-File Report 2016–1191, 99 p., 5 app., 12 pls., scale 1:10,500,000, http://dx.doi.org/10.3133/ofr20161191.

Karl, S.M., and Labay, K.A., 2017, Geospatial analysis identifies critical mineral-resource potential in Alaska: U.S. Geological Survey Fact Sheet 2017–3012, 4 p., https://doi.org/10.3133/fs20173012.

Karl, S.M., Labay, K.A., Shew, N.S., Wang, B., Granitto, M., Kreiner, D., and Case, G., 2017, GIS-based identification of areas that have potential for lode gold deposits in Alaska: Vancouver, British Columbia, Association for Mineral Exploration Roundup Annual Convention poster, 5 maps, scale, 1:5,000,000, https://alaska.usgs.gov/products/poster/2017_Roundup_poster_Au-Karl.pdf.

Wang, B., Ellefsen, 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.

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 the economic and national security of the U.S. Under Executive Order 13817, the Federal government is mandated to identify new sources of critical minerals and improve the topographic, geologic, and geophysical mapping to support exploration of critical minerals. USGS seeks to improve knowledge of critical mineral potential in the United States. The objectives of this study to improve our understanding of critical mineral potential in the Alaska Outer Continental Shelf are to 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 several others meet prospective criteria for mining opportunities. Methods include data synthesis and update of prospective criteria for mineral resource extraction relevant to the Alaska region. Products will include a data-integrated prospective map, a USGS Professional Paper, and recommendation of fieldwork by 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, Arctic Ocean. Source: Hein, J.R., Konstantinova, N., Mikesell, M., Mizell, K., Fitzsimmons, J.N., Lam, P.J., Jensen, L.T., Xiang, Y., Gartman, A., Cherkashov, G., Hutchinson, D.R., and Till, C.P., 2017, Arctic deepwater ferromanganese-oxide deposits reflect the unique characteristics of the Arctic Ocean: Geochemistry, Geophysics, Geosystems, v. 18, no. 11, p. 3771–3800, https://doi.org/10.1002/2017GC007186.

Time frame	Budget	Project partners
2019–24	$100,000–$499,000	Bureau of Ocean Energy Management ($250,000)

Contact

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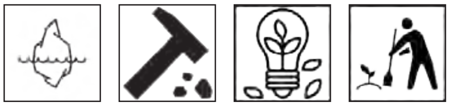
Petrogenesis and Mineralization of the Darby and Kachauik Plutons, Seward Peninsula



White potassium feldspar megacrysts to 5-centimeter (cm) and tan potassium feldspar phenocrysts to 1-cm in Kachauik syenite pluton with radioactivity meter, southeastern Seward Peninsula, Alaska. Photograph by Susan Karl, U.S. Geological Survey.

The Darby and Kachauik plutons on the southeastern Seward Peninsula AK have alkaline compositions with unusually high potassium contents and unevaluated high concentrations of rare earth elements (REE) and high field strength elements (HFSE), such as cerium and lanthanum, which are critically important to modern technology. Our objectives are to investigate the petrogenesis of the alkaline plutons, the sources, mechanisms of transport and concentration of the REE and HFSE, and the tectonic setting in which of these plutons formed. Methods of investigation include mapping rock types and field relations and collecting samples for determination of mineral compositions and paragenesis and for geochemical, geochronologic, and isotopic analysis. These plutons are part of the Hogatza magmatic belt, which extends for 500 kilometers (310 miles) from St. Lawrence Island to the southern Brooks Range. Resolution of the parameters that controlled the magmatic sources, evolution, mineralization, and emplacement of the Darby and Kachauik plutons will contribute significantly to (1) understanding geologic processes that lead to concentrations of REE and HFSE, (2) defining criteria for evaluating the potential for concentrations of REE and HFSE in the Hogatza magmatic belt and elsewhere, and (3) understanding the regional tectonics of northwestern Alaska.

Time frame	Budget	Project Partners
2017–21	<$100,000	Elim Native Corporation, Bering Straits Native Corporation, Kawerak Inc., a consortium of Tribes, Villages, and Corporations in the Bering Strait region

Contact

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Tectonic and Metallogenic Evolution of the Broader Yukon-Tanana Upland

U.S. Geological Survey Alaska Science Center Research Geologist Jamey Jones is working on a geologic mapping and sampling in the West Crazy Mountains of eastern interior Alaska. Photograph by Adrian Bender, U.S. Geological Survey.

USGS Alaska Science Center 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. The five-year project is funded by the USGS Mineral Resources Program, and significant funding was provided in 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 under 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 2020 and 2021 focused on a broad regional transect from Yukon-Charley National Preserve and the Goodpaster 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.

Time frame	Budget	Project partners
2020–24	<$1,000,000	Alaska Division of Geological and Geophysical Surveys, Yukon Geological Survey, and Geological Survey of Canada

Contact

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Project Link

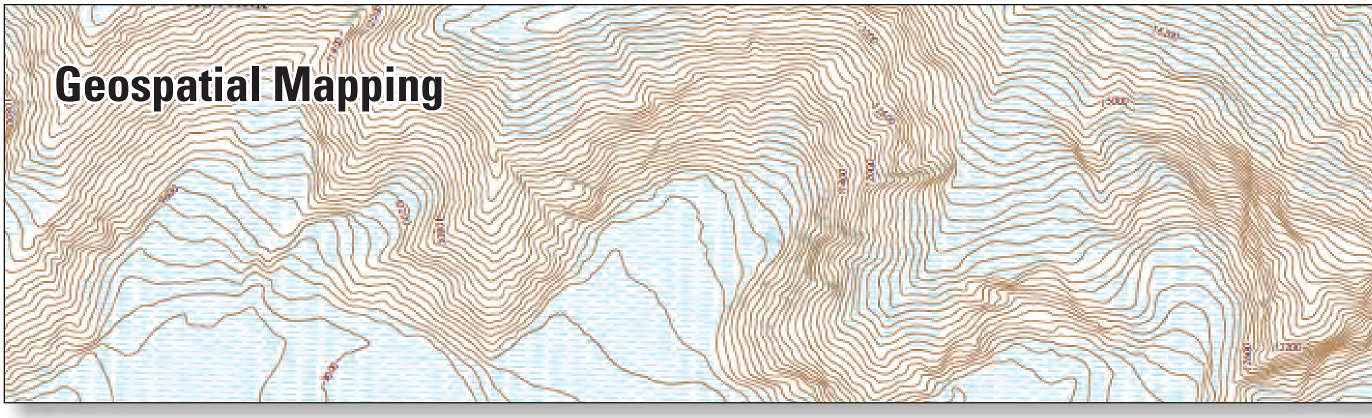
https://www.usgs.gov/centers/asc/science/tectonic-and-metallogenic-evolution-yukon-tanana-upland-alaska

Recent Publications

Bender, A.M., Lease, R.O., Corbett, L.B., Bierman, P.R., Caffee, M.W., and Rittenour, T.M., 2020, Climatic pacing of landscape responses to late-Cenozoic Yukon River capture: Nature Geoscience, v. 13, p. 571–575, http://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: Montreal, Quebec, Canadian Institute of Mining and Metallurgy Special Volume 57, p. 134–175.

Oneschuk, D., Miles, W., Saltus, R.W., and Hayward, N., 2019, Alaska and Yukon magnetic compilation, residual total magnetic field (ver. 2.0): Geological Survey of Canada, Open File 7862, 1 sheet, https://doi.org/10.4095/313537. [Supersedes revised edition released in 2017.]



Geospatial Mapping

Acquisition of Light Detection and Ranging (lidar) Data

The USGS partners with Federal, State, local, and private entities to collect high-quality, three-dimensional (3D) mapping data of the United States. The 3D Elevation Program (3DEP) 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, and the U.S. Department of Agriculture Natural Resources Conservation Service. The USGS facilitates planning and acquisition for the broader community using government contracts and partnership agreements. All data (digital elevation models) will be made publicly available on the USGS The National Map.

This year, the USGS and the Natural Resources Conservation Services (NCRS) are collaborating to obtain lidar elevation products to support conservation planning, emergency watershed planning, engineering applications, and to serve as a base layer for NRCS programs in the area around Delta Junction, Alaska. Clear, high accuracy digital elevation products, such as lidar and its derivatives, are a critical component and foundation to the NRCS mission to provide technical expertise and conservation planning for private landowners, conservation districts, tribes, and other organizations. The USGS is partnering with Alaska Electric Light and Power Company (AELP) to acquire lidar for an area of approximately 27 square kilometers (17 square miles) of the City and Borough Juneau. These data will support AELP and the City and Borough of Juneau in planning and landslide assessment. This will enable the buttressing of critical resources in the area, including the facilities and infrastructure of Bartlett Regional Hospital, and the Salmon Creek Reservoir and Dam.

Time frame	Project partners
2018–ongoing	Federal Emergency Management Agency and the Natural Resources Conservation Service, National Park Service, Ahtna Native Regional Corporation, Natural Resources Conservation Services, Alaska Electric Light and Power Company

Contact

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Alaska Interferometric Synthetic Aperture Radar (Ifsar) Elevation Data Acquisition Program

The USGS Alaska Mapping Initiative supports acquisition of new topographic map data and maps for Alaska. The new data and maps raise the accuracy of Alaska topographic mapping to levels common in the conterminous United States. Topographic maps are generated from radar technology referred to as interferometric synthetic aperture radar (IfSAR) elevation data. IfSAR is used to collect the data because it can penetrate clouds, smoke, and haze often present in Alaska. Alaska IfSAR acquisition supports the broader national 3DEP. Collection of a 5-meter resolution elevation grid for Alaska began in 2012 and was completed in 2020, replacing the former 60-meter statewide elevation grid. Multiple federal agencies and the State of Alaska contributed over $68M to complete the project. All the data are now fully processed and can be downloaded through USGS and State of Alaska public websites. The new elevation data have been used to create a new statewide series of accurate digital topographic maps for Alaska. The final 75 of the 11,278 maps required to achieve statewide coverage of Alaska are currently in production and are expected to be completed before the end of FY2021. New technologies are being investigated to collect high-resolution elevation data for Alaska, which will improve the accuracy of topographic maps in the future.

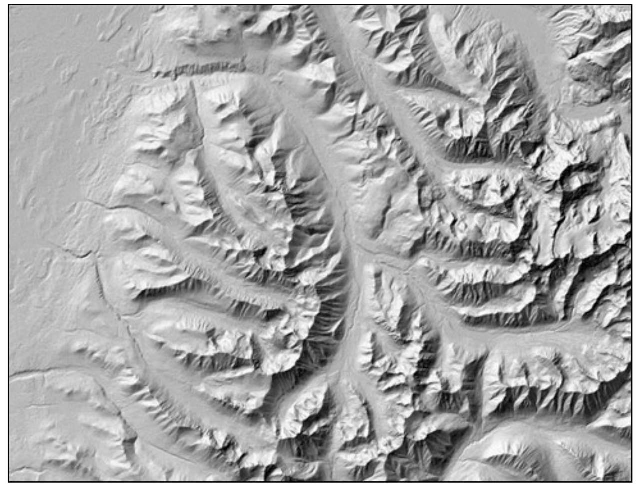

Image showing IfSAR elevation shaded relief created using new 5-meter elevation data near Anchorage, Alaska. Image by Dave Saghy, U.S. Geological Survey.

Time frame
2012–21

Contact

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Project Link

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

Alaska Hydrography Map

The National Hydrography Dataset (NHD), Watershed Boundary Dataset (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 stream gauges. 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.

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

In Alaska, most of the mapping of this water is based on 1950s-era USGS historical topographic maps and is mapped 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 Alaska Hydrography Technical Working Group, which has two goals: (1) update the NHD to national standards, and (2) meet specific hydrography mapping needs of agencies in Alaska. As a result of this collaborative effort, nearly 30 percent of the NHD in Alaska has been updated to the 1:24,000 scale national standard and the data are available to the public. NHD priority updates include data from the Cook Inlet Basin. The updates also include updates to the WBD. The WBD, NHD USGS digital elevation data will be used to generate NHDPlus HR for Alaska in the future.

Contact

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Time frame	Project partners
Ongoing	State, Federal, and private partners engaged in the Alaska Geospatial Council

Landsat 9 Analysis Ready Data

Landsat 9 represents a longstanding partnership between the National Aeronautics and Space Administration (NASA) and the USGS that continues the Landsat program's critical role of repeat global observations for monitoring, understanding, and managing Earth's natural resources. Since 1972, Landsat data have provided a unique resource for those who work in agriculture, geology, forestry, regional planning, education, mapping, hazards, hand global-change research. NASA is responsible for the space segment (instruments and spacecraft/observatory), mission integration, launch, and on-orbit checkout. The USGS Earth Resources Observation and Science (EROS) Center is responsible for the ground system, flight operations, data processing, and data product distribution after NASA completes on-orbit checkout. The Landsat 9 spacecraft and instruments successfully launched into orbit on September 27, 2021. Landsat 9 will image the Earth every 16 days in an 8-day offset with Landsat 8. Landsat 9 will collect as many as 750 scenes per day, and with Landsat 8, the two satellites will add nearly 1,500 new scenes per day to the USGS Landsat archive. All Landsat 9 data products will continue to be made available for download through the USGS EROS Center at no charge. U.S. Landsat Analysis Ready Data (ARD) products are consistently processed to the highest scientific standards and level of conversion required for direct use in monitoring and assessing landscape change. U.S. Landsat ARD is available for the conterminous United States, Alaska, and Hawaii. In Alaska, USGS scientists and others use Landsat imagery to help land and resource managers make informed decisions about the State's energy and mineral resources and wildlife habitats, as well as to contribute to a greater understanding of geologic processes, coastal erosion, and anticipated future landscape changes. Landsat ARD products include Landsat 4-8 collections and are available for Alaska from 1984 to present, with significant expansion in the number of scenes available for download in 1999, 2013, and 2020.

Time frame	Project partners
2015–21	National Aeronautics and Space Administration Kennedy Space Center and Goddard Space Flight Center

Contact

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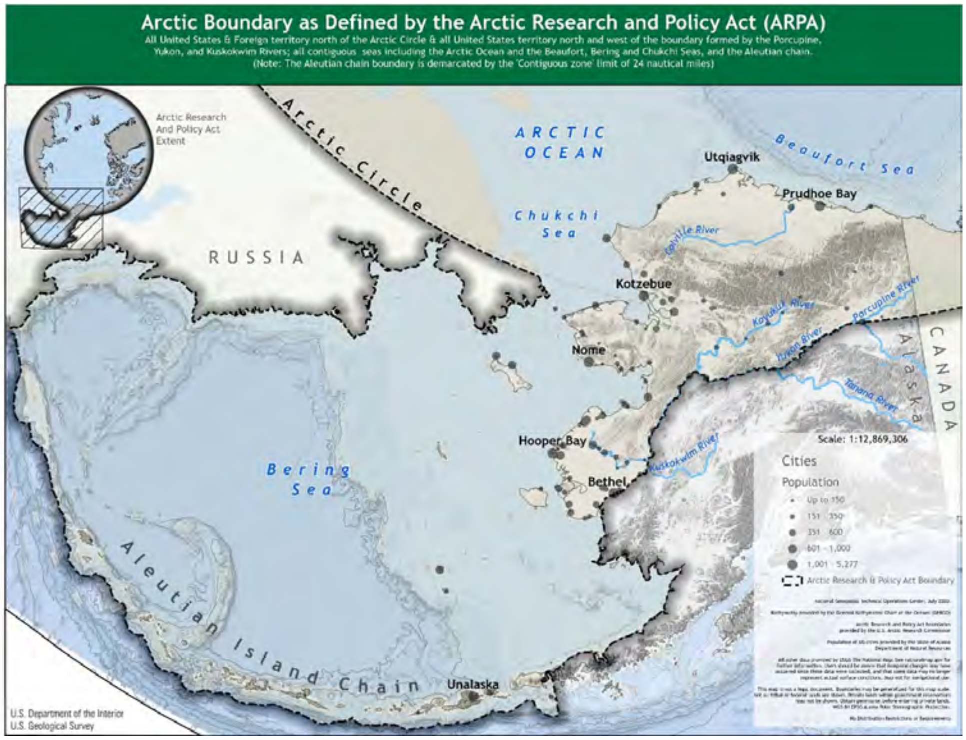
Recent Publication

U.S. Geological Survey, 2019, Landsat 9 (ver. 1.2, April 8, 2020): U.S. Geological Survey Fact Sheet 2019–3008, 2 p., https://doi.org/10.3133/fs20193008. [Supersedes version 1.1, released May 1, 2019.]

U.S. Arctic Research Policy Act (ARPA) Boundary Maps



Arctic Research Policy Act Boundary as it relates to Alaska and marine features of the Bering Sea. Map by Dee Williams and Chris Richmond, U.S. Geological Survey.

The Alaska Regional Office worked with the National Geospatial Technical Operations Center to develop a new series of general reference maps to demonstrate relevant features of the U.S. Arctic boundary as defined by Congress in 1984. The first generation of ARPA boundary maps were originally formatted in 2009 by a private firm contracted with the National Science Foundation and the U.S. Arctic Research Commission (see https://storage.googleapis.com/arcticgov-static/publications/maps/ARPA_Alaska_and_Polar.pdf). The fundamental rationale for the update is the increasing relevance of Arctic issues to national and global affairs that requires more functional projections and online tools to support and maintain domain awareness.

The first plate depicts the ARPA boundary as it relates to Alaska and marine features of the Bering Sea. The second plate depicts the international boundary from a circumpolar perspective. The third plate depicts the national boundary of the U.S. 200 nautical mile Exclusive Economic Zone through the Bering, Chukchi, and Beaufort Seas to facilitate more consistent territorial assessments of the U.S. Arctic. The fourth plate depicts in poster size detail the boundary as it relates to terrestrial features of Arctic Alaska north of the Yukon and Kuskokwim Rivers. The fifth plate depicts in poster size detail the boundary as it relates to marine and terrestrial features of the Aleutian chain.

Collectively, these new maps illustrate several value-added attributes, including (1) updated bathymetry and shoreline refinements, (2) demographic information, (3) international borders and offshore territorial claims, (4) Alaska conservation areas, (5) Alaska land cover, (6) Alaska terrestrial shaded relief, (7) annual sea ice maximum extent, (8) annual circumpolar 10-degrees Celsius isotherm, (9) location of active volcanoes, and (10) enhanced metadata information. The static pdf file maps offer value as stand-alone products but are intended to be used in conjunction with a forthcoming interactive website sourced by annual data updates, enables users to access the various map layers in a dynamic up-to-date environment.

Time frame	Budget	Project partners
2020-21	<$100,000	U.S. Arctic Research Commission, National Oceanic and Atmospheric Administration, Department of State

Contact

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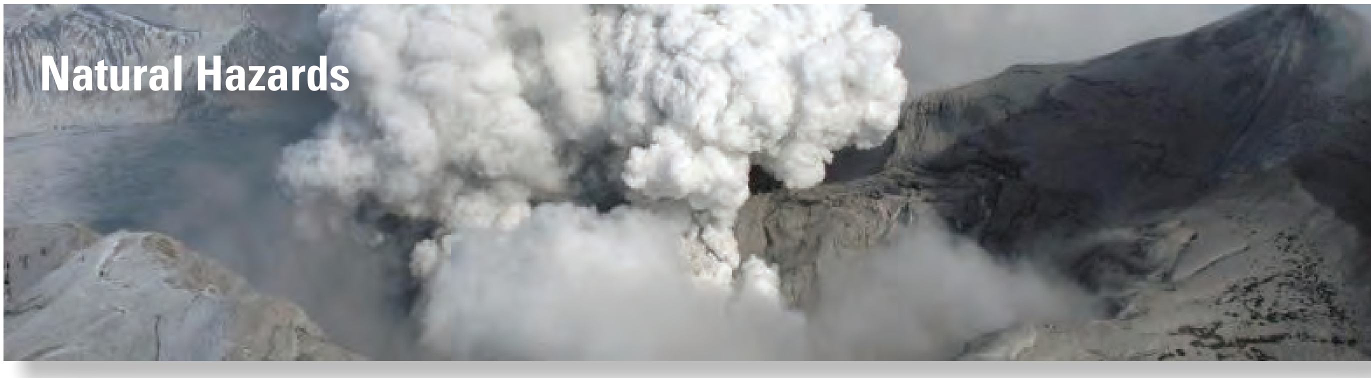

Natural Hazards

Earthquakes and Tsunamis

Alaska Earthquake Hazards

The major fault systems in Alaska, including the Denali and Queen Charlotte-Fairweather Faults, and the Alaska-Aleutian subduction zone, produce large earthquakes that threaten lives and property. Many active faults, especially structures along the subduction zone, can generate large tsunamis that will threaten Alaskan coastal communities and propagate across the Pacific Ocean causing widespread impacts. The main objectives of the Alaska Earthquake Hazards Project focus on more accurately defining the location, magnitude, and frequency of prehistoric earthquakes and tsunamis, which inform probabilistic assessments of future hazards. Using methods in 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 include seismic and tsunami source parameters 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 (NOAA) National Tsunami Hazard Mitigation Program.

U.S. Geological Survey geologist surveying a trace of the 1958 Fairweather Fault earthquake surface rupture, at Crillon Lake, Glacier Bay National Park, 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	Budget	Project Partners
2007–21	$100,000–$499,000	U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory, Alaska Division 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

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Project Link

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

Recent Publications

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, p. 19–32., https://doi.org/10.1785/0220190187.

Witter, R., Briggs, R., Engelhart, S.E., Gelfenbaum, G., Koehler, R.D., Nelson, A.R., La Selle, S., Corbett, D.R., and Wallace, K.L., 2019, Evidence for frequent, large tsunamis spanning locked and creeping parts of the Aleutian megathrust: Geological Society of America Bulletin, v. 131, p. 707–729, https://doi.org/10.1130/B32031.1.

Updating the USGS Ground Failure Product in Southcentral Alaska

The availability of high-quality shaking estimates for the Magnitude 7.1 2018 earthquake in Southcentral Alaska with detailed field observations about ground failure that happened during the 2018 earthquake and past earthquakes make the Alaska region an ideal study to assess the USGS near-real-time ground failure model performance and determine how we could make improvements to the model. The ground failure model estimates the probability of landslide and liquefaction happening as well as population exposure after an earthquake event. The ground failure models can also be used for scenarios and probabilistic hazard studies. Because the models are designed to be rapidly and consistently applicable in any region of the world, they are simple and rely on globally available input datasets. However, the current models do not consider that for many regions of the U.S., we have more detailed susceptibility information. The main objective of the project is to improve the models at regional scales by creating more detailed and higher-resolution model inputs for the Southcentral Alaska region and developing a new modeling framework that enables the incorporation of higher quality susceptibility data.

Lateral spreading triggered by the 2018 Anchorage earthquake damaged Vine Road near Wasilla in south-central Alaska. Many failures of engineered materials happened on or adjacent to saturated lowlands filled with organic sediment, silt, or sand. Photograph by Rob Witter, U.S. Geological Survey.

Time frame	Budget
2020–22	$500,000–$1,000,000

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Recent Publications

Grant, A.R., Jibson, R.W., Witter, R.C., Allstadt, K., Thompson, E., Bender, A.M., and Schmitt, R.G., 2020, Field reconnaissance of ground failure triggered by shaking during the 2018 M7.1 Anchorage, Alaska, earthquake: U.S. Geological Survey data release, https://doi.org/10.5066/P99ONUNM.

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., Thompson, E.M., and Bender, A., 2019, Ground failure from the Anchorage, Alaska, earthquake of 30 November 2018: Seismological Research Letters, v. 91, no. 1, p. 19–32.

Martinez, S.N., Schaefer, L., Allstadt, K., and Thompson, E., 2021, Evaluation of remote mapping techniques for earthquake-triggered landslide inventories in an urban subarctic environment—A case study of the 2018 Anchorage, Alaska Earthquake: Frontiers in Earth Science, v. 9, p. 456.

Martinez, S.N., Schaefer, L.N., Allstadt, K.E., and Thompson, E.M., 2021, Initial observations of landslides triggered by the 2018 Anchorage, Alaska earthquake: U.S. Geological Survey data release, https://doi.org/10.5066/P9S5PVON.

Thompson, E.M., McBride, S., Hayes, G.P., Allstadt, K., Wald, L., Wald, D.J., Knudsen, K.L., Worden, C., Marano, K., Jibson, R.W., and Grant, A.R.R., 2020, USGS near-real-time products and their use for the 2018 Anchorage earthquake: Seismological Research Letters, v. 91, no. 1, p. 94–113.

Prince William Sound Landslide Hazards

In Spring of 2020, a large slow-moving landslide was identified in Barry Arm, a recently deglaciated fjord in Prince William Sound, Alaska. Although this landslide is identifiable in imagery dating to 1957, the rapid retreat of the Barry Glacier in the past decade has increased the risk of large displacement waves. Prior to 2010, failure of the landslide would have resulted in runout on the glacier. After retreat of the glacial terminus, partial or catastrophic failure of the landslide has the potential to directly enter the ocean and generate a tsunami that can forcefully impact nearby communities, marine traffic, and infrastructure. Although the Barry Arm landslide is currently the most publicized instability in the region, other large, potentially tsunamigenic landslides exist in Prince William Sound. The extreme hazard and risk to onshore and offshore assets, and the large geographic area necessitate a thorough characterization of landslide hazards in the region.

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 characterizing motion of the Barry Arm landslide. Photograph by Dennis Staley, U.S. Geological Survey on July 28, 2021.

The Prince William Sound landslide hazards project objectives are to (1) identify potentially tsunamigenic landslides in Prince William Sound, (2) determine geologic and meteorologic controls on landslide movement, (3) surveil potentially hazardous landslides to detect elevated rates of landslide motion that may presage failure, (4) produce coupled landslide and displacement wave hazard and risk assessments in Prince William Sound, (5) provide input for early warning capabilities, and (6) increase situational awareness of potential hazards in the surrounding communities.

Time frame	Budget	Project partners
2020–ongoing	>$1,000,000	Alaska Division of Geological and Geophysical Surveys, National Oceanic and Atmospheric Administration, National Tsunami Warning Center, Alaska Earthquake Center

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Project Link

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

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.

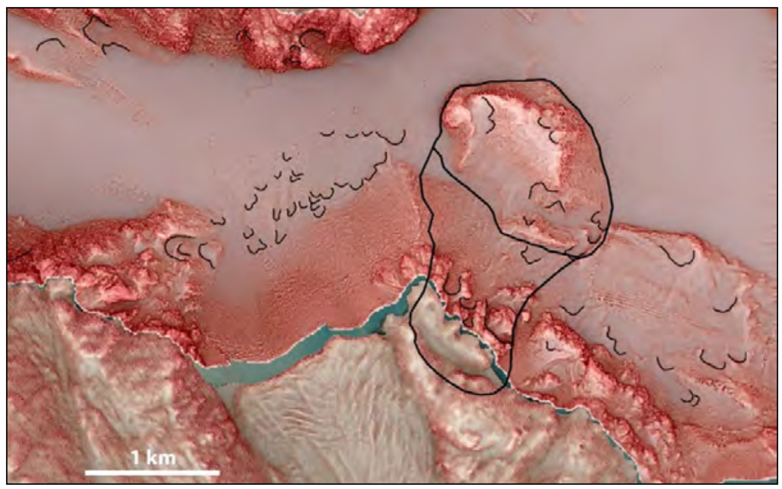
Barnhart, K.R., Jones, R.P., George, D.L., Coe, J.A., and Staley, D.M., 2021, Select model results from simulations of hypothetical rapid failures of landslides into Barry Arm Fjord, Prince William Sound, Alaska: U.S. Geological Survey data release, https://doi.org/10.5066/P9XVJDNP.

Coe, J.A., Wolken, G.J., Daanen, R.P., and Schmitt, R.G., 2021, Map of landslide structures and kinematic elements at Barry Arm, Alaska in the summer of 2020: U.S. Geological Survey data release, https://doi.org/10.5066/P9EUCGJQ.

Schaefer, L.N., Coe, J.A., Godt, J.W., and Wolken, G.J., 2020, Interferometric synthetic aperture radar data from 2020 for landslides at Barry Arm Fjord, Alaska (ver. 1.4, November 2020): U.S. Geological Survey data release, https://doi.org/10.5066/P9Z04LNK.

Schaefer, L., Coe, J.A., Godt, J.W., Wolken, G.J. 2021, Monitoring the ongoing landslide and tsunami threat at Barry Arm fjord, Alaska—European Space Agency Fringe conference, May 31–June 4, 2021: European Space Agency.

Landslide and Tsunami Hazards in Glacier Bay National Park and Preserve



Inlet Junction rockslide (black polygons) near the junction of Johns Hopkins and Tarr inlets in the West Arm of Glacier Bay. Image by Nikita Avdievitch, U.S. Geological Survey.

Large earthquakes and changing climate conditions in Glacier Bay National Park and Preserve (GBNPP) can trigger landslides. In coastal areas of GBNPP, landslide debris falling into the ocean can generate tsunamis, creating a potential risk to cruise ships, tour boats, and sea kayaks. The peak June–August cruise ship visitor season is also the season when climatically induced landslides are most likely to happen. This timing between high numbers of visitors and landslide/tsunami hazard has prompted the USGS to address the following questions: (1) which areas of Glacier Bay are susceptible to rockslides or rock avalanches that could enter the water and potentially generate tsunamis, (2) what is the likelihood that these slides and tsunamis could happen and how large would they be, (3) if they happen, what would be the risk to people, boats and infrastructure, and (4) if a substantial risk to visitors exists, what should be done about it? Methods used to address these questions include (1) landslide mapping using remotely sensed data, (2) field work and modeling to assess inherent landslide susceptibility to earthquake and climatic triggered ground failures, (3) landslide runout and tsunami modeling in critical areas determined to be moderately to highly susceptible to failures, and (4) a risk assessment that uses tsunami modeling. The first year of fieldwork that was initiated in the summer of 2021 to make measurements of rock-mass quality to characterize landslide susceptibility.

Time frame	Budget	Project partners
2021	<$100,000	National Park Service, National Ocean and Atmospheric Administration

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Project Links

https://www.usgs.gov/natural-hazards/landslide-hazards/science/mountain-permafrost-climate-change-and-rock-avalanches?qt-science_center_objects=0#qt-science_center_objects

https://www.usgs.gov/natural-hazards/landslide-hazards/science/potential-landslide-paths-and-implications-tsunami-hazards?qt-science_center_objects=0#qt-science_center_objects

Recent Publications

Avdievitch, N., Schmitt, R.G., Coe, J.A., 2020, Inventory map of submarine landslides in Glacier Bay, Glacier Bay National Park and Preserve, Alaska: U.S. Geological Survey data release, https://doi.org/10.5066/P9GCDYT2.

Bessette-Kirton, E.K., Coe, J.A., and Zhou, W., 2018, Using stereo satellite imagery to account for ablation, entrainment, and compaction in volume calculations for rock avalanches on glaciers—Application to the 2016 Lamplugh rock avalanche in Glacier Bay National Park, Alaska: Journal of Geophysical Research—Earth Surface, v. 123, no. 4, p. 622–641, https://doi.org/10.1002/2017JF004512.

Bessette-Kirton, E.K., and Coe, J.A., 2018, Pre- and post-event digital elevation models generated from high-resolution stereo satellite imagery of the 2016 Lamplugh rock avalanche in Glacier Bay National Park and Preserve, Alaska: U.S. Geological Survey data release, https://doi.org/10.5066/F7TT4Q4B.

Coe, J.A., 2020, Bellwether sites for evaluating changes in landslide frequency and magnitude in cryospheric-mountainous terrain: A call for systematic, long-term observations to decipher the impact of climate change: Landslides, v. 17, p. 2483–2501, https://doi.org/10.1007/s10346-020-01462-y.

Coe, J.A., Schmitt, R.G., Bessette-Kirton, E.K., 2019, An initial assessment of areas where landslides could enter the West Arm of Glacier Bay, Alaska and implications for tsunami hazards: Alaska Park Science, v. 18, no. 1, p. 26–37, https://pubs.er.usgs.gov/publication/70204676.

Coe, J.A., Bessette-Kirton, E.K., and Geertsema, M., 2018, Increasing rock-avalanche size and mobility in Glacier Bay National Park and Preserve, Alaska detected from 1984 to 2016 Landsat imagery: Landslides, v. 15, no. 3, p. 393–407, https://doi.org/10.1007/s10346-017-0879-7.

Dufresne, A., Wolken, G., Hilbert, C., Bessette-Kirton, E.K., Coe, J.A., Geertsema, M., Ekstrom, G., 2019, The 2016 Lamplugh landslide, Alaska—Deposit structures and emplacement dynamics: Landslides, v. 16, no. 12, p. 2301–2319, https://doi.org/10.1007/s10346-019-01225-4.

Crustal Imaging of the Queen Charlotte Fault System

Technicians from the Ocean Bottom Seismic Instrument Center and crew aboard the Canadian Coast Guard Ship John P. Tully ready to deploy ocean-bottom seismometers offshore of western British Columbia in July 2021. Photograph by Maureen Walton, U.S. Geological Survey.

Often called the "San Andreas of the North", the Queen Charlotte fault (QCF) system is a strike-slip plate boundary that separates the Pacific and North American tectonic plates offshore from western Canada and Southeast Alaska. The fault system caused Canada's largest recorded earthquake (Magnitude 8.1) in 1949 and it is the largest seismic hazard to southeastern Alaska and western Canada (outside of Cascadia). Crustal imaging of the Queen Charlotte fault system is needed to characterize deformation and seismic hazard in southeastern Alaska and western British Columbia. In the summer of 2021, an international group of researchers initiated a study to characterize the QCF plate boundary on a regional scale. The Transform Obliquity along the QCF and Earthquake Study (TOQUES) project used seismic energy from marine acoustic sources and ocean-bottom seismometer (OBS) instruments to image the QCF and determine velocity and thermal structure across the fault zone. Additional OBS are scheduled to be deployed in 2021–22 to measure the depth and extent of seismicity in several key regions. Data and interpretations from the TOQUES project will improve understanding of tectonic processes along the QCF fault system, and other strike-slip fault systems, for better hazard assessment and earthquake forecasting.

Time frame	Budget	Project partners
2020–22	$100,000–$499,000	Sitka Sound Science Center, University of New Mexico, University of Washington, Dalhousie University, National Science Foundation, Geological Survey of Canada

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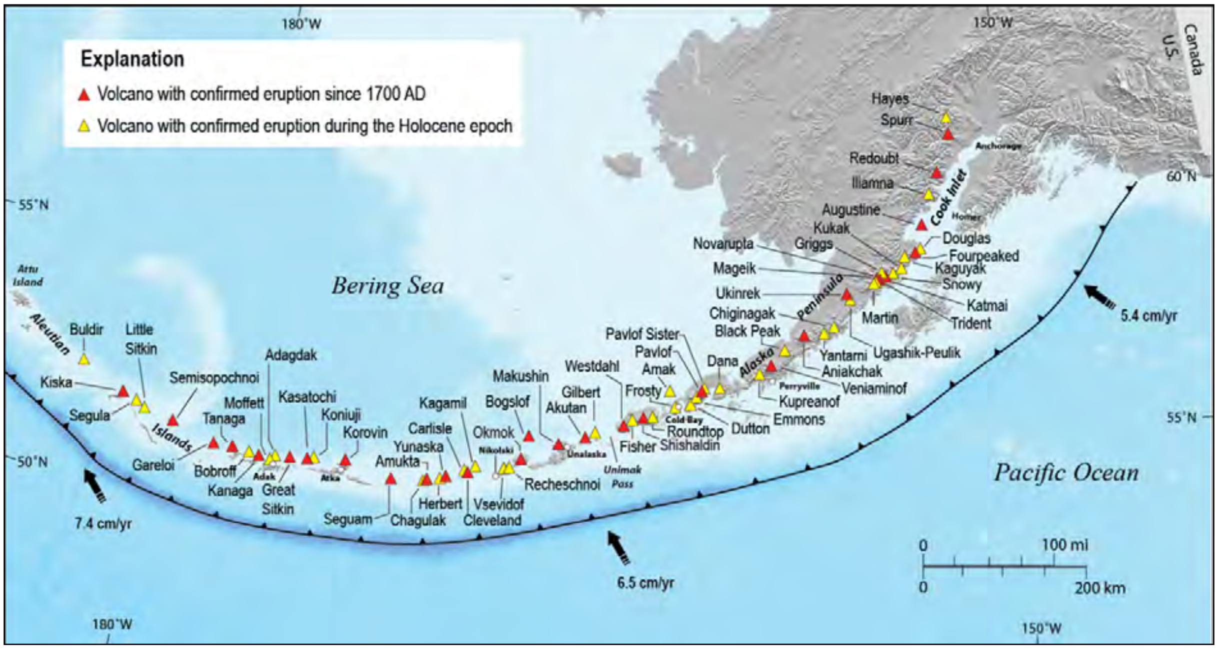
Volcanoes

Alaska Volcano Observatory



Map showing volcanoes of the Aleutian arc in Alaska. The Alaska Volcano Observatory uses various methods including real-time geophysical networks and satellite imagery to monitor activity at Alaskan volcanoes stretching from Mount Hayes, 141 kilometers (88 miles) from Anchorage to Kiska, 2,198 km (1,366 miles) from Anchorage. Not shown are other Holocene volcanoes of the Wrangell Mountains, southeast Alaska, and northwest Alaska. For more information about Alaska's volcanoes, please visit https://www.avo.alaska.edu.

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. The Alaska Volcano Observatory (AVO) is a joint program of the USGS, the Geophysical Institute of the University of Alaska Fairbanks, and the State of Alaska Division of Geological and Geophysical Surveys, was formed in 1988 to (1) monitor and study Alaska's hazardous volcanoes, (2) forecast and record eruptive activity, and (3) mitigate impacts 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 and USGS publications on volcanic processes, methods, and hazards; and hazards assessments and geologic maps.

Time frame	Budget	Project partners
1988–ongoing	>$1,000,000	University of Alaska Fairbanks; Alaska Division of Geological and Geophysical Surveys

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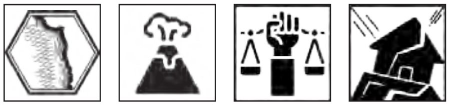
Project Link

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

Analog-to-Digital Conversion of Volcano Monitoring Sites in Alaska



Installing the Very Small Aperture Terminal (satellite communications node) at Fort Glenn, Alaska, on the eastern flank of Okmok caldera as part of the 2021 Analog to Digital campaign. Photograph by Pavel Izbekov, U.S. Geological Survey and University of Alaska Fairbanks Geophysical Institute.

Converting volcano monitoring networks from analog to digital (A2D) upgrades the remaining legacy analog volcano-monitoring equipment used by the Alaska Volcano Observatory (AVO) geophysical network to enhance monitoring capabilities and meet regulatory requirements. New and updated ground-based instrumentation includes modern broadband seismometers, infrasound sensors, and web cameras, which significantly improve AVO's ability to detect unrest, forecast eruptive activity, and issue timely alerts of volcano hazards. The upgrades replace aging analog equipment with modern digital instruments and radios, as well as refurbishment of existing digital equipment at some sites by constructing more robust digital installations. This work is required by the National Telecommunications and Information Administration to vacate radio frequencies used by older analog equipment; it has substantially improved the quality of AVO's monitoring data since the major effort began 2019. The new data will be helpful to other hazard monitoring programs, such as those focused on earthquakes and tsunamis.

In 2019, upgrades were completed at 45 stations on networks around Adak (Gareloi, Tanaga, Kanaga, and Great Sitkin) and on Atka Island. In 2020, progress was slower due to COVID-19, but 13 upgrades were completed. Twenty-five field stations were upgraded in 2021. Volcano monitoring networks at Little Sitkin, Semisopochnoi, and Okmok have been completely converted from analog to digital telemetry. Little Sitkin and Semisopochnoi are the most remote volcanoes in the Aleutians monitored by AVO; these stations are among the most challenging to upgrade, thus marking a major milestone in the project. Other notable accomplishments on the A2D project in 2021 include the construction of a satellite communications hub at Fort Glenn, Umnak Island and the installation of an infrasound array at Amchitka, western Aleutians. In addition to work on the A2D project, critical maintenance was completed at several other volcano networks including Korovin, Unimak, Makushin, and Akutan.

Time frame	Budget	Project Partners
Ongoing	<$1,000,000	University of Alaska Fairbanks; Alaska Division of Geological and Geophysical Surveys

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Project Link

https://avo.alaska.edu/news.php?id=1441

Sea Ice Loss, Coastal Flooding, and Erosion

Alaska Coastal Processes and Hazards

The current warming trend across the Arctic and Alaska is substantially reducing sea ice extent, causing permafrost thaw, and changing climatic and oceanographic patterns. Coastal impacts resulting from these changes are multi-dimensional and include rapid coastal erosion that threatens village and facility (for example, oil and gas) infrastructure, ecosystem stability, and critical cultural and social networks. Parallel to the negative impacts are emerging opportunities related to increasing accessibility impacting planning and economic development strategies. The objectives of this project are to identify hazards; quantify risk; and evaluate impacts of past, present, and future coastal processes on infrastructure, biology, and people along the Alaskan coast. The methods integrate field studies and numerical modeling and include (1) developing new methods for collection of permafrost thermal exchange, (2) nearshore bathymetry and elevation data, and (3) modeling tools for better characterizing future flood hazards, bluff recession, and barrier island landscape change.

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

Time frame	Budget	Project partners
FY2020–ongoing	$100,000–$499,000	Alaska Division of Geological and Geophysical Surveys, University of Alaska Anchorage and Fairbanks

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Ferdinand Oberle, Pacific Coastal & 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

https://wim.usgs.gov/geonarrative/cch-alaska/

Recent Publications

Bristol, E. M., Connolly C. T., Lorenson T. D., Richmond, B M., Ilgen A. G., Choens, R.C., Bull D. L., Kanevskiy, M., Iwahana G., Jones, B. M., McClelland, J. W., 2021, Geochemistry of coastal permafrost and erosion-driven organic matter fluxes to the Beaufort Sea near Drew Point, Alaska: Frontiers in Earth Science, v. 8, p. 639.

Erikson, L.H., Gibbs, A.E., Richmond, B.M., Storlazzi, C.D., Jones, B.M., and Ohman, K.A., 2020, Changing storm conditions in response to projected 21st century climate change and the potential impact on an arctic barrier island–lagoon system—A pilot study for Arey Island and Lagoon, eastern Arctic Alaska: U.S. Geological Survey Open-File Report 2020–1142, 68, p., https://doi.org/10.3133/ofr20201142.

Paull, C.K., Dallimore, S.R., Caress, D.W., Gwiazda, R., Lundsten, E., Anderson, K., Melling, H., Jin, Y.K., Duchesne, M.J., Kang, S.-G., Kim, S., Riedel, M., King, E.L., Lorenson, T., 2021, A 100-km wide slump along the upper slope of the Canadian Arctic was likely preconditioned for failure by brackish pore water flushing: Marine Geology, v. 435, no. 106453, 16 p.

Hamilton, A., 2021, Parameter sensitivity on tidal propagation in Norton Sound, AK: Copenhagen, University of Copenhagen, Department of Geography and Geoinformatics, Master's thesis, 68 p.

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

Like many coastal communities of Alaska, the village of Unalakleet is vulnerable to marine flooding during large storms. Storm surge in Norton Sound typically happens 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 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 run-up, 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 2018). The knowledge gained from this imagery will 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 NOAA, the overriding USGS goal is to develop a real-time system to provide approximately 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 (56 miles) of bathymetry track-line data were collected in the inlet and estuary and along the open coast extending about 1.2 kilometers (0.75 miles) north and south of the inlet and about 1.5 kilometers (0.9 miles) offshore.

Photograph 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	Budget	Project partners
FY2019–ongoing	<$100,000	Alaska Division of Geological and Geophysical Surveys; Native Village of Unalakleet; City of Unalakleet; National Oceanic and Atmospheric Administration

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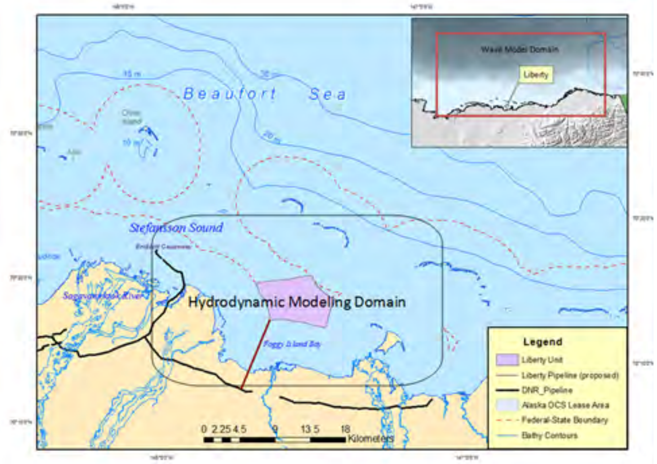
Ann Gibbs, Pacific Coastal and Marine Science Center, agibbs@usgs.gov, (831) 460-7540

Project Link

https://www.usgs.gov/centers/pcmsc/science/using-video-imagery-study-wave-dynamics-unalakleet?qt-science_center_objects=0#qt-science_center_objects

Wave and Hydrodynamic Observations and Modeling in the Nearshore Beaufort Sea

Renewed interest in nearshore oil exploration and production in the central Beaufort Sea has created a general need to advance understanding of the dynamic physical conditions in the Beaufort Sea coastal region. Specifically, the Bureau of Ocean Energy Management requires information on the potential impacts that present-day and future sea-ice and atmospheric conditions will have on waves, currents, and sedimentation rates, and ice pile-up events during the expected timeframe of the offshore Liberty Development Project (about 2020–50). Historical observational data were compiled and a coordinated field effort was completed in 2019 to better characterize the system and support model calibration and validation. USGS is developing a coupled wave-hydrodynamic-sediment transport model to produce a 40-year hindcast (1979–2019) and projection (2020–49) of waves, storm surge, and sediment transport potentials within Foggy Island Bay and greater Stefansson Sound.



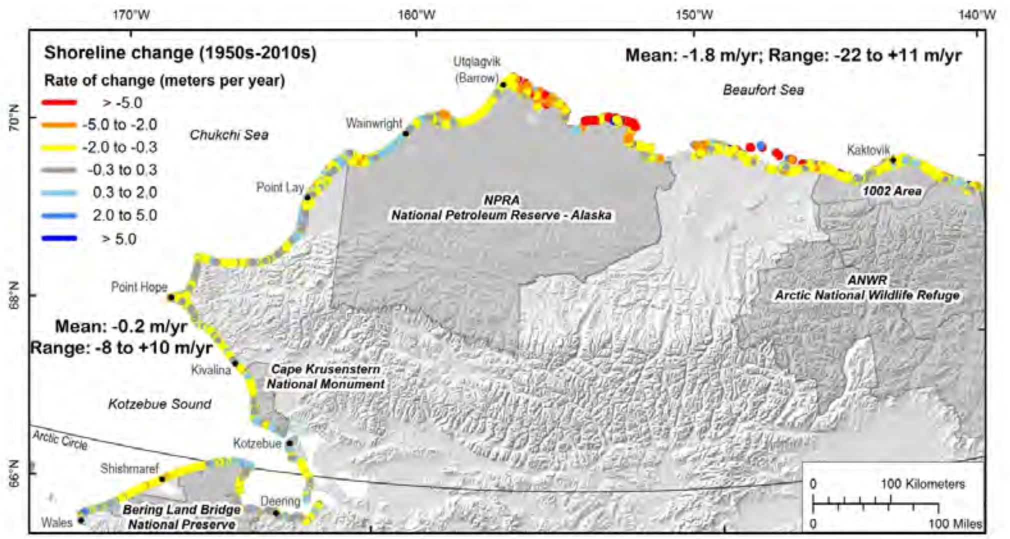
Map showing proposed general location of Liberty Development Project with the study model domain, in Foggy Island Bay and Stefansson Sound area of the Beaufort Sea, on the north coast of Alaska. Source: https://aoos.org/foggy/.

Time Frame	Budget	Partners
2018–22	<$1,000,000	Bureau of Ocean Energy Management, University of Alaska Fairbanks, University of Alaska Anchorage, Alaska Ocean Observing System, Axiom Data Science

Contact

Rob Li Erikson, Pacific Coastal and Marine Science Center, lerikson@usgs.gov, (831) 460-7563

National Assessment of Shoreline Change on the Coast of Alaska



Map showing color-coded shoreline change rates and key geographic locations on the north coast of Alaska. Source: Gibbs and Richmond (2015) and Gibbs and others (2019) (see "Recent Publications" at the end of this section).

Coastal erosion is extensive in Alaska, threatening coastal communities, infrastructure, and nearshore habitat. There is a need to determine rates and patterns of historical shoreline change along Alaska's coast to support long-term planning and decision-making to ensure sustainable coastal communities and ecosystems. As part of the USGS National Assessment of Shoreline Change and Alaska Coastal Processes and Hazards projects, USGS is quantifying rates and patterns of shoreline change across the nation. 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, thereby helping coastal managers and communities plan for a changing climate. Objectives of the projects include developing and improving coastal-change assessments, quantifying rates, 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, started in FY2020, extends the study area south to the Yukon Kuskokwim Delta region. Updated rates will be calculated as new shoreline datasets become available.

Time frame	Budget	Project partners
2006–ongoing	\$100,000–\$499,000	Alaska Division of Geological and Geophysical Surveys

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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., Ohman, K.A., Coppersmith, R., and Richmond, B.M., 2017, A GIS compilation of updated vector shorelines and associated shoreline change data for the north coast of Alaska, U.S.–Canadian border to Icy Cape: U.S. Geological Survey data release, https://doi.org/10.5066/F72Z13N1.

Gibbs, A.E., and Richmond, B.M., 2015, National assessment of shoreline change—Historical shoreline change along the north coast of Alaska, U.S.–Canadian border to Icy Cape: U.S. Geological Survey Open-File Report 2015–1048, 96 p., https://dx.doi.org/10.3133/ofr20151048.

Gibbs, A.E., and Richmond, B.M., 2017, National assessment of shoreline change—Summary statistics for updated vector shorelines and associated shoreline change data for the north coast of Alaska, U.S.–Canadian border to Icy Cape: U.S. Geological Survey Open-File Report 2017–1107, 21 p., https://doi.org/10.3133/ofr20171107.

Gibbs, A.E., Snyder, A.G., Richmond, B.M., 2019, National assessment of shoreline change - Historical shoreline change along the north coast of Alaska, Icy Cape to Cape Prince of Wales: U.S. Geological Survey Open-File Report 2019–1146, 52 p., https://doi.org/10.3133/ofr20191146.

Snyder, A.G., and Gibbs, A.E., 2019, National assessment of shoreline change—A GIS compilation of updated vector shorelines and associated shoreline change data for the north coast of Alaska, Icy Cape to Cape Prince of Wales: U.S. Geological Survey data release, https://doi.org/10.5066/P9H1S1PV.

Other Hazards

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

U.S. Geological Survey researcher holds a tree cross section to look for irregular rings. Photograph by Molly Tankersley, Alaska Climate Adaptation Science Center.

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 combine classical dendrochronological techniques with a novel nested spatial sampling design to develop a time series of large magnitude avalanche events. Combined with a LiDAR-derived, high-resolution, comprehensive avalanche runout model, the results from this project inform stakeholders and partners of the frequency of avalanches that affect public safety and infrastructure. Products 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.

Budget	Project Partners
$100,000–$499,000	University of Alaska Southeast, University of Alaska Fairbanks, Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, City and Borough of Juneau, Alaska Electric Light & Power, Kensington Gold Mine

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Project Link

https://www.usgs.gov/centers/norock/science/examining-snow-avalanche-frequency-and-magnitude?qt-science_center_objects=0#qt-science_center_objects

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., Fagre, D.B., 2021, A regional spatio-temporal analysis of large magnitude snow avalanches using tree rings: Natural Hazards and Earth Systems 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

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

While major geomagnetic storms are rare, there is significant potential for large-scale impacts 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 variation through operation of a network of fourteen observatories across the U.S. and territories (including five in Alaska) and pursues scientific research to estimate and assess geomagnetic and geoelectric hazards. Methods used integrate high-resolution and accurate 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.

Time frame	Project partners
Ongoing	National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, U.S. Forest Service, National Park Service, Schlumberger Technology Corporation ($50,000 for FY2021), Shumagin Corporation

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Project Link

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

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 partnership 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 (112 streamflow sites in 2020, 64 of which also measure water temperature). Streamgages are concentrated along the road system and near population centers, leaving many areas of the State devoid of any hydrologic information. Operation of a streamgage in Alaska is expensive, owing to: complex logistics, personnel, and access to remote sites all contribute to high costs. The average installation cost of a USGS streamgage in Alaska is $30,000 (for materials and fabrication) plus installation logistics, which vary considerably. Streamflow data are recorded at 15-minute intervals, stored on-site, and then transmitted to USGS offices every 1–4 hours, depending on the data relay technique used. 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 of arrival. All real-time data are provisional and subject to revision after a formal review process that includes computation of annual statistics.

Measurement of discharge during high flow at June Creek near Clear, Alaska. Photograph by Heather Best, U.S. Geological Survey.

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

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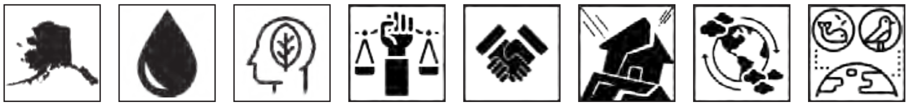
Project Link

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

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 largescale mining activity in the Canadian parts of these watersheds poses a potential threat to the fisheries and traditional lifestyles in Alaska. The objectives of monitoring and assessing 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 partnerships with Tribes and government agencies to ensure that assessments meet the needs of Tribes and local stakeholders. Methods include updated geologic mapping and sample reanalysis, biological sampling, and discrete water quality sampling. Information on streamflow and water-quality conditions collected hourly at downstream monitoring sites will 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.

Water quality sampling on the Unuk River, Alaska. Photograph by Randy Host, U.S. Geological Survey.

Time frame	Budget	Project partners
2019–23	<$1,000,000	USGS Water Mission Area

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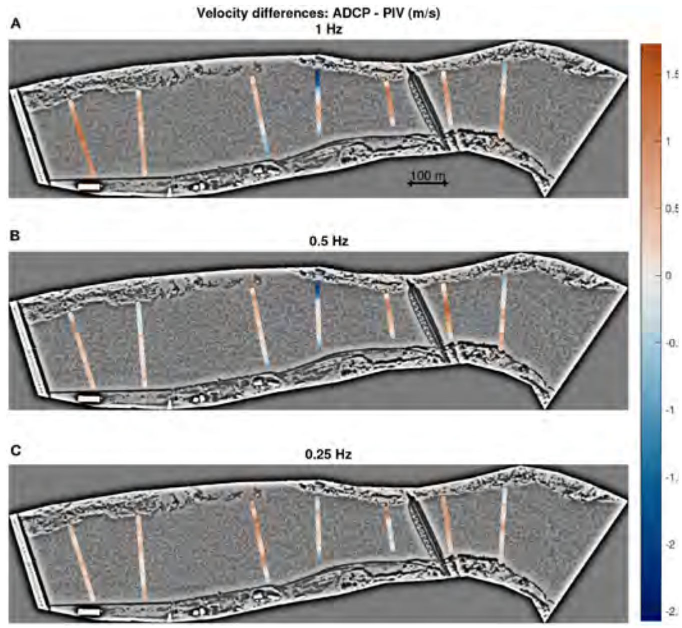
Project Link

https://www.usgs.gov/centers/asc/science/usgs-transboundary-river-monitoring-southeast-alaska?qt-science_center_objects=0#qt-science_center_objects

Developing Remote Sensing Methods to Measure Streamflow in Alaska Rivers

Obtaining timely, accurate information on streamflow in Alaska rivers is difficult because streamgages are sparse. Even for established monitoring stations, the maintenance and periodic measurements required to operate a streamgage pose logistical challenges and can place personnel at risk, particularly under high flow conditions. The core objective of this study is to develop and test remote sensing methods for measuring the river characteristics needed to estimate streamflow. In FY2021, we evaluated a method to estimate surface flow velocities from satellite video of a large, sediment-laden river in Alaska via particle image velocimetry. The accuracy of image-derived velocity estimates was assessed via comparison with direct field measurements made from a boat for our field site on the Tanana River. This research is significant because most Alaskan rivers do not have streamgages, thus efficient remote-sensing methods of measuring discharge could provide valuable streamflow information for water resource management and flood hazard mitigation. The goal is to operationalize these methods so that remote sensing can become a viable tool for the USGS and other stakeholders.

Time frame	Budget
2016–ongoing	<$100,000



Maps of surface flow velocities derived from particle image velocimetry for different frame rates: A, 1 Hz; B, 0.5 Hz; and C, 0.25 Hz processed via the workflow described in Legleiter and Kinzel (2021). The locations of the Acoustic Doppler Current Profiler velocity measurements used for accuracy assessment are shown in red. Source: Legleiter and Kinzel (2021).

Contacts

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

Recent Publications

Legleiter, C.J., and Kinzel, P.J., 2020, Inferring surface flow velocities in sediment-laden Alaskan rivers from optical image sequences acquired from a helicopter: Remote Sensing, v. 12, no. 8, 28 p., https://doi.org/10.3390/rs12081282.

Legleiter, C.J., and Kinzel, P.J., 2021, Surface flow velocities from space—Particle image velocimetry of satellite video of a large, sediment-laden river: Frontiers in Water, v. 3, no. 652213, 20 p., https://doi.org/10.3389/frwa.2021.652213.

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 USGS 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 and stage sensors and collecting 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.

Pier hydraulics at Red Cloud River near Kodiak, Alaska, November 2018. Photograph by Paul Schauer, U.S. Geological Survey.

Time frame	Budget	Project partners
2017–21	$100,000–$499,000	Alaska Department of Transportation and Public Facilities

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Project Link

https://www.usgs.gov/centers/asc/science/streambed-scour-bridges-alaska?qt-science_center_objects=0#qt-science_center_objects

Recent Publications

Beebee, R.A., Dworsky, K.L., and Knopp, S.J., 2017, Streambed scour evaluations and conditions at selected bridge sites in Alaska, 2013–15: U.S. Geological Survey Scientific Investigations Report 2017–5149, 67 p., https://doi.org/10.3133/sir20175149.

Beebee, R.A., and Schauer, P.V., 2015, Streambed scour evaluations and conditions at selected bridge sites in Alaska, 2012: U.S. Geological Survey Scientific Investigations Report 2015–5154, 45 p., https://doi.org/10.3133/sir20155154.

Dworsky, K.L., and Conaway, J.S., 2019, Measurement of long-term channel change through repeated cross-section surveys at bridge crossings in Alaska: U.S. Geological Survey Open-File Report 2019–1028, 118 p., https://doi.org/10.3133/ofr20191028.

Indigenous Observation Network 2.0—Impacts of Environmental Change on the Yukon and Kuskokwim Watersheds

The Indigenous Observation Network 2.0: Impacts of Environmental Change on the Yukon and Kuskokwim Watersheds continues the Indigenous Observation Network (ION) long-term community-based water-quality monitoring project across Alaska and Western Canada. The ION 2.0 project is led by the Yukon River Intertribal Watershed Council in partnership with the USGS and the University of Alaska-Fairbanks. ION 2.0 expands the observation and monitoring program to include measurements of changes in permafrost depth driven by a changing climate at multiple long-term water quality monitoring sites. This work builds on previous findings from ION that changes in major ion chemistry happened over three decades throughout the Yukon River Watershed because of the thawing of discontinuous permafrost. In addition to quantitative data on permafrost thaw, this project entails integration of Indigenous knowledge to better understand local perceptions and knowledge of permafrost distribution in the region and locally. The COVID-19 pandemic emphasizes the ability and value of community-based monitoring programs to collect high quality data in hard–to–reach locations. Water-quality sampling continued successfully owing to the hard work and dedication of the community environmental technicians despite a global pandemic.

Yukon River in Dawson, Yukon Territory, Canada. Photograph by Jody Inkster, Dena Cho Environmental and Remediation Inc.

Time frame	Budget	Project partners
2019–22	$100,000–$499,000	Yukon River Inter-Tribal Watershed Council, University of Alaska Fairbanks

Recent Publications

Herman-Mercer, N.M., 2016, Water-quality data from the Yukon River Basin in Alaska and Canada: U.S. Geological Survey data release, http://dx.doi.org/10.5066/F77D2S7B.

Herman-Mercer, N.M., 2017, Active layer data from the Yukon River Basin in Alaska and Canada: U.S. Geological Survey data release, https://doi.org/10.5066/F7NC5ZFM.

Herman-Mercer, N.M., Antweiler, R., Wilson, N, Mutter, E., Toohey, R., Schuster, P., 2018, Data Quality from a Community-Based, Water-Quality Monitoring Project in the Yukon River Basin. Citizen Science—Theory & Practice, v. 3, no. 2, 1 p.

Schuster, P.F., Maracle, K.B., and Herman-Mercer, N.M., 2010, Water Quality in the Yukon River Basin, water years 2006–08: U.S. Geological Survey Open-File Report 2010–1241, 220 p.

Toohey, R. C., N. M. Herman-Mercer, P. F. Schuster, E. Mutter, and J. C. Koch, 2016, Multi-decadal increases in the Yukon River Basin of chemical fluxes as indicators of changing flowpaths, groundwater, and permafrost. Geophysical Research Letters, v. 43, no. 23, p 12120–12130, https://pubs.er.usgs.gov/publication/70185067.

Project Link

https://www.usgs.gov/centers/casc-sc/science/yukon-river-basin-indigenous-observation-network?qt-science_center_objects=0#qt-science_center_objects

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, with rivers providing 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 1002 region of the Arctic National Wildlife Refuge (ANWR). Methods 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 will provide critical quantification of water resources, aiding managers in balancing ecological and industrial requirements in this extreme, water-limited environment.

U.S. Geological Survey-National Science Foundation intern standing on a 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 during this trip 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	Budget	Project partners
2019–22	$100,000–$499,000	U.S. Fish and Wildlife Service, National Science Foundation

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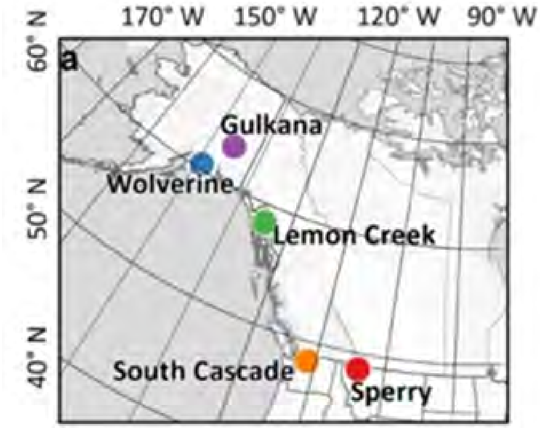
Glaciers

Glaciers are defining features of the physical landscapes in 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 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 accumulation, summer melt, and 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. Map by U.S. Geological Survey.

Time frame	Budget	Project partners
2016–20	$500,000–$1,000,000	U.S. Army Corps of Engineers, Cold Regions Research and Engineering Lab

Contact

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Project Link

https://www2.usgs.gov/landresources/lcs/glacierstudies/benchmark.asp

Recent Publications

McNeil, C., O’Neel, S., Loso, M., Pelto, M., Sass, L., Baker, E., 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 U.S. Geological Survey Benchmark Glaciers—Long-term insight into climate forcing of glacier mass balance: Journal of Glaciology, v. 65, no. 253, p. 850–866.

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, resources for wildlife and society, and the ground stability that affects human infrastructure. Since permafrost soils contain about half of the global soil carbon (C) pool, the magnitude of C losses from permafrost thaw is critically important to the global C cycle, known as the permafrost carbon feedback. The overall objective is to understand greenhouse gas (GHG) flux during the non-growing season from active-layer soils, permafrost, and supra-permafrost taliks, which are areas of unfrozen ground in permafrost areas in forests, bogs, and fens in Alaskan peatlands. Specifically, the study will
(1) quantify the influence of talik formation and non-growing season processes on landscape-scale carbon dioxide and methane fluxes, (2) assess the quantity of old (millennial-aged) C lost from thawing permafrost soils and quantify and regionalize that loss, (3) examine the extent to which permafrost near 0 degrees Celsius is releasing GHG, and (4) compare the vulnerability of C losses among soils of different types and histories.

U.S. Geological Survey researchers taking frozen soil cores from the Alaska Peatland Experiment to study carbon dynamics related to permafrost thaw. Photograph by Kristen Manies and Jack McFarland, U.S. Geological Survey.

Time Frame	Budget	Project Partners
2015–21	$500,000–$1,000,000	University of Alaska Fairbanks, California State University Northridge, University of Washington, University of Helsinki, University of California Irvine, Lawrence Livermore National Lab, Permafrost Research Network

Contact

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

Recent Publication

James, S.R., Minsley, B.J., McFarland, J.W., Euskirchen, E.S., Edgar, C.W., & 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, p. 1–21, https://doi.org/10.1029/2021JF006104.

Mackelprang, R., Tas, N., and Waldrop, M., 2021, Functional response of microbial communities to permafrost thaw, *in* Liebner, S. and Ganzert, L., eds., Microbial life in the cryosphere and its feedback on global change: Berlin and Boston, De Gruyter, p. 27–42, https://doi.org/10.1515/9783110497083.

Turner, J.C., Moorberg, C.J., Wong, A., Shea, K., Waldrop, M.P., Turetsky, M.R., and Neumann, R.B., 2020, Getting to the root of plant-mediated methane emissions and oxidation in a thermokarst bog: Journal of Geophysical Research: Biogeosciences, v. 125, no. 11, 18 p., https://doi.org/10.1029/2020JG005825.

Waldrop, M.P., Anderson, L., Dornblaser, M., Erikson, L.H., Gibbs, A.E., Herman-Mercer, N.M., James, S.R., Jones, M.C., Koch, J.C., Leewis, M.-C., Manies, K.L., Minsley, B.J., Pastick, N.J., Patil, V., Urban, F., Walvoord, M.A., Wickland, K.P., and Zimmerman, C., 2021, USGS permafrost research determines the risks of permafrost thaw to biologic and hydrologic resources: U.S. Geological Survey Fact Sheet 2020–3058, 6 p., https://doi.org/10.3133/fs20203058.

Waldrop, M. P., McFarland, J., Manies, K., and others, 2021, Carbon fluxes and microbial activities from boreal peatlands experiencing permafrost thaw: Journal of Geophysical Research—Biogeosciences, v. 126, no. 3, https://doi.org/10.1029/2020JG005869.

Hydrologic Change in Permafrost Systems

Permafrost exerts a major control on water movement and distribution across the landscapes of interior Alaska. As permafrost thaws, the subsurface becomes more permeable, enabling water and dissolved constituents to flow more freely and deeply below the surface. To better understand and quantify these complex dynamics, this project entails integration of subsurface measurement and modeling approaches to assess the vulnerability of permafrost in interior boreal Alaska and evaluate the impacts on hydrologic processes. Methods for subsurface characterization include borehole, ground-based noninvasive, and airborne geophysical techniques as well as soil sample collection for thermal and hydraulic property analyses. Data-informed hydrogeologic model simulations enable examination of the roles of climate change and landscape disturbance, such as wildfire, in influencing the rate and magnitude of permafrost thaw and consequent effects on water and solute fluxes. Fundamental understanding of permafrost hydrology provides the underpinning for model predictions of streamflow, groundwater availability, and surface-water distribution in response to anticipated changes in air temperature, precipitation, wildfire, and vegetation. Projecting trajectories of water availability in interior Alaska is a primary objective of this effort.

U.S. Geological Survey scientists coring lake ice to collect winter lake water chemistry samples, in the Yukon Flats, Alaska. Photograph by David Rey, U.S. Geological Survey.

Time frame	Budget	Project partners
2016–21	$100,000–$400,000	National Aeronautics and Space Administration

Contact

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Recent Publications

Ebel, B., Koch, J., and Walvoord, M., 2019, Soil physical, hydraulic, and thermal properties in interior Alaska, USA—Implications for hydrologic response to thawing permafrost conditions: Water Resources Research, v. 55, no. 5, p. 4427–4447, https://doi.org/10.1029/2018WR023673.

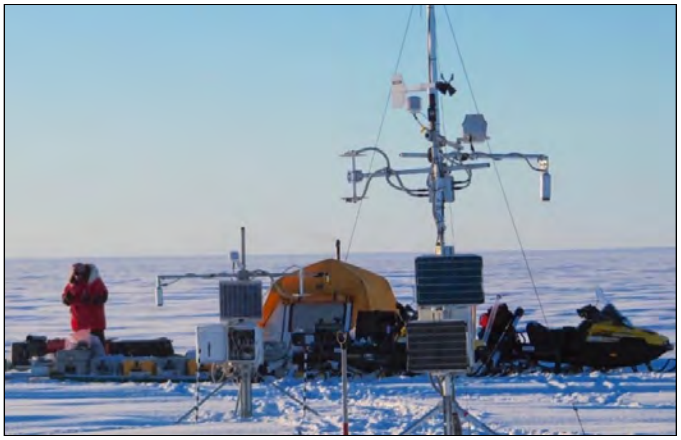
Rey, D., Walvoord, M., Ebel, B., Minsley, B., Voss, C., and Singha, K., 2020, Wildfire-initiated talik development exceeds current thaw projections—Observations and models from Alaska's continuous permafrost zone: Geophysical Research Letters, v. 47, no. 15, 11 p., https://doi.org/10.1029/2020GL087565.

Rey, D.M., Walvoord, M., Minsley, B., Rover, J., and Singha, K., 2019, Investigating lake-area dynamics across a permafrost-thaw spectrum using airborne electromagnetic surveys and remote sensing time-series data in Yukon Flats, Alaska: Environmental Research Letters, v. 14, no. 2, https://doi.org/10.1088/1748-9326/aaf06f.

Tank, S., Vonk, J., Walvoord, M., McClelland, J., Laurion, I., and Abbott, B., 2020, Landscape matters—Predicting the biogeochemical effects of permafrost thaw on aquatic networks with a state factor approach: Permafrost and Periglacial Processes, v. 31, no. 3, p. 358–370, https://doi.org/10.1002/ppp.2057.

USGS Climate and Permafrost Observing Network

The USGS, BLM, and FWS each have an interest in tracking long-term climate patterns in the National Petroleum Reserve in Alaska and the ANWR, 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. Network sensors include air temperature, soil temperatures, relative humidity, precipitation, wind speed, wind direction, barometric pressure, snow depth, and solar radiation. 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 will be released annually and archived within the Global Terrestrial Network for Permafrost and the Global Climate Observing System.



Climate station maintenance in Spring near Teshekpuk Lake, northern Alaska. Photograph by Frank Urban, U.S. Geological Survey.

Time frame	Budget	Project partners
FY2019–23	$100,000–$499,000	Bureau of Land Management, U.S. Fish and Wildlife Service

Contact

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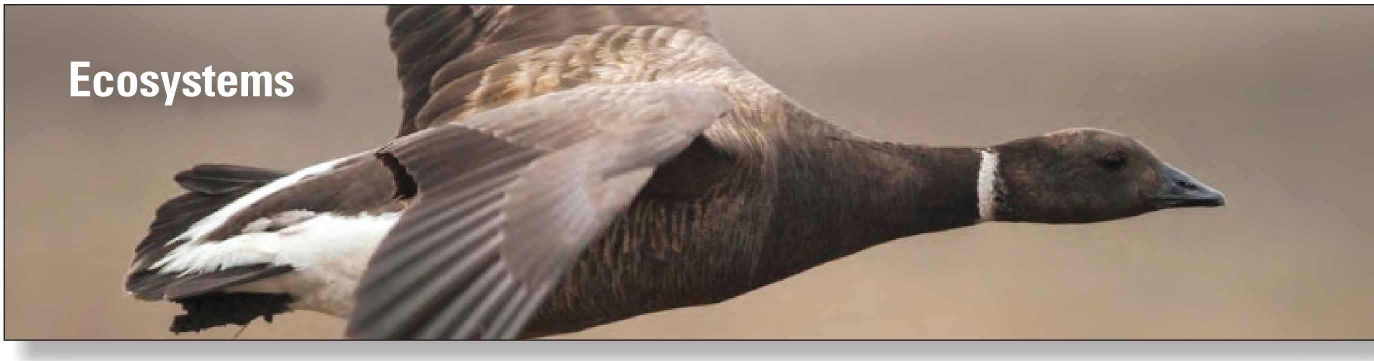
Recent Publication

Clow, G., 2015, Permafrost temperature data from a deep borehole array on the Arctic slope of Alaska (ver. 1): Boulder, Colorado, National Snow and Ice Data Center web page, https://doi.org/10.5065/D6N014HK.



Mammals

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

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

The polar bear is recognized worldwide as a species vulnerable to changing climate because of loss of its required sea ice habitats. 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 founded in understanding gained from long-term studies of the southern Beaufort Sea (SB) 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 length of the open water season over the continental shelf and 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 SB 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.

Time frame	Budget	Project partners
1980s–ongoing	<$1,000,000	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

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Project Link

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

Recent Publications

Bromaghin, J.F., Douglas, D.C., Durner, G.M., Simac, K.S., and Atwood, T.C., 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.

Bourgue, J., Atwood, T.C., Divoky, G., Stewart, C., and McKinney, M.A., 2020, Fatty acid-based diet estimates suggest ringed seal remain the main prey of southern Beaufort Sea polar bears despite recent use of onshore food resources: Ecology and Evolution, v. 10, no. 4, p. 2093–2103, https://doi.org/10.1002/ece3.6043.

Durner, G.M., Amstrup, S.C., Atwood, T.C., Douglas, D.C., Fischbach, A.S., Olson, J.W., Rode, K.D., and Wilson, R.R., 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., https://doi.org/10.3133/ds1121. [Supersedes U.S. Geological Survey Data Series 568.]

Durner, G.M., Douglas, D.C., and Atwood, T.C., 2019, Are polar bear habitat resource selection functions developed from 1985–1995 data still useful?: Ecology and Evolution, v. 9, no. 15, p. 8625–8638, https://doi.org/10.1002/ece3.5401.

Fry, T.L., Friedrichs, K.R., Atwood, T.C., Duncan, C., Simac, K.S., and Goldberg, T., 2019, Reference intervals for blood-based biochemical analytes of southern Beaufort Sea polar bears. Conservation Physiology, v. 7, no. 1, 16 p., https://doi.org/10.1093/conphys/coz040.

Lillie, K.M., Gese, E.M., Atwood, T.C., and Sonsthagen, S.A., 2018, Development of on-shore behavior among polar bears (*Ursus maritimus*) in the southern Beaufort Sea—Inherited or learned?: Ecology and Evolution, v. 8, no. 16, p. 7790–7799, https://doi.org/10.1002/ece3.4233.

Wilson, R.R., and Durner, G.M., 2020, Seismic survey design and effects on maternal polar bear dens: The Journal of Wildlife Management, v. 84, no. 2, p. 201–212, https://doi.org/10.1002/jwmg.21800.

Pacific Walrus Research

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 Pacific walrus is one of four marine mammal species managed by the DOI. The ASC conducts long–term research on Pacific walruses to inform local, State, national, and international policy makers regarding 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. The initial phase of current work began with the collection of population age structure data in three consecutive years (2013–15) from the Chukchi Sea during ship-based research cruises in collaboration with FWS and ADF&G. 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 will use these data to develop new statistical techniques to combine traditional mark-recapture with kinship data to provide more robust estimates of walrus population size. Ongoing and future work includes Unoccupied Aircraft System population surveys of hauled out walruses in northwestern Alaska, assessments of walrus behavioral response to marine vessel interactions, and modeled linkages between future sea ice availability and walrus energetic requirements to population vitality rates.

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

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Project Link

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

Recent Publication

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

Nearshore Marine Ecosystem Research

Sea otter in kelp. Photograph by Benjamin Weitzman, U.S. Geological Survey.

Nearshore ecosystems in Alaska include many resources that are of high ecological, recreational, subsistence, and economic value. They are subject to influences from a wide variety of natural and human-caused perturbations, which can originate in terrestrial or oceanic environments. Our research is designed to evaluate sources of variation in the nearshore and how they influence resources of high conservation interest. Our studies address community members at every trophic level, ranging from intertidal macroalgae and kelps to benthic invertebrates to top-level predators such as sea otters, black oystercatchers, and sea ducks. Key issues addressed by our program include ecosystem recovery from the 1989 Exxon Valdez oil spill; in particular, studies of sea otters and harlequin ducks have provided unprecedented insights into the processes and timelines of recovery of vulnerable species. We have a long history, and ongoing efforts, of investigating population dynamics of sea otters and their effects on other components of nearshore ecosystems. We also study sea ducks, a group of waterfowl of high conservation concern, evaluating factors on marine habitats that influence their distribution, abundance, and demography. A large component of our program is participation in Gulf Watch Alaska, which is designed to monitor marine ecosystem structure and function in the northern Gulf of Alaska.

Time frame	Budget	Project partners
2005–ongoing	<$1,000,000	U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, National Park Service, Exxon Valdez Oil Spill Trustee Council

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Project Link

https://www.usgs.gov/centers/asc/science/nearshore-marine-ecosystem-research

Recent Publications

Esler, D., Ballachey, B.E., Matkin, C., Cushing, D., Kaler, R., Bodkin, J., Monson, D., Esslinger, G., and Kloecker, K., 2017, Timelines and mechanisms of wildlife population recovery following the Exxon Valdez oil spill: Deep Sea Research Part II—Topical Studies in Oceanography, v. 147, p. 36–42, https://doi.org/10.1016/j.dsr2.2017.04.007.

Esslinger, G.E., 2018, Gulf Watch Alaska Nearshore Component—Sea otter aerial survey data from Katmai National Park and Preserve, 2008–2018 (ver. 2.0, March 2020): U.S. Geological Survey data release, https://doi.org/10.5066/F7930SG7.

Kloecker, K.A., and Monson, D.H., 2020, Gulf Watch Alaska Nearshore Component—Sea otter mortality age data from Katmai National Park and Preserve, Kenai Fjords National Park, and Prince William Sound, Alaska, 2006–2017: U.S. Geological Survey data release, https://doi.org/10.5066/F7H993CZ.

Konar, B., Mitchell, T.J., Iken, K., Coletti, H., Dean, T., Esler, D., Lindeberg, M., Pister, B., Weitzman, B., 2019, Wasting disease and static environmental variables drive sea start assemblages in the northern Gulf of Alaska: Journal of Experimental Marine Biology and Ecology, v. 520, 10 p., https://doi.org/10.1016/j.jembe.2019.151209.

Tinker, M.T., Gill, V.A., Esslinger, G.E., Bodkin, J.L., Monk, M., Mangel, M., Monson, D.H., Raymond, W.W., and Kissling, M.L., 2019, Trends and carrying capacity of sea otters in southeast Alaska: The Journal of Wildlife Management, v. 83, no. 5, p. 1073–1089, https://doi.org/10.1002/jwmg.21685.

Willie, M., Esler, D., Boyd, W.S., Bowman, T., Schamber, J., and Thompson, J., 2020, Annual winter site fidelity of Barrow's goldeneyes in the Pacific: The Journal of Wildlife Management, v. 84, no. 1, p. 161–171, https://doi.org/10.1002/jwmg.21767.

Ecology of Terrestrial Vertebrates (Caribou, Moose, Sheep, Wolves, Bears) in Alaska

Understanding population dynamics, predator/prey relations, and habitat ecology of large, terrestrial mammals is critical for the management of these wildlife species in Alaska and elsewhere around the world. Research conducted by the ASC on terrestrial mammals is focused on informing DOI land and resource management decisions across Alaska. Our work provides timely and highly relevant scientific information for management issues such as the response of caribou to a warming climate and human development, future changes in distribution and abundance, and the effects of changing habitats used for forage. Recent research objectives include (1) continued monitoring of the Denali National Park caribou herd, (2) data summary and report on the population dynamics of wolves in Denali National Park, and (3) continued discussion with partners and stakeholders on future science needs.

USGS scientist placing radio collar on a sedated bull caribou in Alaska. Photograph by U.S. Geological Survey.

Time frame	Budget	Project partners
2016–ongoing	$100,000–$499,000	Alaska Department of Fish and Game, National Park Service, Yukon Department of Environment, Bureau of Land Management, Industry

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Project Link

https://www.usgs.gov/centers/asc/science/terrestrial-mammal-ecology-research

Birds

Seabirds and Forage Fish Ecology Program

Photograph showing common murres in a colony in 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 colonies and at sea. 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) compilation and analyses of data on the pelagic distribution of marine birds in the North Pacific relative to biological oceanography and changes in climate; development of methods for censusing and monitoring trends in seabird populations on land and at sea; (2) studies of oceanography, plankton, forage fish, and seabirds around major seabird colonies in Alaska; and (3) measuring the possible impact of algal toxins on seabird mortality.

Time frame	Project partners
2002–ongoing	U.S. Fish and Wildlife Service, National Park Service, Bureau of Offshore Energy Management, Exxon Valdez Oil Spill Trustee Council

Contacts

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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: U.S. Geological Survey, 2 p., https://pubs.er.usgs.gov/publication/70203368.

Drew, G.S., and Piatt, J.F., 2015, North Pacific Pelagic Seabird Database (ver. 3.0, February, 2020): U.S. Geological Survey data release, https://doi.org/10.5066/F7WQ01T3.

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., and Zador, S.G., 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://doi.org/10.3354/meps13211.

Piatt, J.F., Parrish, J.K., Renner, H.M., and others, 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.

Van Hemert, C.R., Schoen, S.K., Litaker, R.W., Smith, M.M., Arimitsu, M.L., Piatt, J.F., Holland. W.C., Hardison, D.R., and Pearce, J.M., 2020, Algal toxins in Alaskan seabirds—Evaluating the role of saxitoxin and domoic acid in a large-scale die-off of common murres: Harmful Algae, v. 92, 9 p., https://doi.org/10.1016/j.hal.2019.101730.

von Biela, V.R., Arimitsu, M.L., Piatt, J.F., Heflin, B., Schoen, S.K., Trowbridge, J.L., and Clawson, C.M., 2019, Extreme reduction in nutritional value of a key forage fish during the Pacific marine heatwave of 2014–2016: Marine Ecology Progress Series, v. 613, p. 171–82, https://doi.org/10.3354/meps12891.

Role of Gulls in Alaska in the Dissemination of Antimicrobial-Resistant Escherichia Coli

The role of gulls in Alaska in the dissemination of antimicrobial resistant *Escherichia coli* bacteria project was initiated after the finding of high bacterial levels in the Kenai River in 2014 by the State of Alaska. Current research objectives of this project by the ASC include (1) determining migratory routes of large gull species that are breeding in Alaska and are potential reservoir and dispersal agents of antibiotic resistant bacteria, and (2) quantifying levels of risk—by geographic area—for the spread of bacteria by national and international migratory routes.

Time frame	Budget	Project partners
2016–21	$100,000–$499,000	U.S. Department of Agriculture, U.S. Fish and Wildlife Service, Alaska Department of Health and Social Services

U.S. Geological Survey scientist holding gull with satellite transmitter attached to its back. Photograph by U.S. Geological Survey.

Contact

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Project Link

https://www.usgs.gov/centers/asc/science/antibiotic-resistant-bacteria-migratory-birds

Recent Publications

Ahlstrom, C.A., Bonnedahl, J., Woksepp, H., Hernandez, J., Reed, J.A., Tibbitts, L., Olsen, B. Douglas, D.C., and Ramey, A.M., 2019, Satellite tracking of gulls and genomic characterization of faecal bacteria reveals environmentally mediated acquisition and dispersal of antimicrobial-resistant *Escherichia coli* on the Kenai Peninsula, Alaska: Molecular Ecology, v. 28, no. 10, p. 2531–2545, https://doi.org/10.1111/mec.15101.

Ahlstrom, C.A., Ramey, A.M., Woksepp, H., and Bonnedahl, J., 2019a, Early emergence of *mcr*- 1-positive Enterobacteriaceae in gulls from Spain and Portugal: Environmental Microbiology Reports, v. 11, no. 5, p. 669–671, https://doi.org/10.1111/1758-2229.12779.

Ahlstrom, C.A., Ramey, A.M., Woksepp, H., and Bonnedahl, J., 2019b, Repeated detection of carbapenemase-producing *Escherichia coli* in gulls inhabiting Alaska: Antimicrobial Agents and Chemotherapy, v. 63, no. 8, 4 p., https://aac.asm.org/content/63/8/e00758-19.

Franklin, A.B., Ramey, A.M., Bentler, K.T., Barrett, N.L., McCurdy, L.M., Ahlstrom, C.A., Bonnedahl, J., Shriner, S.A., and Chandler, J.C., 2020, Gulls as sources of environmental contamination by colistin-resistant bacteria: Scientific Reports, v. 10, 10 p., https://doi.org/10.1038/s41598-020-61318-2.

Ramey, A.M., and Ahlstrom, C.A., 2020, Antibiotic resistant bacteria in wildlife—Perspectives on trends, acquisition and dissemination, data gaps, and future directions: Journal of Wildlife Diseases, v. 56, no. 1, p. 1-15, https://doi.org/10.7589/2019-04-09.

Ramey, A.M., Ahlstrom, C.A., van Toor, M.L., Woksepp, H., Chandler, J.C., Reed, J.A., Reeves, A.B., Waldenström, J., Franklin, A.B., Bonnedahl, J., and Douglas, D.C., 2020, Tracking data for three large-bodied gull species and hybrids (*Larus* spp.) (ver. 1.0, June 2020): U.S. Geological Survey data release, https://doi.org/10.5066/P9FZ4OJW.

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 partners. In 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, spectacled eiders; (4) surveys and assessments of avian influenza in loon species; and (5) general ecology of waterfowl and loons that may inform management agency decisions.

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

Time frame	Budget	Project partners
2005–ongoing	$100,000–$499,000	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?qt-science_center_objects-0#qt-science_center_objects

https://www.usgs.gov/centers/asc/science/loon-research?qt-science_center_objects=0#qt-science_center_objects

Recent Publications

Amundson, C.L., Flint, P.L., Stehn, R.A., 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.

Lewis, T.L., Swaim, M., Schmutz, J.A., and Fischer, J.B., 2019, Improving population estimates of threatened spectacled eiders—Correcting aerial counts for visibility bias: Endangered Species Research., v. 39, p. 191–206, https://doi.org/10.3354/esr00959.

Pearce, J.M., Flint, P.L., Whalen, M.E., and others, 2019, Visualizing populations of North American Sea Ducks—Maps to guide research and management planning: U.S. Geological Survey Open-File Report 2019–1142, 50 p., plus appendixes, https://doi.org/10.3133/ofr20191142.

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.

Uher-Koch, B.D., Spivey, T.J., Van Hemert, C.R., Schmutz, J.A., Jiang, K., Wan, X.-F., and Ramey, A.M., 2019, Serologic evidence for influenza a virus exposure in three loon species breeding in Alaska, USA: Journal of Wildlife Diseases, v. 55, no. 4, p. 862–867, https://doi.org/10.7589/2018-06-165.

Uher-Koch, B.D., Wright, K.G., and Schmutz, J.A., 2019, The influence of chick production on territory retention in Arctic breeding Pacific and Yellow-billed loons: The Condor—Ornithological Applications, v. 121, no. 1, p. 1–11, https://doi.org/10.1093/condor/duy021.

Population Ecology and Habitats of Alaska Landbirds

Alaska supports more than 130 species of breeding landbirds, 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 require information on possible drivers of population change, such as spruce beetle epidemics, fire, and disease. Little information exists 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 include annual ground surveys and banding to understand changes in population size and demography over time.

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

Time frame	Budget	Project partners
2001–ongoing	$100,000–$499,000	Canadian Wildlife Service, U.S. Fish and Wildlife Service—Alaska Region, U.S. Fish and Wildlife Service—Alaska Migratory Bird Management, National Park Service—Alaska Region, Bureau of Land Management—Alaska State Office and Arctic Office, University of Alaska Fairbanks, Alaska Department of Fish and Game

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Project Link

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

Recent Publications

Robinson, B.W., Withrow, J.J., Richardson, R.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: Western Birds, v. 51, no. 2, p. 78–91, 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., Epperly, K., Ha, R., Rohwer, S., Woodall, C.W., Van Hemert, C.R., and Klicka, J., 2020, Cryptic and extensive hybridization between ancient lineages of American crows: Molecular Ecology, v. 29, no. 5, p. 956–969, http://doi.org/10.1111/mec.15377.

Sólymos, P., Toms, J.D., Matsuoka, S.M., Cumming, S.G., Barker, N.K.S., Thogmartin, W.E., Stralberg, D., Crosby, A.D., Dénes, F.V., Haché, S., Mahon, C.L., Schmiegelow, F.K.A., and Bayne, E.M., 2020, Lessons learned from comparing spatially explicit models and the Partners in Flight approach to estimate population sizes of boreal birds in Alberta, Canada: The Condor—Ornithological Applications v. 122, p. 1–22, https://doi.org/10.1093/condor/duaa007.

Stralberg, D., Arseneault, D., Baltzer, J., and others, 2020, Climate-change refugia in boreal North America—What, where, and for how long?: Frontiers in Ecology and the Environment, v. 18, no. 5. p. 261–270, https:/doi.org/10.1002/fee.2188.

Population Status and Ecology of North Pacific Shorebirds

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 needed for management agencies, such as current distribution and abundance of shorebird species in Alaska; (2) factors involved in driving population changes in Alaska and throughout the broad non-breeding distribution of these species; and (3) evaluation of new and emerging topics with this species group. Methods involve population genetics, satellite telemetry and other tagging, and ground surveys.

Bar-tailed Godwit flock flying over the mudflats on Cape Avinof, western Alaska. Photograph by Dan Ruthrauff, U.S. Geological Survey.

Time frame	Budget	Project partners
2001–ongoing	\$100,000–\$499,000	U.S. Fish and Wildlife Service, Bureau of Land Management, Alaska Department of Fish and Game, international partners

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Project Link

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

Recent Publications

Almeida, J.B., Lopes, I.F., Oring, L.W., Tibbitts, T.L., Pajot, L.M., and Lanctot, R.B., 2020, After-hatch and hatch year buff-breasted sandpipers *Calidris subruficollis* can be sexed accurately using morphometric measures: Wader Study, v. 127, no. 2, p. 37–42, https://doi.org/10.18194/ws.00189.

Chan, Y-C., Tibbitts, T.L., Lok, T., Hassell, C.J., Peng, H.B., Ma, Z., Zhang, Z., and Piersma, T., 2019, Filling knowledge gaps in a threatened shorebird flyway through satellite tracking: Journal of Applied Ecology, v. 56, no. 10, p. 2305–2315, https:/doi.org/10.1111/1365-2664.13474.

Kok, E., Tibbitts, T.L., Douglas, D.C., Howey, P., Dekinga, A.A., Gnep, B., and Piersma, T., 2020, A red knot as a black swan—How a single bird shows navigational abilities during repeat crossings of the Greenland Icecap: Journal of Avian Biology, v. 51, no. 8, 11 p., https://doi.org/10.1111/jav.02464.

Naves, L.C., Keating, J.M., Tibbitts, T.L., and Ruthrauff, D.R., 2019, Shorebird subsistence harvest and indigenous knowledge in Alaska—Informing harvest management and engaging users in shorebird conservation: The Condor—Ornithological Applications, v. 121, no. 2,p. 1–19, https://doi.org/10.1093/condor/duz023.

Ruthrauff, D.R., 2019, Alaska shorebird conservation plan (ver. III)—Anchorage, Alaska: Alaska Shorebird Group, 138 p., https://pubs.er.usgs.gov/publication/70203041.

Ruthrauff, D.R., Handel, C.M., Tibbitts. T.L., and Gill, Jr, R.E., 2020, Through thick and thin—Sexing bristle-thighed curlews *Numenius tahitiensis* using measures of bill depth: Wader Study, v. 127, no. 1, p. 31–36, https://doi.org/10.18194/ws.00171.

Ruthrauff, D R., Tibbitts, T.L., and Gill, R.E., Jr, 2019, Flexible timing of annual movements across consistently used sites by marbled godwits breeding in Alaska: The Auk—Ornithological Advances, v. 136, no. 1, p. 1–11, http://doi.org/10.1093/auk/uky007.

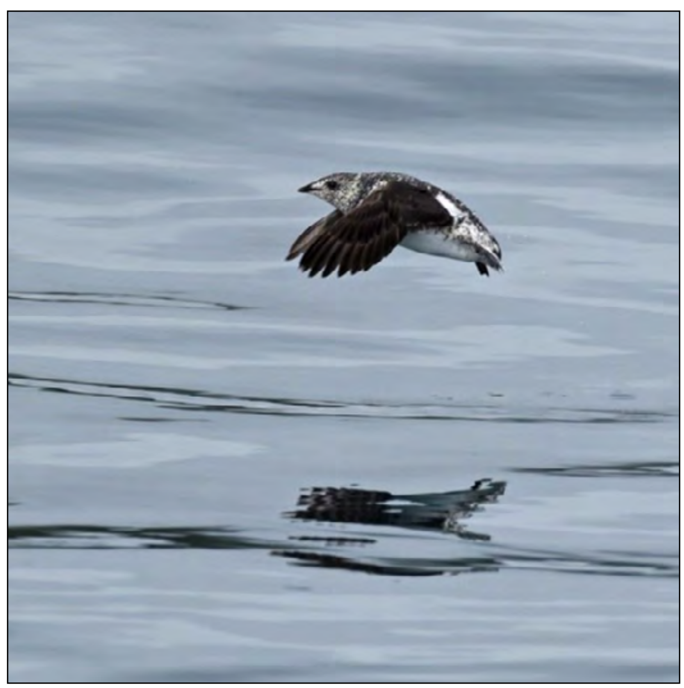
Ruthrauff, D.R., Tibbitts, T.L., and Patil, V.P., 2019, Survival of bristle-thighed curlews equipped with externally mounted transmitters: Wader Study, v. 126, no. 2, 7 p., https://doi.org/10.18194/ws.00145.

Tibbitts, T.L., Ruthrauff, D.R., Underwood, J.G., and Patil, V.P., 2019, Factors promoting the recolonization of Oahu, Hawaii, by bristle-thighed curlews: Global Ecology and Conservation, v. 21, 10 p., https://doi.org/10.1016/j.gecco.2019.e00785.

Weiser, E.L., Lanctot, R.B., Brown, S.C., and others, 2020, Annual adult survival drives trends in Arctic-breeding shorebirds but knowledge gaps in other vital rates remain: The Condor—Ornithological Applications, v. 133, no. 3, 14 p., https://doi.org/10.1093/condor/duaa026.

Contaminant Exposure, Bioaccumulation, and Ecological Effects in Aquatic and Terrestrial Habitats

Alaska contains a diverse suite of aquatic habitats that provide critical ecosystem services. Environmental contaminants are among the key threats to the viability of these habitats and the species they support. Although the proximity of these water bodies to contaminant sources is important, the intrinsic ecological properties of each habitat type can affect contaminant cycling and effects. The USGS Forest and Rangeland Ecosystem Science Contaminant Ecology Program works across a range of aquatic habitats in the Western United States and Alaska to (1) evaluate contaminant exposure, (2) assess the accumulation through the food web, and (3) quantify the biological effects in aquatic and aquatic-dependent wildlife. In addition, program scientists will measure the habitat, landscape, and land-use patterns that contribute to contaminant dynamics. For example, mercury, a toxic metal, may threaten seabird species such as the Kittlitz's murrelet. To evaluate possible impacts, the USGS measured mercury concentrations in Kittlitz's murrelet eggshells, guano, blood, and feathers from four locations in Alaska. Results of this study indicate that mercury concentrations from two Kittlitz's murrelets at Glacier Bay National Park and one at Adak Island were greater than those associated with impaired reproduction in other bird species and may merit further study to determine the potential threat of mercury at the population scale.



Kittlitz's murrelet flying above the water in Cook Inlet, south-central Alaska. Photograph by Sarah Schoen, U.S. Geological Survey.

Time frame	Project partners
2010–21	U.S. Fish and Wildlife Service, National Park Service, Biodiversity Research Institute

Contact

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Recent Publication

Kenney, L.A., Kaler, R.S., Kissling, M.L., Bond, A.L., and Eagles-Smith, C.A., 2018, Mercury concentrations in multiple tissues of Kittlitz's murrelets (*Brachyramphus brevirostris*): Marine Pollution Bulletin, v. 129, no. 2, p. 675–680, https://doi.org/10.1016/j.marpolbul.2017.10.055.

Epidemic of Beak Deformities (Avian Keratin Disorder) Among Wild Bird Populations

Thousands of land birds from 30 different species in Alaska have been reported with grossly deformed beaks since January 1998. Most sightings have been concentrated in south-central Alaska, primarily in black-capped chickadees. Outside Alaska, there have been about 300 reports of individuals of more than 80 species of wild birds with similarly deformed beaks scattered across North America. The geographic distribution of deformities and high prevalence among resident birds suggest an acute, ecosystem-wide problem, but the cause and geographic origin of deformities are still unknown. The research objectives for this project are to determine (1) the factors causing the disease, (2) its geographic distribution, and (3) possible mitigation activities to limit continuation of the deformities in birds. Methods thus far to understand the disease have involved contaminant screening, genetic defect evaluation, changes in forage quality, bone and keratin evaluation, and viral and bacterial factors.

Black-capped chickadee with a beak that has grown long and crossed. Photograph by Rachel Richardson, U.S. Geological Survey.

Time frame	Budget	Project partners
2005–ongoing	<$100,000	U.S. Fish and Wildlife Service—Alaska Regional Office, Alaska Migratory Bird Management Office, Bureau of Land Management—Alaska State Office, citizen science observers and university partners

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Project Link

https://www.usgs.gov/centers/asc/science/beak-deformities-landbirds

Recent Publications

Hofmeister, E., and Van Hemert, C.R., 2018, The effects of climate change on disease spread in wildlife, *in* Miller, E.R., Lamberski, N., and Calle, P., eds., Fowler's zoo and wild animal medicine current therapy: Elsevier Health Sciences, v. 9, p. 247–254, https://pubs.er.usgs.gov/publication/70198103.

Zylberberg, M., Van Hemert, C.R., Handel, C.M., and DeRisi, J.L., 2018, Avian keratin disorder of Alaska black-capped chickadees is associated with Poecivirus infection: Virology Journal, v. 15, no. 100, 9 p., https://doi.org/10.1186/s12985-018-1008-5.

Fish

Heat Stress in Alaska's Pacific Salmon

Pacific salmon are cold-water fishes that historically have been limited by cold temperatures in Alaska. Rapid warming at northern latitudes has 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. In this study we seek to understand whether contemporary water temperatures induce stress in Yukon River Chinook salmon, a population that failed to recover from decline. The methods integrate an experiment and field collections of muscle tissue samples for laboratory analysis of heat stress biomarkers (gene transcription and heat shock proteins) through collaborations with researchers from the USGS Western Ecological Research Center and Leetown Science Center. In an experiment, salmon were placed in 18- and 21-degrees Celsius water temperatures induced heat stress in a particular population. In subsequent field collections across the watershed, about one-half of the field-caught Chinook salmon had biomarkers consistent with heat stress. Given that heat stress increases the risk of in-river mortality prior to spawning and that salmon are managed by in-river counts of spawning adults, our findings suggest the potential for in-river abundance counts (that is, escapement) to overestimate the true number of spawning fish and result in overharvest.

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. 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	Budget	Project partners
2016–ongoing	$500,000–$1,000,000	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

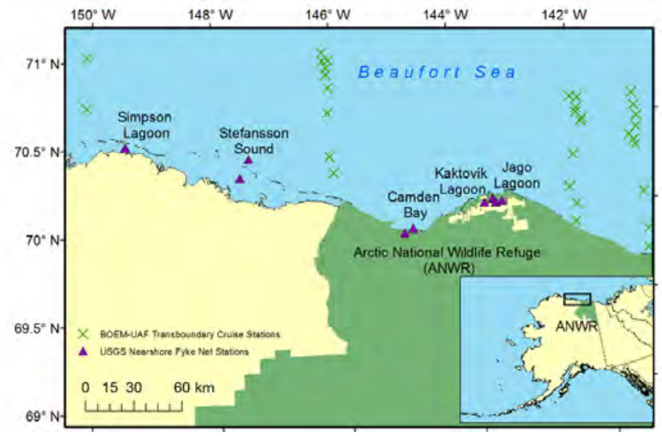
Bowen, L, von Biela, V.R., McCormick, S.D, Regish, A.M., Waters, S., Durbin-Johnson, B., Britton, M., Settles, M., Donnelly, D.S., Laske, S., Carey, M.P., Brown. R.J., and Zimmerman, C.E., 2020, Transcriptomic response to elevated water temperatures in adult migrating Yukon River Chinook salmon (*Oncorhynchus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

Donnelly, D.S., von Biela, V.R., McCormick, S.D., Laske, S., Carey, M.P., Waters, S., Bowen, L., Brown, R.J., Larson, S., and Zimmerman, C.E., 2020, A manipulative experimental thermal challenge protocol for adult salmonids in remote field settings: Conservation Physiology, v. 8, no. 1, 11 p., https://doi.org/10.1093/conphys/coaa074.

von Biela, V.R., Bowen, L., McCormick, S.D., Carey, M.P., Donnelly, D.S., Waters, S., Regish, A., Laske, S.M., Brown, R.J., Larson, S., Zuray, S., 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.

Nearshore Fish Surveys in the Beaufort Sea

In the Arctic, rapid changes in temperature and salinity have led to changes in locations where fish 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 community and use of nearshore habitats will provide management agencies with improved understanding of risks of natural resource development and production in Federal waters for use in their assessments. For example, information from this study will 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.



Map showing fish sample survey locations on Beaufort Sea coast, northern Alaska. Map by Vanessa von Biela, U.S. Geological Survey.

Time frame	Budget	Project partners
2017–ongoing	$500,000–$1,000,000	Bureau of Ocean Energy Management

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Project Link

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

Habitat

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

The North American beaver (*Castor canadensis*) has expanded beyond its historic range into tundra ecosystems, potentially impacting 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. Methods are to (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. These data will 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. Results are intended to promote public education about beavers and their impacts to ecosystems.

Beaver dam on Rabbit Creek, Cape Krusenstern National Monument northwestern Alaska. Photograph by Mike Carey, U.S. Geological Survey.

Time frame	Budget	Project partners
2019–21	$100,000–$499,000	National Park Service, University of Alaska Fairbanks

Contact

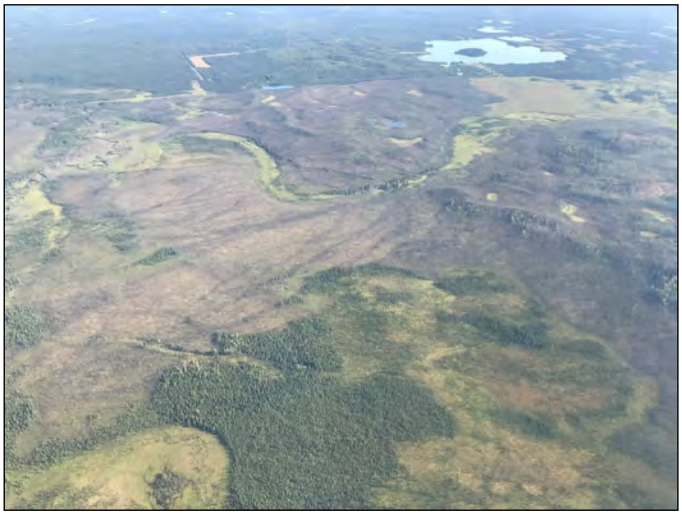
Michael P. Carey, ASC, mcarey@usgs.gov, (907) 786-7197

Project Link

https://www.usgs.gov/centers/asc/science/beavers-impacting-tundra-ecosystems-bite?qt-science_center_objects=0#qt-science_center_objects

Land Cover Classification and Change Detection on the Kenai Peninsula, 1973–2017

Across the Kenai Peninsula lowlands of south-central Alaska and over the last one-half century, disturbance events have removed large areas of forest while succession and landscape evolution have simultaneously facilitated forest regrowth and expansion. Although disturbance events and related land-cover change happen relatively fast, assessing patterns of post-disturbance succession requires long-term monitoring. The objectives of this study were to provide land managers quantitative data regarding where and when prominent land-cover change has happened since 1973. Project methods involve classifying land cover type and quantifying land-cover change over time using Landsat legacy imagery for three historical periods on the western Kenai Peninsula: 1973–2002, 2002–2017, and 1973–2017. Scenes from numerous Landsat sensors were acquired from 1973 to 2017 and were used to classify and track vegetation cover using a random forest classifier, which is a computer-based classification algorithm. Land-cover types are summarized by era and spatially combined to produce a dataset capturing spatially explicit land-cover change at a moderate 30-meter resolution. Products include a spatially explicit dataset that quantifies land-cover types and transitions over time as well as a peer-reviewed publication.



Mosaic of vegetation types and disturbance events on northern Kenai Peninsula lowlands, south-central Alaska. Browns Lake is visible in background. Photograph by Carson Baughman, U.S. Geological Survey.

Time frame	Budget	Project partners
2018–21	<$100,000	U.S. Fish and Wildlife Service

Contact

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Project Links

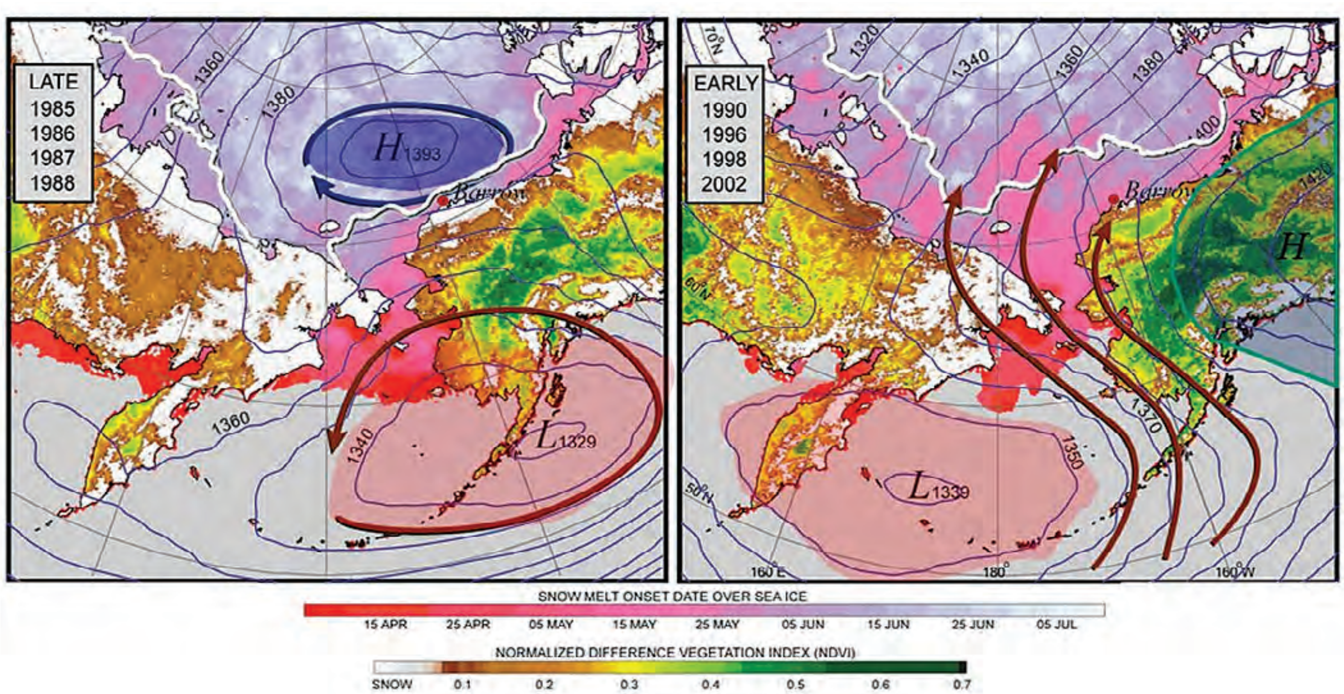
https://www.usgs.gov/centers/asc/science/ecosystems-edge-landscape-and-fire-ecology-forests-deserts-and-tundra?qt-science_=&qt-science_center_objects=0#qt-science_center_objects

https://alaska.usgs.gov/portal/project.php?project_id=430

Recent Publication

Baughman, C.A., Loehman, R.A., Saperstein, L., Magnes, D., and Sherriff, R., 2020, Land cover estimates for the Kenai Peninsula lowlands;1973, 2002, and 2017: U.S. Geological Survey data release, https://doi.org/10.5066/P92BGHW1.

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



Atmospheric circulation patterns influence the timing of snow melt and vegetation green-up. At Barrow/Utqiaġvik, Alaska, years with late snow melt are associated with a blocking high-pressure system over the Arctic basin and low-pressure over the eastern Bering Sea which tends to block the flow of warm air into the higher latitudes. Source: Stone, R.S., Douglas, D.C., Belchansky, G.I., and Drobot, S.D., 2005, Polar Climate—Arctic sea ice in Levinson, D.H., ed., State of the Climate in 2004: Bulletin of the American Meteorological Society, v. 86, no. 6, p. 39–41, https://doi.org/10.1175/1520-0477-86.6s.1.

The Habitat Dynamics Project entails examination of 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 is critical for making informed management decisions. This project is a focal point of capability and expertise for integrating remote sensing, satellite telemetry, and GIS. Working collaboratively with other principal investigators, project participants apply satellite and software technologies to study spatial and temporal interactions between wildlife populations and their environment. Three primary objectives 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.

Time frame	Budget	Project partners
1990s–ongoing	$100,000–$499,000	U.S. Fish and Wildlife Service, North Slope Borough

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Project Link

https://www.usgs.gov/centers/asc/science/habitat-dynamics

Recent Publications

Ahlstrom, C.A., Bonnedahl, J., Woksepp, H., Hernandez, J., Reed, J.A., Tibbitts, T.L., Olsen, B., Douglas, D.C., and Ramey, A.M., 2019, Satellite tracking of gulls and genomic characterization of faecal bacteria reveals environmentally mediated acquisition and dispersal of antimicrobial resistant *Escherichia coli* on the Kenai Peninsula, Alaska: Molecular Ecology, v. 28, no. 10, p. 2531–2545, https://doi.org/10.1111/mec.15101.

Durner, G.M., Amstrup, S.C., Douglas, D.C., Fischbach, A.S., Olson, J.W., Rode, K.D., and Wilson, R.R., 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 U.S. Geological Survey 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.

Tyson-Moore, R.B., Douglas, D.C., Nollens, H.H., Croft, L., and Wells, R.S., 2020, Post-release monitoring of a stranded and rehabilitated short-finned pilot whale (*Globicephala macrorhynchus*) reveals current-assisted travel: Aquatic Mammals, v. 46, no. 2, p. 200–214, https://doi.org/10.1578/AM.46.2.2020.200.

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.

U.S. Geological Survey, 2019, USGS Alaska Science Center wildlife tracking data collection: U.S. Geological Survey Alaska Science Center web page, https://doi.org/10.5066/P9VYSWEH.

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

The Yukon Kuskokwim Delta (YKD) 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 monitoring of key coastal resources and elements vulnerable to impacts from climate changes. The project was developed in response to growing awareness of rapid and potentially persistent climate change impacts to subarctic coastal ecosystems and the need to document impacts on Alaska Native villages and subsistence resources. The YKD 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 partners with predictions of when, where, and how future changes will likely happen.

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

Time frame	Budget	Project partners
2016–21	$100,000–$499,000	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

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Project Link

https://www.usgs.gov/centers/gecsc/science/terrestrial-records-holocene-climate-change-fire-climate-and-humans?qt-science_center_objects=0#qt-science_center_objects

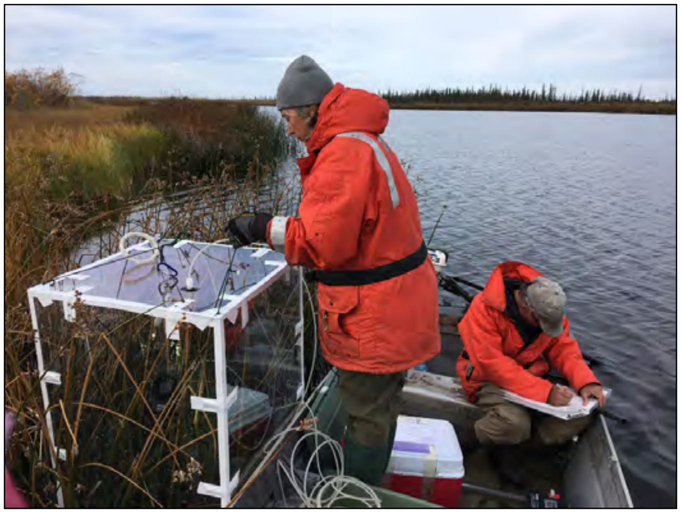
Recent Publications

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, v. 48, p. 85–99, https://doi.org/10.1007/s10745-020-00138-4.

Quantifying Large-Scale Aquatic Ecosystem Carbon Dynamics and Greenhouse Gas Exchange

Carbon and methane are cycled in inland waters (lakes, ponds, streams, and rivers) and water-inundated areas; however, there is large uncertainty in their significance to Arctic boreal region carbon emissions due to limited mapping and carbon measurements. USGS has been conducting large-scale, multi-year studies of carbon dynamics including carbon dioxide and methane exchange in the atmosphere, streams, rivers, lakes, and wetlands across Alaska and Canada in partnership with numerous agencies and academic collaborators. These studies improve estimates of carbon emissions in Arctic and Boreal inland water systems by integrating ground-based measurements of water chemistry and carbon gas fluxes with airborne data to spatially upscale greenhouse gas flux estimates. Study results provide improved greenhouse gas emissions estimates across diverse landscapes, and insights into the impacts of changing climate and permafrost on aquatic carbon dynamics.



U.S. Geological scientists measuring carbon dioxide and methane fluxes at the vegetated shoreline of Canvasback Lake, Yukon Flats National Wildlife Refuge, Alaska. Photograph by Catherine Kuhn, University of Washington.

Time frame	Budget	Project partners
2015–22	>$1,000,000	National Aeronautics and Space Administration (NASA), US Fish and Wildlife Service, University of Washington, Florida State University, numerous other academic partners

Contacts

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Recent Publications

Bogard, M.J., Kuhn, C.D., Johnston, S.E., Striegl, R.G., Holtgrieve, G.W., Dornblaser, M.M., Spencer, R.G.M., Wickland, K.P., Butman, D.E., 2019, Negligible cycling of terrestrial carbon in many lakes of the arid circumpolar landscape: Nature Geoscience, v. 12, p. 180–185, https://doi.org/10.1038/s41561-019-0299-5.

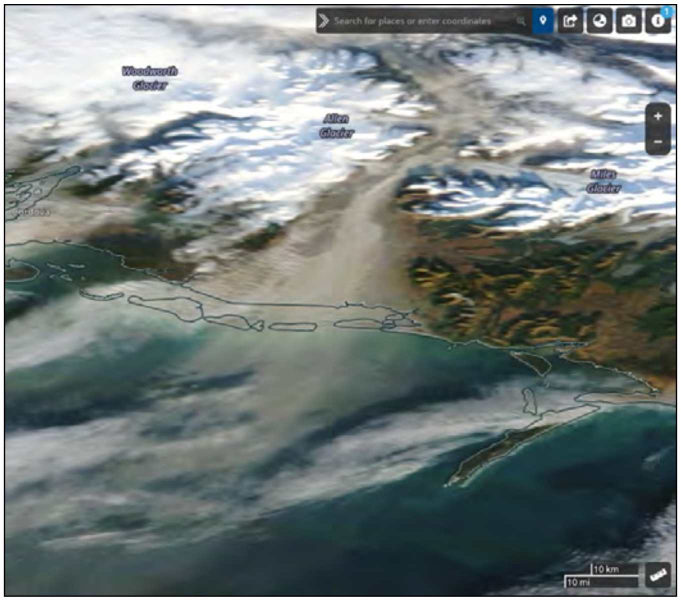
Johnston, S. E., Striegl, R. G., Bogard, M. J., Dornblaser, M. M., Butman, D. E., Kellerman, A. M., Wickland, K. P., Podgorski, D. C., Spencer, R. G. M., 2020, Hydrologic connectivity determines dissolved organic matter biogeochemistry in northern high-latitude lakes: Limnology and Oceanography, v. 65, no. 8, p. 1764–1780, https://doi.org/10.1002/lno.11417.

Kuhn, C.D., Bogard, M., Johnston, S.E., John, A., Vermote, E.F., Spencer, R., Dornblaser, M., Wickland, K.P., Striegl, R.G., Butman, D., 2020, Satellite and airborne remote sensing of gross primary productivity in boreal Alaskan lakes: Environmental Research Letters, v. 15, 12 p., https://doi.org/10.1088/1748-9326/aba46f.

O'Dwyer, M., Butman, D.E., Striegl, R.G., Dornblaser, M.M., Wickland, K.P., Kuhn C.D., Bogard, M.J., 2020, Patterns and isotopic composition of greenhouse gases under ice in lakes of interior Alaska: Environmental Research Letters, v. 15, no. 10, 13 p., https://doi.org/10.1088/1748-9326/abb493

Nutrient and Contaminant Metal Fluxes to Alaskan Coastal Surface Waters

The supply of the essential nutrients, phosphorus, nitrogen, and iron sets limits on various ecosystem biological processes as diverse as the burial of carbon in terrestrial wetlands and biological productivity in lakes and the ocean. Project team members carried out fieldwork to sample and analyze dust in several remote Alaskan settings. A key objective has been to address whether Alaskan glacial flour dust, or Asian dust, or both, are important sources of the nutrients phosphorus, nitrogen, and iron to these terrestrial and marine ecosystems in coastal Alaska. A long-term objective is to infer whether the rates of key processes, such as nutrient cycling, are changing, and if so, why. Methods include time-series filtered air sampling on Middleton Island, which is approximately129 km (80 miles) south of Cordova, analyses of trapped particulates for trace element and isotopic tracers, and modeling of dust transport using the NOAA Hybrid Single-Particle Lagrangian Integrated Trajectory model.



National Aeronautics and Space Administration Worldview satellite image showing dust transported offshore from Copper River Delta on November 12, 2019, during a major dust event when project team members sampled nutrient and metal fluxes on nearby Middleton Island. Source: National Aeronautics and Space Administration Worldview image, https://worldview.earthdata.nasa.gov/.

Time frame	Budget	Project partners
2018–21	$100,000–$499,000	USGS Coastal and Marine Hazards and Resources Program; University of Washington School of Oceanography, Prof. James Murray and Prof. Randelle Bundy; National Science Foundation Chemical Oceanography ($291,000)

Contact

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Project Link

https://www.nsf.gov/awardsearch/showAward?AWD_ID=1756126&HistoricalAwards=false

Recent Publication

Crusius, J., 2021, Dissolved Fe supply to the central Gulf of Alaska is inferred to be derived from Alaskan glacial dust that is not resolved by dust transport models: JGR-Biogeosciences, v. 126, no. 6, 13 p., http://doi.org/10.1029/2021JG006323.

Early Warning Vital Signs in Arctic Network Parklands

Feather moss (Hylocomium splendens), which has been selected by the National Park Service as an inorganic contaminant biomonitor to assess health and degradation of Arctic parkland natural resources. Photograph by J.W. Arms, U.S. Geological Survey.

Coastal Alaska is poised for rapid industrial and environmental change. Increased vessel traffic through the Bering Strait and the Northwest Passage, oil development in the region, and a planned deep-water port to support an increased U.S. presence in the Arctic, are likely to add considerable loads of contaminants to the Arctic ecosystem. Arctic ecosystems are the most sensitive in North America, and total nitrogen input levels as low as 1 kilogram per hectare per year are expected to produce negative effects. The National Park Service intends to use the feather moss (*Hylocomium splendens*) as a cost-effective biomonitor to track the overall health of Arctic Park resources and provide early warning of resource degradation. Our objectives are to establish baseline depositional patterns of elements in *H. splendens* in Bering Land Bridge National Preserve (BELA), which is next to the Bering Strait, and to develop or refine statistical tools relating moss tissue concentrations to critical loads and injury thresholds in both BELA and Cape Krusenstern National Monument. Unfortunately, much of the laboratory work has been delayed until FY2022 due to COVID-19.

Time frame	Budget	Project partners
2019–22	$100,000–$499,000	National Park Service ($48,000), Oregon State University ($55,000), Colorado State University ($144,000)

Contact

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Assessing Baseline Contaminants in the 1002 Areas of the Arctic National Wildlife Refuge, Alaska

Looking southward across tundra surface and lakes on Canning River Delta near the northwestern corner of Arctic National Wildlife Refuge-1002 Area, Alaska. Photograph by U.S. Geological Survey.

Federal agencies, including the U.S. Fish and Wildlife Service, need to assess baseline levels and types of contaminants burdens in biotic and abiotic matrices in the coastal plain (the 1002 Area) of the ANWR prior to oil and gas exploration and development activities. This information will assist industry in understanding, minimizing, and mitigating the impacts of their activities. Baseline data can be used to (1) assess site-specific and area-wide development impacts, (2) address subsistence concerns of ANWR users and nearby communities, (3) evaluate water quality impacts, and (4) if needed, serve in the Natural Resource Damage Assessment process. Methods include the chemical analysis of water, sediments, soils, vegetation, and biota (fish) for a suite of petroleum hydrocarbons and metals. Field work has been delayed due to COVID-19 but is expected to resume in 2022.

Time frame	Budget	Project partners
2019–23	$100,000–$499,000	U.S. Fish and Wildlife Service

Contact

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Cross-Cutting Programs

Earthmap use Case Development in Alaska

EarthMAP is the emerging conceptual mechanism that the USGS will develop over the next 10 years to facilitate and apply more fully integrated, multi-disciplinary science and technological advancements to meet decision-maker and stakeholder needs. Use Cases—as building blocks for EarthMAP—will identify high-priority science applications that advance the following three major components of EarthMAP: (1) data and observation integration across disciplines and agencies, (2) integrated predictive science, and (3) actionable intelligence delivery at the speed and scale of decision-making. Use Cases are fundamentally driven by the needs of stakeholders and serve to identify existing and future USGS (and partner) science capacity and technological innovations that will service those needs. During this first year of EarthMAP Use Case planning, the Alaska Regional Office worked with Center Directors to develop and initiate five different Use Case prospects:

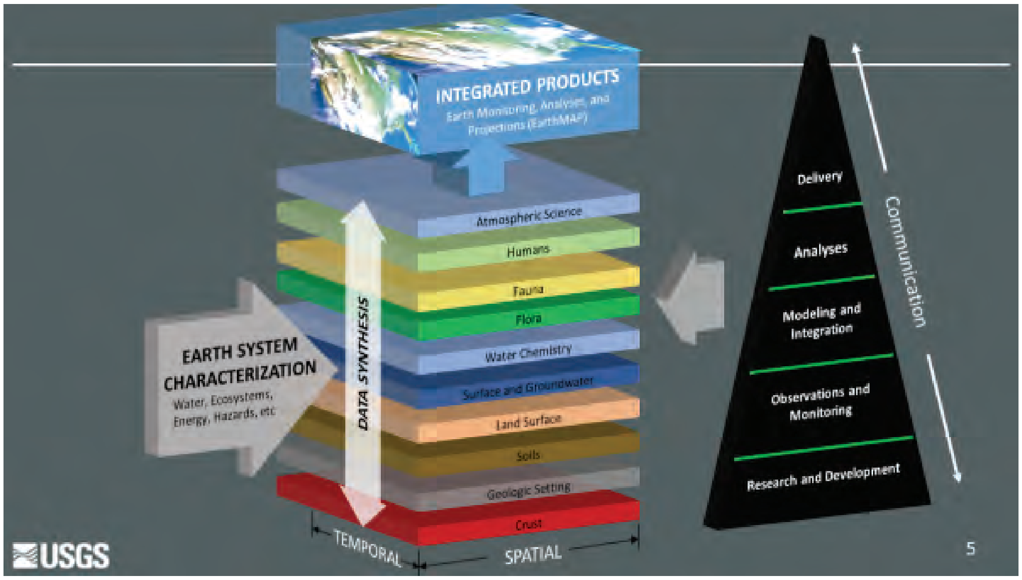

Diagram showing U.S. Geological Survey EarthMAP vision as developed at the Grand Challenges for Integrated U.S. Geological Survey Science workshop, February 2017. Diagram by U.S. Geological Survey.

- Enhanced delivery of integrated ecosystem model output;
- Wildlife tracking portal to improve data documentation, delivery, and analysis;
- Machine learning analysis of near real-time imagery of U.S. volcanoes;
- Building an integrated coastal hazard assessment and mitigation strategy with Bering Sea communities of Alaska; and
- Customized Arctic map products for State, Federal, and international use.

Time frame	Budget	Project partners
2020–21	$1,000–$499,000	University of Alaska Fairbanks, State of Alaska Division of Forestry, Alaska Native communities, Bureau of Land Management Alaska Fire Service, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, Bureau of Ocean and Energy Management, National Oceanic and Atmospheric Administration, Alaska Ocean Observing System, U.S. Department of State

Contact

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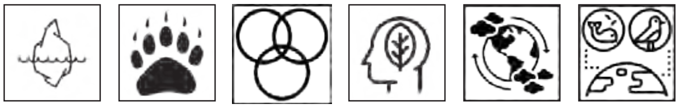
USGS Changing Arctic Ecosystems Initiative



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 development of oil and gas resources on BLM lands and on the Outer Continental Shelf managed by the 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.

Arctic fox in the summer on the northern coast of Alaska. Photograph by Ryan Askren, U.S. Geological Survey.

Time frame	Budget	Project partners
2010–ongoing	<$1,000,000	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

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Project Link

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

Recent Publications

Amundson, C.L., Flint, P.L., Stehn, R.A., 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.

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: Journal of Wildlife Management, v. 84, no. 3, p. 401–412, https://doi.org/10.1002/jwmg.21809.

Laske, S.M., Rosenberger, A.E., Wipfli, M.S., and Zimmerman, C.E., 2019, Surface water connectivity controls fish food web structure and complexity across local- and meta-food webs in Arctic Coastal Plain lakes: Food Webs, v. 21, 13 p., https://doi.org/10.1016/j.fooweb.2019.e00123.

O’Donnell, J.A., Carey, M.P., Koch, J.C., Xu, X., Poulin, B.A., Walker, J., and Zimmerman, C.E., 2019, Permafrost hydrology drives the assimilation of old carbon by stream food webs in the Arctic: Ecosystems, v. 23, p. 435–453, https://doi.org/10.1007/s10021-019-00413-6.

Overduijn, K.S., Handel, C.M., and Powell, A.N., 2020, Does habitat partitioning by sympatric plovers affect nest survival?: The Auk, v. 137, no. 3, 16 p., https://doi.org/10.1093/auk/ukaa018.

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.

Routti, H., Atwood, T., Beschshoft, T., and others, 2019, State of knowledge on current exposure, fate and potential health effects of contaminants in polar bears from the circumpolar Arctic: Science of the Total Environment, v. 664, p.1063–83, https://doi.org/10.1016/j.scitotenv.2019.02.030.

Uher-Koch, B.D., Wright, K.G., and Schmutz, J.A., 2019, The influence of chick production on territory retention in Arctic breeding Pacific and Yellow-billed loons: The Condor—Ornithological Applications, v. 121, no. 1, 11 p., https://doi.org/10.1093/condor/duy021.

Ware, J.V., Rode, K.D., Robbins, C.M., Leise, T., Weil, C.R., and Jansen, H.T., 2020, The clock keeps ticking—circadian rhythms of free-ranging polar bears: Journal of Biological Chemistry, v. 35, no. 2, p.180–94, https://doi.org/10.1177/0748730419900877.

Collaboration with the Interagency Arctic Research Policy Committee

Established by an act of Congress in 1984, the Interagency Arctic Research Policy Committee (IARPC) functions under the White House Office of Science and Technical Policy to set a coordinated agenda for federally funded Arctic research in the United States. IARPC aims to enhance scientific research and monitoring in the Arctic through facilitated coordination among Federal agencies and domestic and international collaborators. Since 2012, IARPC has jointly developed and implemented a 5-year national Arctic Research Plan. The 2022–26 Arctic Research Plan (ARP) was drafted with contributions from IARPC agencies and builds on input from the research community, State agencies, Tribal and non-governmental organizations, and the public. The USGS Director represents all DOI bureaus as the IARPC Principal. Consequently, many USGS personnel are actively engaged in IARPC activities, including leadership roles on collaboration teams, and leadership roles in the planning and development of the 2022–26 ARP, with its associated Biennial Implementation Plan, and the final 2017–21 End of Plan Report. USGS staff will continue to coordinate with IARPC collaborators to implement the plan when it is finalized by the end of 2021.

Time frame	Budget	Project partners
Ongoing	<$100,000	Department of Energy, Department of Homeland Security, National Oceanic and Atmospheric Administration, Marine Mammal Commission, Smithsonian Institute, Department of Agriculture, National Aeronautics and Space Administration, National Science Foundation, Environmental Protection Agency, Department of Transportation, Department of Defense, Department of Health and Human Services

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Dee Williams, Alaska Regional Office, dmwilliams@usgs.gov, (907) 786-7023

Project Link

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

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

Climate change is transforming Arctic hydrology. Changes including permafrost thaw and altered runoff hydrology and river temperatures pose serious threats to Indigenous communities who rely on rivers for subsistence fishing; access to supplies and fuel; and as transportation corridors (especially during the winter months) for overland access to reach subsistence resources, transport goods, and visit family and friends in 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 the potential impacts on rivers, fish, and Indigenous communities. A large interdisciplinary team including an Indigenous Advisory Council has formed to meet this objective. Methods 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 will inform a new state-of-the-art climate model that predict hydrology and river ice across Alaska and the Yukon River Basin. These data will feed fish bioenergetic models that can help predict fish resources in the changing Arctic. Indigenous knowledge will be combined with modeling results to develop storylines of change to support resilience in Indigenous communities.

Ambler River flowing south out of the Brooks Range in Alaska. Photograph by Josh Koch, U.S. Geological Survey.

Time frame	Budget	Project partners
2019–24	>$1,000,000	University of Colorado, Boulder, National Center for Atmospheric Research, Institute for Tribal Environmental Professionals, Yukon River Inter-Tribal Watershed Council, University of Saskatchewan, University of Waterloo

Contacts

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Josh Koch, Alaska Science Center, 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.

Newman, A.J., Monaghan, A.J., Clark, M.P., Ikeda, K., Xue, L., Gutmann, E., and Arnold, J.R., 2021, Hydroclimatic changes in Alaska portrayed by a high-resolution regional climate simulation: Climatic Change, v. 164, no. 1, p. 1–21.

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, 55, p. 3543–3564, https://doi.org/10.1007/s00382-020-05466-1.

USGS Emerging Wildlife Disease Project

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 a critical area for the study of environmental health because of its significant wildlife resources. Within the USGS, the Emerging Wildlife Disease project supports USGS scientists nationwide to address diseases of high concern to the United States. This project focuses on important wildlife disease topics relevant to 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.

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

Time frame	Budget	Project partners
2005–ongoing	$100,000–$499,000	U.S. Fish and Wildlife Service, Bureau of Land Management, U.S. Department of Agriculture, USGS National Wildlife Health Center, Alaska One Health Group, Citizen Scientists across Alaska

Contacts

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Caroline Van Hemert, ASC, cvanhemert@usgs.gov, (907) 786-7167

Project Link

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

Recent Publications

Carter, D., Link, P., Walther, P., Ramey, A.M., Stallknecht, D.E., and Poulson, R.L., 2019, Influenza A prevalence and subtype diversity in migrating teal sampled along the United States Gulf Coast: Avian Diseases, v. 63, no. 1, p. 165–171, https://doi.org/10.1637/11850-041918-Reg.1.

Cross, P.C., Prosser, D.J., Ramey, A.M., Hanks, E.M., and Pepin, K.M., 2019, Confronting models with data—The challenges of estimating disease spillover: Philosophical Transactions of the Royal Society B, v. 374, no. 1782, 10 p., https://doi.org/10.1098/rstb.2018.0435.

Harms, N.J. and Van Hemert, C.R., 2020, Wildlife parasite and pathogen life cycles in the Northwest boreal region, *in* Markon, C., Sesser, A.M., Rockhill, A.P., Magness, D.R., Reid, D., DeLapp, J., Burton, P., Schroff, E., and Barber, E., Drivers of landscape change in the northwest boreal region: Fairbanks, Alaska, University of Alaska Press, p. 97–104, https://press.uchicago.edu/ucp/books/book/distributed/D/bo45711596.html.

Humphreys, J., 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.A., Leacock, B., Crupi, A., 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.

Ramey, A.M., Uher-Koch, B.D., Reeves, A.B., Schmutz, J.A., Poulson, R.L., and Stallknecht, D.E., 2019, Emperor geese (*Anser canagicus*) are exposed to a diversity of influenza A viruses, are infected during the non-breeding period, and contribute to intercontinental viral dispersal: Transboundary and Emerging Diseases, v. 66, no. 5, p. 1958–1970, https://doi.org/10.1111/tbed.13226.

Reeves, A.B., Ramey, A.M., Koch, J.C., Poulson, R.L., and Stallknecht, D.E., 2020, Field-based method for assessing duration of infectivity for influenza A viruses in the environment: Journal of Virological Methods, v. 277, https://doi.org/10.1016/j.jviromet.2020.113818.

Smith, M.M., Van Hemert, C.R., and Handel, C.M., 2019, Evidence of Culiseta mosquitoes as vectors for *Plasmodium* parasites in Alaska: Journal of Vector Ecology, v. 44, no. 1, p. 68–75, https://doi.org/10.1111/jvec.12330.

Stallknecht, D.E., Kienzle- Dean, C., Davis-Fields, N., and others, 2020, Limited detection of antibodies to clade 2.3.4.4 A/Goose/Guangdong/1/1996 lineage highly pathogenic H5 avian influenza virus in North American waterfowl: Journal of Wildlife Diseases, v. 56, no. 1, p. 47–57, https://doi.org/10.7589/2019-01-003.

Van Hemert, C.R., Meixell, B.W., Smith, M.M., and Handel, C.M., 2019, Prevalence and diversity of avian blood parasites in a resident northern passerine: Parasites and Vectors, v. 12, 16 p., https://doi.org/10.1186/s13071-019-3545-1.

Van Hemert, C.R., Schoen, S.K., Litaker, R.W., Smith, M.M., Arimitsu, M.L., Piatt, J.F., Holland, W.C., Hardison, D.R., and Pearce, J.M., 2020, Algal toxins in Alaskan seabirds—Evaluating the role of saxitoxin and domoic acid in a large-scale die-off of common murres: Harmful Algae, v. 92, 9 p., https://doi.org/10.1016/j.hal.2019.101730.

USGS and National Park Service Natural Resources Preservation Program

The Natural Resources Preservation Program is a nationwide science partnership that directs USGS capabilities toward priority research issues identified by the NPS. NPS priorities for these funds change annually; recent focal objectives identified by the NPS Alaska Region include:

- Establishing the geologic framework for NPS resource vulnerability studies and associated geohazards, Denali National Park, Alaska;
- Tracing mercury through lake food webs in Alaska's national parks;
- Determining effects of nest predation and predator abundance on habitat quality for declining passerines breeding in a rapidly changing landscape;
- Developing baseline moss tissue concentrations in Bering Land Bridge National Preserve;
- Modelling spatial patterns of contaminants around the Red Dog Mine in Cape Krusenstern; and
- Determining effects of glacial inputs on nearshore marine communities in a changing environment.

Elodea spp. on a rake in Sand Lake in Anchorage, Alaska. Photograph by Cecil F. Rich, U.S. Fish and Wildlife Service.

Time Frame	Budget	Project Partners
2018–21	$100,000–$499,000	National Park Service

Contact

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Alaska Native Science and Engineering Program Partnership

The USGS Alaska Region partners 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, 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. USGS partners with ANSEP through a cooperative agreement, providing $50,000 per year to support the program. Currently, the USGS is in year 4 of the cooperative agreement with ANSEP, and this is the second agreement with the program. The USGS provides ANSEP students with opportunities to (1) work in a multi-disciplinary natural science environment that examines fish, wildlife, and lands in an ecosystem context; (2) conduct 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. USGS funds these student hires at a cost of $10,000 per year.

Photograph of 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	Budget	Project partners
2006–ongoing	<$100,000	Alaska Native Science and Engineering Program

Contact

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Project Link

https://www.ansep.net/

Alaska Tribal Resilience Learning Network

Storage tank overturned because of flooding in western Alaska. Photograph by Ryan Toohey, Alaska Climate Adaptation Science Center.

The Alaska Tribal Resilience Learning Network (AK TRLN) is a community of learning, sharing, technical assistance, training, and support for Alaska Tribes and Indigenous communities as they respond to the impacts of climate change. This system of support is a joint effort launched in early 2021 by the USGS's Alaska Climate Adaptation Science Center (https://akcasc.org/), the Aleutian Pribilof Islands Association (https://www.apiai.org/), and the University of Alaska Fairbanks. AK TRLN is designed for Alaska Tribes and Indigenous communities addressing their climate adaptation priorities, especially those that have received Bureau of Indian Affairs (BIA) Tribal Resilience Program funding.

In its first year the AK TRLN developed a series of virtual information sessions that explained upcoming funding opportunities and explored current and emerging topics in climate change adaptation and resilience. The network hosted multiple training sessions such as "Climate Change Adaptation 101" and special training topics related to adaptation planning in Alaska Native communities. As the network grows, the focus will shift to direct support for Tribes and Indigenous communities working on climate change adaptation challenges, including changes in subsistence resource availability or access to subsistence resources. In coming years, we anticipate that the AK TRLN will become a vital link between researchers in USGS and its University of Alaska partners, while addressing critical science and information gaps throughout the region.

Time frame	Budget	Project partners
2021–ongoing	$100,000–$499,000	International Arctic Research Center, University of Alaska Fairbanks; Aleutian Pribilof Islands Association ($50,000 via Bureau of Indian Affairs)

Contacts

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Translating Climate Information for use by Decision Makers in Alaska

The complex language of future climate projections can be daunting and inaccessible to resource managers and community leaders and the public unfamiliar with use of research model outputs. Yet, an understanding of changes to the climate and ecosystem factors such as snowmelt, permafrost thaw, wildfires, and vegetation is vital for planning and managing resources into the future. The Alaska Climate Adaptation Science Center (AK CASC) has long-standing relationships with Federal, State, and Tribal partners that enable the co-production of research to directly inform management decisions through a deep understanding of what managers need and what scientists can deliver. Such partnership was illustrated in the development of a Vulnerability Assessment for the Chugach National Forest in southcentral Alaska. Climate projections of future snowmelt conditions enabled the U.S. Forest Service (USFS) to determine which streams in the Chugach National Forest are most vulnerable to major shifts in hydrology over the next 50 years. The AK CASC has supplied or is supplying climate projections and ecosystem summaries for all the major Department of the Interior and US Department of Agriculture lands in the state, including all US Fish and Wildlife Service, National Park Service, and U.S. Forest Service management units. These projections can be used in planning processes and in decisions about land and resource management.

Climate Adaptation Science Center Staff sharing climate summaries with Alaska Native community members. Photo credit: Molly Tankersly, Alaska Climate Adaptation Science Center.

Time frame	Budget	Project partners
Ongoing	<$100,000	U.S. Fish and Wildlife Service, National Park Service, U.S. Forest Service

Contact

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Project Link

https://cascprojects.org/#/project/4f831626e4b0e84f6086809b/586d3410e4b0f5ce109faa63

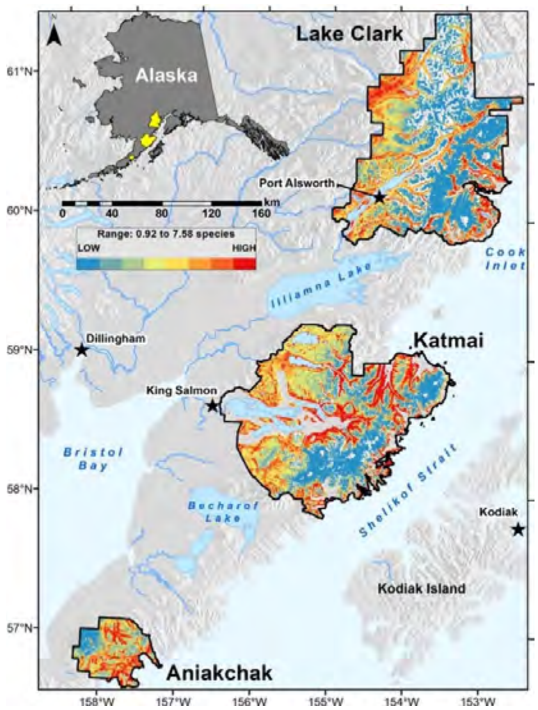
Recent Publication

Littell, J.S., Reynolds, J.H.; Bartz, K.K.; McAfee, S.A.; Hayward, G., 2020, So goes the snow—Alaska snowpack changes and impacts on Pacific Salmon in a warming climate: Alaska Park Science, v. 19, no. 1, 10 p.

Ecosystems Analytics

As analytical techniques have become more powerful, it is increasingly difficult for scientists to become fluent in emerging statistical methods, GIS software, or data visualization. This has created a need to solicit help from expert data analysts 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 specific coding questions to general analysis assistance. Our goal is to save time spent analyzing data by those less familiar with certain techniques or 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, and USGS, and ASC priorities.

Time frame	Budget	Project partners
2020–ongoing	$100,000–$499,000	U.S. Fish and Wildlife Service, Bureau of Land Management, North Slope Borough



Map showing estimated species richness of breeding birds in three Alaska national parks. Source: Amundson and others (2018) (see "Recent Publications" at the end of this section).

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Project Link

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

Recent Publications

Amundson, C.L., Handel, C.M., Ruthrauff, D.R., Tibbitts, T.L., and Gill, R.E., Jr., 2018, Montane-breeding bird distribution and abundance across national parks of southwestern Alaska: Journal of Fish and Wildlife Management, v. 9, no.1, p.180–207, https://doi.org/10.3996/062017-JFWM-050.

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.

Pearce, J.M., Flint, P.L., Whalen, M.E., and others, Visualizing populations of North American sea ducks—Maps to guide research and management planning: U.S. Geological Survey Open-File Report 2019–1142, 50 p., https://doi.org/10.3133/ofr20191142.

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.

Ward, D.H., and Amundson, C.L., 2019, Monitoring annual trends in abundance of eelgrass (*Zostera marina*) at Izembek National Wildlife Refuge, Alaska, 2018: U.S. Geological Survey Open-File Report, 2019–1042, 8 p., https://doi.org/10.3133/ofr20191042.

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.

Weiser, E.L., Lanctot, R.B., Brown, S.C., and others, 2020, Annual adult survival drives trends in Arctic-breeding shorebirds but knowledge gaps in other vital rates remain: The Condor—Ornithological Applications, v. 122, no. 3, 14 p., https://doi.org/10.1093/condor/duaa026.

Looking Forward, Looking Back–Building Resilience Today

Climate change impacts on landscapes are happening faster in the Arctic than elsewhere. For rural Alaska communities, these impacts already require constant coping while preparing for future adaptation. The Alaska Climate Adaptation Science Center, Aleutian Pribilof Islands Association, University of Alaska, and five southwestern Alaska communities developed community-specific climate information and synthesized it for effective risk assessments, climate adaptation plans, funding applications, and to solicit public comments. Using participatory methods, we conducted workshops and meetings to document: (1) topics of interest on climate, (2) concerns about impacts on subsistence practices, and (3) local observations of change due to climate variability. We developed community atlases of climate changes and impacts for watersheds in areas of interest. Communities noted changes in subsistence activities, ease of travel, species loss/gain, and harvest quality. Local observations include weather, climate, and permafrost changes and related impacts on infrastructure, travel, food security, archaeological sites, and purchasing decisions. Common themes have emerged in the data, but considerable sub-regional variation among communities exists. These atlases can serve as a foundation for community adaptation efforts.

Community members defining their traditional use area in Kotlik, southwestern Alaska. Photograph by Ryan Toohey, U.S. Geological Survey.

Time frame	Budget	Project partners
2018–21	$100,000–$499,000	Aleutian Pribilof Islands Association, $145,065 from BIA Tribal Resilience Program, Village of Kotlik, Kotlik Village Council, Kotlik Yupik Corporation, Native Village of St. Michael, St. Michael Village Council, City of St. Michael, Native Village of Kwigillingok, Kwigillingok Village Council, Kwik Incorporated, Native Village of Kwinhagak, Quinhagak Village Council, City of Quinhagak, Qanirtuuq Incorporated, Iliamna Village Council, Village of Iliamna, University of Alaska

Contact

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Recent Publications

Chase, M., Heeringa, K., Littell, J., Toohey, R., and Tankersley, M., eds,, 2020, Looking forward, looking back—Building resilience today training two report: Fairbanks, Alaska, Aleutian Pribilof Islands Association, 26 p.

Chase, M.J., Littell, R. Toohey, and M. Tankersley, eds., 2020, Looking forward, looking back—Building resilience today training one report: Fairbanks, Alaska, Aleutian Pribilof Islands Association, 28 p.

Community of Iliamna, Littell, J.S., Fresco, N., Toohey, R.C., and Chase, M., eds., 2020, Looking forward, looking back—Building resilience today community report: Iliamna and Fairbanks, Alaska, Aleutian Pribilof Islands Association, 48 p.

Community of Kotlik, Littell, J.S., Fresco, N., Toohey, R.C., and Chase, M., eds., 2020, Looking forward, looking back—Building resilience today community report: Kotlik and Fairbanks, Alaska, Aleutian Pribilof Islands Association, 48 p.

Community of St. Michael, Littell, J.S., Fresco, N., Toohey, R.C., and Chase, M., eds., 2020, Looking forward, looking back—Building resilience today community report: St. Michael and Fairbanks, Alaska, Aleutian Pribilof Islands Association, 48 p.

Community of Kwigillingok, Littell, J.S., Fresco, N., Toohey, R.C., and Chase, M., eds., 2020, Looking Forward, looking back—Building resilience today community report: Kwigillingok and Fairbanks, Alaska, Aleutian Pribilof Islands Association, 48 p.

Community of Quinhagak, Littell, J.S., Fresco, N., Toohey, R.C., and Chase, M., eds., 2020, Looking forward, looking back—Building resilience today community report: Quinhagak and Fairbanks, Alaska, Aleutian Pribilof Islands Association, 48 p.

North Pacific Research Board Collaboration

The North Pacific Research Board (NPRB) was created to recommend to the Secretary of Commerce priorities for coastal and marine research in the Gulf of Alaska, Bering Sea, and Arctic Ocean for funding through an annual competitive and peer-reviewed grant program derived primarily from NOAA sources. The USGS Alaska Regional Office has represented DOI interests on the Board since its creation in 2001, advising on numerous strategic initiatives including (1) annual funding decisions, (2) long-term funding allocation strategies, (3) and improving the vitality and relevance of the NPRB Core Program.

In addition to the Core Program, NPRB allocates resources to long-term monitoring and Integrated Ecosystem Research Programs (IERPs) to increase understanding of the complex interactions among the physical, chemical, biological, and social processes that influence Alaska's large marine ecosystems. To date, NPRB has funded three IERPs, and recently committed to a fourth. The first IERP (2007–14), conducted in partnership with the National Science Foundation, provided more than $50 million in research funding to improve understanding the Bering Sea in the context of a changing climate. The Gulf of Alaska IERP (2010–16) provided more than $17 million 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) pooled more than $18 million (including DOI funds) to advance understanding of the linkages between the northern Bering Sea and the Arctic. The Arctic IERP (2016–21) examined 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. The forthcoming IERP will document significant changes in the physical and biological environment in the Northern Bering and Chukchi Seas. Areas of interest include (1) how shifts in environmental conditions and processes may influence species of commercial, ecological and subsistence importance and (2) implications for state and federal fisheries management and communities that depend on these resources. During 2022–24, the Integrated Ecosystem Research Program will support: (1) synthesis research that builds upon the Arctic IERP and (2) an assessment phase for the future IERP centered in the northern Bering Sea.

Since its inception, NPRB has been a proud sponsor and one of the leading organizers of the Alaska Marine Science Symposium, Alaska's premier marine research conference. Usually, more than 700 people attend this 4-day annual conference in January.

Time frame	Budget	Project partners
2010–ongoing	<$100,000	North Pacific Research Board, National Oceanic and Atmospheric Administration, Alaska Department of Fish & Game, Oil Spill Recovery Institute, University of Alaska Fairbanks, Alaska Sea Life Center, US Arctic Research Commission, U.S. Coast Guard, Ocean Conservancy

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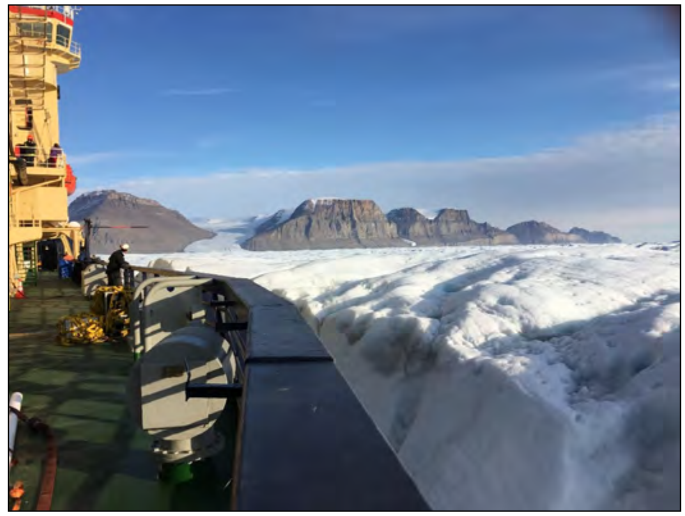
Project Link

https://www.nprb.org/nprb/about-us/

Land-Sea Linkages in the Arctic Global Change R&D—Climate History & 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 impacts 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. This project will entail investigation 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 will be used to document paleo-oceanographic changes during periods of glacial-interglacial climate variability. Pollen assemblages will be used for comparison of 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 prior to the instrumental period of the last few decades.



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	Budget	Project partners
2019–23	$100,000–$499,000	Stockholm University; Princeton University; Columbia University; Aarhus University (Denmark); GEOMAR, Kiel (Germany); University of Arizona, University of Maryland; National Ocean 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?qt-science_center_objects=0#qt-science_center_objects

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.

Cronin T.M., Gemery, L., Briggs, W.M., Jr., Brouwers, E.M., Schornikov, E.I., Stepanova, A., Wood, A., Yasuhara, M., Siu, S., 2021, Arctic Ostracode database 2020: National Oceanic and Atmospheric Aadministration, National Centers for Environmental Information website, https://www.ncdc.noaa.gov/paleo/study/32312.

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.

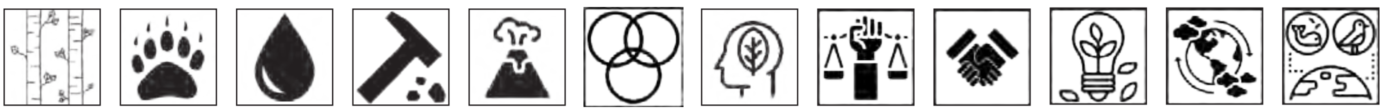
Gemery, L., Cooper, L.W., Magen, C., Cronin, T.M., Grebmeier, J.M., 2021, Stable oxygen isotopes in shallow marine ostracodes from the northern Bering and Chukchi Seas: Marine Micropaleontology, v. 165, 21 p., https://doi.org/10.1016/j.marmicro.2021.102001.

Gemery, L., Cronin, T.M., Cooper, L.W., Dowsett, H.J., Grebmeier, J.M., 2021, Biogeography and ecology of Ostracoda in the U.S. northern Bering, Chukchi, and Beaufort Seas: PLOS One, v. 15, no. 5, p. 1–34., https://doi.org/10.1371/journal.pone.0251164.

Jakobsson, M., Mayer, L.A., Nilsson, J., Stranne, C., Calder. B., O'Regan, M., Farrell, J., Cronin, T.M., Bruchert, V., Chawarski, J., Eriksson, B., Fredriksson, J., Gemery, L., Glueder, A., Holmes, F.A., Jerram, K., Kirchner, N., Mix, A., 2020, Ryder Glacier in northwest Greenland is shielded from warm Atlantic water by a bathymetric sill: Communications—Earth and Environment, v. 1, no. 45, 10 p., https://doi.org/10.1038/s43247-020-00043-0.

O'Regan, M., T. M. Cronin, B. Reilly, A. K. O. Alstrup, L. Gemery, A. Golub, L. A. Mayer, M. Morlighem, M. Moros, O. L. Munk, J. Nilsson, C. Pearce, H. Detlef, C. Stranne, F. Vermassen, G.W., and Jakobsson, M., 2021, The Holocene dynamics of Ryder Glacier and ice tongue in north Greenland: The Cryospher, v. 15, no. 8, p. 4073-4097.

Steese National Conservation Area Science Strategy



Through the Alaska National Interest Lands Conservation Act of 1980, Congress designated 1.22 million acres to the Steese National Conservation Area (NCA) to protect its special features, which include the Birch Creek Wild and Scenic River and surrounding habitat for caribou and Dall sheep. The Bureau of Land Management (BLM) manages the Steese NCA within a multiple use and sustained yield framework, and the BLM uses science to inform management decisions and conserve the special values of the Steese NCA. The BLM and the USGS staff began collaborating in 2021 to develop the Steese NCA Science Strategy, which identifies scientific information needed to address management issues. Led by the USGS Alaska Regional Office, the BLM and the USGS are taking an interdisciplinary and landscape-scale approach to identify priority objectives to inform management of the diverse biological, recreational, cultural, and economic resources of the Steese NCA. The forthcoming science strategy will:

Steese National Conservation Area. Photograph by Bureau of Land Management.

- Identify the scientific mission of the unit and synthesize legacy scientific data,
- Identify management issues and priorities that can be addressed by further scientific study,
- Develop a process to better integrate research findings into management decisions,
- Develop a system to organize and archive reports and communicate findings to the public, and
- Develop protocols that ensure scientific inquiry does not negatively impact the unit and its resources.

The Steese Science Strategy is expected to be released in the first quarter of 2022.

Time Frame	Budget	Project Partners
2021–22	<$100,000	Bureau of Land Management

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Appendix 1. Acronyms

Acronym	Full Name
3DEP	3D Elevation Program
3D	Three-dimensional
A2D	Analog to digital
ADF&G	Alaska Department of Fish and Game
AK CASC	Alaska Climate Adaptation Science Center
AKDOT&PF	Alaska Department of Transportation and Public Facilities
AK TRLN	Alaska Tribal Resilience Learning Network
ANSEP	Alaska Native Science and Engineering Program
ANWR	Arctic National Wildlife Refuge
ARD	Analysis Ready Data
ARDF	Alaska Resource Data File
ARP	Arctic Research Plan
ARPA	Arctic Research Policy Act
ASC	USGS Alaska Science Center
AVO	Alaska Volcano Observatory
BELA	Bering Land Bridge National Preserve
BLM	Bureau of Land Management
BOEM	Bureau of Ocean and Energy Management
C	Carbon
CBJ	City and Borough of Juneau
m	centimeter
COVID-19	coronavirus disease of 2019
DOI	U.S. Department of the Interior
EROS	Earth Resources Observation and Science
FWS	U.S. Fish and Wildlife Service
FY	Fiscal Year
GBNPP	Glacier Bay National Park and Preserve
GHG	Greenhouse gas
GIS	Geographic Information System
HFSE	High field strength elements
Hz	Hertz
IARPC	Interagency Arctic Research Policy Committee
IERP	Integrated Ecosystem Research Program
IfSAR	Interferometric Synthetic Aperture Radar
ION	Indigenous Observation Network
km	Kilometers
LiDAR	Light detection and ranging
NASA	National Aeronautics and Atmospheric Administration
NCA	National Conservation Area
NHD	National Hydrography Dataset
NHDPlus HR	National Hydrography Dataset Plus High Resolution
NOAA	National Oceanic and Atmospheric Administration
NPRB	North Pacific Research Board
NPS	National Park Service
OBS	ocean bottom seismometer
QCF	Queen Charlotte fault
REE	Rare earth elements
SB	Southern Beaufort Sea
TOQUES	Transform Obliquity along the Queen Charlotte Fault and Earthquake Study
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VSC	Volcano Science Center
WBD	Watershed Boundary Dataset
YT	Yukon-Tanana

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Manuscript approved on July 7, 2022

Publishing support provided by the U.S. Geological Survey
Science Publishing Network, Tacoma Publishing Service Center
Edited by Nathan Severance and Vanessa Ball
Layout and design by Yanis Castillo

Powers and Williams—**U.S. Geological Survey—Department of the Interior Region 11, Alaska—2021–22 Biennial Science Report**—Circular 1497

ISSN 2330-5703 (online)
https://doi.org/10.3133/cir1497