

Status of Implementation Plan 2022-2024 Deliverables, April 2024

The Arctic Research Plan 2022-2026 is a bold strategy for a changing Arctic. It outlines a vision for federal agencies to address emerging research questions about this vital region, and provides pathways to strengthen relationships between federal agencies and Indigenous communities, academia and non-federal researchers, the state of Alaska, nonprofits, and private sector and international organizations.

The plan is a high-level strategy. Its overarching goals are accomplished via two-year implementation plans with specific objectives and deliverables. This document provides a status update on the deliverables of the 2022-2024 implementation plan, as of April 9, 2024. Actions are reported as *funded research, publications, meetings/webinars, and other projects*.

More details about the work done on these deliverables can be found [on IARPC Collaborations](#). (Please note: this page requires an IARPC Collaborations account to view. [Sign up for an account here.](#))

The numbers at a glance:

91 deliverables

3 deliverables complete

75 deliverables in progress





13 deliverables not started


Key to the table below:


In progress





Not started




Complete




Status	Objective/Deliverable	Details
	Priority Area: Community Resilience & Health	Seventeen deliverables. Two complete, fourteen in progress, one not started.
	1.1 Support the health of Arctic residents through research on public health needs, disparities, and delivery.	Five deliverables: one complete, four in progress.
	1.1.1 Initiate a Federally-funded project with local partners researching the feasibility and success rate in the treatment of chronic Hepatitis C in remote Arctic communities.	<p><i>Funded research:</i> The Alaska Native Tribal Health Consortium conducted a feasibility project, funded by the Division of Viral Hepatitis at the Centers for Disease Control and Prevention (CDC), to test people living in remote areas of Alaska for hepatitis C virus and link people to effective treatment via telemedicine. The project was helpful to identify barriers to screening and treatment in rural areas. Next steps are to work with Tribal Health Organizations to further scale-up and incorporate the initiative into routine health practice. The initiative was presented in the LiverConnect ECHO by Alaska Native Tribal Health Consortium staff on January 23, 2024.</p> <p><i>Publications:</i> LiverConnect ECHO: The state of liver disease in Alaska Native People in Alaska</p>
	1.1.2 Conduct research on preventive measures for COVID-19 disease and evaluate lessons learned for future pandemic preparedness in the Arctic. Prepare a report on COVID-19 vaccine effectiveness in preventing hospitalizations specifically within Alaska.	<p><i>Funded research:</i> NIH Alaska Native Communities Advancing Vaccine Update (R01). This grant formed a consortium of Tribal health leaders from across Alaska to better understand vaccine attitudes and intentions, including hesitancy, and to increase vaccine uptake in Alaskan ANAI communities.</p>

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		<p><i>Publications:</i> Effectiveness of the COVID-19 vaccines on preventing symptomatic SARS-CoV-2 infections and hospitalizations in Southwestern Alaska, January–December 2021; Effectiveness of COVID-19 mRNA Vaccines in Preventing COVID-19-Associated Outpatient Visits and Hospitalizations Among American Indian and Alaska Native Persons, January–November 2021: A Test-Negative Case-Control Analysis Using Surveillance Data</p>
	<p>11.3 Continue research on air quality and human health. This will include an evaluation of outdoor air quality and health outcomes in Alaskan communities and a Federally-funded, local-partner-conducted evaluation of interventions to improve indoor air quality and decrease respiratory symptoms in children. Research will be shared and summarized in webinars, publications, and reports.</p>	<p><i>Meetings/webinars:</i> IARPC Terrestrial Ecosystems Community of Practice webinar on new science and tools in fire management; EPA webinar on wildland fire research</p> <p><i>Publications:</i> Impact of do-it-yourself air cleaner design on the reduction of simulated wildfire smoke in a controlled chamber environment</p> <p><i>Funded research:</i> NIEHS: “Protecting the Health of Future Generations: Assessing and Preventing Exposures to Endocrine-Disrupting Flame Retardant Chemicals & PCBs in Two Alaska Native Arctic Communities on St. Lawrence Island” (R01, Awarded 2021) NIEHS: “Hazardous Materials Worker Health and Safety Training” (U45, Awarded 2023)</p>






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		<p>NIEHS: "Convergence of multiple exposures during pregnancy: Effect of wildfires and maternal stressors on birth outcomes among Alaskan women" (K01, Awarded 2024)</p> <p>NIEHS: "Improving Rural Population Health through Air Quality and Cardiovascular Health Education" (R25, Awarded 2022)</p> <p>EPA: "Filling data gaps: Development of a community-centered tool for assessing health impacts of intersecting climate hazards, wildfire smoke exposure, and social disparities in rural tribal and aging communities in Alaska." Example tools expected by late fall 2024/spring 2025. (EPA funded; conducted by University of Alaska-Anchorage)</p>
	<p>1.1.4 Along with local health partners, conduct research to support understanding and awareness of emerging zoonotic disease threats identified in the CDC's One Health Zoonotic Disease Prioritization for Alaska workshop report.</p>	<p><i>Meetings/webinars:</i></p> <p>USGS Alaska Science Center coordinated a meeting discussing the potential human health implications of harmful algal bloom toxins in subsistence harvested seabirds.</p> <p><i>Publications:</i></p> <p>Giardia and Cryptosporidium in resident wildlife species in Arctic Alaska</p> <p>National One Health Framework To Address Zoonotic Diseases and Advance Public Health Preparedness in the United States: A Framework for One Health Coordination and Collaboration Across Federal Agencies (draft)</p>

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	<p>1.1.5 Along with collaborating partners, investigate human illness associated with harmful algal blooms (HABs), and develop and distribute preventive messaging based on what is learned.</p>	<p><i>Meetings/webinars:</i> Strait Science: Harmful Algae & Seabirds (USGS) NOAA-hosted HAB workshop USGS-hosted meeting on saxitoxins in subsistence harvested seabirds</p> <p><i>Funded research:</i> NIEHS: "Prevention of Paralytic Shellfish Poisoning in Subsistence Shellfish Harvest Communities of Southeast Alaska" (R01, Awarded 2022) Bureau of Indian Affairs provides partnership funding to the Knik Tribe for the sampling and testing for paralytic shellfish poisoning at six Alaskan communities along with funding for any needed public outreach.</p>
	<p>1.2 Address emerging threats to food safety and access, as well as food and nutrition security in the Arctic, through research that addresses how climate and environmental change is affecting the abundance, accessibility, and use of traditional foods and traditional ways of life.</p>	<p>Nine deliverables: one complete, seven in progress, one not started.</p>
	<p>1.2.1 Provide funding opportunities for research on food safety and food and nutrition security in the Arctic.</p>	<p><i>Meetings/webinars:</i> Marine Ecosystems Community of Practice meeting on salmon and coastal systems</p>
	<p>1.2.2 Provide funding opportunities and conduct studies on the impact of harmful algal blooms (HABs) on availability and safety of traditional and commercial foods.</p>	<p><i>Funded research:</i> NSF award: Collaborative Research: Community Based Phytoplankton Observatory for Northwestern Alaska</p>


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		<p>Coastal Waters</p> <p><i>Meetings/webinars:</i></p> <p>Strait Science: Harmful Algae & Seabirds (USGS)</p> <p>NOAA-hosted HAB workshop</p> <p>USGS-hosted meeting on saxitoxins in subsistence harvested seabirds</p>
	<p>1.2.3 Conduct research and produce a report on seabird mortality events in the Bering Sea, including severity, causes, and ecological implications.</p>	<p><i>Publications:</i></p> <p>Marine bird mass mortality events as an indicator of the impacts of ocean warming</p> <p>Seabird Die-Offs</p> <p>Alaskan Seabird Die-Offs</p>
	<p>1.2.4 Conduct investigations and report on marine mammal unusual mortality events in the Bering, Chukchi, and Beaufort seas to evaluate the severity, causes, ecological implications, and potential health risks to traditional users.</p>	<p>n/a</p>
	<p>1.2.5 Conduct investigations and report on trends in abundance, distribution, and condition of ice-dependent marine mammals in the Bering, Chukchi, and Beaufort seas to identify and forecast changes that may impact food security and the long-term sustainability of traditional food supplies.</p>	<p><i>Publications:</i></p> <p>Identifying indicators of polar bear population status</p> <p>Incremental evolution of modeling a prognosis for polar bears in a rapidly changing Arctic</p> <p>Q&A: Vessel Cruise for Estimates of Pacific Walrus Demography</p> <p>Exploring effects of vessels on walrus behaviors using telemetry, automatic identification system data and matching</p> <p>High winds and melting sea ice trigger landward movement in</p>



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		<p>a polar bear population of concern</p> <p><i>Meetings/webinars:</i> Strait Science: Pacific Walruses: Responding to Change?</p>
	<p>1.2.6 Assess and model changes in abundance, distribution, and harvest of select marine mammals and fishes that are food sources in rural Alaska.</p>	<p><i>Funded research:</i> NSF Award: Collaborative Research: RAPID: Identifying the biogeochemical causes of sudden widespread metal loading in streams of the western Brooks Range, Alaska</p> <p><i>Meetings/webinars:</i> Marine Ecosystems Community of Practice meeting on salmon and coastal systems</p> <p><i>Publications:</i> Kings of the North: Bridging Disciplines to Understand the Effects of Changing Climate on Chinook Salmon in the Arctic-Yukon-Kuskokwim Region Borealization of nearshore fishes on an interior Arctic shelf over multiple decades</p>
	<p>1.2.7 Fund and conduct research, and produce a report, on changes in abundance and distribution of migratory caribou in Arctic Alaska.</p>	<p><i>Publications:</i> Effects of vehicle traffic on space use and road crossings of caribou in the Arctic Survival and reproduction in Arctic caribou are associated with summer forage and insect harassment Caribou Hunting in Alaska</p>
	<p>1.2.8 Provide funding opportunities and conduct research, and produce a report, on the impacts of rapid expansion of</p>	<p><i>Publications:</i> Comparing Sediment Microbial Communities of Arctic Beaver</p>



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	beaver habitat in the U.S. Arctic, including effects on fisheries and ecosystem services, access to traditional foods, and overall community health.	Ponds to Tundra Lakes and Streams Expanding beaver pond distribution in Arctic Alaska, 1949 to 2019
●	1.2.9 Host a session at the 2023 Arctic One Health, One Future conference to advance understanding of causes and consequences of emerging threats to Arctic food safety and security, and identify high-priority research needs.	<i>Meetings/webinars:</i> At the 2023 One Health, One Future Conference hosted by the Center for One Health Research at the University of Alaska Fairbanks, presentations were made by the Health and Well-being Collaboration Team (now Community Resilience and Health Collaboration Team).
◐	1.3 Provide research and technical support for water and sanitation infrastructure.	Three deliverables, all in progress.
◐	1.3.1 Synthesize and expand upon existing efforts to create data visualization maps of areas at high risk for coastal erosion, permafrost thaw, and flooding within specified future time periods (e.g., 10 years, 50 years, 100 years) to identify at-risk areas and inform investments in climate resilient infrastructure.	<i>Meetings/webinars:</i> USGS hosted a permafrost workshop in Golden, CO from September 19–21, 2023. Coastal Resilience Community of Practice meeting on developments in the mapping and modeling of coastal hazards <i>Other projects:</i> USGS pilot project “Building a Coastal Flood Hazard Assessment Tool with at-Risk Alaska Communities.” USGS modelers continue on schedule to refine the modeling products and conduct internal and external reviews for publication and development of the web-based viewer.




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	<p>1.3.2 Develop a publicly accessible database for information on drinking water contaminants (including PFAS) and effective treatment processes. The database will be of use to water treatment operators, regulatory agencies, researchers, and treatment process consultants and designers. It could also support responses to emergency contamination events.</p>	<p><i>Funded research:</i> EPA: \$278 Million in Funding from EPA to Improve Water Infrastructure for Tribes and Alaska Native Villages</p> <p><i>Other projects:</i> EPA has continued to add new information, including on PFAS compounds, to the Drinking Water Treatability Database</p>
	<p>1.3.3 Support research on the feasibility of PFAS treatment for surface water and groundwater in the Arctic. This will help inform a strategy on PFAS remediation of contaminated sites.</p>	<p><i>Funded research:</i> EPA: \$2 Million Alaska PFAS Remediation Facility Feasibility Study EPA: Nearly \$100,000 to student team at the University of Alabama in Huntsville for safer drinking water research EPA: \$278 Million in Funding from EPA to Improve Water Infrastructure for Tribes and Alaska Native Villages</p>
	<p>Priority Area: Arctic Systems Interactions</p>	<p>Twenty-one deliverables. Twenty in progress; one not started.</p>
	<p>2.1 Advance understanding of Arctic amplification and the associated connections with lower latitudes.</p>	<p>Seven deliverables, all in progress.</p>
	<p>2.1.1 Provide funding opportunities for investigator-driven modeling and observational studies that focus on the following aspects of Arctic Amplification: (1) ice-albedo feedback; (2) impacts of atmospheric and oceanic circulation on Arctic Amplification; and (3) transport of heat, moisture, and pollutants between Arctic and lower latitudes. Share knowledge and synthesize results arising</p>	<p><i>Funded research:</i> NSF: Atmospheric H2 in the Northern Hemisphere over the past Millennium NSF: Funding opportunities for Arctic system science</p> <p><i>Meetings/webinars:</i> Physical Oceanography Community of Practice meeting on</p>


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	<p>from these studies.</p>	<p>physics and modeling of atmosphere-ice-ocean interactions Modelers Community of Practice meeting on decadal predictability of the Arctic Earth system</p> <p><i>Other projects:</i> DOE High-Latitude Application and Testing of Earth System Models (HiLAT-RASM) Science Focus Area is teaming up with the Regional Arctic System Model (RASM) project to study transport, exchange, and feedback processes that contribute to Arctic amplification and its global impact DOE InterFACE: Interdisciplinary Research for Arctic Coastal Environments DOE Improving Projections of AMOC and Collapse Through advanced Simulations project DOE Improved Coupled Climate Simulations in E3SM Through Enhanced Sea-Ice Mechanics project DOE ECS in Climate Models: Quantifying the Uncertainties due to Cloud Feedback Versus Ocean Heat Uptake Using a Modeling Hierarchy project DOE Refining the Representations of High-Latitude Surface-Atmosphere Radiative Coupling in the E3SM project DOE Extreme Moist Transport Events as a Driver of Arctic Amplification DOE Next-Generation Ecosystem Experiment in the Arctic (NGEE Arctic) NASA Arctic Radiation-Cloud-Aerosol-Surface Interaction Experiment (ARCSIX)</p>

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	<p>2.1.2 Hold workshops and webinars and produce publications to encourage interagency research coordination on Arctic Amplification.</p>	<p><i>Meetings/webinars:</i> Physical Oceanography Community of Practice meeting on physics and modeling of atmosphere-ice-ocean interactions Physical Oceanography Community of Practice meeting on ocean boundary layer modeling and observing Atmosphere Community of Practice meeting on ICARP-IV process and research topic on "The Role of the Arctic in the Global System" Physical Oceanography Community of Practice meeting on the Consortium of the Advancement of Marine Arctic Science (CAMAS) First workshop of the Consortium for the Advancement of Marine Arctic Science (CAMAS) was held in Santa Fe, NM, February 14-16, 2024 Sea Ice Community of Practice meeting to coordinate on sea ice observations and field activities during the 2024 field season Modelers Community of Practice meeting on decadal predictability of the Arctic Earth system Physical Oceanography Community of Practice meeting on physical oceanography in the Arctic Research Plan 2023 US CLIVAR Summit panel on air-sea processes and gaps in atmospheric rivers Atmosphere Community of Practice meeting on ARCSIX Physical Oceanography Community of Practice meeting on water mass changes and transformations in the Arctic Ocean Modelers Community of Practice meeting on Arctic amplification and physical processes in the climate system</p>



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		<p><i>Publications:</i> More frequent atmospheric rivers slow the seasonal recovery of Arctic sea ice</p>
	<p>2.1.3 Provide opportunities to support and coordinate research to enhance the understanding of connections between Arctic and global ocean circulation with a particular focus on Atlantic Meridional Overturning Circulation.</p>	<p><i>Meetings/webinars:</i> Sea Ice Community of Practice meeting to coordinate on sea ice observations and field activities during the 2024 field season Ocean Sciences Meeting 2024 session on Arctic Ocean change and processes and three sessions fostering discussion between pan-arctic, regional, observational, modeling, and societal activities in Arctic Ocean research. Atmosphere Community of Practice meeting on atmospheric components of the HiLAT-RASM Project Physical Oceanography Community of Practice meeting on water mass changes and transformations in the Arctic Ocean Modelers and Physical Oceanography communities of practice meeting on biases in Arctic Ocean stratification</p> <p><i>Publications:</i> Increased Asian aerosols drive a slowdown of Atlantic Meridional Overturning Circulation</p>
	<p>2.1.4 Advance understanding of the role of atmospheric rivers in Arctic Amplification with a specific task of hosting a conference session in 2023 or 2024.</p>	<p><i>Meetings/webinars:</i> AGU 2023 Fall Meeting sessions held to advance understanding of the role of atmospheric rivers in Arctic Amplification 2023 US CLIVAR Summit panel on air-sea processes and</p>

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		<p>gaps in atmospheric rivers</p> <p>Atmosphere Community of Practice meeting on atmospheric components of the HiLAT-RASM Project</p> <p><i>Publications:</i></p> <p>Evaluating the representations of atmospheric rivers and their associated precipitation in reanalyses with satellite observations</p> <p>The role of interdecadal climate oscillations in driving Arctic atmospheric river trends</p> <p>More frequent atmospheric rivers slow the seasonal recovery of Arctic sea ice</p>
	<p>2.1.5 Hold cross-collaboration-team meetings and workshops, and produce publications, to explore the results of high-resolution and regional Arctic modeling. Meetings will focus on the importance of model resolution to capture Arctic Amplification and its relationship with the lower latitudes.</p>	<p><i>Meetings/webinars:</i></p> <p>Physical Oceanography Community of Practice meeting on ocean boundary layer modeling and observing</p> <p>Physical Oceanography Community of Practice meeting on the physics and modeling of atmosphere-ice-ocean interactions</p> <p>Modelers and Atmosphere communities of practice meeting on biases in the representation of Arctic clouds and their impacts on the surface energy balance</p> <p>Atmosphere Community of Practice meeting on atmospheric components of the HiLAT-RASM Project</p> <p>Modelers and Physical Oceanography communities of practice meeting on biases in Arctic Ocean stratification</p>
	<p>2.1.6 Quantify the contributions of surface properties, clouds, aerosol particles, and precipitation to the Arctic summer surface radiation budget and sea ice melt during</p>	<p><i>Meetings/webinars:</i></p> <p>Sea Ice Community of Practice meeting to coordinate on sea ice observations and field activities during the 2024 field</p>

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	the early melt seasons.	<p>season Atmosphere Community of Practice meeting on ARCSIX</p> <p><i>Publications:</i> Assessment of the pan-Arctic accelerated rate of sea ice decline in CMIP6 historical simulations</p> <p><i>Other projects:</i> NASA ARCSIX</p>
	<p>2.1.7 Facilitate regular discussions to reflect on the diversity of those active in Priority Area 2 and on identifying ways to improve inclusivity. In addition, use the quarterly meeting to consider what has worked well, as well as suggest changes and implement actions to better address barriers to diversity, equity, and inclusion in Priority Area 2 activities.</p>	<p><i>Meetings/webinars:</i> Modelers and Early Career communities of practice meeting highlighting recent graduate student papers on numerical modeling in the Arctic Diversity & Inclusion Community of Practice meeting for IARPC Collaborations team leaders to consider how to integrate equity and inclusion into group activities</p>
	<p>2.2 Observe, understand, predict, and project Arctic ecosystem change and its impacts on humans and the entire Earth system.</p>	<p>Seven deliverables. Six in progress; one not started.</p>
	<p>2.2.1 Advance capacity to better understand, quantify, and predict methane emissions from permafrost changes in the Arctic through international collaborations.</p>	<p><i>Funded research:</i> NSF CAREER: Characterizing Climate Change Feedbacks in Arctic Ponds while Incorporating Next-Generation Technologies and Arctic Field Experiences in Education NSF Collaborative Research: NSFGE0-NERC: Recent changes in Arctic biogenic sulfur aerosol from a central Greenland ice core NSF Collaborative Research: Predicting Micro to Macro-scale</p>




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		<p>Hot-spot and Hot-moment dynamics in Arctic Tundra Ecosystems</p> <p>NSF Collaborative Research: RAPID: Typhoon Merbok in coastal western Alaska: Extent of flooding and impacts on plant communities and ecosystem function</p> <p><i>Meetings/webinars:</i> Technology Innovation and Application Collaboration Team and Permafrost Community of Practice meeting on the measure of methane emissions</p> <p>Permafrost Discovery Gateway Webinar: Bridging the Gap: Enhancing E3SM Land Model Simulation of Pan-Arctic Methane, January 2024</p> <p>USGS hosted a permafrost workshop in Golden, CO from September 19-21,2023.</p> <p><i>Publications:</i> Do beaver ponds increase methane emissions along Arctic tundra streams?</p>
	<p>2.2.2 Carry out and synthesize research and monitoring needed to improve understanding of important Arctic ecosystem processes and feedbacks. This will include responses to environmental changes, such as the associated impacts on wildlife and human communities and infrastructure. This work will include conference sessions and scientific publications.</p>	<p><i>Funded research:</i> NSF Collaborative Research: Exploring Subsistence Economies, Technological Organization, and Site Structure in Eastern Beringia</p> <p><i>Meetings/webinars:</i> Terrestrial Ecosystems Community of Practice meeting on monitoring and mapping permafrost systems Terrestrial Ecosystems Community of Practice meeting on</p>



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		<p>archive centers holding Arctic and boreal terrestrial datasets</p> <p>USGS hosted a permafrost workshop in Golden, CO from September 19-21,2023.</p> <p>Terrestrial Ecosystems Community of Practice meeting on vegetation mapping efforts in Alaska</p> <p>Terrestrial Ecosystems Community of Practice meeting on multi-disturbance synthesis in Arctic and boreal regions of North America</p> <p>Marine Ecosystems Community of Practice meeting on salmon and coastal systems</p> <p>Modelers and Terrestrial Ecosystems communities of practice meeting on forecasting Arctic wildfires</p> <p>Marine Ecosystems Community of Practice meeting on Arctic marine synthesis efforts</p> <p>Terrestrial Ecosystems Community of Practice meeting on NASA ABoVE research highlights and Alaska Fire Science Consortium updates</p> <p><i>Publications:</i></p> <p>Kings of the North: Bridging Disciplines to Understand the Effects of Changing Climate on Chinook Salmon in the Arctic-Yukon-Kuskokwim Region</p> <p>High winds and melting sea ice trigger landward movement in a polar bear population of concern</p> <p>Observed and forecasted changes in land use by polar bears in the Beaufort and Chukchi Seas, 1985-2040</p> <p>Borealization of nearshore fishes on an interior Arctic shelf over multiple decades</p> <p>Increasing Alaskan river discharge during the cold season is</p>


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		<p>driven by recent warming</p> <p>Disturbances in North American boreal forest and Arctic tundra: impacts, interactions, and responses</p> <p>Climate policy must account for community-specific socio-economic, health, and biophysical conditions—evidence from coastal Alaska</p>
	<p>2.2.3 Develop and update meaningful products for delivering findings and information concerning key climate features, including the annual release of the peer-reviewed Arctic Report Card on the current state of the Arctic relative to the historical record.</p>	<p><i>Publications:</i></p> <p>2023 Arctic Report Card</p> <p><i>Meetings/webinars:</i></p> <p>IARPC public webinar on the Fifth National Climate Assessment (NCA5) Alaska chapter</p> <p>Marine Ecosystems Community of Practice meeting on ship tracking activities in the Central Arctic Ocean and its marginal seas</p> <p>Sea Ice Community of Practice meeting on sea ice conditions, predictions, and forecasts</p>
	<p>2.2.4 Continue coordinated interdisciplinary Arctic marine climate and ecosystem observations, and share data and promote synthesis of field observations.</p>	<p><i>Meetings/webinars:</i></p> <p>Field Operations Community of Practice 2023 post-field season meeting featuring short talks from recent recent expeditions and observing networks</p> <p>Marine Ecosystems Community of Practice meeting on ship tracking activities in the Central Arctic Ocean and its marginal seas</p> <p>Field Operations Community of Practice meeting on building early career leadership in sea-going Arctic research and improving safety and inclusivity</p> <p>Sea Ice Community of Practice meeting to coordinate on sea</p>


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		<p>ice observations and field activities during the 2024 field season</p> <p>Sea Ice Community of Practice meeting on sea ice conditions, predictions, and forecasts</p> <p>Field Operations Community of Practice meeting on 2023 research expeditions and field best practices</p> <p>Marine Ecosystems Community of Practice meeting on international observing</p> <p>Marine Ecosystems Community of Practice meeting on Arctic marine synthesis efforts</p> <p>Physical Oceanography Community of Practice meeting on the blue economy</p> <p><i>Other projects:</i> 2023 spreadsheet of research expeditions</p>
○	2.2.5 Convene community-wide workshop highlighting how remote sensing data products can be used to inform multi-scale land models from plot to pan-Arctic and inform use of remote sensing data in land surface models.	n/a
◐	2.2.6 Continue support for research programs that document Arctic marine species distribution, abundance, biodiversity, health and condition, foraging ecology, demography, habitat use in the Arctic, and basic life history information as well as age and growth rates of key links in the food web.	<p><i>Publications:</i></p> <p>Fecal DNA metabarcoding shows credible short-term prey detections and explains variation in the gut microbiome of two polar bear subpopulations</p> <p>Identifying indicators of polar bear population status</p> <p>Long-term assessment of relationships between changing environmental conditions and the physiology of southern Beaufort Sea polar bears (<i>Ursus maritimus</i>)</p> <p>Serum Virome of Southern Beaufort Sea polar bears (<i>Ursus</i></p>


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		<p>maritimus) during a period of rapid climate change</p> <p>Observed and forecasted changes in land use by polar bears in the Beaufort and Chukchi Seas, 1985–2040</p> <p>Evaluating the efficacy of aerial infrared surveys to detect artificial polar bear dens</p> <p>Exploring effects of vessels on walrus behaviors using telemetry, automatic identification system data and matching</p> <p>USGS Q&A: Vessel Cruise for Estimates of Pacific Walrus Demography</p> <p><i>Meetings/webinars:</i></p> <p>Marine Ecosystems Community of Practice meeting on ship tracking activities in the Central Arctic Ocean and its marginal seas</p> <p>Marine Ecosystems Community of Practice meeting on international observing</p> <p>IARPC 2023 Pre-Field Season Meeting</p> <p><i>Funded research:</i></p> <p>MMC: Bridging research efforts to optimize body condition evaluation in two beluga (<i>Delphinapterus leucas</i>) populations: Blubber stratification and use of “omics” techniques to identify biomarkers of body condition</p> <p>MMC: Determining the relationship between prey, body condition and pregnancy in bowhead whales to predict the effects of climate change</p> <p><i>Other projects:</i></p>


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		<p>NOAA Fisheries planned (April 2024) aerial survey to count ribbon, spotted, ringed, and bearded seals in the U.S. waters of the Bering Sea</p> <p>NOAA Fisheries community engagement around aerial surveys for ice seals and polar bears</p>
	<p>2.2.7 Produce and support publications and data products enhancing understanding of the linkages among marine species, oceanographic and sea ice conditions, and climate change. Specifically improve understanding of mechanisms that affect trends in trophic interactions, abundance, distribution, vital rates, and behavior.</p>	<p><i>Publications:</i></p> <p>Polar bear energetic and behavioral strategies on land with implications for surviving the ice-free period</p> <p>Differential heat shock protein responses in two species of Pacific salmon and their utility in identifying heat stress</p> <p>Incremental evolution of modeling a prognosis for polar bears in a rapidly changing Arctic</p> <p><i>Meetings/webinars:</i></p> <p>Marine Ecosystems Community of Practice meeting on ship tracking activities in the Central Arctic Ocean and its marginal seas</p>
	<p>2.3 Understand interactions between social, ecological, and physical Arctic systems, particularly in the context of coastal, climate, and cryospheric change.</p>	<p>Seven deliverables, all in progress</p>
	<p>2.3.1 Observe, understand, and model processes to manage and mitigate potential and realized threats from coastal invasive species, biotoxins, and wildlife diseases on animals and human populations via existing research networks and initiatives, publications, participation in scientific meetings, and public engagement.</p>	<p><i>Publications:</i></p> <p>Survey for Selected Parasites in Alaska Brown Bears (<i>Ursus arctos</i>)</p> <p><i>Funded research:</i></p> <p>NIEHS: "Hazardous Materials Worker Health and Safety"</p>




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		<p>Training" (U45, Awarded 2023)</p> <p>NIEHS: "Restoring Northeast Cape for the Health and Well-Being of the Yupik Communities of St. Lawrence Island, Alaska" (R01, Awarded 2023)</p> <p>NIEHS: "Prevention of Paralytic Shellfish Poisoning in Subsistence Shellfish Harvest Communities of Southeast Alaska" (R01, Awarded 2022)</p>
	<p>2.3.2 Through conference sessions, scientific publications, and IARPC Collaborations meetings, highlight results from missions that contribute to long-term observations of land ice.</p>	<p><i>Meetings/webinars:</i></p> <p>Glaciers & Sea level Community of Practice meeting on NASA Earth Information System and sea level change</p> <p>Glaciers & Sea Level Community of Practice meeting on Greenland Ice Sheet science workshops</p> <p>Workshop on Greenland Ice Sheet Stability</p> <p>Second annual Future of Greenland Ice Sheet Science (FOGSS) meeting</p> <p><i>Publications:</i></p> <p>Seasonal and decadal subsurface thaw dynamics of an Aufeis feature investigated through numerical simulations</p> <p><i>Other projects:</i></p> <p>USGS Benchmark Glacier Project</p>
	<p>2.3.3 Develop and assess ice sheet models for better prediction of sea level rise.</p>	<p><i>Funded research:</i></p> <p>NSF AON: Sustained observation and study of the rapidly evolving Arctic Ocean environment</p> <p>NSF CAREER: What's Past is Prologue: Seamless Assimilation of Past Observations into Simulations of Future Ice Sheets</p> <p>NSF Collaborative Research: Disentangling runoff- and</p>


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		<p>Terminus-driven Velocity Variations of Fast Flowing Outlet Glaciers</p> <p>NSF Collaborative Research: Drivers and Biogeochemical Implications of Saltwater Intrusion Along Arctic Coastlines</p> <p>NSF Collaborative Research: NSFGE0-NERC: Understanding surface-to-bed meltwater pathways across the Greenland Ice Sheet using machine-learning and physics-based models</p> <p>NSF Collaborative Research: Sediment and Stability: Quantifying the Effect of Moraine Building on Greenland Tidewater Glaciers</p> <p><i>Meetings/webinars:</i></p> <p>Glaciers & Sea level Community of Practice meeting on NASA Earth Information System and sea level change</p> <p>Glaciers & Sea Level and Modelers communities of practice meeting on changes/improvements to commonly used community modeling tools since ISMIP6</p>
	<p>2.3.4 Integrate information from field, laboratory, and remote sensing studies to examine and quantify relationships among surface topography, vegetation composition, hydrology, disturbance effects (including fire, thermokarst, land use change, and wildlife), geophysical processes in permafrost soils, and humans. Share results in reports, presentations, and scientific publications.</p>	<p><i>Funded research:</i></p> <p>NSF CAREER: UAV-Based Radar Suite for Bulk-Snow Characterization and Risk Management</p> <p>NSF Collaborative Research: RAPID: Do large recent wildfires in the Yukon River Delta alter the delivery of black carbon to the Arctic Ocean?</p> <p>NSF Collaborative Research: The role of capillaries in the Arctic hydrologic system</p> <p>NSF Collaborative Research: The Role of Ice Sheet Instability in Marine Carbon and Nutrient Cycling in the Eurasian Arctic</p>

Status	Objective/Deliverable	Details
		<p><i>Meetings/webinars:</i></p> <p>Terrestrial Ecosystems Community of Practice meeting on monitoring and mapping permafrost systems</p> <p>USGS hosted a permafrost workshop in Golden, CO from September 19-21, 2023</p> <p>Terrestrial Ecosystems Community of Practice meeting on vegetation mapping efforts in Alaska</p> <p>Terrestrial Ecosystems Community of Practice meeting on NASA ABoVE research highlights and Alaska Fire Science Consortium updates</p> <p>Terrestrial Ecosystems Community of Practice meeting on multi-disturbance synthesis in Arctic and boreal regions of North America</p> <p><i>Publications:</i></p> <p>Unrecorded Tundra Fires of the Arctic Slope, Alaska USA</p> <p><i>Other projects:</i></p> <p>DOE InteRFACE: Interdisciplinary Research for Arctic Environments</p>
	<p>2.3.5 Better understand the rate of terrestrial and subsea permafrost degradation and their roles in environmental and ecosystems processes and services (e.g., atmospheric and terrestrial carbon, Arctic greening, species invasion) by integrating empirical information into modeling efforts at various scales and delivering results via publications and presentations.</p>	<p><i>Meetings/webinars:</i></p> <p>Terrestrial Ecosystems Community of Practice meeting on monitoring and mapping permafrost systems</p> <p>USGS hosted a permafrost workshop in Golden, CO from September 19-21, 2023</p> <p>Terrestrial Ecosystems Community of Practice meeting on vegetation mapping efforts in Alaska</p>





Status	Objective/Deliverable	Details
		<p>Permafrost Discovery Gateway webinar on Bridging the Gap: Enhancing E3SM Land Model Simulation of Pan-Arctic Methane</p> <p>Terrestrial Ecosystems Community of Practice meeting on Arctic and boreal ecosystem data archiving and access across data centers</p> <p>Terrestrial Ecosystems Community of Practice meeting on NASA ABoVE research highlights and Alaska Fire Science Consortium updates</p> <p>Terrestrial Ecosystems Community of Practice meeting on multi-disturbance synthesis in Arctic and boreal regions of North America</p> <p><i>Publications:</i> Increasing Alaskan river discharge during the cold season is driven by recent warming</p>
	<p>2.3.6 Foster continued efforts to link multi-agency investments while expanding empirical datasets and synthesizing information that will inform the development of updated essential variable maps for Alaska, Greenland, and the circumpolar Arctic (e.g., permafrost ground ice content, topography, bathymetry, vegetation).</p>	<p><i>Funded research:</i> NSF CAREER: Follow the Water: Understanding River Discharge Dynamics in Rapidly Changing High Northern Latitudes NSF Collaborative Research: The Past, Present, and Future of Boreal Fire Feedbacks</p> <p><i>Meetings/webinars:</i> Terrestrial Ecosystems Community of Practice meeting on monitoring and mapping permafrost systems Terrestrial Ecosystems Community of Practice meeting on Arctic and boreal ecosystem data archiving and access</p>



Status	Objective/Deliverable	Details
		<p>across data centers</p> <p>Terrestrial Ecosystems Community of Practice meeting on vegetation mapping efforts in Alaska</p> <p>Glaciers & Sea Level Community of Practice meeting on NASA's SnowEx campaign</p> <p>Permafrost Discovery Gateway meeting on next generation plant biomass maps for the Arctic tundra biome</p> <p>Terrestrial Ecosystems Community of Practice meeting on NASA ABoVE research highlights and Alaska Fire Science Consortium updates</p> <p>Terrestrial Ecosystems Community of Practice meeting on multi-disturbance synthesis in Arctic and boreal regions of North America</p> <p><i>Publications:</i></p> <p>Disturbances in North American boreal forest and Arctic tundra: impacts, interactions, and responses</p>
	<p>2.3.7 Improve high-resolution models' ability to capture coastal processes at the interface of ocean, land, and atmosphere by supporting targeted collaborations among model developers, users, and decision-makers. Products will include an interagency scientific peer-reviewed publication and conference sessions that address these models.</p>	<p><i>Funded research:</i></p> <p>NSF Collaborative Research: Assessing the Causal Influence of Atmospheric Opacity and Sea Ice on Arctic Warming in a Novel Circulation-controlled Framework</p> <p>NSF Collaborative Research: Atmospheric controls of moisture extremes over Greenland</p> <p>NSF Collaborative Research: EAGER: Microstructure Observations of Vertical Mixing and Heat Fluxes from Chipods Deployed on Arctic Observing Network Cruises</p> <p><i>Meetings/webinars:</i></p>



Status	Objective/Deliverable	Details
		<p>Glaciers & Sea level Community of Practice meeting on NASA Earth Information System and sea level change</p> <p>Glaciers & Sea Level Community of Practice meeting on community engagement in glaciology</p> <p>Coastal Resilience Community of Practice meeting on developments in the mapping and modeling of coastal hazards</p> <p>Glaciers & Sea Level Community of Practice meeting on hazards in the Arctic</p>
	Priority Area: Sustainable Economies & Livelihoods	Five deliverables. Three in progress; two not started.
	3.1 Conduct and support research to foster the development of Arctic infrastructure. This includes research on improvements in community capacity and infrastructure projects that are prioritized by Arctic communities to support resilience and leverage technology in community redevelopment and relocation efforts.	Two deliverables, both in progress.
	<p>3.1.1 Conduct a study to create an asset map of existing infrastructure as a baseline for understanding how to equip a community to be resilient to climate impacts. Facilitate sharing resources about and mitigation techniques for known threats to infrastructure impacted by climate change.</p>	<p><i>Funded research:</i></p> <p>NSF: Collaborative Research: Climate Change and Human Adaptation in Arctic-like Environments across the Pleistocene-Holocene Transition</p> <p>NSF: Collaborative Research: NNA Incubator: Improving Culturally Sensitive Energy Strategies in the Arctic Residential Buildings with the Co-Production of Knowledge Framework</p>





Status	Objective/Deliverable	Details
		<p><i>Meetings/Webinars</i> Alaska Infrastructure Development Symposium</p> <p><i>Publications:</i> Alaska Stakeholder Community Engagement Network (ASCENT) 2023 Project Report and Dataset</p> <p><i>Other projects:</i> Sustainable Economies and Livelihoods Collaboration Team leaders worked with State of Alaska to coordinate on infrastructure development in Alaska Initial steps taken toward creating an asset map, including collecting metadata of relevant infrastructure data sets in Alaska and collecting a dataset of more than 3,000 funded infrastructure projects in Alaska</p>
	<p>3.1.2 Support new innovations and off-the-shelf technology that can be implemented in community development plans to support the ability of Arctic communities to combat climate change impacts.</p>	<p><i>Funded research:</i> NSF Collaborative Research: NNA Research: Electric Vehicles in the Arctic (EVITA) - Interactions with Cold Weather, Microgrids, People, and Policy</p> <p><i>Meetings/webinars:</i> Cold/High Anaerobic Digestion Community of Practice meetings on research and installations, including EPA pilot digester (Oct 2023, Nov 2023, Dec 2023, Jan 2024) Physical Oceanography Community of Practice meeting on challenges and potential approaches to removing carbon dioxide from the atmosphere and ocean</p>





Status	Objective/Deliverable	Details
○	3.2 Improve understanding of the importance and value of economies in the Arctic. Support local access to Arctic economic opportunities by examining the linkages among economic initiatives, infrastructure, socioeconomic factors, and values of rural Arctic communities.	Two deliverables, neither started.
○	3.2.1 Support research that incorporates economic model insights and synthesizes available data to identify important factors affecting job availability and wages in major economic sectors.	n/a
○	3.2.2 Research regionally appropriate and feasible options for building local human capacity, considering cultural attributes and vocational capabilities juxtaposed with evolving environmental trends and economic opportunities, and articulate results within regional economic development strategies and plans.	n/a
◐	3.3 Improve multi-species and ecosystem approaches to predict climate change impacts on species distributions and on economically viable access to commercial and subsistence species in the next 50 years.	One deliverable, in progress.
◐	3.3.1 Develop short-term comparative model predictions of the distribution and populations of fishery species (e.g. pollock, cod, salmon, halibut, crab) in response to evolving climatic conditions in the Northern Bering Sea and Southern Chukchi Sea.	<i>Meetings/webinars:</i> Marine Ecosystems Community of Practice meeting on Arctic marine synthesis efforts






Status	Objective/Deliverable	Details
	Priority Area: Risk Management and Hazard Mitigation	Seven deliverables, all in progress.
	4.1 Summarize currently available data and information requirements associated with hazard and risk mitigation, adaptation, and response efforts. Synthesize community-led activities and information to identify potential needs for future efforts.	Two deliverables, both in progress.
	4.1.1 Conduct a study identifying where information used in decision-making and planning can be improved through access to new or additional data sources. This study should consider a wide range of activities associated with ongoing responses to common and emerging hazards, including risk reduction efforts and emergency preparedness and response.	<i>Meetings/webinars:</i> Risk Management & Hazard Mitigation webinar series on connecting data and tool development to hazard mitigation, including meeting on the Alaska Coastal Cooperative Collaboratory ACTION Coastal Resilience Community of Practice meeting on NOAA NCOS 2024 Effects of Sea Level Rise (ESLR) Grant Opportunity Modelers and Terrestrial Ecosystems communities of practice meeting on forecasting Arctic wildfires Glaciers & Sea Level Community of Practice meeting on community engagement in glaciology <i>Other projects:</i> Permafrost workshop with focus on hazard mitigation in development (in planning for fall 2024)
	4.1.2 Share findings of deliverable 4.1.1 as a means (1) to spur additional research and science communication aimed at addressing unmet needs for planning, prevention, response, and recovery and (2) to inform	<i>Meetings/webinars:</i> IARPC 2023 Pre-Field Season Meeting

Status	Objective/Deliverable	Details
	time-sensitive decision-making and planning processes.	
	4.2 Update and improve the “Statewide Threat Assessment: Identification of Threats from Erosion, Flooding, and Thawing Permafrost in Remote Alaska Communities.”	Three deliverables, all in progress.
	<p>4.2.1 Undertake a study to identify the top 10 threats/hazards to communities and critical remote state and Federal government infrastructure in the state of Alaska that should be included in the Statewide Threat Assessment. This might include coastal and river erosion, flooding, thawing permafrost, and changes in the seasonal snowpack.</p>	<p><i>Funded research:</i></p> <p>NIEHS: “Restoring Northeast Cape for the Health and Well-Being of the Yupik Communities of St. Lawrence Island, Alaska” (R01, Awarded 2023)</p> <p>NIEHS: “Protecting the Health of Future Generations: Assessing and Preventing Exposures to Endocrine-Disrupting Flame Retardant Chemicals & PCBs in Two Alaska Native Arctic Communities on St. Lawrence Island” (R01, Awarded 2021)</p> <p>NIEHS: “Prevention of Paralytic Shellfish Poisoning in Subsistence Shellfish Harvest Communities of Southeast Alaska” (R01, Awarded 2022)</p> <p>NIEHS: “Convergence of multiple exposures during pregnancy: Effect of wildfires and maternal stressors on birth outcomes among Alaskan women” (K01, Awarded 2024)</p> <p>NSF: Collaborative Research: MEGA - Mercury biogeochemical cycling and export from Greenland to the Arctic</p> <p><i>Meetings/webinars:</i></p> <p>White House Subcommittee on Ocean Sciences and Technology Coastal Resilience Workshop</p>




Status	Objective/Deliverable	Details
		<p>Terrestrial Ecosystems Community of Practice meeting on NASA ABoVE research highlights and Alaska Fire Science Consortium updates</p> <p><i>Other projects:</i> The Denali Commission is working with a UAF team to update the Statewide Threat Assessment</p>
	<p>4.2.2 Upon completion of 4.2.1, establish a data collection and collation plan to include mechanisms to collect threat/hazard data that may not be readily available.</p>	<p><i>Funded research:</i> NIEHS: “Restoring Northeast Cape for the Health and Well-Being of the Yupik Communities of St. Lawrence Island, Alaska” (R01, Awarded 2023) NIEHS: “Protecting the Health of Future Generations: Assessing and Preventing Exposures to Endocrine-Disrupting Flame Retardant Chemicals & PCBs in Two Alaska Native Arctic Communities on St. Lawrence Island” (R01, Awarded 2021) NIEHS: “Prevention of Paralytic Shellfish Poisoning in Subsistence Shellfish Harvest Communities of Southeast Alaska” (R01, Awarded 2022) NIEHS: “Convergence of multiple exposures during pregnancy: Effect of wildfires and maternal stressors on birth outcomes among Alaskan women” (K01, Awarded 2024)</p>
	<p>4.2.3 Collect and integrate disparate threat/hazard information and perform modeling and analysis to understand where natural and human-made threats and hazards pose a risk to Arctic communities.</p>	<p><i>Meetings/webinars:</i> Permafrost Community of Practice meeting on the Alaska Innovation Landscape Network (AILN) USGS hosted a permafrost workshop in Golden, CO from September 19-21, 2023</p>


Status	Objective/Deliverable	Details
		<p>Coastal Resilience Community of Practice meeting on developments in the mapping and modeling of coastal hazards</p> <p><i>Other projects:</i> The Denali Commission is working with a UAF team to update the Statewide Threat Assessment</p>
	<p>4.3 Research to support more resilient and transformative infrastructure to withstand potential impacts from acute and long-term hazards, including those hazards brought about by climate change.</p>	<p>Two deliverables, both in progress.</p>
	<p>4.3.1 Conduct a study focused on expedient and enduring cold regions infrastructure, including water and wastewater, energy, and temporary and enduring structures. Results will be disseminated into a report that will identify and provide background information on the variety of available and emerging water/wastewater, energy, and structure technologies and best practices.</p>	<p><i>Funded research:</i> USACE: funding to USACE Alaska District and CRREL to create building standards for Alaska villages</p> <p><i>Meetings/webinars:</i> Technology Innovation and Application Collaboration Team meeting on technology transfer</p>
	<p>4.3.2 Conduct a study that looks at novel materials that could be used to improve resilience for physical infrastructure from the effects of hazards. Areas of interest include energy, communications, and transportation infrastructure. Share findings in a report.</p>	<p><i>Funded research:</i> USACE: funding to USACE Alaska District and CRREL to create building standards for Alaska villages</p>
	<p>Foundational Activity: Data Management</p>	<p>Seven deliverables. Four in progress; three not started.</p>



Status	Objective/Deliverable	Details
	<p>DATA 1 Encourage and implement FAIR (Findable, Accessible, Interoperable, and Reusable) and CARE (Collective benefit, Authority to control, Responsibility, and Ethics) data management principles in the Arctic.</p>	
	<p>DATA 1.1 Identify verified points of contact (e.g., agency champions, data practitioners, Arctic residents, Indigenous organizations) and their areas of expertise and interests for working with the data team on exploring and implementing FAIR and CARE in Arctic data management. As part of developing the points of contact, identify and track representation across many axes of diversity (demographics, disciplines/sectors, IARPC experience, career stage, and others) to ensure a diverse and representative group of contributors. The data team will check in with these groups regularly to ensure the points of contact are up to date.</p>	<p><i>Other projects:</i> Data Management Collaboration Team leaders have created a list of contacts and will continue to refine, update, and expand it.</p>
	<p>DATA 1.2 Data 1.2 In order to build community buy-in and promote sustained efforts, develop and revisit and update terms of reference which articulate Biennial Implementation Plan Data Management roles, activities, and metrics.</p>	<p><i>Other projects:</i> Data Management Collaboration Team leaders have begun to draft a terms of reference document articulating team roles, activities, and metrics.</p>
	<p>DATA 1.3 Based on input from engagement activities, develop and update centralized documentation of thematic areas of interest, ongoing activities, and key documents and resources that can inform deliverables and future Biennial Implementation Plans.</p>	<p><i>Other projects:</i> The Data Management Collaboration Team has created and continues to update a collaborative working document that collects areas of interest, ongoing activities, and key resources.</p>




Status	Objective/Deliverable	Details
	DATA 1.4 Convene quarterly seminars, discussions, and training on FAIR and CARE data management in the Arctic. Ensure a diverse group of presenters and contributors are represented in these activities.	<i>Meetings/webinars:</i> Data Management and Monitoring, Observing, Modeling, & Prediction collaboration teams meeting on discovery, integration, and reuse of interdisciplinary Arctic sample data Terrestrial Ecosystems Community of Practice meeting on Arctic and boreal ecosystem data archiving and access across data centers Data Management Collaboration Team meeting on Arctic data management and building skills Data Management Collaboration Team meeting to crowdsource data management resources and topics
	DATA 1.5 Develop a common format and structure (e.g., questions, prompts) for team meetings to help elicit and articulate perspectives on all aspects of FAIR and CARE to help work towards the community summary/synthesis products below.	n/a
	DATA 1.6 Develop a summary document of perspectives on implementing FAIR and CARE in Arctic contexts.	n/a
	DATA 1.7 Based on the summaries mentioned in DATA 1.6, develop concise (i.e., one-pager) public-facing documents on data management considerations to align with FAIR and CARE principles.	n/a
	Foundational Activity: Education, Training, and Capacity Building	Four deliverables, all in progress.



Status	Objective/Deliverable	Details
●	EDU 1 Establish a ONE STEM hub.	
●	EDU 1.1 Establish a ONE STEM hub.	<p><i>Other projects:</i> Progress is being made toward the One STEM hub through compilation of activities relevant to education, training, and capacity building in the Arctic.</p>
●	EDU 1.2 Provide access to STEM internships, skill development opportunities, and career pathways for those living in and/or with interest in the Arctic, in particular for rural and Indigenous communities.	<p><i>Funded research:</i> NSF Collaborative Research: REU Site: Arctic REU Greenland - Earth and Environmental Processes from the Inland Ice to the Ocean along the Aasivissuit-Nipisat World Heritage Corridor</p>
●	EDU 1.3 Engage in ongoing and respectful dialogue with communities about education, training, and capacity building needs. Document feedback.	<p><i>Meetings/webinars:</i> Education, Training, and Capacity Building Collaboration Team meeting on new Smithsonian partnerships for culturally responsive STEAM education in Alaska</p>
●	EDU 1.4 Use quarterly meetings to build the STEM Education team into a robust community that supports promotion of STEM careers and skills for rural and Indigenous students.	<p><i>Meetings/webinars:</i> Education, Training, and Capacity Building Collaboration Team meeting on new Smithsonian partnerships for culturally responsive STEAM education in Alaska Education, Training, and Capacity Building Collaboration Team meeting on broadening participation through a storytelling-based learning cycle IARPC webinar on the Alaska Arctic Observatory and Knowledge Hub</p>


Status	Objective/Deliverable	Details
	Foundational Activity: Monitoring, Observing, Modeling, and Prediction	Sixteen deliverables. Fifteen in progress; one complete.
	MOMP 1 Coordinate activities and communities of practice that bring together Arctic modeling, observing, monitoring, and prediction to advance Arctic research.	Five deliverables, all in progress.
	MOMP 1.1 Develop synthesis products, best-estimate datasets, model simulations, and model intercomparison studies from major Arctic field campaigns and long-term observational sites to advance the integration of observational and modeling studies and process-based assessment of model simulations.	<p><i>Funded research:</i> NSF CAREER: Improving Estimates of Changing Firn Meltwater Storage and Flux in Temperate Glacier Systems</p> <p><i>Meetings/webinars:</i> Modelers Community of Practice meeting on CMIP7 planning from an Arctic research perspective American Meteorological Society Annual Meeting session: Observational Constraints for Lagrangian COMBLE-MIP Simulations AGU 2023 Fall Meeting poster presentation: COMBLE-MIP: A model intercomparison to understand LES and SCM uncertainty in marine cold-air outbreaks over the Norwegian Sea AGU 2023 Fall Meeting session: Coupled-System Processes of the Central Arctic Atmosphere–Sea Ice–Ocean System: Harnessing Field Observations and Advancing Models Modelers and Terrestrial Ecosystems communities of practice meeting on forecasting Arctic wildfires Monitoring, Observing, Modeling, and Prediction Collaboration Team meeting on Arctic model evaluation and metrics from MOSAiC, ABoVE, and the DBO</p>

Status	Objective/Deliverable	Details
		<p>2nd International MOSAiC Science Conference session “Aggregated Datasets and Methods for Model Evaluation” AGU 2023 session “Coupled-system Processes of the Central Arctic Atmosphere-Sea Ice-Ocean System: Harnessing Field Observations and Advancing Models”</p> <p><i>Publications:</i> Sensitivity of headwater streamflow to thawing permafrost and vegetation change in a warming Arctic</p> <p><i>Other projects:</i> DOE-supported researchers are organizing a model intercomparison study based on the Cold-Air Outbreaks in the Marine Boundary Layer Experiment (COMBLE) field experiment USGS Alaska Landbird Conservation Plan</p>
	MOMP 1.2 Support development of metrics that measure key Arctic processes and implementation of these metrics in benchmarking packages to facilitate model validation against observations.	<p><i>Meetings/webinars:</i> AGU 2023 Fall Meeting session on Systematic Benchmarking of Earth System Models AGU 2023 Fall Meeting poster presentation on the influence of benchmark data choices on inferred model performance in the Arctic-Boreal region Monitoring, Observing, Modeling, and Prediction Collaboration Team meeting on Arctic model evaluation and metrics from MOSAiC, ABoVE, and the DBO</p> <p><i>Publications</i></p>



Status	Objective/Deliverable	Details
		Boreal–Arctic wetland methane emissions modulated by warming and vegetation activity
	<p>MOMP 1.3 Provide funding opportunities for research coordination between groups working on Arctic coupled data assimilation and reanalysis, emphasizing intercomparison assessments of the full atmosphere-land-ocean-cryosphere coupled system.</p>	<p><i>Funded research:</i> NSF updated Research Coordination Networks solicitation to to advance a field or create new directions in research or education by supporting groups of investigators to communicate and coordinate their research, training and educational activities</p> <p><i>Publications</i> Improvements in September Arctic Sea Ice Predictions Via Assimilation of Summer CryoSat-2 Sea Ice Thickness Observations RARE: The Regional Arctic Reanalysis</p>
	<p>MOMP 1.4 Support ongoing work, such as observing system experiments (OSEs), to quantify the current and potential value of Arctic ocean, atmosphere, sea ice, and land observations for initialized predictions spanning daily to decadal timescales.</p>	<p><i>Meetings/webinars:</i> Sea Ice Community of Practice meeting on sea ice conditions, predictions, and forecasts Modelers Community of Practice meeting on statistical models in Arctic sea ice prediction</p> <p><i>Publications</i> Robustness of Observing System Simulation Experiments</p> <p><i>Funded research:</i> NASA Modeling and Prediction Program supports the PolarMERRA initiative to improve polar processes in the Goddard Earth Observing Model (GEOS) NASA funding efforts through the Decadal Survey Incubation</p>



Status	Objective/Deliverable	Details
		(DSI) program to understand the relative benefits of polar focused remotely sensed data for improving sea ice and land ice state estimation and predictive capabilities
	MOMP 1.5 Hold regular joint meetings of the Observing and Modeling communities of practice to better coordinate these communities of practice, bridge the communication gap between the modeling and observation science communities, and support the priority area research activities.	<i>Meetings/webinars:</i> Physical Oceanography Community of Practice meeting on ocean boundary layer modeling and observing Monitoring, Observing, Modeling, and Prediction Collaboration Team meeting on synthesis data products and modeling from Arctic field campaigns and long-term observational sites RNA CoObs session at 2023 Alaska Forum on Environment focused on observing for community decision-making RNA CoObs and US AON day-long dialogue with First Alaskans Institute in October 2022 focused on strengthening working relationships with Alaska Indigenous communities
	MOMP 2 Support assessment, gaps analysis, and intercomparisons to understand observational and modeling needs in Arctic research.	Five deliverables. Four in progress; one complete.
	MOMP 2.1 Develop an online tool for the research community to support expert elicitation and data visualization for the value tree gaps analysis methodology.	<i>Meetings/webinars:</i> Observations Community of Practice and Monitoring, Observing, Modeling, & Prediction and Risk Management & Hazard Mitigation collaboration teams meeting about applying US AON's Benefit Tool to risks and hazards <i>Other projects:</i> The US Arctic Observing Network (US AON) is developing an



Status	Objective/Deliverable	Details
		<p>online tool for the research community to support expert elicitation and data visualization for the value tree gaps analysis methodology as well as developing case studies for initial analysis (code available here)</p>
	<p>MOMP 2.2 Conduct observational gaps analysis case studies using the value tree methodology to inform understanding of the capabilities, opportunities, and gaps in Arctic observing and data systems, with an initial focus on risk hazard and mitigation.</p>	<p><i>Meetings/webinars:</i> Observations Community of Practice and Monitoring, Observing, Modeling, & Prediction and Risk Management & Hazard Mitigation collaboration teams meeting about applying US AON's Benefit Tool to risks and hazards</p> <p><i>Publications:</i> Shared Arctic Variable Framework Links Local to Global Observing System Priorities and Requirements</p> <p><i>Other projects:</i> The US Arctic Observing Network (US AON) is developing an online tool for the research community to support expert elicitation and data visualization for the value tree gaps analysis methodology as well as developing case studies for initial analysis (code available here)</p>
	<p>MOMP 2.3 Provide support and/or funding opportunities for researchers to participate in existing Arctic-focused model intercomparison projects and explore the feasibility of developing new model intercomparison projects focused on the Arctic system, its components, or its coupling with the broader climate system to understand gaps in modeling and predictability of the Arctic system.</p>	<p><i>Funded research:</i> DOE Warming Permafrost Model Intercomparison Project (WrPMIP) NSF Arctic Research Opportunities solicitation</p> <p><i>Meetings/webinars:</i> Modelers Community of Practice meeting on CMIP7 planning from an Arctic research perspective WrPMIP Site-Level Benchmarking Workshop</p>








Status	Objective/Deliverable	Details
		<p>Sea Ice Community of Practice meeting on sea ice conditions, predictions, and forecasts</p> <p>Modelers and Physical Oceanography communities of practice meeting on biases in Arctic Ocean stratification</p> <p>Modelers Community of Practice meeting on statistical models in Arctic sea ice prediction</p> <p>AGU 2023 session on predictions and predictability in the high latitude climate system</p> <p><i>Publications:</i></p> <p>Sea Ice and Cloud Processes Mediating Compensation between Atmospheric and Oceanic Meridional Heat Transports across the CMIP6 Preindustrial Control Experiment</p>
	<p>MOMP 2.4 Conduct workshops to identify Arctic modeling needs and priorities across research and operational modeling communities.</p>	<p><i>Publications:</i></p> <p>Workshop on Advancing NOAA’s Modeling for Improved Sea Ice Forecasts: Defining Priorities and Key Collaborations</p> <p><i>Meetings/webinars:</i></p> <p>MOMP meeting on outcomes of the Observing, Modeling, and Understanding of the Circulation of the Arctic Ocean and Sub-Arctic Seas workshop</p> <p>First CAMAS workshop, February 2024</p> <p>Sea Ice Community of Practice meeting on sea ice conditions, predictions, and forecasts</p> <p><i>Other projects:</i></p>

Status	Objective/Deliverable	Details
		The Consortium for the Advancement of Marine Arctic Science (CAMAS) was established to facilitate and enhance international collaboration on marine Arctic science
●	MOMP 2.5 Publish observing report tasked to the United States Arctic Observing Network (US AON) Board via IARPC.	<p><i>Other projects:</i> The US AON Board completed and published the report, "On the Need to Establish and Maintain a Sustained Arctic Observing Network", requested by Congress.</p> <p><i>Meetings/webinars:</i> IARPC public webinar on the Arctic Observing Network report</p>
◐	MOMP 3 Support coordination and engagement with Federal, international, and non-Federal partners who are conducting monitoring, observing, modeling, and prediction of the Arctic.	Three deliverables, all in progress.
◐	MOMP 3.1 Support participation of United States researchers in international Arctic modeling and prediction efforts in order to quantify and improve the predictive capabilities of Arctic models as evidenced by relevant scientific papers, presentations, and meeting sessions.	<p><i>Funded research:</i> NSF Activities of the Polar Research Board (2023-2026)</p> <p><i>Meetings/webinars:</i> American Meteorological Society meeting presentation: How Well Do Atmospheric Models Represent the Arctic Boundary Layer? A Multi-Model Evaluation of Arctic Boundary Layer Simulations Using Observations From MOSAiC Sea Ice Community of Practice meeting on sea ice conditions, predictions, and forecasts Ocean Sciences Meeting 2024 session on Arctic Ocean change and processes Modelers and Physical Oceanography communities of</p>






Status	Objective/Deliverable	Details
		<p>practice meeting on biases in Arctic Ocean stratification AGU 2023 session on predictions and predictability in the high latitude climate system</p>
	<p>MOMP 3.2 Coordinate communication of information about field activities to Alaska communities where the research is being conducted through the research expedition vessel status tracker and spring and fall reports on research season activities.</p>	<p><i>Meetings/webinars:</i> Poster on Field Operations Community of Practice presented at Alaska Marine Science Symposium Presentation at Marine Research Planning Night Workshop at the Alaska Marine Science Symposium Sea Ice Community of Practice meeting to coordinate on sea ice observations and field activities during the 2024 field season IARPC 2023 Pre-Field Season Meeting</p> <p><i>Other projects:</i> 2023 spreadsheet of research expeditions</p>
	<p>MOMP 3.3 Coordinate U.S. Federal Arctic observing and modeling research efforts with other relevant U.S. interagency groups (e.g., ICAMS, USCLIVAR, USGCRP, and USGEO) to identify priority activities to support the Arctic component of Earth System Predictability Research and Development Strategic Framework and Roadmap.</p>	<p><i>Meetings/webinars:</i> MOMP meeting on outcomes of the Observing, Modeling, and Understanding of the Circulation of the Arctic Ocean and Sub-Arctic Seas workshop Monitoring, Observing, Modeling, and Prediction team leaders met with the coordinator of the USGCRP Integrated Observations Interagency Working Group to discuss coordination on observational activities IARPC webinar on Alaska chapter of the 5th National Climate Assessment Modelers and Terrestrial Ecosystems communities of practice meeting on forecasting Arctic wildfires Monitoring, Observing, Modeling, and Prediction team</p>

Status	Objective/Deliverable	Details
		leaders met with the ICAMS Earth System Predictability Joint Action Group
	MOMP 4 Support best practices in field observations and modeling.	Three deliverables, all in progress.
	MOMP 4.1 Build on existing efforts within Federal agencies to share resources and implement best practices for improving field safety culture, diversity, and inclusivity, and enforcing safe working environments in the field, including both physical safety while working in harsh and remote Arctic environments and emotional safety from harassment and hostile working conditions.	<p><i>Meetings/webinars:</i></p> <p>Early Career Community of Practice and USAPECS meeting about being a successful, safe, respectful researcher in the field</p> <p>Early Career Community of Practice and Participatory Research & Indigenous Leadership in Research meeting on NSF Safe and Inclusive Fieldwork (SAIf) plans</p> <p>DOE Biological and Environmental Research (BER) program invited a presentation on “Building a Culture of Safety and Trust in Team Science” at its federal advisory committee meeting in October.</p> <p>Diversity & Inclusion Community of Practice and Polar Science Early Career Community Office meeting on inclusive environments and navigating power imbalances in Arctic fieldwork</p> <p><i>Other projects:</i></p> <p>NSF requirement for Plan for Safe and Inclusive Fieldwork plan in all proposals</p> <p>DOE requirement for Promoting Inclusive and Equitable Research (PIER) plans in research proposals</p> <p>NSF addition to NSF 23-1 Proposal & Award Policies and Procedures Guide (PAPPG) to ensure organizations have a plan in place for safe and inclusive research</p>

Status	Objective/Deliverable	Details
	<p>MOMP 4.2 In coordination with the IARPC Diversity and Inclusion Community of Practice and the Participatory Research and Indigenous Leadership in Research Foundational Activity, promote and support best practices for improving diversity and inclusion in Arctic monitoring, observing, modeling, and prediction efforts, including identifying pathways to support Indigenous co-leadership of activities.</p>	<p><i>Meetings/webinars:</i> MOMP and Data Management collaboration teams meeting on data management for physical samples Observations Community of Practice meeting previewing the Arctic Observing Summit</p> <p><i>Publications:</i> Arctic Observing Summit 2022 Workshop Report: What does it mean to observe Indigenous food security?</p> <p><i>Other projects:</i> RNA CoObs is exploring and fostering potential networks around three themes with the intention of supporting the establishment of SAON ROADS Shared Arctic Variable Expert Panels: salmon, harmful algal blooms (HABs) and coastal erosion/extreme weather, in addition to US participation in a Canadian-led Expert Panel on sea ice and the possible additional establishment of a North American wildfire Expert Panel. Craig Chythlook, RNA CoObs Indigenous Liaison, served as IARPC Arctic Observing System Collaboration Team co-lead; Chythlook also held an Indigenous Leadership Fellowship with IARPC. Connections with potential expert panelists at the United Tribes of Bristol Bay Sustainability Summit in February 2023</p>
	<p>MOMP 4.3 In coordination with the Data Management foundational activity, promote and support FAIR and CARE principles for observational and modeling data.</p>	<p><i>Meetings/webinars:</i> Sea Ice Community of Practice meeting on sea ice conditions, predictions, and forecasts</p>

Status	Objective/Deliverable	Details
	Foundational Activity: Participatory Research and Indigenous Leadership in Research	Thirteen deliverables. Seven in progress; six not started.
	PILR 1 Fulfill Federal requirement to consult with Federally recognized Tribes and Alaska Native Corporations.	Three deliverables. Two in progress; one not started.
	PILR 1.1 Create a best practices document on meaningful consultation and engagement on Arctic research with Alaska Indigenous communities that is applicable to all Federal agencies.	<i>Other projects:</i> USFWS & IARPC online self-guided toolkit, Ikaayutinat: Co-Production of Knowledge Toolkit
	PILR 1.2 Evaluate the Principles for Conducting Research in the Arctic 2018, and update as needed based on the evaluation.	<i>Other projects:</i> Participatory Research and Indigenous Leadership in Research Collaboration Team leaders are gathering input from Indigenous communities and academics to craft a survey about the Principles, and are working on the Federal Register process for the survey
	PILR 1.3 Develop and deliver training for agencies to implement the Principles for Conducting Research in the Arctic.	n/a
	PILR 2 Engage Arctic communities and individuals in research in a way that is meaningful to them.	Five deliverables. Three in progress; two not started.
	PILR 2.1 Create a training toolkit for scientists that can be self-guided and used as needed. Topics may include cross-cultural communication, consultation, participatory research, Indigenous Knowledge, overview of Indigenous	<i>Other projects:</i> USFWS & IARPC online self-guided toolkit, Ikaayutinat: Co-Production of Knowledge Toolkit

Status	Objective/Deliverable	Details
	culture groups, formal agreements, and how to contract and consult with Indigenous companies and individuals.	
●	PILR 2.2 Create a report of examples where IARPC member agencies have engaged Indigenous Knowledge holders in research.	<p><i>Meetings/webinars:</i> USGS participation in community engagement on salmon declines in Emmonak as part of a new collaborative research project that combines local and traditional knowledge, western science, and community-based monitoring to understand western Alaska salmon declines with funding from the North Pacific Research Board.</p>
○	PILR 2.3 Request that each Priority Area Collaboration Team host regular meetings that meaningfully engage with Indigenous leaders, groups, and/or communities. This includes developing a list of contacts to support requests for engagement or tracking engagement with Indigenous participation.	n/a
○	PILR 2.4 Analyze and develop a report on broader impacts of science/research teams on Indigenous health and resilience.	n/a
●	PILR 2.5 Hold interagency meetings/workshops to identify mechanisms for Federal agencies to effectively communicate science plans and findings among themselves and with communities.	<p><i>Meetings/webinars:</i> USGS Climate Adaptation Science Centers webinar series on incorporating Indigenous Knowledge into federal research and management USGS Alaska Science Center Polar Bear Research Program hybrid workshop to review studies completed under the current five-year research plan and solicit input for studies to include in the new five-year plan</p>

Status	Objective/Deliverable	Details
		<p><i>Publications:</i> Kings of the North: Bridging Disciplines to Understand the Effects of Changing Climate on Chinook Salmon in the Arctic-Yukon-Kuskokwim Region</p>
	<p>PILR 3 Develop guidance for agencies to consistently apply participatory research and Indigenous leadership in research.</p>	<p>Five deliverables. One in progress; four not started.</p>
	<p>PILR 3.1 Co-define "Indigenous leadership in research" with Tribes, Indigenous organizations, and Federal agencies; and integrate into the Principles for Conducting Research in the Arctic and its training toolkit and best practices documents.</p>	<p>n/a</p>
	<p>PILR 3.2 Hold interagency meetings/workshops to identify methods to streamline contracting/agreements and compensation processes to make co-stewardship and co-production in research more equitable and achievable.</p>	<p>n/a</p>
	<p>PILR 3.3 Convene discussions to identify mechanisms to foster equitable pathways for Indigenous leadership in research.</p>	<p>n/a</p>
	<p>PILR 3.4 Identify best practices for Federal agencies to support capacity for Tribes and Indigenous Knowledge holders in research. Distribute guidance on best practices to IARPC agencies.</p>	<p><i>Meetings/webinars:</i> USGS Climate Adaptation Science Centers webinar series on incorporating Indigenous Knowledge into federal research and management</p>

Status	Objective/Deliverable	Details
		<p><i>Other projects:</i> Alaska Region USGS and USFWS FY24 proposal formats encourage co-production of knowledge</p>
○	<p>PILR 3.5 Ensure consistent terminology for Indigenous Traditional Ecological Knowledge, Indigenous Knowledge, Traditional Ecological Knowledge, and Local Knowledge for IARPC. Suggest primary language for IARPC be Indigenous Knowledge.</p>	n/a
◐	<p>Foundational Activity: Technology Innovation and Application</p>	<p>One deliverable, in progress.</p>
◐	<p>TIA 1.1 Technology is a crosscutting challenge for Arctic researchers, as the Arctic setting requires dedicated investments in technology support to make research activities possible. The Technology Innovation and Application Foundational Activity does not identify separate objectives or deliverables, but instead will support deliverables across this Biennial Implementation Plan.</p>	<p><i>Meetings/webinars:</i> Technology Innovation and Application Collaboration Team meeting on federal technology transfer authorities at USGS Technology Innovation and Application Collaboration Team meeting on technology innovation and opportunity from an academic perspective Technology Innovation and Application Collaboration Team meeting on marine technology innovation and opportunity Technology Innovation and Application Collaboration Team meeting on innovations in instrumentation for observations of methane emissions in the Arctic</p> <p><i>Other projects:</i> Technology Innovation and Application Collaboration Team leaders developed a strategic plan to codify its activities, quarterly foci, and engagement.</p>