

# October 2023 Q3 Reporting Compiled Summary Statements

## Priority Area 1: Community Resilience and Health

**Goal: Improve community resilience and well-being by strengthening research and developing tools to increase understanding of interdependent social, natural, and built systems in the Arctic.**

**Objective 1.1: Support the health of Arctic residents through research on public health needs, disparities, and delivery.**

**Deliverable 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.**

Summary Statement for 1.1.1: The Alaska Native Tribal Health Consortium is conducting 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. Training has been conducted and guidance for healthcare workers amended to incorporate hepatitis C screening and linkage to treatment. As of June 2023, 88 people from 5 communities had been tested and 13 people identified with active HCV infection, who are in varying stages of treatment. The project has been 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.

**Deliverable 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.**

Summary Statement for 1.1.2: Two studies were published on COVID-19 vaccine effectiveness among Alaska Native and American Indian people in Alaska by the Yukon Kuskokwim Delta Health Corporation and the Centers for Disease Control and Prevention (CDC); one study was a collaboration with the Johns Hopkins School of Public Health and Alaska Native Tribal Health Consortium and also included southwestern areas. The studies showed that COVID-19 vaccination offered strong protection against hospitalization (>90%) and medically-attended illness (>80%), and a booster dose was able to restore waning protection against infection related to emerging variants. Documentation of effectiveness of these vaccines contributes to preventing COVID-19 disease and mortality in the region, as future pandemic preparedness.

**Deliverable 1.1.3: 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.**

Summary Statement for 1.1.3: The Terrestrial Ecosystems Community of Practice held a webinar to learn about new science and tools in fire management from the Alaska Fire Science Consortium. Information provided in this webinar is particularly useful for fire managers to assist with the uptake and adoption of new science, adapting to climate change, and advancing co-production by involving managers throughout the research process. In March 2023, EPA provided a public webinar on wildland fire research to protect human health and the environment. Research includes wildfire impacts on human health and ecosystems, a comparative assessment of air quality and public health impacts from prescribed fire and wildfire smoke, air sensors for smoke monitoring applications, an EPA air sensor loan program, resources on indoor air filtration during smoke events, and communication strategies to enhance local readiness for wildfires. In November 2022, EPA published results of a study demonstrating that do-it-yourself air cleaners can effectively reduce smoke concentrations in a laboratory setting. EPA is funding the University of Alaska-Anchorage to conduct research on cumulative impacts in Alaskan communities. The project will co-develop community-centered tools for assessing the complex interrelated challenges of increasing exposure to wildfire smoke in the context of additional climate stressors and existing social vulnerabilities that fill existing data gaps.

**Deliverable 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.**

Summary Statement for 1.1.4: The US Geological Survey (USGS), along with collaborating partners, continues to investigate several wildlife and zoonotic disease issues in Alaska. The

USGS Alaska Science Center coordinated a meeting discussing the potential human health implications of harmful algal bloom toxins in subsistence harvested seabirds. Participants included the Alaska Department of Health, Norton Sound Health Corporation, Alaska Sea Grant, North Slope Borough, Woods Hole Oceanographic Institute, NOAA Northwest Fisheries Science Center, Alaska Harmful Algal Bloom Network, and the U.S. Fish and Wildlife Service.

Along with the US Department of Agriculture (USDA), USGS attended the second USGS-USDA APHIS Wildlife Services Zoonotic Disease Science Exchange. The meeting provided an opportunity to share knowledge and best practices between agencies as well as inspire future collaborations regarding zoonotic disease and other topics.

The USGS Alaska Science Center, Colorado State University, and the USDA published an article about the presence of the intestinal parasites Giardia and Cryptosporidium in resident wildlife species in Arctic Alaska. Arctic foxes were found to be important hosts for both parasites in this region; future investigation is warranted to determine the role of Arctic foxes in community transmission pathways. This is also important to Alaska, as giardia and cryptosporidium were identified as pathogens of high concern in Alaska following a One Health zoonotic disease prioritization workshop.

The Centers for Disease Control and Prevention (CDC) partnered with the U.S. Department of the Interior (DOI), USDA, and other departments and agencies to develop a draft One Health framework to address zoonotic diseases and advance public health preparedness. This framework, which is currently under a public comment period, will facilitate One Health collaboration for zoonotic disease prevention and control across the US agencies for the next five years.

The continued research of emerging zoonotic disease threats has increased the understanding and awareness of these threats, which is critical to decrease potential health risks associated with zoonotic disease in Arctic communities, particularly among subsistence users.

**Objective 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.**

**Deliverable 1.2.3: Conduct research and produce a report on seabird mortality events in the Bering Sea, including severity, causes, and ecological implications.**

Summary Statement for 1.2.3: Multiple agencies contributed to and released reports on sea-bird mortality events. A paper authored by federal, university and other partners summarized 29 years of marine bird mass mortality events throughout Pacific Ocean coastal portions of the U.S., including the Bering Sea, and examined linkages to ocean-climate variability. The authors conclude that given continued global warming, results point to more frequent large-scale mortality events and the potential for a new lower carrying capacity for marine birds in the Northeast Pacific. Additionally, the National Park Service (NPS) and the US Fish and Wildlife Services (USFWS) released reports on seabird die-offs in Alaska. The NPS web report provided information on seabird die-offs in Alaska and specific mortality events on Katmai National Park and Preserve in southcentral Alaska. The USFWS report focused on seabird die-offs in the Bering and Chukchi seas between 2017-2019. These reports provide important information on response efforts and potential causes and impacts to seabird populations.

**Deliverable 1.2.7: Fund and conduct research, and produce a report, on changes in abundance and distribution of migratory caribou in Arctic Alaska.**

Summary Statement for 1.2.7: In a recently published article, staff from the USGS and USFWS along with collaborating partners (Alaska Dept of Fish and Game, Texas A&M University), investigated the impact of summer forage nutrition and mosquito activity on reproductive success in the Central Arctic Herd of Alaska. The Western Arctic Caribou Herd Working group is composed of a broad array of stakeholders involved in the health of arctic caribou. Agency staff have served as advisors to the working group who recently has published a newsletter on population counts of the Western Arctic Herd over the last 40-plus years.

**Deliverable 1.2.8: Provide funding opportunities and conduct research, and produce a report, on the impacts of rapid expansion of beaver habitat in the U.S. Arctic, including effects on fisheries and ecosystem services, access to traditional foods, and overall community health.**

Summary Statement for 1.2.8: USGS and NPS along with university partners at Oregon State University, University of California Davis and University of Alaska Fairbanks examined the microbial structure of ponds and streams with and without active beaver activity in northwestern and central Alaska. The findings will help to understand the ecosystem implications of the northward expansion of beaver habitat in the arctic. Using satellite images and aerial photography, the University of Alaska Fairbanks and collaborating partners have recently characterized the extent of beaver expansion in Alaska as measured by the number of beaver ponds. The work is important in understanding the role of beavers in a rapidly changing tundra environment.

**Objective 1.3: Provide research and technical support for water and sanitation infrastructure.**

General Updates: EPA published research on its work to develop a sustainable sewage treatment system for rural Alaskan villages. The journal article "[An evaluation of solar thermal heating to support a freeze-thaw anaerobic digestion system for human waste treatment in subarctic environments](#)" investigates the technical feasibility of anaerobic digestion of synthetic human feces after freezing. In Alaskan villages, freezing temperatures and remote locations issues make installation and operation of typical wastewater treatment systems impossible. Multiple freezing conditions and incubation temperatures were investigated. Following positive results (methane generation) from the laboratory experiments, thermal modeling was conducted to estimate heat energy demands for hypothetical anaerobic digesters located in several Alaskan towns/villages. Solar radiation and air temperature data from other sources were used to perform the modeling assessment. Academic audiences would be interested to understand the resiliency of anaerobic microbes. Government entities or public groups may be interested in the prospect of anaerobic digestion in cold climates but many technical and social challenges for implementing a system need to be further addressed. [More on EPA's work on sustainable sewage treatment system for rural Alaskan villages.](#)

**Deliverable 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.**

Summary Statement for 1.3.1: USGS has continued to make good progress on the pilot project entitled "Building a Coastal Flood Hazard Assessment Tool with at-Risk Alaska Communities". Since the last progress report, USGS has met and worked with Utqiagvik officials to discuss participation in the project and plan for community-based meetings to occur after the impending city and borough elections held on October 3. USGS also hosted a webinar in September to discuss technical aspects of the modeling and visualization tools with key stakeholder and end-user institutions, including representatives from FEMA, NOAA, State of Alaska DGGS, ANTHC, Kawerak, and community tribal representatives. USGS also participated in the Coastal Resilience workshop held in Anchorage on September 20 to meet with Native village tribal representatives and to offer the potential of providing flood hazard forecasting visualization tools to specific additional communities where project objectives seem to align most closely with urgent community needs (prospects include Quinhagak, Kwigillingok, and Golovin). In the

meantime, USGS modelers continue on schedule to develop and refine the modeling products that have already been promised for Unalakleet and Elim.

**Deliverable 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.**

Summary Statement for 1.3.3: EPA has continued to add new information, including on PFAS compounds, to the Drinking Water Treatability Database. The database presents referenced information on the control of contaminants in drinking water. It provides users—including drinking water utilities, primacy agencies, first responders to spills or emergencies, treatment process designers, research organizations, academicians, and others—with current information on more than 35 treatment processes and over 160 regulated and unregulated contaminants, including 68 PFAS chemicals. The referenced information in the database comprises bench-, pilot-, and full-scale studies of surface, ground, and laboratory waters gathered from thousands of literature sources, including peer-reviewed journals and conferences, other conferences and symposia, research reports, theses, and dissertations.

**Deliverable 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.**

Summary Statement 1.3.3: EPA awarded nearly \$100,000 to a student team at the University of Alabama in Huntsville to develop a low-cost household filter that removes PFAS. This project will help promote clean drinking water supplies, particularly in small, rural, Tribal and disadvantaged communities. [More information.](#)

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## Priority Area 2: Arctic Systems Interactions

**Goal: Enhance our ability to observe, understand, predict, and project the Arctic’s dynamic interconnected systems and their links to the Earth system.**

**Objective 2.1: Advance understanding of Arctic amplification and the associated connections with lower latitudes.**

**Deliverable 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 from these studies.**

Summary Statement for 2.1.1: The Modelers Community of Practice convened on August 31 to discuss the decadal predictability of the Arctic Earth system, with a focus on predictions of an ice-free Arctic. The steady decline of sea ice in the Arctic in recent decades suggests that before long the Arctic Ocean might be virtually ice-free during certain parts of the year. However, Earth system models display significant uncertainties in decadal projections of Arctic sea ice decline. Therefore predictions of when a virtually ice-free Arctic can be expected are also uncertain. The session featured two experts to address this question, namely Alex Jahn (CU Boulder; "Projections of a first versus consistently ice-free Arctic") and Qinghua Ding (UCSB; "Improving Arctic climate projections through observation-constrained model capabilities").

**Deliverable 2.1.2: Hold workshops and webinars and produce publications to encourage interagency research coordination on Arctic Amplification.**

Summary Statement for 2.1.2: There were two webinars hosted by IARPC, and one that was hosted by CLIVAR that addressed Arctic Amplification in this reporting period:

- 1) The webinar by the Modelers Community of Practice, convened on August 31 addressed decadal predictability of the Arctic Earth system, with a focus on predictions of an ice-free Arctic. This webinar had over 7000 views within a month of being posted;
- 2) Additionally, the September meeting of the Physical Oceanography CoP was focussed on effective ways in which the Physical Oceanography CoP can contribute to the success of the Biennial Implementation Plan. Program managers' from various agencies (e.g., NASA, NOAA, the North Pacific Research Board) discussed the most important research directions for Arctic Physical Oceanography research. They also welcomed the community's idea on how to best contribute to the BIP;
- 3) As part of CLIVAR, the co-lead of PA2 (Hailong Wang) and others hosted a panel discussion session on Air-sea Processes and Gaps in Atmospheric Rivers (ARs). Discussions highlighted that more frequent ARs, in response to anthropogenic warming and tropical Pacific variability, slow the seasonal recovery of Arctic sea ice. Continued

research efforts, conference sessions, and dedicated workshops are recommended to improve our understanding of ARs and their role in the changing climate.

**Deliverable 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.**

Summary Statement for 2.1.4: A panel discussion session on Air-sea Processes and Gaps in Atmospheric Rivers (ARs) was convened by Hailong Wang (PA2 co-lead, PNNL) and Colin Zarzycki (Penn State U) at the 2023 U.S. CLIVAR Summit (July 31 - August 2). ARs account for more than 90% of the annual moisture transport from the tropics into high latitudes. While our understanding of ARs has improved significantly in recent years, there are still process-level knowledge gaps in the related dynamic and thermodynamic processes, especially involving air-sea interactions for the initiation, maintenance, and impact of ARs. Uncertainty in projecting AR changes under climate warming is likely tied to fundamental challenges in modeling such processes in Earth system models. The presentations by Ruby Leung (PNNL) and Emily Slinskey (UCLA) and panel discussion identified knowledge gaps and related research in moisture supply for AR precipitation and difference between landfalling ARs in different regions, controlling factors of spatiotemporal variability of air-sea fluxes under ARs, impact of ARs on coastal/open oceans and subsequent storms, co-occurrence of AR and other weather features, processes controlling AR heavy precipitation and their change with climate warming, and uncertainties in model forecast and projection.

A combination of observational studies (maybe targeted field campaigns) and advancements in coupled modeling capabilities is required to address the knowledge gaps identified in this session. A recent work published in Nature Climate Change (jointly supported by NSF, NASA and DOE) based on observations and climate model simulations shows that more frequent ARs, in response to anthropogenic warming and tropical Pacific variability, slow the seasonal recovery of Arctic sea ice. Continued research efforts, conference sessions, and dedicated workshops are recommended to improve our understanding of ARs and their role in the changing climate. The panel proposed collaborations with the US CLIVAR Polar Amplification workshop group (January 2024) to study hemispheric asymmetry in ARs as well as WCRP Global Precipitation Experiments (GPEX).

**Deliverable 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.**



Summary Statement for 2.1.5: In its September webinar meeting (September 26, 2023), the Atmosphere CoP, the DOE funded HiLAT project provided an overview of the themes of the project. This project in coordination with the Energy Exascale Earth System Model developed the first coupled global model with regional refinement over the Arctic. This model will be used to advance the four themes of the project:

- The role of sea ice in mediating meridional heat transports in the ocean and atmosphere.
- The role of fine-scale and transboundary transport processes in arctic change.
- Extra-polar impacts of arctic change, and
- Decadal predictability of high-latitude environmental change.

This HiLAT-focused meeting connects to deliverables 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), 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), and 2.1.5 (Hold cross-collaboration-team meetings and workshops, and produce publications, to explore the results of high-resolution and regional Arctic modeling. The meeting focused on the importance of model resolution to capture Arctic Amplification and its relationship with the lower latitudes) of the implementation plan associated with the current 5-year US Arctic Research Plan.

**Objective 2.2: Observe, understand, predict, and project Arctic ecosystem change and its impacts on humans and the entire Earth system.**

**Deliverable 2.2.1: Advance capacity to better understand, quantify, and predict methane emissions from permafrost changes in the Arctic through international collaborations.**

Summary Statement for 2.2.1: The U.S. Geological Survey hosted a permafrost workshop in Golden, CO from September 19-21, 2023. The purpose of this workshop was to bring USGS scientists together to share their permafrost related work and identify ways to collaborate. There were several breakout sessions: one session focused on how to advance deliverables outlined in the IARPC Biennial Implementation Plan and to begin planning a second workshop in Anchorage, and the second workshop included broader participation from IARPC members, Federal, State, academic and Tribal entities.

**Deliverable 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.**

Summary Statement for 2.2.2: The U.S. Geological Survey hosted a permafrost workshop in Golden, CO between September 19–21, 2023. The purpose of this workshop was to bring USGS scientists together to share their permafrost related work and identify ways to collaborate. Breakout sessions were convened for detailed discussions, including a session focused on how to advance deliverables outlined in the IARPC Biennial Implementation Plan. Another breakout was held to focus on planning a second workshop in Anchorage, and is expected to include broader participation from IARPC members, Federal, State, academic and Tribal entities.

In April of 2023, University of Alaska Fairbanks and Anchorage, Fisheries and Ocean Canada, Carleton University, USGS, and the Woodwell Climate Research Center [published a paper on the Arctic–Yukon–Kuskokwim \(AYK\) region](#) that encompasses the northern extent of the Chinook Salmon range where populations are experiencing rapid rates of environmental change across both freshwater and marine habitats due to global climate change. Climate–salmon interactions in the AYK region are a particularly pressing issue as many local communities have a deep reliance on a subsistence way of life. The paper synthesized perspectives shared at a recent workshop on Chinook Salmon declines in the AYK region.

Scientists from Colorado State University, USGS Alaska Science Center, and the USDA examined if climate triggers that may be driving the growing proportion of polar bears to summer onshore in northern Alaska. The study tested whether biological and/or time-varying environmental variables thought to influence polar bear movement and habitat selection also drive decisions to swim ashore. Results suggest that storm events (i.e., sustained high wind speeds) may force polar bears from severely degraded ice habitat and catalyze seasonal movements to land. The findings describe an emergent and climatically mediated behavior in an Arctic marine mammal vulnerable to rapid habitat decline. [The paper was published in February of 2023.](#)

Throughout much of their range, polar bears are increasingly using terrestrial habitats in response to Arctic sea ice decline. A [paper in December of 2022 by USGS and USFWS](#) examined trends in land use over three decades by polar bears in the southern Beaufort Sea (SB) and Chukchi Sea (CS) where bears have traditionally spent most of the year on the sea ice. The study estimated future land use through 2040 by extrapolating trends and by combining observed relationships between land use and sea ice with projections of future sea ice from an ensemble of earth system models. The study estimated that 50–62% of SB and 79–88% of CS bears will spend 90–108 and 110–126 days onshore during summer in the SB and CS, respectively, by 2040. Observed and forecasted increases in polar bear land occupancy puts more bears in proximity to human activities and settlements for longer durations while extending the lack of access to their primary prey.

In December of 2022, the USGS, USFWS, and University of Texas collaborators published a [paper on the borealization of nearshore fishes in the Arctic](#). Borealization is a type of community reorganization where Arctic specialists are replaced by species with more boreal distributions in response to climatic warming. Scientists revisited two nearshore lagoons in the eastern Alaska Beaufort Sea (Kaktovik and Jago lagoons, Arctic National Wildlife Refuge, Alaska, USA) and compared summer fish species among three periods that spanned a 30-year record (baseline conditions, 1988–1991; moderate sea ice decline, 2003–2005; rapid sea ice decline, 2017–2019). Results agree with predictions that Arctic-boreal fishes (e.g., saffron cod) are well positioned to exploit the changing Arctic ecosystem. Another Arctic-boreal species, Dolly Varden appear to have already responded to warming by shifting from Arctic nearshore to shelf waters.

**Deliverable 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.**

Summary Statement for 2.2.3: On September 25th, 2023 the Sea Ice Community of Practice held a meeting on the topic of 2023 sea ice conditions, predictions, and forecasts. The primary objectives of this meeting were to provide a comprehensive update on current sea ice conditions and forecast efforts to foster informed discussions, encourage collaborative research, and enhance our collective understanding of the rapidly changing Arctic environment. Ted Scambos of the Cooperative Institute for Research in Environmental Sciences (CIRES) and University of Colorado presented a talk on the recent Arctic sea ice extent minimum and Antarctic maximum and 2023 Greenland ice sheet surface melt conditions results of which will feed into the 2023 Arctic Report Card.

**Deliverable 2.2.4: Continue coordinated interdisciplinary Arctic marine climate and ecosystem observations, and share data and promote synthesis of field observations.**

Summary Statement for 2.2.4: On September 25th, 2023 the Sea Ice Community of Practice held a meeting on the topic of 2023 sea ice conditions, predictions, and forecasts. The primary objectives of this meeting were to provide a comprehensive update on current sea ice conditions and forecast efforts to foster informed discussions, encourage collaborative research, and enhance our collective understanding of the rapidly changing Arctic environment. Ignatius Rigor (University of Washington) shared the International Arctic Buoy Program (IABP) deployments for 2024 (flights, ice camps, and ice) with the community to inform and coordinate field activities.

**Deliverable 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.**

Summary Statement for 2.2.6: NOAA Fisheries is conducting work around aerial surveys for ice seals and polar bears community engagement. The goal of the program is to estimate the abundance of ringed, bearded, spotted, and ribbon seals and understand how these animals are responding to changes in the Arctic. Information is provided to managers to inform their decisions. As the Arctic opens to more industrial activity, having current information about these species will help equip managers to make better decisions than they can if they are working with out of date information. This benefits communities by helping to ensure that sustainable populations are maintained for subsistence hunting activities. Data is also provided to the U.S. Fish and Wildlife Service to help with their efforts to monitor polar bear populations. The program recognizes the importance of these species to coastal communities as a source of food and material to sustain cultural practices. It is a priority to work together to improve these survey efforts. In the future the program hopes to have a productive conversation to help us better serve coastal communities of Alaska.

Scientists from the USGS Alaska Science Center and the University of Wisconsin authored two papers on polar bear health. The first study, which evaluated relationships between changing environmental conditions and bear physiology and was [published in July 2023](#), found evidence of dysregulation of water balance following years with a lower annual Arctic oscillation index (AOI). Water balance in polar bears is linked to their diet, primarily via consumption of ringed seal blubber, and body condition of ringed seals typically declines in years with a lower AOI. In addition, polar bear liver enzyme values increased over time, which is suggestive of potential hepatocyte damage as the Arctic has warmed. The [second study](#) used metagenomic DNA sequencing to characterize the serum virome of polar bears. Researchers identified 48 viruses, all of the family Anelloviridae. Anelloviruses are small, ubiquitous infectious agents with circular single-stranded DNA genomes that are not known to cause disease but, in humans, covary in diversity and load with immunological compromise. These studies provide insight into how changes to the Arctic marine ecosystem are influencing polar bear health.

**Objective 2.3: Understand interactions between social, ecological, and physical Arctic systems, particularly in the context of coastal, climate, and cryospheric change.**

**Deliverable 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.**

Summary Statement for 2.3.2: Scientists with the USGS Benchmark Glacier Project study the process and impacts of glacier change, including sea-level rise, water resources, environmental hazards and ecosystem links. At the core of this research are mass balance measurements at five glaciers in the United States: the Gulkana, Wolverine and Lemon Creek glaciers in Alaska, South Cascade glacier in Washington, and Sperry glacier in Montana. Since the 1960s, these glaciers have been studied using direct observations of glaciers and meteorology. The USGS project integrates remotely sensed data to enhance our understanding of how glaciers respond to changes in climate. When paired with weather, streamflow and geochemical data, this research helps managers prepare for local, regional, and global impacts of glacier change. In August of 2022, the USGS released a [new informational factsheet on the Benchmark Glacier Project](#).

**Deliverable 2.3.3: Develop and assess ice sheet models for better prediction of sea level rise.**

Summary Statement for 2.3.3: A variety of commonly-used community modeling tools exist to help glaciologists predict future changes in the Greenland ice sheet. On September 14 2023, the Modelers and Glaciers and Sea Level Communities of Practice jointly [hosted a meeting](#) to update the glaciology and ice sheet modeling community on changes and improvements to commonly used community modeling tools since ISMIP6. Eric Larour (NASA JPL) provided an update to the Ice Sheet System Model (ISSM), and Andy Aschwanden (UAF) gave an update to the Parallel Ice Sheet Model (PISM). There was also significant discussion about challenges ahead for the ice sheet modeling community, specifically regarding uncertainties surrounding support for ISMIP7 from US funding agencies. The meeting also included information about IARPC and the Glaciers & Sea Level Community of Practice, and an opportunity for team members to provide other relevant community updates.

This webinar/meeting is relevant: NASA Year of Open Science: open glacier model: Glaciers & Sea Level Community of Practice Meeting January 2023

**Deliverable 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.**

Summary Statement for 2.3.4: The U.S. Geological Survey hosted a permafrost workshop in Golden, CO, September 19-21, 2023. The purpose of this workshop is to bring USGS scientists together to share their permafrost related work and identify ways to collaborate. There were several breakout sessions. One session focused on how to advanced deliverables outlined in the ARPC Biennial Implementation Plan and to begin planning a second workshop in Anchorage. The second workshop included broader participation from IARPC members, Federal, State, academic, and Tribal entities.

The [Interdisciplinary Research for Arctic Coastal Environment \(InteRFACE\)](#) project shared their research at the virtual all-hands meeting, including a lightning presentation on Tuesday August 15th, and two GatherTown poster sessions on Tuesday August 15, and again on Monday August 21. The InteRFACE project focuses on the impacts to and responses of coastal systems to climate change in the Arctic. The project pursues multi-disciplinary science to explore the coupled feedbacks between natural and human systems at the coastal interface in the Arctic. The project uses and develops regional and global earth system models to explore the coupled interactions between rivers, coastal oceans, sea ice, and marine biogeochemistry. In the framework of a changing Arctic, the local to global feedbacks with energy resources, transportation, and marine resources are modeled and analyzed.

Wildfire and Invasive Plants in Alaska's Boreal Forest (Speakers: Katie Spellman, Christa Mulder, and Taylor Seitz (University of Alaska Fairbanks)): A warmer climate, increased human disturbance and transport, increased propagule pressure from growing non-native plant populations, and increased areas disturbed by wildfire have created a perfect storm of conditions for the spread of non-native plant species into Alaska's boreal forest. Previous studies have primarily concentrated on short-term relationship (less than 5 years) between wildfires and non-native species, leaving a significant gap in our understanding of long-term implications. This presentation will highlight the current status of in non-native plant invasions in burned areas of Alaska's boreal forest region and ongoing research efforts studying long-term trends. We will also provide an overview of what factors influence the vulnerability of boreal forests to non-native plant invasions along with how non-native plants are reaching affected habitat.

**Deliverable 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.**

Summary Statement 2.3.5: The U.S. Geological Survey hosted a permafrost workshop in Golden, CO, September 19–21, 2023. The purpose of this workshop is to bring USGS scientists together to share their permafrost related work and identify ways to collaborate. There were several breakout sessions. One session focused on how to advanced deliverables outlined in the IARPC Biennial Implementation Plan and to begin planning a second workshop in Anchorage. The second workshop included broader participation from IARPC members, Federal, State, academic, and Tribal entities.

**Deliverable 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).**

Summary Statement with 2.3.6: The Terrestrial Ecosystems Community of Practice held a webinar on vegetation mapping efforts in Alaska. We started with a presentation by Elizabeth Powers describing the Alaska Geospatial Council’s plans to develop a statewide suite of vegetation mapping products for Alaska. Matt Macander provided an overview of his team’s NASA ABoVE vegetation mapping project in Alaska and how his methods will be utilized for the statewide vegetation mapping initiative. Then, the Terrestrial Ecosystem Community of Practice co-leads discussed the outcomes of a recent USGS permafrost workshop and their plans to host a broader permafrost vegetation disturbance workshop in Alaska in 2024.

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## Priority Area 3: Sustainable Economies and Livelihoods

**Goal: Observe and understand the Arctic’s natural, social, and built systems to promote sustainable economies and livelihoods.**

**Objective 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.**

**Deliverable 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.**

Summary Statement for 3.1.1: During the 3rd quarter of 2023, Priority Area 3 Members completed the following actions:

The Co-leads continued coordination with the State of Alaska Office of Infrastructure and other State of Alaska departments, working towards a centralization of coordination efforts between the State of Alaska and Federal Agencies engaged in infrastructure development in Alaska.

Members participated in the 2023 Infrastructure Symposium, at which AK DOT displayed a new “dashboard” to help coordinate Department of Transportation projects. This is hopefully the first step towards more comprehensive coordination of State-led infrastructure development.

As part of Erik O'Brien's Merbok Housing project, plans were scoped to build a best practices Housing Depot and Procurement Consortium. These are foundational steps toward the asset map initiative.

Ryan Witten began a graduate research assistantship funded by the Denali Commission on a project called: “Technical Assistance for Alaska” in UAA’s Department of Public Policy and Administration.

Through this assistantship, Ryan, under the direction of Marie and the IARPC team, have begun collecting metadata of relevant infrastructure data sets in Alaska. These metadata sets will help the team build a prototype for the asset map and submit a research funding proposal for the asset map work.

Ryan began preparing a poster on IARPC’s Priority Area 3 for UAA’s College of Business and Public Policy’s Showcase Event; said poster will be used to write and submit an abstract for a presentation at the International Congress of Arctic Social Sciences triennial meetings in Bodø, Norway, June 2024.



Dr. Marie Lowe submitted an LOI for the NOAA Coastal Resilience RFP in conjunction with the Alaska Municipal League called: "Alaska Municipal Coastal Resilience Consortium and Decision Support" as another activity to support PA3's "Sustainable Economies and Livelihoods" goals.

Ryan Witten and members of the Akv3 team, with the support of the Denali Commission, collected a dataset of over 3000 funded infrastructure projects in Alaska. Through community dialogue and workshops, they explored the potential of those projects to induce additional long-term economic activity. [A final report, a copy of the data set, and community tools to link and leverage infrastructure projects were created and posted online.](#)

[A copy of the final report for ASCENT can be found here.](#)

[A copy of the ASCENT dataset for manipulation and download can be found here.](#)

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## Priority Area 4: Risk Management and Hazard Mitigation

**Objective 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.**

General Updates: EPA is funding Iowa State University to conduct research on the impacts of climate change on water infrastructure, quality, and security in Alaska Native communities. The project, titled "Building Adaptive Capacity to Climate Change in Alaska Native Communities by Reducing Health Risks from Water Infrastructure, Quality, and Security" will assess the relationships between diverse climate-induced concerns related to water infrastructure and water quality and its effects on health in Alaska Native communities. The project also aims at building adaptive capacity to climate change risks by addressing the issues of water infrastructure in Alaska Native communities. Water quality, water insecurity and local vulnerabilities will directly affect health outcomes of Indigenous people. In a holistic manner, this project captures health outcomes based on health indicators and biomarkers, mental health indicators and non-Western perspective of health outcomes. The three-year project will specifically propose achieving the following objectives: Identify the effects of climate change on water infrastructure, quality and

insecurity (Objective 1); Identify the cumulative effects of water quality, water insecurity and local vulnerabilities on health (Objective 2); Build adaptive capacity to climate change through community-based adaptation (Objective 3). [Project description.](#)

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## Foundational Activity: Data Management

**Data Objective 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.**

**DATA Deliverable 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.**

Summary Statement for Data 1.1: Contacts were emailed and the list of confirmed contacts has been updated. This network will continue to be refined, updated, and expanded to further develop Arctic Data Management champions across the IARPC space and beyond. These contacts will help advance all other Data Management deliverables.

**DATA Deliverable 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.**

Summary Statement for Data 1.3: The Data Management Collaboration Team continue to update a collaborative working document and share it via the IARPC Collaborations Data Management collaboration team page. This document streamlines the work of the Data Management FACT, facilitates transparency of the team’s work, and welcomes participation of all other collaboration teams and IARPC agencies into the team’s work. The Data Management FACT will continue to enable the work of the priority area goals by using this living document to open up the work of the Data Management FACT and also collate suggestions and interests from the other foundational and priority areas, as well as federal / non-federal / local partners.

**DATA Deliverable 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. Agencies: DOD, Denali, DHS-USCG, DOE-SC, DOI-USGS, DOT, HHS, NASA, NOAA, NSF, SI, USDA**

Summary Statement for Data 1.4: The Data Management team used its September meeting to host a presentation and discussion on the topic of where to get started building Arctic data management skills. A recording, slides, and collaborative document sharing further resources are available [via the event page](#). Data management literacy directly facilitates a wide range of PA goals, and networking during this event will also support those aims.

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## Foundational Activity: Monitoring, Observing, Modeling, And Prediction (MOMP)

**MOMP Objective 2: Support assessment, gaps analysis, and intercomparisons to understand observational and modeling needs in Arctic research.**

**MOMP Deliverable: 2.1 Develop an online tool for the research community to support expert elicitation and data visualization for the value tree gaps analysis methodology.**

Summary Statement for MOMP 2.1: A foundational Arctic observational capability requires a sustained, coordinated, and integrated observing network. Understanding gaps in the current observational system is a critical part of planning and developing that sustained network. 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. An expert committee was convened to provide input on methods, data management, and partnership development. Over 40 scoping meetings have been held across Federal agencies, IARPC Collaboration Teams and with non-Federal partners in the state of AK to identify key topics for this analysis. [An early version of the tool was made available online.](#) A joint meeting with Observations, MOMP, and PA4 teams was held on Oct 10, 2023, titled "Applying US AON's Benefit Tool to risks and hazards," during which the US AON team presented an overview of the Benefit Tool and methodology and received feedback from the community.

**MOMP Deliverable 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.**

Summary Statement for MOMP 2.2: A foundational Arctic observational capability requires a sustained, coordinated, and integrated observing network. Understanding gaps in the current observational system is a critical part of planning and developing that sustained network. 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. An expert committee was convened to provide input on methods, data management, and partnership development. Over 40 scoping meetings have been held across Federal agencies, IARPC Collaboration Teams and with non-Federal partners in the state of AK to identify key topics for this analysis. [An early version of the tool was made available online.](#) A joint meeting with Observations, MOMP, and PA4 teams was held on Oct 10, 2023, titled "Applying US AON's Benefit Tool to risks and hazards," during which the US AON team presented an overview of the Benefit Tool and methodology and received feedback from the community.

**MOMP Objective 3: Support coordination and engagement with Federal, international, and non-Federal partners who are conducting monitoring, observing, modeling, and prediction of the Arctic.**

**MOMP Deliverable 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.**

Summary Statement for MOMP 3.3: Many interagency groups that work on global climate, meteorology, earth observations, and modeling include Arctic-related work as part of their efforts. To improve coordination between these groups and IARPC research efforts, MOMP has provided updates on IARPC modeling efforts to the ICAMS Joint Action Group, discussed potential areas of coordination with the co-chairs of the USGCRP Interagency Working Group on Observations, and worked with the IARPC secretariat to schedule an IARPC-wide webinar on the Alaskan chapter of the USGCRP 5th National Climate Assessment to inform IARPC collaboration teams about the NCA and to promote more communication and coordination between IARPC and the NCA team.

**MOMP Objective 4: Support best practices in field observations and modeling.**

**MOMP Deliverable 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.**

Summary Statement for MOMP 4.1: Federal agencies and IARPC researchers continue to share resources and implement best practices improving field safety culture, diversity, and inclusivity, and enforcing safe working environments in the field. NSF has implemented new requirements for organizations to certify that they have plans in place for safe and inclusive off-site or off-campus research and is also piloting an effort for PIs to include a “Plan for Safe and Inclusive Fieldwork” as supplementary documents in their proposals. DOE is now requiring “Promoting Inclusive and Equitable Research (PIER) Plans” as part of all research proposals. The DOE Biological and Environmental Research (BER) program invited a presentation on “Building a Culture of Safety and Trust in Team Science” from an IARPC researcher at its federal advisory committee meeting in October. The Polar Science Early Career Community Office (PSECCO) and the Interagency Arctic Research Policy Committee (IARPC) Diversity & Inclusion Community of Practice co-hosted a panel discussion for early career researchers on how to build an inclusive fieldwork environment and navigate potential power imbalances in the field.

## Foundational Activity: Participatory Research and Indigenous Leadership in Research

General Summary Statement: The PILR co-leads continued to focus their efforts on honing and implementing the Principles survey. The PILR team continued to gather essential input from Indigenous communities and leadership and academics to better craft the Principles' survey. Specifically, non-federal Co-Lead Cana Uluak Itchuaqiyag (Virginia Tech) was invited to Nome to speak with Caleb Scholars Program in July and Fairbanks to speak with members of the International Arctic Research Center at University of Alaska, Fairbanks in September. Critical to this work has been the rebranding of the Principles. In this effort the PILR team with assistance from IARPC staff worked with Native artist Dylan Paisaq Crosby to create a Principles' logo. In addition, and essential to the process is the completion of federal processes (e.g., Federal Registry) necessary for survey progress and potential release.

**PILR Objective 1: Fulfill Federal requirement to consult with Federally recognized Tribes and Alaska Native Corporations.**

**PILR Deliverable 1.2: Evaluate the Principles for Conducting Research in the Arctic 2018, and update as needed based on the evaluation.**

Summary Statement for 1.2: The PILR team continued to gather essential input from Indigenous communities and leadership and academics to better craft the Principles' survey. Specifically, non-federal Co-Lead Cana Uluak Itchuaqiyag (Virginia Tech) was invited to Nome to speak with Caleb Scholars Program in July and Fairbanks to speak with members of the International Arctic Research Center at University of Alaska, Fairbanks in September. The team with help from IARPC staff worked with Alaska Native artist Dylan Paisaq Crosby to create a Principles' logo. And finally, the team is working to finish federal processes (e.g., Federal Registry) necessary for survey release. The PILR team presented a survey update at the fall 2023 Principals meeting.

**PILR Objective 2: Engage Arctic communities and individuals in research in a way that is meaningful to them.**

**PILR Deliverable 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 culture groups,**

**formal agreements, and how to contract and consult with Indigenous companies and individuals.**

Summary Statement for 2.1: USFWS Crystal Leonetti and Leah Shizuru created and released an online science self-guided toolkit entitled "[Ikaayutiᑉat: Co-Production of Knowledge Toolkit.](#)"

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## Foundational Activity: Technology Innovation and Application

**TIA Deliverable 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.**

Summary Statement for TIA 1.1: Tech FACT developed a strategic plan that codified its year one activities, and developed a cyclical yearly plan that would define its quarterly foci, including external engagement, cross IARPC team engagement, and Tech FACT team engagement. This also aligns with availability of researchers from the Arctic and Antarctic field seasons. Tech FACT will revisit strategic planning each summer, when it doesn't anticipate having very much engagement because of the availability of researchers being in the field.