INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE BIENNIAL REPORT 2016–2017

A Report by the

INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE

A WORKING GROUP OF THE COMMITTEE ON ENVIRONMENT

of the

NATIONAL SCIENCE & TECHNOLOGY COUNCIL

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The Arctic Research and Policy Act of 1984 (ARPA), Public Law 98-373, July 31, 1984, as amended by Public Law 101-609, November 16, 1990, provides for a comprehensive national policy dealing with national research needs and objectives in the Arctic. The ARPA establishes an Arctic Research Commission (ARC) and an Interagency Arctic Research Policy Committee (IARPC) to help implement the Act. Since its inception, IARPC activities have been coordinated by the National Science Foundation (NSF), with the Director of the NSF as chair. A Presidential Memorandum issued on July 22, 2010, made the NSTC responsible for IARPC, with the Director of the NSF remaining as chair of the committee.

About this Document

This report was developed by the IARPC Staff Group and includes an overview of how the *Arctic Research Plan 2017-2021* supports the Administration's FY2019 research and development budget priorities and highlights IARPC accomplishments during the period 2016-2017. The report continues with brief descriptions of the *Arctic Research Plan 2013-2017* and *Arctic Research Plan 2017-2021* and concludes with a summary of how the *Arctic Research Plan 2017-2021* responds to the most recent (2015-2016) recommendations of the U.S. Arctic Research Commission.

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Introduction

The United States of America has been an Arctic state since 1867, when Alaska was purchased from the Russian Empire. The importance of Alaska and the Arctic to the nation was not fully appreciated until the advent of the Cold War in the late 1940s and, later, the discovery in the late 1960s of the "super giant" oilfield (greater than five billion barrels of recoverable oil) at Prudhoe Bay on Alaska's northernmost coast facing the Arctic Ocean. Since then, Prudhoe Bay and nearby oilfields have continued to contribute significantly to the Alaskan and national economy. Continued national attention on Alaska and the Arctic materialized in response to environmental change. These changes are exemplified by the diminishing sea ice cover during the summer, which has significant implications for the people of Alaska, in particular Alaska Natives, as well as for national and homeland security as maritime transportation, natural resource development, and tourism, including cruise ship operations, are projected to increase.

Recognizing the growing importance of Alaska and the Arctic to the nation, and the need for research to increase scientific knowledge and understanding to inform decisions and policy, Congress passed the Arctic Research and Policy Act of 1984.[1] It established the U.S. Arctic Research Commission (USARC)[2] "to promote Arctic research and to recommend Arctic research policy" and the Interagency Arctic Research Policy Committee (IARPC)[3] to "develop a national Arctic research policy and a five year plan to implement that policy." The Act also requires IARPC to submit to Congress through the Executive Office of the President a biennial report containing a statement of activities and accomplishments of the IARPC, and a statement "detailing with particularity the recommendations of the Commission with respect to Federal interagency activities in Arctic research and the disposition and responses to those recommendations." This biennial report addresses this requirement for the period 2016-2017, which includes the final year of the implementation of the *Arctic Research Plan 2013-2017*[4] and the first year of the implementation of the *Arctic Research Plan 2017-2021*.[5]

The report begins with an overview of how the *Arctic Research Plan 2017-2021* supports the Administration's FY2019 research and development budget (R&D) priorities, followed by select highlights of IARPC accomplishments during the period 2016-2017. The report continues with brief descriptions of the *Arctic Research Plan 2013-2017* and the *Arctic Research Plan 2017-2021*, and concludes with a summary of how the *Arctic Research Plan 2017-2021* responds to the most recent (2015-2016) recommendations of the USARC.

[1] https://www.nsf.gov/geo/opp/arctic/iarpc/arc_res_pol_act.jsp
[2] https://www.arctic.gov/
[3] The following Federal departments, agencies, and Executive Office of the President components comprise IARPC: Department of Commerce, Department of Defense, Department of Energy, Department of Health and Human Services, Department of Homeland Security, Department of the Interior, Department of State, Department of Transportation, Environmental Protection Agency, Marine Mammal Commission, National Aeronautics and Space Administration, National Science Foundation (Chair), Office of Management and Budget, Office of Science and Technology Policy, Smithsonian Institution, and U.S. Department of Agriculture.
[4] https://www.iarpccollaborations.org/uploads/cms/documents/2013_arctic_research_plan.pdf
[5] https://www.iarpccollaborations.org/uploads/cms/documents/iarpc_arctic_research_plan_2017-2021.pdf

The Arctic Research Plan 2017–2021 and Administration Research and Development Priorities

In August 2017, the Office of Management and Budget and the Office of Science and Technology Policy in the Executive Office of the President issued a memorandum describing the Administration's FY2019 research and development (R&D) priorities.[6] The five R&D priority areas are *Military Superiority*, *Security*, *Prosperity*, *Energy Dominance*, and *Health*. The budget memorandum also identified *supporting innovative basic and early-stage research* and *maximizing interagency coordination* as R&D priority practices.

IARPC practices the maximization of interagency coordination of basic and early-stage research in the Arctic. This coordinated research is described in the *Arctic Research Plan 2017-2021* (the Plan) which supports the FY2019 R&D priorities in many ways.

The Plan supports *Military Superiority* by enhancing knowledge and understanding of the Arctic operational environment—in the air, on and under the ocean and sea ice, and on the land—and the transition of that knowledge and understanding into improving computer models and operational forecasting capabilities. In similar fashion, the Plan supports the *Security* and *Prosperity* of the people of Alaska in the face of emerging natural threats and hazards—severe weather, storm surges, flooding, coastal and riverine erosion, and wildfires—by enhancing knowledge and understanding of the environment and increasing the ability to make timely and accurate water, weather, and ice forecasts that support the safety of life and property.

Alaska, particularly the North Slope of Alaska, continues to contribute significantly to *Energy Dominance* thanks to basic and early-stage applied research that enable the oil industry to operate in an extreme environment where the weather, sea ice, and permafrost alone present particular challenges not experienced anywhere else in the United States. The Plan also addresses the *Health and Well-being* of the people of Alaska, who depend on research into many issues, including food, water, and energy security; water, sanitation, and hygiene; mental health; substance abuse; violence; occupational safety and health; and health care delivery.

The Arctic continues to be an area of extraordinary opportunity for scientific research and discovery that stands to impact the United States for generations to come. The following section of select highlights of the implementation of the Arctic Research Plans in 2016-2017 describes some recent research and discovery outcomes, and illustrates how IARPC is contributing to the Administration's R&D priorities.

Highlights of IARPC Accomplishments in 2016–2017

1. Engaging with Stakeholders and Collaborators

Engagement with multiple stakeholders and collaborators is essential to the work that is underway to update the IARPC Principles for the Conduct of Research in the Arctic (the Principles).[7] Almost as old as IARPC, the Principles are being updated because much has changed in the Arctic region and in Arctic research since the Principles were released in 1990. Among those changes is the growing recognition of the important role of Indigenous people and Indigenous knowledge in Arctic research.

[6] https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2017/m-17-30.pdf
[7] https://www.nsf.gov/geo/opp/arctic/conduct.jsp

IARPC efforts to increase engagement with Alaska Natives are exemplified by the work of the Coastal Resilience Collaboration Team[8] (CRCT). During 2017, this team sent information about IARPC and itself to all 97 tribal councils that the Inuit Circumpolar Council (ICC) Alaska advocates on behalf of, all co-management bodies, all Arctic Council Permanent Participants, and all ICC Alaska membership organizations and ICC offices overseas. The CRCT also used the ICC Alaska networks to bring Indigenous community members into its monthly teleconferences. Once these members are engaged, the CRCT solicits their input and addresses the needs they express.

2. Health & Well-being

The rapidly changing environment in the Arctic poses new risks to food, water, and energy security, with implications for the health and well-being of Arctic residents. Major achievements of the *Health and Well-being* Collaboration Team[9] have included supporting integrative approaches to human health that recognize the connections among people, wildlife, the environment, and climate; documenting the prevalence and nature of violence against Alaska Native women and youth; and increasing understanding of mental health, substance abuse (including opioids), and well-being for Alaskan youth, as well as supporting programs that address those impacts and strengthen youth resilience.

3. Marine Ecosystem Research

Through the collective efforts of six countries (Canada, China, Japan, Republic of Korea, Russia, and the United States), comprehensive surveys of the Distributed Biological Observatory[10] (DBO) were completed between June and October of 2016 and 2017. Initiated by the United States in 2010, with support from the National Oceanic and Atmospheric Administration (NOAA) and the National Science Foundation (NSF), and since supported by multiple IARPC departments and agencies, and their overseas counterparts, the DBO is a change detection array for the identification and consistent monitoring of biophysical responses to environmental change. The array encompasses "biological hotspots"—where there is high productivity, biodiversity, and/or rates of change—and sampling transect lines along a gradient that begins in the northern Bering Sea, goes through the Bering Strait, and extends into the Chukchi and Beaufort seas.

In August and September 2017, NOAA led a marine ecosystem research cruise, which included DBO surveys and the Northern Chukchi Integrated Survey, aboard the U.S. Coast Guard cutter 'Healy' in the northern Bering and Chukchi seas. The ship went as far as 160 nautical miles north of Utqiaġvik (formerly known as Barrow) and did not encounter any sea ice. The absence of sea ice exemplifies the continuing retreat of the Arctic sea ice cover in the summer, which is particularly significant in the Pacific region of the Arctic Ocean and provides exciting new opportunities for research and discovery.

The 2017 cruise aboard the 'Healy' represented a second opportunity for NOAA to operate the 'Saildrone' in an innovative collaboration with the private sector (the first operation was in the Bering Sea in Summer 2016). An autonomous Saildrone, a 7 m (23 foot) long platform with outriggers and a rigid sail supported by a 6 m (20 foot) tall mast, can be instrumented with multiple sensors for atmospheric and oceanographic research. In 2017, two Saildrones departed from and returned to Dutch Harbor, Alaska, each completing an unprecedented round-trip voyage of 13,910 km (7,509 nautical miles) through the Bering Sea, Bering Strait, Chukchi Sea, and Beaufort Sea. Navigation of the Saildrones in these Arctic waters was aided by ice charts provided by the Navy-NOAA- U.S. Coast Guard

[8] https://www.iarpccollaborations.org/teams/Coastal-Resilience
[9] https://www.iarpccollaborations.org/teams/Health-Well-being
[10] https://www.pmel.noaa.gov/dbo/

National Ice Center. During their 76 day voyages, which included the first ever passage through the Bering Strait by unmanned surface vehicles, the Saildrones made thousands of measurements of carbon dioxide concentration in the atmosphere and ocean as part of a continuing study of Arctic Ocean acidification.

The Marine Ecosystems Collaboration Team[11] convened an international think-tank of 17 leading Arctic scientists from six countries and a conceptual artist to construct a unifying pan-Arctic perspective of marine ecosystems and related physical considerations. Outcomes of the meeting in November 2016 will include innovative interactive software that will enable users to explore particular topics and linkages in the Arctic marine ecosystem.

4. Coordinating International Arctic and Boreal Ecosystems and Socio-Ecological Systems Research

Through the Terrestrial Ecosystems Collaboration Team,[12] the the National Aeronautics and Space Administration (NASA) Arctic Boreal Vulnerability Experiment (ABoVE)[13] Science Team is coordinating research funded by other government and non-government organizations in the United States, Canada, and Europe. ABoVE is a large-scale remote sensing and field study of environmental change and its implications for social-ecological systems in the Arctic-Boreal region, including Alaska, Yukon, Nunavut, and Northwest Territories. In the United States, one of ABoVE's key collaborations is with the Next Generation Ecosystem Experiments[14] (NGEE) Arctic project of the Department of Energy. The goal of NGEE Arctic is to advance the predictive power of Earth system models through understanding of the structure and function of Arctic terrestrial ecosystems. NGEE Arctic field activities take place on the North Slope of Alaska and the Seward Peninsula in western Alaska. The Permafrost Action Team of the Study of Environmental Arctic Change, a project supported by NASA, the National Center for Atmospheric Research, NSF, USARC and the United States Geological Survey, plays a leading role in the synthesis of results from ABoVE, NGEE, and international projects to increase understanding of the role of Arctic freshwater and terrestrial ecosystems in the global carbon cycle.

5. Observing and Modeling Researchers Increase Collaboration

Multiple large observational datasets that provide valuable constraints to computer models have been released. The Glaciers and Sea Level Collaboration Team[15] reports that they include the Surface Mass Balance and Snow on Sea Ice Working Group, Making Earth System Data Records for Use in Research Environments, Greenland glacier termini and ice velocity, various NASA Operation IceBridge ice sheet and sea ice datasets, and the Arctic Digital Elevation Model (supported by a partnership between the National Geospatial-Intelligence Agency and NSF).

Collaboration between the observing and modeling research communities is increasing, providing greater opportunities for scientific advancement. This collaboration includes the growing use of *in situ* observations, such as those described in the previous paragraph, in computer modeling research to improve understanding of physical and biological processes, system-level interactions and feedback, and forecasting and prediction capabilities. For example, the Sea Ice Collaboration Team[16] reports that

[11] https://www.iarpccollaborations.org/teams/Marine-Ecosystems
[12] https://www.iarpccollaborations.org/teams/Terrestrial-Ecosystems
[13] https://above.nasa.gov/
[14] http://ngee-arctic.ornl.gov/
[15] https://www.iarpccollaborations.org/teams/Glaciers-Sea-Level
[16] https://www.iarpccollaborations.org/teams/Sea-Ice

sea ice observations from satellites and aircraft are being assimilated into and used to evaluate the skill of the U.S. Navy Arctic Cap Nowcast/Forecast System and the NOAA Earth System Research Laboratory Arctic sea ice forecasts. The interagency Sea Ice Prediction Network,[17] co-funded by the Department of Energy, NSF, and the Office of Naval Research with in-kind support from NASA and NOAA, is advancing sea ice forecasting at the seasonal scale through the annual Sea Ice Outlook, which uses an iterative process involving observations and model outputs to project the annual, end-of-summer sea ice minimum at Arctic-wide and regional scales.

The Arctic Research Plan 2013–2017

In February 2013, the IARPC, through its parent body, the Committee on Environment, Natural Resources, and Sustainability of the National Science and Technology Council (NSTC) released the 5-year *Arctic Research Plan 2013-2017*.[4] The plan focused on advancing knowledge of the Arctic by improving collaboration in seven priority research areas:

1. Sea Ice Physics and Marine Ecosystems
2. Terrestrial Ice and Terrestrial Ecosystems
3. Atmospheric Studies
4. Observing Systems
5. Regional Climate Models
6. Human Health Studies
7. Adaptation Tools for Communities

Twelve collaboration teams were formed to respond to the 145 milestones distributed across the seven research areas. The collaboration teams were also charged with enhancing inter-institutional and interdisciplinary implementation of scientific research on local, regional, and circumpolar environmental and societal issues in the Arctic.

The collaboration teams were chaired by Federal Government subject matter experts, and in some cases co-chaired with an external partner. Team members met monthly by teleconference or Webinar to inform each other about ongoing and planned programs and share new research results, as well as to inventory existing programs, identify gaps in knowledge and research, and address the milestones and evaluate progress toward reaching them. These discussions were open to researchers and others in the Federal Government; State of Alaska agencies; northern residents, including Alaska Natives; academia; non-governmental organizations; and the private sector. All meetings of the teams were announced on the new IARPC website—IARPC Collaborations[18]—a platform for sharing knowledge, generating new ideas, and reporting on research progress toward accomplishing milestones.

In 2015, IARPC released a Biennial Report[19] highlighting major accomplishments in the implementation of the *Arctic Research Plan 2013-2017* during the period 2013-2014. In October 2016, program managers responsible for implementing the Plan released their final annual reports,[20] summarizing achievements during the final implementation phase of the plan. The final annual reports were sent to the Arctic Executive Steering Committee for reporting on the implementation of the National Strategy for the Arctic Region.[21]

[17] https://www.arcus.org/sipn
[18] http://www.iarpccollaborations.org/index.html
[19] https://www.iarpccollaborations.org/uploads/cms/documents/iarpc_biennial_report_10.12.15_low.pdf
[20] https://www.iarpccollaborations.org/news/7207
[21] https://www.iarpccollaborations.org/uploads/cms/documents/national-strategy-for-the-arctic-region-executive-office-of-the-president-2013.pdf

The Arctic Research Plan 2017–2021

While IARPC significantly advanced Arctic science through enhanced interagency collaboration to implement the *Arctic Research Plan 2013-2017*, much remained to be done. The United States is an Arctic nation, and America's Arctic—Alaska—has seen climate, environmental, and socio-economic changes that are testing the resilience and sustainability of communities and ecosystems. The changes that are occurring in the Arctic also have global consequences.

In response, IARPC prepared the second comprehensive Arctic research plan—*Arctic Research Plan 2017-2021*.[22] As with its predecessor—the *Arctic Research Plan 2013-2017*—the new plan does not attempt to address all Arctic research supported by the Federal Government. Many important single agency efforts are not included because of the Plan's emphasis on interagency collaboration.

The Arctic Research Plan 2017-2021 has nine research goals:

1. Health and Well-being
2. Atmosphere
3. Sea Ice
4. Marine Ecosystems
5. Glaciers and Sea Level
6. Permafrost
7. Terrestrial and Freshwater Ecosystems
8. Coastal Resilience
9. Environmental Intelligence

Like the *Arctic Research Plan 2013-2017*, the *Arctic Research Plan 2017-2021* is being implemented by Federal and non-Federal stakeholders and collaborators through IARPC Collaborations. IARPC continues to welcome diverse participation in the implementation of its research plans and encourages all who want to address difficult research challenges in the Arctic to work together. Comprehensive annual reports[23] describing each collaboration team's accomplishments implementing the *Arctic Research Plan 2017-2021* in 2017 are available online at IARPC Collaborations.

Through the *Arctic Research Plan 2017-2021*, IARPC will continue to address the need for coordinated basic and applied research that will increase knowledge and understanding for science-informed decisions and policy for Alaska, the Arctic region, and the planet. In recognition of the broader factors that contribute to health and community vitality, the new plan includes a stronger focus on the health and well-being of northern residents. The plan also emphasizes the role that northern residents play in the co-production of knowledge.

Additionally, with a new goal focused on *Permafrost*, IARPC brings together basic geophysical research with adaptation research, and improves the treatment of permafrost processes in predictive models. The *Coastal Resilience*[24] topic is also new to this plan and draws together a rich array of existing activities

[22] The preparation of the *Arctic Research Plan 2017-2021* was informed by discussions with researchers and others in the U.S. Government, State of Alaska agencies, Alaska Natives, academe, non-governmental organizations, and the private sector. The draft plan was made available for public comment via the Federal Register in July 2016.

[23] https://www.iarpccollaborations.org/news/10523

[24] Coastal resilience research addresses the need to increase knowledge and understanding that will inform decisions and policy for decreasing the vulnerability and increasing the resilience (the ability to "bounce back") of the coupled human-physical-biological system in Arctic coastal regions that are experiencing rapid changes.

in a more coordinated effort. Finally, the concept of *Environmental Intelligence*[25] is also a new addition, but draws on some familiar topics: observations, models, and data management. The Environmental Intelligence framework will identify areas where an interagency focus on these topics can strengthen the role of research in decision support.

Response to Recommendations of the U.S. Arctic Research Commission

The ARPA establishes the relationship between IARPC and the USARC, and calls for IARPC to develop its 5-year plans "in consultation with the Commission, the Governor of the State of Alaska, the residents of the Arctic, the private sector and public interest groups." In accordance with ARPA, the 2015-2016 USARC Goals and Objectives Report[26] provided key input in developing the *Arctic Research Plan 2017-2021*. How the 2015-2016 USARC Goals and Objectives Report informed the *Arctic Research Plan 2017-2021* is described here.

While the structure and purpose of the USARC Goals and Objectives Report and the *Arctic Research Plan 2017-2021* are distinct, connections to the Report are found at all levels in the Plan. It is important to note that, while the Report looks broadly at how Federally-sponsored research could address emerging and persistent needs, the IARPC Plan focuses on topics requiring interagency collaboration. Specifically, this means that some Arctic research topics addressed by individual Federal agencies are not included in the Plan. The six goals in the USARC Report are:

1. Arctic Environmental Change
2. Arctic Human Health
3. Arctic Natural Resources
4. The Arctic "Built Environment"
5. Arctic Cultures and Community Resilience
6. International Scientific Cooperation

The structure of the IARPC Plan is tiered, and begins with Policy Drivers and Implementation Strategies. The Policy Drivers of *Well-being*, *Stewardship*, *Security*, and *Arctic-Global Systems* are high-level and capture the scope of all six of USARC's goals. The Plan's Implementation Strategies address how IARPC will coordinate research, and again, the USARC goals are reflected in these principles. The principles include integration of basic and applied research, and that Arctic research should be conducted in collaboration with indigenous and international partners.

The nine Goals of *Arctic Research Plan 2017-2021* each reflect a topic that the USARC Report considers important. In some cases, the Report identifies a research objective that is not reflected in the IARPC Plan. There are two fundamental explanations for this discrepancy. The first is when other Federal interagency work is already addressing an issue identified by USARC, IARPC sought a non-duplicative and exclusive Plan. For example, the Report highlights the important issue of ocean acidification in the Arctic, which is covered by the NSTC interagency Subcommittee on Ocean Science and Technology. The Report also stresses the importance of research into oil pollution prevention and response in Arctic waters, which is addressed by the Interagency Coordinating Committee on Oil Pollution Research. The second occurs when there are limited Federal activities addressing a topic recommended by the Commission or it is the remit of a single agency. For example, the Report identifies topics, like socio-

[25] Environmental Intelligence is a system through which timely, reliable and suitable information obtained, for example, by people, autonomous sensors and platforms, ships, airplanes and satellites, about a particular region or process is collected and integrated for the benefit of decision makers.

[26] https://www.arctic.gov/reports_goals.html

economic research focused on the North, yet there are limited Federally-funded efforts to coordinate across agencies. In other cases, like renewable energy, there is significant Federal work, but interagency efforts have only recently been initiated and will take more time to develop concrete objectives.

Examples where the Plan clearly reflects USARC recommendations include:

The Plan reflects the Report's emphasis on efforts to enhance research on Arctic environmental change (USARC Goal 1) in multiple ways, and examples include:

- a focus on ecosystem interactions among marine trophic levels and their impacts on human communities;
- interagency efforts to understand the warming-induced degradation of permafrost and other components of the cryosphere such as glaciers and sea ice; and
- research to understand how change in fire activity is impacting rural and urban communities and atmospheric emissions.

Additionally, USARC calls for greater support of scientific monitoring and improved modeling of the Arctic System along with improved data sharing and integration (USARC Goal 1). The Plan responds vigorously through its Research Goal on Environmental Intelligence, which emphasizes systems research and the need to integrate observations, data sharing and modeling across all areas of foundational science in support of improving scientific understanding of Arctic environmental change.

The Plan's responsiveness to the USARC emphasis on human health (USARC Goal 2) can be seen in IARPC's Research Goal on human health and well-being through its support for the following activities:

- research seeking to explore the interconnections between human health and the natural environment;
- community monitoring of environmental impacts associated with climate change on health, and research to increase understanding and surveillance of diseases, especially climate sensitive diseases;
- efforts surrounding health-care education, water quality and sanitation innovations, improving indoor air-quality, and supporting residents to become involved in health care processes;
- research on violence against Alaskan Native women and children; and
- efforts to improve effectiveness of responses, and support health care delivery across the Arctic through methods like telemedicine.

Some emerging work in the Plan relates to Report recommendations toward the "built environment" (USARC Goal 4) and community resilience (USARC Goal 5). New efforts under the Permafrost and Coastal Resilience Goals consider the impacts of permafrost degradation and coastal erosion on infrastructure. Issues related to community resilience are woven directly into the *Health and Well-being* Research Goal, for example research on the resilience of Alaskan Youth, and are present in community-based research approaches organized under the Coastal Resilience Goal.

Although the Plan spans a five-year period, Performance Elements are designed to be completed within two years and new Performance Elements will be designed to take their place. With this "living document" structure, IARPC hopes, through collaboration with partners like USARC, to add socio-economic research and renewable energy to the Plan in the near future. IARPC enjoys a beneficial partnership with USARC and looks forward to its next Report.