AMPLIFYING THE ARCTIC: STRENGTHENING SCIENCE TO RESPOND TO A RAPIDLY CHANGING ARCTIC

HEARING

BEFORE THE

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September 20, 2022

AMPLIFYING THE ARCTIC: STRENGTHENING SCIENCE TO RESPOND TO A RAPIDLY CHANGING ARCTIC

TUESDAY, SEPTEMBER 20, 2022

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Committee met, pursuant to notice, at 10:01 a.m., in room 2318 of the Rayburn House Office Building, Hon. Eddie Bernice Johnson [Chairwoman of the Committee] presiding.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HEARING CHARTER

Amplifying the Arctic: Strengthening Science to Respond to a Rapidly Changing Arctic

Tuesday, September 20, 2022

10:00 a.m. ET – 12:00 p.m. ET

2318 Rayburn House Office Building and Online via Zoom

PURPOSE

With the Arctic warming two to four times faster than the rest of the planet, the purpose of this hearing is to discuss the Interagency Arctic Research Policy Committee's Arctic Research Plan 2022-2026, which is informed by the U.S. Arctic Research Commission. The hearing will explore gaps in research and analysis, needed improvements to federal science capabilities, research vessels and infrastructure, and barriers to strengthening our response to local and global climate change impacts, such as carbon and methane emissions released from permafrost thaw. Additionally, we will discuss gaps in Arctic system monitoring, observing, modeling, and prediction efforts. Importantly, we will examine the role of traditional knowledge holders and equitable practices in the coproduction of research, especially in critical areas such as food security and biodiversity. Finally, the hearing will be an opportunity to discuss the impact of geopolitical tensions on science diplomacy in the Arctic and challenges for future international collaboration in key research including boreal forest fires, sea ice melt and land ice loss, particularly the Greenland Ice Sheet.

WITNESSES

- **Dr. Larry Hinzman,** Assistant Director of Polar Sciences, White House Office of Science and Technology Policy and Executive Director, Interagency Arctic Research and Policy Committee
- **Dr. Mike Sfraga**, Chair, U.S. Arctic Research Commission
- **Ms. Vera Kingeekuk Metcalf**, Executive Director, Eskimo Walrus Commission
- **Dr. Susan Natali,** Arctic Program Director, Woodwell Climate Research Center

Overarching Questions:

1. How did IARPC identify the priorities in the latest 5-year research plan? Why is the two-year implementation plan necessary? What discussions are taking place to consider longer-term research planning for the Arctic?
2. What outstanding research questions remain to be answered to improve our understanding of climate change impacts in the Arctic? What research infrastructure, vessels, capabilities, and partnerships are necessary to support this work? What is the status of the U.S. Arctic Observing Network?

3. What guidelines exist to help researchers improve communication and collaboration in Arctic communities when carrying out field work? How is the science community addressing barriers to coproduction of knowledge?
4. How are geopolitical tensions from Russia's war on Ukraine impacting domestic Arctic research under IARPC and international research through the Arctic Council? What are the future considerations for scientific collaboration in the Arctic?

The Arctic

The U.S. is an Arctic state by virtue of Alaska. The Arctic is home to about 4 million people and the boundaries of this area are defined in multiple ways, with the simplest definition being the land, sea, and ocean area north of the Arctic Circle (66°34' N).[1] In the United States, the *Arctic Research and Policy Act* (ARPA) of 1984 [P.L. 98-373] (15 U.S.C. 4108) defines "Arctic" to mean "all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas; and the Aleutian chain." Definitions of the Arctic may also be based on climate-related factors such as average temperature, northern tree line, extent of permafrost on land, extent of sea ice on the ocean, which could encompass different areas over time because of climate change.[2]

The rapid rate warming of the Arctic compared to the global average is a phenomenon known as Arctic amplification. The 2014 "Arctic in the Anthropocene: Emerging Research Questions," report by the Polar Research Board of the National Academies of Sciences, Engineering, and Medicine described the need for our Arctic response as follows:

> "What happens in the Arctic has far reaching implications around the world…The climate, biology, and society in the Arctic are changing in rapid, complex, and interactive ways, with effects throughout the region, and increasingly, the globe. If we as a global society are to respond effectively to these challenges, understanding the Arctic system has never been more important… the ability to identify and predict the ways in which the loss of sea ice affects climate, biology, and society will help us better prepare and adapt, in the Arctic and beyond."[3]

Arctic Research and Policy Act (ARPA) of 1984

ARPA provides for a comprehensive national policy addressing research needs and objectives in the Arctic. It was last amended in 1990 [P.L. 101-609]. It established the U.S. Arctic Research Commission and the Interagency Arctic Research Policy Committee.

[1] https://www.crs.gov/Reports/R41153?source=search&guid=bc5b6db978814e3bb87a66ecf3e53c71&index=0
[2] https://www.crs.gov/Reports/R41153?source=search&guid=62ed4276fb9f46c88043d5ab49634f34&index=0
[3] https://nap.nationalacademies.org/read/18726/chapter/2#2

U.S. Arctic Research Commission (USARC)

The U.S. Arctic Research Commission (USARC or the Commission) is responsible for helping develop and recommend a national Arctic research policy. It is also required to coordinate with the Interagency Arctic Research Policy Committee (IARPC) to establish an implementation plan for the Arctic research policy. The Commission is composed of seven members appointed by the President. The National Science Foundation (NSF) serves as an ex officio member. Four members represent academic or research institutions with Arctic expertise in areas including physical, biological, health, environmental, social, and behavioral sciences. One member is to be appointed from among Indigenous residents of the Arctic and two members are to represent industry. The President designates one of the seven members as chairperson. The Commission also publishes an annual statement of goals and objectives to guide IARPC and an annual report on the Commission's activities and accomplishments.

Interagency Arctic Research Policy Committee (IARPC)

ARPA designated NSF as the lead agency responsible for implementing Arctic research policy and directed the President to establish an Interagency Arctic Research Policy Committee (IARPC) to develop a comprehensive national Arctic research policy. In 2010, Executive Order 12501 redefined IARPC as a Working Group under the National Science and Technology Council (NSTC) of the Office of Science and Technology Policy. ARPA designated the following agencies to be represented in IARPC: NSF (chair), Departments of Commerce (National Oceanic and Atmospheric Administration – NOAA), Defense, Energy, Interior, State, Transportation, Health and Human Services, the National Aeronautics and Space Administration (NASA), and the Environmental Protection Agency (EPA). Other agencies that contribute to IARPC work are the Departments of Agriculture and Homeland Security, the Marine Mammal Commission, the Denali Commission, the Smithsonian Institution, the Office of Management and Budget, and the Office of Science and Technology Policy.

IARPC is directed to determine priorities for future Arctic research and to work with the Commission to develop and establish an integrated national Arctic research policy, develop comprehensive 5-year plans to implement the Arctic research policy, and develop guidelines for Federal agencies for awarding and administering Arctic research grants for adherence to each 5-year research plan. Additionally, IARPC is required to provide coordination, data, and assistance for the preparation of a single multiagency budget request for Arctic research. ARPA also directs OSTP to review agency budget requests related to the Arctic and directs OMB to consider all agency requests as one integrated, multiagency request and review it prior to submission of the budget for adherence to the 5-year research plan.

Finally, IARPC is required to facilitate cooperation between the Federal government and State and local governments, including the State of Alaska, facilitate international research cooperation, and facilitate Federal interagency coordination of all Arctic research activities. The activities and accomplishments of IARPC and the Commission is due to Congress in a biennial report.

2022-2026 Arctic Research Plan

OSTP published the 2022-2026 Arctic Research Plan developed by IARPC in December 2021. The four priority areas under the plan are:

> 1) Community Resilience and Health: 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;
>
> 2) Arctic Systems Interactions: Enhance our ability to observe, understand, predict, and project the Arctic's dynamic interconnected systems and their links to the Earth system;
>
> 3) Sustainable Economies and Livelihoods: Observe and understand the Arctic's natural, social, and built systems to promote sustainable economies and livelihoods; and
>
> 4) Risk Management and Hazard Mitigation: Secure and improve quality of life through research that promotes an understanding of disaster risk exposure, sensitivity to hazard, and adaptive capacity.

The impetus for these four categories was to be responsive to priorities identified by Arctic communities, Federal agencies with a presence in Alaska, the state of Alaska, and other non-Federal entities. This plan is intended to support basic, use-inspired, and applied research to ensure emerging challenges of the next five years are addressed.

Federal Agency Arctic Research

Many agencies carry out Arctic-related science, including NSF, NOAA, DOE, and NASA, each of which is part of IARPC. In addition to its role as chair of IARPC, NSF carries out Arctic research under two agency programs. The Office of Polar Programs under the Geosciences Directorate maintains an Arctic Sciences office with a budget of $105 million annually that funds research grants and logistics. Additionally, NSF budgets $30 million a year to carry out cross-agency work under the Navigating the New Arctic (NNA) program, part of the agency's 10 Big Ideas in 2017 to support convergence research. NSF also maintains Summit Station in Greenland, which is the only high altitude, high latitude, inland observing station in the Arctic. Finally, NSF and NOAA also support Arctic Observing Network programs. The IARPC 5-year research plan prioritizes more robust observation capabilities. Additionally, the FY 2023 House CJS Appropriations includes a directive to OSTP to submit a report on the need to establish and maintain an Arctic observing network.

NOAA's Arctic enterprise contributes to IARPC work through its goals of expanding climate services and products, supporting the New Blue Economy, and equity in services and workforce. The agency supports short-term weather and long-term climate monitoring and observation and advancing modeling and prediction. It also provides critical information for subsistence harvests and decision support for unique Artic hazards, including river ice breakup, coastal flooding, landslide-based tsunami risks, and fires. NOAA maintains three non-ice capable research ships and has facilities and observational assets across Alaska. Its annual funding estimate for research, products, and services in Alaska and the Arctic is $100 million.

DOE's Arctic Energy Office (AEO) was reestablished in 2020 to serve as a principal advisor to the Under Secretary of Energy on all domestic Arctic issues, including energy, science, and national security. AEO coordinates activities across the Department's program offices and national laboratories. Some of its crosscutting activities includes work on hydrokinetics, supporting microgrid efforts, a zero-emission shipping corridor proposal, solar research, legacy nuclear reactor monitoring, earth systems field work and monitoring, and other areas.

NASA also carries out important Arctic research, including research related to terrestrial ecology and the cryosphere, under its Earth Science Division. Started in 2015, the Arctic-Boreal Vulnerability Experiment (ABoVE) under the Terrestrial Ecology Program, is conducting an 8–10-year field campaign in Alaska and western Canada to better understand the vulnerability and resilience of ecosystems and society to climate change impacts such as permafrost thaw, boreal forest fires, coastal erosion, and changes to the wildlife habitat that supports subsistence lifestyles of Arctic Indigenous peoples. Additionally, NASA gathers critical remote sensing observations with aircraft and satellites, such as Ice, Cloud, and land Elevation Satellite (ICESat-2) to monitor sea ice loss, thickness, and changes, including Greenland Ice Sheet loss, to inform Earth system science and Arctic research modeling. NASA also coordinates field work with NSF in Greenland.

In 2021, the Biden Administration reactivated the Arctic Executive Steering Committee to advance U.S. Arctic interests, coordinate Federal actions in the Arctic, and reinforce collaborative partnerships with Alaska Native communities to harness science and Indigenous knowledge to inform management and policy.

Finally, another important area of research is carbon and methane emissions from permafrost thaw and Arctic wildfires. These Arctic feedbacks are not fully accounted for in climate models that inform global emissions budgets. The Woodwell Climate Research Center has significant expertise in this area of research and has funding by private donors. The Center's Arctic Program Director is testifying at this hearing.

Co-production of Knowledge

Improving the collaboration between Indigenous knowledge systems and western science is an ongoing challenge to research in the Arctic. In 2018, IARPC published, "Principles for Conducting Research in the Arctic," that includes respecting Indigenous knowledge and cultures and building and sustaining relationships. The Inuit Circumpolar Council of Alaska also published "A framework for the coproduction of knowledge in the context of Arctic research" and a 2022 report, "Circumpolar Inuit Protocols for Equitable and Ethical Engagement." Co-production is a major priority in the 5-year plan. A group of Alaska Native Tribal organizations sent a letter to NSF regarding the NNA program in 2020 and a follow-up letter in 2021 expressing concern about the continuing disconnect between resource managers, policymakers, academics, agencies, and local Alaskan communities. The letters describe a lack of access by traditional knowledge holders to inform the research process, including limited opportunity to weigh in on research needs and questions that are funded. One recommendation by co-production of knowledge experts is consultation with and access to research grant funding by co-

management organizations, such as the Eskimo Walrus Commission (EWC). Co-management organizations enter into cooperative agreements with Federal agencies to conserve marine mammals and provide co-management of subsistence use by Alaska Native organizations. The EWC is represented on the NSF-funded Study of Environmental Arctic Change (SEARCH) as a co-principal investigator. SEARCH is a collaboration of scientists, Indigenous People, and decision-makers established to communicate research findings to diverse audiences. The Executive Director of the EWC is testifying at this hearing.

Research Vessels and International Collaboration

The R/V *Sikuliaq*, owned by NSF and operated by cooperative agreement with the University of Alaska Fairbanks, is the only ice-capable Global Class research vessel in the U.S. academic research vessel fleet.[4] Ice-capable vessels can break 2 ½ feet of ice at 2 knots. It became fully operational in 2016 and supports national and international research. NSF research missions can also be conducted on the U.S. Coast Guard (USCG) Cutter *Healy,* a multi-mission medium polar icebreaker equipped with science capabilities that operates in the Arctic. The *Healy* can break 4 ½ feet of ice continuously at 3 knots[5] and is one of the nation's two operational polar icebreakers. The other is a heavy icebreaker, the *Polar Star*, which operates in the Antarctic. In 2020, a fire in one of the *Healy's* main propulsion motors rendered it inoperable, and it has undergone extensive repairs.[6] It is now back in service.

Arctic research missions are often collaborative with the U.S. partnering with international scientists and conducting research on vessels flown under a different flag. For example, the 2019 NSF-funded Northwest Passage Expedition was a U.S./Canadian team of scientists and students that conducted research aboard the Swedish Icebreaker *Oden*, which departed from a U.S. Air Base in Greenland.[7] Another example is the 2019 Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition on the R/V *Polarstern*, a German vessel. This was an international effort with leadership by Germany, the U.S. and others.

Geopolitical impacts on Science in the Arctic

The Department of State leads U.S. participation in the Arctic Council and collaborates with agencies, including science agencies, that lead delegations of Arctic Council working groups. These agencies include the EPA, National Nuclear Security Agency, NOAA, U.S. Fish and Wildlife Service, and U.S. Global Change Research Program, as well as other federal agencies with Arctic interests. The Arctic Council, established in 1996, is the leading intergovernmental forum promoting cooperation in the Arctic, including science supporting sustainable development and environmental protection.[8] In addition to the U.S., the other seven Arctic states are Canada, the Kingdom of Denmark, Finland, Iceland, Norway, the Russian Federation, and Sweden. There is a 2-year rotating chairmanship, which is currently chaired by Russia until

[4] https://www.unols.org/ships-facilities/unols-vessels
[5] https://www.pacificarea.uscg.mil/Our-Organization/Cutters/cgcHealy/
[6] https://www.crs.gov/Reports/RL34391?source=search&guid=8abb8f6db38a4399bf7bc08b947a3adc&index=6#fn14
[7] https://northwestpassageproject.org/
[8] https://www.arctic-council.org/

2023. The Arctic Council operates on a consensus basis and paused all activities since Russia's invasion of Ukraine. The U.S. held the chairmanship from 2015-2017 and will next chair 2031-2033. The Arctic Council also includes six Indigenous organizations as Permanent Participants and 38 non-Arctic observer states and organizations, including China, which claims it is a "near-Arctic" state. This is not an internationally recognized status.

In the U.S., and many other countries, Russian scientists have been prohibited from attending international science meetings and collaborating on Arctic projects. In addition, data collected by Russian scientists during international expeditions, such as the MOSAiC, is inaccessible for U.S. researchers, which is significant considering roughly half of the Arctic Ocean coastline is Russian.

Additionally, the National Academies of Sciences, Engineering, and Medicine and science academies around the world joined in denouncing the war.[9] The Academies makes efforts to support scientists across the world displaced by conflict, including Ukrainian scientists and researchers.[10]

[9] https://www.nationalacademies.org/news/2022/03/we-stand-with-our-colleagues-in-ukraine-say-u-s-national-academies-presidents

[10] https://www.nationalacademies.org/news/2022/06/international-science-academies-meet-in-poland-to-explore-how-to-support-ukrainian-science-and-researchers?utm_source=NASEM+News+and+Publications&utm_campaign=f588718f49-EMAIL_CAMPAIGN_2022_06_06_03_41&utm_medium=email&utm_term=0_96101de015-f588718f49-103694093&mc_cid=f588718f49&mc_eid=15ea17c53d

Chairwoman JOHNSON. This hearing will come to order. And without objection, the Chair is authorized to declare recess at any time.

Before I deliver my opening remarks, I wanted to note that, today, the Committee is meeting both in person and virtually. I want to announce a couple of reminders to the Members about the conduct of this hearing. First, Members and staff are—attending in person may choose to be masked, but it is not a requirement. However, any individuals with symptoms, a positive test, or exposure to someone with COVID–19 should wear a mask while present.

Members who are attending virtually should keep their video feed on as long as they are present in the hearing. Members are responsible for their own microphones, so please keep your microphones muted until you are speaking.

Finally, if Members have documents they wish to submit for the record, please email them to the Committee Clerk, whose email address was circulated prior to the meeting.

Good morning, and welcome to our witnesses. The Arctic, sometimes referred to as the land of the midnight sun or the top of the world, evokes images of the Northern Lights, the running of the iconic Iditarod dogsled race, and of course polar bears. We don't imagine increasing toxic algae blooms on Alaska's seafloor or increasing burn areas of boreal forest fires, nor do we picture the sinking homes and impassable roads caused by thawing of the once-frozen ground they built upon. But these are the realities faced by the 4 million people living in the Arctic. These realities became even more dire over the weekend as western Alaska faced the strongest September storm seen in 70 years. The storm caused a record storm surge of nearly 9 feet in some areas, flooding, and buildings to be swept off of their foundation. Environmental changes have had many social, cultural, and economic impacts, including on the food security of many local communities.

The Arctic is warming faster than any other part of the globe. Some changes are seen in a matter of years, not decades. Now more than ever it is becoming clearer that what happens in the Arctic has both local and global impacts. People in my home State of Texas experienced a historic winter storm in February of 2021 that left many without running water, power, or heat for days. Researchers have linked this storm to Western wildfires and other extreme weather events in the lower 48 States to warming of the Arctic.

Support of robust, coordinated Arctic research and science is critical. I applaud the interagency effort and work of experts to develop the 2022 to 2026 Arctic Research Plan. I look forward to hearing how the plan will lay the foundation for our priorities for the next 5 years. The changes in the Arctic are happening today, and we must be agile and strategic in our response. This starts with working meaningfully with local and indigenous communities of Alaska and the Arctic who know their needs the most.

Efforts have been made to bridge Indigenous Knowledge (IK) and Western science, but more needs to be done to elevate co-production of knowledge in the research enterprise. Research opportunities such as field research and expedition are a highlight for many scientists who study the Arctic. Unfortunately, the feeling is not al-

ways mutual among local communities. We must find ways to build better relationships if the research is to be as productive as possible.

In addition to expanding participation in Arctic research, we must also strengthen and increase our Arctic science capabilities, including research vessels, infrastructure, and facilities, which are constrained. If we are to continue our leadership in Arctic science, what additional capabilities are necessary? Likewise, what are our plans to support more robust monitoring, observing, modeling, and prediction that will help us better understand changes in the Arctic?

Well, we have a lot to address at this morning's hearing, and I again want to thank our witnesses for being here.

[The prepared statement of Chairwoman Johnson follows:]

Good morning and welcome to our witnesses.

The Arctic, sometimes referred to as the Land of the Midnight Sun or the Top of the World, evokes images of the northern lights, the running of the iconic Iditarod dog sled race, and of course, polar bears. We don't imagine the increasing toxic algal blooms on Alaska's sea floor or increasing burn areas of boreal forest fires. Nor do we picture the sinking homes and impassable roads caused by thawing of the once frozen ground they are built upon. But these are the realities faced by the 4 million people living in the Arctic. These realities became even more dire over the weekend as western Alaska faced the strongest September storm seen in 70 years. The storm caused record storm surge of nearly 9 feet in some areas, flooding, and buildings to be swept off their foundations. Environmental changes have many social, cultural, and economic impacts, including on the food security of many local communities.

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Efforts have been made to bridge Indigenous knowledge and western science, but more needs to be done to elevate co-production of knowledge in the research enterprise. Research opportunities such as field research and expeditions are a highlight for many scientists who study the Arctic. Unfortunately, the feeling is not always mutual amongst local communities. We must find ways to build better relationships if the research is to be as productive as possible.

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Well, we have a lot to address at this morning's hearing, and I again want to thank our witnesses for their testimony.

Chairwoman JOHNSON. The Chair now recognizes Mr. Lucas for his opening statement.

Mr. LUCAS. Good morning, Chairwoman Johnson, and thank you for holding today's hearing to examine our national R&D (research and development) efforts in the Arctic.

The Arctic presents us with a variety of scientific and technical challenges and opportunities because of its unique environmental,

geopolitical, and resource structure. We're currently experiencing a period of unprecedented changes in all these areas, and our investments in fundamental Arctic-related research will be critical to understand and adapting to these changes.

In 2017, I had the opportunity to visit the Arctic and witnessed firsthand the research being conducted there, including the Barrow Arctic Research Center. One of the highlights of this trip was being outfitted in cold weather gear and touring Summit Station, a critical research facility at the summit of the Greenland Ice Sheet. This trip to the Arctic demonstrated to me the sensitivity that the environment—to things like changing carbon dioxide levels.

The scientific data that is being collected at our Arctic research centers and fuel stations are key to understanding the factors affecting the Arctic's regional, atmosphere, ocean, and sea ice over. And when we understand these changes, we can make informed decisions related to the region, the continent, U.S., and the entire globe. So I appreciate the great work being done by many of our agencies to further this understanding.

The National Oceanic and Atmospheric Administration (NOAA) is conducting extensive data-gathering and research activities through multiple programs, informing decisions support for unique Arctic hazards such as river ice breakup, fires, coastal flooding. NASA (National Aeronautics and Space Administration) is gathering critical remote-sensing observations from aircrafts and satellites to inform Earth system science and Arctic research modeling.

The National Science Foundation (NSF) is supporting innovation, convergent research through "Navigating the New Arctic Program."

The U.S. is only one of eight Arctic nations, and, as such, it has a critical role to play in the future of the region. This is essentially true—especially true, I should say, as we look at the economic and geopolitical consequences of the rapid changes occurring in the Arctic. Territorial disputes in this region are taking on greater importance as resource-rich land and new shipping routes are revealed. There are significant economic implications from the energy rights, mineral deposits, and tourism opportunities being uncovered.

I would be remiss if I did not acknowledge the impact of the—Russia's invasion of the Ukraine on international cooperation in the Arctic. Russia's unprovoked invasion of the Ukraine violated the core principles of sovereignty, and I stand with the decision to suspend engagement in the Arctic Council. As a result, the U.S. must leverage and expand our research partnerships with our Arctic and non-Arctic allies to ensure that the U.S. remains a leader in the region.

I look forward to hearing from our witnesses today about how the research conducted in the Arctic plays a central role in understanding and addressing the key consequences of change in the region and how the U.S. can play a leading role in the new Arctic. Thank you for being here today, and I yield back the balance of my time, Madam Chair.

[The prepared statement of Mr. Lucas follows:]

Good morning Chairwoman Johnson and thank you for holding today's hearing to examine our national R&D efforts in the Arctic.

The Arctic presents us with a variety of scientific and technical challenges and opportunities because of its unique environmental, geopolitical, and resource structure.

We're currently experiencing a period of unprecedented changes in all these areas, and our investments in foundational Arctic-related research will be critical to understanding and adapting to these changes.

In 2017, I had the opportunity to visit the Arctic and witness, first-hand, the research being conducted there, including at the Barrow Arctic Research Center.

One of the highlights of this trip was being outfitted in cold weather gear and touring Summit Station, a critical research facility at the summit of the Greenland Ice Sheet. This trip to the Arctic demonstrated to me the sensitivity of that environment to things like changing carbon dioxide levels.

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Chairwoman JOHNSON. Thank you, Mr. Lucas.

If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

At this time, I'd like to introduce our witnesses. Our first witness is Dr. Larry Hinzman, who serves in the White House Office of Science and Technology Policy, OSTP, as the Assistant Director for Polar Sciences. He is also the Executive Director of the Interagency Arctic Research Policy Committee (IARPC) and is leading the effort to implement the 2022 to 2026 Federal Arctic Research Plan. He recently served as the President of the International Arctic Science Committee, and as the Vice Chancellor for Research, and Professor of Civil and Environmental Engineering at the University of Alaska in Fairbanks.

Our next witness is Dr. Mike Sfraga, who is the Chairman of the United States Arctic Research Commission and the founding Director of the Polar Institute at Woodrow Wilson International Center

for Scholars. A geographer by training, his work focuses on the changing geography of the Arctic and Antarctic landscapes, Arctic policy, and the implications of a changing climate on political, science, social, and economic, environmental, and security regimes in the Arctic. He previously served as a distinguished co-lead scholar for the U.S. Department of State Inaugural Fulbright Arctic Initiative from 2015 to 2017, a complementary program to the U.S. Chairmanship of the Arctic Council.

Our third witness, Dr. Vera Kingeekuk Metcalf, since 2002, she has served as the Director of the Eskimo Walrus Commission (EWC) at Kawerak. The Commission represents 19 coastal Alaska Native communities to promote community involvement and research, document Indigenous Knowledge, and co-manage the Pacific walrus population. She also is a Bering Strait Commissioner for the U.S. Department of State, facilitating travel between the indigenous people and Chukotka, Russia, and the Strait region in Alaska.

Our final witness, Dr. Susan Natali, she is the Arctic Program Director and a Senior Scientist at Woodwell Climate Research Center. She is also a renowned Arctic Ecologist, whose research focus is on permafrost. She is currently leading a project called Permafrost Pathways, which is designed to amplify efforts to collect the best data on Arctic carbon emissions, contextualize this information within a global budget, and transform the science into actionable policy.

As our witnesses should know, you each will have 5 minutes to use for your spoken testimony. Your written testimony will be included in the record for the hearing. When all of you have completed your spoken testimony, you will begin with questions. Each Member will have 5 minutes to question the panel. We will start out with Dr. Hinzman.

TESTIMONY OF DR. LARRY HINZMAN,
ASSISTANT DIRECTOR OF POLAR SCIENCES,
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
AND EXECUTIVE DIRECTOR,
INTERAGENCY ARCTIC RESEARCH AND POLICY COMMITTEE

Dr. HINZMAN. Thank you. Chairman Johnson, Representative Member—Ranking Member Lucas, and distinguished Members of the Committee, thank you for holding this important hearing. I am Dr. Larry Hinzman. I am honored to appear before you today. I serve as the Executive Director of the Interagency Arctic Research and Policy Committee, and as the Assistant Director for Polar Sciences at the White House Office of Science and Technology Policy. I live in Fairbanks, Alaska, and have been engaged in Arctic research for almost 40 years.

I'd like to take just a brief moment to first acknowledge the suffering and loss occurring in both Alaska and Puerto Rico. The Alaskan typhoon was a huge storm, and there has been terrible damage that was spread over 1,000 miles of Alaska coastline. I have worked in several of these Alaska communities and worry about their recovery from the devastation before winter sets in.

I will start by commending this Committee for your visionary leadership in shaping Arctic policy both in current times and in re-

cent decades. Today, I will testify about the necessity of Arctic research and the work of IARPC, and I also will remark upon the importance of research infrastructure required for Arctic research, international collaboration, and respectful engagement with indigenous peoples as key facets of Arctic research.

The United States is an Arctic nation. The ongoing environmental and climate changes in the Arctic have impacts across the American economy and society. Environmental changes in the Arctic reverberate through the globe, affecting coastlines, weather, and availability of resources in more temperate regions. It is in the U.S. national interest to understand Arctic processes and their impacts on the global system. The Arctic territory is remote and data sparse, and thus, understanding Arctic change requires significant effort, expertise, and commitment to sustaining and recapitalizing critical research infrastructure.

The Arctic is ongoing rapid change in ecological and socioeconomic responses to climate and other drivers. Climate effects are causing direct and indirect impacts on the region's physical, chemical, and biological environments. Social, cultural, and environmental changes alter the fabric of indigenous and other communities and may inhibit the preservation of Alaska Native cultures and Indigenous Knowledge. Economic change can bring opportunities but also dislocation as local residents are trained to work in fields that may not exist or persist in their home regions.

This region is geographically vast, sparsely populated, and characterized by strong connections among its indigenous peoples, and the land and the sea. Adaptation to climate change intersects with other environmental issues and needed policies confronting Arctic residents, including those concerning food security, human health and welfare, environmental security, and quality of life, and the resilience of ecosystems.

IARPC facilitates partnerships and collaborations that improve our understanding of the rapidly changing Arctic system and its impact on the Earth system through critical advances in cryosphere, atmosphere, ocean, and ecosystem science, advanced modeling projections of environmental dynamics, and future climate conditions, improved understanding of current and future Arctic change, and advanced human-centered research critical to the Alaskan community health, infrastructure, and environmental safety.

This plan builds on the Administration's priorities for racial equity and tribal engagement. This plan includes participatory research and indigenous leadership in research as a foundational activity to support true engagement and community participation and co-production of knowledge.

The Arctic scientific community is very strong and collaborative. The Federal agencies leading Arctic research are making important contributions to help the people of the United States and the world prepare for an uncertain future but one that is certainly different from today. Our Nation must continue to invest in Arctic research, as the Arctic is demonstrating an outsized effect on the global climate system. The benefits are clearly far greater than the cost. We must place greater emphasis upon convergent science that draws together relevant disciplines, scientific engineering, and social

changes to resolve more complex or sophisticated challenges to our communities.

So I'll say again, it is in the U.S. national interest to understand Arctic processes and their impacts to the global system. I thank you again for convening this important hearing and allowing me the opportunity to testify, and I look forward to your questions.

[The prepared statement of Dr. Hinzman follows:]

Written Testimony of
Dr. Larry Hinzman
Executive Director, Interagency Arctic Research and Policy Committee
Assistant Director of Polar Sciences
White House Office of Science and Technology

For a hearing on
"Amplifying the Arctic: Strengthening Science to Respond to a Rapidly Changing Arctic"

Before the
Committee on Science, Space, and Technology
U.S. House of Representatives

September 20, 2022

Chairwoman Johnson, Ranking Member Lucas, and distinguished members of the Committee, thank you for holding this important hearing. I am Dr. Larry Hinzman, and I am honored to appear before you today. I serve as Executive Director of the Interagency Arctic Research and Policy Committee (IARPC) and Assistant Director for Polar Sciences at the White House Office of Science and Technology Policy (OSTP).

I will start by commending this Committee for your visionary leadership in shaping Arctic policy, both in current times and in recent decades. Today, I will testify about the necessity of Arctic research and the work of IARPC, and I will also remark upon the importance of research infrastructure required for Arctic research, international collaboration, and respectful engagement with Arctic communities as key facets of Arctic research. The importance of Arctic research at this time cannot be overstated. While the impacts of the changing climate are drastically affecting Arctic people, wildlife, infrastructure, and the environment, the consequences of these changes are reverberating throughout the global climate system, influencing extreme weather, wildfires, sea level, and increases in temperatures of communities throughout our nation.

Arctic Research

The U.S. is an Arctic nation. The ongoing environmental and climate changes in the Arctic have impacts on the American economy and society.

The Arctic territory is remote and data-sparse, thus understanding Arctic change requires significant effort, expertise, and commitment to sustaining and re-capitalizing critical research infrastructure. There are changes underway in the Arctic, from changes in climate and the environment, to changes in demographics, to changes in economies and livelihoods. Research is critically important to understand the drivers, the societal and environmental responses, and possible pathways to adapt to these changes.

The Arctic is undergoing rapid change in ecological, socio-economic, and political responses to climate and other drivers. The impact of climate change in the Arctic is the engine for the

evolution of the physical, social, operational, and geopolitical environments. Climate change is impacting our national security across this region, and science is the foundation in understanding the evolution of the Arctic. Now and for decades to come, that scientific understanding will enable the U.S. to be proactive in advancing our national security objectives and those of our like-minded allies and partners. For example, climate effects are causing direct and indirect impacts on the region's physical, chemical, and biological environments. Social, cultural and environmental changes alter the fabric of Indigenous and other communities, and may inhibit the continuation of Native cultural practices and the ability to actively pass on Indigenous Knowledge.

Economic change can bring opportunities but also dislocation as local residents are trained to work in fields that may not exist or persist in their home regions. This region is geographically vast, sparsely populated, and characterized by strong connections among its Indigenous Peoples and the land and sea. Adaptation to climate change intersects with other environmental issues and needed policies confronting Arctic residents, including those concerning food security, human health and welfare, environmental security and quality of life, and resilience of ecosystems.

The complex interplay of physical, chemical, biological, and social processes interacts to such an extent that an understanding of future trajectories requires a holistic perspective of the complete system. To achieve this goal, the U.S. Arctic research community must work collectively and in collaboration with our international colleagues.

Environmental drivers are increasingly impacting the lives of people in riverine and coastal communities and other parts of the Arctic. These impacts are expected to grow in magnitude and effect during the 21st century. Changes that affect Arctic coastlines will continue to direct, for example, the location of human habitations and the staging and feasibility of subsistence activities. The changes in the duration and distribution of sea ice will severely impact the availability of marine and coastal subsistence resources that are critical for survival. The small number of jobs, high cost of living, and rapid social change makes rural (predominantly Indigenous) communities highly vulnerable to climate change, especially through impacts on traditional hunting and fishing activities and cultural connections to the land and sea.

Both mitigation and adaptation responses to climate change are underway in the region in order to reduce and manage current and future risks. Small-scale farming and gardening in Alaska are providing locally-grown food resources and might alleviate some food insecurities that are likely to increase in the coming years. Long-term monitoring and adaptive management approaches can help us understand the effectiveness of human interventions (e.g., management or regulatory policies) and develop an understanding of trajectories of change.

Thawing of permafrost is having serious implications for the integrity of homes, municipal buildings, and essential facilities, including infrastructure of the oil, gas, and mining industries and Department of Defense installations. Innovative scientific and engineering research is needed to resolve ongoing technical challenges to infrastructure while developing novel solutions to enable future growth and development.

The relatively few roads in the Arctic and difficulty of off-road travel has prompted most travel by boats or on frozen rivers or sea ice. However, reduced coverage of sea ice and river ice compounds the difficulty of winter travel. More challenging travel conditions and increasing unpredictability of animal movements and availability of those animals can decrease harvest success and require additional hunting effort associated with additional fuel costs, time away from jobs and families, increased wear and tear on equipment, and increased risk of exposure and injury.

Interagency Arctic Research and Policy Committee (IARPC)

IARPC was established by Congress in the Arctic Research and Policy Act of 1984 (ARPA), legislation that advanced through this very committee. The law called for a comprehensive national policy focused on Arctic research, and IARPC was created to implement the legislation. IARPC was later reorganized as an interagency working group of the National Science and Technology Council (NSTC), which OSTP leads. IARPC comprises 17 Federal agencies, departments, and offices. OSTP is also the home of the Arctic Executive Steering Committee, which has a mandate to help Arctic communities adapt to the rapidly changing environment.

IARPC facilitates partnerships and collaborations that improve our understanding of the rapidly changing Arctic system and its impact on the Earth system through critical advances in cryosphere, atmosphere, ocean, and ecosystem science; advanced modeling and projections of environmental dynamics and future climate conditions; improved understanding of current and future Arctic change; and advanced human-centered research critical to Alaska community health, infrastructure, and environmental safety.

IARPC also supports IARPC Collaborations, a platform that facilitates implementation of the Arctic Research Plans and coordination among 3,500 researchers from the Federal Government, universities, foundations, and international organizations, along with Arctic community members. IARPC Collaborations has been successful by bringing together expertise, data, and resources, to solve complex problems that cannot be addressed in isolation. An example of successful interagency collaborations is the creation of a new position of Indigenous Community Engagement Specialist, which serves to coordinate federal research activities with local Indigenous communities in Alaska. The position is open in Anchorage; it is cooperatively funded by four Federal agencies. This position is stationed with the Smithsonian Arctic Studies Center's Alaskan office at the Anchorage Museum.

IARPC's 2022-2026 Arctic Research Plan

Section 109 of ARPA requires IARPC to create and implement five-year Arctic Research Plans, which show how Federal agencies work together to conduct Arctic research. The plans are developed in consultation with the U.S. Arctic Research Commission, the State of Alaska, Arctic residents, the private sector, and public interest groups. IARPC's role is to facilitate and encourage collaboration in Arctic research.

In December 2021, IARPC introduced the 2022-2026 Arctic Research Plan to address complex research challenges that are of great concern to our nation. This plan builds on focus of the

previous plans on processes, such as sea ice dynamics, permafrost changes, and oceanic stratification and circulation. The 2022-2026 Plan moves beyond disciplinary-specific goals to the following four interdisciplinary priorities:

1. **Community Resilience and Health**: 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.

2. **Arctic Systems Interactions**: Enhance our ability to observe, understand, predict, and project the Arctic's dynamic interconnected systems and their linkages to the Earth system as a whole.

3. **Sustainable Economies and Livelihoods**: Observe and understand the Arctic's natural, social, and built systems to promote sustainable economies and livelihoods.

4. **Risk Management and Hazard Mitigation**: Secure and improve quality of life through an understanding of disaster risk exposure, sensitivity to hazard, and adaptive capacity.

This plan builds on the Administration's priorities for racial equity and Tribal engagement. The plan includes "Participatory Research and Indigenous Leadership in Research" as a foundational activity to support true engagement, community participation, and co-production of knowledge.

The pace of change and achievement has been so rapid that it is important to set long-term goals every five years that define the trajectory of research foci, while also periodically assessing our accomplishments, considering the changing scientific landscape, and resetting our intermediary targets. The IARPC agencies and collaborating researchers will implement the guidance provided in the 2022-2026 Arctic Research Plan through Biennial Implementation Plans (BIPs), detailed plans that identify specific activities and deliverables that can be achieved in the near-term and names the agency that will provide the leadership to complete those deliverables.

IARPC's U.S. Arctic Observing Network (U.S. AON)

Accurate assessment of environmental conditions is essential. The U.S. Arctic Observing Network (U.S. AON), which is a subcommittee of IARPC, is an initiative to promote establishing and maintaining sustained networks of Arctic observations among Federal agencies and other partners. These networks will provide high-quality monitoring, observations, and expertise.

Presently, the monitoring density of meteorological, hydrological, oceanographic, seismic, and other environmental variables in the Arctic is inadequate to enable us to answer the critical questions being posed by society. The land area of U.S. Arctic, as defined by ARPA (1984) is 267,185 square miles. In that area, which is about the size of Texas, there are 6 ASOS meteorological stations operated by the U.S. National Weather Service and 14 river monitoring stations operated by the U.S. Geological Survey (but only 8 are currently active). At this density of observations, most storms or flood events would not be detected, let alone well characterized. Sustained environmental monitoring is necessary for field research studies and for documenting

rates of change, but this information is also vital for industry, resource managers, state agencies, and community planners. Due to limited information, infrastructure was not designed and constructed for the environmental conditions likely to be encountered, but rather roads, bridges or culverts were repaired or replaced as needed. Due to the lack of observations and limited understanding of climate change, the Trans-Alaska Pipeline has been repeatedly retrofitted with additional thermosyphons to prevent thawing of underlying permafrost. Federal agencies and non-Federal organizations administer observation stations operating at single points but those stations cannot capture the scale of the problem of characterizing this huge area, almost entirely in remote locations with little to no infrastructure or technical support, and typically in harsh weather, with inquisitive wildlife, and unstable surface conditions.

Sustained marine and terrestrial observations are essential in developing, verifying, and validating the models used to forecast weather, plot aircraft or ship navigation, or predict extreme events, wildfire behavior, or volcanic plume trajectories. These are just a few of the hundreds of civil applications that are products of research born of field observations. Examples of on-going research that will similarly yield societal benefits include projecting species migrations, quantifying sea level rise, characterizing coastal zone stability or vulnerability, or forecasting harmful algal blooms. Our nation will benefit substantially from strategically enhanced, well-coordinated observing capacity in the Arctic. U.S. AON was created to help coordinate and implement a pan-Arctic observing system. Many nations, including non-Arctic countries, are providing substantial support to help achieve the goals laid out by the international Sustaining Arctic Observing Network (SAON) strategy.

Research Infrastructure

High quality Arctic research requires high quality research infrastructure. In addition to U.S. AON that I discussed above, Arctic researchers have many other infrastructure needs, including some that I discuss here.

For the foreseeable future, we will have Arctic sea ice in the winter, with remnants into spring. The U.S. Arctic research community needs icebreakers to access the Arctic Ocean and marginal seas even as ice cover diminishes. The magnitude and consequences of the scientific questions regarding the role of sea ice in global climate dynamics, commercial fisheries, and transpolar shipping are immense with tremendous impacts to the U.S. and global economies. The research community would welcome additional capabilities for increasing sea ice research.

The Summit Station Greenland is the premier and only high-latitude, high-altitude, year-round observing platform in the Arctic. It is a uniquely critical platform for understanding past and current climate and environmental changes, which also permits modelling of future ice sheet, climate, and sea level rise scenarios. Unfortunately, there is a great need to maintain and update the Summit facility. The current infrastructure is near failure, sinking into the snow, creating access and maintenance challenges. The rapid loss of ancient ice from the Greenland Ice Sheet presents a tremendous threat to U.S. coastal infrastructure.

There is a need for greater collection, storage, and accessibility of Arctic data, across scientific fields and nations. Infrastructure that supports data management and curation is costly and

relatively invisible compared to more physical infrastructure, but is sorely needed. We must enable optimum utilization of the existing observed and modeled data to maximize the return on our scientific investments, while also promoting synergy across scientific disciplines and new scientific findings.

International Collaboration in the Arctic

The Arctic research community has long been a beacon and a bastion of international collaborations. International partnerships with European and Asian partners greatly advanced our understanding of the role of the Arctic in the global climate system. Such cooperation promotes more rapid learning and more efficient achievements.

Following Russia's further invasion of Ukraine in February, the U.S. ceased government-to-government and multilateral engagement with Russia that was not in the U.S. national security interest. Research that has been disrupted includes field studies of natural carbon emissions, permafrost degradation, large river discharges, and population dynamics of walrus, polar bears, and waterfowl. Since Russia decided to escalate this brutal war, Federal scientists have ceased these partnerships and shelved plans for new joint efforts. We have had no choice but to forgo the regular collegial communications that enriched our understanding of Arctic science since the thawing of the Cold War.

Russia's unlawful invasion of Ukraine has caused tremendous suffering and a cascade of misery throughout Europe; the disruption of Arctic science is but one negative outcome that is far outweighed by the loss of life and threats to democracy. However, we must not ignore the impact to science, and we remain hopeful that Russia will fully withdraw from Ukraine and end this war. It was through scientific partnerships and collaborations that the U.S. and Russia developed a more open working relationship at various points in history. We remain hopeful that the scientific friendships we developed in the past can one day pave the way for mutual respect and cooperation in science and policy. It is for this reason that I worry about proposals to erect barriers to future scientific collaboration, such as a policy contained in Section 535 of H.R. 8256, the *Commerce, Justice, Science, and Related Agencies Appropriations Act, 2023*, which would prohibit OSTP, NASA, and the National Space Council from collaborating with Russia.

The magnitude of the challenges associated with climate change in the Arctic are simply too great for any nation to resolve in isolation. We must continue to collaborate with our international partners, particularly in field studies and observations, but also by sharing results, accomplishments, and understanding.

Indigenous Knowledge

Climate impacts on Arctic Indigenous communities are magnified by additional social and economic stresses. Additionally, many Indigenous communities still suffer from enduring health disparities and socioeconomic conditions.

The insights and knowledge of Indigenous Peoples and other local residents must be part of an approach to relevant adaptation planning. Integrating Indigenous Knowledge with science-based

management principles can yield culturally-appropriate solutions that incorporate scientific and technological advances. The inclusion of Indigenous Knowledge, traditional knowledge holders and equitable practices in the co-production of research offers benefits to local communities and Federal agencies. Engaging a whole ecosystem perspective, which includes humans, in understanding the drivers and impacts of change, enables communities and Federal agencies to be better stewards of limited resources and assure sustainable management. This Administration is committed to strengthening the relationship between the Federal Government and Tribal Nations, which includes advancing equity for Indigenous and Native American people, including American Indians and Alaska Natives. IARPC endeavors to implement these commitments by listening to and learning from Indigenous communities and ensuring that IARPC agencies meaningfully consider their views. We have worked with our Federal agencies to ensure there is an understanding and a process to conduct regular, meaningful, and robust engagement with Tribal officials. IARPC went to great lengths to hear and incorporate the opinions of Indigenous individuals and organizations in the development of these Federal research plans.

The 2022-2026 Arctic Research Plan differs from earlier collaborative plans in the creation of a Foundational Activity entitled "Participatory Research and Indigenous Leadership in Research". Implementation of this plan is not based upon a one-way flow of information from the Federal Government and researchers to Indigenous communities, but true engagement, community participation, and co-production of knowledge. Such partnerships in research can yield immediate benefits in terms of research findings, and can also enhance capacity building and better communications among agencies, researchers, and community members.

Conclusions

It is in the U.S. national interest to understand Arctic processes and their impacts to the global system. The Arctic scientific community is very strong and collaborative. The Federal agencies leading Arctic research are making important contributions to help the people of the U.S. and the world prepare for an uncertain future, but one that is certainly different from today. Our nation must continue to invest in Arctic research as the Arctic is demonstrating an outsized effect on the global climate system. The benefits are clearly far greater than the cost. We must also place greater emphasis upon convergent science that draws together relevant scientific, engineering, and social science disciplines to resolve the more complex or sophisticated challenges confronting our communities. Collaborations across agencies, with non-Federal collaborators and with Indigenous communities should be a priority.

I thank you again for holding this important hearing and allowing me the opportunity to testify. I look forward to your questions.

Biography of Larry Hinzman, Ph.D.

Dr. Larry Hinzman serves in the White House Office of Science and Technology Policy (OSTP) as the Assistant Director for Polar Sciences. He is also the Executive Director of the Interagency Arctic Research Policy Committee (IARPC) and is leading the effort to implement the 2022-2026 Federal Arctic Research Plan. Dr. Hinzman recently served as the President of the International Arctic Science Committee and as the Vice Chancellor for Research and Professor of Civil and Environmental Engineering at the University of Alaska Fairbanks (UAF). He served as the Director of the UAF International Arctic Research Center from 2007 to 2015.

His primary research interests involve permafrost hydrology. He conducted hydrological and meteorological field studies in the Alaskan Arctic continuously for over 35 years while frequently collaborating on complementary research in the Russian and Canadian Arctic. Dr. Hinzman's research efforts have involved characterizing and quantifying hydrological processes and their inter-dependence with climate and ecosystem dynamics. He has served as a member of the U.S. National Academy of Sciences Polar Research Board. Dr. Hinzman is strongly committed to facilitating national and international partnerships to advance our understanding of the Arctic and Antarctic systems.

Dr. Hinzman earned B.S. degrees in Soil Science and Chemistry from South Dakota State University in 1979, followed by an M.S. degree in Agronomy with emphasis in remote sensing from Purdue University in 1981. Dr. Hinzman began conducting research in Alaska that same year, eventually earning a Ph.D. in Soil Physics from the University of Alaska Fairbanks in 1990.

Chairwoman JOHNSON. Thank you very much. Dr. Sfraga.

TESTIMONY OF DR. MIKE SFRAGA,

CHAIR, U.S. ARCTIC RESEARCH COMMISSION

Dr. SFRAGA. Chairwoman Johnson, Ranking Member Lucas, and distinguished Members of the Committee, thank you for convening this hearing today on Arctic research. I'm Dr. Mike Sfraga, and I'm honored to appear before you today. Like Dr. Hinzman, I too am a resident of Fairbanks, Alaska, and I also serve as the presidentially appointed Chair of the United States Arctic Research Commission.

The knowledge and understanding we gain from Arctic research inform our Nation's Arctic policies and actions on climate change, infrastructure development, energy security, economic development, as well as community, homeland, and national security. The United States Arctic Research Commission is an independent Federal agency established by the *Arctic Research Policy Act* that plays a central role in advancing these issues. Sound research informs sound policy development and implementation.

The Commission publishes a biennial report to the White House and Congress on Arctic research goals and objectives. This report guides the development of our Nation's Arctic Research Plan that is produced by IARPC, as described by Dr. Hinzman. In my written testimony, I've included a full description of the Commission, our current members, and our duties assigned by law.

Here's a preview of the five overarching Arctic research goals that will be included in the Commission's next report. The first is environmental risk and hazard. The superstorm that just inundated and devastated so many communities along the Bering Strait region of my home State of Alaska is a sad, yet poignant reminder of the vulnerability of our Arctic communities. Our report will recommend research to improve coastal community resilience planning, enhance Arctic observing and monitoring efforts, and encourage seafloor depth mapping to improve marine commerce. According to our colleagues at NOAA, only 4.1 percent of the United States maritime Arctic has been mapped to modern standards.

Two, community health and well-being: The investment of more than $11 billion into Alaska Native communities through the *Infrastructure Act* will help communities adapt to a warming climate. They'll build water and sanitation infrastructure and expand access to broadband. Remaining challenges, however, include the enduring presence of health disparities in many parts of Alaska. Food, energy, water insecurity, housing, and indoor air quality deficiencies, and work force development insufficiencies are still present.

Our third area will be infrastructure. The Commission recommends research to improve access to reasonably priced broadband networks, telehealth, in-home running water, and affordable heat and fuel, all of which must be operable and scalable in Arctic conditions. Infrastructure that is practical and functional at the community level is critical, and human infrastructure, people to teach, create, operate, and maintain technology is also essential, yet over—yet often underappreciated and overlooked.

Our fourth area will be economic research, new for the Commission. While economic research is vital to inform Arctic-relevant policies and decisionmaking, few economists focus on the region. Economic research can help achieve regional sustainable development and provide a greater understanding of market and non-market forces.

Our fifth area will be research cooperation. As many Arctic issues are circumpolar in nature and inherently transnational, they are best addressed by domestic and international research cooperation, which brings me to an opportunity in interagency cooperation. That opportunity is to equip for scientific research purposes the commercially available polar icebreaker that the Coast Guard intends to purchase with funds in its Fiscal Year 2023 budget request to Congress. The Commission recommends that if this icebreaker is procured and is refit to meet the Coast Guard's requirements, that the refit includes scientific research infrastructure to meet science mission requirements.

Madam Chairwoman and Ranking Member Lucas, it is impossible to discuss Arctic research without acknowledging that Russia's invasion of Ukraine has halted cooperation with Russia on international Arctic research activities. There have been many programs impacted by this lack of cooperation. Nevertheless, Arctic research will continue because it must. Changes in the Arctic will not wait for geopolitical challenges to be settled. The challenges can be met by doubling down on our Arctic research efforts and by working with many of our partners in and outside of the region.

Finally, I would like to express the Commission's support for proposed updates to the *Arctic Research Policy Act* contained in legislation introduced by Senator Lisa Murkowski of Alaska in S. 4736, the *Arctic Commitment Act.* In particular, I'd like to call attention to the need and value of an Arctic research budget crosscut of the relevant Federal agencies. We do not have an accurate account of what our Nation spends on Arctic research, nor the funding trends over time. To improve accountability and to help achieve our Nation's objectives in the Arctic, we encourage the Office of Management and Budget (OMB) to conduct an annual budget crosscut, as it does for other research initiatives such as nanotechnology and global change.

Madam Chairwoman and Ranking Member Lucas and Members of the Committee, thank you again for this opportunity to testify today and provide the U.S. Arctic Research Commission's views and priorities on Arctic research. Thank you.

[The prepared statement of Dr. Sfraga follows:]

Written Testimony of
Dr. Mike Sfraga
Chair, United States Arctic Research Commission
House Committee on Science, Space, and Technology

For a hearing on
"Amplifying the Arctic: Strengthening Science to Respond to a Rapidly Changing Arctic"

Before the Committee on Science, Space and Technology
U.S. House of Representatives

September 20, 2022

Chairwoman Johnson, Ranking Member Lucas, and distinguished members of the Committee, thank you for convening this hearing on Arctic research. I am Dr. Mike Sfraga and I am honored to appear before you today. I am the presidentially appointed Chair of the United States Arctic Research Commission (Commission).

From my perspective, research is a central tenet in the advancement of U.S. interests and objectives in the Arctic and indeed, globally.

I have been asked by the Committee to address five key areas:

1. Provide an overview of the U.S. Arctic Research Commission (USARC);
2. Describe the role of the Commission in development of the recent Interagency Arctic Research Policy Committee (IARPC) 5-year plan;
3. Discuss priorities for the USARC's upcoming Goals and Objectives report;
4. Outline the impact of current geopolitical tensions on Arctic research and international collaboration; and
5. Provide recommendations for updates to the Arctic Research and Policy Act (ARPA).

I begin my testimony with anecdotes on how research has positive impacts on the Arctic region. Indigenous Knowledge, supported by scientific research, has shown that bowhead whales, arguably the most important subsistence species in Northern Alaska, live to be over 200 years of age. This is based on scientific analysis of the whale's baleen and eye lenses along with the discovery of ancient stone and ivory harpoon tips in the blubber of subsistence-harvested whales, and is important in the population management of the species.

These whales, as well as caribou, moose, musk ox and other traditional foods can be found in community freezers and ice cellars across the Arctic. "Food security" is defined as everyone having "physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life[1]."

Much of what is gained from hunting, fishing, and whaling is brought back to communities and shared between families far and wide, or through community freezer programs such as Siglauq in

[1] https://www.fao.org/3/i0876e/i0876e00.htm

Kotzebue, Alaska. In 2014[2], the U.S. Farm Bill was updated and revised to include traditional foods, but the U.S. Department of Agriculture hadn't changed their regulations on inspection and preparation of wild game. Maniilaq Association, Northwest Alaska's health provider, and other agencies worked to update the regulations to make the Kotzebue-based program possible. This trend has spread and, today, inpatients at the Alaska Native Medical Center in Anchorage can order a variety of dishes with caribou, moose, salmon, herring eggs, Alaskan berries and even akutaq--Eskimo ice cream. These foods are more nutritious than most store-bought foods and provide cultural, emotional, social, spiritual, and physical benefits.

Just to the north, in Wales, Alaska, the mainland United States' westernmost town, planning has begun to provide piped water to homes—a first for the majority of this community of 220 people. Research shows the absence of running water is associated with a higher prevalence of respiratory and skin diseases, especially in children. The Infrastructure Investment and Jobs Act will help provide running water in Alaska's unserved and underserved communities, which will make a tremendous difference in the quality of life for those living in rural Alaska.

In Anchorage, Alaska, the 176th Maintenance Group at Joint Base Elmendorf-Richardson is piloting a new virtual reality training laboratory which will enhance training capabilities for maintenance Airmen by giving them an interactive tool to learn maintenance processes without the presence of a physical airframe. This technology may be transferable to training needs in rural communities and remote research installations.

The knowledge and understanding we gain from Arctic research impacts the lives of those who live in and outside of the region. It informs and influences our nation's Arctic policies and related actions in key global matters, such as the broad array of challenges brought about by climate change, for example, to include mitigation and adaptation measures, as well as infrastructure development, and our national and homeland security.

Later in my testimony I will outline the Commission's central Arctic research goals and objectives – each reinforcing and expanding upon the important issues previously noted. Arctic research provides insight into the cause and effects of our changing climate, advances economic development, enhances our nation's national and homeland security, to include environmental, energy, food, and community security writ large. Put simply, investments in Arctic research are investments in our citizens, as well as our nation's security and prosperity.

Research is central to our nation's ability to address the many challenges we face in the region and enables us – with our many international partners – to help shape the environmental, political, social, economic, and security landscape. A well-planned and appropriately funded U.S. Arctic research enterprise is essential to crafting and implementing a well-developed, purposeful, integrated, and complementary national strategy for the Arctic region. It will enhance our applied and basic research efforts across the federal government, and by doing so, help establish fact-based, research-driven policies at the community, regional, sub-national, national, and international levels. Due to the harsh environment, U.S. and international space-based or satellite-derived observations are critically important to underscore research, environmental monitoring, weather forecasting, and economic development.

[2] https://www.fns.usda.gov/cn/service-traditional-foods-public-facilities

The United States Arctic Research Commission plays a critical role in advancing these efforts. The Commission is an independent federal agency established by the Arctic Research Policy Act of 1984 (ARPA). It is composed of eight commissioners, seven of whom are directly appointed by the President. The eighth commissioner is the Director of the National Science Foundation (NSF) who serves as a non-voting *ex officio* member.

The current members of the Commission are:

- Dr. Mike Sfraga, Chair; filling an academic/research seat, the founding director of the Wilson Center's Polar Institute, former director, Global Risk and Resilience Program, Wilson Center, and currently serving as chair and distinguished fellow, Polar Institute, Wilson Center.
- Dr. Nikoosh Carlo; filling an academic/research seat, the founder and chief strategist at CNC North Consulting.
- Elizabeth Qaulluq Cravalho; filling an industry seat, the vice president of lands for NANA Regional Corporation, an Alaska Native Corporation.
- David Kennedy; filling an academic/research seat, the current Global Fellow at the Wilson Center's Polar Institute, Board Member of the World Maritime University, and Chairman of the External Advisory Board of the School of Marine Science and Ocean Engineering at the University of New Hampshire.
- Dr. Mark Myers; filling an industry seat, the principal of Myenergies.
- Dr. Jacqueline Richter-Menge; filling an academic/research seat, a research affiliate with the University of Alaska Fairbanks, 34 years of experience with the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory.
- Deborah Vo; filling the Indigenous seat, Program Officer with the Rasmuson Foundation.
- Dr. Sethuraman Panchanathan; Director, NSF

The Commission releases a biennial report to the White House and to Congress on Arctic research goals and objectives to guide the IARPC five-year plan and to inform overall U.S. Arctic research efforts. The Commission also assists IARPC in establishing a national Arctic research program plan every five years to implement Arctic research policy.

In addition to the above tasks, the Commission's duties, assigned by law, include:

- Facilitating cooperation between the Federal Government and State and local governments with respect to Arctic research;
- Reviewing Federal research programs in the Arctic and recommending improvements in coordination among programs;
- Recommending methods to improve logistical planning and support for Arctic research;
- Recommending methods for improving efficient sharing and dissemination of data and information on the Arctic among interested public and private institutions;
- Offering other recommendations and advice to the IARPC as it may find appropriate;
- Cooperating with the Governor of the State of Alaska and with agencies and organizations of that State which the Governor may designate with respect to the formulation of Arctic research policy; and
- Recommending to the IARPC the means for developing international scientific cooperation in the Arctic.

The USARC is a statutory member of the North Pacific Research Board and the North Slope Science Initiative. The USARC is also a member, participant, liaison, or observer on the IARPC, the Interagency Coordinating Committee on Oil Pollution Research, the National Ocean Council, the Extended Continental Shelf Task Force, the Study of Environmental Arctic Change (SEARCH), the Civil Applications Committee, the Scientific Ice Expeditions Interagency Committee (Navy submarines), the Arctic Icebreaker Coordinating Committee of the University National Oceanographic Laboratory System, the Alaska Ocean Observing System, the Department of State's Arctic Policy Group, the Arctic Research Consortium of the United States, the International Permafrost Association, and the Ted Stevens Center for Arctic Security Studies.

BIENNIAL REPORT

The Commission is drafting its next biennial report which will be released in January. We have identified five primary goals which are: environmental risks and hazards, community health and well-being, infrastructure, economic research, and research cooperation. Madam Chairwoman and Ranking Member Lucas, you will see overlapping and reinforcing areas of Arctic research priorities between the Commission and the IARPC.

- **Environmental risks and hazards**: Risks from climatic and geologic hazards have enormous social and economic consequences. Knowledge from research reduces vulnerability and helps prevent or reduce the effects of disasters. Some of the key issues the Commission thinks should be highlighted include: improved monitoring of emissions of greenhouse gas emissions from industry leaks of oil and gas infrastructure, the mapping of priority coastal areas to improve marine commerce (according to the National Oceanic and Atmospheric Administration (NOAA), only 4.1 percent of the U.S. maritime Arctic has been mapped to modern standards[3]) and facilitate coastal community resilience planning, and a better understanding of the risks of permafrost thaw.

- **Community health and well-being**: The investment of more than $11 billion into Alaska Native communities through the Infrastructure Investment and Jobs Act will help communities adapt to a warming climate, build water and sanitation infrastructure, expand broadband, and improve Tribal transportation. Remaining challenges, however, include the enduring presence of health disparities in Alaska between Arctic and non-Arctic residents, climate-related health and social risks, food/energy/water insecurity, housing and indoor air quality deficiencies, and workforce development insufficiencies. Among other issues, maternal health research that identifies needed care, and barriers to care, specific to remote Arctic communities, the creation of equitable pathways for Indigenous leadership and mechanisms to improve communication and participation at the local level, and workforce recruitment/retention in remote communities, especially in the health professions are among the Commission's priorities.

- **Infrastructure**: Access to reasonably priced broadband networks, telehealth, in-home running water, and affordable heat and fuel all depend upon innovation to make these

[3] https://nauticalcharts.noaa.gov/updates/noaa-surveys-the-unsurveyed-leading-the-way-in-the-u-s-arctic/

technologies operable and scalable in Arctic conditions. Infrastructure that is practical and functional at the community level is critical, and human infrastructure—people to teach, create, operate and maintain technology—is also essential. Quantifying the resources needed to increase local capacity to meet infrastructure-related innovation and education requirements, ensuring human health and infrastructure research is incorporated into a "whole-of-government" approach to water and sanitation infrastructure build-out efforts, and encouraging research methods to modify infrastructure to adapt to changing Arctic environmental conditions are important steps to infrastructure development and deployment in the Arctic.

- **Economic Research**: While economic research is vital to inform Arctic-relevant policies and decision making, few economists focus on the region. Economic research can help achieve regional sustainable development, and provide a greater understanding of market forces, natural capital, and Indigenous economies. Research emphasis focused on Arctic economics based on work initiated by the NSF's Arctic Social Science program, a "natural capital accounting" in the Arctic to inform decision making, and a better understanding of Arctic marine operations, shipping, and mariculture are some of the areas the Commission believes should be encouraged.

- **Research Cooperation**: As many Arctic issues are circumpolar in nature, and inherently transnational, they are best addressed by international research cooperation. Cooperation and co-production of knowledge that is consistent with Indigenous values, rights, and protocols will result in a more genuine collective effort to create greater understanding about the Arctic. U.S. Arctic researcher engagement in the European Union's Horizon Europe, with Arctic-related elements, accelerated progress in developing an international plan for the "Joint Program of Scientific Research and Monitoring" associated with the Central Arctic Ocean Fisheries Agreement that entered into force in 2021, and researcher adoption of the new standard in international engagement with Inuit released in June 2022 by the Inuit Circumpolar Council are among the international research cooperation goals of the Commission.

GEOPOLITICAL CONSIDERATIONS

While the final Goal of our report focuses on international research cooperation, it is impossible to discuss Arctic research without acknowledging that Russia's full-scale invasion of Ukraine has halted cooperation with Russia on international Arctic research. Impacted projects and initiatives include, but are not limited to:

- Joint U.S./Canada/Russia fisheries expeditions in the Bering Sea and the Gulf of Alaska:
- Research on harmful algal blooms;
- Pan-Arctic Observing Networks;
- International partnerships to study polar bears, whales, walruses and seals;
- Collaboration on changes in permafrost, biome shifts, and tundra fires;
- Food security of Indigenous Peoples in Alaska and Siberia, and community vulnerabilities to changes in sea ice and economic expansion; and

- The interruption of Arctic Council working groups focusing on contaminants, monitoring, conservation of flora and fauna, the marine environment, sustainable development, and emergency prevention, preparedness and response.

We often note the desire for the Arctic to remain a "zone of peace" and an area of cooperation and collaboration. That is difficult to achieve now when Russia, which occupies nearly 50 percent of the Arctic, has embarked on an unprovoked invasion of a sovereign country.

That does not mean, however, that Arctic research cannot continue. It must. Changes in the Arctic will not wait for geopolitical challenges to be settled. There already is an *arc of cooperation – an arc of commonality* – that spans the North American Arctic, between the U.S. (Alaska), Canada, and Greenland. We should leverage, enhance, and expand the work that occurs within and across this *arc of cooperation and commonality*; the realities of a rapidly changing Arctic require nothing less.

That *arc of cooperation and commonality* extends to Iceland, the Nordic nations and Europe. Russia's absence from research activities with other Arctic nations has left a void, and the United States should seize the moment and double down on our efforts throughout the region. We have an opportunity to encourage and facilitate international research projects to be carried out in Alaska and throughout the Arctic region such that the US remains an active and reliable scientific leader in the region. The results of such actions would have additional, consequential impacts such as reinforcing the international rules-based order, strengthening the Transatlantic Alliance, enhancing partnerships with non-Arctic nations with interests in the Arctic, and who share our commitment to a peaceful, stable, and productive region, and reinforce respect for the Arctic's indigenous peoples. The United States would certainly benefit from the knowledge, financial investments, and research assets international partners could bring to a heightened international research enterprise, but it requires the United States to make its own investments in the region to attract these partnerships.

I would also like to highlight research opportunities that abound in Greenland. While China's investment interests in the mining sector, and Russia's invasion of Ukraine brought a greater security focus to Greenland, there is substantial potential to grow our diplomatic, scientific, environmental and economic involvement on the island. Reopening the U.S. consulate in Nuuk was an important step forward and one the U.S. must remain committed to. But there is also the opportunity to enhance this partnership and build upon recent scientific collaborations that NSF has fostered between the U.S. and Greenland research communities.

The Inuit peoples live across the North American Arctic, and there are many commonalities between the Inuit in Alaska, Canada, and those in Greenland including language, history and culture. Finding ways to promote joint partnerships and the sharing of best practices between those who share a common heritage is in our own interests and will build upon the existing relationship between the United States, the Kingdom of Denmark, and Greenland.

Earlier this month I participated in several panels at the Arctic Circle Forum in Nuuk, Greenland. I found the Greenlandic government, researchers, and scholars eager to enhance and expand our research and economic ties, to reinforce the inherent cultural and social ties that bind us,

particularly among Indigenous Peoples, and a desire to leverage our shared expertise and understanding of the North for the betterment of the North. Greenland is, in many ways, emblematic of the new North, where you find, the key drivers of Arctic change occurring simultaneously: the geopolitical, environmental, economic, cultural, social and, security landscape in Greenland reflects the broader realities of the region. And many colleagues I spoke to in Nuuk underscored the centrality of U.S. Arctic research and international research cooperation as a shared foundation upon which these challenges can and should be addressed.

Along those lines, I want to highlight the importance of the NSF's efforts to recapitalize the outdated infrastructure at Greenland Summit Station. Originally established as a temporary ice drilling camp in 1990, Summit Station today is the premier, and only, high-latitude, high-altitude, year-round observing platform in the Arctic. It is a uniquely critical platform for understanding past and current climate and environmental changes which then permit modelling of future ice sheet, climate, and sea level rise scenarios. Summit Station is a prime example of long-term, positive science cooperation with Greenland. Whether you live along the coast in Norfolk, Virginia or Nome, Alaska, you should care about what happens to the Greenland icesheet.

Broader than the North American Arctic, there is a need for the research community to be actively engaged with Arctic infrastructure matters such as the critical need for U.S. icebreakers and fiber optic cable and other communication infrastructure. Technologies like unmanned aerial vehicles, or unmanned maritime vehicles are increasingly used in the remote Arctic for research purposes and domain awareness. It is critical that these technologies can effectively operate and adapt to changing Arctic conditions.

On this topic, I would like to bring one particularly interesting opportunity to the Committee's attention, and it is associated with Arctic marine scientific research and the U.S. Coast Guard (USCG), which has long served as a valuable partner in this enterprise, consistent with law. Specifically, among the USCG's seven statutory primary duties, listed in 14 U.S.C. §102, is the duty to "engage in oceanographic research of the high seas and in waters subject to the jurisdiction of the United States."

Over the 20-year history of U.S. Coast Guard Cutter (USCGC) HEALY operations, most of the days that icebreaker has been at sea were in support of conducting science operations that originated with, and were funded by other agencies, such as NSF, NOAA, and ONR. Fundamental data have been collected, and discoveries made. Ship-based science technical support on HEALY, which benefits many agencies, has been funded entirely by the NSF.

For example, over many expeditions, NOAA, the US Geological Survey and State Department supported the mapping of the US's extended continental shelf in the Arctic region, consistent with international law. This has been a critically important process in determining US sovereign rights on and under this seabed, beyond the US's 200-mile Exclusive Economic Zone.

But demands for the use of USCGC HEALY have increased recently, and the vessel is more frequently being used for non-science missions, while, at the same time, the demand for science missions continues to grow.

And that returns me to the opportunity, which is to equip, for scientific research purposes, the "commercially available polar icebreaker" that the USCG intends to purchase with funds in its fiscal year 2023 request to Congress.

Consistent with the "whole of government" approach we are encouraged to pursue, and the high cost of icebreaker operations, the Commission recommends that if the icebreaker is procured, and is refit to meet the requirements of the USCG, that the refit include scientific research infrastructure (e.g., the ability to host and deploy/retrieve remotely operated vehicles and autonomous underwater vehicles, the capability to launch small drone aircraft for ice survey and reconnaissance, laboratory space for biological and chemical analyses, a sub-bottom profiler, and most importantly a multibeam sonar system that maps, in detail the depth of seafloor for a variety of purposes, beyond just research) to meet science mission requirements, subject to the availability of appropriations for such purposes. Complementary support to federal science agencies for operation and maintenance costs, and for research on the shipboard data collected, will also need to be considered.

In addition to the research and technology that the NSF supports on USCGC HEALY, I would also like to recognize the NSF's support for their scientific research on the vessel *R/V Sikuliaq*, which is most capably operated by the University of Alaska's College of Fisheries and Ocean Sciences. Since 2015, the vessel has conducted scientific expeditions in and around Alaska and the western Arctic, improving our understanding of marine ecosystems, fisheries, physical oceanography, marine geology and geophysics.

ARPA UPDATES

The Commission supports proposed updates to the ARPA included in Section 11 and Section 12 of S. 4736, the Arctic Commitment Act introduced by Alaska Senator Lisa Murkowski. Many are technical in nature to revise legislation written nearly 40 years ago. Others seek to include the growing number of federal agencies that operate in the Arctic and engage in Arctic policy development and implementation. However, the Commission's positions on Sections 11 and 12 should not be used to infer the Administration's position on the bill in its entirety.

Section 11(a) updates the Findings and Purposes section of ARPA to emphasize that the Arctic is critical to homeland defense, notes the impact that a changing Arctic has on global weather and climate patterns, and, given the profound impact a rapidly changing climate will have on the region, supports the need for robust Arctic research to inform and influence U.S. domestic and international Arctic policies.

Section 11(b) cleans up language in Section 103 of ARPA which establishes the Commission, as well as increases the number of service days that the Chair of the Commission may be compensated from 90 to 120. I can personally testify that the Chair of the Commission is engaged in official Commission activity on an almost daily basis – much more than the 90 days identified for compensation in ARPA – but I will also recommend that any increase in compensation should begin with the next Chair of the Commission.

Section 11(c) gives greater flexibility to the Commission for entering into contracts with federal entities other than the General Services Administration. The General Services Administration no longer provides the full suite of services required by agencies, which may have been the case in 1984. Other agencies, such as the U.S. Department of Agriculture and the Department of the Interior's Interior Business Center, are now key service providers to other federal agencies, on a cost-reimbursable basis.

Section 11(d) adds the Department of Agriculture, the Marine Mammal Commission, the Smithsonian Institution, and the Denali Commission to the IARPC. Each of these entities play an important role in formulating and carrying out Arctic policy and the Commission believes they should be formally included in the IARPC.

Section 11(e) clarifies that the IARPC five-year Arctic research plan must be transmitted to Congress, notwithstanding the Federal Reports Elimination and Sunset Act of 1995. The Commission believes sharing this document with Congress is important and should be required.

Section 12 of the same bill seeks to highlight and implement an existing section of ARPA: a budget crosscut report of Arctic research programs by every federal agency. The Commission views this activity as imperative to develop a baseline of Arctic research activity within the Federal Government – something that does not exist and is a considerable gap in Arctic research knowledge – and a useful budgeting tool for Congress and Federal agencies moving forward in implementing Arctic research priorities. I would like to emphasize that the Commission does not view this as a one-time activity, but an ongoing, annual crosscut to show funding trends - as is conducted for other research programs.

CONCLUSION

Thank you for this opportunity to testify before the Committee and provide the U.S. Arctic Research Commission's views and priorities on Arctic research.

Dr. Michael Sfraga

Dr. Michael Sfraga was the founding director of the Polar Institute and served as the director of the Global Risk and Resilience Program at the Woodrow Wilson International Center for Scholars in Washington, DC. He currently serves as chair and distinguished fellow in the Polar Institute, where his scholarship and public speaking focus on Arctic policy.

An Alaskan and a geographer by training, his work focuses on the changing geography of the Arctic and Antarctic landscapes, Arctic policy, and the impacts and implications of a changing climate on political, social, economic, environmental, and security regimes in the Arctic.

Sfraga served as distinguished co-lead scholar for the U.S. Department of State's inaugural Fulbright Arctic Initiative from 2015 to 2017, a complementary program to the U.S. Chairmanship of the Arctic Council; he held the same position from 2017 to 2019. He served as chair of the 2020 Committee of Visitors Review of the Section for Arctic Science (ARC), Office of Polar Programs, National Science Foundation, and currently serves on the Scientific Advisory Council of the Finnish Institute for International Affairs. Sfraga previously served in several academic, administrative, and executive positions, including vice chancellor, associate vice president, faculty member, department chair, and associate dean. Sfraga earned the first PhD in geography and northern studies from the University of Alaska Fairbanks.

Chairwoman JOHNSON. Thank you. Ms. Metcalf.

TESTIMONY OF MS. VERA KINGEEKUK METCALF, EXECUTIVE DIRECTOR, ESKIMO WALRUS COMMISSION

Ms. METCALF. [Speaking Native language.] Good morning, Chairwoman Johnson, Ranking Member Lucas, and Members of this Committee. I am truly honored to be part of this hearing and to present to you today.

Before beginning, I must say that it is my intention to—that my words are proper and responsible to my ancestors, my family, and my community, and to [speaking Native language], which is our way of life and cultural values on St. Lawrence Island, Alaska. My name is Vera Kingeekuk Metcalf, born and raised on St. Lawrence Island, which lies in the Bering Strait between Alaska and Russia's Chukotka Peninsula. I have been the Executive Director of the Eskimo Walrus Commission in Nome, Alaska, since 2002. The EWC was formed in 1978, with membership from 19 Alaska Native communities on the Bering Chukchi and Beaufort Seas, and works to be necessary and valuable partners in Pacific waters, conservation management through actively participating in research, striving for indigenous food security, and contributing our Indigenous Knowledge.

It is important for me to state up front that Alaska Native people cannot be separated from our environment and natural resources. We are and always have been absolutely dependent on this intimate relationship way with our environment and its gifts. If they are healthy, so are we.

So what is Indigenous Knowledge? In my language, it is [speaking Native language], which simply translated is our knowledge, what we know. But it implies so much more that's not so easy to explain and includes the understanding that we can only know so much. It adds a bit of humility to how much we think we know because, as my IK experts remind us sometimes, [speaking Native language], there is always more to know.

IK is an ongoing synthesis of new information and observations gathered firsthand and from others where—which are considered by IK experts who together apply their cultural understanding and IK to guide future plans and decisionmaking. It is an active social process based in cultural protocols and grounded in a way of knowing.

I have offered examples in my written testimony of how Alaskan Native communities have contributed their IKs to co-management and examples of co-production of knowledge projects that I anxiously hope that are helpful to this Committee.

I have characterized the old school way science and government has conducted research in the Arctic in the past as one-sided and very extractive. And I have described the mismatch of the science-research-government-industry with Indigenous Knowledge community. I suggested it might be helpful to recognize the difference between knowledge systems and how that affects co-production research. It is very important to realize that Indigenous Knowledge isn't any one person's intellectual property, and no one person is the holder of a community's Indigenous Knowledge. And that is not something simply to be documented as data to be used by others

for their purposes. Instead, its true value is found when it is supplied by our experts and knowledge bearers to questions about the health and conditions of their world, the land, the water, air, and all who inhabit it.

Engaging IK for co-production projects needs to involve the larger community and should provide opportunities for multiple IK experts to discover all the nuance and the wisdom of what they jointly share. Their contribution together will be much more powerful.

So I'll end with this thought. The Arctic is our home, eternal and sacred. We will continue to adapt as we need to live properly in it. Perhaps collaborating on co-production knowledge research is simply another way that we are adapting. We will share our Indigenous Knowledge to advance research. While it is beyond translation, this profoundest IK, a way of knowing my language is [speaking Native language]. It encompasses and connects all things. This is what we will continue to rely on, and we will have greater confidence knowing it is included in future scientific study and in new governance in the Arctic.

[Speaking Native language.] Thank you for this opportunity again.

[The prepared statement of Ms. Metcalf follows:]

Written Testimony of Vera Kingeekuk Metcalf

Before the
Committee on Science, Space, and Technology
U.S. House of Representatives

Hearing on
"Amplifying the Arctic: Strengthening Science to Respond to a Rapidly Changing Arctic"

Tuesday, September 20, 2022

Quyakamsi. Good morning, Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee. I sincerely thank you for this opportunity to testify today.

Before beginning, I must say that it is my intention that my words are proper, respectful, and responsible to my ancestors, my family, and my community, and to our *Nangaghneghput*— which is our way of life and cultural values on St. Lawrence Island.

My name is Vera Kingeekuk Metcalf, I was born and raised on St. Lawrence Island, which lies in the Bering Strait between Alaska and Russia's Chukotka Peninsula. My home is the sixth largest U.S. island and is actually closer to Russia (36 miles) than to mainland Alaska (164 miles). We remain close to our Chukotkan neighbors with whom we share an Indigenous language, culture, family and clan connections, and our traditional natural resources and environment.

I have been the Executive Director of the Eskimo Walrus Commission in Nome, Alaska, since 2002. The Eskimo Walrus Commission (EWC) was formed in 1978 with membership from nineteen Alaska Native communities on the Bering, Chukchi, and Beaufort seas, which contains the full range of the Pacific walrus population. EWC has a co-management agreement with the U.S. Fish & Wildlife Service (USFWS) to provide Alaska Native participation in Pacific walrus management and conservation.

EWC's co-management goals are Research, Education, Connecting and Convening, and Advocacy. These all support our effort to be necessary and valuable partners in Pacific walrus conservation and management through actively participating in research, striving for our Indigenous Food Security, and contributing our Indigenous Knowledge (IK).

It is important for me to state upfront that Alaska Native people cannot be separated from our environment and natural resources. We are and always have been absolutely dependent on this intimate relationship with our environment and its gifts. To be grounded in this dependent relationship is a cultural strength, as we are with our land, waters, and air, with the Pacific walrus, bowhead and beluga whales, ice seals, migratory seabirds, fish, and so much more. If they are healthy, so are we. This is a basic Indigenous Knowledge concept.

At this point, I offer this definition of Indigenous Knowledge as developed by the Inuit Circumpolar Council (ICC), which is commonly used by the Inupiaq, Yup'ik, and St. Lawrence Island Yupik in Alaska. *[Note: For the purposes of this testimony, Indigenous, Alaska Native, and Inuit all apply to the Inupiaq, Yup'ik, and St. Lawrence Island Yupik in Alaska.]*

> Indigenous Knowledge is a systematic way of thinking applied to phenomena across biological, physical, cultural and spiritual systems. It has developed over millennia and is still developing in a living process, including knowledge acquired today and in the future, and it is passed on from generation to generation.
>
> Under this definition, IK goes beyond observations and ecological knowledge. It is not something simply to be documented as data to be used by others for their purposes. Instead its true value is found when it is applied by IK experts and knowledge bearers to questions about the health and condition of their world—the land, waters, air and all who inhabit it.

In my language, this is *Liisimalleghput*, which simply translated is "our knowledge—what we know." But it implies so much more that's not so easily explained. It also includes the understanding that we can only know so much. It adds a bit of humility to how much we think we know. Because as my IK experts remind us sometimes, *Kenlengituq*—there is always more to know. IK is an on-going synthesis of new information and observations gathered firsthand and from others, which are considered by IK experts who together apply their cultural understanding and IK to guide future plans and decision-making. It is an active social process based in cultural protocols and grounded in our way-of-knowing.

I'll highlight some examples of how IK can add to and improve research. Through the years working with scientists and federal managers, we have provided our knowledge of walrus behavior unknown or previously undocumented that significantly impacted research. For example, when reviewing aerial photographs of walrus on ice to begin the important task of estimating population, hunters suggested that the amount of time walrus spend in the water compared to the time spent resting on the ice during springtime must be accounted for and that walrus will also rest by hanging on ice by their tusks, which are not easily seen in the photographs. Although this improved the accuracy of the population estimate done in 2006, the confidence level of this estimate is still very low.

During a recent spring season with little proper sea ice for calves to nurse on, there was naturally great worry for calf survivability. While we were concerned, too, we also knew and documented that walrus can nurse in the water, which further shows the ability of walrus to adapt to varying conditions. Much like with the wider awareness of herds of walrus coming onshore instead of resting on diminishing sea ice caused great alarm, we understood this was normal and indicative of walrus living within and adapting to their environment. We have great respect for and learn from the marine mammals we live with and depend on.

EWC communities have contributed to scientific research in other ways, too. During a USGS marking/tagging expedition on an icebreaker in early spring sea ice in the Bering Sea, two experienced Indigenous advisors were onboard to learn about the project. It was an expensive project using a helicopter and small inflatables to find and approach walrus on ice. After days of heavy fog that prevented any successful tagging and with ship time running short, the EWC representatives suggested quieting the engines and all ship noise as they have often done when hunting. The noise and odor of the herd then drifted in through the fog, allowing walrus to be located and the research project to tag sufficient walrus to be successful. Also, perhaps more significantly, since the early days of EWC, Alaska Native hunters have contributed biological samples from harvested walrus for research. Consequently, there is a collection of source

materials for a multitude of scientific research projects comparing walrus health over the years and into these times of rapid climate change. I think it is important to realize that these samples would not be available without the participation of Indigenous communities.

The Arctic is our home and like Indigenous people everywhere, we believe our homeland and waters are the most precious and sacred place on earth. We remain dependent on hunting and gathering for our food security, whether it is fishing and picking greens and berries in the summer, hunting migrating marine mammals in fall and spring with the advance and retreat of sea ice, or traveling over our frozen world for what may come to us in winter. This all informs the Indigenous Knowledge of our world and is why we are the first observers of changes to our environment and those who inhabit it.

Countless are the observations and samples retrieved by Alaska Native communities of both the strangely sick and dead wildlife or in the presence of new, different species, or of oil contamination and excessive trash debris in our marine waters, and of eroding beaches and dangerous sinkholes caused by thawing permafrost, or of unusual and disruptive weather impacting our daily lives and Indigenous food security. Perhaps others now better understand what we've been saying for years, which is that climate change is not simply an interesting research topic. It is real and causing significant change to our way of life, and we will rely on our Indigenous Knowledge, as always, to find our proper relationship with our world.

I'll offer two examples for how this can happen. Let me first say that I have experienced many frustrations, disagreements, and misunderstandings regarding the co-management relationship with our partner, U.S. Fish & Wildlife Service (USFWS) during my twenty years with the Eskimo Walrus Commission (EWC). I have always felt that it was because the unequal power and authority dynamics of the arrangement prevented Alaska Native communities from ever being "seated at the table" during walrus management and research discussions. So when EWC was approached by USFWS with a long list of questions about what their researchers wanted to know about Pacific walrus and our relationship with them to use in developing a "harvest risk assessment" computer model, it was fairly typical of the usual way of doing business with us and the way scientific research, in general, has been conducted in the Arctic—one-sided and extractive.

This is where a different approach could offer a much more successful result for the goals of Pacific walrus conservation and management. We recommended creating a new initiative that would involve Alaska Native communities and IK experts from the beginning with the assumptions and questions that are necessary to consider in any modeling effort and on to examining the implications for the model. We suggested that even the term, "harvest risk assessment," negatively characterized our protected Indigenous right to harvest walrus for our food security. So I was very glad when the current USFWS Alaska Region Marine Mammal Division readily accepted and provided funding for the "Walrus Population and Harvest Model Project."

This will include USFWS visits to two Alaska Native communities to present their proposal and the selection of five IK experts from each community to gather in Anchorage to consult on the models and develop how Indigenous Knowledge can be used to improve both the population and harvest models. The project will also involve local community members who will conduct the research interviews. It is absolutely critical that communities are fully involved and understand

that their IK is incorporated in the models, because these will eventually be used to monitor and perhaps guide Alaska Native tribal harvest management plans. By including Indigenous Knowledge and collaboration, co-management now becomes co-production of knowledge (CPK) that will greatly improve the conservation and management of the Pacific walrus. In order for Indigenous communities to trust and have confidence in research, its results, and its implications for their future, it must include their participation and Indigenous Knowledge.

My other example is the current NSF-funded Study of Environment Arctic Change (SEARCH) project that I am involved with as a Co-PI and co-production team leader. SEARCH is "a collaboration of scientists, Indigenous People, and decision makers (from government and the private sector) synthesizing—across disciplines and knowledge systems—and sharing holistic understandings of the drivers and consequences of Arctic environmental change." At multiple occasions and multiple levels of inquiry, SEARCH provides opportunities for Indigenous Knowledge, from our observations to our communities' perspectives and on to our worldview, to guide and inform science and public policy.

From the project planning stage, SEARCH recognized the Inuit Circumpolar Council's (ICC) principle of "Nothing About Us Without Us" that declares "to others to respect our rights and promote Inuit self-determination and self-governance" as implemented in the UN Declaration of the Rights of Indigenous People (UNDRIP). But, actually, it truly is simply working properly and respectfully with Indigenous communities on any action, plan, or government policy that may affect them in Inuit Nunaat—Inuit Homeland.

Even though its model for co-production intends to evolve and improve over its four years, SEARCH has already begun collaborating in new, different ways. Instead of attempting to combine science and IK into single sets of data or one explanation of a climate change impact, each discipline, whether marine biology or public policy, and knowledge system approaches and examines changes to our land, waters, and all living in them in their own way. It offers a multi-year commitment to allow relationships, learning, and trust to grow in team members. Each will contribute to SEARCH produced papers, science briefs, conference presentations, and public media at the international, national, statewide, and local/regional level while making sure to reach our three represented constituencies, scientists, Indigenous People, and decision makers (government and private). This is effective co-production of knowledge for the Arctic. It recognizes Indigenous Knowledge from the beginning and incorporates Indigenous contributions throughout, while also ensuring its purpose and outcomes are relevant and useful for Arctic residents.

It is my sincere hope that my descriptions of Indigenous Knowledge and how it connects us to our land, waters, air, and all who live in them and my examples of some valuable features necessary for co-production of knowledge projects are meaningful and useful to the committee. I next hope to offer some observations about barriers to inclusive research and recommendations on how Federal science community can better partner with Indigenous Knowledge and communities.

First, I should begin with a disclosure statement that I have recently completed twelve years as vice president of Inuit Circumpolar Council (ICC)—Alaska and as a member of the Executive Council of ICC—International. As you may know, ICC was founded in 1977 by the late Eben Hopson of Utqiagvik, Alaska, and is an international non-government organization representing

approximately 160,000 Inuit of Alaska, Canada, Greenland, and Chukotka (Russia). ICC holds Consultative Status II at the United Nations Economic and Social Council and is a Permanent Participant at the Arctic Council. This experience provides me the confidence to recommend ICC as a reliable and valuable source for understanding the Alaska Native, Arctic Indigenous viewpoint. ICC's published statements, reports, and quadrennial General Assembly declarations are, in fact, Indigenous Knowledge and should be accepted as such.

Of special interest here, I highly recommend ICC's recently published *Circumpolar Inuit Protocols for Equitable and Ethical Engagement*. It offers eight protocols with specific directives for each. As stated in the report: "There are many steps and processes required to build long-lasting relationships, trust, and respect and to implement appropriate approaches, such as bringing together Indigenous Knowledge and science through a co-production of knowledge. The EEE Protocols and directives must be practiced collectively. For example, one cannot take one Protocol or directive under that Protocol and use it as the sole foundation of equitable and ethical engagement. These are not boxes to check - they are a collective pathway to equitable and ethical engagement."

Instead of simply reviewing this report, I will offer comments that are specific to my experience, which are reflected in some of its protocols. But again, I recommend the *Circumpolar Inuit Protocols for Equitable and Ethical Engagement* as required reading for those working with Arctic Indigenous communities.

My first comment is to express my sincere appreciation to those who prepared IARPC's Arctic Research Plan 2022-2026. The acknowledgement of the necessity of involving Indigenous Knowledge, leadership, and communities in research planning is important, because it hasn't always been the case. The *Participatory Research and Indigenous Leadership in Research* section is a clear statement of intention to collaborate honestly through the four objectives. This is a good start.

Let me begin by stating what I believe is the biggest barrier, it is the inherent mismatch between the science-research-government industry and the Indigenous-Alaska Native community. The resources afforded to science-research-government in financing, workforce, and decision-making authority can overwhelm the capacity of Alaska Native communities. From my experience the inequity has widened over the past twenty years when the Arctic was rediscovered because of climate change. While I have no verifiable numbers of the increase in research funding or number of projects and campaigns or news stories, I feel very certain that the increase is significant.

This funding provides for full-time, career professional scientists focused on their field of study to pursue their research projects. Their institutions provide them offices, equipment, travel, attendance at conferences, sometimes with support staff and student assistants, resulting in publications and peer recognition. However, those who I consider esteemed Indigenous Knowledge experts remain connected to their traditional role of provider, hunter, whaling captain and to their home land and waters. Others are respected examples of compassion and care during life's challenging times harvesting, feeding, sewing, nurturing children, family and many others with dignity and grace. They remain practitioners of their IK and feel responsible to share it with their family and community. IK Expert is not a job description or career. Instead, I offer this quote from an older experienced hunter and IK holder when asked how things were for

he and his family, he replied with "We're still here doing what we do." This is our way of life—providing for our Indigenous food security and caring for our families—and it continues still today.

I want to be clear that I'm not resentful of science-research-government institutions. I value their work and investment and serve on advisory boards for several research organizations. But this is the mismatch, the uneven level of capacity and activity dedicated to research. With the SEARCH project, we're taking some steps to lessen the barriers for IK participants. Instead of a "drive-by" interview, we've committed to multiple years at a funding level that begins to compensate them for their involvement more appropriately. Since many of our IK contributors do not have access to a computer and the internet, SEARCH also provides IK participants with a mobile tablet and prepaid online service so they can connect to project resources and meetings. However, there are still problems with the quality of service and access for our village-based participants where there is no broadband or technical and user support.

Another observation about the mismatch between knowledge systems and their representatives is that Indigenous Knowledge isn't any one person's intellectual property, and no one person is necessarily the holder of all a community's IK. As with EWC's plan to participate with USFWS on the co-production project on the walrus population and harvest model, we are engaging both St. Lawrence Island villages with meetings that include the entire community, who will choose five IK representatives to work on the project. Having ten IK experts from St. Lawrence Island in one room discussing their relationship and understanding of Pacific walrus will be an absolutely incredible occasion. This may seem expensive or time-consuming, but it is necessary to properly engage with Indigenous Knowledge for co-production research.

Another aspect of the mismatch is how the two knowledge systems are supported and nurtured. The question of how we raise the next generation of knowledge holders is constantly with me, and I believe it is with you, too. The STEM initiative in education is cited and endorsed seemingly everywhere, including the IARPC Arctic Plan, because there is a major concern about the future strength of our science, technology, engineering, and math industries.

I propose that Indigenous Knowledge should have equivalent initiatives to ensure there is the next generation of IK experts and practitioners in all communities and regions. This is absolutely critical for Indigenous communities' full and proper partnership in co-production of knowledge projects in the Arctic into the future. The science-academic-research institutions are firmly established and well-funded to perpetuate themselves normally, but even it must create large funding initiatives to support additional STEM education, post-graduate internships, and post-doc opportunities to develop the next generation of scholars, scientists, and researchers to continue their work.

In broad terms, Indigenous education is comprehensive and involves extensive experiential learning, language instruction, and study of cultural practices, beliefs, and spirituality. It requires Indigenous food security and sovereignty be protected and supported and, as the foundation of our culture and identity, Indigenous languages be legally protected and language schools established. This IK sharing—learning experience is a necessity for the well-being of Indigenous people, families, and communities and absolutely necessary for ensuring Indigenous Knowledge remains a capable partner and contributor to co-production of knowledge research projects in the Arctic. It is a mistake to expect the Indigenous Knowledge system to naturally perpetuate

itself in these times of extraordinary climate change when impacts to us are so strange and unnatural.

So this leads me into some final, more specific, thoughts about IARPC's research plan for the Arctic and the role Indigenous Knowledge and Alaska Native communities have in it. The Arctic Plan states:

> IARPC will seek opportunities to support the development or expansion of community-driven programs, liaison offices, and existing resources for researchers on how to engage with community and Indigenous organizations already in place.
>
> IARPC will work with and make researchers aware of existing Indigenous organizations, advisory committees, and co-management councils that focus on food security, community infrastructure, health and well-being, Indigenous practices, and species and ecosystems management. IARPC will also advance new venues where research activities can be informed by Indigenous Knowledge and the needs of Indigenous communities. (p. 30)

While these are good suggestions, they might serve only to enhance the mismatch that I've identified. As an existing co-management organization, EWC's annual budget is $200,000, which is insufficient to properly fulfill its most basic mission. I am its sole employee. I continually seek partnership opportunities to sponsor projects, like our Young Hunters Summit next month that will bring young providers and our next generation of IK experts together to prepare to be community leaders in natural resource management. But we are stretched very thin in our capacity to take on additional requests. For example, EWC does not receive any additional support for helping researchers connect to our communities.

Another example of a mismatch or disconnect would be the relatively new threat of harmful algal blooms (HABs) in the Arctic. As our waters warm, algal blooms are beginning to appear more regularly and some contain very high levels of toxin. This is especially concerning to Alaska Native coastal communities that actively harvest marine mammals, seabirds, among other marine resources and depend on them for their food security. For instance, we consume all parts of the walrus, including its intestines and stomach contents, which are normally clams, and this is where high levels of saxitoxin will be concentrated. So while HABs level in the ocean may not seem to require an emergency response, high levels of saxitoxin in the food chain is an immediate human health concern. However, it has been difficult for our communities to find who can help test both our marine waters and our food for contamination. Identifying the applied research and healthcare systems that can help us respond to this emerging climate change issue is a big worry for us.

I'll offer one last comment regarding the Arctic Plan to advance new venues to connect research with Indigenous communities. While there is currently one major science conference in Anchorage, Alaska annually, this is still very removed from Indigenous Arctic communities. It is an expensive trip, especially for those without financial support, and it seems more designed for researchers to satisfy the outreach requirements of their funding and not for seriously connecting with Alaska Native communities and interests. These venues need to be closer to and in our communities and organized to allow for open dialogue and conversation. Building trust

and a longer lasting relationship will require maintaining these gatherings annually. Each gathering will build on the previous and their focus and effectiveness will improve over the years.

I'll end with this thought—The Arctic is our home, eternal and sacred. We will continue to adapt, as we need, to live properly in it. Perhaps collaborating on co-production of knowledge research is simply another way we are adapting. We will share our Indigenous Knowledge to advance research. While it is beyond translation, this profoundest IK and way-of-knowing in my language is *Esla*. It encompasses and connects all things. This is what we will continue to rely on, and we will have greater confidence knowing it is included in future scientific study and in new governance in the Arctic.

Igamsiqayuvikamsi. Thank you.

Vera Kingeekuk [king GEE kuck] Metcalf

Vera is Yupik and was born and raised in Savoonga on St. Lawrence Island, Alaska. Since 2002, Vera has been the Director of the Eskimo Walrus Commission at Kawerak, Inc., which represents 19 coastal Alaska Native communities to promote community involvement in research, document Indigenous knowledge, and co-manage the Pacific walrus population.

Vera is Special Advisor on Native Affairs on the Marine Mammal Commission, an Advisory Panel member of the North Pacific Research Board, a Steering Committee member for the Alaska Center for Climate Assessment and Policy, a advisory board member on the Sea Grant Marine Advisory Program and the School of Fisheries and Ocean Science at University of Alaska Fairbanks.

Vera is also a Bering Strait Commissioner for the U.S. Department of State facilitating travel between the Indigenous people of Chukotka, Russia and the Bering Strait regions of Alaska.

Chairwoman JOHNSON. Thank you very much. Dr. Susan Natali.

TESTIMONY OF DR. SUSAN NATALI,
ARCTIC PROGRAM DIRECTOR,
WOODWELL CLIMATE RESEARCH CENTER

Dr. NATALI. Chairwoman Johnson, Ranking Member Lucas, and distinguished Members of the Committee, thank you for inviting me to testify at today's hearing. My name is Dr. Susan Natali, and I'm the Arctic Program Director and a Senior Scientist at Woodwell Climate Research Center. Woodwell is a nonprofit organization made up of research scientists and policy experts dedicated to advancing climate policy solutions. My work focuses on the local to global effects of permafrost thaw in Arctic and boreal regions.

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[Slide.]

Permafrost is ground that has been frozen for at least 2 consecutive years and often for hundreds to thousands of years. It underlies about 15 percent of the Northern Hemisphere land and 38 percent of Alaska's lands. Permafrost has exceptional significance for global climate because it holds a massive amount of ancient frozen carbon. There's an estimated 1.4 trillion tons of carbon in the permafrost region, which is roughly twice as much carbon as is currently contained in the Earth's atmosphere. This carbon has accumulated for millennia from dead plants and animals, which cold and frozen conditions have prevented from fully decomposing.

But rapid warming across the northern region, which is now occurring three to four times faster than the global average, is causing permafrost to thaw. An estimated 7 percent of near-surface permafrost has already been lost across the Arctic, and about 25 to 70 percent of permafrost is expected to thaw over the next century. Once thawed, the accumulated carbon in the soil can be decomposed and released into the atmosphere as greenhouse gases, carbon dioxide, and methane.

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[Slide.]

Over the coming decades, the amount of carbon released from thawing permafrost could be equivalent to continued emissions from major greenhouse gas emitting nations, perhaps even as large as or larger than the United States at our current emission rate. Greenhouse gas emissions from thawing permafrost could use up 25 to 40 percent of our remaining carbon budget to stay below 2 degrees Celsius warming, yet these emissions are generally underaccounted in part due to major gaps in Arctic carbon monitoring and modeling.

The failure to accurately account for permafrost emissions undermines the integrity and efficacy of global mitigation policy. By not accounting for permafrost emissions, we're essentially aiming for the wrong climate target, making it that much harder to mitigate climate warming.

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[Slide.]

Improving understanding of permafrost thaw is also critical for informing climate adaptation policies. When permafrost thaws, it

can induce ground collapse, which is impacting homes and infrastructure, Arctic lands, water, wildlife subsistence, resources, and indigenous ways of living. Further, the interacting hazards of permafrost thaw, erosion, and flooding are being exacerbated by more severe storm impacts, as was witnessed in Alaska this past week.

More than 70—next slide, please.

[Slide.]

More than 70 villages across Alaska faced significant threats from erosion, flooding, or permafrost thaw. For over a decade, the GAO (Government Accountability Office) has warned that impacted communities need Federal Government support to adapt to climate change. And in the most severe cases, this may include relocation. Yet there still is no national relocation governance framework or dedicated and coordinated funding mechanism to facilitate planned relocation, which will become a critical need not only in Alaska, but across the Nation.

Next slide.

[Slide.]

Arctic residents and scientists have been observing permafrost thaw for decades, but we cannot fully address this problem without amplified research and policy support from Congress. I highlight five areas that I feel should be prioritized for increased research support. First, strategic funding opportunities for permafrost as a larger scope and long-term research priority.

Second, focused investment to reduce uncertainty in climate monitoring and modeling.

Third, improved interagency coordination on Arctic research planning and funding.

Fourth, recognition that permafrost thaw, like climate change, is an international issue that warrants international solutions, including pathways for data exchange, grant funding, and equipment-sharing.

And fifth, direct support to Alaska Native tribes to co-produce knowledge and to lead climate change research.

Today's hearing demonstrates the Committee's dedication to confronting the climate crisis through a participatory and transparent process. I look forward to seeing Members of this Committee lead that effort, and I offer my continued support. Thank you.

[The prepared statement of Dr. Natali follows:]

Woodwell Climate Research Center

149 Woods Hole Road
Falmouth, MA 02540-1644

woodwellclimate.org
508 540 9900

info@woodwellclimate.org

House Committee on Science, Space, and Technology
"Amplifying the Arctic: Strengthening Science to Respond to a Rapidly Changing Arctic"
Tuesday, September 20, 2022, 10 a.m. ET

Dr. Susan M. Natali
Arctic Program Director and Senior Scientist - Woodwell Climate Research Center

Chairwoman Johnson, Ranking Member Lucas, and distinguished Members of the Committee, thank you for inviting me to testify at today's hearing. My name is Dr. Susan M. Natali and I am the Arctic Program Director and a Senior Scientist at Woodwell Climate Research Center ("Woodwell"). My work focuses on the local to global effects of permafrost thaw in Arctic and boreal regions. The following testimony elaborates on this work and explains the current knowledge of permafrost emissions within the greater context of climate change and the extent to which current climate models account for such emissions. The testimony also sheds light on how available evidence and existing gaps are informing adaptation and mitigation policies. Finally, the testimony features recommendations that will empower this Committee to advance evidence-based policy solutions to permafrost thaw for the ultimate benefit of those living within the circumpolar Arctic and beyond.

Woodwell's commitment to advancing Arctic research and understanding of permafrost thaw.

Woodwell is a non-profit organization based in Falmouth, Massachusetts that comprises research scientists and policy experts who work with partners worldwide to understand the impacts of and to address climate change on a global scale. Woodwell scientists helped to launch the United Nations Framework Convention on Climate Change in 1992 and shared the Nobel Prize awarded to the Intergovernmental Panel on Climate Change (IPCC) in 2007. The organization continues to have global impact, bringing together cutting-edge science and translating scientific advances into climate policy solutions.

Woodwell's Arctic program examines the impacts of climate change in this region, and like the Arctic itself, our impact transcends geopolitical borders. Our research, conducted through on-the-ground observations, satellite remote sensing, and computational modeling, is enabling us to measure and monitor changes across tundra and boreal landscapes. The cascading effects of these changes pose immediate threats to Alaskan communities, ecosystems, and infrastructure, but they also present severe risks to the long-term health, stability, and safety of our planet. In fact, in November of last year, I testified before your colleagues in the Foreign Affairs Committee on the national security implications of climate change in the Arctic. In that testimony, I addressed the particular threat to security emanating from permafrost thaw and presented unequivocal evidence to support urgent policy action.

Less than one year later, we have discovered that the negative consequences of inaction are much higher than previously understood. The latest data confirm that the Arctic has warmed three to four times greater than the global average temperature increase of 1.1°C above pre-industrial levels (Rantanen et al., 2022). In the coming years, Arctic temperatures are projected to continue rising. And with these rising temperatures, we can expect to exacerbate a host of climate hazards, including wildfires across Arctic tundra and boreal forests, sea ice melt, coastal erosion, altered abundance and distributions of key Arctic species, and permafrost thaw (Armstrong McKay, et al., 2022).

Arctic residents and scientists have been observing permafrost thaw for decades. However, the scale and coordination of the research in this space haves not been sufficient to meet the urgency of the threat and drive meaningful policy change. That is why, in April of this year, Woodwell launched Permafrost Pathways, a new

Woodwell Climate Research Center
149 Woods Hole Road
Falmouth, MA 02540-1644
woodwellclimate.org
508 540 9900
info@woodwellclimate.org

initiative funded through the Audacious Project. With partners at the Arctic Initiative at Harvard Kennedy School and Alaska Institute for Justice, Permafrost Pathways will amplify our efforts to collect the best data on Arctic carbon emissions, contextualize this information within global emissions budgets, and transform this science into actionable policy recommendations.

Current knowledge of permafrost thaw processes, local impacts, and global carbon budget.

As part of this process, we need to ensure that decision makers have a fundamental understanding of permafrost and its relevance to climate change. Permafrost is ground that has been continually frozen for at least two consecutive years and often for thousands of years. Permafrost extends across the boreal and tundra biomes and in mountain regions across the globe, underlying roughly 15% of the exposed land surface area in the Northern Hemisphere (Obu, 2021) and 38% of Alaska's land area (Pastick et al., 2015). As global temperatures rise, this once-frozen ground is beginning to thaw, creating an increasingly unstable and dangerous environment. Among the most observable impacts is thaw-induced ground collapse, which can contribute to the destruction of infrastructure, homes, schools, medical facilities, roads, and public utilities that ensure access to electricity, clean water, and other necessities. Permafrost thaw is also impacting critical military infrastructure, including at the Northern Warfare Training Center at Fort Wainwright, Alaska (Guy et al., 2021), where military leaders must increasingly focus not only on threats from foreign actors but also on the changing conditions of their own local environments.

Left: Researcher in front of exposed permafrost cliff - photo by Becky Tachihara.
Right: Field site in Canada's Northwest territories - photo by Scott Zolko.

For Alaskan residents living on the front lines of the climate crisis, permafrost thaw is compounding the hazardous, and at times life-changing and life-threatening conditions, created by rapid climate change. For coastal communities, the risk and severity of climate impacts are particularly high, as the loss of sea ice along the coastlines is increasing storm impacts, and permafrost thaw is exacerbating coastal and riverine erosion and flooding (Lantuit et al., 2012; GAO, 2009). Recognizing the compounding effects of multiple environmental hazards, the State of Alaska Hazard Mitigation Plan and the Denali's Commission's recent statewide environmental threat assessment now include a new hazard, usteq (Yup'ik word meaning "surface caves in"), which is a catastrophic form of ground collapse that occurs from the combined effects of thawing permafrost, flooding, and erosion (Denali Commission, 2019; State of Alaska, 2018). Indigenous communities that have contributed the least to climate change, are also experiencing less-quantifiable losses of cultural resources, traditional food procurement, storage, and ways of living. (Brubaker et al., 2011; Brinkman et al., 2016; Bronen,

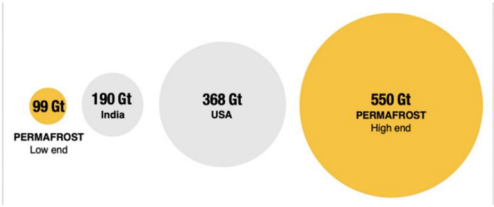
Woodwell Climate Research Center
149 Woods Hole Road
Falmouth, MA 02540-1644
woodwellclimate.org
508 540 9900
info@woodwellclimate.org

2015; Hong, Perkins, and Trainor, 2014). As discussed below, these communities are facing adaptation challenges as they attempt to navigate a policy landscape that does not account for permafrost thaw.

Beyond these localized impacts of permafrost thaw, which present risks to communities across the Arctic, the global significance of permafrost lies with the sheer volume of the carbon it stores: 1.4 trillion tons of carbon—or four times the amount of carbon that humans have released since the Industrial Revolution and roughly twice as much carbon as is currently in the Earth's atmosphere (Hugelius et al., 2014; Schuur et al., 2015). Cold and frozen conditions have prevented carbon-rich organic material, which is derived from dead plants and animals, from decomposing, creating a massive "carbon store" in permafrost soil where captured carbon is locked away beneath the earth's surface.

Much of this carbon has been locked in the soil for decades, centuries, or even millenia. However, as permafrost thaws, ancient carbon stored in the soil is breaking down, releasing carbon dioxide and methane into the atmosphere, which can further exacerbate climate change. We are at the precipice of a potentially transformational and devastating shift—one in which the massive store of carbon is slowly becoming a source of greenhouse gasses (GHG). This shift is already occurring at individual sites throughout the Arctic and boreal regions where carbon emissions are surpassing carbon uptake. (Natali et al., 2019).

As global temperatures continue to rise, an increasing proportion of permafrost across the Arctic will be lost, contributing to GHG emissions. Permafrost warmed an average of 0.29°C between 2007 and 2016 (IPCC, 2019) and an estimated 7% of near-surface permafrost has already been lost across the Arctic (Li et al., 2021). Experts predict a loss of up to 69% (likely range) of near-surface (top 3m) permafrost over the next century (McGuire et al., 2018). Even with low levels of additional warming and a high mitigation effort, the loss of nearly a quarter of near-surface permafrost is likely. Without aggressive, near-term climate mitigation, the resulting carbon emissions could be as high as 550 Gt CO2 by 2100, on par with or even exceeding continued emissions from the United States based on current rates (Natali et al., 2021).



Range of projected cumulative permafrost carbon emissions from 2022 through 2100 (Gt CO2; 1 Pg C = 3.67 Gt CO2) for low Gasser et al., 2018) to high emissions scenarios (Schuur et al., 2015) compared to cumulative emissions from major fossil fuel emitting nations, (Friedlingstein et al 2022) if their current (2020) emissions rates continue through the end of the century. Note that the rates of permafrost emissions are not consistent over this time period; they will increase through 2100 and will likely continue for decades or centuries beyond this timeframe (Natali et al., 2022).

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149 Woods Hole Road
Falmouth, MA 02540-1644

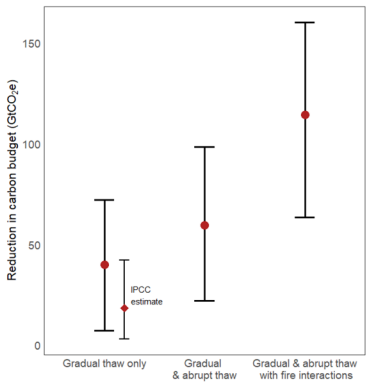
woodwellclimate.org
508 540 9900

info@woodwellclimate.org

Uncertainty due to gaps in monitoring and modeling.

These troubling projections of future carbon release due to permafrost thaw are very likely an underestimate of actual future emissions because they do not include critical disturbance processes that may double the magnitude of the permafrost carbon feedback (Turetsky et al. 2020, Natali et al. 2021). Models of permafrost carbon emissions typically depict permafrost thaw as a slow top-down process in which elevated air temperatures gradually increase heat transfer into the soil and thaw permafrost (e.g., at a rate of <centimeter per year). However, the rate of permafrost thaw can be exacerbated by abrupt, nonlinear thawing that causes extensive ground collapse in areas with high ground ice. Abrupt thaw events, while often taking place on comparatively small spatial scales, can rapidly expose deeper permafrost layers, and therefore a larger volume of stored carbon, over rapid timescales (e.g., meters per year or quicker) (Natali et al., 2021). Abrupt thaw events can be triggered by extreme weather, such as the recent heat waves in Siberia and Alaska. More frequent and severe Arctic and boreal wildfires further catalyze the emissions feedback loop from the permafrost region by directly releasing large amounts of carbon during combustion, and by expediting permafrost thaw (Natali et al., 2021). All of these processes are accelerating due to climate change, and the scientific community is increasingly recognizing the amplifying effect that these under-represented mechanisms of carbon loss from the permafrost region have on the magnitude and timescale of resulting emissions (Turetsky et al. 2020).

Unfortunately, only a small minority of global-scale climate models incorporate permafrost thaw, and none of these represent processes other than gradual thaw. Models used to inform nationally determined contributions under the Paris Agreement, for example, failed to account for key processes that can greatly accelerate permafrost thaw rates and carbon emissions, notably abrupt thaw and wildfires in Arctic regions (Baillargeon et al., 2021). For almost a decade, the IPCC has reported with high confidence the likelihood of a permafrost carbon feedback on global climate. Yet, the IPCC reports low confidence when it comes to assessing the timing, magnitude, and form (carbon dioxide or methane) of this feedback. The latest Sixth Assessment Report (AR6) made a significant step forward as it was the first time that permafrost carbon was included in the Earth System Models that informed the IPCC report (Coupled Model Intercomparison Project Phase 6, CMIP6) (Ciais et al., 2013; IPCC 2018; Canadell et al., 2021) (IPCC, 2021). However, just two of 11 ESMs in CMIP6 included permafrost and neither of these models represented abrupt thaw, wildfire-mediated thaw, or the release of carbon from below-ground combustion during wildfire (Canadell et al 2021, Natali et al., 2022).



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149 Woods Hole Road
Falmouth, MA 02540-1644

woodwellclimate.org
508 540 9900

info@woodwellclimate.org

Left. As featured in Woodwell's joint submission to the first Global Stocktake of the Paris Agreement (2022). Estimates of the reduction in the remaining carbon budget for 2°C (IPCC, 2021) associated with emissions from permafrost thaw, as a more comprehensive range of permafrost thaw processes are included (from left to right). These estimates are derived from a compact Earth System Model, whose permafrost processes are based on a range of published studies (*e.g.,* Gasser et al., 2018; Turetsky et al., 2020; Holloway et al., 2020). Equivalent IPCC estimate (IPCC, 2021) is included for comparison.

Improving certainty of permafrost thaw for more effective mitigation and adaptation policies.

While rapid progress is being made by the scientific community in this area, the sparse nature of on-the-ground measurements combined with the scale and complexity of Arctic regions and limitations on funding relative to the need for improving permafrost representation in models remain a considerable challenge to progress (Natali et al., 2022). This ongoing scientific challenge highlights the need to more effectively and expeditiously communicate the science of permafrost thaw to key decision-makers and for decision-makers to then integrate this science into ambitious climate policy.

Advancing Arctic carbon monitoring and modeling is necessary to truly understand the magnitude and timescale of permafrost thaw emissions—and respond accordingly. Permafrost emissions could take up as much as 40% of the remaining carbon budget to stay below 2°C warming (Gasser et al., 2018). That fraction is even higher if the goal is limiting warming to 1.5°C—the threshold at which we can expect to trigger a critical tipping point for permafrost, ice sheets, and coral reefs (Armstrong McKay, et al., 2022). Resolving scientific uncertainty surrounding permafrost thaw is therefore critical for ensuring the accuracy of the United States' carbon budget and national ambition. The potential harm from neglecting permafrost thaw cannot be overstated. Even the most alarming projections of 3-41 $GtCO_2$ per 1°C of warming by 2100 likely underestimate the potential of permafrost carbon emissions (Baillargeon & Natali, 2021; Natali et al., 2021). While the Administration has committed to reducing emissions by 50% from 2005 levels by 2030, this goal will likely be insufficient if the carbon budget does not account for permafrost thaw.

Resolving scientific uncertainty is also a prerequisite to informing adaptation policies that better respond to the urgent and severe impacts of permafrost thaw on Arctic communities. Federal emergency response and disaster relief programs, including those under the 1988 Robert T. Stafford Disaster Relief and Emergency Assistance Act ("Stafford Act"), often do not consider slow-onset impacts of permafrost thaw, and state, local, and tribal governments are simply not equipped to the hazards of permafrost thaw without federal support (Bronen, 2021). As communities realize the limits of their capacity to adapt to climate change in their current locations, some are considering relocation as the only viable long-term option. The U.S. Government Accountability Office (GAO) recently concluded that more than 70 out of over 200 Alaskan Native villages face significant threats from erosion, flooding, or thawing permafrost (GAO, 2022)–nearly a decade after the GAO identified 31 Alaskan villages in such a position (GAO, 2009). Despite efforts by three Alaska Native communities to fully relocate, to date, no village has successfully completed this process. Instead, communities are facing insurmountable obstacles, citing a lack of governance framework, dedicated federal funding, and government support to facilitate relocation efforts (Bronen and Chapin, 2013; Bronen 2021).

Recommendations for Congressional Action.

Among our top priorities under the Permafrost Pathways project is to develop a rigorous program that will fill in gaps in monitoring of greenhouse gas emissions (i.e., carbon dioxide and methane) across Arctic and boreal

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149 Woods Hole Road
Falmouth, MA 02540-1644
woodwellclimate.org
508 540 9900
info@woodwellclimate.org

lands. The first step to filling these gaps, and thereby reducing scientific uncertainty in the permafrost carbon feedback, is a strategically planned and coordinated carbon flux monitoring network that spans the range of ecological, climatic, and physiographic conditions that occur across the northern permafrost regions. We are also working with Alaska Native villages to monitor permafrost thaw and support climate adaptation planning, including calling for a national climate adaptation and relocation governance framework that respects the human rights of impacted communities.

The success of these efforts largely depends on cooperative actions by this Congress and support from federal agencies whose missions align with the advancement of Arctic research. Recommendations for such actions are as follows:

Develop strategic funding opportunities for permafrost as a larger-scope and long-term research issue. The climate in the Arctic is changing faster than we can perform the science. To keep up with changes and promote a cohesive and continuous research environment, we need lengthened grant periods beyond the traditional three-year cycle of government funded grants. Access to high-resolution satellite imagery through the National Aeronautics and Space Administration (NASA) and National Science Foundation (NSF) should be open-sourced and not fixed to these short grant periods, so that the research community can perform long-term monitoring of hard-to-reach areas of the Arctic.

Allocate focused investment to reduce uncertainty in climate monitoring and modeling. Narrowing the range of potential future emissions from permafrost thaw requires increasing data coverage in space and time and better connecting the measuring and modeling communities. U.S.-funded Earth System Models, which are critical for understanding future changes in the Earth's systems, must reflect the full spectrum of permafrost thaw processes, which will require prioritization, including funding, from the top down to place high value in improving existing climate models. Improved models, increased data coverage in space and time, and novel ways of combining outputs from monitoring towers, atmospheric measurements, and process models will reduce the current uncertainty in Arctic carbon budgets (Natali et al., 2022).

Improve interagency coordination on Arctic research planning and funding. An extensive list of federal agencies with missions that align with our work in the Arctic, including the National Oceanic and Atmospheric Administration (NOAA), NASA, NSF, Department of Defense (DOD), National Park Service (NPS), Fish and Wildlife Service (FWS), Federal Emergency Management Agency (FEMA), Bureau of Indian Affairs (BIA), Housing and Urban Development (HUD), and Environmental Protection Agency (EPA) to name a few. But the regulatory and funding landscape is disjointed. The Interagency Arctic Research Policy Committee (IARPC) presents a dedicated effort to improve coordination, and the latest Research Plan reinforces opportunities for collaboration across different disciplines. Given the rapid pace of environmental change in the Arctic, I can only emphasize the importance of leveraging this platform to engage Indigenous communities, academia, scientists, and government agencies in multi-disciplinary Arctic research.

Develop international solutions to permafrost thaw, which, like climate change, is an international issue. This means developing pathways for data exchange, grant funding, and equipment sharing that facilitate international cooperation. Explicit restrictions on data sharing and financing of foreign investigators under some agency programs impede knowledge-sharing and the development of cross-border research. To advance understanding of the global impacts of permafrost thaw, we need a transnational approach that will allow and incentivize the free flow of science (including experts, data, and equipment) across national boundaries.

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info@woodwellclimate.org

Support the capacity of Alaska Natives to coproduce knowledge and lead climate change research. While there are BIA and HUD grants that are specifically designed for Tribes, funding for climate research is almost exclusively available to academic institutions. Through Permafrost Pathways, Woodwell is trying to overcome this challenge by collaborating with ten Alaska Native tribes to monitor permafrost thaw and other climate-caused environmental impacts and to support climate adaptation planning. Through this initiative, all monitoring, modeling, and other scientific and technical work is fully driven by Alaska Native communities' environmental observations, social and ecological knowledge, research priorities, and adaptation needs. That is to say, the research agenda is set out by the tribes themselves, not the scientists. The depth and breadth of Indigenous knowledge of the land and the climate far exceeds any understanding that can be gained by quantitative observations alone. Given the complexities and connections among Earth System components, a holistic understanding of the changing Arctic can only be attained through a combination of multiple ways of knowing. If the United States is truly committed to understanding the climate crisis in the Arctic, then the current funding process should be reevaluated with this goal in mind, including by directly funding Alaska Native tribes to continue to conduct Earth observations as they have for millennia and to guide decision making for protecting Arctic lands.

The loss of permafrost carbon is irreversible on a human-relevant timeframe, as is the damage to Alaskan communities who are being forced to fight for their survival—we cannot simply focus on limiting Arctic temperature rise or refreezing permafrost. The decisions we make today must be responsive to the urgent and immediate conditions currently experienced on the ground, while also taking into account ongoing commitments to global climate ambitions. That is why, even as we continue to refine policy solutions, we need champions in Congress to direct and implement actions.

This Committee has shown an unparalleled dedication to addressing the climate crisis through this and other hearings that present an open invitation for knowledge-sharing. As a research scientist, I too, recognize the value of obtaining the best available science to inform decisions about our planetary and public health. As I hope my testimony today has effectively conveyed, we must now decide next steps and take dedicated policy action. This immediacy of this issue requires an urgent response from this Congress, one which I hope the Members of this Committee will lead with my support and that of my fellow experts. Thank you.

Susan Natali

Susan M. Natali

Woodwell Climate Research Center
149 Woods Hole Road
Falmouth, MA 02540-1644
woodwellclimate.org
508 540 9900
info@woodwellclimate.org

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149 Woods Hole Road
Falmouth, MA 02540-1644

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508 540 9900

info@woodwellclimate.org

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149 Woods Hole Road
Falmouth, MA 02540-1644

woodwellclimate.org
508 540 9900

info@woodwellclimate.org

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149 Woods Hole Road
Falmouth, MA 02540-1644

woodwellclimate.org
508 540 9900

info@woodwellclimate.org

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Woodwell Climate Research Center

149 Woods Hole Road
Falmouth, MA 02540-1644

woodwellclimate.org
508 540 9900

info@woodwellclimate.org

Dr. Susan M. Natali
Arctic Program Director and Senior Scientist - Woodwell Climate Research Center

Dr. Susan M. Natali is the Arctic Program Director and a Senior Scientist at Woodwell Climate Research Center, a non-profit organization based in Falmouth, Massachusetts, that comprises research scientists and policy experts who work with partners worldwide to understand the impacts of and to address climate change on a global scale. Dr. Natali is a highly renowned Arctic ecologist whose focus on permafrost is motivated by an acute awareness of the risks that it poses in the Arctic and globally. She has conducted research in remote regions across the Arctic for more than a decade. Dr. Natali has published more than 75 academic papers, contributed to hundreds of presentations for the public, scientists, and policymakers, including briefings on Capitol Hill. She leads multiple projects, including the recently launched, Permafrost Pathways, which was awarded funding through The Audacious Project. Permafrost Pathways brings together partners at the Arctic Initiative at Harvard Kennedy School and Alaska Institute for Justice, and is designed to amplify efforts to collect the best data on Arctic carbon emissions, contextualize this information within the global budget, and transform this science into actionable policy. Dr. Natali is leading a team of experienced scientists from Woodwell to help implement the plan for enhanced permafrost measurement sites, permafrost modeling, and is supporting policy and adaptation work with communities that have been most affected by permafrost thaw.

Ms. STEVENS [presiding]. Great. At this point, we'll begin our first round of questions, and the Chair will recognize herself for 5 minutes.

Dr. Hinzman, the *Arctic Research and Policy Act* was enacted 40 years ago, and Congress last amended it in 1990. Four decades of changes in the Arctic have had social, cultural, environmental, and economic impacts. How has research planning evolved to address today's challenges? And what steps did the IARPC take to balance fundamental research priorities and research to address local research needs? And what are the most important research questions that we need to address the most significant unknowns?

Dr. HINZMAN. Well, thank you Representative——

Ms. STEVENS. Known and unknowns, yes, thank you.

Dr. HINZMAN. Thank you, Representative Stevens. That's a very large question. So the the *Arctic Research and Policy Act* was established in 1984 and was initiated to facilitate coordination, collaboration among Federal agencies and their investment in Arctic research to ensure that we had minimal duplication, to ensure that we could facilitate the partnerships and collaboration needed. And I think that that has been very successful over the last 40 years. I am very pleased to see the coordination that we have today amongst the partnerships and the collaborations among the agencies.

So IARPC does exist to facilitate that partnership. IARPC hosts a platform we call IARPC collaborations, which exists to enable the collaborations among Federal researchers, the researcher scientists in the agencies with the non-Federal researchers from universities, foundations, and international researchers. And it has been very successful in identifying the priorities that are of most urgent need to the United States, to their—to our Federal agencies and focus this large partnership of researchers on those issues. And so there's been remarkable work done, and I think there is a need to up—as Dr. Sfraga said, there is a need to update that policy, but I am pleased with where we are today.

Ms. STEVENS. Well, all hail research collaboratives like IARPC, and thank you to the dedicated researchers who are part of it.

And, Dr. Sfraga, the witnesses today have described rapid changes in the Arctic, critical partnership and research needs, limited research vessels, and sinking research infrastructure. The *Arctic Research and Policy Act* directs OSTP to review agency budget requests related to the Arctic and directs OMB to consider all agency requests as one integrated multiagency request and review it prior to submission of the budget for adherence to the 5-year research plan. How would you characterize the degree to which this has been carried out over the years? And what should it look like moving forward to ensure Congress can carry out sufficient oversight of the Arctic research budget?

Dr. SFRAGA. Thank you, Representative Stevens. Well, I can say that, although Dr. Hinzman has provided us a very good, practical, and informative narrative regarding the work that has been done by IARPC and by the Arctic Research Commission and the research community, I can say that definitively. What I cannot say is that we have a very good handle on the amount of investment our Nation makes in Arctic research. As you noted, ARPA has been

in place for 4 decades. We have not had a comprehensive budget crosscut for our Federal research, Arctic research done anytime that I can remember. And by that I mean we simply don't know in aggregate what we're spending on Arctic research in the United States. We simply don't know that we have the resources available to us to implement, to fund, the IARPC plan, as outlined by Dr. Hinzman.

And so what my recommendation and our Commission's recommendation is that we have a budget crosscut done each year by the Office of Management and Budget to secure good data on what each Federal agency is spending on Arctic research so we have a baseline and we can see our trending and funding over time. That demand for Arctic research will only continue, which means the request for resources from Congress will only continue, but I think we need a solid baseline of what it is we spend right at the moment on Arctic research. Then, I can answer the second part, I think, of your question, Representative Stevens, which is how can we take the IARPC plan, which has spent—which they have spent so much time building for our Nation in a rapid time of change? How do we know and how can we secure the resources to implement that plan? So, A, we need a good idea of our baseline over time, what we have provided for Arctic research, and that should be done every year. And two, we should take the plan that Dr. Hinzman and his colleagues have put together and we should crosswalk that with available funding to actually understand whether or not we can implement, whether we can afford, whether we can enable the research plan that his—he and his colleagues have put together.

Ms. STEVENS. Yes. Well, thank you for that. And, you know, we understand that IARPC is comprised of 17 Federal agencies, departments, and offices, again, a great example of a whole-of-government approach. NSF and NOAA alone budget about $230 million annually toward Arctic-related work as part of IARPC. And so we will get a question for the record to Dr. Hinzman as we move to the next witness—or, excuse me, the next Member for questioning. And I believe that's Mr. Lucas here——

Mr. LUCAS. Thank you.

Ms. STEVENS [continuing]. For 5 minutes.

Mr. LUCAS. Dr. Hinzman and Dr. Sfraga, data collected in 2019 by a fleet of sail drone unmanned surface vehicles in the Arctic was found by NASA and NOAA to have a remarkably strong correlation to the measurements taken by satellite. Time and time again, commercial data has proven accurate and beneficial to Federal agencies at a cost-effective price. What role do you see the private sector and commercial data playing in the future of Arctic research? And along with that, should the Administration better utilize commercial data buys and partnerships?

Dr. HINZMAN. Thank you. Thank you, Representative Lucas, excellent question and really profound insight in that the commercial capabilities have advanced remarkably in the past few decades, and they have opened up our capabilities tremendously, not just through sail drones but through sub-ocean technology and through radio communications, through telemetry that we can impart in the field, through data loggers. It's been a remarkable accomplishment. And without the contributions, without the engagement of the com-

mercial industry, we would never be where we are today. We are so fortunate to have as good partners, that they have stepped up to provide this technology to us. So I wholeheartedly endorse that.

Mr. LUCAS. Absolutely. Doctor?

Dr. SFRAGA. Ranking Member Lucas, thank you for the comment. I agree with my colleague Dr. Hinzman. Public-private partnerships have worked well in many parts of our society. Arctic research should not stand alone as something where we don't encourage the public-private partnerships going forward. Industry is innovative. They move faster than government can move. Sometimes they're more innovative. Seated with Federal research funds, we see that our Nation's industry can lead in so many different sectors. I think it's probably part of our DNA, and it should be going forward. When you have a top-down nation that can dictate what happens within its nation, it's very hard—it's very easy to put resources in particular places.

Our country is built differently. Our country is built to be inclusive. Our country is built to be innovative. And we should take advantage of private industry and, as Dr. Hinzman noted, in so many different sectors, including satellite and fiber communications and telecommunications, in drones and marine assets. We should bring the whole team to the game because the Arctic is changing so fast. We have to bring the whole team to game. And if we can bring industry to the table, we can show them and provide an opportunity for them to make a profit in the north while serving the north, I think that would be a very good thing.

Mr. LUCAS. Dr. Hinzman, as I mentioned in my statement, I had an opportunity to visit Summit Station back in 2017, and it was clear then that the facilities were inadequate for the world-class science being conducted there. Dr. Hinzman, both you and Dr. Sfraga stated in your testimony the importance of this facility and the need to recapitalize its outdated infrastructure. I know NOAA just upgraded the Barrow Atmospheric Baseline Observatory. Can you speak to any plans that are currently in motion to upgrade Summit Station?

Dr. HINZMAN. Thank you, Ranking Member Lucas. That is—I am so pleased that you were able to visit Summit Station, and I'm so pleased that you bring that to the attention of this Committee. So that station is in dire need of maintenance and upgrades at this point. It is—the surface melt has extended all the way to the summit, so that station is—over the past few years is sinking into the ice, and it does need a serious upgrade. It does need serious investments to enable it to continue these—the important measurements that have been taken over the last 40 years, 50 years since that's been in operation.

The role of Greenland in influencing our global climate dynamics just cannot be overstated. It is so important. It affects the atmospheric circulation. It affects the oceanic properties. It affects ocean circulations. We have to continue those observations. Thank you.

Mr. LUCAS. Absolutely. Dr. Sfraga, can you—could you please provide—because part of my responsibility as a Member of Congress is explain to the folks back home why we make these investments. Could you provide one or two examples of how basic research funded by the Federal Government science agencies sees

like NSF, NOAA, and NASA play a role in national security decisionmaking in support of the Arctic? And along with that, what role does the U.S. Arctic Research Commission play in connecting defense and non-defense communities? I'm looking for a town meeting answer here.

Dr. SFRAGA. Thank you, Member Lucas. I can say that—well, first of all, Greenland is emblematic of the new north. It—so many of the issues at play right now in the new north, whether it's social, political, economic, environmental. If you live in Norfolk, Virginia, or Nome, Alaska, you will feel the impacts of what happens in Greenland with melting ice cap.

But I can tell you that if you're interested in a national security component of research, here's where we're at. The United States needs to have a better idea of our domain. Why? Our Arctic domain is changing drastically. And if you are a resident citizen of our country, you need to know that Arctic research is a part of our national security, so securing money and resources for research secures our national security. If you're interested in homeland security, understand full well that we have a great power competition underway in several different forms, Russia, China, even North Korea and other countries. The Arctic now is a globalized Arctic. It is not a place on a map far removed. It is now a part of geopolitics, which increases our dependence on so many different things like the ripple effect of global energy, global wheat supply and demand, global commodities, shipping costs. If you're shopping each day, you're being impacted by global commodities. So energy, resources, shipping, I can continue on and on. All facets of the economy now are woven into the Arctic, whether we see that or not. It's really apparent to so many that that is the case.

Mr. LUCAS. I agree, Doctor, and yield back the balance of what time I do not have, Madam Chair.

Ms. STEVENS. All in good faith. And with that, we will hear from 5 minutes of questions from the distinguished Science Committee Member Ms. Lofgren.

Ms. LOFGREN. Thank you very much. This is such an important hearing, and I'm grateful to each of our witnesses for their important testimony.

Pivoting to Mr. Lucas's question and the town hall meeting, it's worth noting that we have had some studies, one, Lawrence Livermore National Lab did a study in 2017, and just this year, the Pacific Northwest National Lab both linked wildfires in California to Arctic melting. The dry, hot conditions in California are directly linked. And so since we've learned these connections in our understanding, I guess the question is, what do we do? Can this information assist us as we prepare in the western continental United States for wildfires, and could it be an early warning to help us better cope with that phenomena that we are seeing in Washington, Oregon, California, New Mexico, and the like? Yes, Doctor.

Dr. HINZMAN. Thank you, Representative Lofgren. That's a very important issue and one that I think our government is trying very hard to address.

So there are several advances going on. And I'll—first, I'll take the broader picture with respect to the role of the Arctic in these increasing numbers of extreme events. There's—you are absolutely

correct. There are more severe—there's a greater frequency of extreme events and a greater severity of these extreme events, and that includes wildfire. And there is a role of the Arctic in influencing these global climate dynamics that are increasing these disastrous wildfires.

So what are we doing about that? So there is now a new interagency, ICAMS, Advanced—Interagency Council on Advanced Meteorological Services, excuse me, and one of the primary focuses of that is on addressing wildfire behavior, predicting, projecting where the wildfires will occur so we can be prepared for them, and then being able to better predict the wildfire behavior. And IARPC is participating in that group to try and understand—to contribute what the Arctic's role is in that effort, but it is—I agree with you. That's a very important issue.

Ms. LOFGREN. Well, thank you very much. Dr. Natali, as your statement described the latest sixth assessment report for the first time included the permafrost carbon in the Earth systems models that informed the IPCC (Intergovernmental Panel on Climate Change) report. And we've made it clear much more is needed. How would—how will this research impact to allow for a more accurate picture as we nationally determine contributions in carbon budgets around the world. What—how do you see that proceeding? You need to turn your mic on. Thanks.

Dr. NATALI. Thank you, Representative Lofgren. Yes, so this is—yes, thank you for this question. So first, I just want to talk briefly about these models, Earth system models. Earth system models explain, you know, the—how the climate is going to work, and it incorporates biogeochemistry, so carbon cycling, and it puts like human actions into that.

Earth system models were not developed with the Arctic in mind, so things like permafrost and things—the connection between the Arctic climate and the rest of the planet is not built into these models, and it's not trivial to build them into the models. And so this is one of the reasons why we are—have surprises like wildfires in the West that—currently, in order to be able to respond to these and be prepared for these, we need to improve these models. And that's a really challenging thing. It requires support from the top down for, you know, U.S. climate-based models to advance these.

One of the key issues is the incorporation of permafrost carbon. Yes, in this last IPCC report, two of the models did incorporate permafrost carbon, certainly not fully, not in the way that we understand that permafrost thaws. And what this means is when we're thinking about how much carbon do we have available for humanity to stay below 2 degrees Celsius, or 1.5 degrees Celsius, we're not hitting the mark. So even if all of the nations, you know, put together a budget, and we say, yes, we're going to keep to that, we're not—we're aiming for the wrong target right now. And so the very least that we need to do to start out with is to do our bookkeeping correctly, right? We're not doing that bookkeeping correctly because the science isn't up to pace with the needs.

Ms. LOFGREN. Well, I think that's very important. And as we look at the unfolding disaster around the world, it really does lead to how are we going to turn a corner on this if we don't accommodate in our models the carbon from the permafrost. And I would

add the link to the wildfires. I mean, you know, the forests burn. Well, if they're no longer capturing carbon, they're emitting carbon throughout the West, and unless we adjust our models to accommodate for that, and it's not obviously just here, it's around the world, we're not only going to miss the mark because of inaction, we're going to miss the mark because we haven't adequately set the mark.

So my time is up, and I yield back. And I thank these witnesses for their tremendous testimony.

Ms. STEVENS. Thank you. And with that, we will hear from Mr. Posey for 5 minutes of questioning.

Mr. POSEY. Thank you, Chairwoman Stevens.

Dr. Hinzman, the National Science Foundation recently announced it was relying on Starlink satellite internet to support McMurdo Station in Antarctica. That's a mouthful. Can you highlight how high-speed, low-latency satellite broadband systems like Starlink can enhance scientific efforts and connect research projects in the remote Arctic?

Dr. HINZMAN. Absolutely. And I have been fortunate to be able to utilize that system in the past. And it is a remarkable boon to science in that it does provide access in very remote locations, provides quick, reliable access that can be used to collect data from stations that are not manned and that are left for long periods of time. It's an incredible asset that we are very fortunate to have.

I am—I understand that it's working very, very well in the Antarctic, and I—we do utilize it at several remote stations in the Arctic. And I think that it's—such capability will enable our science to do more activities that we've never been able to achieve in the past where we've had to have people in the process in the field to do that work. So thank you.

Mr. POSEY. Thank you. Dr. Sfraga and Dr. Hinzman both on this one, we're trying to increase their scientific missions to the Arctic, which we know are frequently dual use. What is the United States doing to counter their influence in the region and within international bodies such as the Arctic Council?

Dr. SFRAGA. Thank you, Representative. Indeed, China has—China is playing the game Go around the world, the classic board game Go. The Arctic is a part of that game for them. They simply want to influence the political landscape and, you know, exert their will around the globe. We see that in a lot of their hard and soft power investments. Certainly, research is one of them. They now have the ability to indigenously build their own icebreakers. They have a relationship with the Russian Federation that allows them domain awareness in the Arctic. We see their expeditions in the Arctic navigating the Arctic Ocean in a way that is research-based but could be dual use and multiuse as well.

The best counter to that, obviously, we can get into the national security side of this. I guess the best possible counter to that is to ensure that the United States, that the United States leads in Arctic research as well. That means that we have the icebreaking capacity, the research capacity in the north. And we have something that China and Russia frankly do not have, and that is a set of partners and allies that are in the Arctic and outside of the Arctic that have an incredible amount of expertise in Arctic research.

And this—if there ever was a time to double down to invest more in Arctic research, more in our presence in the Arctic, more of our research capacity in the Arctic, and better leveraging and integration with our partners around the north, I think now is the time because of what you just mentioned, Representative, and that is that both Russia and China do see the Arctic as an opportunity for a number of things, including more presence and influence in the north, along with, of course, basic research that can be used for other goals and motives that they might have.

Mr. POSEY. Yes, that was great. Dr. Hinzman, you want to add to that?

Dr. HINZMAN. I think Dr. Sfraga was very eloquent in his assessment. I do share our concerns that have been expressed with respect to the Chinese advancements into the Arctic. They are developing stations in collaborations with the Russians. They are incredibly investing into Arctic research, and just as they're doing in many other other parts of the globe. So their long-term motives and their short-term actions are of great concern to our government. And I appreciate the caution and the concern that our government has put forth with respect to these actions. Thank you, Representative Posey.

Mr. POSEY. Yes, same two—question the same two witnesses. With Russia currently chairing the Arctic Council, has this hampered the ability for international cooperation like, you know, what efforts has Russia made to cooperate with China concerning research?

Dr. HINZMAN. So I'll take the first crack really quickly, Dr. Sfraga. So yes, that has had a serious impact on collaborative research. The U.S. Government has ceased Federal collaborations in Arctic science. I am disappointed to see this impact of science, but I fully support this action of the U.S. Government. So Dr. Sfraga?

Dr. SFRAGA. I agree with Dr. Hinzman, fully support the actions that the United States and our other six partners in the Arctic Council have taken. It has hindered research in the Arctic. If you're trying to put together a puzzle and you only have half the pieces, you really don't have a great shot at completing a good picture of the puzzle. And you've just taken out Russia, which is 50 percent of the Arctic. So many of the issues we've just talked about, whether it's fire, permafrost thaw, ocean acidification, all of the issues facing all of the Arctic, which means the globe, we've just parked 50 percent of the Arctic to the side.

Having said that, I am in full agreement with the actions that the United States and other nations have taken. It has hindered our ability to have solid international cooperation. The Arctic has prided itself, for good reason, for being a zone of peace and cooperation, even through the cold war. However, the invasion of Ukraine is beyond the pale. And so what best to do now? What best to do now is to work with our allies and partners and double down in our investments right now so that we can leverage the expertise of our allies in a way that we can continue the research that needs to be done at a time of dramatic change. But make no mistake, it really will hinder our research and our understanding of the north more fully, but we can't be held hostage to what has happened. We

have to move forward. And we're lucky enough to have allies and partners to move forward with.

Mr. POSEY. I thank the witnesses. And I thank you, Madam Chair, for letting him finish answering that question. And I yield back.

Ms. STEVENS. Absolutely. And with that we were going to hear from one of Oregon's finest, Congresswoman Bonamici, for 5 minutes of questioning.

Ms. BONAMICI. Thank you to the Chair and Ranking Member and to our witnesses.

Experts predict that by the end of the century, hundreds of towns, cities, and villages across the United States and around the world will be all or partially underwater. I'm grateful we're having this hearing today to amplify the role of the Arctic and, as it says, strengthening science to respond to a rapidly changing Arctic. And I hope that what we're hearing today, the solutions that we find in this Committee and in this Congress meet the moment with the gravity of what we're hearing today.

Dr. Hinzman, you talked about the infrastructure needs for Arctic researchers and adaptations along shorelines or they're typically in, you know, gray solutions like concrete or green solutions such as absorbing floodwaters in urban areas. So will you please elaborate on how priorities are set regarding adaptation that's needed for the infrastructure to support researchers? And I know Ranking Member Lucas asked about research facilities, but if you could also mention the challenges of travel now and how that has changed in light of the thawing permafrost.

Dr. HINZMAN. Thank you, Representative Bonamici. Again, excellent questions. And so the way the priorities are set, we exist—IARPC collaborations, IARPC exists to facilitate the collaborations, the partnerships with the Federal agencies and with non-Federal partners. And so we've gone to great efforts to solicit input from the Federal agencies what the urgent research needs are but also from the Arctic communities, from the individuals, from indigenous organizations, and from the State of Alaska. So we've identified those urgent priorities that must be identified and then worked with the Federal agencies, the indigenous communities to try and understand the best approach to address these urgent priorities.

As far as, you know, what the urgent needs are and the the priority approaches to address the rising climate—or, I'm sorry, the rising sea levels, that is a huge challenge, which requires again, as Dr. Sfraga was talking, about huge international collaborations in partnership to address the—we're seeing remarkable degradation of glaciers around the world, which in the past several decades, it's been primarily the glaciers that have contributed to the sea level rise, and now we're facing the incredible degradation of Greenland and the losses from the Antarctic. It is a tremendous problem. What we're trying to do now is just trying to characterize—best understand what that sea level rise is going to be over what time so that we can help our communities adapt. And I'll stop there. Thank you.

Ms. BONAMICI. Thank you, Dr. Hinzman. I'm want to ask Ms. Metcalf. Welcome. You discussed the importance of better connection between Indigenous Knowledge and what you refer to as the

science-research-government-industry. One issue mentioned is a mismatch or disconnect. That's harmful algal blooms, or HABs, which with warming temperatures are creating a new threat to the Arctic. This is an issue that I've worked on on a bipartisan basis, particularly with Representative Posey over the years. In fact, we just recently received a GAO report about the interagency NOAA-EPA (Environmental Protection Agency) workgroup confirming that we need to do more.

So, Ms. Metcalf, what are your suggestions for addressing that disconnect so that you can access the reliable testing you need for the water and for the food you eat that comes from the ocean?

Ms. METCALF. Well, thank you for that question. Congresswoman. One of the issues that we constantly deal with is that our communities are well-adapted to providing biological samples to science who can do the assessment of if it's safe to eat some of our food resources. The problem is that sometimes it's very, very difficult to get results back in a timely manner to our—back to our communities who harvest, you know, bowhead whales and Pacific walrus and ice seals and birds. You know, is it safe to eat these resources when we don't get any results back in a timely manner? Although our communities have been providing samples for many, many years, that's the issue that we have. How can we incorporate Indigenous Knowledge, local input in adapting or mitigating coastal erosion, for example, that was mentioned, or changes along our coastline? How can we incorporate our knowledge into these issues that we've been saying——

Ms. BONAMICI. Ms. Metcalf, I don't mean to cut you off, but I want to get one more question in. My time's running out.

Ms. METCALF. No problem.

Ms. BONAMICI. Quickly, Dr. Natali, you testified in Foreign Affairs—the Foreign Affairs Committee you mentioned last year. And then in your testimony today, you said less than 1 year later, we discovered that the negative consequences of inaction are much higher than we previously understood. What happened in the last year?

Dr. NATALI. I think each year and each day and each week that goes by the scientific community [inaudible] continuously.

Ms. STEVENS. Could you please turn——

Dr. NATALI. Sorry about that—continuously surprised by the rapidity of the changes and the interactions that are happening. And I'd say this storm that happened in Alaska, I'm—is not—maybe is not a surprise, but it was a surprise, and it's something that I think we need to be continuously prepared for. And I think what's happening now is that I think the climate is actually changing faster than the science can happen. And so what that means is that we're seeing extreme events both in the Arctic and also in lower latitudes as a result of the rapid Arctic changes that are happening. And these extreme events are impacting Arctic residents and also the rest of the planet.

Ms. BONAMICI. I appreciate that. I see my time has expired. Thank you to the witnesses for your excellent answers. I yield back.

Ms. STEVENS. OK, and with that, we will move to Mrs. Bice for 5 minutes of questioning from the great State of Oklahoma.

Mrs. BICE. Thank you, Madam Chairwoman. And I want to say thank you to the witnesses for joining us for this discussion today.

Dr. Natali, in your bio, you mentioned that you had testified to the Foreign Affairs Committee about some of the challenges with the changes with the Arctic and particularly Greenland ice shelf. Do you want to maybe expand a little bit? As someone who sits on the Armed Services Committee, certainly, national security is something that I, you know, take very seriously. Can you talk a little bit—since some of the other witnesses have broached the topic, what are your perspectives on these changes and how it impacts our national security?

Dr. NATALI. Yes, thank you for that question. So there's very direct impacts when you think about the changes that are happening on the ground, and so I focus a lot on permafrost thaw, but permafrost thaw does not happen independent from the rest of the system. So these changes that are happening on lands in the Arctic are impacting communities that live in the Arctic, but also military facilities and in other infrastructure, gas and oil pipelines. And so I'm talking about ground collapsing when the ice and the permafrost melts and the ground starts to collapse. That in turn then causes flooding and increases coastal erosion and makes infrastructure more vulnerable to storm damage. And so this is a very direct impact.

And I guess I would say another priority that needs to be a focus when we're thinking about, I guess, security, I guess I would also really want to highlight security of human systems and food security and food sovereignty because this is also being impacted not only by permafrost thaw, but by the number of other changes that are happening across the Arctic. And I think others on this panel can speak more directly to that from their personal and professional experiences, but the impact of the climate changes on both the human communities, the infrastructure, the economic impacts that is happening are far and wide-reaching beyond the Arctic.

Mrs. BICE. And to follow up on that, and this is actually for Ms. Metcalf, or Dr. Hinzman. Aside from the release of carbon and methane emissions, are there any other threats from thawing permafrost that could potentially pose a threat to local or global community's health, and can you gauge the seriousness of those?

Ms. METCALF. Thank you for that question. Yes, sinkholes are something new that is happening in our region. We see that because moose hunter—moose hunting just ended, but hunters are reporting large sinkholes along the roads that are affecting our ability to harvest these resources that are very important to us.

Dr. HINZMAN. If I may add, thank you for that question, Representative Bice. If I may add, it is a very important issue for national security in that all of our—in the Arctic, all of our military facilities are built upon permafrost, which is also degrading, so the infrastructure is at risk. And we need to develop better techniques to improve our design criteria and our construction techniques so that the facilities that are built are functional throughout their projected lifespan, so we have to come up with better building techniques and we have to come up with better design criteria.

Mrs. BICE. That's a great, I think, perspective there. This is to all of the witnesses. Given the harsh environment in the Arctic,

can you talk about the need to invest in Arctic technology that is developed to maintain and to remain operational and sustainable under these extreme circumstances? We've talked a little bit and I know that we're putting together sort of this holistic view, but what are some of the technologies you think are really maybe crucial currently?

Dr. HINZMAN. May I?

Mrs. BICE. Please.

Dr. HINZMAN. So thank you again for that question. So I think what we need to do—the mistakes we've made in the past is that when we were building—we were building facilities, pipelines, roads, we built upon the historic weather data. We didn't look forward. We weren't using climate projections to understand how the—how this environment was going to change, and to build the—our facilities to design our infrastructure to last for that design criteria. So what we need to do, we need to come up—we need to use climate models to integrate with our building techniques, with the engineering designs so that these facilities are appropriate for the environmental conditions they are going to see throughout their lifespan. And that's something we—we're not doing now but we really need to.

Ms. METCALF. May I add quick?

Mrs. BICE. Yes, Ms. Metcalf.

Ms. METCALF. Yes, Indigenous Knowledge and local perspectives need to be included in these plans, so that's very important to consider. So thank you.

Mrs. BICE. Thank you. And that concludes my time. Madam Chairman, I yield back.

Ms. STEVENS. Thank you. And with that, we will hear from Congressman McNerney for 5 minutes of questioning.

Mr. MCNERNEY. Well, I thank the Chairwoman. You didn't say anything about California, so I'll live with that.

Ms. STEVENS. From the wonderful State of California, the jovial State of California.

Mr. MCNERNEY. Thank you. Well, I thank the witnesses. Dr. Hinzman, the Arctic Observing Network is a system of atmospheric, land, and ocean-based environmental monitoring capabilities. Data is received from ocean buoys, satellites, and other sources. How would you characterize the current state of Arctic monitoring, observing, and modeling in the prediction efforts?

Dr. HINZMAN. Our observing system in the Arctic is very, very sparse at this point. And so it—as far as the role that it plays in observing, predicting, it's tenuous at best in that our models are developed—they—our models require validation, verification, and it is very difficult with the extent of the observations that we have now to really rigorously validate those models. And so it does hurt our ability for even short-term predictions with respect to weather predictions, which has a big impact on the more temperate regions but also with respect to the long-term projections of future climates.

Mr. MCNERNEY. Is there an opportunity to fill in those gaps?

Dr. HINZMAN. I certainly hope so. We are trying to enhance and improve the observing network in collaborations with many of our international colleagues, and with other institutions, other govern-

ments. We are trying to build a reliable, robust Arctic Observing Network.

Mr. MCNERNEY. Thank you. Now, Dr. Natali, a top priority of the Permafrost Pathways is to fill in the gaps again and monitoring greenhouse gas emissions across the Arctic. What are your recommendations of a Carbon Flux Monitoring Network?

Dr. NATALI. Thank you for this question. So as part of the Permafrost Pathways Project, we're trying to fill in gaps in carbon cycling on land from the Arctic so that we can know now is the Arctic a carbon source or a sink as it has been? So is it continuing to take up carbon as it has been for thousands of years? And what will this look like into the future?

One of the challenges we've recognized are these major gaps. And so we're taking a—I'd say a top-down approach, saying if you want to know the carbon budget of the Arctic, where would you strategically put these monitoring sites? And I feel like in terms of Arctic carbon cycling, that hasn't happened in the past. Sites generally get established somewhat opportunistically by grants, and so I think that kind of more coordinated effort. There is a challenge right now because we cannot be working on the ground in Russia.

I think another major need here in order to help us to fill this gap is this satellite data. So right now, high-resolution satellite data is critical for seeing places in the Arctic that we can't access on the ground. Some of the commercial data right now is only accessible if you're an NSF- or a NASA-funded scientists—accessible, I would say like for free. So making these data widely available and beyond the funding cycles would greatly advance the scientific community's ability to continue monitoring these sites, even in places and to get the ground truth data, even from the—from satellites in order to verify these models.

And I'd say the last thing we need is really dedicated commitment toward improving these models. There are a number of U.S.-based Earth system models that could use that support.

Mr. MCNERNEY. Well, has there been any research on how solar radiation management, for example, by injecting sunlight reflecting particles into the stratosphere, would slow the permafrost thawing?

Dr. NATALI. I think there are a lot of challenges with this and solar radiation management I think—I'm not opposed to exploring all options, but I would strongly, strongly suggest that that conversation is—that indigenous Arctic residents are brought into the room and others as part of that.

Mr. MCNERNEY. Anyone else on the panel want to take that? Dr. Hinzman?

Dr. HINZMAN. Yes. Thank you for that questions. So there has been extensive discussion within the Arctic research community, within the whole scientific community as far as geoengineering, and they're—at present, the United States does not support research into geoengineering as far as any of those activities. We're not really—we're more concerned about the possible consequences. But there are right now active investigations going on into potential modeling studies to try and understand that, if that occurred, what the consequences would be.

Mr. MCNERNEY. That was my question. Thank you.

Well, major changes in the Arctic can be seen within a single generation. Now we're seeing that happen. And I don't have time to ask anyone specifically, but I'll throw the question out there before I retire. How many—how will the biennial implementation approach for the Arctic Research Plan impact research effectiveness?

And with that, I'll yield back.

Ms. STEVENS. Well, thank you. And as I had passed the 5 minutes of questioning over to my colleague who has served this Committee very admirably, I did so with a lot of admiration. And, you know, the remaining weeks that we have of this months that we have of this term, it's just been such an honor to serve with my friend and colleague, Jerry.

And with that, we're going to pass it over to Mr. Feenstra of Iowa for 5 minutes of questioning.

Mr. FEENSTRA. Thank you, Madam Chairman. And thank you, Ranking Member Lucas. And thank you all to our witnesses for your testimony and sharing your extensive experience and knowledge on this subject.

There's been a lot of research on the Arctic, and that—and could—can be very important, but we should build off what we've already done. For example, the DOE's (Department of Energy's) Biological and Environmental Research Program used drones to conduct high-resolution monitoring for changes in the Arctic vegetation. There was also collaboration between the DOE and the NSF to study microbes in Arctic soil that can absorb carbon dioxide, as well as adapted to take advantage of a thawing of permafrost.

So my question is this, Dr. Sfraga. Can you tell us more about incorporating these terrestrial research investments with the Arctic? And are there studies and data produced by agricultural—agriculture and life sciences research like Iowa State University that can also be used in the new Arctic research?

Dr. SFRAGA. Thank you, Representative Feenstra. Yes, the answer is yes. I think where your comments and your questions are coming from is, is there a better way to integrate and leverage what we already have invested as a country, not just in financial resources, but in our intellectual capacities and capabilities as a way to feed that into the more broader Arctic research indefinitely? And the answer is yes because the systems are connected. This is a globalized Arctic now.

So if we're doing research in Iowa on the hydro cycle, if we're doing research on vegetation, water cycles, we're looking at pestilence, migrations, all of those issues, since the global patterns have changed, we can see the benefit of understanding what the impacts are across our country and indeed, across the world. So if there are assets like drones being used, if there's research, as you have noted, on microbial research endeavors, then I think there is a way and there are ways to leverage those areas of expertise and show the interconnectedness, the cause and effect, the impacts of what's happening in the Arctic to places around the world, including crop yields.

Mr. FEENSTRA. Can I further ask that question of—so I'm an academic myself. How do we get more involvement in the academic world in this arena? Dr. Sfraga?

Dr. SFRAGA. Yes. Thank you. Thank you again for that. I think there's an understanding. You know, as fellow scholars [inaudible], and we're seeing more and more institutions, whether they be in Iowa or in Florida or in California, have increased capacity and interest in the Arctic. And that is where one academic may—one scholar may have had a particular focus in their area and that might have been a region outside of the Arctic, and now we're seeing the transfer of their intellectual capacities and their research to the Arctic and even in the Antarctic as well. So we're—we see a lot of this referencing and transition of their work [inaudible] with scholarship. It comes with publications, it comes with conferences, but it also comes with the understanding [inaudible] throughout the Arctic community and throughout the academic community that these global systems are indeed tied. And we're seeing the——

Mr. FEENSTRA. Absolutely.

Mr. SFRAGA [continuing]. Cause and effect of it.

Mr. FEENSTRA. Yes. Yes. Thank you. Thank you for that. So Iowa State also recently received an award from NSF for the project entitled "Collaborative Research Toward Resilient Water Infrastructure in Alaska Native Communities Through Knowledge and Co-Production." One of the major research objectives for this grant will be to outreach efforts aimed at training community members in the use of water supply and leak detection sensing equipment. Ms. Metcalf, from your perspective, how receptive are Alaskan indigenous communities to implementing Federal research ideas like this? So it's coming out of the academic world, so how do we apply it and how do we implement it based on the community members that are out there?

Ms. METCALF. Yes, thank you for that comment and question. We have a similar project here that we are doing called SEARCH that is funded by NSF and it utilizes our 12 IK experts in that project that is looking at health policy and knowledge systems within the Arctic to conduct that project. So I think I keep emphasizing Indigenous Knowledge, the use of and incorporating that in any kind of project is important, so thank you. I hope I answered the question.

Mr. FEENSTRA. Absolutely. Thank you so much for your comments. I'm very grateful for each one of your testimonies. And I yield back.

Mr. TONKO [presiding]. The gentleman yields back, The gentleman yields back. The Chair now recognizes the gentlewoman from North Carolina. Representative Ross, you're recognized for 5 minutes, please.

Ms. ROSS. Thank you very much, Mr. Chairman, and the Ranking Member. And thank you so much to all of the witnesses for your testimony.

I recently returned from a climate and energy meeting with several Members of Congress. It was bipartisan in Iceland. And we looked at geothermal energy, we looked at carbon capture, and we talked to a wide variety of people in Iceland, working in both climate and energy. One of the biggest takeaways that we took from that trip was how there were many, many women involved in energy and climate. And for some of the largest companies dealing with these issues, 50 percent of the board of directors. And of

course, we have a female Prime Minister of Iceland, who's in D.C. this week.

And so one of the focuses of this Committee has been increasing the STEM (science, technology, engineering, and mathematics) pipeline so that we can have many different perspectives and talents addressing the most difficult problems that we have. And so I wanted to know what the STEM education and work force needs are in the Arctic, including supporting the continuity of Indigenous Knowledge, and what are the challenges?

Dr. HINZMAN. Are you—can you—who would you direct that question to?

Ms. ROSS. Anyone. You can start, sir.

Dr. HINZMAN. Well, thank you. Thank you for that question. So I will—I'll certainly jump in and then perhaps pass to my colleagues. So IARPC, the Interagency Arctic Research Policy Committee, has recently released the Arctic Research Plan. A component of that plan, one of the foundational activities of that plan is, of course, STEM education. That is very important to us. So we are—and another component of it is—actually is indigenous engagement, and—I'm sorry, participatory research and indigenous leadership in research. And part of that is we want to utilize the co-production of knowledge. We want to gain from the expertise and the culture that exists, but we also want to improve the capacity of the—in the community so that they can address the issues and take these challenges on themselves. And STEM education is a critical part of that. And so we've been directed by the agencies to address that to the best of our abilities, and we are definitely trying to respond. Thank you.

Ms. ROSS. And, Ms. Metcalf, I would love to hear from you.

Ms. METCALF. Yes. Thank you for that question. I am a big proponent of co-production of knowledge. I would suggest including Indigenous Knowledge or local communities from the beginning of any project development. I think we are—always have been part of the solution, so it's very important to note that. Thank you.

Ms. ROSS. Does anyone else have anything to add before I ask my next question?

OK. My next question, right before we went to Iceland, President Biden announced that he's interested in creating a position of Ambassador to the Arctic. And I know that we—we've talked a lot about the international challenges in the Arctic. I'd like any reaction that any of the panelists have to that and how you see dealing with climate and science as a role for whoever that Ambassador might be. And why don't we start with Dr. Hinzman and then anybody else who wants to chime in?

Dr. HINZMAN. So the United States is one of the very few Arctic nations that does not have an Arctic Ambassador, so we are very pleased to learn of this new announcement. And I think that there are some wonderful people who can really play a great role for us and facilitating these engagements we need with our other Arctic nations partners. And so this is a great step forward, particularly at this time when we've ceased the active engagement of the Arctic Council, so this is a critical role at this time. And I'll pass the floor from that. Thank you.

Dr. SFRAGA. Representative Ross, I would just—please.

Dr. NATALI. OK. I guess I'll just quickly add I think from a science perspective, the climate and the changes that are happening don't see national boundaries, and so I think this is really a critical point in helping us to advance the science across the Arctic outside of the United States as well.

Ms. ROSS. Great. Dr. Sfraga?

Dr. SFRAGA. Thank you, Representative Ross, I, too, think that it's a pretty good idea for the United States to create this Ambassador position. I see the role as someone who can project and reflect United States policy across the board to international partners, especially at this time, as Dr. Natali just noted, someone who can communicate in aggregate all of the U.S. policies, can communicate where we stand on many issues across the board, one office, one individual with support that can do that for all of the—our interests in the north would be not only something good for the United States but I think our allies and partners, too, are awaiting someone like this as well.

Ms. ROSS. OK. Thank you. Thank you, Mr. Chair. I yield back.

Mr. TONKO. The gentlewoman yields back. The Chair now recognizes the gentleman from Kansas. Representative LaTurner, you're recognized for 5 minutes, please.

Mr. LATURNER. Thank you, Mr. Chairman. And good morning to all of our conferees.

Dr. Hinzman, how are the goals for the current Arctic Research Plan—how do the goals for the current Arctic Research Plan improve on previous iterations of the plan? And are you concerned that overly broad priority areas will make substantive change difficult?

Dr. HINZMAN. So that's an excellent question. This plan is very different from previous plans. And I think it's taken a new approach because this is where we are with respect to the science. Previous plans were really focused upon understanding the disciplinary sciences, looking at sea ice processes or permafrost dynamics or ecosystem evolution. At this point, what we're trying to do is we're trying to take on the more complex, the more sophisticated societal-level questions of health and community resilience and economies, livelihoods, risk management, hazard mitigation. Those are areas where we need to draw together the many disciplines of science, the many, many components of science, but also engineering and economics and the other policy issues so that we can address these higher-level questions, these more sophisticated questions that can't be taken on from a more basic disciplinary perspective.

Mr. LATURNER. Can you talk about the economic change that occurs in Arctic communities and how that influences your goal setting for the IARPC?

Dr. HINZMAN. Yes, unfortunately, Arctic communities have very limited economic opportunities, and so what we're trying to do is we're trying to understand how we can—what the research components—what research can add to understanding sustainable livelihoods, what—how we can help understand—help communities understand what their resources are, how they can utilize them to best move forward to maintain a thriving community into the future. And so we're really looking at the economies of the resources

but also the human resources, the capital and the capabilities and the culture that they have, how we can pull all this information together to make sustainable, thriving communities.

Mr. LATURNER. Thank you. Dr. Sfraga, how could collaboration be improved between U.S. Arctic Research Commission and other government agencies to promote research in Arctic communities?

Dr. SFRAGA. Thank you for the question, Representative. We do that a great deal now. There's a lot of communication between the Arctic Research Commission, our Commissioners. They're representative of—five of the seven Commissioners are Alaskans. They each have different seats on the Commission. So there's a lot of integration and a lot of communication between the Commission and communities throughout the State of Alaska. So that's one.

Two is that we spend our days communicating to—throughout the State of Alaska with the government, with indigenous groups, with State Commissioners, but also with our Federal partners as well. Most of the work of the Commission is not creating a 2-year goals report. Most of the work of the Commission is exactly what you know, Representative, which is communicating to communities and having communities communicate to the Commissioners to inform our work, and then work with our Federal partners as well, as well as our international partners.

Mr. LATURNER. I appreciate that. I want to stick with you. And this is really important. How does the United States use research and development programs as soft diplomacy tools to build relationships with our allies?

Dr. SFRAGA. Yes, that's a wonderful question. I would say that—let me give you—I'll give you one example. You know, research has always been a part of the U.S. soft diplomacy, always, and it's a bedrock of what we do. If you look at the Arctic and you think about it in arcs, just in these arcs to and from the Arctic, there's an arc of, I would say, commonality and an arc of cooperation in the North American Arctic. That's Alaska, the United States, Canada, Greenland.

And by looking at that tranche of North American Arctic, you can see many research projects that span the Arctic with likeminded nations that already have working relationships in research from Greenland, as noted, to our bilateral relationship with Canada and Alaska through the United States. So by reinforcing those areas, that's reinforcing a rules-based order. It's reinforcing a transatlantic alliance and the transatlantic partnerships, as you'd think about this arc of commonality that goes into the Nordics and into Europe. So these are the ties that bind us. Research is a bedrock of that partnership and those ties that bind us.

Mr. LATURNER. Thank you very much. I appreciate your answers.

Mr. Chairman, I yield back.

Ms. STEVENS [presiding]. Thank you. And with that, we are going to hear from Mr. Tonko for 5 minutes of questioning.

Mr. TONKO. Well, thank you to Madam Chair. So, Chair Johnson and Chair Stevens, and Ranking Member Lucas, thank you for hosting us today. And to the witnesses, thank you for being here to provide great insight.

The consequences of a rapidly changing Arctic landscape have the potential to impact billions of people worldwide. Alaskan residents and countless indigenous communities, however, are already on the frontlines of the most observable impacts of climate change such as thawing permafrost. As global temperatures continue to rise, millions of lives and critical civilian and military infrastructure in the Arctic are urgently at risk.

So, Dr. Natali, we know that when permafrost thaws, enormous quantities of greenhouse gases like carbon dioxide and methane are released into the atmosphere, not to mention the ancient bacteria and viruses that could trigger another global pandemic. How are increasingly frequent extreme weather events speeding up permafrost thaw? And what are the immediate and long-term consequences of abrupt thaw events?

Dr. NATALI. Thank you for your question, Representative Tonko. So abrupt climate events like heat waves, like these massive storms that we're seeing, can trigger rapid permafrost thaw, the sinkholes that Ms. Metcalf had mentioned. And when these rapid events happen, so when the—when the ground thaws, it can happen very gradually where you have heat being transformed, but you can also have these rapid events happening, particularly in areas where you have a lot of ice in the ground. Once those happen, then you have more ground exposed, so it can happen faster and faster and faster. So rapid events that trigger it then cause this exponential increase in the rate of permafrost thaw.

Once that happens, it's essentially irreversible, at least on a human-relevant timeframe. It's taken a long time for the carbon, thousands of years in many cases for the carbon to get into the ground. When you have this massive erosion, even if we cool our climate, you're not going to get the shorelines back that have eroded. And so these triggering events can—even though they're happening perhaps on a—you know, on a smaller spatial scale, can have outsized impacts, both on global climate and on the ground for people who are living on permafrost and the infrastructure that's on permafrost.

Mr. TONKO. So that being said, how does this impact on accurate pictures for nationally determining contributions and carbon budgets?

Dr. NATALI. Yes, so that's the challenge because right now, permafrost is rarely included in global climate models and rarely incorporated into these budgets for how much carbon is remaining to stay below 1.5 or 2 degrees Celsius. These abrupt events are absolutely not included at all. They're quite complex to put into a model. We can make estimates of it, and I strongly suggest that, using the best information that you have at hand. There are a number of models, and my group is one of them, working on advancing the models to incorporate these abrupt events. But when we're thinking about analyzing and responding to risk, I think we need to really seriously consider these upper extremes that we're being pushed to that we perhaps haven't been able to consider in kind of the traditional models that we've been running.

Mr. TONKO. And can you elaborate on your approach to collaborative research with Alaska Native tribes?

Dr. NATALI. Yes. So as part of a new project that I'm leading called Permafrost Pathways, we'll be working with 10 tribes in Alaska who are making really difficult decisions about climate change adaptation as a result of permafrost thaw, flooding, and erosion. And so my approach for going into this really is to let the tribes lead the research that's needed. So what I do when I'm there is based on what their needs are. And so yes, my specialty may be in permafrost science, but if the needs come out that, you know, there's—the ground is sinking and this is then impacting water quality, then I try to make this happen.

And, as Ms. Metcalf mentioned, there's been a real challenge for the tribes getting information back to them, so any information that is collected, it belongs to the tribe, it's driven by the tribe, and it's for their information in terms of helping them making decisions for moving forward.

Mr. TONKO. Thank you. And my time is just about up, but I'll ask that all of our witnesses consider any recommendations that you could share with us as a Committee for making Federal funding more accessible for Arctic research, and perhaps provide that to us in writing since I have just seconds remaining.

OK. With that, I yield back, Madam Chair.

Ms. STEVENS. Well, thank you to our very dedicated Committee Member, Mr. Tonko, for those 5 minutes of questioning.

And with that, we're going to turn it over to Ms. Kim for 5 minutes of questioning.

Ms. KIM. Thank you very much. I want to thank our witnesses for appearing before us today and answering our questions and, you know, discussing this very important topic.

I know you just talked about—Dr. Natali, about the permafrost emissions and all that so—but I—for my better understanding, I want to continue on that line of questioning. In your testimony, you call for increasing data coverage in space and time and better connecting the measuring and modeling communities to reduce uncertainty in climate monitoring and modeling. So in recent years, we have seen the innovative carbon and methane emission detection technologies come forward in the oil and gas sector. So can you talk more about the Woodwell Climate Research Center, how it is leveraging new and emerging technologies like these to improve permafrost emissions tracking, as well as those barriers to deploying those technologies?

Dr. NATALI. Yes, thank you, Representative Kim, for your question. One of the challenges of working in the Arctic is that it's dark and it's cloudy, and this makes it a real challenge for using some types of satellites to detect changes that are happening on land. The other issue with using satellite data, say, for detecting greenhouse gas emissions from thawing permafrost is that they're currently tuned to detect peaks, very, very high spikes that, say, that may be coming out of gas and oil industry, less so tuned for this very, very large area where emissions from a very—you know, one area itself may be relatively low, but it's this sort of cumulative effect over this large area.

And so that's one of the real big challenges and barriers, say, for using remote technology for detecting what's happening on the ground, which is why we are working to set up on-the-ground mon-

itoring. And then we use satellite data to, what we say, upscale that information. And then we are also working to link that information into process models to make sure that the monitoring information—monitoring and modeling are communicating with each other because that currently, surprisingly, is not the case. The scientific communities tend to kind of get separated when when we're working by discipline and also just by methodology. And so this is key for us. It's a—called a data model simulation and it's a process that's used by the weather forecasting community. It's made our weather forecasts much better. And so we're working on a new data model assimilation framework for carbon cycling for the Arctic.

Ms. KIM. Thank you so much. I'd like to ask the next question to all three doctors, Hinzman, Sfraga, and Dr. Natali. In your testimonies, you also emphasized the need for international research and scientific collaboration in the Arctic. And you also share concerns regarding the barriers to future science collaboration and explicit restrictions on data sharing and financing of foreign investigators, right? So in your opinion, how can we best navigate those transnational collaboration on scientific and advancement in the Arctic amid the ongoing geopolitical tensions, as well as future conflicts that may arise? And how do we balance protecting our U.S. national security and our allies and promoting scientific collaboration with adversaries like Russia?

Dr. HINZMAN. Thank you, Representative Kim. That's, again, an excellent question. So I would like to go back to what Dr. Sfraga said earlier, sorry if I steal your thunder, Mike. But the collaborative research that we've had with our international partners has been just a cornerstone of our international relationships of our partnerships. And so the—even now, we anticipate, we expect, we hope that this conflict in Ukraine will end. And following that, that the scientific collaborations will, again, open the door for better scientific relationships, and hopefully better policy relationships among our nations.

At the same time, we do—we must protect our intellectual properties, we must protect our capabilities, but we can also benefit by sharing our expertise and sharing our understanding. And so hopefully, these partnerships, these collaborations can open that door for that better policy relationship.

Ms. KIM. Would you like to chime in?

Dr. NATALI. Data sharing is—I have to say, has been a problem for a long time now. As a U.S.-funded scientist, all of my data are publicly shared. That's required from the Arctic funding agency. It's very challenging to get data from other nations and I would say particularly Russia, and this has been for a while now. So the solution to that, I don't know what the solution to that is. You know, as a scientist, I work one-on-one with other scientists, and we collaborate and we share data. At some point, it would be great to see a top-down effort to encourage data sharing, to encourage—you know, bringing equipment in and out across nations is also another challenge. So just really recognizing sort of that these boundaries are creating a barrier for scientists trying to work across the Arctic and to come up with a pan-Arctic answer to some of these issues.

Ms. KIM. Do we have time to listen from—Dr. Sfraga, would you like to chime in?

Dr. SFRAGA. Oh, thank you very much. I'll make this—hopefully make this brief. Again, encouraging the international cooperation with allies and partners, as I noted before, but we should not underestimate the power that—and expertise that other countries bring to the table, countries that believe in a rules-based order like Japan, South Korea, the United Kingdom. The EU has a Horizons Europe Program with a significant investment being made in Arctic research.

In aggregate, when you look at all of that together with the United States in a leadership role here, you can leverage the expertise and focus the Arctic research that needs to get done not just for a nation-state, but also for the entire Arctic region by encouraging that, by the United States communicating its interest in continued leadership, but also these international cooperations and partnerships. I think that would be responded to well, but also with U.S. leadership, areas in which we believe to be important, I know many other nations do as well, and encouraging these international partnerships going forward would be helpful.

I would also note that the United States is a part of the International Science Cooperation Agreement signed through the Arctic Council. That will—that has been helpful, but it has not solved the problem of at least data and assets crossing borders, as Dr. Natali has noted, but it is helpful to know that there is an agreement in place. It will not help us with the information in and out of Russia at the moment, but the international community continues to try to think pan-Arctic.

Ms. STEVENS. Thank you. And with that, we're going to hear from Dr. Foster for 5 minutes of questioning.

Mr. FOSTER. Thank you, Ms. Chair.

Ms. Metcalf, I have some questions related to sort of demographic trends and particularly in Inuit areas. Are the Inuit areas, for example, facing the same sort of—in Russia facing the same sort of demographic collapse that the rest of Russia is facing? Or is it—is there a fairly uniform situation around the Arctic? And how are they—these demographic trends likely to be impacted by climate change? And what's the sort of range of opinion on how to support the population under different climate scenarios going forward? Has there been, you know, some scenario planning done for what the future will look like, depending on how well we deal with this?

Ms. METCALF. Well, I hope so. Thank you for that question. Well, the Arctic Council has stated that the Arctic should be a conflict-free zone, so that's what we hope would be emphasized. The Inuit Circumpolar Council, which is a permanent participant to the Arctic Council, recognizes that and really emphasize that the Arctic is supposed to be a conflict-free zone. We do have people across the waters that are our family and friends and neighbors, and they are living in Russia's Chukotka Peninsula. We maintain that relationship, despite the differences or despite the politics. We hope that research continues to be conducted because this—we share the same resources that they do. Marine mammals have no boundaries,

but we have a very straight region that separates us, so I hope this is a good answer for you. Thank you.

Mr. FOSTER. Yes, and, Dr. Natali, you mentioned relocation as—you know, what sort of scenario planning has been done for relocation if, you know, we have 5 or 50 feet of sea level rise? What does that do? Has that been looked at in any detail about how this is going to play out?

Dr. NATALI. I think on the Federal level, there perhaps might be others here who may want to comment on this. But my understanding of this is that there's limited Federal governance framework for addressing relocation and other adaptation needs related to climate change in the Arctic or anywhere else in this country, so I think this is something that is a very high priority. This would involve teams of Arctic residents, of scientists, decisionmakers, engineers, and policymakers because, right now, in addition to the really difficult environmental challenges that are happening, there are major, major policy barriers to communities who are having to make these decisions about how to protect themselves from the changes that are happening right now.

Mr. FOSTER. Yes. Dr. Hinzman, are there——

Dr. HINZMAN. Yes, thank you. Thank you for that question, Representative Foster. Community relocation is very important in Alaska right now. There are—the GAO did a report on the number of communities threatened. I believe it was 23 communities are actively being threatened right now by coastal erosion or riverine erosion. Many of those communities are actively considering relocation or actively making plans, and so they're—they are working with several of our Federal agencies. The Corps of Engineers is playing a very important role, the Denali Commission, Housing and Urban Development. It's—there is a very—a formal and coordinated process that is going forward to help these communities consider relocation, but it is—as Dr. Natali said, it does begin with the community. The community must come together to decide if that is in their best interest, if that is what they want to do, and then to determine the locations that would be suitable for it.

And it is, as Dr. Natali did, I agree 100 percent. It is such a complicated issue, involving biological sciences, economics, social science, engineering, and so it's a very difficult process. But we are fortunate right now that many of—the bipartisan *Infrastructure Act* is helpful. There are resources available. And I do believe also that the *IRA (Inflation Reduction Act)* will also be beneficial in this regard. Thank you.

Mr. FOSTER. Now, one of the areas where we have, I guess, sort of diverged from Russia is that they're continuing to work and develop and produce nuclear icebreakers, which are, of course, much more—they're actually one of the technologies that are—where nuclear reactors are really valuable. And then—is that something that we suffer from a lot by not having that capability in research?

Dr. HINZMAN. So Russia has many nuclear icebreakers, and they are currently planning on building more. And actually, as Dr. Sfraga mentioned earlier, China has two icebreakers, and they're considering—they're trying to develop a third nuclear icebreaker. Nuclear icebreakers do have incredibly more power. The United States research community has partnered with Russian icebreakers

in the past to do some midwinter research into the deep ice. And so it does limit our capabilities. There are, of course, many other considerations besides the value of the research or the access, and so, you know, that's a more complex question than than I'm capable of answering.

Mr. FOSTER. All right, thank you. My time is up, and I'll yield back.

Ms. STEVENS. All right, we're going to turn to Mr. Beyer for 5 minutes of questioning from the Commonwealth of Virginia.

Mr. BEYER. Thank you, Madam Chair, very much. And thank you for this incredibly important discussion and hearing.

Dr. Natali, you make the really powerful case about the dangers of the permafrost melting, you know, that it has four times the amount of carbon that humans have released since the Industrial Revolution, twice as much carbon as is in the Earth's atmosphere right now. And there were—you had a number of recommendations. The first was about lengthening the grant periods from a 3-year cycle to much longer. But overall, almost all the recommendations were about greater investment in the science, climate monitoring, research planning, data exchange, grant funding. Is anything we can actually do, not just study, but do to slow or stop the permafrost thaw right now?

Dr. NATALI. Thank you, Representative Beyer. So a really great question. I mean, the No. 1 priority I guess I would say is to—you know, we've taken great steps in the United States for reducing and planning to reduce our fossil fuel emissions, but I think the main message is that that needs to be greatly ramped up if we actually want to keep global climate below 2 degrees or 1.5 degrees Celsius. I think we also need to recognize that we've already committed to a lot of changes in the Arctic, and so the emphasis on understanding the science, I think, is really critical in order for planning and for risk assessment and for understanding both what's happening now but what's happening in a year and in 10 years and 50 years and 100 years.

So I think—yes, I mean, I think the Arctic is a challenge because really, it's a global problem. Greenhouse gas emissions from thawing permafrost impact everywhere else on the planet, but at the same time, protection of forests, keeping carbon in agricultural soils, reducing fossil fuel emissions, all of these things will impact permafrost. And, you know, permafrost, can refreeze. There are some changes that are happening that are irreversible. The carbon that's coming—or irreversible on a human timeframe, these abrupt events that are happening. But we're not at a point where we can't decide the future. We can certainly reduce the amount of permafrost that will thaw by sort of greatly increasing our ambition for mitigation.

Mr. BEYER. Thank you very much.

Dr. Hinzman, you wrote that we have had no choice but to forego the regular collegial communication that enriched our understanding of our science since the thawing of the cold war because of the war in Ukraine. Dr. Sfraga had made the same comment, I think Dr. Natali the same. You know, we're still working with Russia on the International Space Station. We know how horrific and upsetting the war in Ukraine is, but we also know that the

melting of the permafrost could change not just tens of thousands or hundreds of thousands of lives but billions of lives on Earth. Is there no case to be made that this should be the one area where we continue to work with Russia?

Dr. HINZMAN. Thank you, sir. I—that is such a difficult question, and there is no good answer in that the threats to democracy and the suffering in Europe are, you know, almost, you know, terrible and compare—and so in comparison, you know, the setback to the sciences is hard to place it on the same scale.

I do understand what you're saying as far as looking at the long-term threats to humanity with respect to the changing climate, and so that—I guess I don't believe that we can forsake our approach with respect to ceasing these collaborations with Russia to stop this terrible conflict. I think that's critically important. At the same time, I think we can work with our researchers, with our collaborators, researchers to—and with all nations to try and stop this continued emissions of carbon and the effect on the climate change and the effect that it does have on permafrost. I don't believe that the partnerships with Russia on permafrost are going to change the climate in the—over the next year or whatever it takes to end this war. Thank you, sir.

Mr. BEYER. Yes, yes, thank you. The tradeoff there, too, is not working with Russia on permafrost, is that going to be the lever that somehow ends this war? But thank you very much. And with 8 seconds left, Madam Chair, I yield back.

Ms. STEVENS. All in good faith. With that, we're going to hear from Mr. Casten of Illinois for 5 minutes of questioning.

Mr. CASTEN. Thank you, Madam Chair, and to our speakers. The challenge with being late in the session is I got to try to say something novel that hasn't been said before.

I also had the good fortune to travel with Congresswoman Ross to Iceland recently, and we met, among others, with former President Grimsson, who's now the Chairman of the Arctic Circle organization, and fascinating conversations, a lot of it well beyond the jurisdiction of this Committee. But a lot of our conversation with him was around the fact that as these sea lanes have opened up—his words, not mine—he said Russia has basically been acting like a toll collector in areas that are well beyond their international waters, but they've been allowed to block some of those areas and limit access to those areas.

And I guess my first question for you, Dr. Hinzman, is have you seen that, and has Russian access to these melting waters or limitations on access in any way interfered with our ability to do research in the region?

Dr. HINZMAN. So we have seen tremendous increase over the last—you know, over the last decade, we've seen tremendous increase of Russian traffic through the Bering Strait. The current conflict has certainly affected the Arctic research, you know, particularly the collaborations that we have with the Russians, and Russia does occupy 50 percent of the Arctic. They have, you know—most of it—or a large part of the land area, at least 50 percent of land area, more than half the population, probably more than 50 percent of the minerals. And so it does have a big impact.

The important collaborations that have ceased are the the major Arctic rivers, the biggest rivers that flow into the Arctic Ocean are coming from Russia. We no longer have access to that data. They also have important measurements on the carbon emissions, as Dr. Natali mentioned. We don't have access to that data. There are other issues, too, as far as we have—in the past, we have partnered on polar bear distributions, on walrus populations, on migratory waterfowl. And so there are so many important things that have ceased, important research activities that have ceased. But again, I believe at this time that is the appropriate course of action.

Mr. CASTEN. OK. And you've touched on this before, but from a scientific funding perspective, one of his other observations was that the United States and our allies have strategic superiority in the air, strategic superiority underneath the ice cap but increasingly, because of our lack of icebreakers, don't control the surface as much as we used to. There's a military angle to that that's outside of this jurisdiction. But can you give a little bit of color on to what the scientific community is doing to expand our access to icebreakers? Should we? Where are we limited? And what would you like to see our Committee do to try to make sure—and I hate to frame it in a militaristic sense, but there is that link to it. So your comments, thoughts, requests?

Dr. HINZMAN. Yes, thank you, Representative Casten. So I cannot address the military aspects, but I can address what the IARPC, the Interagency Arctic Research Policy Committee, and our Arctic research community is doing to help address the scientific needs of our military. So you—we did talk about the infrastructure needs before and how we're—we are trying to develop more stable infrastructure, trying to develop a better understanding of the sea properties, the ocean properties, the ocean circulation, the weather forecasting. All of those characteristics, all those scientific needs do affect our military readiness and our domain awareness for our military. And so the research that we're doing does benefit our national security.

Mr. CASTEN. Dr. Sfraga, with the time left, anything that you'd like to add on either of those questions?

Dr. SFRAGA. Yes. Thank you, Representative Casten. I would say that, back to my original testimony, which is if the Coast Guard does purchase a commercially available icebreaker and it's retrofitted, that we ensure that the scientific—the needs of our scientific and research community is placed on that research—on that vessel so that we can take advantage of that research platform. And that should go for any research—any icebreaker that the United States builds. Right now, we're lined up to hopefully have six new polar security cutters built over the next several years, maybe a decade. And the scientific community, in my opinion, their needs should be incorporated into those designs, along with other research vessels that the Nation should build. That's on the research side.

Obviously, presence is influence, and so there's two parts to your conversation with President Grimsson. One is the research capacity of the United States. Here, we can partner with other countries that do have far more icebreaking capacity and research vessel capacity than we do. We have good relations with these countries. We should continue to do that. And two is on the security side, which

is again, presence is influence in the north, whether that's with our U.S. Navy or with our United States Coast Guard.

Mr. CASTEN. Thank you all, and I yield back.

Ms. STEVENS. OK. So before we bring this hearing to a close, I want to thank and recognize our witnesses for testifying before our Committee today. We want to sincerely thank all of those dedicated to the pursuit of scientific research in the face of enormous challenges. I came into this hearing thinking ice, ice, ice, ice, ice. You know, I read a lot of articles about a world without ice, and now I'm leaving thinking permafrost, permafrost, permafrost. So thank you, Dr. Natali, and—for your contributions today. And thank you all for leaving this Committee with a program of thought on how we can go forward for our Arctic. And particularly as those who authorize on behalf of this Nation, a budget, a design, and a scope of work for the future of this Nation.

And as a reminder to everyone watching at home that, yes, the United States is an Arctic nation. And to have, you know, this great representation here today of witnesses so connected to the beautiful State of Alaska and what contributions that that State makes to our Nation is certainly quite determinative. And we have just witnessed a, you know, representation change in Alaska with the passing of Mr. Young and now the arrival of Ms. Mary Peltola, so, you know, certainly encourage you to reach out to her today as well.

But know that our Committee as a whole stands committed to what we discussed today. And thanks, you and your teams, by the way, and certainly, Ms. Metcalf, for everything you represent. We can't be doing this without our friends in the tribes and who are connected to some of the incredible origin stories of this Nation and how we do address what is changing in the Arctic going forward without all of you. And thank you, too, to Dr. Natali for your contributions on that front as well.

So the record is going to remain open for 2 weeks for additional statements from Members or additional questions. Some already made recognition that they were going to be submitting questions for the record, and so they may submit those for the 2-week period.

And at this point, the witnesses will be excused, and the hearing will now be adjourned. Thank you.

[Whereupon, at 12:05 p.m., the Committee was adjourned.]

Appendix

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Larry Hinzman

Response to Questions for the Record
Dr. Larry Hinzman
Executive Director, Interagency Arctic Research and Policy Committee
Assistant Director of Polar Sciences, White House Office of Science and Technology

Following a hearing on
"Amplifying the Arctic: Strengthening Science to Respond to a Rapidly Changing Arctic"
September 20, 2022
Committee on Science, Space, and Technology
U.S. House of Representatives

Dr. Hinzman, please provide responses to the following questions from Chairwoman Eddie Bernice Johnson:

1. Arctic research missions are often collaborative with the U.S. partnering with international scientists and conducting research on vessels flown under different flag. For example, the 2019 Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition was conducted on a German vessel, the *Polarstern*. This was an international effort with leadership by Germany, the U.S., and others. How are U.S. researchers in non-Arctic states advancing and supporting Arctic research?

Research conducted in the United States to understand the Arctic system is not concentrated in Alaska or even in a few specialty research centers. Each of our U.S. states has important connections to the Arctic and most actually maintain active and vibrant programs that together and in collaboration with the research of Federal agencies comprise the strongest network of Arctic researchers in the world. IARPC Collaborations is a networking platform that facilitates Arctic research collaborations among approximately 3500, researchers, most of whom are associated with foundations and universities across the United States. These researchers work together to address the urgent research needs identified by our Federal agencies. It is this critical confluence of expertise and facilities, and strategic leveraging of resources, data, and abilities that has enabled the remarkable scientific advancements of the past decade.

2. The Indigenous Community Engagement Specialist is a new position created by IARPC to coordinate federal research activities with local Indigenous communities in Alaska. The Biden Administration also reaffirmed the Executive Order on Consultation and Coordination with Indian Tribal Governments which charges all Federal departments and agencies to meaningfully engage with Tribal officials in development of Federal policies that have Tribal implications.

• How is the Administration planning to ensure these efforts are carried out and achieve the objectives set for them related to research?

The 2022-2026 U.S. Arctic Research Plan includes a foundational activity entitled "Participatory Research and Indigenous Leadership in Research", which is meant to undergird and infuse all of the research done under the Plan. All of the IARPC member federal agencies will be involved. The equitable inclusion of Indigenous Knowledge holders in this research plan will strengthen methods for measuring threats to community resilience and health, including but not limited to the impacts of sea level rise, coastal erosion, permafrost thaw, and other environmental changes on societies and culture, food security

and water quality, and built systems. Improvements in meaningful federal agency engagement with Indigenous and local organizations through participatory research will include mutually beneficial research involving co-production throughout the research cycle, such as identifying research questions, conducting research, developing wellness indicators, producing results, and disseminating findings together. Meaningful engagement and collaboration will lead to more relevant and timely community-based knowledge that can be used by decision-makers like health services providers and community and civic leaders.

• What additional education is needed within agencies tasked to consult with Tribal organizations on research?

Indigenous Peoples have been part of the Arctic region for millennia, and their histories, cultures, and knowledge are critical to understanding Arctic systems. Federally funded research efforts have had varying levels of success in regularly, sufficiently, and ethically including Arctic peoples. Indigenous Peoples deserve respect from researchers entering their communities, lands, and societies and should have the opportunity to benefit from the research, as well as engage in meaningful consultation. Participatory research ensures important research ideals are followed, such as free, prior, and informed consent, and that rights of Indigenous communities to self-determination, sovereignty, and data sovereignty are observed. Participatory research also supports asset-based research and co-production of knowledge with the inclusion of Indigenous Knowledge or non-Indigenous place-based knowledge in whatever way the community wants to participate. IARPC is committed to working with Federal agencies in cultivating participatory research, and protocols for respectful engagement with Indigenous communities in the Arctic.

Responses by Dr. Mike Sfraga

Questions for the Record to:
Dr. Mike Sfraga
Chair
U.S. Arctic Research Commission
Submitted by Chairwoman Eddie Bernice Johnson

1. During the U.S. chairmanship of the Arctic Council from 2015 to 2017, the Secretary of State and foreign ministers of the other seven Arctic governments signed the Agreement on Enhancing International Arctic Science Cooperation. The agreement went into effect in 2018 and is intended to facilitate access by scientists to identified areas of the Arctic belonging to other Arctic nations, access to research and facilities, and access to data. The agreement also calls on parties to promote education, career development, and training opportunities, and encourages activities associated with traditional and local knowledge. What more can be done to enhance data sharing with our like-minded partners in the Arctic and outside of the Arctic?

"What more can be done to enhance data sharing with our like-minded partners in the Arctic and outside of the Arctic?

What the US could do:

1. Provide additional and sustaining support for federal data centers and repositories (e.g., the NOAA National Centers for Environmental Information, and the NASA-supported National Snow and Ice Data Center), which are struggling with the challenges of preserving, monitoring, assessing and providing public access to the Nation's treasure of geophysical data and information. These centers provide stewardship, products, and services, from our planet, including the Arctic region. These centers are receiving unprecedented amounts of data, from many different systems, and funding for these centers is not keeping pace with their required infrastructure and support needs, which includes balancing the security of these data with public accessibility.

2. Encourage greater sharing of data by individual scientists by providing federal incentives to do so.

3. Encourage faster declassification of data for use by the scientific research community.

4. Establish a centralized federal Arctic data hub that would link to the many agency-specific efforts (e.g., the National Science Foundation (NSF) Arctic Data Center) that exist on the timescale of individual (i.e., time limited) awards, and includes data only produced by NSF-funded research programs.

5. Establish a national "Arctic Observing Network" that would be linked to a scientific observing effort of key Arctic environmental parameters.

6. Provide greater support for programs and initiatives that encourage international Arctic scientific research between US and partner nations (both Arctic and non-Arctic States) which inherently leads to cooperation, collaboration, building of trust, and enhanced data sharing. Such programs exist in the National Science Foundation, and even in State Department, which hosts the Fulbright Arctic Initiative.

What others (partners) could do:

1. Provide additional support for world data centers and repositories which are struggling with the same challenges faced by US entities.

Responses by Ms. Vera Kingeekuk Metcalf

1. The Indigenous Community Engagement Specialist is a new position created by IARPC to coordinate federal research activities with local Indigenous communities in Alaska. It is located in Anchorage. You noted in your written statement that there is one major science conference each year in Anchorage, which is very removed from Indigenous Arctic communities. How do you think the location of this new office will impact meaningful engagement? What would you recommend be done to address that impact?

I would suggest the expectations for the position should involve developing research needs assessment opportunities that are sponsored at the invitation of and in collaboration with Alaska Native organizations and communities. This will require IARPC to have funding to sponsor or co-sponsor meetings or workshops that are endorsed by ANOs. This position will need to find partnerships, build collaborations, and bring something to the table, like funding and outcomes that are relevant and useful to communities. As I mentioned, the rural regions of Alaska have the interest and occasions that might be leveraged with funding and IARPC connections to build on-going dialogue. It is important that these opportunities are repeated and normalized, which will provide deeper and more useful research recommendations.

2. I understand that co-management organizations, such as the Eskimo Walrus Commission, enter into cooperative agreements with Federal agencies to conserve marine mammals and provide co-management of subsistence use by Alaska Native organizations. What improvements can be made across the Federal agencies to ensure the research needs of EWC and other co-management organizations are met, especially in critical areas such as food security?

As you recognize, ensuring our Indigenous Food Security is what drives EWC's work, so any research that increases our knowledge of the health of the Pacific walrus population is important. This research seems to be well-funded and generally directed properly. However, I would emphasize the responsibility of science to present their projects and to explain and interpret their findings in a useful way to EWC commissioners and communities. This must be required of projects funded by Federal agencies, so communities can understand and apply this information to their planning and decision-making. Additionally and perhaps more importantly, on-going community-based and -directed research on Indigenous Food Security concerns and issues must be funded. These projects are critical to identifying needs to support Alaska Native resilience to climate change, which I believe is grounded in our Indigenous Food Security that provides us economic sustainability, cultural continuity, social well-being, and spiritual foundation. I honestly think that these projects would offer insights and guidance that are currently not being explored.

3. For Native Alaskan and Indigenous Peoples of the Arctic, subsistence farming, hunting, and whaling is a way of life, a cultural identity, and means for providing for one's family and community. The NSF-funded *Sikuliaq* research vessel has an agreement in place with several whaling organizations to mitigate interruption of subsistence activities during harvesting time. Are there any other subsistence or cultural activities that would benefit from similar agreements with the research community to mitigate disruption in local communities?

This is a concern of coastal communities with ship traffic and activity, in general. Certainly research vessels should all be aware and apply contact avoidance protocols for subsistence activities. Whaling represents the most obvious example of an Indigenous harvest activity because of its comparatively large effort during a relatively defined period of time. The harvest

of other marine mammals, like walrus, belugas, and ice seals, is perhaps more variable and spread over longer periods of open water. This is why our communities remain vigilant and wary of all ship traffic. The US Coast Guard partnered with ANOs to form with private funding the Arctic Waterways Safety Committee to address concerns related to ship traffic, which could be considered as a model for future cooperation. Advance notification, public identification, and on-going communication between research vessels and communities should be normal business practice. Also, EWC collaborates with USFWS to provide Indigenous participants on walrus-related field research, which benefits science with Indigenous expertise and communities with exposure to scientific methods. Where possible, I would recommend funding and involving Indigenous participants in fieldwork when appropriate.

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