2019 Annual Report on the Implementation of the Arctic Research Plan 2017-2021

Report to the Interagency Arctic Research Policy Committee[1]

The 2019 annual report highlights activities of the IARPC Collaboration Teams that address the policy drivers outlined in the Arctic Research Plan 2017-2021 (hereafter the Plan). Consistent with U.S. Arctic Region Policy[2], the policy drivers for the Plan are:

(1) Enhance the well-being of Arctic residents;
(2) Advance stewardship of the Arctic environment;
(3) Strengthen national and regional security; and
(4) Improve understanding of the Arctic as a component of planet Earth.

The research conducted to implement the Plan in support of these policy drivers is coordinated by nine Collaboration Teams[3] each supporting one of nine research goals. The Plan does not attempt to cover all Arctic research supported by the Federal Government. Rather, it addresses key topics for which an interagency approach is most likely to accelerate progress. The nine goals and their corresponding Collaboration Teams are:

(1) Enhance understanding of health determinants and improve the well-being of Arctic residents (Health & Well-being Collaboration Team – HWCT)
(2) Advance process and system understanding of the changing Arctic atmospheric composition and dynamics and the resulting changes to surface energy budgets (Atmosphere Collaboration Team – ACT)
(3) Enhance understanding and improve predictions of the changing Arctic sea ice cover (Sea Ice Collaboration Team – SICT)

[1] IARPC is a National Science and Technology Council sub-committee of the Committee on Environment. The Federal agencies comprising IARPC are: Department of Commerce (DOC), Department of Defense (DOD), Department of Energy (DOE), Department of Health and Human Services (HHS), Department of Homeland Security (DHS), Department of the Interior (DOI), Department of State (DOS), Department of Transportation (DOT), Environmental Protection Agency (EPA), Marine Mammal Commission (MMC), National Aeronautics and Space Administration (NASA), National Science Foundation (NSF, Chair), Office of Management and Budget (OMB), Office of Science and Technology Policy (OSTP), Smithsonian Institution (SI), and United States Department of Agriculture (USDA). Other agencies also contribute to implementation of the Arctic Research Plan.
[2] National Security Presidential Directive/NSPD 66, Homeland Security Presidential Directive/HSPD 25: Arctic Region Policy, The White House, Washington DC, 2009

[3] Health and Well-being Collaboration Team (HWCT); Atmosphere Collaboration Team (ACT); Sea Ice Collaboration Team (SICT); Marine Ecosystems Collaboration Team (MECT); Glaciers & Sea Level Collaboration Team (GSLCT) Permafrost Collaboration Team (PCT); Terrestrial Ecosystems Collaboration Team (TECT); Coastal Resilience Collaboration Team (CRCT); Environmental Intelligence Collaboration Team (EICT); Arctic Observing Systems Collaboration Sub-Team (AOOST); Arctic Data Sub-Team (ADST); Modeling Sub-Team (MST)

(4) Increase understanding of the structure and function of Arctic marine ecosystems and their role in the climate system and advance predictive capabilities (Marine Ecosystems Collaboration Team – MECT)
(5) Understand and project the mass balance of glaciers, ice caps, and the Greenland Ice Sheet, and their consequences for sea level rise (Glaciers & Sea Level Collaboration Team – GSLCT)
(6) Advance understanding of processes controlling permafrost dynamics and the impacts on ecosystems, infrastructure, and climate feedbacks (Permafrost Collaboration Team – PCT)
(7) Advance an integrated, landscape-scale understanding of Arctic terrestrial and freshwater ecosystems and the potential for future change (Terrestrial Ecosystems Collaboration Team – TECT)
(8) Strengthen coastal community resilience and advance stewardship of coastal natural and cultural resources by engaging in research related to the interconnections of people, natural and built environments (Coastal Resilience Collaboration Team – CRCT)
(9) Enhance frameworks for environmental intelligence gathering, interpretation, and application toward decision support (Environmental Intelligence Collaboration Team – EICT). EICT has three sub-teams:
    - Arctic Observing Systems Sub-team (AOSST);
    - Arctic Data Sub-team (ADST); and
    - Modeling Sub-team (MST)

The Plan is implemented using the collaborative framework of IARPC Collaborations[4], which brings together Federal government researchers and program managers to address Arctic research challenges in collaboration with academic researchers and others outside the Federal government, and where each Collaboration Team has a leadership group comprising at least one "Fed" and one "non-Fed".

For each team, a 2019 annual report and a summary of progress on performance elements was prepared by the Federal government Collaboration Team leaders and is available on the IARPC Collaborations website. What follows are highlights from those annual reports that address how the teams have responded to the Plan's four policy drivers.

(1) Enhance the Well-being of Arctic Residents

Principles for Conducting Research in the Arctic: In November 2018, the IARPC Principals approved new Principles for Conducting Research in the Arctic. Researchers working in the Arctic have a responsibility to respect local culture and knowledge and advance stewardship of the Arctic environment. The original principles, released in 1990, were revised to strengthen guidelines for the conduct of research, to better align with U.S. Arctic policy, to incorporate the latest advances in research methods, and to reflect expanded research efforts and disciplinary breadth. Several collaboration teams contributed to this effort, with team leaders from the CRCT contributing significant support.

Mental Health: The HWCT advanced several initiatives to improve Alaskan Native mental health, including the new toolkit from RISING SUN (Reducing the Incidence of Suicide in Indigenous Groups – Strengths United through Network – an activity arising from the U.S. chairmanship of the Arctic Council). In addition, the team highlighted the work of ANCHRR (Alaska Native Collaborative Hub for Research on Resilience), which conducts resilience focused research as a way to understand how to increase community health and strategically strengthen institutions and programs to prevent suicide and other

[4] IARPC Collaborations: www.iarpccollaborations.org

associated issues. This project works to integrate community needs; is driven, supported, and led by communities; and seeks to understand strength-based approaches at a community level.

One Health: Zoonotic diseases are those that can be transferred from wildlife species to humans, which is an emerging issue in northern regions with warmer temperatures. Wildlife pathogens and vectors common to more southerly latitudes may become more common in the Arctic. In March of 2019, the CDC hosted a One Health Zoonotic Disease Prioritization Workshop in Fairbanks, Alaska, which brought together tribal and agency partners to rank zoonotic diseases important in the State of Alaska that could be approached through a multi-sectoral One Health perspective. The workshop was invaluable for providing a forum where Alaska Indigenous partners could voice their concerns about zoonotic diseases and make known their priorities to ensure the health and well-being of rural residents.

Helping to Inform Decision Making in the Alaskan Arctic: Rapid and significant changes were witnessed in the Bering Sea in the summer of 2018 and 2019. These changes were characterized by warmer ocean temperatures, lack of a clear temperature difference between the southern and northern Bering seas, a northerly shift in fish populations, continued die-offs of seabirds, and an unusually early loss of all sea ice cover in the central Bering. The IARPC Staff Group, responding to concerns expressed by the IARPC Principals, has formed a Bering Sea Task Force to gather existing documentation, learn decision support needs, map needs to existing research programs and tools, and produce and convey a priority list of short- and long-term research needs to be addressed by IARPC agencies.

The rapid rate of sea ice loss in the Bering Sea in 2018 and 2019 prompted the CRCT, EICT, MECT, SICT and the Field Operations Working Group to actively engage the research community to identify resources that could provide timely information. Cross-disciplinary discussions emphasized efforts to better coordinate fieldwork observations and leverage research activities during upcoming funded cruises. Also, developing useful and improved ice forecasting products for Arctic stakeholders remains an ongoing effort of the SICT. DOD has sponsored research on co-producing sea ice tools to improve situational awareness and crisis response in the Arctic. The research provides insight from stakeholders, including marine operators and responders, subsistence users, and service providers on needs for a sea ice notification system using real-time observations.

Building Resilience in Alaskan Arctic Communities: In cooperation with the Aleutian Pribilof Islands Association (APIA), the Alaska Center for Climate and Arctic Policy (ACCAP), the Scenarios Network for Alaska + Arctic Planning (SNAP), and the International Arctic Research Center (IARC), TECT members launched a series of trainings focused on building resilience in communities. These workshops highlight both the role of science in local decision making, as well as the need to fully incorporate local observations and perspectives into the scientific process.

Indigenous and Community Perspectives: In June 2019, multiple IARPC Collaboration Team leads and staff met in Anchorage, Alaska, to strengthen existing collaboration and strategize on emerging and persistent topics in the Arctic deserving of engagement. A key feature of this meeting was highlighting Alaska Indigenous and community stakeholder perspectives that IARPC Collaboration Teams and staff need to consider as we develop communication and research plans.

(2) Advance Stewardship of the Arctic Environment

Understanding Impacts of Sound in the Marine Ecosystem: The MECT is advancing interagency collaboration around marine sound from anthropogenic and biological sources in the Arctic. NOAA's Alaska Fisheries Science Center continues to record and analyze long-term passive acoustic recordings from 20 subsurface moorings deployed annually in the Bering, Beaufort, and Chukchi Seas. Arctic moorings were redeployed in 2018 and 2019. Over half of these recorders are co-located with oceanographic instrumentation from NOAA/PMEL funded by BOEM/NOAA/Navy.

Responding to Changes Brought on by Warmer Temperatures and Diminishing Sea Ice: With diminishing sea ice, warmer ocean temperatures, warmer air temperature in coastal and marine areas, and wildlife mortality events in coastal areas, harmful algal blooms (HABs) in the Arctic are becoming an urgent topic. Communities and agencies frequently request more information on testing of natural resources and subsistence foods for algal toxins, and there are frequent requests for information on potential impacts to human health through consumption of wildlife. The CRCT and EICT made efforts to ensure broad-scale communication among agencies prior to and during field seasons in the Bering and Chukchi seas. This allowed for coordinated sampling of appropriate materials to address multiple questions. They also quickly pulled together 2019 observations from rural communities and agencies for early dissemination. In December 2018, EICT Team Co-leads Molly McCammon and Emily Osborne hosted a townhall event at AGU on "Unprecedented Bering Sea Ice Extent and Impacts to Marine Ecosystems and Western Alaskan Communities," attended by more than 50 members of the research community and coastal community residents, and streamed via Facebook live to Alaska residents. EICT also hosted a 'Harmful Algal Blooms in the Bering Sea' townhall session at the January 2019 Alaska Marine Science Symposium. The MEST and SICT identified opportunities to link the sea ice modeling community with HAB researchers to explore development of models to predict future HABs.

(3) Strengthen National and Regional Security

Arctic Observing to Support National and Regional Security: A sustained Arctic observing network is critical for providing the information needed to understand the Arctic system and to improve predictive capability for emergency response and security. In direct support of the national and regional security policy driver, AOSST hosted three meetings on maritime domain awareness. The presentations and ensuing discussions at these meetings focused on the observational needs in support of national and regional security in the Arctic and the application of multi-use observing networks for both research and domain awareness. As a follow-on activity, the US Arctic Observing Network (US AON) Board (the Federal-only arm of the AOSST) began a thematic mapping exercise to link policy drivers to key objectives to identify actions with the goal of optimizing benefits of the observing system.

In FY19, ADST reviewed Federal tools, processes, and human capital needed to enhance discoverability, understanding, and interoperability of Arctic data and tools across Federal data centers. The Federal tools included a variety of state-of-the-art metadata sharing and interoperability tools available to the Arctic research community. The team reviewed current data policies and data governance artifacts from a variety of Federal agencies that support and serve the Arctic research community. Finally, the team looked at key questions from across the IARPC community and assessed whether data are available to meet these needs pursuant to the Federal Data Strategy and Action Plan. These summaries of tools, processes, and human capital will inform the Arctic Data Roadmap that is in development.

(4) Improve Understanding of the Arctic as a Component of Planet Earth

Observational Campaigns: The ACT highlighted progress related to multi-agency supported efforts associated with the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC). Included were discussions on Arctic aerosols, net contributions from a central-Arctic observatory including the impact of MOSAiC on model improvement, and linking MOSAiC observations to those from NSF, DOE and NOAA-funded observatories surrounding the Arctic Ocean through activities like Terrestrial-MOSAiC (T-MOSAiC). Through T-MOSAiC, Arctic terrestrial climate and ecosystem data will be assembled over the study year and synthesized with data from the drifting observatory (MOSAiC) to link Arctic Ocean and atmospheric dynamics to terrestrial ecosystem, water, and atmospheric processes. The unique contributions of T-MOSAiC are to expand the focus on the needs of stakeholders and identification of critical services that environmental stewardship agencies provide to society. The PCT teamed up with the TECT to expand the scope of importance and breadth of this effort.

The MECT tracked timeseries observations of the marine ecosystem, such as the Distributed Biological Observatory (DBO), Arctic Marine Biodiversity Observing Network (AMBON), and Beaufort Lagoons Ecosystems (BLE) Long-Term Ecological Research (LTER) sites which are providing information on status and change in the Arctic in response to changing environmental drivers. The DBO includes scientific efforts and objectives from multiple U.S. Federal and non-federal organizations (NSF, NOAA, BOEM, USFWS, NPRB), academic institutions, and international organizations (PAG, IASC).

Exploring Linkages between Arctic and Mid-Latitude Weather: With increased awareness of Arctic and mid-latitude weather linkages, the ACT focused on emerging scientific findings related to the Polar Vortex[5]. They explored the differences between stratospheric and tropospheric polar vortices, their increasing influence on mid-latitude weather and extreme events, and connections between these features and climate.

ICESat-2 Launch and Early Results: ICESat-2 was launched September 15, 2018 from Vandenberg Air Force Base. It continues the record of polar height data that first began with the ICESat satellite, which operated from 2003 to 2009, and the airborne Operation IceBridge (OIB) mission, which "bridged the gap" between the two satellites. The mission successes of both OIB and ICESat-2 supports this Policy Driver by providing improved sea ice data to better understand physical, atmospheric, and oceanic processes that link the changes in the Arctic to global climate. The sole instrument on ICESat-2 is the Advanced Topographic Laser Altimeter System (ATLAS), which collects elevation measurements along repeated ground tracks to reveal changes in sea-ice freeboard, from which sea ice thickness can then be inferred. After the launch in September, the SICT received an immediate update from ICESat-2 Science Team Members and also throughout the year during discussions on sea ice freeboard and thickness.

More than a trillion new height measurements from ICESat-2 are now available to the public at NASA National Snow and Ice Data Center Distributed Active Archive Center (NSIDC DAAC). Release 001 of the ICESat-2 products was on 28 May 2019. That data now span from 14 October 2018 to 3 May 2019. The

[5] The polar vortex is a large area of low pressure and cold air surrounding the Earth's North and South poles. The term vortex refers to the counter-clockwise flow of air that helps keep the colder air close to the poles. Often during winter in the Northern Hemisphere, the polar vortex will become less stable and expand, sending cold Arctic air southward over the United States with the jet stream.
(https://www.noaa.gov/multimedia/infographic/science-behind-polar-vortex.)

geolocation of these data is accurate to ~10 m, frequently even less. An initial paper comparing ICESat-2 sea ice elevation and freeboard data products with OIB coordinated underflights was published in Geophysical Research Letters.

Improving Models: The MECT cooperated with the MST to host a two-part discussion of improving integration among the observational science and modeling communities to improve ecosystem models that include biogeochemistry. The discussion focused on current capabilities of models and opportunities for observations to contribute to model development and validation. The discussion included program managers from several agencies that fund modeling and the collection of observations and the discussion provided information about needs for future investment.

The ACT and MST hosted a joint meeting focused on the Polar Amplification Model Intercomparison Project (PAMIP). Efforts are underway to enhance interagency coordination for numerical model development, evaluations, synthesis, and verification that enhances predictability and the understanding of important processes in the context of the broader Arctic system.

In order to improve prediction of permafrost processes in a warming climate, a proposed first-step future product discussed by the PCT is to generate a survey for data holders and users on metadata related to ground ice prior to trying to synthesize the data themselves. The group discussed leveraging T-MOSAiC, NASA-ABoVE (Arctic Boreal Vulnerability Experiment), Rapid Arctic Transitions due to Infrastructure and Climate (RATIC), and other activities to maximize access to potential data holders. Because of the international interest in this topic, the PCT discussed moving this effort forward in the coming year by creating a working group focused on refining ground ice maps and regional responses to abrupt thaw of ice-rich permafrost through the International Permafrost Association and/or the Permafrost Carbon Network.

Improved Process Understanding and Modeling of the Greenland Ice Sheet (GrIS) and Arctic Glaciers: The GSLCT held meetings to bring together modelers and observationalists from several disciplines in Earth Science to address outstanding atmospheric, subglacial, and operational questions concerning the present state and future of the Arctic cryosphere. Federal and academic scientists discussed the challenges of projecting the future of the GrIS, and ice-sheet modelers were exposed to the complexity and variability of sub-daily radiative forcing and sediment discharge across the GrIS. The GSLCT and MST held a meeting in late March to summarize ongoing work for the Ice Sheet Model Intercomparison Project (ISMIP), a set of numerical experiments using dynamical ice sheet models to understand the GrIS contribution to global sea level under various scenarios.

The USGS's Landsat-8 satellite and NASA's Operation IceBridge airborne mission both continued to survey the Arctic cryosphere in detail this past year. NASA's GRACE-FO and ICESat-2 satellites, launched last year, will soon generate more detailed measurements of the mass balance of Arctic glaciers and the Greenland Ice Sheet. USGS has extended its Benchmark Glacier program to include a fifth glacier (Lemon Creek Glacier), and published reanalysis results that reveal surprisingly consistent mass loss and climate forcing across maritime and continental glaciers. Multiple NSF projects are exploring the long-term glacier behavior and glacier mechanics in the Arctic and near-Arctic. The Polar Geospatial Center released its final version of the high-resolution Arctic Digital Elevation Model (ArcticDEM), which enhances international collaboration by ensuring that a consistent pan-Arctic surface-elevation database is freely available to all.

Conclusion

Over the past year, the IARPC Staff Group and Collaboration Teams have promoted communication, coordination, and collaboration on research activities among agencies and with external partners in an effort to better understand the Arctic. The work of the Collaboration Teams has focused on implementing the Plan and taking actions to address performance elements under their purview. At the same time, they are identifying new, emerging, and critical issues meriting the attention of the research community and seeking responsible ways to communicate with and gain perspectives from Alaska Native and rural community members.

Additionally, in 2019, the IARPC Staff Group stood up the Bering Sea Action Team (described above) and the Diversity and Inclusion Self-forming Team to promote a diverse and inclusive science workforce of the future. In addition, an IARPC STEM Education Working Group is developing a white paper to address the linkages and gaps between Arctic STEM education and the Committee on STEM Education's decadal plan as well as plan two listening sessions and a workshop in Alaska to understand best practices in STEM education in the Arctic. The IARPC secretariat continues to host a well-reviewed interdisciplinary science communications workshop through its ground-breaking website, IARPC Collaborations.

In September 2019, the IARPC Principals approved the timeline and launch of the development of the next Arctic Research Plan with an expected delivery in the fall of 2021.