

Federal Strategic Document Synthesis Narrative

Introduction

The Federal Strategic Document Synthesis (Federal Synthesis) is a synthesis of research priorities identified in public facing federal strategic documents published between 2014 and 2020. Documents include strategic plans, action and implementation plans, priority documents, research program goals and objectives, and high level reports including the USARC Goals Report. The purpose of the Federal Synthesis is to summarize Arctic research priorities and identify cross-cutting themes across agencies. The Federal Synthesis is complemented by three additional syntheses that highlight Arctic Research Priorities at the state, northern community, and international level. Individually, these syntheses provide insight into research priorities in each sector, collectively, they seek to highlight themes that exist across all four sectors.

How to Use the Synthesis

The Federal Synthesis is not a document created by federal agencies. It is a survey of recently released strategic documents and may not fully represent the full suite of current research priorities. Additionally, the documents in the synthesis were not intended specifically as input to the development of the Arctic Research Plan. The Federal Synthesis should be used as a resource to aid workshop participants and drafting teams in the development of the next Arctic Research Plan. It should not be used as the definitive guide on federal Arctic research priorities. The Federal Synthesis should be used in tandem with the synthesis of federal input specific to the Arctic Research Plan ("federal agency input synthesis") which is a summary of input provided by IARPC departments and agencies and submitted in June 2020. The federal agency input is consolidated at the agency level whereas this Federal Document Synthesis contains documents and considers plans from the bureau level. The information in the federal agency input synthesis is more current than the information found in this Federal Synthesis

Federal Synthesis Thematic Overview

The Federal Synthesis identifies major cross-cutting themes that permeate across agencies as well as themes shared by multiple agencies. Major cross-cutting themes include environmental change, hazard mitigation, infrastructure, and energy development.

Environmental Change: Understanding the drivers and impacts of environmental change underlie many of the themes presented throughout the Federal Synthesis. At a global scale this includes an increased understanding of high latitude systems and their global impacts.

Emissions and Pollutants: There is a need for increased research and tracking of emissions and pollutants accelerating Arctic change impacts on human health. This includes the impact of black carbon and methane as well as a better understanding of the production and fluxes of carbon dioxide and methane from Arctic wetlands to improve climate projections.

Monitoring, Observing and Forecasting: Increased forecasting to better understand global influences, consequences and opportunities of Arctic change as well as increased observation of oceanic, terrestrial and climatic processes and changes. Technological advances are needed for surveying and conducting Arctic research including unmanned aerial systems and technological advances in tagging approaches. Throughout all monitoring, observing, and forecasting there is the need for Increased engagement with local residents to co-produce knowledge.

Erosion, Permafrost and Infrastructure: An increased understanding of the drivers and impacts of erosion (riparian and coastal) and permafrost thaw. The comprehensive mapping of shorelines and soil profiles as well as increased analysis on flood risk and impact. Increased monitoring and identification of practices to slow thaw and erosion as well as identification of community expansion areas that will minimize the potential for impacts of thaw and erosion on infrastructure. Increased research on the impact of permafrost thaw and erosion on infrastructure including identifying climate resilient infrastructure, research on how infrastructure across sectors (including building, energy, communication) can evolve with Arctic change, and identifying major infrastructure gaps that should be identified to promote safe and sustainable Arctic communities.

Energy Development, Shipping, Hazard Response and Mitigation: Increased understanding of oil and gas potential on the North Slope as well as an increased regional and synthesized understanding of the cumulative effect of climate change on development activities. Research to support contingency planning, oil spill impacts and response, and hazard mitigation. Improved Arctic modeling and understanding of vessel activity as well as identification of low-impact shipping corridors.

Ecosystem Changes, Species Management, and Sea Ice: Need for increased sea ice forecasting as well as understanding of the impacts of sea ice changes. Increased monitoring and understanding of marine, coastal, and terrestrial ecosystems changes (including tundra processes) at a broad level as well as at the species level. Characterization of key habitats and food web dynamics, increased monitoring of species populations, invasive species, productivity and demographic changes, as well as impacts of development on wildlife and improved species management through co-production of knowledge. Investigations into the impact and causes of harmful algal blooms on species as well as across the food web including on human health and increasing early detection techniques. Expand coastal data collection and leverage innovation in mapping technology development.

Fisheries: Increased understanding of fisheries changes occurring with climate change, impacts of fishing, community vulnerability to fisheries changes as well as the impact of development on fisheries.

Community Health: Better understanding and supporting mental health challenges as well as an increased monitoring and understanding of emerging diseases. Increased understanding of health impacts from landfills, lack of adequate access to in-home water, and development impact on

subsistence resources. There is a need for data collection on the status of Alaska Indigenous languages as well as research that assesses the effectiveness of programs that teach Indigenous languages.

International Cooperation: A need to strengthen partnerships in research through bilateral and multilateral research cooperation as well as through specific mechanisms such as the implementation of the Central Arctic Ocean Fisheries Agreements and the Arctic Science Cooperation Agreement.

Education: Research on the effectiveness of formal and informal education activities as well as on the methods and impact of dissemination of STEM research results.

Convergence: A need for the formation of collaborations for convergence research in the new Arctic as well as convergence research approaches to understand the complex relationship between Arctic residents and their natural and cultural landscape.

Technology: Increase use of new technologies to collect data and conduct research including cloud technology, unmanned systems, artificial intelligence, and 'omnics.

Documents from:

1. U.S. Army Corps of Engineers
2. Environmental Protection Agency (EPA)
3. Bureau of Ocean and Energy Management (BOEM)
4. Center for Disease Control (CDC)
5. Department of Homeland Security (DHS)
6. Department of Defense (DOD)
7. Department of Energy (DOE)
8. DOE (Atmospheric Radiation Measurement Climate Research Facility)
9. DOE (High Latitude Application and Testing of Earth System Models)
10. DOE (National Strategy for the Arctic Region)
11. Department of Transportation (DOT)
12. National Aeronautics and Space Administration (NASA)
13. Navy
14. National Institute of Health (NIH)
15. National Oceanic and Atmospheric Administration (NOAA)
16. North Pacific Fishery Management Council (NPFMC)
17. National Science Foundation (NSF)
18. Smithsonian Institution (SI)
19. Department of Defense; U.S. Committee on the Marine Transportation System (DOT)
20. United States Arctic Research Commission (USARC)
21. United States Coast Guard (USCG)
22. United States Global Change Research Program (USGCRP)
23. United States Geological Survey (USGS)
24. United States Executive Branch (White House)
25. North Pacific Research Board (NPRB)

Cross Cutting Themes:

Cross cutting themes are themes that emerge across and exist within the individual themes listed below. Cross-cutting themes are not in prioritized order.

- Environmental Change
- Hazard mitigation

¹ This document was prepared by Sorina Stalla for the Plan Development Steering Group

- Infrastructure
 - Energy development
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Themes:

Themes are not in prioritized order.

- Energy Development
 - Oil Spill Response and Mitigation
 - Infrastructure
 - Permafrost
 - Erosion
 - Community Health
 - Harmful Algal Blooms
 - Safe Shipping
 - Co-Production
 - Species Management
 - Fisheries
 - Sea Ice/ Marine Ecosystems & Coastal Ecosystems
 - Terrestrial Ecosystems
 - High Latitude Systems
 - Observing and Forecasting Arctic Change
 - Emissions
 - Technology
 - International Scientific Cooperation
 - Education
 - Convergence
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Energy Development

- Better understand oil and gas potential of Alaska's North Slope, with specific foci on petroleum systems that exist beyond the outer continental shelf area and under the continental slope ([USGS](#))
 - Identify the resource potential of gas hydrates via production testing field experiments ([USGS](#))
 - Detailed geologic mapping to better understand the distribution and resource potential of minerals and to develop new databases for mineral resource analysis ([USGS](#))
 - Marine acoustic research and assess energy development in the Arctic ([Navy](#))

- An increased regional and synthesized understanding of the impacts of climate change and how climate change effects will interact with outer continental shelf activities ([USGS](#)) ([BOEM](#))
 - Physical parameters, such as storm frequency and intensity, and circulation patterns ([USGS](#))

Energy Development	U.S. Geological Survey—Department of the Interior Region 11, Alaska—2019 Annual Science Report	USGS
	USARC Goals Report	USARC
	Navy Strategic Outlook for the Arctic	Navy
	An Evaluation of the Science Needs to Inform Decisions on OCS Energy Development in the Chukchi and Beaufort Seas, Alaska	USGS
	BOEM Alaska Annual Studies Plan FY 2020	BOEM

Oil Spill Response and Mitigation

- Research to support contingency planning, oil spill response, and hazard mitigation ([DHS](#))
 - Models to support disaster response: Oil Spills in Arctic Ocean environments and Storm Surge ([DHS](#))
- Increased oil spill studies to understand oil spill impacts
 - Induced polarization to characterize oil spills within sea ice conditions ([DHS](#))
 - More information about hydrocarbon-consuming organisms resident in the Arctic ([BOEM](#))
 - Understand impact to Arctic mussels and copepods for oil spill modeling ([DHS](#))

Oil Spill Response and Mitigation	ADAC Summary Support to Arctic Science	DHS
	BOEM Alaska Annual Studies Plan FY 2020	BOEM

Infrastructure

- Fundamental science and engineering research in forward-looking, sustainable, adaptable, and resilient infrastructure to meet current and future challenges of a changing Arctic ([NSF](#))
- Research on permafrost thaw impact to built infrastructure
 - Inspect public infrastructure and a sampling of residential structures to identify distress related to permafrost ([U.S. Army Corps of Engineers](#))
 - Identify areas of drifting snow, ponded water or drainage features, impacts of structures including utilities or roadways, or any other man-made features which may contribute to thawing of permafrost ([U.S. Army Corps of Engineers](#))
 - Characterize the impacts of climate change over the next 10- and 50-year horizon on thawing permafrost and the potential interaction with engineered features ([U.S. Army Corps of Engineers](#))
- Increased research on climate resilient building Infrastructure ([USARC](#)) ([DOD](#)) ([NSF](#))

- Demonstration projects to address engineering design of Arctic infrastructure ([USARC](#))
- Research on permafrost effects to infrastructure ([DOD](#))
- Transfer knowledge from engineering research projects to design guidance documents ([USARC](#))
- Basic data on rural infrastructure and buildings needed for heat modeling (including kind of fuel and appliances used) ([USARC](#))
- More research on how energy infrastructure and how it can evolve with Arctic change
 - More research on systems specifically designed to meet Arctic challenges in new and innovative ways ([DOE](#))
 - Increased knowledge about energy storage, electric and heat hybrid systems and efficient transportation systems ([DOE](#))
 - Better understand how oil and gas production and transportation infrastructure must evolve to adapt to changing Arctic environments ([USARC](#))
 - Appropriate new technologies support small-scale integrated energy systems while concurrently improving existing infrastructure ([DOE](#))
 - Exploring the effects of climate change on communities and their existing and future energy systems ([DOE](#))
- Review U.S. Arctic maritime commercial activities to identifying major infrastructure gaps that should be addressed to promote safe and sustainable Arctic communities ([Committee on the Marine Transportation System](#))([USARC](#))
- Consider dual-use opportunities for research when planning Arctic communication infrastructure. For example, submarine fiber optic cables traditionally used for telecommunication could also be used to collect ocean observations and to detect earthquakes ([USARC](#))

Infrastructure	National Science Foundation Navigating the New Arctic (NNA) Program	NSF
	Statewide Threat Assessment: Identification of Threats from Erosion, Flooding, and Thawing Permafrost in Remote Alaska Communities	U.S. Army Corps of Engineers
	USARC Goals Report	USARC
	DoD 2019 Arctic Strategy	DOD
	National Strategy for the Arctic Region (NSAR) - 10-Year Renewable Energy Plan	DOE
	A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic	DOT

Permafrost

- Identify primary factors driving active permafrost thaw (climatic and anthropogenic) ([U.S. Army Corps of Engineers](#))
- Develop and implement a community geotechnical investigation plan that will incorporate existing geotechnical data along with geophysical data to characterize the soil profiles ([U.S. Army Corps of Engineers](#))
- Identify non-structural practices that can be locally implemented to slow or check destructive permafrost thaw ([U.S. Army Corps of Engineers](#))
- Identify potential community expansion areas which minimize the potential for adverse impacts on infrastructure over the next 50 years ([U.S. Army Corps of Engineers](#))

Permafrost	Statewide Threat Assessment: Identification of Threats from Erosion, Flooding, and Thawing Permafrost in Remote Alaska Communities	U.S. Army Corps of Engineers
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Erosion

- Map existing riverine and coastal shoreline ([U.S. Army Corps of Engineers](#))
- Identify infrastructure and cultural features that may be adversely impacted by erosion and flooding ([U.S. Army Corps of Engineers](#))
- Determine the long-term viability of the current community site based on model projections of erosion and flooding ([U.S. Army Corps of Engineers](#))
- Increase understanding of drivers and cumulative impacts of coastal erosion
 - Identify the anticipated frequency and severity of storms that may adversely impact communities ([U.S. Army Corps of Engineers](#))
 - Estimate the anticipated water surface elevation for storm surges for the 10%, 4%, 2%, and 1% annual exceedance probability ([U.S. Army Corps of Engineers](#))
 - Estimate erosion for 5, 10, 20 and 30 years into the future considering anticipated changes in climate, sea level rise, tidal data and geology ([U.S. Army Corps of Engineers](#))
- Identify and evaluate potential mitigation strategies including plans for community growth that reduces erosion impacts and effectiveness and feasibility of structural and non structural mitigation measures ([U.S. Army Corps of Engineers](#))
- Better understand drivers and impacts of riparian erosion
 - Determine historical linear erosion rates and delineate short-term threats to community infrastructure ([U.S. Army Corps of Engineers](#))
 - Identify primary factors driving active erosion (geomorphic and anthropogenic) ([U.S. Army Corps of Engineers](#))
 - Estimate flows and velocities at which significant erosion occurs ([U.S. Army Corps of Engineers](#))
 - Establish long-term erosion projections based on hydrologic and hydraulic modeling for 5, 10, 20 and 30-year horizons ([U.S. Army Corps of Engineers](#))
- Flooding
 - Collect bathymetric or river cross-section data ([U.S. Army Corps of Engineers](#))
 - Establish a tidal determination for tidally influenced areas or a base flow elevation for interior rivers ([U.S. Army Corps of Engineers](#))
 - Estimate frequency and severity of storm systems and analyze wave dynamics ([U.S. Army Corps of Engineers](#))
 - Estimate relative sea level rise ([U.S. Army Corps of Engineers](#))
 - Utilizing hydrodynamic modeling, estimate the water surface elevation for return periods of the 10%, 4%, 2%, and 1% annual exceedance probability and develop flood maps for each annual exceedance probability ([U.S. Army Corps of Engineers](#))
 - Expand Arctic coastal and river water-level observations to support flood and storm surge warnings ([Committee on the Marine Transportation System](#))

Erosion	Statewide Threat Assessment: Identification of Threats from Erosion, Flooding, and Thawing Permafrost in Remote Alaska Communities	U.S. Army Corps of Engineers
	A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic	DOT

Community Health

- Advance resilient and healthy Arctic communities and economies ([NOAA](#)) (EPA)
- Better understand health risks from landfills and improved waste management techniques (EPA)
- Better understand and support mental health in rural and Alaska Native communities
 - Develop an Alaska Suicide Surveillance Model that helps identify and provide early intervention approaches for use in rural communities. A better understanding of the full range of risk and protective factors is needed to decrease the rates of suicidal behavior among Indigenous youth ([USARC](#))
 - Improve mental and behavioral health workforce capacity in Alaska and establish Alaska-specific estimates for the number and types of mental health care providers ([USARC](#))

- Create research-informed alternative approaches to providing mental health care in remote areas, including telemedicine ([USARC](#))
- Collect data on the status of Alaska Native languages and conduct research that assesses the effectiveness of programs that teach Alaska Native languages. Provide support for the Community Online Database that monitors the status of Alaska Native languages ([USARC](#))
- Better understand emerging diseases
 - Better understand, predict, and provide surveillance for emerging pathogens and processes that may be appearing or expanding in response to climate change ([USARC](#))
 - An environmental DNA (eDNA) approach to determine eelgrass pathogen distribution in Alaska ([USGS](#))
 - Application of molecular tools for assessing the range expansion of Cryptosporidium and *Giardia* in Arctic Alaska ([USGS](#))
 - Pandemic effects: Covid-19 and Culture Change in the Arctic (SI)
 - Evaluate animal-to-human infectious threats that may be sensitive to climate change, such as intestinal giardiasis, which can be transmitted from beavers and may be moving northward in Alaska ([CDC](#))
- Use a One Health Approach to research ([NIH](#))
- Investigate the cascade of impacts experienced by those without adequate access to in-home water for drinking and hygiene, including their direct and indirect economic effects ([USARC](#))
- Better understand to what extent subsistence activities have been affected by industry infrastructure and industry activity, or may be in the future ([BOEM](#))

Community Health	NOAA's Arctic Action Plan	NOAA
	USARC Goals Report	USARC
	USGS Alaska Science Center Develops New 5-year Arctic Research Plan	USGS
	Smithsonian Arctic Studies 2020: State of the Field and Beyond	SI
	Improving Health for Alaska and Arctic Residents	CDC
	One Health	NIH
	<i>email</i>	EPA
	BOEM Alaska Annual Studies Plan FY 2020	BOEM

Harmful Algal Blooms

- Investigate algal toxins in Alaska seabirds ([USGS](#))
 - Assess the effects of saxitoxin ingestion by common murrelets ([USGS](#))
 - Understand biogeography of biotoxins in seabirds across Alaska ([USGS](#))
- Assess biotoxin accumulation and transfer through pelagic food webs in Alaska ([USGS](#))
- Increase early detection techniques for HABS in small lakes (EPA)
- Better understand causes of HABS and investigate measures for improved reduction of nutrient loading (EPA)
- Increased understanding of the adverse effects of harmful algal blooms ([NPRB](#))

Harmful Algal Blooms	USGS Alaska Science Center Develops New 5-year Arctic Research Plan	USGS
	<i>email</i>	EPA
	North Pacific Research Board Science Plan	NPRB

Safe Shipping

- Improve Arctic modeling and understanding of vessel activity
 - Improve forecasting capabilities for operational support ([Navy](#))
 - Improve predictive capabilities for the Arctic region ([Navy](#))
 - Look at potential drivers of vessel activity in the Arctic (Section II) and an analysis of past and present vessel activities in the Arctic (Section III) to inform scenario planning ([Committee on the Marine Transportation System](#))
- Big Data analytics to support NOAA bathymetric survey prioritized on vessel traffic ([DHS](#))
- Identify low-impact shipping corridors in Arctic Alaska and Canada, including routing and mitigation measures to help improve maritime safety and spill prevention ([White House](#))

Safe Shipping	Navy Strategic Outlook for the Arctic	Navy
	A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic	DOT
	ADAC Summary Support to Arctic Science	DHS
	FACT SHEET: White House Announces Actions to Protect Natural and Cultural Resources in Alaskan Arctic Ocean	White House

Co-Production

- Develop processes to guide the use of subsistence data, local knowledge, and traditional knowledge information from the Bering Sea in the Council process ([NPFMC](#))
- Scientists should engage with local residents to co-design research projects and to co-produce knowledge by gathering and incorporating community-based observations and insights ([USARC](#))

Co-Production	NPFMC: Bering Sea Fishery Ecosystem Plan	NPFMC
	USARC Goals Report	USARC

Species Management

- Improve species management through co-production of knowledge by scientists and Indigenous Knowledge holders. Recognize the important role co-management plays in informing and supporting research goals and projects ([USARC](#))
- Investigate human, animal, and climate interactions and fluctuations in key polar species. track ongoing change, providing scientific and Indigenous perspectives to inform academic and policy dialogues (SI)

- Characterize critical habitats and habitat vulnerabilities:
 - Document the use and vulnerability of critical migratory bird stopover areas ([USARC](#))
 - Ongoing need for basic research to characterize habitat features and their relationships to marine organisms including habitat mapping and sources of habitat degradation ([NPRB](#))
- Increased monitoring and understanding of species population, productivity, and demographic changes
 - Monitoring of endangered species ([BOEM](#))
 - Develop a simplified framework to assess Arctic species status, based on population size, range, behavior, and health, as a means to inform conservation and management efforts ([USARC](#))
 - Understand demographic trends of the Pacific walrus as well as body conditions and reproductive rates ([USGS](#))
 - Assessing the effects of climate-induced variability on the behavior, distribution and demography of the Porcupine Caribou Herd ([USGS](#))
 - Genomic capacity of threatened eiders in a rapidly changing environment ([USGS](#))
 - Assess possible drivers of red-throated loon productivity in the Beaufort Sea ([USGS](#))
 - Assess the population status of two rare taxa endemic to the central Bering Sea, Alaska: McKay’s Bunting and Pribilof Rock Sandpiper ([USGS](#))
 - Assessment of how any changes in the bowhead whale migration’s distance from shore could relate to subsistence success ([BOEM](#))
 - Information is needed to more fully understand how this shift to land-based haulouts affects walrus foraging behavior, diet, and energetic needs ([BOEM](#))
 - Understand species’ response to environmental changes, for which periodic population and distributional surveys could provide key data ([USGS](#))
 - Understand implications of oceanic shifts, such as whether conditions and impact on krill and arctic copepods ([BOEM](#))
- Increase understanding of energy development on wildlife
 - Characterize the cumulative effects of rapid environmental change and industrial development on the behavior and population dynamics of polar bears ([USGS](#))
 - Quantifying the response of Arctic caribou to different types of energy infrastructure and effectiveness of mitigation measures for minimizing impacts ([USGS](#))
 - Assessment of helicopter-induced disturbance on molting black brant in the National Petroleum Reserve – Alaska ([USGS](#))
 - BOEM will continue to develop specific information on the hearing capabilities of baleen whales and other marine mammals with the goal of better understanding their behavior in response to industrial noise ([BOEM](#))
- Increased understanding of physical, chemical, and biological processes that drive primary and secondary production at the base of the food web ([NPRB](#))
- Research on the biology of marine birds and mammals is of interest across a wide variety of areas, including population assessment and modeling, species distribution and movement patterns, ecology and physiology, and how human and environmental factors affect individuals and populations ([NPRB](#))

Species Management	USARC Goals Report	USARC
	BOEM Alaska Annual Studies Plan FY 2020	BOEM
	USGS Alaska Science Center Develops New 5-year Arctic Research Plan	USGS
	North Pacific Research Board Science Plan	NPRB

Fisheries

- Better understand fishery changes occurring with climate change ([NPFMC](#)) ([NPRB](#))
 - Investigate options for responding to changing environmental and climatic circumstances such as changes to fish distribution and abundance, shipping patterns, etc. ([NPFMC](#))
 - Understand impact of ocean acidification on Arctic Cod spawning habitat ([USARC](#))
 - Collect additional data on the ecology of commercial fish species to better understand growth and movements in response to warming seas ([USARC](#))
- Increase understanding and surveys of fisheries and fish stocks
 - Identify food web supports to Arctic fisheries ([USGS](#))
 - Support additional trawl surveys in the Bering Sea and north of the Bering Strait to assess fish stocks in light of shifting population localities and continue to develop camera survey techniques for untrawlable habitats ([USARC](#))
 - Spatial distribution and movement of crabs relative to life history events and fishing ([NPFMC](#))
 - Fish, crab, and oceanographic surveys in the Arctic Ocean ([NPFMC](#))
 - Stock-specific ecosystem indicators and incorporate into stock assessments ([NPFMC](#))
 - Cooperative research efforts to supplement existing at-sea surveys that provide seasonal, species specific information on upper trophic levels ([NPFMC](#))
 - Maturity estimates for Bering Sea and Aleutian Island crab stocks ([NPFMC](#))
- Fishing impacts
 - Bycatch reduction initiatives ([NPFMC](#))
 - Retrospective analysis of the impact of Chinook PSC avoidance measures on communities of western Alaska ([NPFMC](#))
- Better understanding community vulnerabilities to fisheries changes
 - Development of tools for analyzing coastal community vulnerability to fisheries management changes ([NPFMC](#))
 - Dependence and impacts of halibut management actions on communities ([NPFMC](#))
- Better understand development impacts to fisheries²
 - Potential environmental effects of OCS development on marine fish ([BOEM](#))
 - More detailed information about the biology and ecology of many marine fish species inhabiting areas of potential oil and gas activity ([BOEM](#))
 - More information regarding the effects of seismic exploration on the health, behavior, distribution, and migration of the numerous important fish species of the Beaufort and Chukchi seas ([BOEM](#))
 - More information on the forage fish resources and their relation to apex predators on the outer continental shelf ([BOEM](#))
 - Understanding of the seasonal distribution, abundance, and habitat use of forage fish, including the effects of changing temperatures and prey availability ([BOEM](#))
 - Understanding of key spawning and migration events that quickly transfer large amounts of energy to upper trophic levels ([BOEM](#))
- Increased information on species to inform fisheries management ([NPRB](#))

Fisheries	NPFMC: Bering Sea Fishery Ecosystem Plan	NPFMC
	North Pacific Fishery Management Council: Research Priorities	
	USARC Goals Report	USARC

² this is information BOEM needs, not research BOEM is leading

	BOEM Alaska Annual Studies Plan FY 2020	BOEM
	North Pacific Research Board Science Plan	NPRB

Sea Ice/ Marine Ecosystems & Coastal Ecosystems

- Increase sea ice forecasting as well as causes and consequences of reduced sea ice cover in the Arctic
 - Implement short-range, sea-ice forecasting capability ([Committee on the Marine Transportation System](#))
 - Observe and forecast sea ice ([NOAA](#)) ([Navy](#))
 - Develop more accurate sea ice forecasts that permit local governments and managers to prepare, enhancing the long-term security of residents and local economies ([USGCRP](#))
 - Work to identify best practices for building community and ecosystem resilience to the impacts of declining sea ice and help decision makers respond proactively to future changes ([USGCRP](#))
 - Predict the direction and speed of floating sea ice ([NOAA](#))
 - Increase forecasts of sea ice and queuing bathymetry surveys to improve safety of Arctic shipping ([DHS](#))
 - Create models on fine scale sea-ice characterization at various scales ([DHS](#))
 - Additional research on potential range expansion related to climate change and the intensification of shipping related to receding ice ([NPRB](#))
- Increase monitoring and understanding of marine ecosystems
 - Identify and develop interdisciplinary conceptual models of the connected Bering Sea ecosystem components ([NPFMC](#))
 - Long term monitoring - ecosystem monitoring surveys in the gulf of Alaska ([NOAA](#))
 - Assessments and reporting of living marine resources activity ([Navy](#))
 - Detect changes in ecosystem structure that could affect bird, mammal, and fish species ([NOAA](#))
- Increase understanding of ecosystem changes and ecosystem responses to climate change
 - Strengthen foundational science to understand and detect Arctic climate and ecosystem changes ([NOAA](#))
 - Support scientific exploration, monitoring, and research to increase understanding of the changing Arctic environment, associated impacts, and emergent maritime threats ([USCG](#))
 - Forecast and project the impacts of climate change on marine fish production ([NOAA](#))
 - Research programs in recruitment processes, ocean acidification, life history characteristics, fish and crab behavior, and predator-prey relationships to understand environmental forcing on focal species in the Gulf of Alaska ([NOAA](#))
 - Understand Alaska Native observations of climate change among Bering Strait communities (Smithsonian)
 - Understand the effects of ongoing and future change (warming land, loss of snow and ice) on nearshore Arctic biogeochemistry ([DOE](#))
 - Understand the key processes through which Arctic marine biogeochemistry impacts the food web in response to climate change ([DOE](#))
 - Conduct risk assessments on fish species ([NOAA](#))
 - How will reductions in Arctic sea ice and the associated changes in the physical environmental influence the flow of energy through the ecosystem in the Chukchi Sea ([NPRB](#))
 - Patterns in subsistence use and potential shifts in response to ecosystem change ([NPRB](#))
 - Physical, biological and ecological drivers and important thresholds/tipping points relevant to the distribution and life history of apex predators, species importance to subsistence, and species or species guilds critical to ecosystem function ([NPRB](#))
 - Influence of sea ice dynamics and advection on the phenology, magnitude and location of primary and secondary production, match-mismatch, benthic-pelagic coupling, and the influence of winter conditions ([NPRB](#))

- Understanding and mitigating the adverse effects of contaminants, pathogens and biotoxins, and invasive species ([NPRB](#))
- Expand Coastal Data Collection to Deliver the Priority Geospatial Products Stakeholders Require ([NOAA](#))

Sea Ice/ Marine Ecosystems & Coastal Ecosystems	A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic\	DOT
	NOAA's Arctic Action Plan	NOAA
	Arctic Research Program Objectives	
	A climate science regional action plan for the Gulf of Alaska	
	Navy Strategic Outlook for the Arctic	Navy
	United States Global Change Research Program (USGCRP): The National Global Change Research Plan 2012-2021 and 2017 update	USGCRP
	ADAC Summary Support to Arctic Science	DHS
	NPFMC: Bering Sea Fishery Ecosystem Plan	NPFMC
	Coast Guard Strategy	USCG
	Marine Biogeochemistry in the Coastal Arctic: Towards Improved Quantitative Understanding of the Controls on Marine Biogeochemical Processes in the Arctic Coastal Zone, and Their Impacts on Climate and the Food Web: A White Paper for DOE's Regional and Global Model Analysis (RGMA) Program	DOE
	NPRB: Arctic Integrated Ecosystem Research Program Integrated Work Plan	NPRB
	North Pacific Research Board Science Plan	
	MAPPING THE COAST OF ALASKA: A 10-Year Strategy in Support of the United States Economy, Security, and Environment	

Terrestrial Ecosystems

- Increase understanding of tundra processes and terrestrial ecosystems ([DOE](#))
 - Reduce uncertainty in climate prediction through improved representation of critical tundra processes ([DOE](#))
 - Identify processes likely to have the largest influence on climate, based on current knowledge of the Arctic tundra system, and define a connected (nested) hierarchy of modeling scales necessary to resolve those processes ([DOE](#))
 - Develop a quantitative scaling framework that provides effective migration of new knowledge gained through process studies and observations to inform model representations and to improve prediction of Arctic ecosystem dynamics and interactions with climate at the global scale ([DOE](#))
 - Understand what controls the vulnerability and resilience of Arctic ecosystems to disturbance and how disturbances alter the physical and ecological structure and function of ecosystems ([DOE](#))

- Investigate the underlying processes and their interactions that control vulnerability and resilience in Arctic and Boreal ecosystems of western North America to environmental change, and to assess how people within and beyond this region may respond to changes in these processes and interactions ([NASA](#))

Terrestrial Ecosystems	Next Generation Ecosystems Experiments	DOE
	ABoVE Concise Experiment Plan	NASA

High Latitude Systems

- Understand and quantify the drivers, interactions, and feedbacks both among the high-latitude components and between the high latitudes and the global system to reduce uncertainties and improve predictive understanding of high-latitude systems and their global impacts ([DOE](#))
 - Understand the roles of regional processes and feedbacks in shaping the high-latitude Earth system, its variability and trends ([DOE](#))
 - Understand how high- and lower latitudes are coupled through atmospheric and oceanic circulation cells ([DOE](#))
 - Understand the roles of interactions between land ice (i.e. ice sheets, ice shelves, and glaciers) and atmosphere and ocean on sea level rise ([DOE](#))
 - Understand the consequences of high-latitude climate change for the regional and global carbon cycle ([DOE](#))
- Increase understanding of processes involving ocean heat and freshwater and their sources and pathways into and out of the Arctic region, including their effect on global ocean circulation and stability of the global climate system ([NOAA](#))
- Increase understanding of the first order physics controlling regional circulation and ice conditions within the U.S. Beaufort and Chukchi Seas, as well as interactions with the Arctic basin and Canadian Beaufort, would inform and improve regional analyses for NEPA documents, and review of oil-spill response planning documents ([BOEM](#))
 - More information is needed to assess the impact of ice on the nature and amplitude of the upwelling/downwelling, to evaluate influences of Atlantic water and other water masses, and to gain a better understanding of the dynamics associated with river outflow plumes, especially under ice ([BOEM](#))
- Understand the role of sea ice in mediating meridional heat transports in the ocean and atmosphere ([DOE](#))

High Latitude Systems	Earth and Environmental Systems Sciences Division Strategic Plan	DOE
	High-Latitude Application and Testing of Earth System Models (HiLAT) Science Focus Areas	
	Arctic Research Program Objectives	NOAA
	BOEM Alaska Annual Studies Plan FY 2020	BOEM

Observing and Forecasting Arctic Change

- Increase forecasting to understand global influences, consequences, and opportunities arising from a changing Arctic ([NSF](#))
 - Study and forecast interdependent changes in the biogeochemical, geophysical, biological, ecological, institutional, and social processes occurring in the new Arctic, including, when appropriate, global feedbacks ([NSF](#))
 - Generate Arctic climate data-sets to support operational weather forecasts ([NOAA](#))
 - Improve weather and water forecasts and warnings ([NOAA](#))

- Improve weather, water, and climate predictions to an equivalent level of service as is provided to the rest of the nation ([Committee on the Marine Transportation System](#))
- Continue and increase observing networks and observations of Arctic changes in oceanic, terrestrial, and climatic processes
 - Continue oceanographic observations ([Navy](#))
 - Expand the general concept of a sustained Arctic observing network into an integrated, fully operational system that provides increased and timely access to data, critical information, and derived products for scientific research, as well as operational intelligence and decision support ([USARC](#))
 - Need for innovations in interoperable national and international Arctic observational networks, instruments, sensing and sensor-networking technologies; shared and open data collections; and/or intelligent data management, analysis, and/or modeling efforts ([NSF](#))
 - Install and maintain a suite of climate observing networks (ocean, sea ice, and atmosphere) in the Arctic ([NOAA](#))
 - Contribute to improvements in observing technology that improve the spatial and temporal scale of observations ([NOAA](#))
 - Increase year-round or continuous surface and subsurface biophysical observations ([DOE](#))
 - Observe timing and magnitude of terrestrial fluxes from deltas, coastal erosion, and nonpoint source input of water ([DOE](#))

Observing and Forecasting Arctic Change	National Science Foundation Navigating the New Arctic (NNA) Program	NSF
	Arctic Research Program Objectives	NOAA
	NOAA's Arctic Action Plan	
	A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic	DOT
	Navy Strategic Outlook for the Arctic	Navy
	USARC Goals Report	USARC
	Marine Biogeochemistry in the Coastal Arctic: Towards Improved Quantitative Understanding of the Controls on Marine Biogeochemical Processes in the Arctic Coastal Zone, and Their Impacts on Climate and the Food Web: A White Paper for DOE's Regional and Global Model Analysis (RGMA) Program	DOE

Emissions

- Better understand the production and fluxes of carbon dioxide and methane from Arctic wetlands to improve climate projections ([USARC](#))
- Increase pollution detection and tracking capabilities ([USCG](#))
- More information is needed to evaluate how high levels of substances such as black carbon and methane might impact climate change, as well as human health, in the region ([BOEM](#))
- Advance “attribution science”—efforts to scientifically distinguish the role of human-caused global warming from the role of natural climate fluctuations in causing individual extreme weather events, to help planners understand which extreme events are likely to increase with additional warming ([USARC](#))
- Investigate ways to reduce air pollutant emissions that form PM2 (EPA)

Emissions	USARC Goals Report	USARC
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	Coast Guard Strategy	USCG
	BOEM Alaska Annual Studies Plan FY 2020	BOEM
	<i>email</i>	EPA

Technology

- Technological advances in unmanned aircraft systems, or drones, and regulatory efforts to safely incorporate them into the nation’s airspace are quickly improving Arctic research ([USARC](#))
- Encourage agencies responsible for surveying and conducting census counts of marine and terrestrial mammals to consider advanced technologies, such as unmanned aircraft systems, to improve assessments ([USARC](#))
- The North Slope of Alaska atmospheric observatory is being enhanced through aerial measurements including routine missions using unmanned aerial systems (UAS) and tethered balloon systems (TBS) for scientific research ([DOE](#))
- Research that couples state-of-the-art geophysical observations from unmanned aerial systems with a community-engaged research approach to bridge scientific and indigenous understanding of sea ice change in the Alaskan Arctic ([White House](#))
- Efforts to further technological developments in a variety of tagging approaches, including deployment and recovery strategies ([NPRB](#))
- Leverage Innovation in Mapping Technology Development ([NOAA](#))
- Increase use of new technologies to collect data and conduct research including cloud technology, unmanned systems, artificial intelligence, and ‘omnics ([NOAA](#))

Technology	USARC Goals Report	USARC
	Department of Energy Arctic Observatories in Barrow and Oliktok Point	DOE
	FACT SHEET: White House Announces Actions to Protect Natural and Cultural Resources in Alaskan Arctic Ocean	White House
	MAPPING THE COAST OF ALASKA: A 10-Year Strategy in Support of the United States Economy, Security, and Environment	NOAA
	Draft NOAA Citizen Science Strategy	NOAA
	NOAA Data Strategy	NOAA
	NOAA Cloud Strategy	NOAA
	NOAA Unmanned Systems Strategy	NOAA
	NOAA Artificial Intelligence Strategy	NOAA

	NOAA 'Omics Strategy	NOAA
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International Scientific Cooperation

- Implement the Central Arctic Ocean Fisheries Agreement
 - The United States should implement the “Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean” and work with the Parties to establish a durable marine science organization to promote Arctic-focused ecosystem science and to realize the Agreement’s joint program of scientific research ([USARC](#))
- Implement the Arctic Science Cooperation Agreement.
 - The United States should implement the “Agreement on Enhancing International Arctic Scientific Cooperation” to improve cross-border access of scientists, equipment, and data. The United States should work with other Parties to develop procedures for consultation and dispute resolution. To promote coordination and consultation among US interests and stakeholders, the United States should develop internal processes and procedures, and these may assist with international implementation of the agreement ([USARC](#))
- Strengthen Bilateral and Multilateral Research Cooperation
 - The United States should pursue opportunities to strengthen bilateral research cooperation along our borders with the Russian Federation and Canada, including ecosystem level marine research and long-term monitoring ([USARC](#))
- Enhance international and national partnerships ([NOAA](#))

International Scientific Cooperation	USARC Goals Report	USARC
	NOAA's Arctic Action Plan	NOAA

Education

- Research on the effectiveness of formal and informal education activities; on methods and impact of dissemination of STEM research results; and on formation of collaborations for convergence research in the new Arctic ([NSF](#))

Education	National Science Foundation Navigating the New Arctic (NNA) Program	NSF
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Convergence

- Convergence research approaches to understand the complex relationship between Arctic residents and their natural and cultural landscape ([NSF](#))

Convergence	National Science Foundation Navigating the New Arctic (NNA) Program	NSF
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