2011 Annual Report

Arctic Landscape Conservation Cooperative

Advancing Science, Understanding Change.

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Executive Summary

Things heated up considerably during year two for the Arctic LCC, in ways that had little to do with climate change. We just about tripled our on-the-ground research and management efforts, established working relationships with a greatly-expanded community of partners, hired a full-time database manager to handle the incoming flood of information, developed policies on data sharing and project endorsement, launched a concerted effort to engage with Alaska tribal governments, and fostered some great interdisciplinary partnerships that address resource management in our changing arctic. Our new website, arcticlcc.org, made its debut, and is already hosting datasets for use by the public. We have a first generation model for thermokarst lake fate completed, and continue to participate in the largest ecosystem modeling effort in Alaska (the Integrated Ecosystem Model). Staff made at least 15 presentations on LCCs in general, or on the Arctic LCC in particular, and our partners presented many more posters and papers at numerous venues.

In 2011, about $1.4 Million of Arctic LCC funds supported 22 projects addressing climate–related issues in the Arctic. Our funds were matched by over $3.7 Million in partner contributions. These funds resulted in 13 new project starts, continued funding of six projects we funded in 2010, and accounted for Arctic LCC contributions to three projects that were ongoing, but without prior LCC partnership. About 20% of our 2011 project funds went to NGOs, with the remaining 80% divided roughly evenly among federal agencies and universities.

The Arctic LCC remains committed to addressing climate-related information needs and management issues, focusing on the terrestrial and nearshore region. Our selection of projects reflects a focus to date on increasing our understanding of how changing geophysical processes are reshaping the arctic landscape. Nevertheless, we have funded a number of studies examining climate-driven effects on some species or suites of species. While our focus to date has been primarily on the portion of the LCC within Alaska, 2011 saw us increase our activities in Canada, and our partnership with entities in Canada will likely strengthen further in 2012 as a result of our 2011 activities. Likewise, 2012 will see us more fully engaged with Alaska tribes, and, hopefully, with First Nation peoples as well.

For more information on the Arctic LCC, visit www.arcticlcc.org, or contact Greg Balogh, Coordinator at greg_balogh@fws.gov or Philip Martin, Science Coordinator at Philip_martin@fws.gov.

Accomplishments

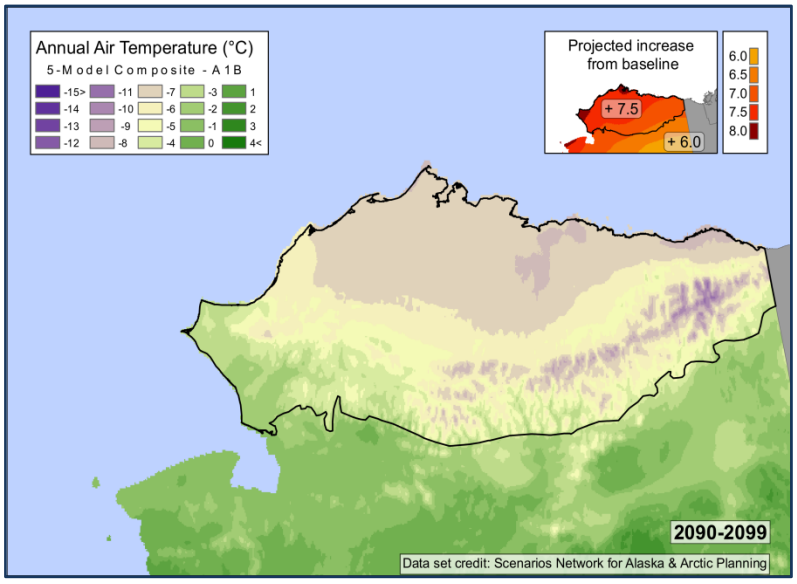
2012 marks the second anniversary of the Arctic LCC. Over the last two years, we have become firmly established, and our list of milestones continues to grow. Here are just a few of our notable accomplishments for 2011.

Arctic LCC's website goes live

Perhaps one of our most important accomplishments for 2011 was the launch and substantial population of our website, http://arcticlcc.org. The website allows resource managers, scientists, our partners, and other interested parties easy access to information about the Arctic LCC. Furthermore, the site serves as a clearinghouse for information about our projects. There, you can find details about the project, progress reports, and in some instances, data products available for download. In short, arcticlcc.org is the "one-stop-shop" for all things Arctic LCC.

Climate maps for Alaska

One objective of the Arctic LCC is to make climate science readily available to all interested parties, not just those directly involved in resource management in Alaska. Climate data, such as temperature and precipitation, are available from a variety of sources, but these data are typically in a format that cannot be used by someone who does not have specific technical skills and specialized software. Arctic LCC staff processed temperature and precipitation projections for Alaska into a series of maps that can be downloaded from our website. The maps are available in different formats that can be printed and used as handouts, used in presentations, or imported into other documents. In addition, the underlying raster data is available for analysis.



Example of a climate map produced by Arctic LCC Staff. The map represents projected average annual air temperature by the end of the 21st Century.

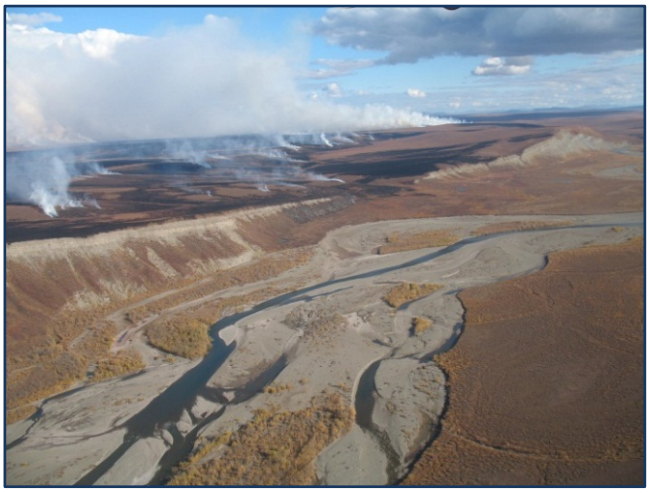
Completion of the "Thermokarst Lakes" project

Lakes of the Arctic Coastal Plain of northern Alaska provide essential habitat for many species of water birds and fish. These lakes persist because the landscape is characterized by low air temperatures and the presence of continuous permafrost. As a consequence, these habitats are vulnerable to the effects of a warming climate. As ground thaws, lake margins change. Some lakes will grow larger while others may drain. The goal of this project was to model how the distribution and abundance of lakes in the western portion of Arctic Alaska may change during the 21st Century. Project output includes a dataset that identifies lakes that are most at risk of drainage. Gathering this information is one of the first steps in assessing the vulnerability of species that rely on these unique water bodies.

A lake recently drained due to rapid erosion of the Beaufort Sea coastline. Photo courtesy of Benjamin Jones, USGS.

Alaska Integrated Ecosystem Model– Phase I

The physical and biotic components of arctic and boreal ecosystems are tightly linked and sensitive to climate change. The ability to visualize potential future landscapes depends on having a better understanding of the interplay among climate, permafrost, fire, and vegetation. Fortunately, the Arctic LCC was in a position to help pilot development of a tool designed to do just that – The Integrated Ecosystem Model for Alaska (AIEM). Building the different components of the AIEM will occur in phases, but when it is fully developed, the Principal Investigators will have produced a model that will greatly improve our understanding of ecosystem change in response to changing climate.



Tundra fire on the North Slope of Alaska. Photo courtesy of Benjamin Jones, USGS.

Establishing the Arctic LCC

Temperatures across the Arctic are warming far more rapidly than the global average, and climate projections suggest that temperature will continue to rise throughout the 21st Century. This warming has already impacted marine and terrestrial environments. Recent years have been characterized by dramatic reductions in sea ice and by powerful autumn storms along the Arctic coast. On land, permafrost is warming, summers are drier, and the growing season is lengthening. All of these changes have the potential to impact lakes, wetlands, plant communities, and the fish, wildlife, and Native villages that depend on them.

The Arctic LCC–the first operational LCC in Alaska–was established to assist land managers in addressing landscape-scale management issues, primarily those related to climate change. In 2010 the Steering Committee developed and adopted a Charter that outlines its operational guidelines. During the same year, the Steering Committee identified four priority conservation goals for the Arctic LCC:

1. Better understand and predict effects of climate change and other stressors on landscape level physical and ecosystem processes.
2. Better understand the impacts of environmental change on subsistence and cultural resources.
3. Provide support for resource conservation planning.
4. Contribute to improved data management and integration.

Copies of Charter and Arctic LCC Conservation Goals can be downloaded from http://arcticlcc.org/about.

The mission of the Arctic LCC is to identify and provide information needed to conserve natural and cultural resources in the face of landscape scale stressors, focusing on climate change, through a multidisciplinary program that supports coordinated actions among management agencies, conservation organizations, communities, and other

Arctic LCC Organizational Structure

Steering Committee

The Arctic LCC Steering Committee provides operational oversight, including establishing broad conservation goals, setting priorities, and pooling resources across participating entities to accomplish priority tasks. Committee members are responsible for keeping the group

informed of activities of interest to the ARCTIC LCC as a whole. Each committee member is also responsible for representing the views of their respective agency/entity and making decisions on its behalf (Table 1).

Table 1. Arctic LCC Steering Committee Representatives

Affiliation	*Names*
Alaska Department of Fish & Game	Douglas Vincent-Lang and Susan Rodman
Bureau of Land Management	Lon Kelly & Steve Hartmann
Bureau of Ocean Energy Management	Cathy Coon & Dee Williams
Fish & Wildlife Service	David Payer& Sarah Conn
National Oceanic & Atmospheric Administration	Amy Holman & Robyn Angliss
National Park Service	Frank Hays & Jim Lawler
North Slope Borough	Brian Person (Observer)
Point Lay Traditional Council	Willard Neakok & Danny Pikok
US Arctic Research Commission	Cheryl Rosa (Chair)
US Army Corps of Engineers, Alaska District	George Kalli & Michael Salyer
US Geological Survey, Alaska Climate Science Center	Steve Gray (Observer)
US Geological Survey, Alaska Science Center	Karen Oakley & Mark Shasby

Staff

The role of the Arctic LCC Staff is to coordinate activities of the Steering Committee, respond to requests and direction provided by the Steering Committee, coordinate among constituent agencies/entities and other partners, manage projects, maintain the website, manage data, and represent the Arctic LCC in the National LCC Network and various arctic initiatives.

Arctic LCC staff includes:

Greg Balogh, Coordinator

Philip Martin, Science Coordinator

Jennifer Jenkins, Geospatial Analyst

Joshua Bradley, Data Manager

Technical Working Groups

The only requirement for participation on an Arctic LCC Technical Working Group is technical expertise in that working group's respective field. Technical working groups advise staff and the Steering Committee on priority conservation needs and issues in their respective areas of expertise. They contribute to the science planning process, and report to the Steering Committee at the Steering Committee's request. Technical working group participants appear in Appendix A.

Partners

The Arctic LCC Partners group is comprised of any agency or organization with the capacity to further the purpose of this LCC. Our Partner's role is to provide input into development of conservation goals and science planning. Partners are especially vital in leveraging support for priority Arctic LCC research,

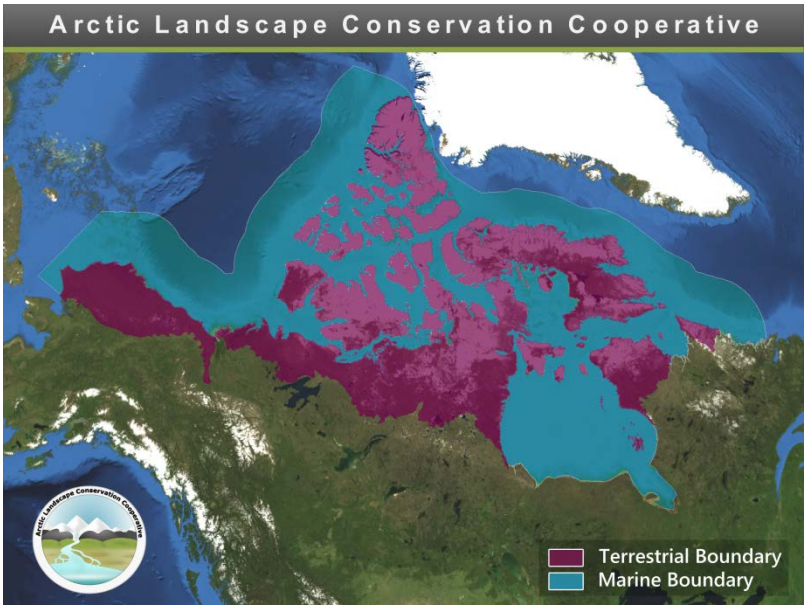
conservation, and management projects. They include those who have contributed funding or made in-kind contributions, those who have received Arctic LCC funding, those who are participating on the Steering Committee or Technical Working Groups, and those who have indicated a wish to remain informed of Arctic LCC activities. This long list of partners is available upon request by contacting a member of the Arctic LCC Staff at staff@arcticlcc.org.

Engagement of Tribes

The Arctic LCC has and will continue to engage the 12 tribal entities in Alaska's arctic. Hard copy mailings were sent to all Arctic Alaska tribes (those tribes within the Alaskan portion of the Arctic LCC), as well as e-mails to each tribe explaining who we are, why they should become involved, and the different capacities in which they can participate. Phone calls have also been made seeking direct contact with appropriate tribal representatives. The Arctic LCC seeks to increase the presence of tribal representatives on our Steering Committee and Technical Working Groups. The Village of Point Lay is the first tribe to commit to serving on the Steering Committee, appointing both a primary and alternate representative. We look forward to meeting with other interested tribes in the coming year as we seek additional tribal representation.

Expanding our Efforts into Canada

The vast majority of the Arctic LCC exists within the borders of Canada. We made relatively good progress in engaging with our Canadian partners in 2011, and we are currently joint funding four projects with Canadian entities, including Environment Canada, the Provincial Government of the Northwest Territories, Ducks Unlimited Canada, The University of Alberta, Trent University, Simon Fraser University, and the University of Quebec. We contracted with The Nature Conservancy to serve as our ambassadors in Canada, using their established network of Canadian contacts and knowledge of Canadian politics and government structure to help introduce us to the proper officials and to help us in selecting potential Canadian representatives on our Steering Committee. We continue to hold meetings with members of the Canadian federal government as we seek avenues for collaboration.



Arctic LCC Scope

In 2011, the Arctic LCC narrowed its focus. The Steering Committee indicated that this narrowing of focus does not preclude partnering on, or funding of projects that do not fall within the confines of this narrowed scope. Rather, it serves to guide investigators and the Directors of other arctic initiatives in determining whether the Arctic LCC is a likely partner. With respect to the narrowed focus of the Arctic LCC, the Steering Committee agreed on the following:

> While the Arctic LCC geographic domain is both marine and terrestrial, we will focus on terrestrial and nearshore marine systems. Initial focus will be within those geographic areas influencing management decisions in the Alaska portion of the Arctic LCC. Future focus may expand based on capacity. The Arctic LCC will focus on climate change, but other landscape stressors will not be excluded. The Arctic LCC will focus on habitat and how species interact with their habitat.

Science needs

The science needs of the Arctic LCC derive from the four conservation goals identified by the Steering Committee:

1. Better understand and predict effects of climate change and other stressors on landscape level physical and ecosystem processes.
2. Better understand the impacts of environmental change on subsistence and cultural resources.
3. Provide support for resource conservation planning.
4. Contribute to improved data management and integration.

Gaps in our understanding of the rate and spatial extent of anticipated habitat changes currently hinder our ability to assess species' vulnerability to climate change. These gaps must be addressed through a coordinated program of monitoring, hypothesis-driven research, and modeling.

A current emphasis of the Arctic LCC is on developing a program of sustained observations of physical and ecological indicators of landscape change, particularly those related to hydrology and climate. Technical experts on fish, wildlife, and subsistence resources (Species and Habitats Work Group) have provided guidance on high-priority topics that emanate from conceptual models that illustrate pathways by which climate drivers influence key aspects of species life history and ecology (Table 2). These topics span a wide range of physical and ecological properties. Long-term monitoring of environmental variables most relevant to climate change effects on habitat quality and availability will need to be thoughtfully coordinated among partner agencies and organizations, as operational costs are extremely high in this remote region.

In the complex field of climate science and environmental change, information management and delivery is as important as the acquisition of new data. There is a continual need to aggregate, organize, and present scientific information in a manner which is useable to resource management professionals and the interested public. The Arctic LCC is committed to developing and maintaining interfaces and services to provide public access to datasets generated by the program, as well as synthesizing key

historical datasets. The Arctic LCC will provide data stewardship and custody services, but will also strive to move beyond information warehousing to deliver products that synthesize and communicate information in a form that is understandable to the resource management community and to the public.

Table 2. High-priority climate-related topics that influence key aspects of species life history and ecology.

Topic	Birds	Fish	Mammals	Access to Subsistence Resources
Climate				
Air temperature, precipitation	X	X	X	X
Frequency of extreme events (e.g., storms, drought)	X	X	X	X
Windiness				X
Water/Hydrology				
Surface storage/soil moisture	X	X		
Streamflow/connectivity		X		
Formation of new drainage networks	X	X		
Lake volume/lake drainage	X	X		
Snow			X	
Winter Icing Events	X		X	X
Water temperature		X		
Water chemistry		X		
Sediment transport/deposition	X			
Glacier input (sediments and water)	X	X		
Permafrost				
Permafrost temperatures				X
Lower Trophic Levels				
Vegetation change/shrub encroachment	X		X	X
Aquatic/semi-aquatic invertebrate abundance	X	X		
Coastal/Marine				
Lagoon water chemistry/productivity	X	X		
Coastal erosion, inundation	X	X		
Sea ice and sea state				X
Seasonality				
Lake/river break-up and freeze-up		X		X
Snow-on/snow-off	X		X	X
Green-up/peak greenness	X		X	
Insect emergence/activity levels	X			

Arctic LCC Technical Work Groups

One of the Arctic LCC goals is to better understand and predict effects of climate change and other stressors on landscape level physical and ecosystem processes. Toward that end, the Arctic LCC Steering Committee authorized the formation of seven technical work groups:

- Climate/Downscaled Models
- Permafrost
- Hydrology
- Coastal Processes
- Species and Habitats
- Geospatial Data
- Cultural Resources

Technical Working Groups are an important element of the Arctic LCC's science planning process because they provide up-to-date information from experts in specific disciplines directly to the Arctic LCC staff and Steering Committee regarding priority conservation needs and issues. Of the seven groups authorized, six are active. The Cultural Resources Group has not yet been established. A roster for each of our six Technical Working Groups is provided in Appendix A.

How do the Technical Working Groups help the Arctic LCC?

The four physical process Technical Working Groups (Climate/Downscaled Models, Permafrost, Hydrology, and Coastal Processes) were provided with a document that summarized science needs previously identified by the Steering Committee and Arctic LCC staff. With this information in hand, they reviewed current work to gauge the sufficiency of current effort to meet the identified needs, and general approaches to meeting those needs. Each group produced documents that include the following items:

1. List of previously identified questions or science needs, derived from existing source documents.
2. General approaches (e.g., long-term monitoring, hypothesis-driven research, modeling, etc.) and discrete work elements needed to address each question.
3. Adequacy of current efforts, and need for additional work
4. Order-of-magnitude (50k, 500k, or 5 million) estimates for effort/cost for each work element (both initial and annual costs).

The Species and Habitat Technical Working Group was established to help the Arctic LCC narrow the focus on those physical processes that are most consequential to species of management concern. The Species and Habitats group was divided into four subgroups that focused on: birds, fish, mammals, and species important to subsistence users. The subgroups were asked to develop a list of climate-related

physical process shifts considered to most strongly influence broad species assemblages. The process shifts could involve direct or indirect influences on their species group. For each process identified, a narrative explains what type of change is projected, how (by what mechanism) it would affect fish and wildlife populations, and which species or species assemblages are most sensitive to the projected change.

The task assigned to the Geospatial Technical Working Group was different. This group was asked to generate a list of high priority/high value spatial datasets that are unavailable or outdated, and suggest means by which these data could be acquired.

Arctic LCC Supported Projects

During the year of its inception, the Arctic LCC did not have a Steering Committee in place in time to guide the project selection process. Instead, Arctic LCC staff used information from the Wildlife Response to Environmental Arctic Change (WildREACH) Workshop Report and the North Slope Science Initiative (NSSI) Emerging Issues Summaries to guide the selection and development of projects for 2010. Copies of these reports can be downloaded from http://arcticlcc.org/resources .

In 2011, the Arctic LCC was pleased to fund 22 of the 37 proposals we received, in amounts ranging from $24,000 to $174,000. We were fortunate enough to direct over $1.4 Million to projects addressing climate change and landscape level threats in the Arctic. University programs and federal agencies each received roughly 40% of Arctic LCC funds, while non-governmental organizations, mostly non-profits, received the remaining 20%.

These two reports represent findings of multi-agency and multi-stakeholder groups focused on identifying high priority information needs related to climate change and other stressors in the Arctic. Our 2011 projects were selected by our newly-formed Steering Committee following deliberations of how each project addressed the conservation goals of the Arctic LCC, feasibility of the project, and the ability of the Arctic LCC to sufficiently fund the project.

Our projects can generally be categorized as addressing:
1) Immediate land management issues;
2) Geophysical processes;
3) Biological studies and assessments;
4) Human dimensions;
5) Geospatial data acquisition and synthesis; and
6) Landscape level monitoring and modeling.

See Appendix B for a list of projects and contributing partners.

Immediate Land Management Issues

Polar bear den habitat model (2011)

This project will combine information about snow, topography, and polar bear biology to produce more refined and accurate maps predicting suitable polar bear den habitat than are currently available. This information will benefit both industry and regulatory agencies. For example, placement of new infrastructure can be planned in a way that avoids areas that typically provide good denning habitat. Furthermore, this information can be used to plan ground operations so they avoid areas that are likely to have enough snow to be suitable denning habitat in any given year.

Polar bear cubs in their den. Photo by USFWS.

Fostering collaboration across North America's Arctic (2011)

The Nature Conservancy (TNC) has been enlisted to use their network of established contacts and existing relationships to serve as ambassadors of the Arctic LCC in Canada. They are engaging potential Canadian partners and summarizing our current and planned climate-related work; highlighting potential areas of overlapping interest between Canada Federal, Provincial and First Nation governments and the Arctic LCC. An expected outcome of this project is strategic selection of Arctic LCC Steering Committee members from appropriate Canadian entities.

Geophysical Processes

Long-term monitoring of the impacts of climate change on the glaciers and rivers in the Arctic National Wildlife Refuge (2010)

Terminus of McCall Glacier, Arctic National Wildlife Refuge. Photo by Matt Nolan, UAF.

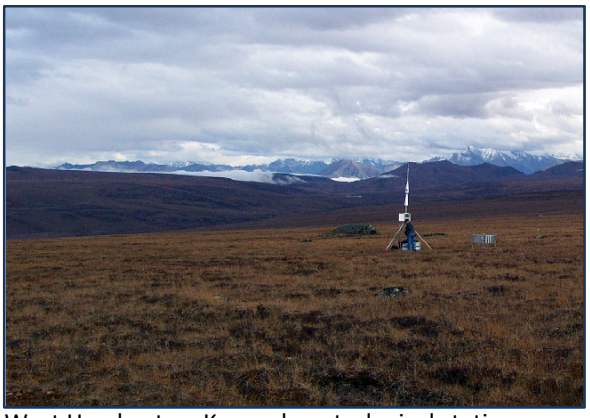
This work will extend the 50-year record of the dynamics of McCall Glacier and complete preliminary investigations of nearby Esetuk Glacier for a short-term comparison study of mass balance and glacier-climate interactions. This information is important to managers because the loss of water from these glaciers will impact associated rivers in the Arctic National Wildlife Refuge that support subsistence fisheries and important shorebird habitat.

Streamflow monitoring on the upper Kuparuk and Putuligayuk Rivers (2010 & 2011)

The Arctic LCC is providing stop-gap funding to support continued collection of long time series hydrological datasets in the Kuparuk and Putuligayuk watersheds. These datasets are important to the LCC because hydrologic data for the Alaska Arctic are sparse, and fewer still are long-term (> 10 year) datasets.

Hydroclimatological data rescue, data inventory, network analysis, and data distribution (2010 & 2011)

The density of weather stations and stream gages on the North Slope is orders of magnitude less than in other parts of the U.S., and data collected from these sites tends to be scattered among many entities. This project brings together these scarce datasets and places them under one data structure and location, making them much easier to use. In addition, these data will serve as the basis for designing a North Slope Hydrologic Observation Network.



West Headwaters Kuparuk metrological station. Photo by Rob Gieck, UAF.
http://ine.uaf.edu/werc/projects/NorthSlope/upper_kuparuk/w_headwater/images/WH-tower-rob.jpg

Barrier island-lagoon systems (2011)

This effort will investigate the dominant and relative importance of physical processes shaping the modern Arctic coastline. As climate warms, storms increase in severity, there is an increase in the likelihood that storms will more frequently wash seawater over the tops of Arctic barrier islands, flooding the protected lagoon systems with seawater. This study seeks to assess how climate change will affect this barrier island - lagoon system.

Jago and Niguanak river deltas with barrier islands in the foreground. Photo by Matt Nolan, UAF.

Climate projection maps and rasters (2011)

Climate data, such as temperature and precipitation, are available from a variety of sources, but these data are typically in a format that cannot be used by someone lacking specific technical skills and specialized software. Arctic LCC staff processed temperature and precipitation projections for Alaska, based on two different greenhouse gas emission scenarios, into a series of maps and datasets the can be downloaded from our website. The maps are available as handouts, presentation slides, or as images that can be incorporated to any document. Copies of these maps are provided in Appendix D.

Fish Creek hydrology (2011)

Support from the Arctic LCC will help maintain a network of hydrology monitoring sites in this representative Arctic Coastal Plain watershed. The work is being conducted within the context of climate change and impending oil and gas activities in the region, the latter of which is the impetus for focusing on this specific watershed.

Beaded stream. Photo by USFWS.

Glacier dynamics and estuarine chemistry (2011)

This effort will further our understanding of the impacts of climate change on the most massive element of the landscape that is likely to change–glaciers–and how loss of these glaciers will impact downstream ecosystems over the next 50 years.

Hydrologic monitoring of the Hulahula River (2011)

Hulahula River valley, Arctic National Wildlife Refuge. Photo by USFWS.

The Arctic LCC supported installation of a new USGS stream gage on the glacier-fed Hulahula River. The funds provided by the Arctic LCC will support stream gage operation for a period of 5 years. These data are a critical component of our efforts towards developing a better understanding of climate–glacier interactions.

Precipitation trends in Alaska (2011)

This retrospective analysis of precipitation records will determine whether detected inconsistency in station-based precipitation data are associated with changes in station location or the manner in which it is operated, or accurately reflect historical climate variability.

Thermokarst lake drainage – vulnerability to climate change and prediction of future lake habitat distribution on the North Slope (2010)

Thermokarst (erosion caused by the effects of melting ground ice) sculpts the arctic landscape. When it occurs along lake margins, it can cause them to increase in size, or cause them to drain. Researchers developed a model that projects the relative vulnerability of individual lakes to drainage as a function of permafrost conditions and topography. Results generated by this model were then used to construct maps that identify lakes at greatest risk of draining during the 21st Century.

A lake recently drained by rapid erosion of the Beaufort Sea coastline. Photo by of Benjamin Jones, USGS.

Biological Studies and Assessments

Linking North Slope climate, hydrology, and fish migration (2010)

Recent observations confirm that water can disappear entirely from portions of some North Slope stream-beds during periods of drought, and this is likely to become more common as climate warms. Drying of riverbeds poses a problem for migrating fish, which must be able to move from breeding and summer feeding areas to overwintering sites. This work uses the best available long-term hydrologic dataset for the North Slope to develop a model to assess the vulnerability of stream systems to periodic drought, and the risks imposed on migrating fish by diminished stream flow.

Modeling shorebird distribution on the North Slope (2010)

Shorebirds are among the most abundant and visible high-latitude vertebrates, and their life history makes them particularly sensitive to climate change in the arctic. The Arctic LCC is supporting development of habitat selection models that combine bird survey data with remotely-sensed habitat maps to "fill in the gaps" where observations are sparse. Such habitat models are needed so we can

project which species will be positively affected and those likely to be negatively impacted under the warmer arctic conditions of the future.

Shorebird demographics and climate change (2010-2011)

The Arctic Shorebird Demographic Network is an international collaboration engaged in evaluating how climate mediated changes in the arctic ecosystem are affecting shorebird distribution, ecology, and demography. Support from the Arctic LCC contributes to the efforts of the network by providing resources to hire a network coordinator. Our participation also allows for the tracking of key environmental attributes (e.g. water and prey availability) that are expected to link climate with changing shorebird populations.

Long-billed Dowitchers (*Limnodromus scolopaceus*) foraging for invertebrate prey. Photo by USFWS.

Modeling aquatic insects (2011)

This study will enable us to better predict climate-related changes in the timing and duration of insect prey availability for arctic-breeding shorebirds. Using Arctic Shorebird Demographic Network data, these investigators will develop mathematical models that relate the timing and duration of insect emergence and activity to accumulated temperature, weather, and other environmental variables. The resulting models will be a valuable resource for projecting future changes in the timing of arctic insect availability based on climate change projections. Collaboration with shorebird experts will help clarify how projected changes may affect shorebird populations in the future.

Seasonality of invertebrates (2011)

Chironomids, known as gnats to many, form an important prey base to many species of arctic breeding birds. Unlike in warmer climates, these insects take years to reach maturity, and "hatch" into their winged adult forms. These hatches are typically synced with environmental triggers related to temperature. This work will provide a better understanding of how water temperature in ponds on Alaska's Arctic Coastal Plain regulates the seasonal timing of aquatic insect emergence and the availability of invertebrate biomass for benthic-feeding birds such as eiders and other waterfowl.

Photo by Malcolm Butler, NDSU.

Modeling avifaunal responses (2011)

Project investigators will use a climate envelope approach to project how the distribution and abundance of boreal forest birds across North America will respond to different scenarios of future climate change. Investigation emphasis will be on mapping and quantifying potential range expansions of boreal bird species into Arctic and subarctic regions across Alaska and Canada. This work is largely focused on bird species that range largely south of our geographic extent, but may become more common across the arctic landscape of the future. The final products will result in a broad continental-scale overview of potential shifts in avian distribution.

Female Rusty Blackbird in breeding plumage. Photo by USFWS.

Post-breeding shorebird habitat use (2011)

Arctic shorebirds need to build up fat reserves just prior to their incredibly long fall migration. Most depend upon the abundant invertebrate resources found in exposed coastal shorelines and mudflats. This study will quantify the spatial and temporal distribution of benthic invertebrates at coastal lagoons and river deltas along the Beaufort Sea coast within the Arctic National Wildlife Refuge at 3 sites associated with the coastal lagoons: the terminus of the Jago, Okpilak, and Canning Rivers. In addition to quantifying these invertebrate resources, researchers will assess whether patterns of invertebrate abundance and distribution correspond to foraging shorebird abundance and distribution.

Vulnerability analysis for 55 species of Arctic breeding birds (2011)

The Wildlife Conservation Society is nearly complete with the process of assessing the climate change vulnerability of bird species that regularly breed in substantial populations in Alaska using the NatureServe Climate Change Vulnerability Index (CCVI) tool. They focused on 55 Arctic bird species; including 18 shorebird, 21 waterfowl and waterbird species (loons, gulls, terns, jaegers), and 16 land bird species (passerines, raptors, ptarmigan). Determining which species may stand to gain from climate change and which will be severely stressed will help guide managers in directing their bird conservation efforts.

Dunlin in breeding plumage. Photo by USFWS.

Human Dimensions

BIOMap Alaska (2011)

This work supports development of a web-based citizen-science initiative to collect information on marine species of concern, those undergoing range changes, invasive species and local ecological knowledge of the marine ecosystems along the Alaska region of the Chukchi and Bering seas. Community members in Kotzebue, Barrow and Kaktovik will engage in a test to evaluate a reporting system that enables uploading of observations into a central system. This Citizen Science initiative brings the field of climate change science to the villagers, engaging them as sources of important information.

Rural Alaska Monitoring Program (2011)

Barren-ground caribou grazing with autumn foliage in background. Photo by USFWS.

This project will develop the technology and training and will implement an environmental monitoring program for rural Alaska villages. This information to be useful in understanding how climate change is affecting traditional food storage methods and the health and relative food safety of subsistence-harvested animals that may harbor zoonotic diseases harmful to human health.

Geospatial Data Acquisition & Synthesis

AQUABASE: Expanding the North Slope fish distribution and water quality database (2010)

The distribution and abundance of fishes in Alaska Arctic is poorly known, especially for resident species. Only a few arctic watersheds have been the subject of fisheries or water quality studies. Such information, when it exists, is often difficult to locate because it typically does not exist in digital form. This project compiles and digitizes disparate fish and water quality datasets, and serves as a comprehensive information source for use in habitat assessment, modeling activities and for planning industrial activities.

Threatened eider database (2010)

Arctic LCC contains two species of eiders that are listed as threatened under the Endangered Species Act, yet there is no comprehensive source of survey effort and bird distribution information for these species. Providing a one-stop-shop for threatened eider data would facilitate both the NEPA and ESA Section 7 consultation processes for North Slope development. It would also ensure that all parties are accessing the same set of best available scientific information for these species; the importance of which Deputy Secretary David Hayes stressed during his 2012 presentation to the Alaska Forum on the Environment. In order to provide this needed single source for all known eider distribution data and survey efforts, the Arctic LCC is supporting the development of a database that synthesizes existing information, serves as a repository for eider distribution and survey information collected in the future.

Male Steller's eider in flight. Photo by Ted Swem.

Yellow-billed loon geodatabase (2010)

The yellow-billed loon was designated as a candidate species for listing under the Endangered Species Act in 2009. But due to its expansive range throughout remote habitats at extremely low densities, little is known about the species. As a starting point, we seek to consolidate the known distribution data for this large-lake-dependent arctic bird. The original Yellow-billed loon database was released to the public in 2008. The update produced in 2010 expanded the geographic scope of the dataset to include all of Alaska and portions of Canada.

Loon at sunset. Photo by USFWS.

Ecological mapping & field plot database (2011)

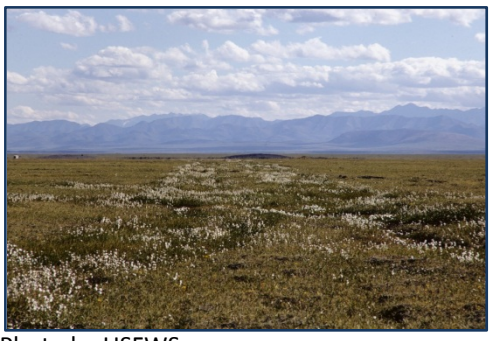


Photo by USFWS.

This project will result in uniform and consistent ecological mapping of the North Slope region. In addition to the map itself, a summary of existing field site ecological descriptions (including photos) will be made available to the public through a web based environment.

North Slope land cover (2011)

Support from the Arctic LCC allowed for completion of this ongoing Bureau of Land Management and NSSI initiative to develop a North Slope-wide cover type map and create a crosswalk that integrates other cover type maps, resulting in a comprehensive North Slope cover type map. Timely participation of the Arctic LCC allowed field validation efforts to be completed in 2011 and lowered overall project cost by $150,000. Future efforts will crosswalk cover type classes used in Alaska to those used in Canada, to provide a valuable and seamless data layer that spans international boundaries.

Arctic tundra habitat. Photo by USFWS.

Secure data services (2011)

This initiative will facilitate research within the North Slope science community through improved data sharing and collaboration. This will be achieved through the development and implementation of secure data services (SDS) protocols within the North Slope Science Data Catalog.

Landscape Level Monitoring & Modeling

Alaska climate-biome shift model (2010)

This effort uses climate-biome models using downscaled climate data (temperature and precipitation) to help identify areas which are most likely to undergo change, and areas of "refugia" where the temperature and precipitation conditions will be most similar to what they are today. The results will help managers, landscape planners, conservationists and others identify when preservation may be a goal, and where adaptation should be facilitated.

Shallow wetland in interior Alaska. Habitats such as this are sensitive to changes in both air temperature and summer precipitation. Photo by USFWS.

Integrated Ecosystem Model (IEM) for Alaska (2010 & 2011)

For this large, multi-year effort, an interdisciplinary team of university based modelers will develop a model framework that integrates the driving components of vegetation succession, disturbance, hydrology, and permafrost dynamics for the state of Alaska. Phase I of the AIEM was supported by funding from Arctic LCC, but further development of the AIEM will be supported through collaboration among the Alaska LCCs and the Alaska Climate Science Center. The outcome will be our most comprehensive glimpse yet into how future climate conditions may alter ecosystems across the state.

Post-fire succession in Interior Alaska, Mark Bertram/USFWS.

Anaktuvuk River fire monitoring (2011)

The 2007 Anaktuvuk River Fire was the largest and most severe Alaska tundra fire in history. This one fire released more carbon into the atmosphere than all northern hemisphere tundra sequestered during the entire year in which it occurred. As the Arctic continues to warm, tundra fires will increase in both frequency and severity. So monitoring the tundra's recovery from this fire is essential in understanding how the tundra of the future will be affected by this landscape process.

Anaktuvuk River fire of 2007. Photo by Benjamin Jones, USGS.

Events and Workshops

Workshops

Climate Change Vulnerability Assessment for Breeding Birds in the Arctic Workshop

The Arctic LCC-funded the Climate Change Vulnerability Assessment for Breeding Birds in the Arctic Workshop, held in Anchorage during December, 2011. This workshop, organized and executed by the Wildlife Conservation Society, focused on arctic breeding birds and concerned itself with review of species specific input from experts on each of 54 bird species. At the workshop, experts on Arctic Breeding birds from Alaska were joined by colleagues from Russia, Canada, Uruguay, and Mexico for two full days of presentations, discussion, critique of the NatureServe Climate Change Vulnerability Index assessment tool, and analysis of results. Revised analysis, based on workshop input, and a final report are forthcoming in the first half of 2012.

Webinars

Let it Snow! An introduction to the forces that control the distribution of snow across the landscape

Snow covers most of the lands that fall within the Arctic LCC boundary for nearly 9 months out of the year. It is a dominant landscape feature, affecting nearly all physical and biological processes, but in ways that we understand rather poorly. To better address how we may better understand this highly dynamic landscape feature, the Arctic LCC hosted a webinar featuring Glen Liston, one of the world's foremost experts in the field of snow modeling. Dr. Liston highlighted his Arctic LCC-funded efforts in modeling polar bear maternal denning habitats, and discussed how his existing snow models and historical snow data could be used to develop custom tools that arctic wildlife biologists could use to answer very specific questions regarding arctic species, and how snow and icing events affect them.

Arctic Fox in winter. Photo by USFWS.

Integrated Ecosystem Model for Alaska: a collaborative research project for the Arctic Landscape Conservation Cooperative.

The Arctic LCC hosted a webinar featuring Dr. Amy Breen, coordinator for the Integrated Ecosystem Model (IEM) for Alaska project. The presentation outlined the AIEM research team's approach for completing the first phase of the project and also discussed the broader implications of their work. A copy of the presentation slides can be downloaded from http://arcticlcc.org/assets/presentations.

Hydroclimatological data rescue, data inventory, network analysis, and data distribution

Dr. Jessica Cherry, project lead for the Hydroclimatological data rescue, data inventory, network analysis, and data distribution project, gave a presentation on her work inventorying weather stations and streamgages in northern Alaska. Dr. Cherry's work represents the first step towards building a well-coordinated climate observation network in northern Alaska.

Presentations and poster sessions

G. Balogh. How Federal Agencies Can Better Communicate Their Work to Each Other and to Rural Alaska Residents. Presentation at: Science, Natural Resources, and Subsistence in Alaska's Arctic Lands and Waters: A Continuing Dialogue on Working Together to understand our Changing Arctic. March 29-31, 2011; Barrow Alaska.

Jenkins, J., P. Martin, and G. Balogh. State of the Arctic Landscape Conservation Cooperative. Poster session presented at: Science, Natural Resources, and Subsistence in Alaska's Arctic Lands and Waters: A Continuing Dialogue on Working Together to understand our Changing Arctic. March 29-31, 2011; Barrow Alaska.

Venues at which Presentations were made by Arctic LCC Staff during 2011:

- Arctic LCC Partners meeting held in conjunction with Western Alaska LCC in Anchorage
- Arctic LCC Partners meeting held in Fairbanks
- Briefing of DOI officials from DC visiting Anchorage
- Anchorage tele-briefing with Senate Interior Appropriations Committee staff and Senator Murkowski's staff
- D.C.- based briefing of FWS Agency Leaders
- Anchorage-based briefing of Acting FWS Director and Deputy Assistant Secretary for Fish, Wildlife, and Parks
- Alaska Forum on the Environment
- R7 FWS Law Enforcement annual meeting
- Refuge Information Technician annual meeting
- FWS Migratory Bird Management annual meeting
- Four North Slope Science Initiative (NSSI) meetings
- Alaska Climate Change Executive Roundtable meeting
- USFS Classrooms for Climate at UAA
- Alaska Marine Ecosystem Forum
- Alaska Hydrology Working Group annual meeting
- Arctic Research Commission meeting
- American Society of Professional Engineers
- USGS Water Program, Anchorage meeting
- University of Alaska Natural Resource Management class

Key Partnerships

All entities participating at the Steering Committee or Technical Working Group level of the Arctic LCC are contributing both valuable manpower and expert guidance to the Arctic LCC, and are consequently considered key partners (see Arctic LCC Organizational Structure section and Appendix A: Technical Working Group Composition). In addition, we have obvious partnerships with all of our Project PI parent organizations (see Appendix B for a list of Projects and associated partner organizations). The Arctic LCC works closely with the North Slope Science Initiative on shared priorities and we participate in Arctic Council initiatives that connect to the Arctic LCC's strand in the web of international arctic initiatives. We participate in, and look forward to receiving guidance from, the Alaska Data Integration Working Group. The Geographic Information Network for Alaska (GINA) is a key partner in our shared mission of data and metadata discovery and in serving databases to the public in user-friendly formats over the web.

Especially important are those organizations that, in the collaborative spirit of LCCs nationwide, have contributed funds or uncompensated manpower towards the implementation of on-the-ground projects that serve to address the conservation goals of the Arctic LCC. These organizations include:

DOI Alaska Climate Science Center

The Alaska Climate Science Center (Alaska CSC) was established shortly after the establishment of the Arctic LCC. The two entities have collaborated closely since. The Director of the Alaska CSC participates at all Steering Committee meetings, and the Arctic LCC staff provides feedback and coordination with Alaska CSC activities. Some highlights of this collaboration in 2011 include:

- **Shared funding** – The Arctic LCC, Western Alaska LCC and Alaska CSC all jointly funded the Integrated Ecosystem Model project undertaken by the University of Alaska, Fairbanks.
- **Science Planning** – The initial and current annual science plans for the Alaska CSC reflect the priorities and needs identified by the Arctic LCC Technical Working Groups and Steering Committee, as well as the content of our draft science plan.
- **Data Sharing and Data Management** – The Arctic LCC Data Sharing Policy was heavily influenced by language being used to generate the National Climate Science Center Network's data sharing policy. In addition, the CSC's and Arctic LCC active participation in the Alaska Data Integration Working Group helps ensure that we remain on a parallel track as we contemplate how to make new and existing information available to the public.

U.S. Geological Survey

The USGS Alaska Science Center has been a key partner in strategic funding of projects. On occasion, we refer project funding to each other when existing agreements make project implementation more efficient. At other times, we have jointly funded projects of mutual interest. This important partnership has made the following projects possible (all of which are described elsewhere in this document):

- Integrated Ecosystem Model
- Barrier Islands and Lagoon Systems Ecology
- Modeling Avifaunal Responses of Boreal Birds
- Glacier Dynamics and Estuarine Chemistry
- Hydrologic Monitoring of the Hulahula River

USGS is also a key partner in the development of a plan for coordination of long-term monitoring activities that help us track changes in physical processes and ecosystem response. The Alaska Science Center funds the participation of Dr. Benjamin Crosby, Idaho State University, to serve as chair of the Arctic LCC Hydrology Working group, and principal author of the Arctic LCC Ecological Monitoring Plan, in preparation.

Exposed ice lens. Photo by USFWS.

Bureau of Land Management

The Arctic LCC and the Bureau of Land Management have collaborated on several important projects of mutual interest:

- Anaktuvuk Fire Monitoring
- North Slope Land Cover (funded largely by North Slope Science Initiative, housed within BLM)
- Fish Creek Hydrology
- Yellow-billed Loon Database

North Slope Science Initiative

The Arctic LCC's narrowing of scope helps to define a niche that is distinct from the broader mission of the North Slope Science Initiative (NSSI). While the Arctic LCC and NSSI operate in overlapping geographic areas, have partnered on projects, and share interests in obtaining many of the same types of information, we remain two distinct entities with different missions. The NSSI is focused primarily on science needs associated with resource development, while the Arctic LCC is focused primarily on the ecological consequences of climate change, and implications for natural resource conservation. Both entities recognize the intersections between these areas of interest, and are committed to a productive collaboration. The Arctic LCC works closely with the NSSI on data management and accessibility,

participated actively in the NSSI's 2011 workshop in Barrow, and the Arctic LCC Science Coordinator serves on the NSSI Science Technical Advisory Panel.

U.S. Fish and Wildlife Service

While all Arctic LCC program funds come through the U.S. Fish and Wildlife Service, other programs within the Service have covered costs for a number of other Arctic LCC projects, including:

- BIOMap Alaska, supported entirely by Fisheries and Ecological Services (FES)
- Threatened Eider Database, supported entirely by FES
- Thermokarst Lake Model, supported entirely by FES
- Yellow-billed Loon Database, supported in part by FES
- AQUABASE, supported entirely by FES
- North Slope Land Cover Map, supported in part by Migratory Bird Management (MBM)
- Modeling Avifaunal Responses of Boreal Birds, supported in part by MBM
- Modeling Shorebird Distribution on the North Slope, supported in part by MBM
- Arctic Shorebird Demographics Network, supported in part by MBM and Arctic National Wildlife Refuge
- Hydroclimatological Data Rescue, Data Inventory, Network Analysis, and Data Distribution, supported by Realty and Natural Resources
- Long-term Monitoring of the Impacts of Climate Change on the Glaciers and Rivers in the Arctic National Wildlife Refuge, supported in part by Refuges' Water Resources Program and the Arctic National Wildlife Refuge
- Hydrologic Monitoring of the Hulahula River, supported in part by Refuges' Realty and Natural Resources Program
- Polar Bear Den Habitat Model, supported in part by Marine Mammal Management

Photo by USFWS.

Table2. Projects funded with Arctic LCC funds have also received funding from these generous partners.

Project Title	Partners contributing funds
Streamflow Monitoring of Upper Kuparuk and Putiligayak rivers	University of Alaska, Fairbanks, Water & Environmental Research Center; Alaska Department of Transportation & Public Facilities; National Science Foundation; Department of Energy; Alaska Department of Natural Resources
Changing Climate-Biomes Model	University of Alaska, Fairbanks, Scenarios Network for Alaska & Arctic Planning; The Nature Conservancy, Canada; U.S. Fish & Wildlife Service; Ducks Unlimited, Canada; Government Canada; Provincial Government for the Northwestern Territories
Shorebird Demographics and Climate Change	Manomet Center for Conservation Sciences; Environment Canada; U.S. Fish & Wildlife Service; Kansas State University; Simon Fraser University; Wildlife Conservation Society; Trent University; Cornell University; University of Quebec
Precipitation Trends in Alaska	The Wilderness Society
Fish Creek Hydrology	Bureau of Land Management; National Fish & Wildlife Foundation
Rural Alaska Monitoring Program	Alaska Native Tribal Health Consortium; Indian Health Service; Center for Disease Control
Post-breeding Shorebird Habitat Use	Bureau of Ocean Energy Management
Vulnerability Assessment for 55 Bird Species	Kresge Foundation, Wildlife Conservation Society
Fostering Collaboration Across North America's Arctic	Ducks Unlimited, Canada; Provincial Government of the Northwest Territories
North Slope Land Cover Mapping	North Slope Science Initiative; University of Alaska, Anchorage, Alaska Natural Heritage Program; Natural Resource Conservation Service; National LandFire Program; University of Alaska, Fairbanks; Bureau of Land Management; U.S. Fish & Wildlife Service; Spatial Solutions, Inc.; Ducks Unlimited, Inc.
Modeling Avifaunal Responses	University of Alberta; U.S. Fish & Wildlife Service; Environment Canada
Glacier Dynamics and Estuarine Chemistry	National Science Foundation
Secure Data Services	University of Alaska's Geographic Information Network for Alaska
Seasonality of Invertebrates	National Science Foundation

How has the Arctic LCC addressed our conservation goals?

Tackling the management implications of climate change is a daunting task, and the sheer number and diversity of interrelated topics and information gaps poses a prioritization challenge. This diversity is reflected in a project list that may seem a bit unfocused. This would be a fair critique -- while all of our projects will contribute to meeting our goals, we recognize the need to concentrate our efforts in a more strategic fashion. Learning from experience, we are working to refine our scope, our internal processes, and planning documents to help build a more focused and coherent scientific program.

Our suite of projects touch on all 4 of our conservation goals, but it is also fair to say that we have addressed them unevenly. While we do not believe that the 4 goals should be addressed with equal effort or funding, we recognize that the current mix of projects is not optimally allocated among the 4 goals.

We are pleased with the progress we are making on our first goal "Better understand and predict effects of climate change and other stressors on landscape level physical and ecosystem processes", as the vast majority of our funding and collaboration efforts have gone towards addressing what we view as our most important goal.

In contrast, we are expending a disproportionately lesser effort toward addressing goal 2 "Better understand the impacts of environmental change on subsistence and cultural resources". Effects on subsistence resources are inextricably linked with change in the ecosystem as a whole, so most projects that address Goal 1 are relevant here, as well. Nevertheless, this goal is intended to emphasize the importance of considering the subsistence and cultural needs of arctic residents , and the particular topics relevant to local communities should receive more of our attention in future years.

The Arctic LCC is engaged in projects with near-term tangible land management implications. Most notable among these is the Alaska Integrated Ecosystem Model, which will provide the most comprehensive view of future landscape conditions available. Initial output of the Polar Bear Habitat Model shows great promise in homing in on the most important sites for polar bears that are seeking to excavate maternal dens on land; information vital to land managers seeking to minimize human disturbance of these animals. Our consolidated threatened eider and yellow-billed loon databases should prove valuable to those involved in both the NEPA and ESA Section 7 processes.

We believe that Arctic LCC conservation Goal 3 "Provide support for resource conservation planning" is being adequately addressed by our current suite of projects. The Steering Committee has been consciously selecting for those projects that have the most explicit ties to outstanding management needs. The climate focus poses some special challenges with respect to conservation planning as we are obligated to anticipate the science that will be needed to address management decisions that will

become evident decades in the future. We attempt to balance the need for long-term investment in information with more immediate management concerns. Several of our most important projects will, indeed, result in the direct development of management tools in the near-term. For example, our Polar Bear Den Habitat model will improve predictive capability for the location of maternal den sites; our vulnerability assessment for arctic-breeding birds will provide the foundation for mangers to prioritize among potential conservation targets; the Arctic Shorebird Demographic Network will help identify the life history stages that are limiting the populations of declining shorebird species.

Our efforts at improving data management and integration, which address our fourth conservation goal, have been notable. We have taken the step of hiring a full time database manager to lead our efforts in digesting and serving the impending flood of information that will begin as our initial wave of funded projects are completed. In addition, we are working with the data managers at the University of Alaska's GINA program and with the Alaska Data Integration Working Group to develop data sharing tools and policies that will serve us well in the near future.

Appendix A: Technical Working Group Composition

Coastal Processes Work Group	
Affiliation	***Number of representatives***
US Army Corps of Engineers, Alaska District	1
US Geological Survey, Pacific Coastal and Marine Science Center	3
National Oceanic & Atmospheric Administration	1
US Geological Survey, Alaska Science Center	1
Alaska Ecoscience	1
University of Alaska Fairbanks	1

Climate and Downscale Modeling Work Group	
Affiliation	***Number of representatives***
University of Alaska Fairbanks , International Arctic Research Center	1
US Geological Survey	2
National Oceanic & Atmospheric Administration	2
Alaska Ocean Observing System	1
National Park Service	1

Hydrology Work Group	
Affiliation	***Number of representatives***
University of Alaska Fairbanks, Water & Environmental Research Center	6
National Oceanic & Atmospheric Administration	1
University of Alaska Fairbanks, International Arctic Research Center	4
US Geological Survey	1
US Army Corps of Engineers, Alaska District	1
The Wilderness Society	1
US Army Corps of Engineers, Cold Regions Research & Engineering Laboratory	1
Fish & Wildlife Service	1
Bureau of Land Management	1
Idaho State University; US Geological Survey	1

Permafrost Work Group	
Affiliation	***Number of representatives***
National Park Service	2
University of Alaska Fairbanks, Geophysical Institute	3
US Geological Survey	1
US Army Corps of Engineers, Cold Regions Research & Engineering Laboratory	1

Species and Habitats Work Group	
Affiliation	***Number of representatives***
National Park Service	2
Audubon Alaska	1
Wildlife Conservation Society	1
US Geological Survey	2
Alaska Department of Fish & Game	2
Fish & Wildlife Service	5
MJM Research	1
Defenders of Wildlife	1
The Wilderness Society	1
Oceans North; Pew Environmental Group	1

Geospatial Work Group	
Affiliation	***Number of representatives***
Arctic LCC; Fish & Wildlife Service	1
Bureau of Land Management	2
Alaska Department of Fish & Game	1
Fish & Wildlife Service	1
Geographic Information Network of Alaska; North Slope Science Initiative	1
National Park Service	1
Audubon Alaska	1

Appendix B: Projects and Associated Partners

Project Title	**Partners** (bold text indicates affiliation of PI)
Changing Climate-Biomes Model	**University of Alaska, Fairbanks, Scenarios Network for Alaska & Arctic Planning**; The Nature Conservancy, Canada; U.S. Fish & Wildlife Service; Ducks Unlimited, Canada; Government Canada; Provincial Government for the Northwestern Territories
Modeling Shorebird Distribution on the North Slope	**Manomet Center for Conservation Sciences**; U.S. Fish & Wildlife Service
Expanding the North Slope Fish Distribution and Water Quality Geodatabase (Aquabase)	**University of Alaska, Fairbanks, Alaska Cooperative Fish & Wildlife Research Unit**; U.S. Fish & Wildlife Service
Hydroclimatological Data Rescue, Data Inventory, Network Analysis, and Data Distribution	**University of Alaska Fairbanks, Water & Environmental Research Center**; University of Alaska, Fairbanks, International Arctic Research Center; U.S. Fish & Wildlife Service
Alaska Integrated Ecosystem Model (AIEM)	**University of Alaska, Fairbanks, Scenarios Network for Alaska & Arctic Planning**; University of Alaska, Fairbanks, Alaska Cooperative Fish & Wildlife Research Unit; Western Alaska Landscape Conservation Cooperative; U.S. Geological Survey Alaska Climate Science Center
Linking North Slope Climate, Hydrology, and Fish Migration	**University of Alaska, Fairbanks, Water & Environmental Research Center**; U.S. Fish & Wildlife Service; Marine Biological Laboratory; National Science Foundation
Long-term Monitoring of the Impacts of Climate Change on the Glaciers and Rivers in the Arctic National Wildlife Refuge	**University of Alaska, Fairbanks, Institute of Northern Engineering**; U.S. Fish & Wildlife Service
Streamflow Monitoring on the Upper Kuparuk and Putuligayuk Rivers	**University of Alaska, Fairbanks, Water & Environmental Research Center**; Alaska Department of Transportation & Public Facilities; National Science Foundation; Department of Energy; Alaska Department of Natural Resources
Thermokarst Lake Drainage - Vulnerability to Climate Change and Prediction of Future Lake Habitat Distribution on the North Slope	**University of Alaska, Fairbanks, Geophysical Institute**; U.S. Fish & Wildlife Service
Threatened Eider Database	**ABR, Inc**.; U.S. Fish & Wildlife Service
Shorebird Demographics and Climate Change	**Manomet Center for Conservation Sciences**; Environment Canada; U.S. Fish & Wildlife Service; Kansas State University; Simon Fraser University; Wildlife Conservation Society; Trent University; Cornell University; University of Quebec
Streamflow Monitoring of the Canning and Tamayariak Rivers	**North Slope Science Initiative**
Hydrologic Monitoring of a the Hulahula River	**U.S. Geologic Survey**; U.S. Fish & Wildlife Service
Yellow-Billed Loon Geodatabase	**Bureau of Land Management**; U.S. Fish & Wildlife Service
Polar Bear Den Habitat Model	**Interworks Consulting**; National Science Foundation; National Fish & Wildlife Foundation
Barrier Island-Lagoon Systems	**U.S. Geological Survey**

Project Title	**Partners** (bold text indicates affiliation of PI)
Precipitation Trends in Alaska	**The Wilderness Society**
Fish Creek Hydrology	**University of Alaska, Fairbanks, Water & Environmental Research Center**; Bureau of Land Management; National Fish & Wildlife Foundation
Ecological Mapping & Field Plot Database	**University of Alaska Geographic Information Network for Alaska**
Rural Alaska Monitoring Program	**Alaska Native Tribal Health Consortium**; Indian Health Service; Center for Disease Control; University of Alaska, Fairbanks
Modeling Aquatic Insects	**University of Alaska, Anchorage, Alaska Natural Heritage Program**; Arctic Shorebird Demographic Network
Post-breeding Shorebird Habitat Use	**University of Alaska, Fairbanks, Alaska Cooperative Fish & Wildlife Research Unit**; Bureau of Ocean Energy Management
Anaktuvuk River Fire Monitoring	**Bureau of Land Management**
Vulnerability analysis for 55 Bird Species	**Wildlife Conservation Society**; Kresge Foundation
Fostering Collaboration Across North America's Arctic	**The Nature Conservancy**; Ducks Unlimited, Canada; Provincial Government for the Northwestern Territories
LiDAR Data Processing	**U.S. Geological Survey**
North Slope Land Cover	**North Slope Science Initiative**; University of Alaska, Anchorage, Alaska Natural Heritage Program; Natural Resource Conservation Service; National LandFire Program; University of Alaska, Fairbanks; Bureau of Land Management; U.S. Fish & Wildlife Service; Spatial Solutions, Inc.; Ducks Unlimited, Inc.
Modeling Avifaunal Responses	**University of Alberta**; U.S. Fish & Wildlife Service; Environment Canada
Glacier Dynamics and Estuarine Chemistry	**University of Alaska, Fairbanks, Institute of Northern Engineering**; National Science Foundation
Secure Data Services	**University of Alaska, Fairbanks, Geographic Information Network for Alaska**
Seasonality of Invertebrates	**North Dakota State University**; National Science Foundation
BIOMap Alaska	**University of Alaska, Fairbanks, International Arctic Research Center**; **Alaska Sea Life Center**; U.S. Fish & Wildlife Service

Projects Funded in 2011

The Big Picture

In 2011, the Arctic LCC funded wholly, or in part, 21 projects totaling over $1.4 Million. Most of the projects were new starts, with a small number of continuations from our 2010 funding efforts. All projects will further our understanding of Arctic ecosystems and processes as they face a changing environment due to a rapidly warming, and often drying, ice-dependent arctic climate. In 2011, Arctic LCC project dollars were matched by over $3.6 Million in partner contributions, nearly a three to one match!

In 2011, the Arctic Landscape Conservation Cooperative (Arctic LCC) was pleased to fund 21 of the 37 proposals we received, in amounts ranging from $24,000 to $174,000. We were fortunate enough to direct over $1.4 Million to projects addressing climate change and landscape level threats in the Arctic. University programs received just over 40% of available funding, while federal agencies received just under 40%. Non-governmental organizations, mostly non-profits, received the remaining 20% of Arctic LCC funds.

Our 2011 projects can generally be categorized as addressing: 1) immediate land management issues; 2) geophysical processes; 3) biological studies and assessments; 4) human dimensions; 5) geospatial data acquisition and synthesis; and 6) landscape level monitoring and modeling.

Projects were selected by the Arctic LCC Steering Committee following discussion of how each project addressed the conservation goals of the Arctic LCC. Consideration was given to the feasibility of the project and the ability of the LCC to sufficiently fund the project.

Of the 21 funded projects, two address land management issues, six address some aspect of arctic geophysical processes, five are wildlife ecology studies, two address affects of climate change on humans and climate change-related observations made by residents living in Alaska's arctic, four are contributing to our geospatial knowledge of the landscape, and two are addressing landscape-level monitoring and modeling efforts. Evidence that LCC borders are, indeed, porous is evident when one considers that 6 of the 21 funded Arctic LCC projects go well beyond the arctic in their scope.

The presence of ice-rich permafrost soils makes arctic tundra uniquely vulnerable to the effects of warming. Photo by USFWS.

To learn more about these and other Arctic LCC projects visit: www.arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov or Philip Martin at philip_martin@fws.gov.

Immediate Land Management Issues

Polar Bear Den Habitat Model

Project description: This model will ultimately integrate snow physics, high-resolution digital terrain models, and bear biology to produce more refined and accurate maps predicting suitable polar bear den habitat than are currently available. The work will consist of data gathering, consultation between snow and bear scientists, modeling, and sensitivity studies to determine the impact of changing atmospheric conditions on den location and evolution along the Beaufort Coast. It will provide better information to industry and regulatory agencies regarding the likely locations of polar bear dens.

Polar bear cubs in their den. Photo by USFWS.

Project Lead: Interworks Consulting

Partners co-funding this work: National Science Foundation

Fostering Collaboration Across North America's Arctic

Project description: The Nature Conservancy will draw upon its existing Canadian network to coordinate with potential Canadian partners on behalf of the Arctic LCC. TNC will address the Arctic LCC's need to identify specific overlapping goals, objectives and geographic interest between the Arctic LCC and those potential partners. TNC will provide information about the Arctic LCC to potential Canadian partners; initiate contact and help build relationships with those potential partners; they will summarize current and planned climate-related work and other areas of overlapping interest with the Arctic LCC, and identify the top six to eight most appropriate potential Canadian partners with which the Arctic LCC should engage.

Project Lead: The Nature Conservancy

Partners co-funding this work: Ducks Unlimited, Canada, and Provincial Government for the Northwestern Territories.

Contributors to these Arctic LCC projects include:

- Alaska Department of Natural Resources
- Alaska Native Tribal Health Consortium
- Alaska Natural Heritage Program
- Alaska Shorebird Demographic Network
- Bureau of Ocean Energy Management Regulation & Enforcement
- Bureau of Land Management
- Center for Disease Control
- Department of Energy
- Ducks Unlimited, Inc.
- Environment Canada
- Indian Health Service
- Kresge Foundation
- National Fish & Wildlife Foundation
- National LandFire Program
- National Resource Conservation Service
- National Science Foundation
- North Slope Science Initiative
- Spatial Solutions, Inc.
- Provincial Government for the Northwestern Territories
- The Nature Conservancy
- The Wilderness Society
- The Wildlife Conservation Society
- U.S. Fish and Wildlife Service
- University of Alaska, Fairbanks
- University of Alberta
- U.S. Geological Survey

Geophysical Processes

Barrier Island-Lagoon Systems

Project description: This effort will investigate the dominant and relative importance of physical processes shaping the modern Arctic coastline as well as decadal responses due to projected conditions out to the year 2100. This study will determine dominant forces responsible for projected changes to the arctic coastal landscape, and to assess the likelihood of Arctic barrier island-lagoon system habitat inundation by seawater in response to changing ocean conditions related to global warming.

Jago and Niguanak river deltas with barrier islands in the foreground. Photo by Matt Nolan.

Project Lead: U.S. Geological Survey

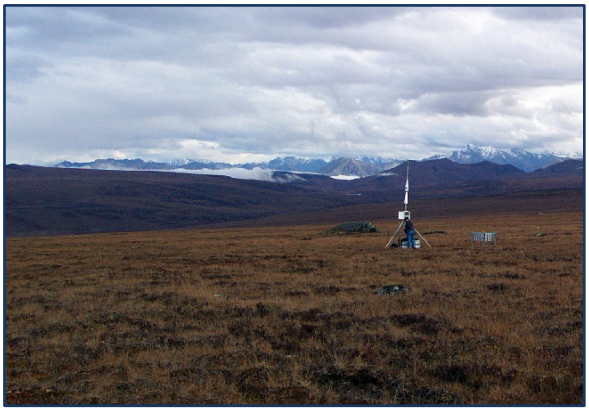
Partners co-funding this work: U.S. Geological Survey

Precipitation Trends in Alaska

Project description: This retrospective analysis of precipitation records will determine whether detected inconsistency in station-based precipitation data are associated with changes in station location or the manner in which it is operated, or are related to historical climate variability. It will evaluate actual trends in precipitation using two analytical methods over both short and long analytical periods.

Project Lead: The Wilderness Society

Partners co-funding this work: The Wilderness Society



West Headwaters Kuparuk metrological station. Photo by Rob Gieck.
http://ine.uaf.edu/werc/projects/NorthSlope/upper_kuparuk/w_headwater/images/WH-tower-rob.jpg

Geophysical Processes (continued)

Fish Creek Hydrology

Project description: LCC funding for this project will help maintain a network of hydrology monitoring sites in a representative watershed of the Arctic Coastal Plain. The work is being conducted within the context of climate change and impending oil and gas activities in the region, the latter of which is the impetus for focusing on the Fish Creek watershed.

Beaded stream. Photo by USFWS.

Project Lead: Bureau of Land Management

Partners co-funding this work: Bureau of Land Management and National Fish and Wildlife Foundation

Glacier Dynamics and Estuarine Chemistry

Project description: This effort will further our understanding of the impacts of climate change on the most massive element of the landscape that is likely to change – glaciers – and how loss of these glaciers will impact downstream ecosystems over the next 50 years.

Project Lead: University of Alaska, Fairbanks, Institute of Northern Engineering

Partners co-funding this work: National Science Foundation

Terminus of McCall Glacier, Arctic National Wildlife Refuge. Photo by Matt Nolan.

Hydrometeorological Data Rescue

Project description: This multi-year data rescue effort will inventory data sets and finalize the geolocated inventory of available climate, hydrology, and aquatic ecology data for Alaska and North Western Canada. In addition, this project will continue to populate the existing hydroclimatological geodatabase with high priority datasets including high-priority datasets held by the Bureau of Land Management. This geodatabase will be made available to the general public through the project website.

Project Lead: University of Alaska Fairbanks, International Arctic Research Center

Partners co-funding this work: Bureau of Land Management

Kuparuk Hydrology

Project description: Hydrologic data for the Alaska Arctic are sparse, and fewer still are long-term (> 10 year) datasets. This lack of baseline information hinders our ability to assess long-term alterations in streamflow due to changing climate. The Arctic LCC is providing stop-gap funding to support continued collection of long time series hydrological data sets in the Kuparuk and Putuligayuk watersheds.

Project Lead: University of Alaska, Fairbanks, Water and Environmental Research Center

Partners co-funding this work: Alaska Department of Transportation and Public Facilities, National Science Foundation, Department of Energy, and Alaska Department of Natural Resources

Biological Studies and Assessments

Modeling Aquatic Insects

Project description: This study will enable us to better predict climate-related changes in the timing and duration of insect prey availability for arctic-breeding shorebirds. Using Arctic Shorebird Demographic Network data, these investigators will develop mathematical models that relate the timing and duration of insect emergence and activity to accumulated temperature, weather, and other environmental variables. Resulting models will predict future changes in the timing of arctic insect availability based on climate change projections.

Project Lead: University of Alaska, Anchorage, Alaska Natural Heritage Program

Partners co-funding this work: Arctic Shorebird Demographic Network

Biological Studies and Assessments (continued)

Post-breeding Shorebird Habitat Use

Project description: In addition to quantifying invertebrate resources, this study will assess whether the resources available to shorebirds are sufficient to prepare the birds for their fall migration. This study will also survey the shorelines and consist of taking core samples for laboratory analysis for chemical analysis, population structure, numbers of individuals, and diversity of populations from the interstitial spaces within the littoral zone of coastlines along the Beaufort Sea.

Sandpipers feeding along the Beaufort Sea shoreline. Photo by USFWS.

Project Lead: University of Alaska, Fairbanks, Alaska Cooperative Fish and Wildlife Research Unit

Partners co-funding this work: Bureau of Ocean Energy Management Regulation and Enforcement

Vulnerability Analysis for 55 Bird Species

Project description: The Wildlife Conservation Society will assess the climate change vulnerability of bird species that regularly breed in substantial populations in Alaska using the NatureServe Climate Change Vulnerability Index (CCVI) tool. Initial work will focus on 55 Arctic bird species; 18 shorebird, 21 waterfowl and waterbird species (loons, gulls, terns, jaegers), and 16 land bird species (passerines, raptors, ptarmigan).

Project Lead: Wildlife Conservation Society

Partners co-funding this work: Kresge Foundation

Dunlin in breeding plumage. Photo by USFWS.

Biological Studies and Assessments (continued)

Modeling Avifaunal Responses

Project description: Using a bioclimatic envelope approach, University of Alberta investigators will project how the distribution and abundance of boreal forest birds across North America will respond to different scenarios of future climate change. Investigation emphasis will be on mapping and quantifying potential range expansions of boreal bird species into Arctic and subarctic regions across Alaska and Canada. The final products will result in a broad continental-scale overview of potential shifts in avian distribution.

Female Rusty Blackbird in breeding plumage. Photo by USFWS.

Project Lead: University of Alberta

Partners co-funding this work: U.S. Fish and Wildlife Service, Environment Canada, and University of Alberta

Seasonality of Invertebrates

Project description: Investigators on this project will improve our understanding of how climate drives availability of prey for tundra-nesting birds reliant upon aquatic invertebrates in Alaska's Arctic. They seek to understand how water temperature in ponds on Alaska's Arctic Coastal Plain regulates the seasonal timing of aquatic insect emergence – a crucial event for a majority of tundra-nesting bird species – and the availability of invertebrate biomass for benthic-feeding birds such as eiders and other waterfowl.

Project Lead: North Dakota State University

Partners co-funding this work: National Science Foundation

Midge with shed exoskeleton. Photo by Mac Butler

Human Dimensions

Rural Alaska Monitoring Program

Project description: Project PIs will examine risk that climate change poses to food safety of subsistence users in Alaska, relative to both food storage in ice cellars and exposure to zoonotic diseases. They will also provide information on the risk of zoonotic diseases to the health of the subsistence harvested species.

Project Lead: Alaska Native Tribal Health Consortium

Partners co-funding this work: Alaska Native Tribal Health Consortium, Indian Health Service, Center for Disease Control

Barren-ground caribou grazing with autumn foliage in background. Photo by USFWS.

BIOMap Alaska

Project description: Investigators from the University of Alaska, Fairbanks and Alaska Sea Life Center will test a web-based citizen-science initiative to collect information on marine species of concern, those undergoing range changes, invasive species and local ecological knowledge of the marine ecosystems along the Alaska region of the Chukchi and Bering seas. Community members in Kotzebue, Barrow and Kaktovik will engage in a test to evaluate a reporting system that enables uploading of observations into a central system.

Subsistence fish camp near Kaktovik. Photo by USFWS.

Project Co-Leads: Alaska Sea Life Center and the University of Alaska, Fairbanks, International Arctic Research Center

Geospatial Data Acquisition & Synthesis

Ecological Mapping & Field Plot Database

Project description: The Geographic Information Network for Alaska will complete uniform and consistent ecological mapping of the North Slope region and provide a summary of existing field site ecological descriptions (including photos) in a web based environment. Existing automated field information and photos that have reliable geolocation information will be compiled and entered in a web based geographic display based on the ecological mapping.

Photo by USFWS.

Project Lead: University of Alaska Geographic Information Network for Alaska

LiDAR Data Processing

Project description: US Geological Survey staff will expediently process LiDAR data acquired in Summer 2010 along the North Slope of Alaska between Colville River and Staines River. As part of this task, the LiDAR data will be quality-checked for relative and absolute accuracy (where ground data are available). The data will be processed and filtered to a representation of bare-earth topography. Data will be tiled in a 2km by 2km grid to allow easy access in GIS software, and will be made available in standard ASPRS LAS point-cloud format and gridded GeoTIFF format.

Project Lead: U.S. Geological Survey

North Slope Land Cover

Project description: LCC funding will allow completion of this ongoing BLM initiative to develop a North Slope-wide cover type map and create a crosswalk that integrates all component cover type maps that comprise the larger overall North Slope cover type map.

Project Lead: Bureau of Land Management

Partners co-funding this work: North Slope Science Initiative, Alaska Natural Heritage Program, Natural Resource Conservation Service, National LandFire Program, University of Alaska, Fairbanks, Bureau of Land Management, U.S. Fish and Wildlife Service, Spatial Solutions, Inc., and Ducks Unlimited, Inc.

Geospatial Data Acquisition & Synthesis (continued)

Secure Data Services

Project description: This initiative intends to facilitate research within the North Slope science community through improved data sharing and collaboration. This will be achieved through the development and implementation of secure data services (SDS) protocols within the North Slope Science Catalog.

Project Lead: University of Alaska, Fairbanks, Geographic Information Network for Alaska

Partners co-funding this work: University of Alaska, Fairbanks Geographic Information Network for Alaska

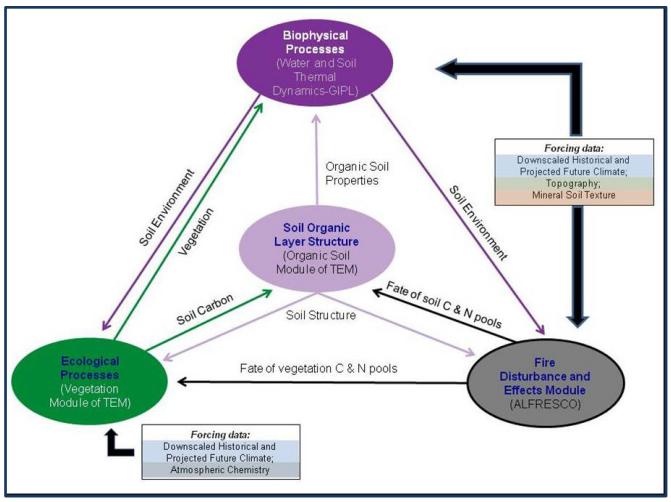
Landscape Level Monitoring & Modeling

Integrated Ecosystem Model

Project description: For this large and multi-year effort, a multi-disciplinary team of university based modelers will develop a modeling framework that integrates the driving components of vegetation succession, disturbance, hydrology, and permafrost dynamics for the state of Alaska. This framework will couple models of disturbance and vegetation succession (ALFRESCO), biogeochemistry (TEM), and permafrost (GIPL).

Project Lead: University of Alaska, Fairbanks, Scenarios Network for Alaska Planning

Partners co-funding this work: Western Alaska Landscape Conservation Cooperative and U.S. Geological Survey, Alaska Climate Science Center



Schematic illustrating how the IEM modeling framework will couple the ALFRESCO, TEM and GIPL models.

Landscape Level Monitoring & Modeling (continued)

Anaktuvuk River Fire Monitoring

Project description: In this study, BLM staff will continue to assess the recovery of tundra vegetation and changes in soil properties following the largest, highest-severity wildfire recorded on Alaska's North Slope since records began in 1956, with an emphasis on impacts to caribou forage.

Anaktuvuk River fire of 2007. Photo by Ben Jones.

Project Lead: Bureau of Land Management

Partners co-funding this work: Bureau of Land Management

To learn more about these projects and other Arctic LCC projects visit: **www.arcticlcc.org**
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

Alaska Climate-Biome Shift Model

The Big Picture

Understanding how climate change will affect species distribution and access traditional subsistence resources in the future is a challenge facing land, resource, and conservation agencies in Alaska. To develop this understanding, we need spatially explicate projections that allow managers to visualize future landscape scenarios under different climate change, as they may be altered by changing climate.

Project ID: ARCT2010-01
Year Funded – 2010
Start – April 2010
End – September 2011
Budget – $192,000

Research Partners:
University of Alaska Fairbanks'
Scenarios Network for Alaska & Arctic Planning
Ecological Wildlife Habitat Data Analysis for the Land and Seascape Laboratory
US Fish and Wildlife Service

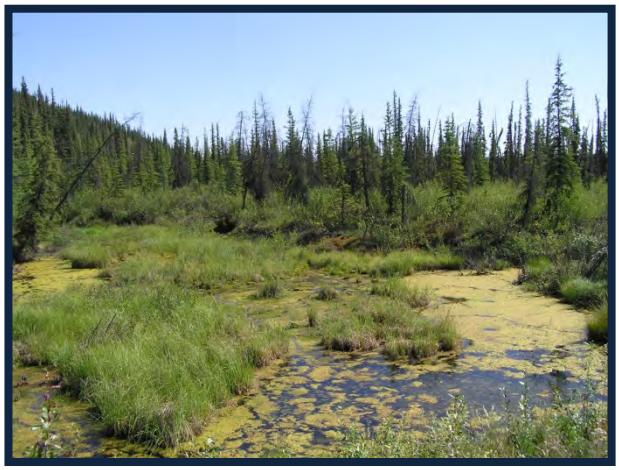
Forecasting temperature and precipitation patterns under future climate scenarios

Project Description

Researchers from the University of Alaska (UAF), The Nature Conservancy, and U.S. Fish and Wildlife Service will use 'climate envelope' models (i.e., models that infer a species' environmental requirements from locations where they are currently found) to explore how patterns in temperature, precipitation, and landcover (i.e., climate-biomes) may shift as a result of changing climate.

Why We Are Interested

The project will give managers and other stakeholders a new tool to visualize how temperature and precipitation patterns may shift as a result of climate change. This information will be useful in considering potential impacts of climate change within a given landscape, and also in designing conservation strategies.



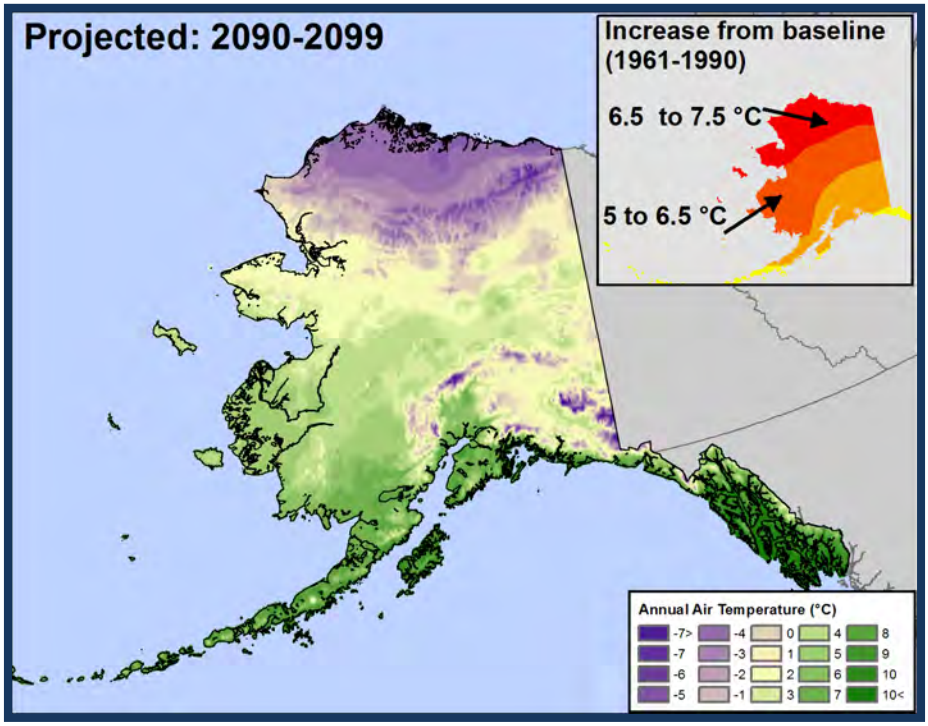
Shallow wetland in interior Alaska. Habitats such as this are sensitive to changes in both air temperature and summer precipitation. Photo by USFWS.

What Will Be Done

This project will use historical climate records for Alaska and Western Canada to identify climate-biomes seen across this region today. These climate-biome models will be coupled with future climate projections in an effort to identify areas within Alaska expected to undergo extreme change, and areas of "refugia" where temperature and precipitation patterns are expected to remain similar to what they are now.

Expected Outcomes

This modeling effort will use climate projections to produce spatially explicate models identifying areas of relative stability and areas of extreme change over the next 100 years. This information has direct applicability to conservation planning and development of vulnerability assessments species of management concern.



Projected average annual air temperature for the decade spanning 2090-2099. Temperatures are projected to increase by 6.5 to 7.5 °C (~11 to 13.5°F). Changes of this magnitude will likely result in the species composition and ultimately the biomes of Alaska and surrounding areas.

Timeline

April 2010 – April 2011: Model development.
September 2011: Final report and complete set of GIS models that represent potential climate-biomes from three different time periods.

The mission of the Arctic LCC is to identify and provide information needed to conserve natural and cultural resources in the face of landscape scale stressors, focusing on climate change, through a multidisciplinary program that supports coordinated actions among management agencies, conservation organizations, communities, and other stakeholders.

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Climate change will eventually shift the species composition and ultimately the biomes of Alaska and Western Canada.

June 2011

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

Shorebird distribution maps for Arctic Alaska

The Big Picture

As the Arctic warms, we expect widespread changes in water availability and vegetation, but it is not clear how these changes in habitat may impact bird species. Shorebirds are abundant in the Arctic, and individual species exhibit a wide range of habitat preferences. Therefore we expect differences in their response to climate change. A better understanding of each species' habitat association will provide a solid basis for predicting those responses. As a group, shorebirds may be good indicators of climate-associated ecological shifts.

Project ID: ARCT2010-02
Year Funded – 2010
Start – June 2010
End – June 2012
Budget – $246,966

Research Partners:
Manomet Center for Conservation Sciences
U.S. Fish and Wildlife Service

Using geospatial habitat modeling as a first step in assessing effects of climate change

Project Description

Researchers from the Manomet Center for Conservation Sciences will combine field observations of shorebirds with mapped physical and ecological parameters to develop a series of spatially dependent habitat selection models that predict the contemporary distribution of shorebird species across the Arctic Coastal Plain of Alaska.

Why We Are Interested

Reliably forecasting future species distribution and abundance depends on a solid foundation of empirical data. Unfortunately, the contemporary distribution of shorebirds on the Coastal Plain is poorly known, because few field observations are available. This project lays the ground-work for habitat selection models and models of future population response to climate-associated habitat change

Ruddy Turnstone (*Arenaria interpres*). Photo by USFWS

What Will Be Done

Researchers will compile existing shorebird presence/absence data and nest locations from a variety of sources (Figure 1). They will test whether species distributions are statistically related to measurable habitat characteristics, such as landcover and distance to coast. If so, they will develop habitat selection models that would describe the contemporary distribution of shorebird species across Alaska's Arctic Coastal Plain.

Expected Outcomes

This work will generate predictive models that can be used to predict the presence of various shorebird species throughout Alaska's Arctic Coastal Plain. If these models cannot be developed due to a lack of data, then this project will identify gaps that need to be filled in order to predict species response to climate change.

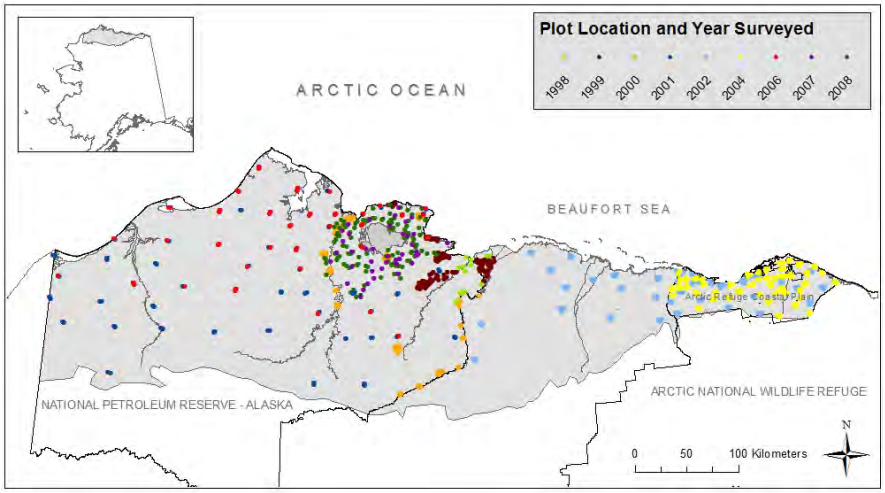

Figure 1: Location of the study area (shaded), major administrative boundaries, major riverine areas, and plots surveyed between 1998 and 2008.

Timeline

July 2011: Text Compile GIS databases on shorebird presence and absence and nest sites; identification of key physical and ecological parameters to include in the model.
July 2012: Final report and predictive models.

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Climate-mediated changes in habitat may have a profound effect on those species of shorebirds that rely on habitats on the Arctic Coastal Plain during the breeding season.

June 2011

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

Improved access to natural resource data

The Big Picture

Conservation planning for fish and wildlife species depends on reliable access to up-to-date information on species distribution. In Alaska, however, this information is not easily obtained, even by specialists. To meet this need, we are assembling web-accessible spatial datasets that describe species distribution. These products will inform near-term conservation management actions and serve as a baseline for measuring distribution change, regardless of the cause.

Project IDs:

Fishes– ARCT2010-03
Eiders – ARCT2010-10
Loons – ARCT2010-14

Year Funded – 2010
Start – July 2010
End – September 2011
Budget – $101,078

Research Partners:
Bureau of Land Management
Fish and Wildlife Service

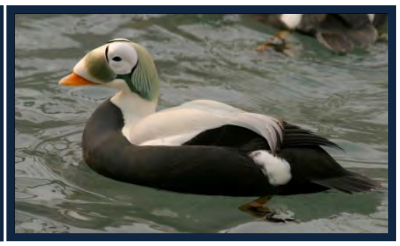
Supporting conservation planning by compiling geospatial data for species of management interest

Description

The Arctic LCC and our partners are working toward creating the first comprehensive database describing the distribution and abundance of Alaska's two threatened eider species. We are also supporting updates to a yellow-billed loon observation database, and a resident and anadromous fish distribution and abundance.

Why We Are Interested

These projects target "high-value" data sets. Better access to eider data will improve the efficiency and effectiveness of Endangered Species Act section 7 consultations and NEPA reviews that address these species. Better yellow-billed loon and fish distribution data will facilitate environmental planning and permitting processes, as well as informing water allocation decisions.



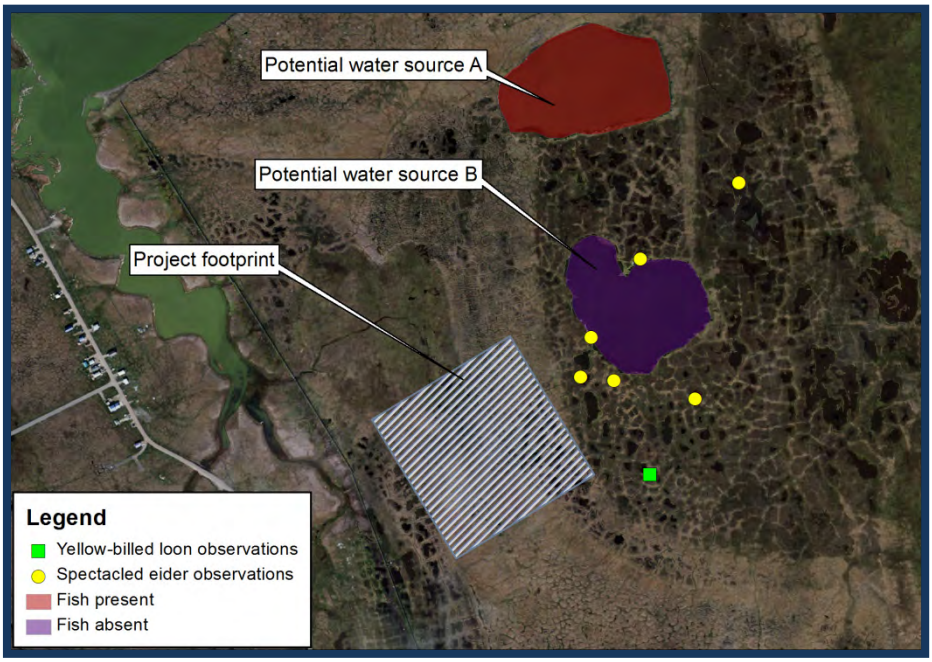
Left: Lake trout (*Salvelinus namaycush*) & *Right*: A male spectacled eider (*Somateria fischeri*).

What Will Be Done

Development of these databases requires gathering, re-formatting, and compiling data from many sources including state and federal agencies, private research firms, and individuals. When complete, these datasets will be made available through a website that can be accessed by all and viewed in either tabular or map views.

Expected Outcomes

These projects represent our first steps towards our goal of improving access to natural resource data. We intend to provide the technical and/or financial support necessary to keep these datasets as current as possible.



Example of how these three datasets could be combined and used to evaluate the environmental impacts of a potential project.

Timeline

July 2010 – August 2011: Data acquisition and synthesis.
September 2011: Spatial and tabular data will be made available to resources managers, industry, and the general public.

The mission of the Arctic LCC is to identify and provide information needed to conserve natural and cultural resources in the face of landscape scale stressors, focusing on climate change, through a multidisciplinary program that supports coordinated actions among management agencies, conservation organizations, communities, and other stakeholders.

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Improved access to natural resource data will facilitate environmental review and planning for development projects, helping to streamline permitting processes and achieve more effective conservation.

June 2011

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

Inventory and rescue of hydro-climate data

The Big Picture

Global climate models project a warmer and potentially wetter future for northern Alaska. How and where water will be distributed on the landscape is a crucial aspect of habitat change. We need to know how hydrologic processes may change under different climate scenarios, and to do that we need the most complete historical baseline possible. A first step is to inventory and compile available hydrologic and climate data.

Project ID: ARCT2010-04
Year Funded – 2010
Start – July 2010
End – February 2012
Budget – $268,000

Research Partners:
University of Alaska Fairbanks
International Arctic Research Center
Water and Environmental Research Center

First step toward developing a hydrology monitoring network in Arctic Alaska

Project Description

Researchers from the University of Alaska Fairbanks are working with state, federal, and private entities in an effort to inventory and compile data related to hydrology and climate in Arctic Alaska. These data will be used in an analysis that identifies key locations for future environmental monitoring efforts in Arctic Alaska and parameters to measure at these locations (e.g., stream flow, air and soil temperature, snow depth, and solar radiation)

Why We Are Interested

This project gathers together scarce hydrology data, currently scattered among many places and institutions, and places it within one data structure and location. While there are many uses for these data, we are most interested in their ability to inform the design of a long-term hydrologic observation network for the Arctic LCC.

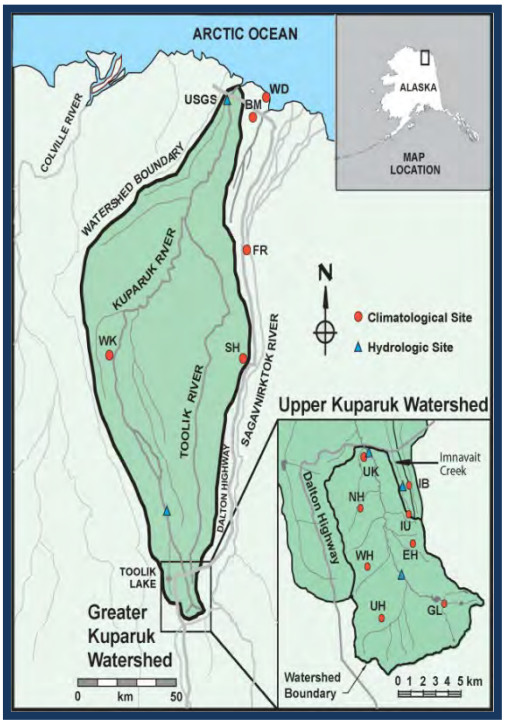
Upper Kuparuk River near the Dalton Highway. Photo credit: Rob Gieck/WERC.
http://ine.uaf.edu/werc/projects/NorthSlope/upper_kuparuk/images

What Will Be Done

This work will be completed in two phases. During phase one, we will inventory available data related to hydrology and climate in Arctic Alaska and start to compile data within a relational geodatabase. During the second phase, we will make the data accessible through the web, and use it to design an improved climate and hydrologic monitoring network for Arctic Alaska.

Expected Outcomes

This work is the first step towards developing a network of long-term monitoring sites designed to enhance our understanding of water balance in arctic habitats and improve forecasts of future habitat conditions. In the near-term, the scientific, conservation, and engineering community will benefit from the existence of a comprehensive hydro-climate database.



The Greater Kuparuk Watershed is one of the few rivers systems in Arctic Alaska with a history of long-term hydrologic monitoring. Map courtesy of Erica Betts/UAF.

Timeline

2010-2011: Inventory available hydro-climate data; design database; compile records.
February 2012: Final report that identifies key location for maintaining or re-establishing long-term monitoring.

The mission of the Arctic LCC is to identify and provide information needed to conserve natural and cultural resources in the face of landscape scale stressors, focusing on climate change, through a multidisciplinary program that supports coordinated actions among management agencies, conservation organizations, communities, and other stakeholders.

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Changes in water balance are expected to occur as the Arctic warms, but given the scant historical record, they may be difficult to document. Compiling data collected by numerous institution into a single database will help analyze trends.

June 2011

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

Integrated Ecosystem Model (IEM) for Alaska

The Big Picture

The physical and biotic components of arctic and boreal ecosystems - permafrost, hydrology, disturbance (e.g., fire), and vegetation - are tightly linked and sensitive to climate change. Managers need tools to visualize potential future landscapes that result from the interaction of ecosystem components and physical processes. IEM provides a framework for forecasting ecosystem change and will help with vulnerability assessments, and guide inventory and monitoring activities.

Project ID: ARCT2010-05
Year Funded – 2010
Start – February 2010
End – September 2011
Budget – $410,000

Research Partners:
UAF
The Wilderness Society

Improving our understanding of ecosystem change in response to changing climate

Project Description

Researchers from the University of Alaska Fairbanks (UAF) and collaborators from The Wilderness Society developed a framework for linking several existing models to produce a single integrated model that simulates vegetation succession, disturbance regimes, hydrology, and permafrost dynamics. The ultimate goal is to produce maps for the entire state that forecast ecological conditions under specified climate scenarios.

Why We Are Interested

Researchers have developed three models that forecast the response of permafrost, vegetation communities, and fire to changing climate. These models provide important information on how the Alaskan landscape may respond to climate change. However, an integrated model would provide resource managers with more accurate forecasts of future habitat conditions, in a more useable form.

Post-fire succession in Interior Alaska, Mark Bertram/USFWS.

What Was Done

Work completed in 2010-2011 was the first stage of a multi-year effort to develop a model (Fig. 1) that combines output from Boreal-ALFRESCO, the Terrestrial Ecosystem Model (TEM), and the Geophysical Institute Permafrost Model-1 (GIPL-1). Using climate projections from two Global Circulation Models and the Yukon River basin as a study area, researchers linked fire regime outputs of ALFRESCO to TEM, thus simulating the impact of fire on soils. Moss and organic layer thickness outputs from TEM were then used to drive the GIPL-1.

Outcomes

Simulations by the GIPL-1 model driven by ALFRESCO coupled with TEM organic layers indicate fire produces significant changes in ground temperatures and permafrost throughout the 21st Century. These results suggest that there are important linkages between the fire regime, forest composition, and the structure of soil organic horizons that influence the vulnerability of permafrost degradation in interior Alaska.

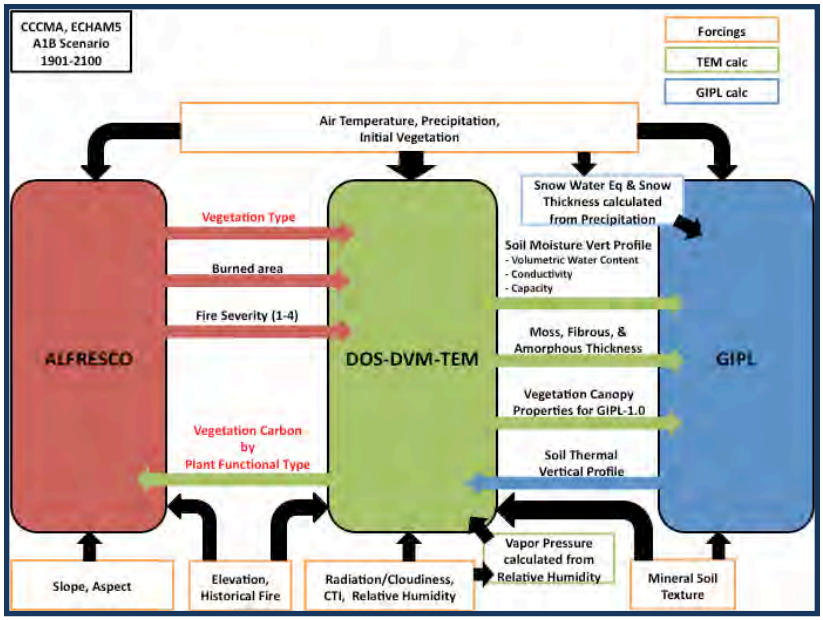

Figure 1: Modeling framework for proposed synchronous coupling among ALFRESCO, TEM and GIPL-1.

Reports & Publications:

Rupp, T. S. et al. 2012. *Integrated Ecosystem Model for Alaska*. Final report prepared for the Arctic Landscape Conservation Cooperative, Fairbanks, Alaska. 30p.
http://arcticlcc.org/projects/landscape/integrated-ecosystem-model-iem-for-alaska/

The mission of the Arctic LCC is to identify and provide information needed to conserve natural and cultural resources in the face of landscape scale stressors, focusing on climate change, through a multidisciplinary program that supports coordinated actions among management agencies, conservation organizations, communities, and other stakeholders.

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The IEM will improve our understanding of ecosystem change in response to changing climate and also could inform the structure, design, and location of monitoring activities across agencies.

January 2012

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

Linking Climate, Stream Flow, and Fish Migration

The Big Picture

Fish on the North Slope rely on seasonal migrations to access spawning, summer feeding, and overwintering areas. To complete their annual cycle, fish migrate between main stem rivers, small headwater streams, deep lakes, and shallow ponds. Maintaining surface water connectivity between these habitats is essential for successful migration. These ephemeral waterways are sensitive to changes in precipitation. This work will help managers identify fish populations whose seasonal migrations may be impacted by a warmer, drier Arctic.

Project ID: ARCT2010-06
Year Funded – 2010
Start – July 2010
End – June 2012
Budget – $100,244

Research Partners:
UAF, Water and Environmental Research Center

Understanding how changing climate could influence fish migration on the North Slope

Project Description

Researchers from the University of Alaska Fairbanks (UAF) will develop a model that examines the relationship between measured steam flow and surface water connectivity between summer feeding and overwintering habitats for fish on the North Slope. Work initiated in 2010 will focus on the Upper Kuparuk River (Figure 1).

Why We Are Interested

Recent observations suggest that portions of some North Slope stream-beds become dry during brief periods in later summer and early fall. This is cause for concern because climate models forecast even drier summers in the future. This could pose a problem for migrating fish, which must be able to move back and forth from breeding and summer feeding areas to scarce overwintering sites.

Upper Kuparuk River during the drought of 2005. Note the dry streambed. Photo courtesy of Doug Kane/UAF.

What Will Be Done

This work uses the best available long-term stream gaging data set for the North Slope (the upper Kuparuk River watershed) to develop a model to assess the vulnerability of stream systems to periodic drought, and the vulnerability of migrating fish to a temporary loss of stream flow. The project complements studies of fish migration and ecology conducted by US Fish and Wildlife Service and Woods Hole Marine Biological Laboratory.

Expected Outcomes

This project will establish a relationship between streamflow and water depth within the portions of the Kuparuk River that are prone to drying. Using these data, researchers will develop a hindcast model to explore the frequency, timing, and duration of low flow events over the years for which we have steamflow data.

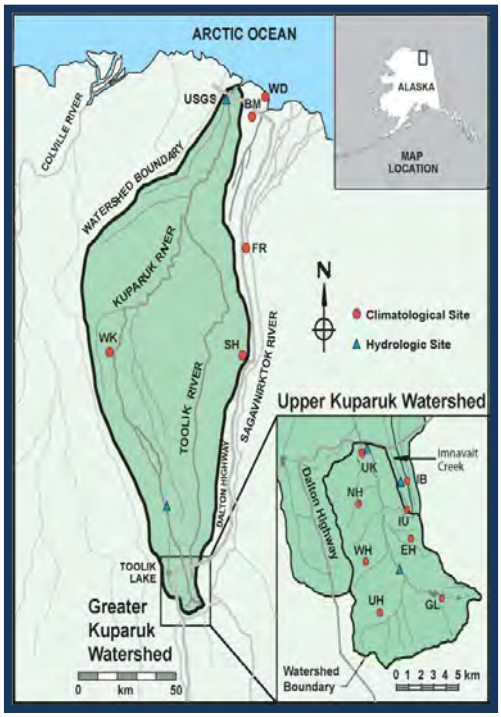

Figure 1. Location of stream gages, meteorological stations, and project locations on the North Slope of Alaska

Timeline

July 2010 – May 2012: Field work and model development
June 2012: Report of manuscript summarizing results of data analysis and models.

The mission of the Arctic LCC is to identify and provide information needed to conserve natural and cultural resources in the face of landscape scale stressors, focusing on climate change, through a multidisciplinary program that supports coordinated actions among management agencies, conservation organizations, communities, and other stakeholders.

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This project represents the necessary first step towards quantifying the importance of low water conditions and fish migration on the North Slope of Alaska.

May 2011

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

Monitoring glaciers & rivers in Arctic Alaska

The Big Picture

The overarching goal of this work is to integrate study of McCall Glacier with other research on the impacts of climate change on the landscape of Arctic Alaska. Glaciers in the Eastern Brooks Range supply water to rivers systems that support important Dolly Varden subsistence fisheries. Recent work suggests that these glaciers are melting quickly and will likely be lost by the end of the century. Managers and subsistence users need a better understanding of how these systems may change after these glaciers melt.

Project ID: ARCT2010-07
Year Funded – 2010
Start – July 2010
End – December 2014
Budget – $240,000

Research Partners:
University of Alaska Fairbanks

Understanding the impacts of climate change on glacier dominated systems in the Arctic

Project Description

Researchers from the University of Alaska Fairbanks (UAF) will investigate glacier-climate interactions within the Arctic National Wildlife Refuge, including impacts of glacier change on the downstream aquatic ecosystems. This work builds upon the only long-term monitoring program of glaciers in Arctic Alaska.

Why We Are Interested

Glaciers in the Brooks Range of Arctic Alaska are losing ice mass at an accelerating rate, and if current trends continue, the glaciers will disappear over the next century. When the glaciers disappear, streamflow in rivers such as the Jago, Okpilak, and Hulahula will decrease (Figure 1). Diminished flows, will affect local fisheries and the subsistence users that depend on them, and likely result in changes to conditions in coastal estuaries.

A B

Images of McCall Glacier, Brooks Range Alaska. Image "A" taken in 1958 by Austin Post; image "B" was taken in 2003 by Matt Nolan.

What Will Be Done

The baseline efforts include primarily the maintenance of the long-term monitoring on McCall Glacier. In addition, this work will include measurement of mass balance on McCall Glacier and site investigations of Esetuk Glacier for a short-term comparison study of mass balance and glacier-climate interactions. This project complements streamgaging activities on both the Hulahula and Jago rivers.

Expected Outcomes

Results from this project, combined with other research activities, will foster a better understanding of just how much of the water in the Hulahula and Jago river systems is derived from glacier meltwater. With this understanding, researchers will have a better sense of what water levels in these systems may be in the future and how that may impact stream ecology and subsistence fisheries.

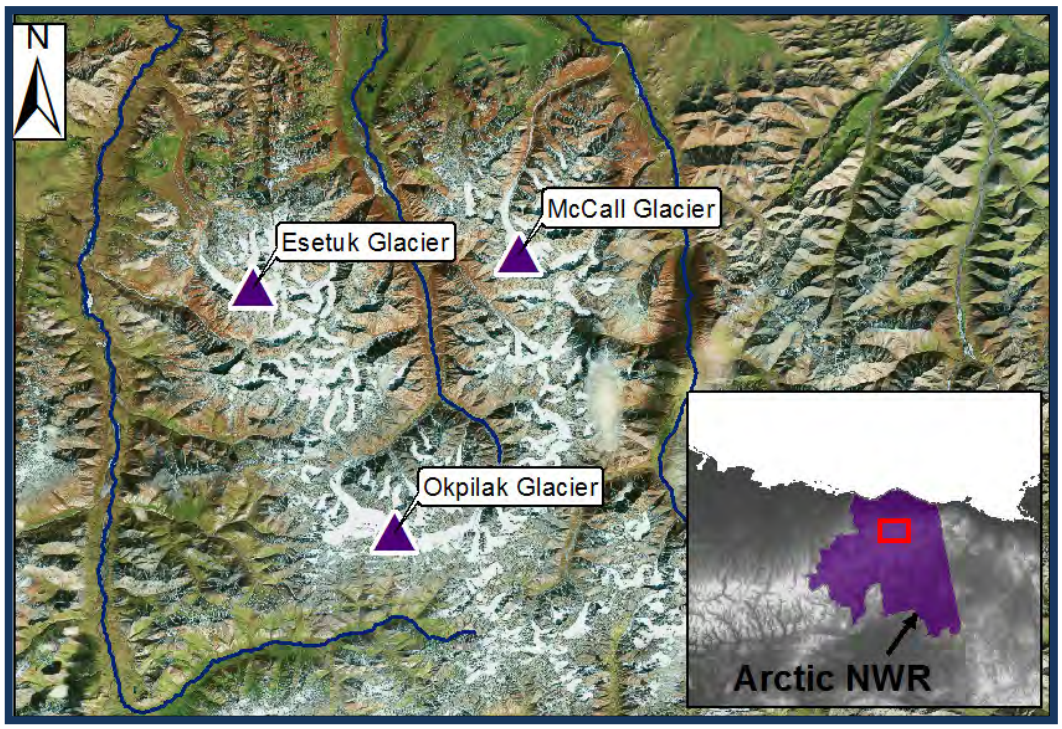

Figure 1: Location of selected glaciers within Arctic NWR (see inset). McCall Glacier drains into the Jago River; Okpilak Glacier drains into the Okpilak River; and Esetuk Glacier drains into the Hulahula River.

Timeline

Summer 2010 – Summer 2014: Field work
Fall 2014: Report and/or manuscript detailing results of this investigation.

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The rate at which glaciers in Arctic Alaska are losing ice is accelerating and if current trends continue, glaciers within the Brooks Range will disappear over the next century

June 2011

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

River monitoring in Arctic Alaska

The Big Picture

There are far fewer stream gages in Alaska than in other comparably size parts of the U.S. The result is a lack of baseline hydrological data for streams in Alaska's Arctic. Without these data it is difficult to understand current flow regimes and projecting future streamflow becomes difficult at best. To help meet this need, the Arctic LCC is contributing to streamflow monitoring in five river systems

Project IDs:
Kuparuk and Putuligayuk – ARCT2010-08
Canning and Tamayariak – ARCT2010-12
Hulahula River – ARCT2010-13

Year Funded – 2010
Budget – $245,000

Research Partners:
University of Alaska Fairbanks' Water and Environmental Research Center
North Slope Science Initiative
US Geological Survey
US Fish and Wildlife Service

Contributing to an improved understanding of Arctic hydrologic systems

Project Description

The Arctic LCC and partners are supporting stream gages in five different river systems. The rivers being monitored fall into three broad categories: glacial streams originating in the Brooks Range (Hulahula river), streams with only minor glacial input (Kuparuk, Canning & Tamayariak rivers), and non-glacial streams that are contained entirely within the Arctic Coastal Plain, such as the Putuligayuk River (Figure 1).

Why We Are Interested

Rivers in Alaska Arctic will likely respond differently to climate change depending on the source of water (e.g., glacier-fed systems vs. precipitation driven systems). Unfortunately, hydrologic data for these rivers are sparse, and fewer still have associated long-term (> 20+ year) datasets. This lack of baseline information hinders our ability to assess long-term alterations in streamflow due to changing climate conditions.

A B

Examples of glacier-influenced (A) and precipitation-driven (B) river systems. Both systems are sensitive to changes in air temperature and summer precipitation, but will likely respond differently. Photos by USFWS.

What Will Be Done

Arctic LCC provided stop-gap funding to continue long-term stream monitoring of the Kuparuk and Putuligayuk rivers and contributed funds in support of stream gaging programs on the Canning and Tamayariak Rivers. We also provided support for installation of a new stream gage on the Hulahula River that will be in operation for a period of 5 years.

Expected Outcomes

The streamgages, in combination with other LCC projects are intended to build toward establishment of a Hydrologic Monitoring Network. These data will be integrated into the Arctic LCCs hydroclimatological database (see project ARCT2010-04). This will improve our understanding of water availability across the North Slope and will inform models that project how water balance may change under a scenario of continued arctic warming.

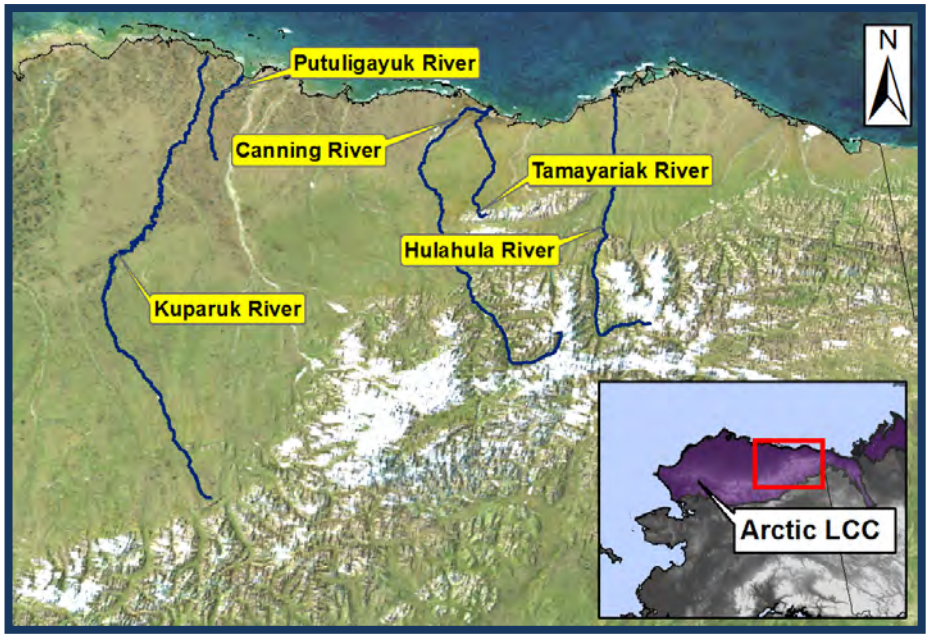

Figure 1: Location of rivers where the Arctic LCC is contributing to stream monitoring efforts. The Kuparuk and Putuligayuk rivers are the only two systems in Arctic Alaska for which we have long-term datasets.

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These datasets are invaluable to modeling efforts that forecast stream flows under scenarios of changing climate, and the associated changes in the ecology of rivers, floodplains, and nearshore marine environments.

July 2011

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

Arctic Lake Drainage

The Big Picture

Lakes of the Arctic Coastal Plain of northern Alaska provide essential habitat for many species of water birds and fish. In this low-precipitation environment, abundant lakes persist because of low temperatures and the presence of continuous permafrost. These habitats, therefore, are uniquely vulnerable to the effects of a warming climate. The Arctic Lake Drainage project provides managers with a spatially explicit model of projected landscape change due to lake drainage.

Project ID: ARCT2010-09
Year Funded – 2010
Start – July 2010
End – September 2011
Budget – $94,000

Research Partners:
Geophysical Institute, UAF
Alaska Science Center, U.S. Geological Survey

Vulnerability to climate change and projection of future lake loss on the North Slope

Project Description

Researchers from the University of Alaska Fairbanks (UAF) and U.S. Geological Survey developed a spatially explicit model that identifies relative risk of individual lakes to drainage due to natural geomorphic processes that may be enhanced in a warmer climate. This work was focused on lakes located across a vast region of western Arctic Coastal Plain and portions of the National Petroleum Reserve–Alaska (Fig. 1).

Why We Are Interested

Mean annual air temperature in Arctic Alaska is projected to increase 7°C by 2100 (5-7 times the national average). A warming climate will influence permafrost in ways that can either promote or jeopardize the persistence of individual lakes. Understanding the potential changes in the abundance and distribution of these habitats is an important first step in assessing the vulnerability of species that depend on them.

A lake recently 'tapped' by rapid erosion of the Beaufort Sea coastline. Note the drainage way bisecting the lake basin. Photo courtesy of Benjamin Jones/USGS.

What Was Done

Researchers developed a spatially explicit model that projects the relative vulnerability of individual lakes to drainage as a function of permafrost conditions and topography. This model was used to generate maps that identify lakes at risk of draining during the 21st Century.

Outcomes

Based on drainage gradients and historical lake expansion rates, researchers identified 36 lakes in the year 2025 class, 167 lakes in the year 2050 class, and 452 lakes in the year 2100 class as being at risk of draining. Because changes in air temperature and precipitation may increase lake expansion rates, the model was run using a scenario which assumes lake expansion at twice the historical rate. Under this scenario, they identified 206, 452, and 1,966 lakes at risk of draining by the years 2025, 2050, and 2100, respectively.

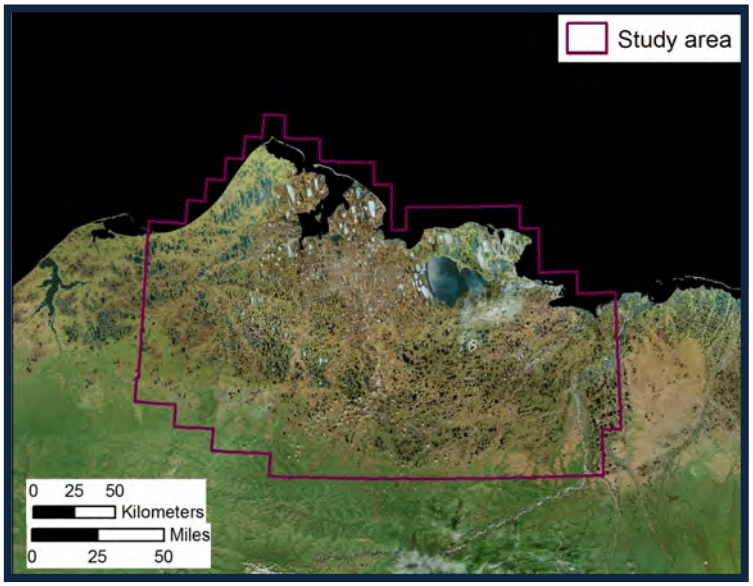

Figure 1: Western Arctic Coastal Plain study area. Image courtesy of SDMI-GINA (www.alaskamapped.org).

Reports & Publications

Grosse, G. and B. Jones. 2012. *Thermokarst Lake Drainage - Vulnerability to Climate Change and Prediction of Future Lake Habitat Distribution on the North Slope*. Project summary prepared for the Arctic Landscape Conservation Cooperative, Fairbanks, Alaska. 3p.

Jones, B., Grosse, G., Jenkins, J., Martin, P. 2010 (in prep). Analysis of drainage gradients using a digital elevation model and development of a lake drainage potential dataset for the western Arctic Coastal Plain of northern Alaska.

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Warming of air and water temperature will likely increase erosion of permafrost along lake shores allowing some lakes to grow . Other lakes, however, may be susceptible to sudden drainage and convert to a different habitat.

January 2012

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
or Philip Martin, Science Coordinator at philip_martin@fws.gov

Shorebird Demographics and Climate Change

The Big Picture

Arctic shorebirds are declining and climate-associated habitat change could further impact population levels. The goal of the Arctic Shorebird Demographic Network is to better understand the causes of shorebird declines by studying their demography (e.g., nest success, and adult survival). This information will help managers develop conservation strategies that tackle the most pressing problems facing these species.

Project ID: ARCT2010-11
Year Funded – 2010
Start – July 2010
End – June 2012
Budget – $187,787

Research Partners:
Manomet Center for Conservation Sciences
Kansas State University
Simon Fraser University
USFWS
Environment Canada
Wildlife Conservation Society
Trent University
Cornell University
University of Quebec

Enhancing our understanding of how shorebirds may respond to a changing Arctic

Project Description

The Arctic Shorebird Demographic Network (Network) is an international collaboration dedicated to gaining a better understanding of why arctic-nesting shorebirds are in decline and determine which life history stage (i.e., breeding success vs. adult survival) is limiting shorebird population growth or driving declines.

Why We Are Interested

This work will enhance our understanding of how shorebirds may respond to climate-driven changes, such as changes in food resources, snow cover, surface water, and availability coastal habitats. This knowledge is critical to development of contemporary species-habitat association maps and models that allow managers to explore projections of future shorebird distribution under different climate scenarios.

Long-billed Dowitchers (*Limnodromus scolopaceus*) foraging for invertebrate prey. Photo by USFWS.

What Will Be Done

Researchers established a network of sites (figure 1) where they collect information on shorebird breeding success and a suite of environmental variables, such as distribution of surface water, phenology of invertebrates, and air temperature, that may influence shorebirds and are likely affected by climate change. These parameters will be correlated with measures of shorebird distribution, ecology, and demography.

Expected Outcomes

This work will enhance our ability to target conservation activities in the places and for the species in which the need is greatest. The accompanying habitat studies will allow us to integrate the long-term climate-change outlook into these activities.

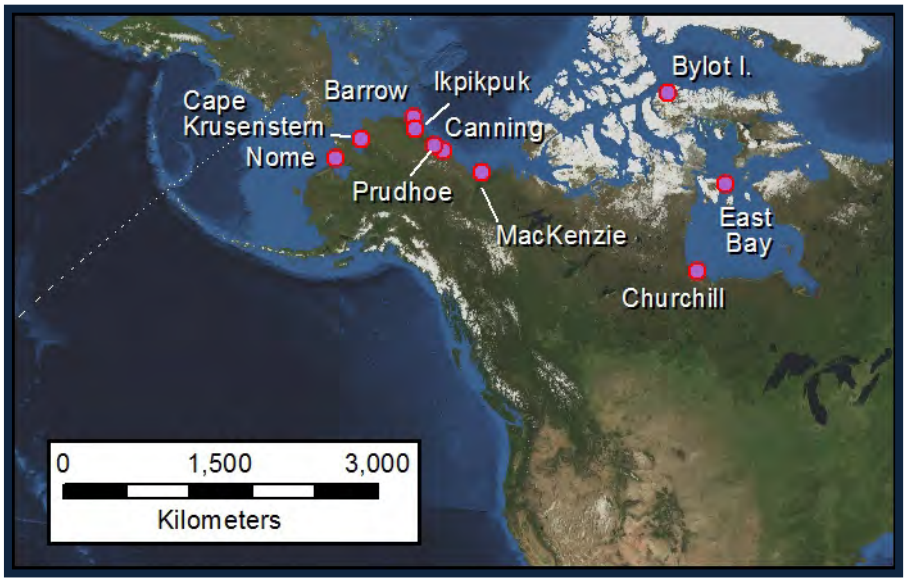

Figure1: Location of Network sites in 2010. The Nome site is operated by Kansas State University & Simon Fraser University; Cape Krusenstern & Barrow sites are operated by the USFWS; Ikpikpuk and Prudhoe Bay sites are operated by the Wildlife Conservation Society; Canning River site is operated jointly by the USFWS & Manomet, Inc.; Mackenzie Delta site is operated by the Environment Canada; East Bay site is operated by Environment Canada & Paul Smith Consulting; Churchill site is operated by Trent University & Cornell University: Bylot Island is operated by the University of Quebec at Rimouski.

Timeline

Summer season 2010 –2012: Field work and data synthesis. The Network hopes to continue work at least through 2014.

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Data collected by the Network and their collaborators will allow researchers to assess the potential impacts of climate change on shorebirds breeding in the Arctic.

June 2011

To learn more about this project and other Arctic LCC projects visit: arcticlcc.org
or contact Greg Balogh, Coordinator at greg_balogh@fws.gov
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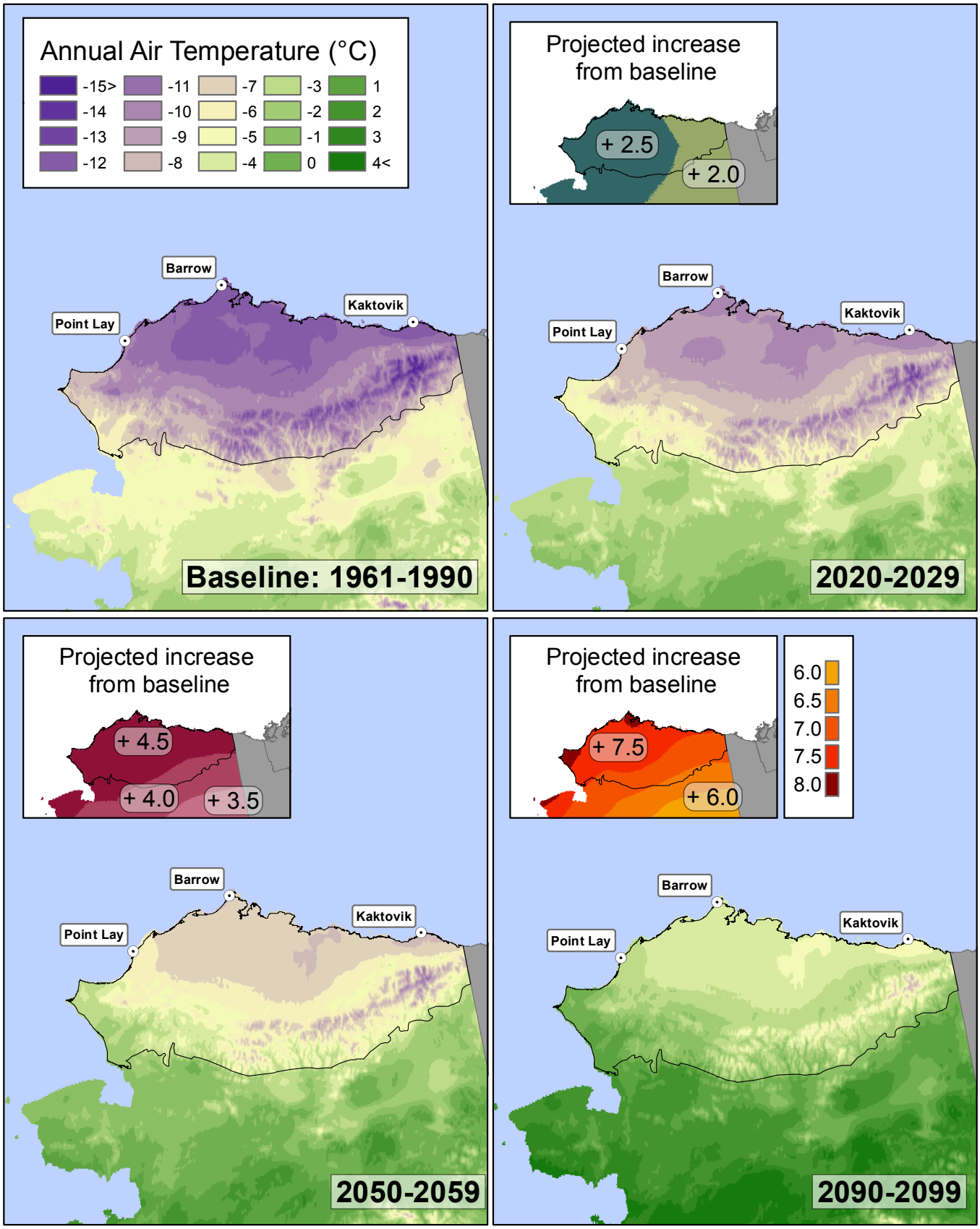
Mean annual air temperature for a 30-year baseline and three future decades.



Maps created by Arctic Landscape Conservation Cooperative Staff. Data courtesy of Scenarios Network for Alaska & Arctic Planning. Baseline data derived from the Climate Research Unit (CRU) and projected air temperatures are from the 5-model composite, **A1B** emission scenario. Insets depict projected change (degree C) from baseline for three future time periods. Alaska portion of the Arctic LCC terrestrial boundary is depicted by a black line.
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Updated September 14, 2011

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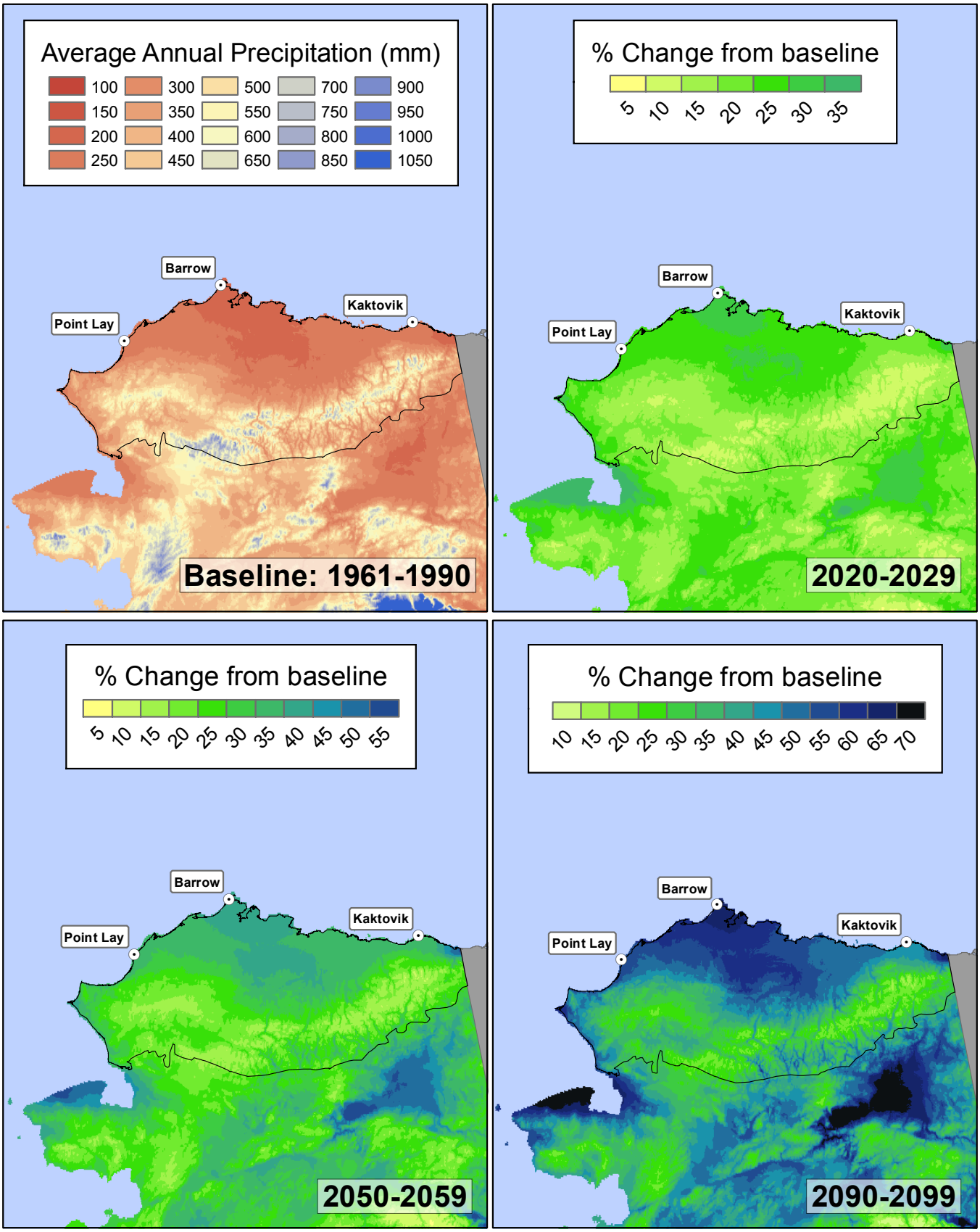

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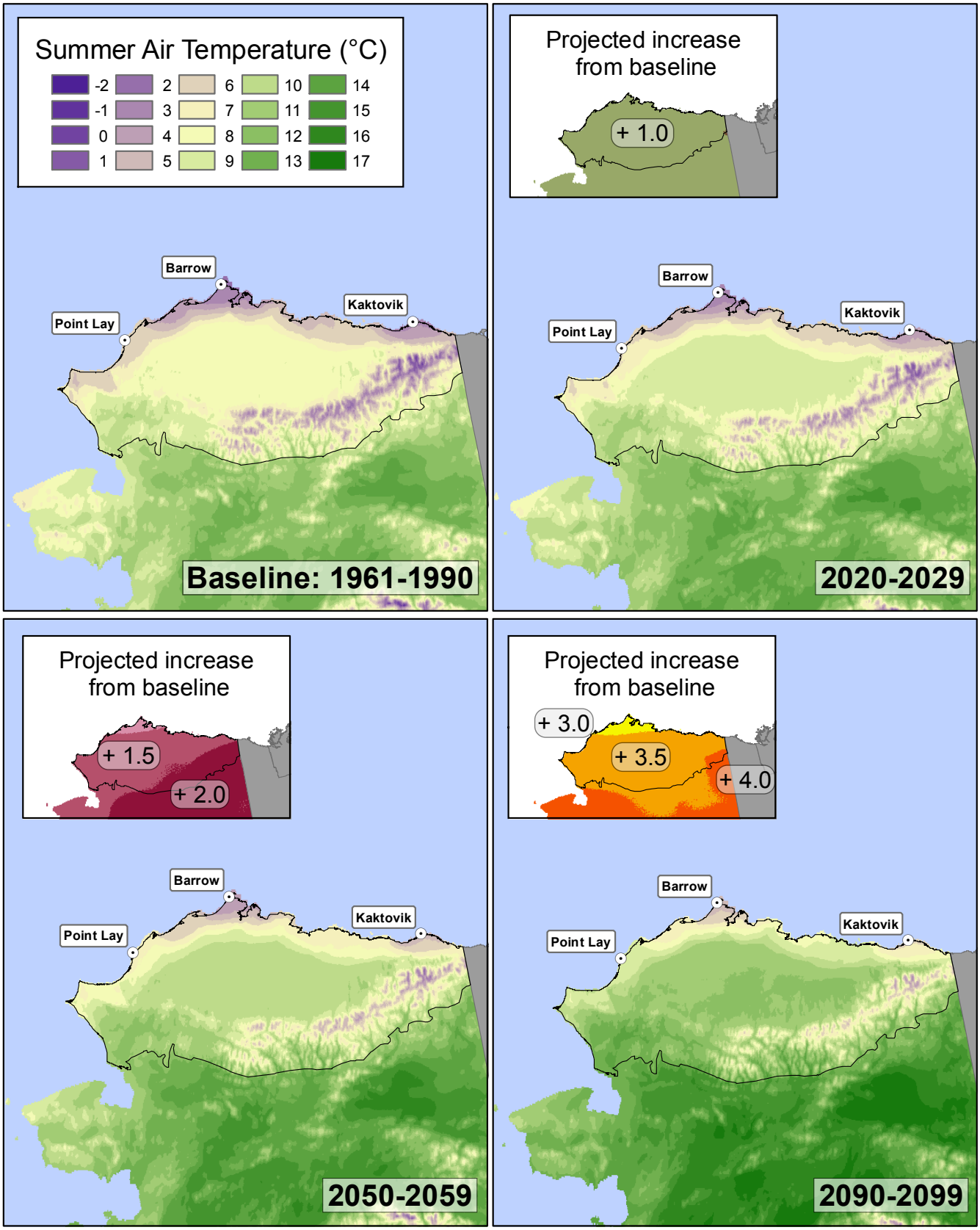

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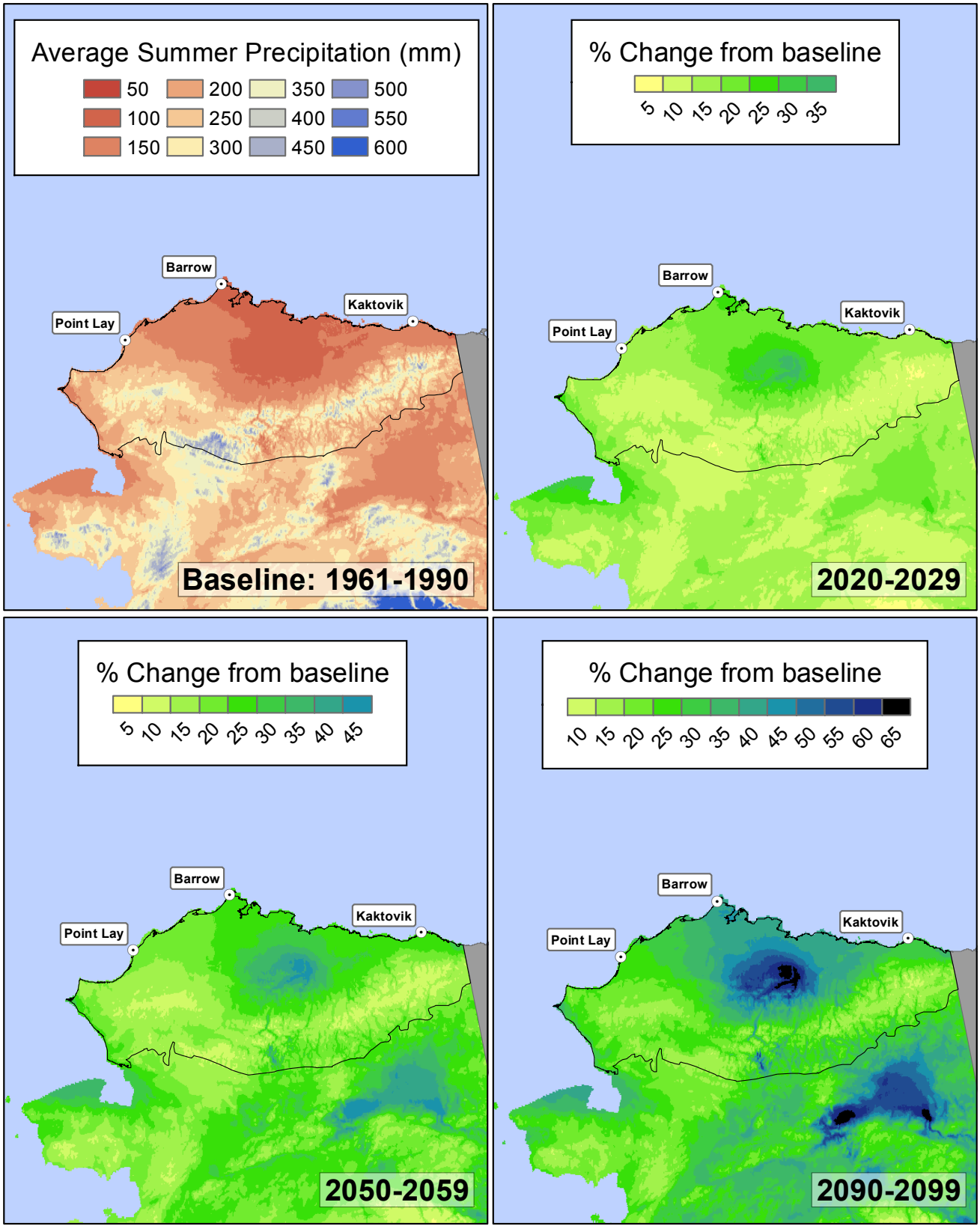

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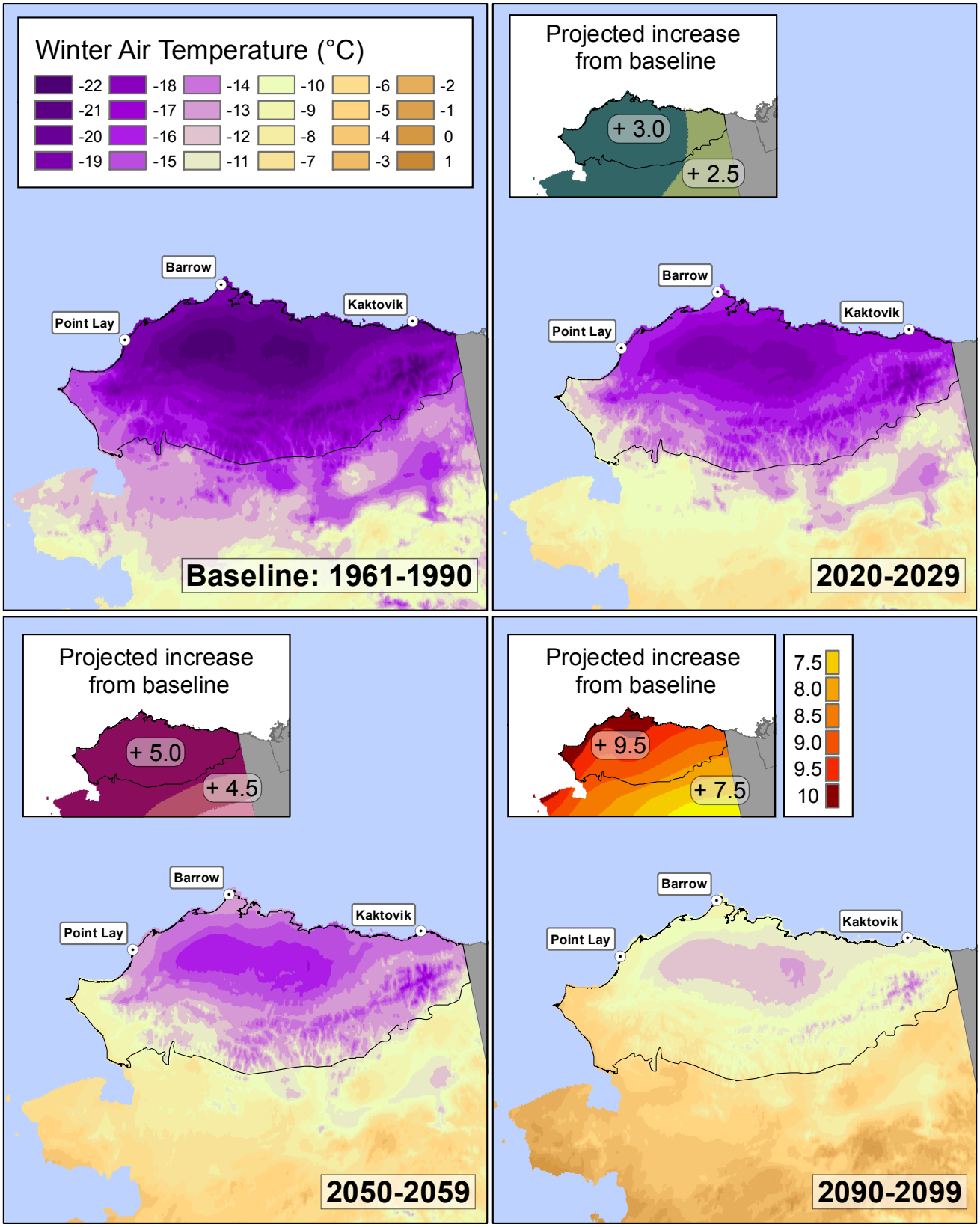

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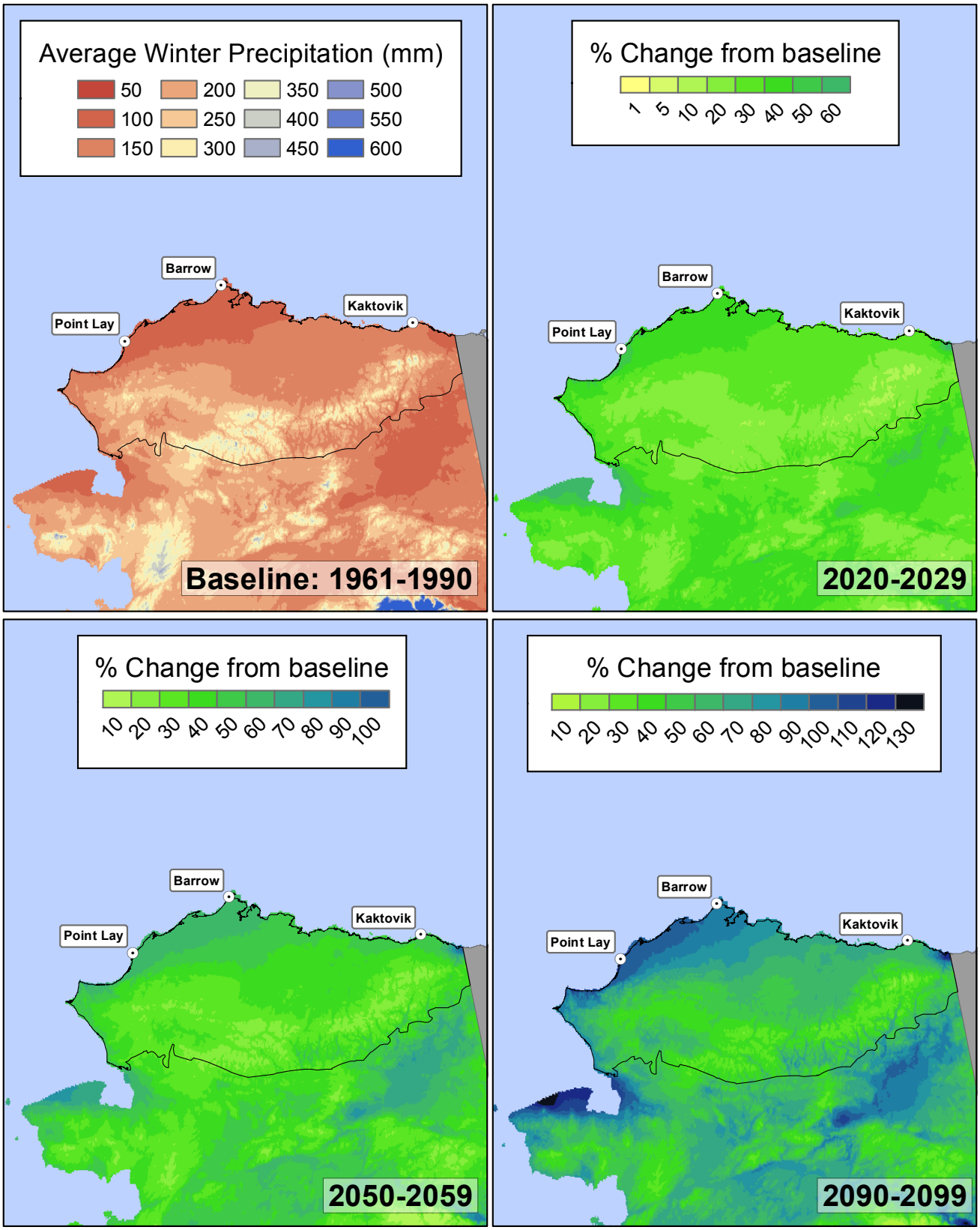

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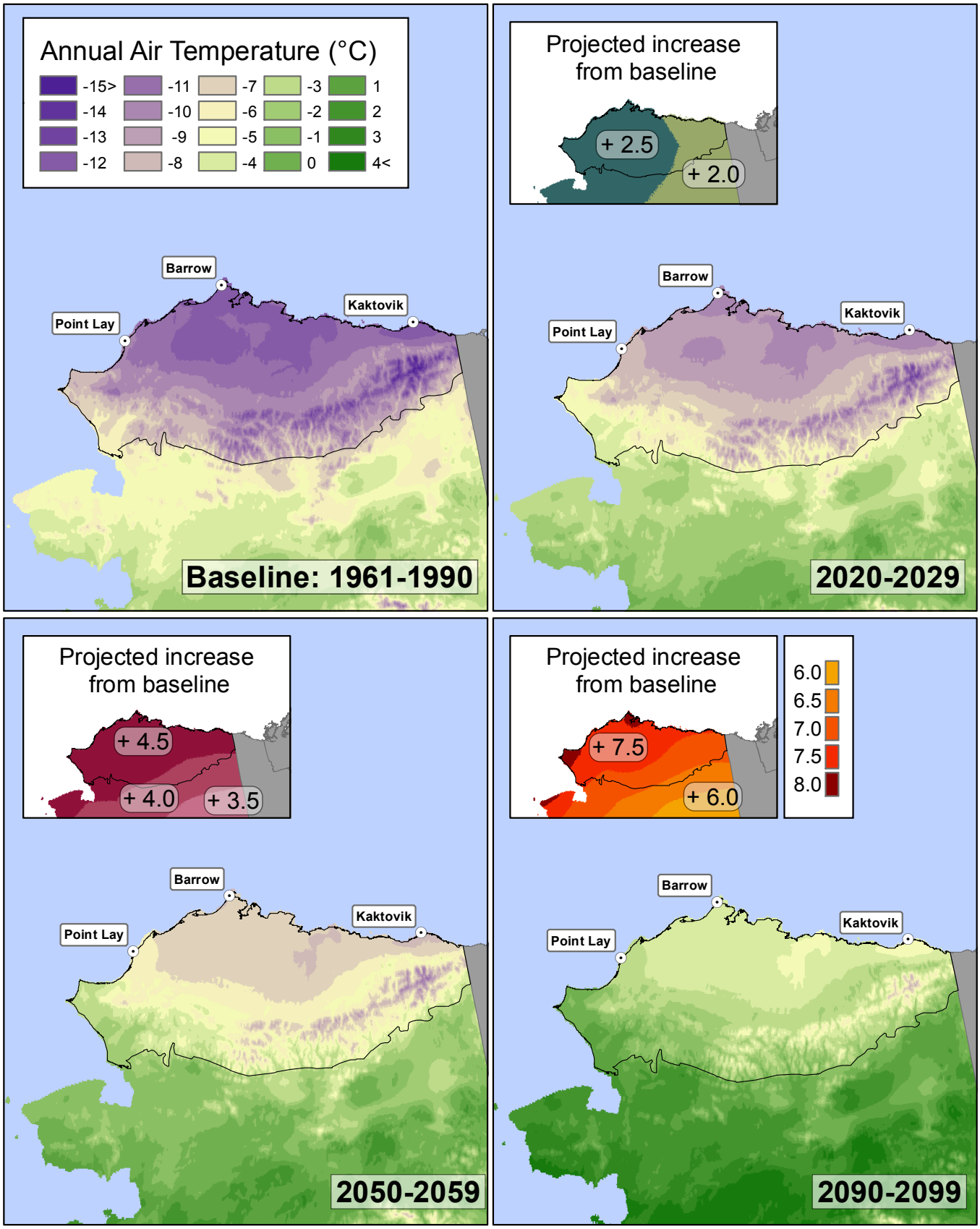

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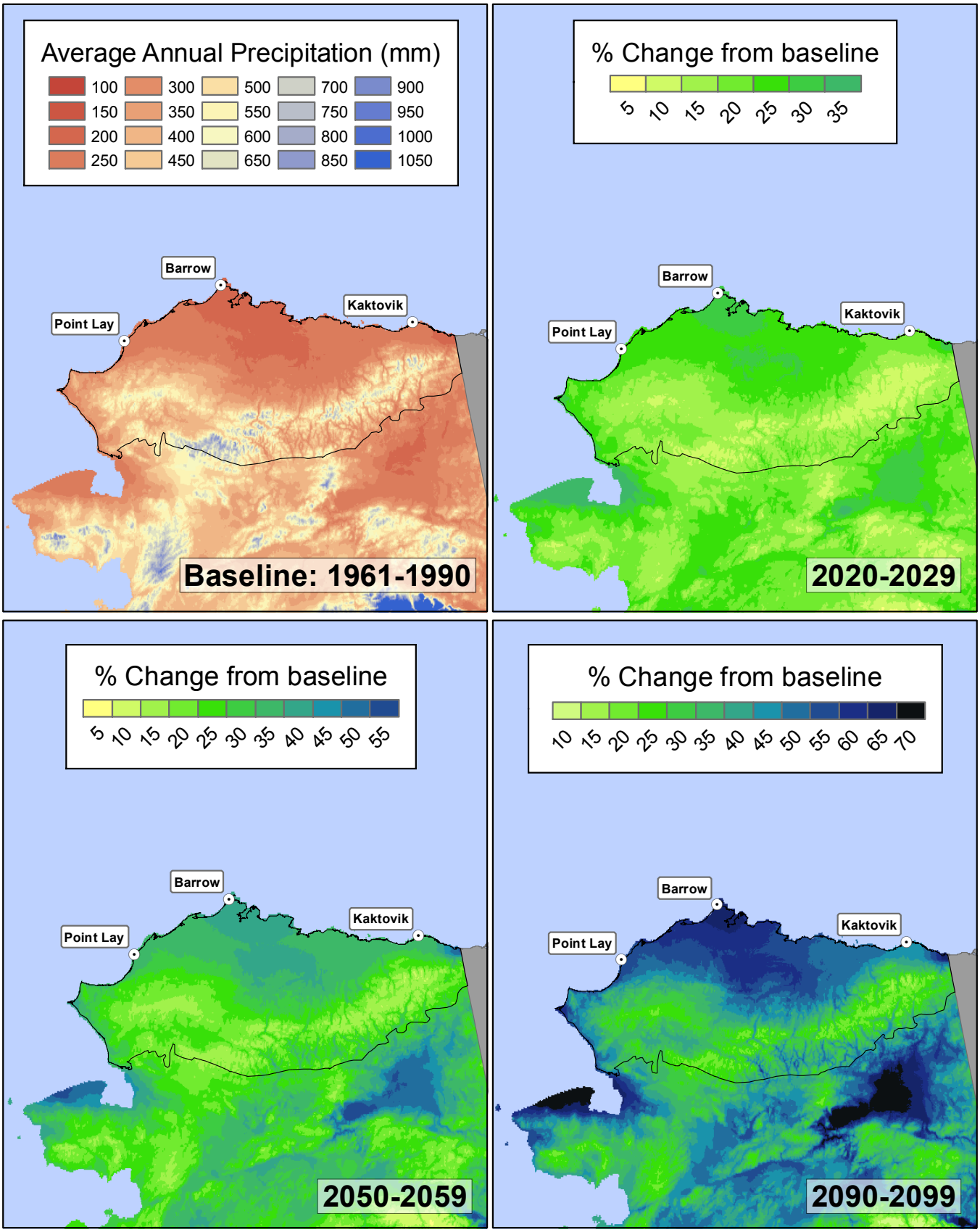

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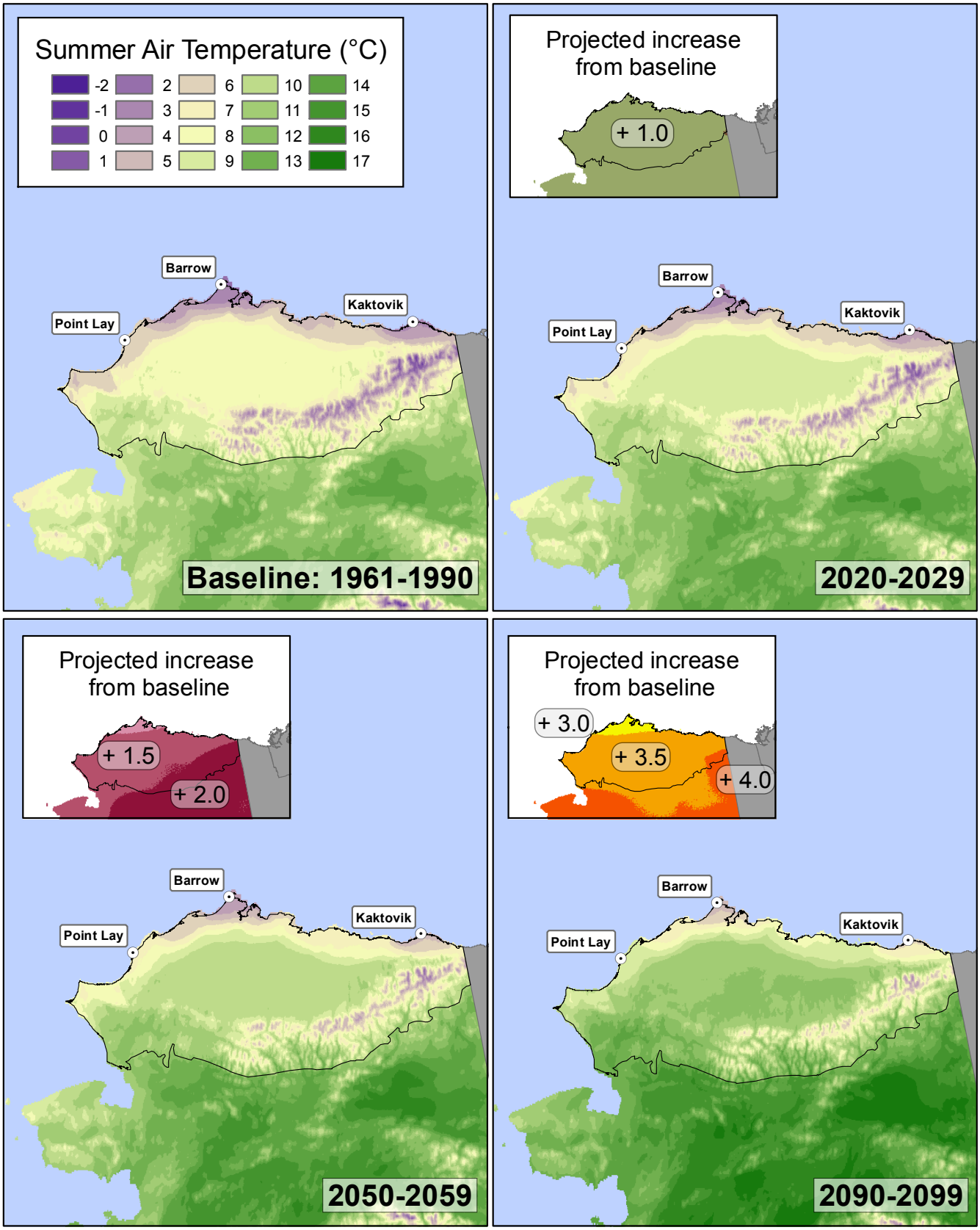

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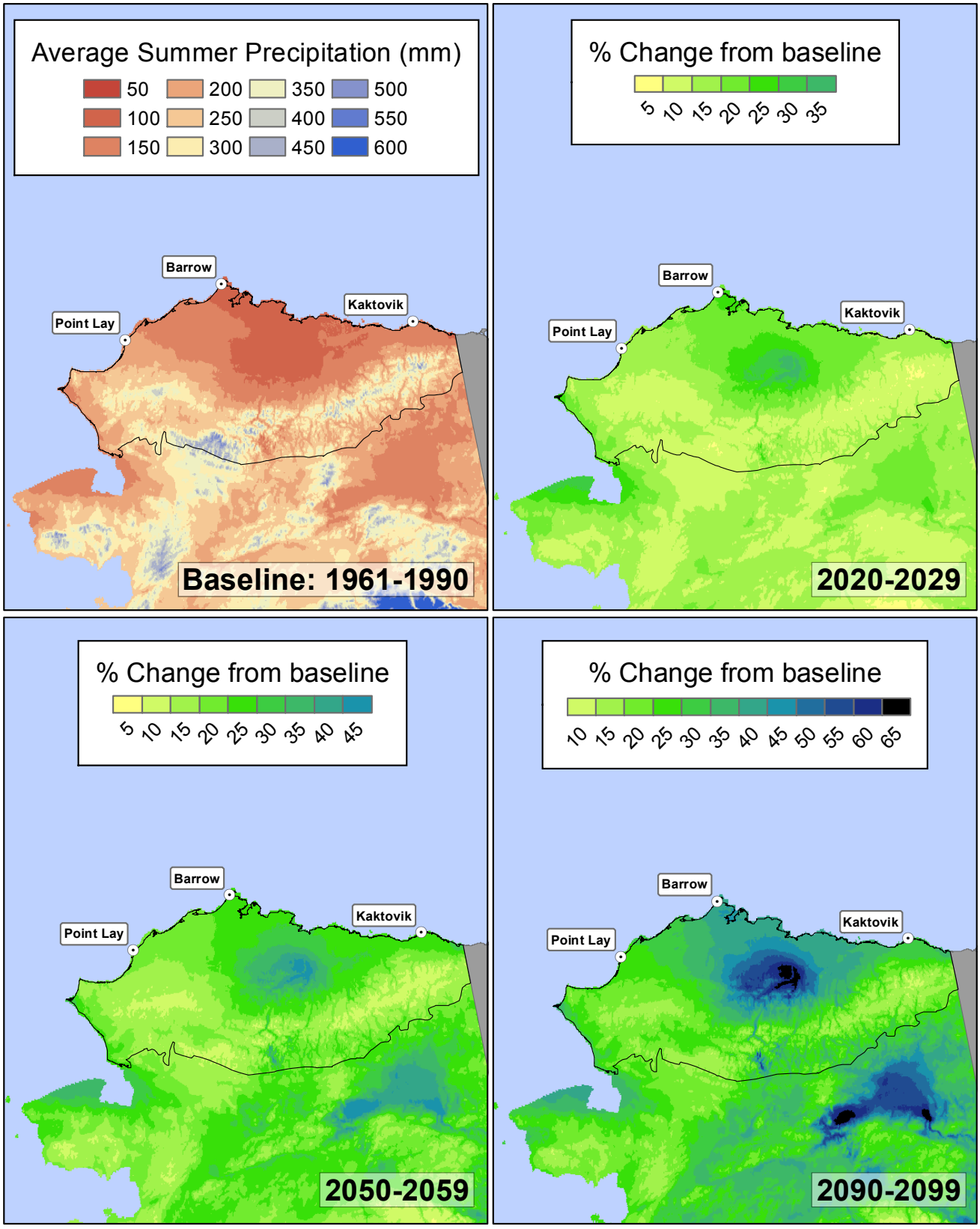

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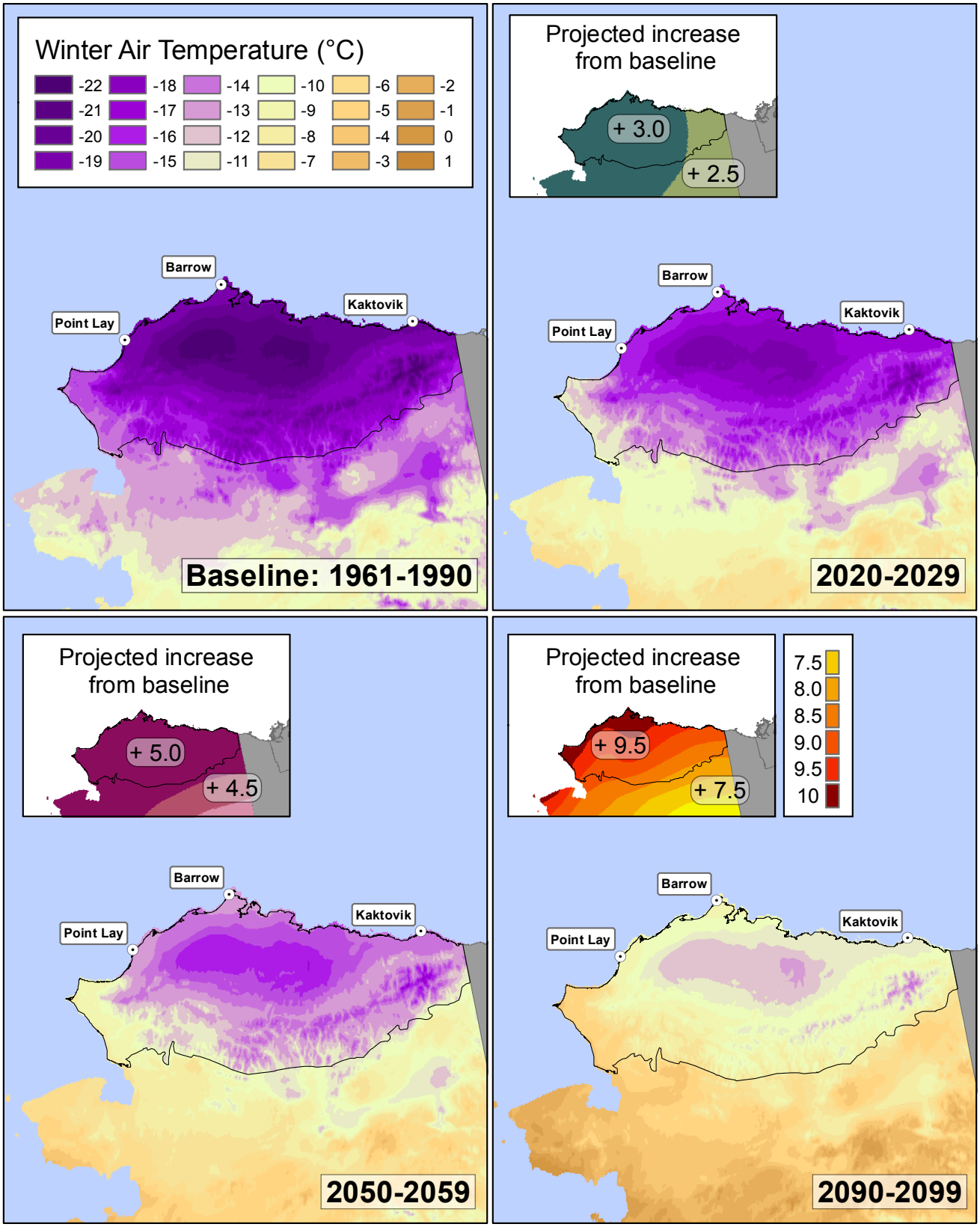

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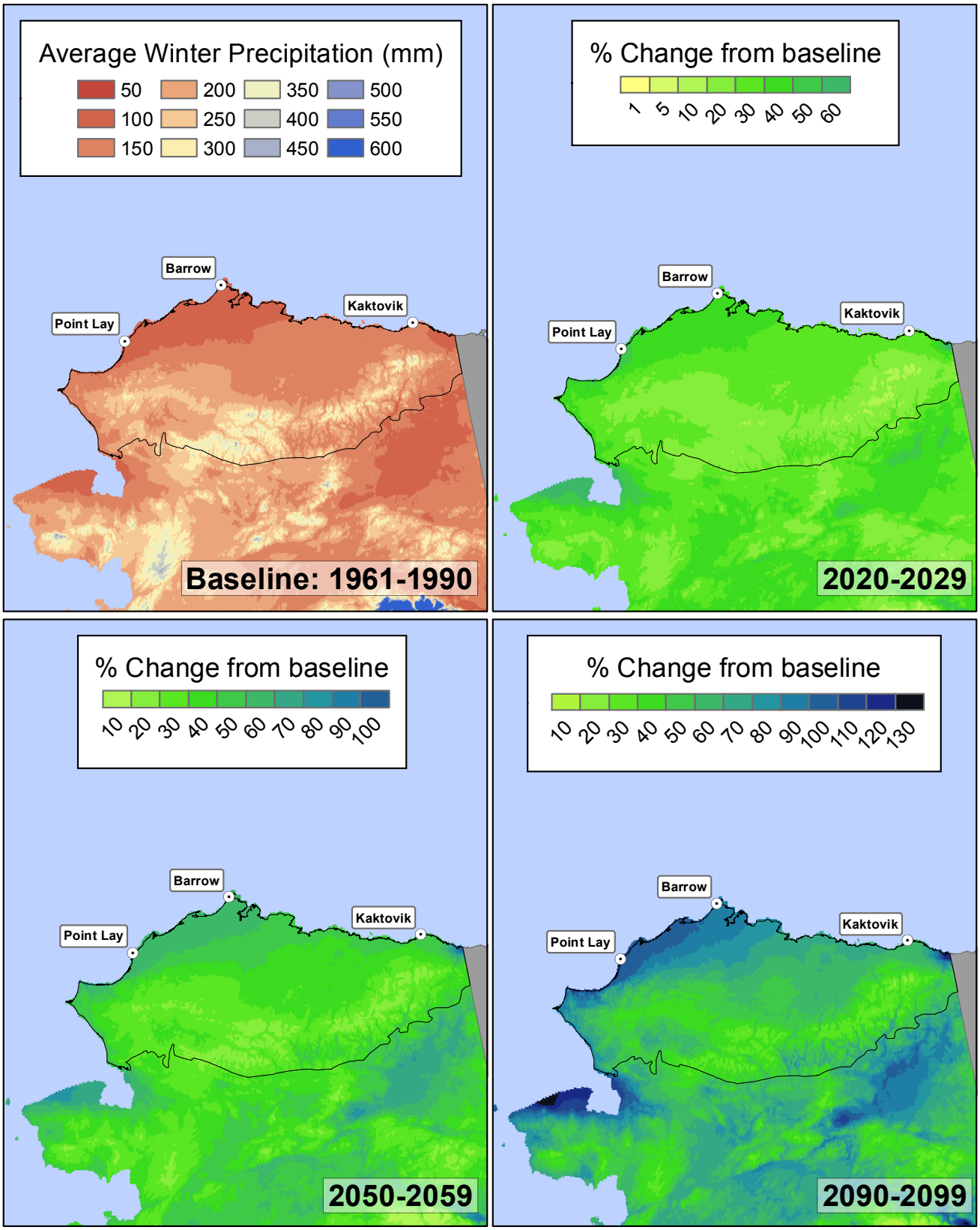

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