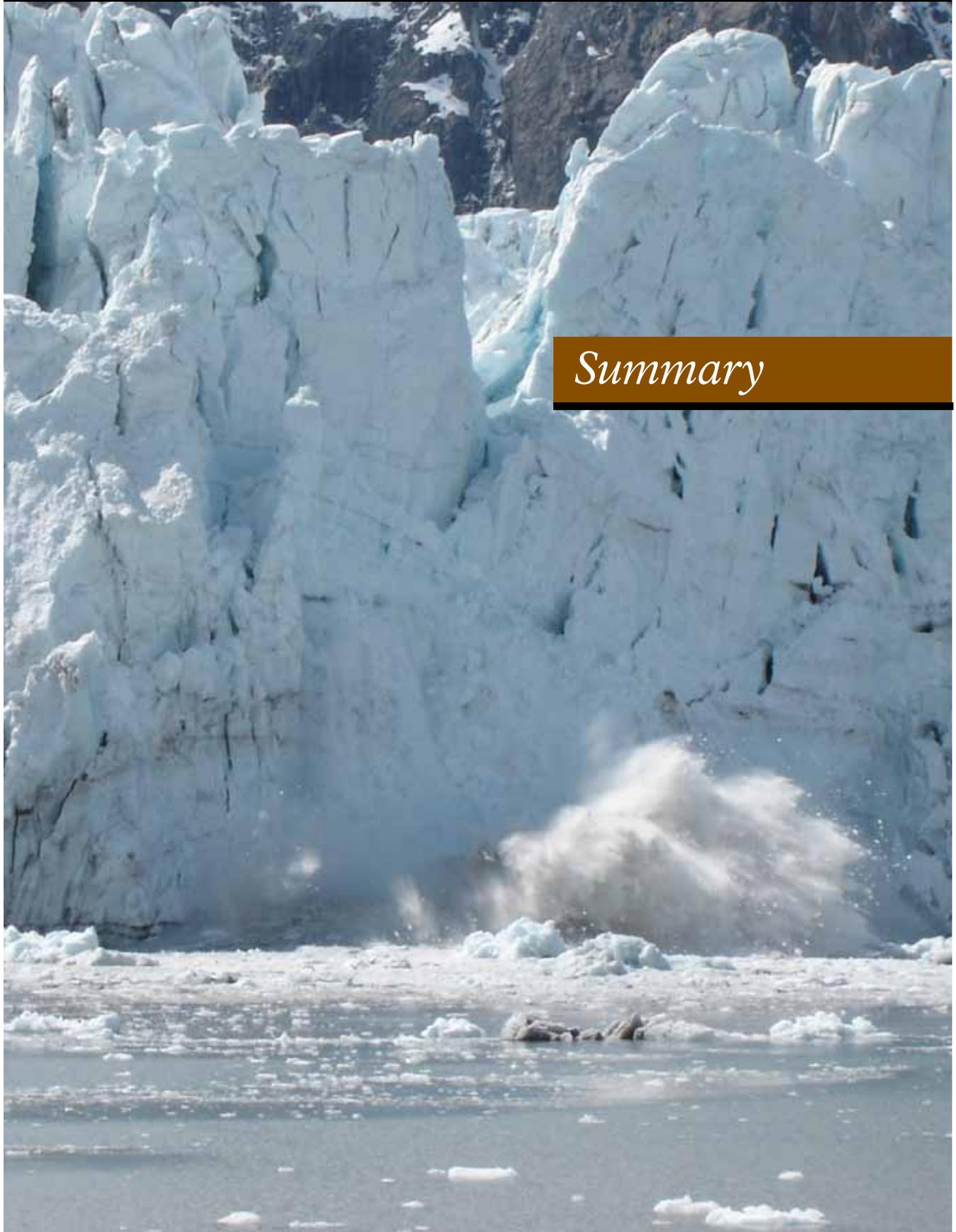


# Alaska Region Climate Change Response Strategy

National Park Service  
U.S. Department of the Interior

Alaska Region



## *Summary*

*National Park Service. Alaska Region Climate Change Response Strategy 2010-2014: Summary. National Park Service. Anchorage, Alaska. [www.nps.gov/lakso/documents/AKCCRS\\_summary.pdf](http://www.nps.gov/lakso/documents/AKCCRS_summary.pdf)*

**Figure 1. (Cover) Calving ice at Margerie Glacier. Glacier Bay National Park and Preserve.**

NPS photograph

*National Park Service. Alaska Region Climate Change Response Strategy 2010-2014: Summary. National Park Service. Anchorage, Alaska. [www.nps.gov/lakso/documents/AKCCRS\\_summary.pdf](http://www.nps.gov/lakso/documents/AKCCRS_summary.pdf)*

**Figure 16. (Backcover) Thermokarst formation and road collapse on the Nome to Taylor Highway, outside of Bering Land Bridge (BELA). The pond resulted from thawing and collapse of ground ice.**

NPS photograph by Robert Winfree

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## Climate Change Challenges



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Figure 2. Caribou migration. Gates of the Arctic National Park and Preserve.

*Climate change will challenge how the National Park Service (NPS) manages park resources and services in Alaska. Working with the best available information, and with others, will help NPS to protect and preserve America's natural and cultural heritage for current and future generations. The NPS Alaska Region Climate Change Response Strategy (Strategy) outlines current and expected impacts of climate change on park resources, assets and operations in the Alaska Region and recommendations for addressing those effects. It outlines a vision for the NPS Alaska Region Climate Change Response Program during the next five years (2010-2014), explains why climate change matters for managing national parks and how it affects NPS operations and resources. While focusing primarily on NPS units in the Alaska Region, the Strategy also draws heavily on relevant information from cooperative planning efforts, especially US Department of the Interior (DOI) and NPS national efforts, and from several inter-agency coordinating committees in Alaska.*

### What we know about climate change in and near national parks in Alaska

Alaska's landscape is changing fundamentally and will continue to do so, as ice and permafrost thaw, and landcover vegetation and wildland fires change. The range of documented and probable climate change impacts is large and increasing, though the entirety of physical-biological interactions and indirect effects may not be readily apparent. Climate change affects weather patterns, the amount and timing of precipitation, the amount and timing of snowfall

and snowpack, the amount of ice in lakes, glaciers, and seacoasts, thawing of permafrost, the stability of once-frozen ground, water flow in freshwater systems, salinity and temperature in marine and groundwater environments, migration and food habits of animals, vegetation, the frequency and intensity of fires, and with all of the above—visitor experience. There is strong agreement between monitoring data and models that major changes are already taking place in the nature and extent of boreal coniferous forests, deciduous forests, and tundra due to extended growing seasons, moisture stress, pest irruptions, and fire.



NPS photograph by Robert Winfree

Figure 3. Drying salmon at a subsistence fish camp.



NPS photograph by Page Spenser

Figure 4. Spruce mortality due to bark beetle pest irruption. Lake Clark National Park and Preserve.

## How will park managers be challenged to deal with the effects of climate change?

**Habitat for rare and common species of wildlife will change markedly.** It is very likely that without extraordinary efforts, some parks will experience major population changes (including crashes) among plants, wildlife, fish, and invertebrate species (*Figure 2*).

New and invasive species will expand their presence in parks. The ability of NPS to preserve natural and healthy wildlife and fisheries species, and to preserve subsistence and wildlife viewing opportunities, will

be challenged in many locations (*Figure 3*). In some cases, expanding species ranges, pest irruptions and invasives will hasten decline of native and familiar species (*Figure 4*). Some local residents and management agencies may advocate managing for new species that have the potential to replace diminished subsistence hunting, trapping, and fishing opportunities, and for intensified management of native species.

**Parks will lose assets.** Erosion, ground failures, submergence, and rebound (rising of recently deglaciated land) will become increasingly important, especially where permafrost thaw is accelerating due to rising temperatures and where wave action is increasing due to reduced sea ice. Some constructed assets, historic



NPS photograph

Figure 5. Clearing a mudflow from the Denali Park road. Denali National Park and Preserve.

and prehistoric sites will no longer be sustainable and will require triage to determine which to repair, relocate, document, or abandon.

**Safety hazards will develop or be recognized in relation to climate change.** We can expect erratic flooding, changing fire and smoke hazards, slope failures (mudslides, landslides, tsunami hazards), and expansion of disease organisms (fish, wildlife, and human) and their vectors. As glaciers waste away and rapid snowmelt events become more common, glacial lakes will fail with increasing but still unpredictable frequency, putting park staff, residents, and visitors at risk of flash floods and debris flows. Rapid glacial retreat and permafrost thaw also leave steep and unstable slopes in valleys and fjords. Landslides and mudflows will occur widely in some parks (*Figure 5*), and there is also risk of tsunamis associated with unstable slopes in fjords. Surface and ground water supplies that depend on seasonal glacial recharge will become less predictable.

**Resource development and economic activity will expand around parks.** As global demand for energy and resources continues to expand with



NPS photograph by Robert Winfree

Figure 6. Scenic vistas are changing as shrubs and trees expand to higher latitudes and altitudes. Denali National Park and Preserve.

rising global population, the economic incentives for developing Alaska’s mineral resources will also expand. A longer growing season and Alaska’s abundant summer sunlight will provide new agricultural opportunities in some areas. Infrastructure development will expand along Alaska’s coasts and interior to provide needed services, facilities, and transportation systems for other expanded activities.



NPS photograph by Robert Winfree

Figure 7. Tour operators may shift itineraries to provide new glacier viewing opportunities. Glacier Bay National Park and Preserve.



**Shipping activity will expand, as will the potential for accidents.** Seasonal reductions in Arctic sea ice will become more predictable, and an increasingly diverse array of ships, freighters, tankers, exploration rigs and other vessels will regularly transit the Bering Strait on their way to Alaska's North Slope, the Northwest Passage (north of Canada) or the Northern Sea Route (north of Russia). Inevitably, some accidents will occur close to Alaska's coastal parks, with increased risk and frequency of fouling coastal communities, park bays and beaches with cargo and fuel.

**Visitor experiences will be altered.** With changes to vegetation, soil, and water conditions, iconic scenery will also change as will access for subsistence, hiking and boating. As warming continues, most tidewater glaciers will melt, appearing to recede upslope. Some scenic tundra vistas become thick with deciduous trees and shrubs, obscuring wildlife observations from visitor centers and park roads (*Figure 6*). Visitor use patterns will shift as tour operators seek to provide visitors with more opportunities to experience increasingly uncommon glacier scenery. Cruise ships and day tour operators may shift some itineraries away from the parks they've traditionally visited, or seek more opportunities to shift itineraries deeper into the parks (*Figure 7*). Land based operators may press to bring groups further into the park through aircraft, airboats, snowmobile tours, off road vehicles (ORVs), and road extensions. Some changes will undoubtedly be conducive to more visitation, and some may not, depending on local conditions.

## A Framework for Planning



Figure 8. The rapid glacial retreat and expansion of terrestrial vegetation, Carroll Glacier. Glacier Bay National Park and Preserve.

This Alaska Region strategy is guided first and foremost by the NPS mission:

*To preserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations, and cooperate with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.*

The vision and four goals that follow reflect integrated components of the national NPS Climate Change Response Strategy: science, adaptation, mitigation, and communication (NPS 2010). A number of general objectives have been identified to advance these goals, with specific actions identified and prioritized by representatives of multiple parks, programs, and advisory groups in the Alaska Region (Appendix B).

### Goals

#### Goal 1

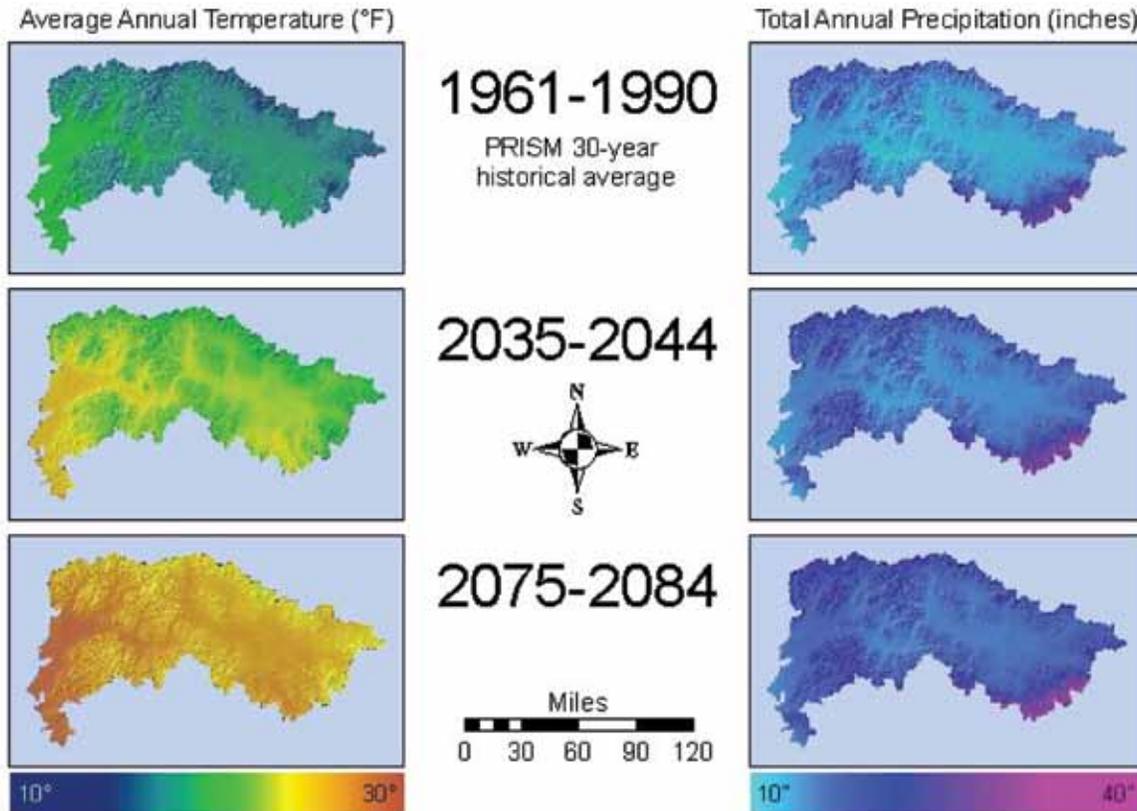
*The Strategy's first goal is for Science to support resource inventories, monitoring and research to better understand the current and potential impact of changing climate on park resources.*

Alaska is still data-poor and lacks several basic datasets needed for accurate assessments, forecasting, planning and decision making. The NPS Natural Resource Inventory & Monitoring Program (I&M) is vital to determine environmental and resource status and trends (Figure 9), data that will also be needed to validate modeled projections (Figure 10). Modeling and forecasts are also needed to support scenario



Figure 9. Long-term climate monitoring records are critical for identifying climate trends and assessing potential effects. Kenai Fjords National Park.

Noatak National Preserve  
 Projected Climate Change Scenarios



Magnitude of climatic change

| Projected Temperature (TEMP) Change (°F) |      |            |         | Projected Precipitation (PRCP) Change (in.) |      |            |         |           |
|--|------|------------|---------|---|------|------------|---------|-----------|
| Season                                   | Time | Avg. TEMP  | Δ TEMP* | Season                                      | Time | Total PRCP | Δ PRCP* | % Δ PRCP* |
| Annual                                   | Hist | 16.6 ± 0.5 | NA      | Annual                                      | Hist | 17.4 ± 1.0 | NA      | NA        |
|  | 2040 | 22.4 ± 0.5 | 5.8     |   | 2040 | 20.1 ± 1.0 | 2.6     | 15%       |
|  | 2080 | 26.9 ± 0.5 | 10.3    |   | 2080 | 21.9 ± 1.1 | 4.4     | 25%       |
| Summer                                   | Hist | 44.6 ± 0.4 | NA      | Summer                                      | Hist | 10.6 ± 0.7 | NA      | NA        |
|  | 2040 | 47.0 ± 0.4 | 2.4     |   | 2040 | 11.8 ± 0.7 | 1.3     | 12%       |
|  | 2080 | 49.7 ± 0.4 | 5.1     |   | 2080 | 12.4 ± 0.7 | 1.9     | 18%       |
| Winter                                   | Hist | -3.4 ± 0.6 | NA      | Winter                                      | Hist | 6.8 ± 0.4  | NA      | NA        |
|  | 2040 | 4.8 ± 0.6  | 8.2     |   | 2040 | 8.2 ± 0.4  | 1.4     | 20%       |
|  | 2080 | 10.6 ± 0.6 | 14.0    |   | 2080 | 9.4 ± 0.4  | 2.6     | 38%       |

\* Δ PRCP/TEMP: change in decadal precipitation/temperature average from historic value

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Figure 10. Modeling can help resource managers to identify potential future changes and effects.

planning, inform monitoring and research, and to anticipate operational impacts that will occur due to climate change. Many questions will require new research.

Managing a protected area in a time of rapid change is a very different task. Climate change needs to be integrated into planning, compliance and mitigation, but many questions arise. Can the NPS preserve the unique and special values that are identified in enabling legislation in the face of climate change? How can resource managers develop adaptation strategies for animals and plants, when their natural climate zone may move beyond our border? How much should NPS invest to preserve historic conditions in a rapidly changing area? Engagement with other agencies, adjacent landowners, and communities will be critical to identify and address common issues. Welcoming scientists with other agencies and institutions, and maintaining the unique role of NPS as stewards of unimpaired landscapes will both be important. NPS stewardship capacity in marine and freshwater environments warrants expansion, to assist parks with specific needs and to have the ability to represent NPS in related interagency efforts. Efforts to prevent and control invasive exotic species must be expanded if they are to be effective, by applying best practices to prevent their establishment, and increasing monitoring, control and native plant restoration.

### Science Objectives

- I.I. Acquire basic datasets required for accurate assessments, forecasting, planning and decision making.
- I.I. Acquire or develop and use modeling, forecasts, and other decision support tools.
- I.I. Continue development and implementation of natural resource and other monitoring. Enhance or expand monitoring where needed, to determine status and trends of environmental and indicators of climate change, including information needed to evaluate modeled projections.
- I.I. Expand research on climate change topics needed to better understand, manage, and be able to communicate trends, processes, and effects on ecosystems and people.
- I.I. Foster partnerships with other agencies, organizations, tribes, adjacent land managers/owners, park affiliate communities, and international

partners to address common needs relative to resource stewardship and science.

- I.I. Expand and improve response capabilities to known and expected climate change impacts to park resources (e.g., freshwater and marine resources, invasive species).

### Goal 2

*The second goal is **Adaptation**, to modify management practices to manage parks in an era of climate change.*

Adaptation includes assessing the effects of climate change on park resources and values to mitigate impacts where feasible and appropriate, and to adapt policies, operations, and constructed assets to changes that are beyond current control. Here again, is the call for active engagement statewide, nationally and internationally in climate change coordination efforts with other federal, state, community, and non-government counterparts. The output from climate models and forecasts can be used in scenario planning to develop and evaluate alternatives for dealing with probable future changes (*CCSP 2007*), such as to climate, fire regimes, sea level, permafrost, and water supply. Risks, response capacities for safety and resource protection, and mitigation measures need to be evaluated and prioritized relative to the issues already mentioned. It will be important to identify which park assets will be affected most by climate change, to make plans to take needed actions (*Figure 11*). Visitor services and activities are also likely to be affected. What is needed to prepare for changes in subsistence and sport hunting opportunities, wildlife viewing, and access to



Figure 11. Permafrost thaw seriously affects road stability across much of Alaska. Denali National Park and Preserve.



NPS photograph by Robert Winfree

Figure 12. Climate change affects visitor experience in many ways, including weather conditions, abundance and distribution of wildlife and fisheries, wildland fire, and scenery. Gates of the Arctic National Park and Preserve.

changing scenery (*Figure 12*)? Engagement in policy analysis at appropriate levels can help to ensure that policies are sufficiently robust and flexible to guide the NPS through climate change.

**Adaptation Objectives**

- 2.1. Identify and prioritize risks to parks resulting from climate changes and identify response options and capacities.
- 2.1. Identify park assets, resources, visitor services, and activities that are likely to be affected by climate change and determine what management actions are needed to prepare.
- 2.1. Engage in scenario planning to develop and evaluate alternatives and options for managing a range of probable changes. Use trend data, models, and forecasts to support scenario planning to identify probable changes and potential impacts that will occur due to climate change.

- 2.1. Develop adaptive management as a tool for assessing situations, designing, implementing, monitoring, evaluating, and adjusting management decisions.
- 2.1. Enhance collaborative management with federal, state, and other land managers in Alaska in order to coordinate climate change response strategies on a landscape scale.
- 2.1. Develop guidelines consistent with current law and policy for park stewardship in a rapidly changing environment.
- 2.1. Conduct analyses to identify legal and policy issues affecting an agency’s ability to respond to climate change. Recommend changes as necessary.
- 2.1. Incorporate consideration of climate change in planning, compliance and mitigation processes.
- 2.1. Convene interdisciplinary groups to review, update, and identify high priority actions under goals as needed.

### Goal 3

The strategy's third goal is **Mitigation**, through innovation, demonstration projects, and new business practices to become a model of environmentally sustainable operation at all locations.

The Alaska Region will continue and expand current efforts for mitigation of climate change impacts through environmentally sustainable operations. There is no one single answer to sustainable operations, energy, and construction (Figure 13). The most efficient answer has to be evaluated locally, especially in remote locations. Still, there is much that is already known. Sharing and implementing best practices is something everyone can do right now.

#### Mitigation Objectives

- 3.1. Develop programs to encourage and facilitate the adoption of sustainable energy practices and reduce carbon footprints in Alaska parks.
- 3.2. Track energy use at the park level relative to reduction goals and provide for accountability.
- 3.3. Develop and implement Best Management Practices for sustainable operations and ensure capacity to continue sustainable practices and maintain new technologies.
- 3.4. Consider sustainability in planning new or replacement facilities and infrastructure.
- 3.5. Learn and participate in local sustainable operations by coordinating with other government entities, non-profits, municipalities, boroughs rather than just looking inward.
- 3.6. Encourage innovation in employee transportation to and from work.
- 3.7. Develop and interpret one sustainability demonstration project at each park.

### Goal 4

The fourth goal of the strategy is **Communication** to increase public and employee awareness and understanding of the causes and effects of climate change, and the measures that will reduce or mitigate these effects.

NPS has an exceptional venue to accurately interpret climate change on a local level to people from all around the world, and it needs to become more explicit about communication to share knowledge about



Figure 13. With Alaska's long summer days, solar electricity can be a practical and sustainable energy source for remote installations. Gates of the Arctic National Park and Preserve.



Figure 14. NPS has exceptional opportunities to interpret the local effects of climate change to visitors from other areas. Klondike Gold Rush National Historic Park.

NPS photograph by Robert Whitfree

NPS photograph by Josh Foreman



climate change and its effects on parks (*Figure 14*). Educational materials, training and other programs are needed to inform employees, other educators and the public about aspects of climate change that are especially relevant to their needs and interests.

#### **Communication Objectives**

- 4.I. Using contemporary interpretive and education methods provide educational materials and programs for internal and external audiences to understand what is happening and how we're going to respond.
- 4.I. Incorporate climate change as a key interpretive message at each park, and NPS Public Land Information Centers (AAPLIC and FAPLIC). Develop messages, programs and products relative to the intersection of park resources and climate change.
- 4.I. Communicate the implications of changing climate through life-long learning opportunities in every park, and encourage individuals to take appropriate actions to maintain sustainability for future generations.
- 4.I. Communicate internally about our successes and failures with regards to environmentally sustainable practices.
- 4.I. Support efforts to collaborate and utilize parks as centers of continuous learning and as indicators of climate changes in Alaska, in order to communicate trends and changes in natural systems.

## Implementation Plan



NPS photograph by Robert Whitfree



Figure 15. We know that Alaska is changing and understand the direction of some changes, but many questions remain to be answered. Gates of the Arctic National Park and Preserve.

The final section of the strategy calls for five initial *Implementation* steps to:

1. Identify and coordinate existing assets for strategy implementation
2. Coordinate NPS Alaska Region involvement with other climate change planning efforts
3. Establish priorities and determine the sequencing of new actions
4. Identify funding requirements and approach
5. Establish timetables and implement early actions

NPS responses to climate change did not begin with this strategy, as many are already well established through policies, management strategies, and programs. For example, climate change was factored into the conceptual models and vital sign indicators for the ongoing natural resource Inventory and Monitoring Program. Research, modeling, and assessments have already been initiated with cooperators on several important questions including: downscaled climate models, a cultural resource vulnerability assessment, wildland fire and wildlife habitat modeling. Highly sustainable construction practices and testing of innovative alternative energy systems have been employed in parks for several years. The NPS is also continually sharing what we learn with employees, cooperators, visitors, and the general public through development of interpretive products, training, and experiential learning programs.

Climate change will undoubtedly affect how NPS manages park resources and services in the Alaska Region. We know that Alaska is changing, as are other places, but we do not yet know how those changes will play out. Working with the best available information, and with others, will help NPS to protect and preserve America's natural and cultural heritage for current and future generations (*Figure 15*).

