



## Key Message 1

Anchorage, Alaska

### Marine Ecosystems

Alaska's marine fish and wildlife habitats, species distributions, and food webs, all of which are important to Alaska's residents, are increasingly affected by retreating and thinning arctic summer sea ice, increasing temperatures, and ocean acidification. Continued warming will accelerate related ecosystem alterations in ways that are difficult to predict, making adaptation more challenging.

## Key Message 2

### Terrestrial Processes

Alaska residents, communities, and their infrastructure continue to be affected by permafrost thaw, coastal and river erosion, increasing wildfire, and glacier melt. These changes are expected to continue into the future with increasing temperatures, which would directly impact how and where many Alaskans will live.

## Key Message 3

### Human Health

A warming climate brings a wide range of human health threats to Alaskans, including increased injuries, smoke inhalation, damage to vital water and sanitation systems, decreased food and water security, and new infectious diseases. The threats are greatest for rural residents, especially those who face increased risk of storm damage and flooding, loss of vital food sources, disrupted traditional practices, or relocation. Implementing adaptation strategies would reduce the physical, social, and psychological harm likely to occur under a warming climate.

## Key Message 4

### Indigenous Peoples

The subsistence activities, culture, health, and infrastructure of Alaska's Indigenous peoples and communities are subject to a variety of impacts, many of which are expected to increase in the future. Flexible, community-driven adaptation strategies would lessen these impacts by ensuring that climate risks are considered in the full context of the existing sociocultural systems.

## Key Message 5

### Economic Costs

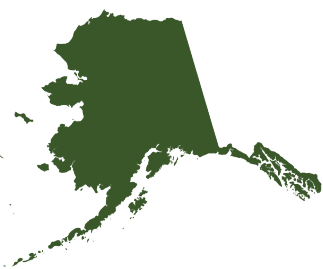
Climate warming is causing damage to infrastructure that will be costly to repair or replace, especially in remote Alaska. It is also reducing heating costs throughout the state. These effects are very likely to grow with continued warming. Timely repair and maintenance of infrastructure can reduce the damages and avoid some of these added costs.

## Key Message 6

### Adaptation

Proactive adaptation in Alaska would reduce both short- and long-term costs associated with climate change, generate social and economic opportunity, and improve livelihood security. Direct engagement and partnership with communities is a vital element of adaptation in Alaska.

## Executive Summary



Alaska is the largest state in the Nation, almost one-fifth the size of the combined lower 48 United States, and is rich in natural capital resources. Alaska is often identified as being on the front lines of climate change since it is warming faster than any other state and faces a myriad of issues associated with a changing climate. The cost of infrastructure damage from a warming climate is projected to be very large, potentially ranging from \$110 to \$270 million per year, assuming timely

repair and maintenance. Although climate change does and will continue to dramatically transform the climate and environment of the Arctic, proactive adaptation in Alaska has the potential to reduce costs associated with these impacts. This includes the dissemination of several tools, such as guidebooks to support adaptation planning, some of which focus on Indigenous communities. While many opportunities exist with a changing climate, economic prospects are not well captured in the literature at this time.

As the climate continues to warm, there is likely to be a nearly sea ice-free Arctic

during the summer by mid-century. Ocean acidification is an emerging global problem that will intensify with continued carbon dioxide (CO<sub>2</sub>) emissions and negatively affects organisms. Climate change will likely affect management actions and economic drivers, including fisheries, in complex ways. The use of multiple alternative models to appropriately characterize uncertainty in future fisheries biomass trajectories and harvests could help manage these challenges. As temperature and precipitation increase across the Alaska landscape, physical and biological changes are also occurring throughout Alaska's terrestrial ecosystems. Degradation of permafrost is expected to continue, with associated impacts to infrastructure, river and stream discharge, water quality, and fish and wildlife habitat.

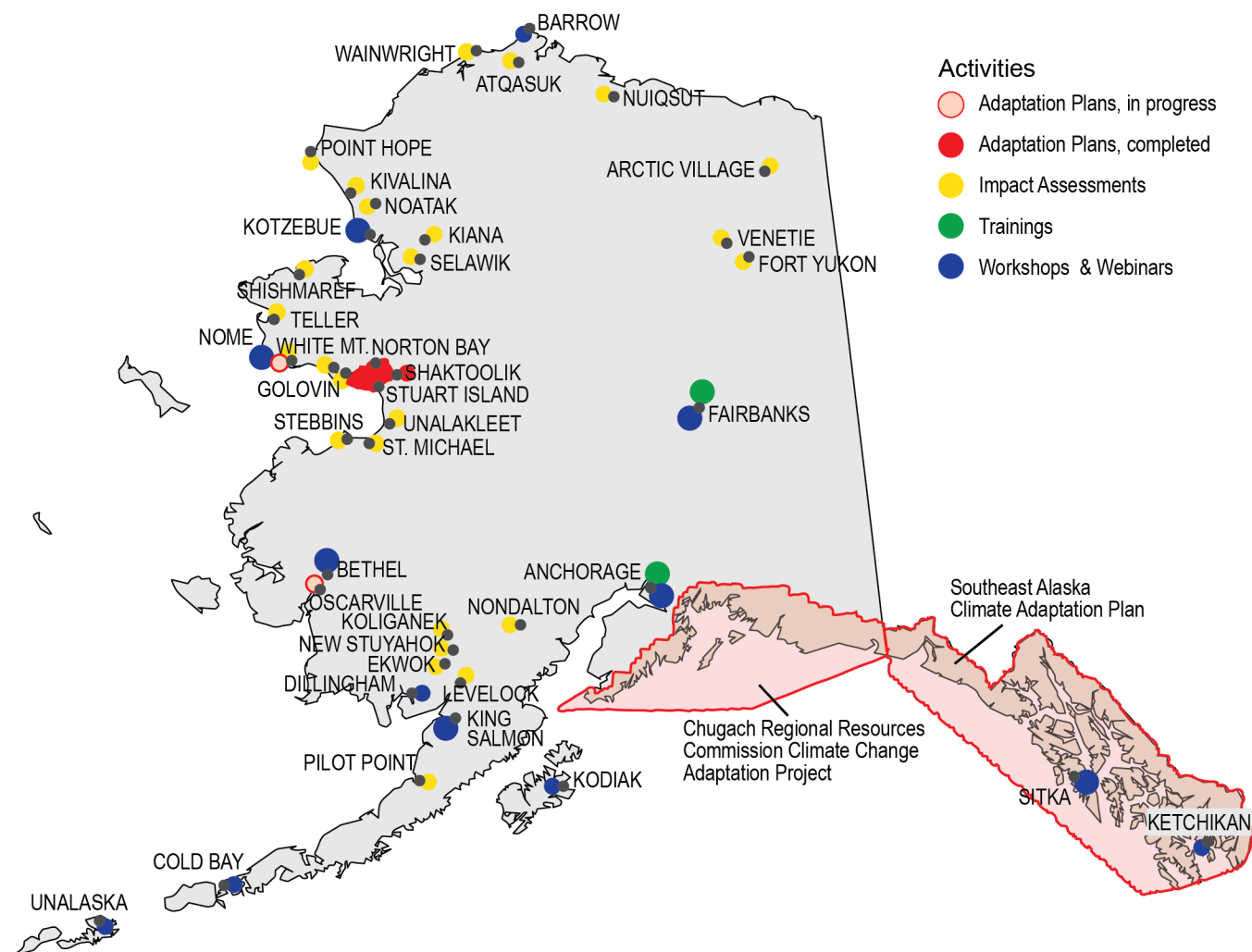
Longer sea ice-free seasons, higher ground temperatures, and relative sea level rise are expected to exacerbate flooding and accelerate erosion in many regions, leading to the loss of terrestrial habitat in the future and in some cases requiring entire communities or portions of communities to relocate to safer terrain. The influence of climate change on human health in Alaska can be traced to three sources: direct exposures, indirect effects, and social or psychological disruption. Each of these will have different manifestations for Alaskans when compared to residents elsewhere in the United States. Climate change exerts indirect effects on human health in Alaska through changes to water, air, and soil and through ecosystem changes affecting disease ecology and food security, especially in rural communities.

Alaska's rural communities are predominantly inhabited by Indigenous peoples who may be disproportionately vulnerable to socioeconomic and environmental change; however, they also have rich cultural traditions of resilience and adaptation. The impacts of climate change will likely affect all aspects of Alaska Native societies, from nutrition, infrastructure, economics, and health consequences to language, education, and the communities themselves.

The profound and diverse climate-driven changes in Alaska's physical environment and ecosystems generate economic impacts through their effects on environmental services. These services include positive benefits directly from ecosystems (for example, food, water, and other resources), as well as services provided directly from the physical environment (for example, temperature moderation, stable ground for supporting infrastructure, and smooth surface for overland transportation). Some of these effects are relatively assured and in some cases are already occurring. Other impacts are highly uncertain, due to their dependence on the structure of global and regional economies and future human alterations to the environment decades into the future, but they could be large.

In Alaska, a range of adaptations to changing climate and related environmental conditions are underway and others have been proposed as potential actions, including measures to reduce vulnerability and risk, as well as more systemic institutional transformation.

## Adaptation Planning in Alaska



The map shows tribal climate adaptation planning efforts in Alaska. Research is considered to be adaptation under some classification schemes.<sup>1,2</sup> Alaska is scientifically data poor, compared to other Arctic regions.<sup>3</sup> In addition to research conducted at universities and by federal scientists, local community observer programs exist through several organizations, including the National Weather Service for weather and river ice observations;<sup>4</sup> the University of Alaska for invasive species;<sup>5</sup> and the Alaska Native Tribal Health Consortium for local observations of environmental change.<sup>6</sup> Additional examples of community-based monitoring can be found through the website of the [Alaska Ocean Observing System](#).<sup>7</sup> From Figure 26.9 (Source: adapted from Meeker and Kettle 2017<sup>8</sup>).