

## ALASKA VILLAGES FACE INCREASED HAZARDS FROM CLIMATE CHANGE

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### INTRODUCTION

Natural hazards have always been an important consideration in Alaska, and many of these hazards have been exacerbated by recent increases in temperature and changing weather patterns. The effects of global climate change are more pronounced in polar regions than in other areas. Considering the nexus between natural hazards and climate change, the effects of natural hazards can be expected to pose increased coastal management challenges in the future.

Recent scientific studies confirm the effects of climate change in Alaska are significant. The average temperature has been increasing by one degree Celsius per decade in Alaska compared to the global average of 0.6 degrees. Glaciers in Alaska are melting faster than in any other area of world, nine percent of the rise in sea level is attributed to melting Alaska glaciers.

The most important natural hazards in Alaska include flooding, erosion, storm surges, ice, forest fires, melting permafrost, volcanoes, earthquakes, and tsunamis. Climate change itself can be thought of as a natural hazard because of the potential for adverse impacts to human health and safety. With the exception of volcanoes, earthquakes and tsunamis, all of the hazards identified above are affected in some way by climate change.

### FLOODING, STORM SURGES AND EROSION

Native villages are extremely susceptible to erosion because they are usually located either along rivers or along the coast. As a result of climate change, increased rains have resulted in more frequent flooding along rivers.

Coastal villages are often located on sand spits and these villages are increasingly vulnerable to storm surges. Because of the later freeze up of marine waters, fall storms have placed many coastal villages in danger of eroding away. Some of the highest recorded storm surges have occurred in recent years. Storm surges can be up to 10 feet or more and erode up to 100 feet of coast in a single storm.

A 2003 study by the General Accounting Office found that 184 out of 213 Alaska Native villages are affected by flooding and erosion to some extent and that the increased susceptibility to flooding and erosion is due in part to rising temperatures. Five Native villages in imminent danger erosion due to flooding and storm surges include Newtok, Kivilina, Koyukuk, and Shishmaref.

Newtok, a village located in the Yukon-Kuskowim River Delta, is currently being moved to a new location because of riverine flooding. During one storm, ten feet of beach eroded away, and a 1,000-gallon fuel tank was damaged. Over the past 40 years, over two miles of land between the village and the ocean has eroded away.

Kivalina, located on a sand pit in the Northwest Arctic Borough just north of Kotzebue, is in imminent of eroding into the Chukchi Sea. It will cost an estimated \$100 – \$400 million to relocate the 385 residents of the village.

Shishmaref, a village of 600 people, is located on a barrier island in the Bering Straits region. The shoreline has been eroding on an average of 10 feet per year. The U.S. Army Corps of Engineers (ACOE) estimates the village site will be lost to the sea in about 15 years and that it will cost \$180 million to move the village to a new site.

In addition to loss of life and property, coastal erosion also results in loss of antiquities. For example, the Village of Point Hope in the North Slope Borough was established 2,600 years ago. As a result of erosion, the village has already been moved to a new location on the same sand spit. The old village site has eroded away resulting in the loss of an important archaeological site. The current village site will eventually need to be moved, and in the mean time, there are plans to build an escape route for the 725 villagers to move to higher ground in the event of a serious storm.

#### ICE HAZARDS

Ice plays a dual role of protecting coastlines from certain natural hazards and acting as a natural hazard itself. During periods when offshore waters are frozen, shorelines are protected from erosion and flood damage. During freeze up and spring thaw, however, ice hazards can be a significant threat.

During the last few decades, science and traditional knowledge have revealed that offshore areas in Northern Alaska are freezing later in the year and melting earlier. In addition, the extent of sea ice has diminished 14 percent since 1978 and the thickness of the ice has thinned by 40 percent since the mid 1960s. During 2005, there was a record low for the amount of sea ice. Some scientists predict that if the offshore ice continues to retreat at this rate, the Arctic Ocean could be ice-free by the end of the century.

Various types of ice hazards occur in Alaska waters, and climate change can affect when and where these hazards occur. The unstable area between the shore-fast ice and the multiyear ice pack is known as the shear zone. Ice forces in this area can cause damage to offshore structures. Ice gouging occurs when large pieces of ice scrape along the shore bottom. Strudel scour occurs when spring floods enlarge holes in the ice, and force of the water excavates a hole in the bottom of the water column. Ice override, known by Inupiat people as an ivu, occurs when offshore ice is forced onto shore.

#### MELTING PERMAFROST

Much of Alaska is covered by continuous or discontinuous permafrost, that is, areas of the ground that are frozen year round. The increase in temperature has resulted in the

melting of permafrost known as thermokarst, that is melting ice in soil that results in uneven topography with wet depressions. In addition, changing vegetation patterns can lead to melting of permafrost because dark vegetation absorbs more heat than snow.

Permafrost is an important consideration in Alaska because improperly conducted surface activities can result in thawing of the ground and compromise structural integrity of pipelines, roads, utilities, houses, and airfields. In some areas, melting permafrost has resulted in toppled forests.

Some measures can be taken to prevent thermokarst, including building new structures on pilings, using hydraulic jacks to lift buildings, and installing mechanisms to disperse heat through the air from structures including pipelines. As average temperatures increase, it will become more challenging to mitigate the effects of melting permafrost when building new roads and facilities.

Melting permafrost also presents new challenges to subsistence users who depend on frozen ground to insulate ice cellars for storage of food. In recent years, there have been increasing reports of ice cellars melting in Arctic villages.

#### **WILD FIRES**

The trend of warming temperatures has resulted in a greater danger of wild fires from insect outbreaks and changing weather patterns. For example, on the Kenai Peninsula in Southcentral Alaska, vast forests of white spruce have died from spruce beetle infestations. Warmer temperatures have allowed the beetles to multiply at twice the normal rate, and as a result, over four million acres of spruce forests have died.

In addition to insect outbreaks, hot and dry conditions create more fires from thunderstorms. In 2004, Alaska's largest fire season ever resulted in the burning of over 6.6 million acres burned in Alaska. The third largest fire season occurred in 2005 when 4.6 million acres burned.

Long-term changes to vegetation patterns in response to climate change may also result greater danger for forest fires. In some areas of Alaska, tundra vegetation is being replaced by shrubs and trees. The vegetation changes may result in increased fuel loads and the potential for uncontrolled wild fires.

#### **COASTAL MANAGEMENT CHALLENGES**

As the threat of natural hazards increases in coastal areas, a greater emphasis will need to be placed on responding to and preventing negative consequences to human health and safety. Management challenges include relocation of villages, erosion control, mitigation of cultural impacts, response to impacts to fish and wildlife species, health concerns, wildfires, preventing damage from new developments, and ensuring local governments have the tools they need to respond to the expected increase in natural hazards.

An immediate need to relocate villages and install erosion control mechanisms in other villages will require considerable resources. The villages most susceptible to erosion

must decide if the villages will be relocated or if they should be abandoned. At this time, the villages have indicated a strong preference to relocation of the village rather than assimilating residents into other villages. Erosion control measures for some villages have had mixed results, and the experience of these villages will provide information on successful approaches for other villages.

The cultural effects of increased occurrence and duration of natural hazards include reduced opportunities for subsistence hunting and fishing by Alaska Natives and the loss of archeological and cultural sites. Throughout most of rural Alaska, people depend on traditional hunting, fishing and gathering activities to sustain themselves physically and spiritually. On-ice subsistence hunting of marine mammals provides safety issues during periods when ice is unstable. Subsistence whalers in Barrow have been stranding on ice flows that break away from the shorefast ice, and subsistence users in the Northwest Arctic Borough have reported reduced subsistence activities because of unstable ice. In addition, coastal and riverine erosion is destroying archaeological sites.

A changing climate is also affecting the abundance and distribution of fish, wildlife and vegetation. For example, change to the species composition of fish in the Bering Sea has been attributed to warming waters, and Alaska fishermen have reported catching warm-water species in recent years. Also in the Bering Sea, reduced forage fish has affected seabird species such as Kittiwakes. In the Beaufort Sea, the retreating ice pack is resulting in polar bears staying onshore longer than usual providing safety issues for villages in the North Slope Borough. In addition, increased deaths of polar bears have been attributed to the greater distances bears must swim to reach the retreating ice pack.

Unexpected health and safety concerns may become more pronounced in the future. For instance, warming waters caused a recent infectious outbreak in farmed oysters that sickened a number of people. The cool, clean Alaska waters have provided an excellent opportunity for mariculture, and warming waters could have an adverse impact on this industry in the future.

Climate change has important implications for existing and new development projects. Location of projects outside of flood zones and erosion-prone areas will become more important. Later freeze-up and earlier ice melt have the potential to limit some activities such as winter oil and gas activities when the ground and marine waters are frozen. In addition, erosion has resulted in delayed effects from past development projects. For example, the North Slope Borough reports that an abandoned gas well that was formerly onshore is now located offshore due to erosion, and this well appears to be leaking gas. In another example, waste sites from oil and gas exploration at Umiat are becoming exposed due to erosion of the Colville River.

The management implications from increased natural hazards provide a challenge to coastal management. Unfortunately, recent changes to the Alaska Coastal Management Program (ACMP) have diminished opportunities for local control. Legislation in 2003 made major changes to the program, and regulations adopted in 2004 made significant changes to the statewide natural hazards standard. Under the new standard, natural

hazards may only be addressed during an ACMP consistency review if the project site is in an area designated for a specific natural hazard. The statewide standard incorporates existing codes or safety standards, and in the absence of such standards, deference is given to an engineer hired by the project applicant. While coastal districts were previously encouraged to develop local enforceable policies to address hazards, the State of Alaska has denied almost all of the natural hazards enforceable policies proposed by coastal districts. New reforms to the ACMP will be necessary for coastal management to have a meaningful role in responding to the increased dangers from natural hazards as effects of climate change become more pronounced.

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