

Drought, Melting Ice & Sea Level Rise, and Storms & Flooding Tribal Climate and Health Adaptation Webinar #3



Since Last Webinar

- Groups.io
 - Subgroups

Suggested action steps (complete before next webinar)

- Identify which temperature and wildfire related indicators are being tracked for your region (e.g. tribal environment or health department, intertribal health organization, or other agency)
- Take a moment to talk to elders and consider how wildfire and temperature changes have affected your tribe.
- Activity: Input your location into <u>The Climate Explorer</u> to see temperature data and projections for your community

Suggested reading (complete before next webinar)

• Pick one chapter (2-8) of <u>Impacts of Climate Change on</u> <u>Human Health in the United States</u>

	Climate Driver	Exposure	Health Outcome	Impact
Extreme Heat	More frequent, severe, prolonged heat events	Elevated temperatures	Heat-related death and illness	Rising temperatures will lead to an increase in heat-related deaths and illnesses.
Outdoor Air Quality	Increasing temperatures and changing precipitation patterns	Worsened air quality (ozone, particulate matter, and higher pollen counts)	Premature death, acute and chronic cardiovascular and respiratory illnesses	Rising temperatures and wildfires and decreasing precipitation will lead to increases in ozone and particulate matter, elevating the risks of cardiovascular and respiratory illnesses and death.
Flooding	Rising sea level and more frequent or intense extreme precipitation, hurricanes, and storm surge events	Contaminated water, debris, and disruptions to essential infrastructure	Drowning, injuries, mental health consequences, gastrointestinal and other illness	Increased coastal and inland flooding exposes populations to a range of negative health impacts before, during, and after events.
Vector-Borne Infection (Lyme Disease)	Changes in temperature extremes and seasonal weather patterns	Earlier and geographically expanded tick activity	Lyme disease	Ticks will show earlier seasonal activity and a generally northward range expansion, increasing risk of human exposure to Lyme disease-causing bacteria.
Water-Related Infection (Vibrio vulnificus)	Rising sea surface temperature, changes in precipi- tation and runoff affecting coastal salinity	Recreational water or shellfish contaminated with <i>Vibrio vulnificus</i>	Vibrio vulnificus induced diarrhea & intestinal illness, wound and blood- stream infections, death	Increases in water temperatures will alter timing and location of <i>Vibrio vulnificus</i> growth, increas- ing exposure and risk of water- borne illness.
Food-Related Infection (Salmonella)	Increases in temperature, humidity, and season length	Increased growth of pathogens, seasonal shifts in incidence of <i>Salmonella</i> exposure	Salmonella infection, gastrointestinal outbreaks	Rising temperatures increase Salmonella prevalence in food; longer seasons and warming winters increase risk of exposure and infection.
Mental Health and Well-Being	Climate change impacts, especially extreme weather	Level of exposure to traumatic events, like disasters	Distress, grief, behavioral health disorders, social impacts, resilience	Changes in exposure to climate- or weather-related disasters cause or exacerbate stress and mental health consequences, with greater risk for certain populations.

Chat Discussion:

What did you learn from your elders? What health impact chapter did you choose to read about and why?

TCHP Framework

- Today we cover Drought, Storms & Flooding, and Melting Ice & Sea Level Rise
 - Secondary exposures
 - Impacts
 - Sample strategies
 - Tribal case studies







Hurricane-Induced Flood Effects



Key Climate Exposure Facts

- Severe storms include increased extreme rainfall/snowfall events, an upward trend tropical cyclone activity (including North Atlantic hurricanes, and more variable thunderstorm events (including wind, hail and tornados)
- These storm events trigger flash floods, prolonged flooding along rivers and streams, and coastal flooding
- Exacerbated by sea level rise and earlier snowmelt, along with manmade changes to landscape
- Contribute to landslides, mudslides and erosion
- Number of 100-year floods in the contiguous United States to rise steadily for the remainder of the century
 - Approximately twice as many flood events projected under RCP8.5 compared to RCP4.5 by the end of the century

Regions Affected

All – varying degrees and types of storms and flooding

Figure 17.1. Number of 100-Year Floods

In each plot, black dots are the median value across the five GCMs throughout the contiguous U.S. in each year of the 21st century, thick blue bars are the middle 50% of models, whiskers extend to the 95th percentile of values, and dots represent outliers. Thick black lines are five-year moving averages across all models.



Group Discussion: What health impacts can you anticipate?

2010 2020











Possible Health Impacts

- Storm and flooding-related injury and death
 - Floods are one of the deadliest weather-related hazards in the U.S. – second only to heat
 - In the U.S. inland flooding caused over 4,500 deaths between 1959 and 2005

People within Flood Hazard Area





Possible Health Impacts

- Mental health impacts including post-traumatic stress, depression, anxiety and grief
 - Flood-related mental health impacts are associated with direct and longerterm losses, social impacts, stress, and economic hardship.

What happens when people experience a disaster or traumatic event?

Shock and denial are typical responses to large-scale natural disasters, especially shortly after the event. Both shock and denial are normal protective reactions.

Once the initial shock subsides, reactions vary from one person to another. The following are common responses to a traumatic event:

- Feelings become intense and sometimes are unpredictable. You may become more irritable than usual, and your mood may change back and forth dramatically. You might be especially anxious or nervous, or even become depressed.
- Thoughts and behavior patterns are affected. You might have repeated and vivid memories of evacuating or seeing the fire approach. These flashbacks may occur for no apparent reason and may lead to physical reactions such as rapid heartbeat or sweating. You may find it difficult to concentrate or make decisions, or become more easily confused. Sleep and eating patterns also may be disrupted.
- Recurring emotional reactions are common. Reminders or "triggers" such as smoke, ash, sirens or fire trucks can create anxiety.
- Interpersonal relationships can become strained, particularly if you are living in temporary housing. You may experience arguments with family or friends. On the other hand, you might become withdrawn and isolated and avoid your usual activities.
- Physical symptoms may accompany the extreme stress. For example, headaches, nausea and chest pain may result and may require medical attention. Pre-existing medical conditions may worsen due to the stress.

It is important to realize that there is no one 'standard' pattern of reaction to the extreme stress of traumatic experiences.



Possible Health Impacts

- Damage to infrastructure limits access to health services, can result in illness and carbon monoxide poisoning
 - Power outages & de-energization
 - Road closures
 - Damaged health and emergency facilities
 - Emergencies can overwhelm health and emergency services
 - Can also lead to school and business closures and economic damages

STRY DX Kevin Joy September 11, 2017 1:00 PM

Ripple Effect: How Hurricanes and Other Disasters Affect Hospital Care

Natural disasters can overwhelm busy hospitals for days after storms dissipate. The reason: a wave of medical needs beyond injuries — from patients without resources.





Related Exposures

• Triggers the following secondary exposures:



- Indoor Mold
- Mosquitos
- Water contamination and supply disruption
- Food contamination and supply disruption



Chat Discussion: What health impacts can you anticipate?

Possible Health Impacts

• Illness associated with mold exposure



Change in the Magnitude of River Flooding in the United States, 1965–2015



Data source: Slater, L., and G. Villarini. 2016 update and expansion to data originally published in: Mallakpour, I., G. Villarini. 2015. The changing nature of flooding across the central United States. Nature Climate Change 5:250–254.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

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Possible Health Impacts

- Infections and illness from contaminated water and marine food
- Drinking water and food supply interruption
- Lack of nutritional and medicinal abundance



David Gibbons, left, and Shane Mesteth ride down a muddy road to the highway to gather food, water and medical supplies for residents on the Pine Ridge Indian Reservation in South Dakota. Kristina Barker for The New York Times

'A State of Emergency': Native Americans Stranded for Days by Flooding

On the Pine Ridge Indian Reservation in South Dakota, extreme weather and bad roads have left some residents stranded for nearly two weeks with limited food and water.



Possible Health Impacts

• Vector borne disease (e.g. West-Nile, Zika, Dengue)









Vulnerable Populations

- Children and elders
- Residents living in older homes
- Neighborhoods lacking green space
- People with physical disabilities
- People without health insurance
- People susceptible to health impacts from poor air quality
- People with mental, behavioral, and cognitive disorders
- Electricity-dependent populations
- Outdoor workers
- Transit-dependent populations
- Households in poverty

Sample of Population Sensitivity and Adaptive Capacity Factors

- 100 and 500 year flood area
- Hydrogeological conditions
- % area covered by impervious surface
- Population or critical structures within floodplain
- Hospitals per 100,000
- Economic hardship or social vulnerability index
- Community cohesion



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Storms and Flooding

Possible Impacts to Social, Economic and Cultural Health

- Displacement, destruction of historical or cultural sites/assets
- Lost school days and business revenues
- Economic damage (e.g. response and recovery costs; fishing losses)



Chat Discussion:

How might cultural wellbeing and traditional ways of life be disrupted by storms and flooding?



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Storms and Flooding

Natural Environment Impacts

 Storm and flooding related disruptions, declines and stresses to habitats, waterways, and important or sensitive plant and wildlife species (e.g. loss of vegetation, erosion, runoff, fish mortality)

Built Environment Impacts

- Damage to homes and businesses
- Disruption to public services and infrastructure (e.g. roads, water treatment)



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Chat Discussion:

What adaptation strategies may be able to reduce negative impacts to your community?



Sample Strategies to Address Impacts

- Develop policies and plans to preserve wetlands and establish vegetated buffers along rivers and streams to reduce flooding, runoff and erosion.
- Restrict development in high-risk or post-disaster areas to reduce losses.
- Develop preventative initiatives before next disaster to build human resilience skills
- Connect community members to financial resources for disaster insurance
- Build alternative power supplies e.g. building or community-scale microgrids incorporating renewables to avoid power outages for critical facilities during storms and flood
- Seek assistance, resources, grants and loans from federal agencies for disaster planning, emergency management, distressed communities







Tribal Case Study

Flash Floods on The Drought-Impacted Hopi Reservation

- Severe drought conditions prior to 2010 heavy rainfall event and rockslides
- \$930,000 in costs to repair roads, telephone lines, and water and sewer systems
- Gravesites damaged





Trainee Examples

Melting Ice & Sea Level Rise





Melting Ice & Sea Level Rise

Key Climate Exposure Facts

- Rising temperatures are increasing ocean water mass (melting ice) and volume (thermal expansion)
- Global mean sea level (GMSL) has risen by about 7– 8 inches (about 16–21 cm) since 1900, with about 3 of those inches (about 7 cm) occurring since 1993 (CSSR)

Related Exposures

- Contributes to storm surges and coastal flooding
- Triggers the following secondary exposures:





Alaska, Coastal



Group Discussion: What health impacts can you anticipate?



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Melting Ice and Sea-level Rise

Possible Human Health Impacts

- Storm surges increase "Storm and Flooding" health impacts. In addition:
- Melting, thinning and thawing ice-related injuries (e.g. hunting and fishing)
- Lack of nutritional abundance due to loss of safe hunting, fishing or herding practices
- Mental health impacts including posttraumatic stress, depression, anxiety and grief
- Prehistoric diseases unearthed

Sample of Population Sensitivity and Adaptive Capacity Factors

• Proximity to coast, ice and permafrost





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Melting Ice and Sea-level Rise

Possible Impacts to Social, Economic and Cultural Health

- Displacement, destruction of historical or cultural sites/assets
- Lost school days and business revenues
- Economic damage (e.g. response and recovery costs; fishing/hunting losses)



Chat Discussion:

How might cultural wellbeing and traditional ways of life be disrupted by melting ice and sea-level rise?



Melting Ice and Sea-level Rise

Natural Environment Impacts

• Disruptions, declines and stresses to habitats, waterways, and important or sensitive plant and wildlife species (e.g. habitat fragmentation, saltwater intrusion)

Built Environment Impacts

- Damage to homes and businesses
- Disruption to public services and infrastructure (e.g. power outages)
- Disruption to agricultural operations





Sources:

Sources: - Post, A. 1958. McCall Glacier, Glacier photograph collection. Boulder, Colorado: National Snow and Ice Data Center/World Data Center for Glaciology. http://nisidc.org/data/g00472.html. - Nolan, M. 2003. McCall Glacier, Glacier photograph collection. Boulder, Colorado: National Snow and Ice Data Center/World Data Center for Glaciology. http://nisidc.org/data/g00472.html.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.



Melting Ice and Sea-level Rise

Sample Strategies to Address Impacts

- Update Hazard Mitigation Plan to include melting ice and sea level rise projections
- Relocate critical facilities and roads that have experienced repeated exposure to melting ice and sea level rise
- Develop plans for phased relocation, if necessary, including opportunities to retain community and cultural cohesion
- Build flood and saltwater intrusion barriers to protect assets (e.g. fortify seawalls, diking, aquifer recharge)
- Implement advanced surveillance equipment for locational ice changes hazards (for hunters)
- Establish a regional network of environmental observers (e.g. LEO Network)





Melting Ice and Sea-level Rise

Tribal Case Study

Thinning Ice at Shishmaref, Alaska

- Since 2001, an average of 23 feet of shoreline is being lost per year because of storms.
- A few of the village's 60 or so buildings have already been abandoned given their proximity to the edge of the town's eroding shoreline
- Eighty-six percent of Alaska Native Villages are threatened by thawing permafrost, erosion and flooding. Thirty-one villages face imminent threats and at least 12 have decided to relocate or to explore relocation options.

Relocation of Biloxi-Chitimacha-Choctaw tribe (LA)

- Tribe lost 98% of its land on the Isle de Jean Charles since the 1950s
- Hurricanes have destroyed houses and caused families to leave





Trainee Examples



Jamie Judkins, Planner

Shoalwater Bay Indian Tribe (Tokeland, WA)

Great, great, great, great granddaughter of Chief George Allen Charley, Jamie moved to the Reservation in 1995 and has lived on or near the reservation since then. She grew up in Los Angeles, CA and Bellingham, WA prior to that and visited the reservation occasionally. Along with working for the Tribal Government, she joined the board of Willapa Bay Enterprises (WBE) in December of 2015. Her skills include accounting, grant compliance and reporting, policy development, team building, meeting and event planning. Currently sits as backup delegate on the Sea Grant Shellfish 2 year Workgroup.

She loves to empower people to do good work. and become self-reliant.







Key Climate Exposure Facts

- Recent drought or water deficits have reached record in intensity in parts of the country.
- Strong evidence that climate change increases evapotranspiration and soil moisture deficits (CSSR)
- One of the most pervasive climateinduced weather exposures for tribes

Regions Affected

Southwest, Great Plains

Group Discussion: What health impacts can you anticipate?

Drought Outlook through May **Current Drought Monitor** March Drought Outlook The drought outlook through May 2020. The Climate Prediction Center's (CPC) Seasonal Drought Outlook is issued monthly on the third Thursday of each month-The outlook predicts whether drought will emerge, stay the same or get better in the next three months, based on the U.S. Drought Monitor conditions when the outlook was released on February 20, 2020 Learn more about the US Seasonal Drought Outlook Drought persists 7.7% Drought present on February 20, 2020 is expected to of U.S. continue through May 2020. Drought remains but improves 0.8% Drought present on February 20, 2020 is expected to of U.S. continue, but improve through May 2020. Drought removal likely 0.4%

Driest: 7.27in. (36% of Average), 1947 Jan 2018 - Dec 2018 | 13.52in. (67%) | Rank: 28 of 124

(1 = Record Driest, 124 = Record Wettest

of U.S.

6.7%

of U.S.



Drought present on February 20, 2020 is expected to be

moved from the map by the end of May 2020.

Abnormally dry conditions on February 20, 2020 are

Most Recent Year:

expected to intensify by the end of May 2020.

Drought development likely

Contiguous US Alaska Hawaii Puerto Rico



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Drought

Possible Health Impacts

 Mental health impacts including anxiety, grief, and helplessness (e.g. displacement, economic change or insecurity, damage of local environment)

"Mni Wiconi" – Lakota for "Water is Life"

<u>SAMHSA</u>: Warning signs for emotional distress related to drought may include:

- Feelings of overwhelming anxiety
- Constant worrying
- Trouble sleeping and other depression-like symptoms
- Disputes between people over limited water supplies
- Health concerns related to dust, low water flow, or poor water and air quality
- Financial concerns related to crop failures, low supply and demand of agricultural-related products, or rising food prices



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Drought

Related Exposures

- Contributes to wildfire and storms and flooding
- Triggers the following secondary exposures:
 - - Dust, allergens, and ozone
 - Water supply disruption
 - Lower agricultural yields
 - West Nile Virus
 - Hantavirus (rodents)
 - Forest infestation and disease



Figure 3.2: Depletion of Groundwater in Major U.S. ▲ ⊚ ≪ Regional Aquifers



Group Discussion: What health impacts can you anticipate?

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Drought

Possible Health Impacts

- Respiratory and cardiovascular illness
- Valley Fever







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Possible Health Impacts

- Vector borne disease
 - E.g. West-Nile, Hantavirus (rodents)



Incidence of West Nile Neuroinvasive Disease in the United States



Possible Health Impacts

- Drinking water supply interruption
- Lack of nutritional and medicinal abundance





Vulnerable Populations

- Children and elders
- Communities reliant on groundwater for drinking water
- Agricultural workers
- People susceptible to health impacts from poor air quality
- People with mental, behavioral, and cognitive disorders
- Electricity-dependent populations

Sample of Population Sensitivity and Adaptive Capacity Factors

- Population size of vulnerable individuals
- Food environment index
- Proximity to transit
- Size of water system (including storage)



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Drought

Possible Impacts to Social, Economic and Cultural Health

- Displacement
- Disruptions to culturally important activities and species (e.g. fishing)
- Lost school days and business closures
- Economic damage (e.g. agricultural losses)
 - CA Climate Assessment: water shortages could cost up to \$1B/year

Relocation – Domestic Migration

Figure 9.1. Climate Change-Induced Domestic Migration

Relative net differences in county-level population projections by RCP and year. Values represent the average percentage change across the five GCMs compared to a "no climate change" control scenario.



"In Northwestern California, drought has decimated the salmon stock, an important food, economic, and ceremonial resource for the Yurok, Hoopa Valley, and Karuk tribes on the Klamath and Trinity rivers." - Mapping Resilience Report

Chat Discussion:

How might cultural wellbeing and traditional ways of life be disrupted by drought?



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Drought

Natural Environment Impacts

 Drought related disruptions, declines and stresses to habitats, waterways, and important or sensitive plant and wildlife species (e.g. tree mortality, pest infestation, decline in wetlands, riparian tree diebacks, wildlife migration, loss of waterways and aquatic species)

Built Environment Impacts

- Disruption to public services and infrastructure (e.g. water systems)
- Disruption to agricultural operations



Chat Discussion:

What adaptation strategies may be able to reduce negative impacts to your community?



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Drought

Sample Strategies to Address Impacts

- Create or update Drought Contingency Plans
- Restrict development in high-risk areas to reduce water burden
- Develop or promote water conservation or efficiency program to help households, businesses and agricultural operations replace irrigation systems and install water recycling systems and water conservation measures
- Build infrastructure needed for aquifer storage and recovery
- Diversify options for water supply and expand current sources
- Increase water storage capacity



Fact Sheet

Federal Insurance and Mitigation Administration

Aquifer Storage and Recovery

Purpose

The President's 2015 Opportunity, Growth, and Security Initiative (OGSI), Executive Order 13653 Preparing the United States for the Impacts of Climate Change, the President's 2013 Climate Action Plan, FEMA's Climate Change Adaptation Policy, and the 2014-2018 FEMA Strategic Plan, all identify the risks and impacts associated with climate change on community resilience to natural hazards, and direct Federal agencies to support climate resilient infrastructure.

FEMA is encouraging communities to incorporate methods to mitigate the impacts of climate change into eligible Hazard Mitigation Assistance (HMA) funded risk reduction activities by providing guidance on mitigating flood and drought conditions. FEMA has developed initial guidance on flood and drought mitigation activities including green infrastructure methods, expanded ecosystem service benefits, and three flood reduction and drought mitigation activities: Aquifer Storage and Recovery (ASR), Floodplain and Stream Restoration (FSR), and Flood Diversion and Storage (FDS).

FEMA encourages communities to use this information in developing eligible HMA project applications that leverage risk reduction actions and increase resilience to the impacts of climate change.

Project Description

Aquifer Storage and Recovery is capturing water when it is abundant such as a rainy season or during spring snow melts, storing the water in the subsurface in brackish aquifers, and recovering the water when needed. There are two types of aquifers, confined and unconfined. A confined aquifer is a closed system and, for these projects, can only be recharged using an injection well. Project design includes a "mixing zone" which is created between the injected water and native groundwater to ensure variations in water quality are managed safely and effectively.

An unconfined aquifer can be recharged either by using an injection well or by allowing surface water to infiltrate and seep into the aquifer. Through infiltration, the surface water helps replenish groundwater supplies; the surface water mixes with native groundwater, and slowly flows through the aquifer. The appropriate method of recharge, and source and treatment of water added to the aquifer should be based on specific site conditions and may include drinking water, raw and/or partially treated surface water, and, infrequently, raw groundwater or reclaimed water. Communities can recover the stored water from the aquifer by using a well and use the water as a freshwater supply.

Group Discussion:

What partners in your community are already working on drought response?





Tribal Case Study

• Navajo drought conditions



Individual Reflection: Please take a few minutes to complete Section 2 of "Your Work, Your Community" Form

Wrapping Up

Thank you for being part of our training community!

Suggested reading (complete before next webinar)

• Oregon Climate Change Research Institute: <u>"Tribal Climate Chang Guidebook"</u> Pages 36-38

Next webinar:

April 21, 2020 (10AM PST / 1 EST)

Vulnerability Assessments Part 1 (Module 3)

Questions?

Changing Exposures and Impacts – Key Resources

Guidance

- USGCRP Impacts of Climate Change on Human Health in the United States
- USGCRP Fourth National Climate Assessment
 - <u>Climate Science Special Report</u>
 - Human Health Chapter
 - Tribes And Indigenous Peoples Chapter
 - Water Chapter
- USGCRP Third National Climate Assessment
 - Indigenous Peoples, Lands, and Resources
 - Human Health
- EPA <u>Climate Change Indicators in the United States</u>
- EPA <u>Multi-Model Framework for Quantitative Sectoral</u> <u>Impacts Analysis: A Technical Report for the Fourth</u> <u>National Climate Assessment</u>
- CDC Assessing Health Vulnerability to Climate Change A Guide for Health Departments
- IPCC Chapter 11: Human Health: Impacts, Adaptation, and Co-benefits
- National Wildlife Federation: <u>Facing the Storm: Indian</u> <u>Tribes, Climate-Induced Weather Extremes, and the Future</u>.
 <u>for Indian County</u>
- APHA How Climate Change Affects Your Health
- Tribal Public and Environmental Health Think Tank <u>Priorities in Tribal Public Health</u>

- National Indian Health Board <u>Climate Ready Tribes</u>
- Drought.gov Current Conditions
- FEMA- Aquifer Storage and Recovery Fact Sheet

Tools and Templates

- TCHP Exposures, Impacts, Strategies Inventory (EISI) tool – Beta Version
- TCHP <u>Blog: "Data Sources to Assess Tribal Climate and</u> <u>Health Data"</u>
- TCHP <u>Resources Clearinghouse</u>

Examples

- Reuters Biloxi-Chitimacha-Choctaw
- UNC Thinning Ice at Shishmaref, Alaska
- National Wildlife Federation <u>White Mountain Apache</u> <u>Tribe (Arizona) and the Rodeo Chediski Fire</u>
- US Climate Resilience Toolkit <u>Navajo Nation: Hotter,</u> <u>Drier Climate Puts Sand Dunes on the Move</u>
- U.S. Climate Resilience Toolkit <u>Mescalero Apache Tribe</u> <u>Adapts to Warmer and Drier Climate</u>
- National Wildlife Federation Flash Flood on The Drought-

Impacted Hopi Reservation; Thinning Ice Threatens Alaska Native Village of Shishmaref, Alaska

- Climate Adaptation Knowledge Exchange <u>The Igliniit</u> <u>Inujit Sea Ice Use and Occpuany Project</u>
- U.S. Climate Resilience Toolkit <u>Inupiag Work to Preserve</u> <u>Food and Traditions on Alaska's North Slope</u>
- NIHB Climate Ready Tribes

High Country News – <u>Northern California tribes face down</u> <u>massive wildfires</u>