Updated March 2019

FIND YOUR STATE

1. ALASKA

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	Alaska's temperatures are warming twice as fast as the global average[1], and Denali National Park is now 3.3°F warmer than it was 100 years ago.[2] Average temperatures during winter in Alaska are nearly 6°F higher than in 1970.[3]	By 2050, daily high temperatures in Alaska may increase up to 8°F compared to 1981-2000; the coldest nights may increase by more than 12°F, and the number of nights below freezing may decrease by 20+ nights per year.[4] The number of heat wave days could more than triple by 2050.[5]	The recent heat wave in the Gulf of Alaska reduced fisheries catch and led to an approximately 80% reduction in the allowable Pacific Cod quota in 2018.[6] Permafrost thawing is damaging buildings, roads, and cultural heritage sites and structures as the ground sinks.[7]
COASTAL FLOODING	The number of coastal flood days observed on the Pacific Coast in the period between 2005 and 2014 was more than six times as high as that observed in the 1950s.[8] Of the 735 coastal flood days since 1950, 75% are attributed to human-caused climate change.[9]	The 100-year coastal floodplain in Alaska is projected to expand from nearly 13,000 square miles to more than 15,000 square miles by midcentury, which will affect around 3,000 more residents.[10]	Flooding and erosion of coastal and river areas affect over 87% of the Alaska Native communities.[11] As the sea ice edge moves northward, storms produce larger waves and cause more coastal flooding and erosion, threatening communities.[12]
WILDFIRES	Alaska has more area burning in wildfires than any other state, and the wildfire season is now 40% longer than in the 1950s, with nearly 350,000 more acres burned each year, and on average around 40 more large wildfires each year – twice as many as 60 years ago.[13]	The area burned by wildfires from 2006-2100 could be 120 million acres if greenhouse gas emissions continue unabated.[14]	Wildfires and temperature increases have caused changes in forest and vegetation types, which affects wildlife and rural communities.[15] Wildfire smoke exposure is a concern for children and people with chronic respiratory and cardiovascular conditions.[16]
EXPECTED DAMAGES[17] **IN ALASKA BY 2100 WITHOUT CLIMATE ACTION**	• Costs to mitigate or remediate damage public infrastructure to mitigate damage to public infrastructure could cost a cumulative cost a cumulative cost \$4.7 billion (in 2018 dollars) by end of century. • Many communities may choose to partially or completely relocate, which can cost hundreds of millions dollars for each of millions dollars for each community.		

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[1] https://nca2018.globalchange.gov/chapter/26#fig-26-1

- The statewide annual average temperature record shows no clear change from 1925 to 1976 due to high variability, but from 1976–2016 a clear trend of +0.7°F per decade is evident.

[2] https://www.climatecentral.org/gallery/graphics/100-years-of-warming-at-the-national-parks

- Source data from Hadley CRU Hi-Res Dataset.

[3] https://www.climatecentral.org/gallery/graphics/seasonal-warming-trends-across-the-us

- Trends for meteorological seasons are calculated using monthly average temperature data between 1970 and 2017 (data from the NOAA NCEI). For clarity and the ability to compare different seasons, authors omitted the annual data points and displayed only the linear trends over time.

[4] https://nca2018.globalchange.gov/chapter/26/

- These temperature projections assume the high emissions scenario RCP8.5.

[5] http://assets.statesatrisk.org/summaries/Alaska_report.pdf

- The annual number of heatwave days is calculated as the average number of days each year on which the daily maximum temperature exceeds the 95th percentile of daily maximum temperature in the baseline (1991-2010) period for at least three consecutive days. While days above this temperature are not all potentially harmful to human health, an increase in hot days is an indicator of general warming.

[6] https://nca2018.globalchange.gov/chapter/26/

- These reductions are having significant impacts on Alaska fishing communities and led the governor of Alaska to ask the Federal Government to declare a fisheries disaster. Events such as these are requiring the use of multiple, alternative models to appropriately characterize uncertainty in future population trends and fishery harvests.

[7] https://nca2018.globalchange.gov/chapter/26/

- As evidenced by Nelson et al. 2001, Hong et al. 2014, and Raynolds et al. 2014.

[8] https://www.climatecentral.org/gallery/graphics/natural-human-caused-coastal-flood-days-in-the-us

- Authors subtracted yearly estimates for human-caused global sea level rise based on Kopp et al. 2016, from hourly water level records at 27 tide gauges around the United States. They then compared how many days the water level exceeded the local threshold for nuisance flooding — with or without the subtractions.

[9] https://www.climatecentral.org/gallery/graphics/natural-human-caused-coastal-flood-days-in-the-us

- Authors subtracted yearly estimates for human-caused global sea level rise based on Kopp et al. 2016, from hourly water level records at 27 tide gauges around the United States. They then compared how many days the water level exceeded the local threshold for nuisance flooding — with or without the subtractions.

[10] http://assets.statesatrisk.org/summaries/Alaska_report.pdf

- Coastal flooding could disproportionately affect Native Alaskans, who make up the majority of residents in Alaska's remote coastal villages along the western and northern coasts where topography is relatively flat.

[11] https://nca2018.globalchange.gov/chapter/26/

- Estimate based on the assessment of five separate studies: Cochran et al. 2013, Inter-agency Working Group 2009, U.S. Army Corps of Engineers 2009, U.S. Government Accountability Office 2009, and U.S. General Accountability Office 2003.

[12] https://nca2018.globalchange.gov/chapter/26/

- As highlighted in Gibbs and Richmond 2015, the National Assessment of Shoreline Change: Historical Shoreline Change along the North Coast of Alaska.

[13] http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[14] https://nca2018.globalchange.gov/chapter/26/

- These projections of area burned by wildfires assume the high emissions scenario RCP8.5.

[15] https://nca2018.globalchange.gov/chapter/26/

- The vegetation of forested interior Alaska now has less acreage of older spruce forest and more of post-fire early successional vegetation, birch, and aspen than it did prior to 1990. This change favors shrub-adapted wildlife species such as moose but also destroys the slow-growing lichens and associated high-quality winter range that caribou prefer, though the effects of fire-driven habitat changes to caribou population dynamics are uncertain.

[16] https://nca2018.globalchange.gov/chapter/26/

- Air conditioning in homes is rare in Alaska, so relief is seldom available for at-risk persons to escape high temperatures or from smoke exposure due to wildfires, assuming proper filters are not installed.

[17] https://nca2018.globalchange.gov/chapter/26/

- Public infrastructure costs are based on a 2017 estimate of annual costs between 2015 and 2060: Melvin et al. 2017. These annual costs are projected to the end of the century in 2015 dollars with a 3% discount rate and are based on a business-as-usual scenario (RCP8.5). Estimates have been adjusted to 2018 dollars for this factsheet.
- U.S. Army Corps of Engineers studies have identified several communities requiring partial or complete relocation as a result of coastal and riverine erosion and flooding. A 2009 GAO report estimates that relocation costs can range in the hundreds of millions of dollars.

2. ARIZONA

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	Arizona is 4th-fastest warming state in U.S.[1] Phoenix is 2nd-fastest warming city in the U.S. followed by Prescott as the 5th and Tucson as the 7th.[2] Average temperatures in Arizona during spring have warmed by 4°F since 1970.[3]	Heat wave days in Arizona are expected to more than triple by 2050 from 15 to 50 days a year.[4] 'Dangerous' heat days are projected to grow from 50 days a year to 80 by 2050.[5] Number of days above 100°F in Phoenix may nearly double from 80 to 150 by end of century.[6]	Tucson ranks 6th in U.S. cities with the largest increase in 'disease danger days' (risk of disease transmission by mosquitoes), increasing by 29 days since 1970.[7] By midcentury, Arizona summers could see 20% reduction in electricity generation capacity.[8]
DROUGHT	Drought in the southwestern U.S. is declining the western snowpack, and this along with rising temperatures have reduced water flow down the Colorado River.[9]	By 2050, the severity of widespread summer drought is projected to more than triple in Arizona, the second largest increase behind Washington.[10]	Reduced water flow from the Colorado River is impacting Arizona's water supply; Tucson gets almost all their water from the River, while Phoenix receives about half its supply.[11] Higher number of cases of Valley fever have occurred in Arizona from drier conditions.[12]
WILDFIRES	Arizona now sees three times more fires burning per year than in the 1970s, which has led to thousands of more acres burned each year.[13]	By 2050, Arizona is projected to see over one more month of high wildfire potential, leading to 115 at-risk days each year.[14]	Nearly 3 million people living in Arizona – 45% of the state's population – are at elevated risk of wildfire.[15] Infrastructure is especially vulnerable to increased wildfires.[16]
EXPECTED DAMAGES[17] **IN ARIZONA BY 2100 WITHOUT CLIMATE ACTION**	At least 1,700 additional deaths per year A 50 to 70% decrease in major crop yields for several counties, including in Maricopa County, which is home to nearly 4 million people Over 15% more spent on energy in half of counties, nearly 20% more spent in Maricopa		

[1] http://statesatrisk.org/arizona/extreme-heat

- Warming rates are evaluated from year 1970 to today.

[2] https://www.climatecentral.org/news/fastest-warming-cities-20535

- This analysis considered the top 200 largest metro areas in the U.S. and calculated their average annual temperature from 1981-2010. To determine which of those 200 cities have been warming the fastest, authors calculated how average annual temperatures have been changing since 1965.

[3] https://www.climatecentral.org/gallery/graphics/seasonal-warming-trends-across-the-us

- Trends for meteorological seasons are calculated using monthly average temperature data between 1970 and 2017 (data from the NOAA NCEI). For clarity and the ability to compare different seasons, authors omitted the annual data points and displayed only the linear trends over time.

[4] http://statesatrisk.org/arizona/extreme-heat

- The annual number of heatwave days is calculated as the average number of days each year on which the daily maximum temperature exceeds the 95th percentile of daily maximum temperature in the baseline (1991-2010) period for at least three consecutive days. While days above this temperature are not all potentially harmful to human health, an increase in hot days is an indicator of general warming.

[5] http://statesatrisk.org/arizona/extreme-heat

- “Dangerous” and “extremely dangerous” heat days are classified by the National Weather Service Heat Index, taking into account both temperature and relative humidity.

[6] https://nca2018.globalchange.gov/chapter/1#fig-1-16

- These temperature projections assume the high emissions scenario RCP8.5.

[7] https://www.climatecentral.org/news/us-faces-a-rise-in-mosquito-disease-danger-days-21903

- Temperature trends were calculated using average daily temperature data from the Applied Climate Information System (rcc-acis.org). Years with more than 30 days of missing data were excluded from the analysis. The temperature range of disease transmission (61-93F) as well as the range for peak transmission (79-84F) were chosen based on the findings in Mordecai et al. 2017.

[8] https://nca2018.globalchange.gov/chapter/25#fig-25-8

- Heat-induced reduction of energy efficiency calculated based on a higher emissions scenario (SRES A2).

[9] https://nca2018.globalchange.gov/chapter/14/

- Highlighted by McCabe et al. 2017, Udall and Overpeck 2017, and Woodhouse et al. 2016.

[10] http://statesatrisk.org/arizona/drought

- Severity of widespread summer drought is defined as the sum of soil moisture deficit (standard score) in the summer months for model grid cells where the standard score is less than -1, when at least 30% of grid cells in a state meet this criterion.

[11] http://statesatrisk.org/arizona/drought

- If upstream states continue to be unable to make up the shortage, Lake Mead, whose surface is now about 1,085 feet above sea level, will drop to 1,000 feet by 2020. Under present conditions, that would cut off much of Arizona’s water supply.

[12] https://nca2018.globalchange.gov/chapter/14/

- Valley fever can cause persistent flu-like symptoms, with over 40% of cases hospitalized and 75% of patients unable to perform their normal daily activities for weeks, months, or longer. Relationship between valley fever cases and drier conditions established by Coopersmith et al. 2017.

[13] http://www.climatecentral.org/gallery/graphics/hotter-years-more-fires

- Authors analyzed 45 years of U.S. Forest Service records of large wildfires (those fires burning more than 1,000 acres) from the western U.S. in the new report, “Western Wildfires: A Fiery Future.”

[14] http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-

2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[15] http://statesatrisk.org/arizona/wildfires

- Individuals living within the wildland-urban interface, where developed wild lands converge and intersperse, are at elevated risk for wildfire.

[16] http://statesatrisk.org/arizona/wildfires

[17] http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/

- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5), and are aggregated to the state-level where appropriate.
- Mortality increases: county-level changes in all-cause mortality rates across all age groups, relative to 2012. Mortality rates are translated to absolute estimates and aggregated to the state-level based on 2012 county populations. As we do not project county populations to 2100, additional mortalities by 2100 are likely a conservative estimate.
- Crop yield declines: percent changes relative to 2012 for cotton, maize, wheat, and soybean yields are translated to proportional changes in the value of that sector's gross output by 2100.
- Increased energy expenditures: county-level changes in residential and commercial energy expenditures relative to 2012, as a result of climate change impacting energy demand.

3. CALIFORNIA

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	California has warmed 2.5°F on average since 1970,[1] and Yosemite National Park has warmed 4.5°F over the past century.[2] Riverside is the 4th fastest warming city in the U.S.[3]	Heat wave days in California are projected to more than triple by 2050, from 15 to more than 45 days per year.[4]	San Francisco mosquito season is now 2 weeks longer than during the 1980s.[5] Heat waves in CA have already caused hundreds of deaths, thousands of hospital visits, and billions in economic costs.[6]
DROUGHT	Higher temperatures intensified the 2011-2016 drought, and led to the largest ‘snow drought’ on record as more precipitation fell as rain.[7]	The severity of widespread summer drought in California is projected to almost triple by the end of the century.[8]	The increase in heat and reduction of snow have amplified recent water shortages.[9] The recent drought led to 10,000+ lost jobs and $900M of gross crop revenue lost.[10]
WILDFIRES	The number of fires and amount of acres burning annually in California has roughly doubled since the 1970s.[11] In 2018, 400,000+ acres burnt – nearly 3 times the amount in the 1970s.[12]	The frequency of wildfires may increase by 25% in the Southwest by end of century, along with a tripling of very large fires.[13]	11+ million people in California (30% of the state population) are at elevated risk of wildfires.[14] Wildfires in California in 2017 and 2018 resulted in over $42 billion in damages.[15]
COASTAL FLOODING	Sea level has risen around 9 inches at Golden Gate Bridge and in San Diego over past century.[16] Scientists say 150+ coastal flood days in San Fran and La Jolla over past decade are 80%+ human-caused.[17]	Projected sea level rise by 2050 could make 100-year floods in La Jolla, Los Angeles, and San Diego 100 times more likely.[18] Areas in coastal floodplain zone could double by 2050.[19]	200,000+ more people are projected to be at risk of coastal flooding by 2050.[20] Sea level rise and storm surge may erode 2/3 of southern California beaches by 2100.[21]
EXPECTED DAMAGES[22] **IN CALIFORNIA BY 2100 WITHOUT CLIMATE ACTION**	At least 3,200 additional deaths per year San Bernardino county, currently home to 2 million people, expected to see around a 50% decrease in major crop yields relative to 2012 levels 8 counties that currently cover 10 million people are each expected to spend 10% more on energy relative to 2012 levels		

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[1] https://www.climatecentral.org/news/us-warming-trend-earth-day-20257

- Since the 1970s, the contiguous 48 states have been warming at a rate of 0.45°F per decade. This analysis draws on temperature data from the national Climatic Data Center's Climate at a Glance database.

[2] https://www.climatecentral.org/gallery/graphics/100-years-of-warming-at-the-national-parks

- Source data from Hadley CRU Hi-Res Dataset.

[3] https://www.climatecentral.org/news/fastest-warming-cities-20535

- This analysis considered the top 200 largest metro areas in the U.S. and calculated their average annual temperature from 1981-2010. To determine which of those 200 cities have been warming the fastest, authors calculated how average annual temperatures have been changing since 1965.

[4] http://assets.statesatrisk.org/summaries/California_report.pdf

- The annual number of heatwave days is calculated as the average number of days each year on which the daily maximum temperature exceeds the 95th percentile of daily maximum temperature in the baseline (1991-2010) period for at least three consecutive days. While days above this temperature are not all potentially harmful to human health, an increase in hot days is an indicator of general warming.

[5] https://www.climatecentral.org/news/more-mosquito-days-increasing-zika-risk-in-us-20553#dropdown

- The analysis of mosquito season length is based on the ideal temperature and humidity conditions for Asian Tiger Mosquitoes (*Aedes albopictus*), which is one of the species known to transmit the Zika virus. These mosquitoes have high mortality rates at temperatures outside the range of 50-95°F or at relative humidity below 42 percent.

[6] https://nca2018.globalchange.gov/chapter/25/

- Compared to non-heat wave summer days, it is estimated that the event led to an additional 600 deaths, 16,000 emergency room visits, 1,100 hospitalizations in California, and economic costs of $5.4 billion (in 2008 dollars).

[7] https://nca2018.globalchange.gov/chapter/25/

- Impact of higher temperatures on the 2011-2016 drought outlined by Williams et al. 2015, Diffenbaugh et al. 2015, Griffin and Annchukaitis 2014, Luo et al. 2017, and Shukla et al. 2015; impact on low snowpack outlined by Mote et al. 2016, Berg and Hall 2017, Luo et al. 2017, and Belmecheri et al. 2016.

[8] http://assets.statesatrisk.org/summaries/California_report.pdf

- Severity of widespread summer drought is defined as the sum of soil moisture deficit (standard score) in the summer months for model grid cells where the standard score is less than -1, when at least 30% of grid cells in a state meet this criterion.

[9] https://nca2018.globalchange.gov/chapter/25/

- Evidenced by Williams et al. 2015, Berg and Hall 2017, Diffenbaugh et al. 2015, Mao et al. 2015, and Seager et al. 2015. Snow droughts can arise from a lack of precipitation, temperatures that are too warm for snow, or a combination of the two.

[10] https://nca2018.globalchange.gov/chapter/25/

- The California drought led to losses of more than 10,000 jobs and the fallowing of 540,000 acres (220,000 hectares), at a cost of $900 million in gross crop revenue in 2015.

[11] https://www.climatecentral.org/gallery/graphics/hotter-years-more-fires

- Authors analyzed 45 years of U.S. Forest Service records of large wildfires (those fires burning more than 1,000 acres) from the western U.S. in the new report, "Western Wildfires: A Fiery Future."

[12] http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[13] https://nca2018.globalchange.gov/chapter/25/

- The increased projected fire frequency is based upon a higher emissions scenario (SRES A2).

[14] http://assets.statesatrisk.org/summaries/California_report.pdf
- Individuals living within the wildland-urban interface, where developed wild lands converge and intersperse, are at elevated risk for wildfire.

[15] https://www.ncdc.noaa.gov/billions/events/US/1980-2018
- This is a sum of the costs of Weather and Climate Billion-Dollar Disasters (NOAA data) stemming from California wildfires in 2017 and 2018.

[16] https://nca2018.globalchange.gov/chapter/25/
- The increased projected fire frequency is based upon a higher emissions scenario (SRES A2).

[17] https://www.climatecentral.org/news/climate-change-increases-sunny-day-floods-20784#dropdown
- This analysis is based on a broader February 2016 Climate Central analysis that looked at the human-caused sea level rise contribution to nuisance flooding over a 65-year period. That study focused on 27 tidal gauges with high quality hourly water level records dating back several decades.

[18] https://www.climatecentral.org/gallery/graphics/sea-level-rise-is-increasing-coastal-flood-risk
- Source data comes from the Intermediate High NCA Projection and Climate Central.

[19] http://assets.statesatrisk.org/summaries/California_report.pdf
- The sea level rise and coastal flood analysis aimed to delineate zones with 1% annual flood risk (100-year coastal floodplains), given baseline and projected sea levels in the years 2000 and 2050, and to tabulate the current population residing within them. Median sea level rise (SLR) projections from Kopp et al. (2014) are for 2050 under RCP 8.5 at 69 tide gauges along the U.S. coast. The projections take vertical land motion into account.

[20] http://assets.statesatrisk.org/summaries/California_report.pdf
- The sea level rise and coastal flood analysis aimed to delineate zones with 1% annual flood risk (100-year coastal floodplains), given baseline and projected sea levels in the years 2000 and 2050, and to tabulate the current population residing within them. Median sea level rise (SLR) projections from Kopp et al. (2014) are for 2050 under RCP 8.5 at 69 tide gauges along the U.S. coast. The projections take vertical land motion into account.

[21] https://nca2018.globalchange.gov/chapter/25/
- Estimated by Vitousek et al. 2017.

[22] http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/
- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5), and are aggregated to the state-level where appropriate.
- Mortality increases: county-level changes in all-cause mortality rates across all age groups, relative to 2012. Mortality rates are translated to absolute estimates and aggregated to the state-level based on 2012 county populations. As we do not project county populations to 2100, additional mortalities by 2100 are likely a conservative estimate.
- Crop yield declines: percent changes relative to 2012 for cotton, maize, wheat, and soybean yields are translated to proportional changes in the value of that sector's gross output by 2100.
- Increased energy expenditures: county-level changes in residential and commercial energy expenditures relative to 2012, as a result of climate change impacting energy demand.

3a. CALIFORNIA – CENTRAL

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	The hottest year on record in Bakersfield, Monterey, and Santa Maria, CA occurred during the 2010s.[1]	Days above 100°F in Fresno may triple by end of century if current emissions trends continue, from 30 days currently to 97 days by 2100.[2]	Santa Maria and Fresno, CA rank 3rd and 9th for U.S. cities with the largest increase in 'disease danger days' (risk of disease transmission by mosquitos) increasing by 39 and 27 days since 1970, respectively.[3]
DROUGHT	Higher temperatures intensified the 2011-2016 drought, and led to the largest 'snow drought' on record as more precipitation fell as rain.[4]	The severity of widespread summer drought in California is projected to almost triple by the end of the century.[5]	The increase in heat and reduction of snow have amplified recent water shortages.[6] The recent drought led to 10,000+ lost jobs and $900M of gross crop revenue lost.[7]
WILDFIRES	The number of fires and amount of acres burning annually in California has roughly doubled since the 1970s.[8] In 2018, 400,000+ acres burnt – nearly 3 times the amount in the 1970s.[9]	The frequency of wildfires may increase by 25% in the Southwest by end of century, along with a tripling of very large fires.[10]	Wildfires in California in 2017 and 2018 resulted in over $42 billion in damages.[11]
EXPECTED DAMAGES[12] **IN CALIFORNIA BY 2100 WITHOUT CLIMATE ACTION**	Fresno county, currently home to nearly 1 million people, and the third largest county in the nation in terms of value of agriculture produced, is expected to see around a 20% decrease in major crop yields relative to 2012 levels Fresno county expected to spend 10% more on energy relative to 2012 levels		

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[1] https://www.climatecentral.org/gallery/graphics/hottest-years-for-us-cities

- Data was gathered from the Applied Climate Information System. Average annual temperature was determined using the average of days (not the average of months). Years with more the 30 days of missing data were removed from the analysis. In case of a tie (22 occurrences), the most recent year is represented. Former Weather Channel meteorologist Guy Walton maintains a comprehensive records database, analyzing monthly, annual, and decadal records trends.

[2] https://www.climatecentral.org/gallery/graphics/future-days-above-95f

- Projections of the days each year above a threshold temperature are based on a downscaled and bias-corrected ensemble of climate models known as CMIP5 (the same models used in the IPCC). Each labeled year shows the average of the preceding 20 years. Data for 2016 are the annual averages of a gridded historical data set (Daymet, Oak Ridge National Lab) for 1997-2016.

[3] https://www.climatecentral.org/news/us-faces-a-rise-in-mosquito-disease-danger-days-21903

- Temperature trends were calculated using average daily temperature data from the Applied Climate Information System (rcc-acis.org). Years with more than 30 days of missing data were excluded from the analysis. The temperature range of disease transmission (61-93F) as well as the range for peak transmission (79-84F) were chosen based on the findings in Mordecai et al. 2017.

[4] https://nca2018.globalchange.gov/chapter/25/

- Impact of higher temperatures on the 2011-2016 drought outlined by Williams et al. 2015, Diffenbaugh et al. 2015, Griffin and Annchukaitis 2014, Luo et al. 2017, and Shukla et al. 2015; impact on low snowpack outlined by Mote et al. 2016, Berg and Hall 2017, Luo et al. 2017, and Belmecheri et al. 2016.

[5] http://assets.statesatrisk.org/summaries/California_report.pdf

- Severity of widespread summer drought is defined as the sum of soil moisture deficit (standard score) in the summer months for model grid cells where the standard score is less than -1, when at least 30% of grid cells in a state meet this criterion.

[6] https://nca2018.globalchange.gov/chapter/25/

- Evidenced by Williams et al. 2015, Berg and Hall 2017, Diffenbaugh et al. 2015, Mao et al. 2015, and Seager et al. 2015. Snow droughts can arise from a lack of precipitation, temperatures that are too warm for snow, or a combination of the two.

[7] https://nca2018.globalchange.gov/chapter/25/

- The California drought led to losses of more than 10,000 jobs and the fallowing of 540,000 acres (220,000 hectares), at a cost of $900 million in gross crop revenue in 2015.

[8] https://www.climatecentral.org/gallery/graphics/hotter-years-more-fires

- Authors analyzed 45 years of U.S. Forest Service records of large wildfires (those fires burning more than 1,000 acres) from the western U.S. in the new report, "Western Wildfires: A Fiery Future."

[9] http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[10] https://nca2018.globalchange.gov/chapter/25/

- The increased projected fire frequency is based upon a higher emissions scenario (SRES A2).

[11] https://www.ncdc.noaa.gov/billions/events/US/1980-2018

- This is a sum of the costs of Weather and Climate Billion-Dollar Disasters (NOAA data) stemming from California wildfires in 2017 and 2018.

[12] http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/

- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5).
- Crop yield declines: percent changes relative to 2012 for cotton, maize, wheat, and soybean yields are translated to proportional changes in the value of that sector's gross output by 2100.
- Increased energy expenditure: Changes in residential and commercial energy expenditures relative to 2012, as a result of climate change impacting energy demand.

3b. CALIFORNIA – SOUTHERN

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	Riverside is the 4th fastest warming city in the U.S.[1] The hottest year on record in San Diego and Palm Springs occurred during the 2010s.[2]	The number of dangerous heat days observed each year are projected to almost double in Los Angeles by 2050.[3]	Heat waves in California have already caused hundreds of deaths, thousands of hospital visits, and billions in economic costs.[4]
DROUGHT	Higher temperatures intensified the 2011-2016 drought, and led to the largest 'snow drought' on record as more precipitation fell as rain.[5]	The severity of widespread summer drought in California is projected to almost triple by the end of the century.[6]	The increase in heat and reduction of snow have amplified recent water shortages.[7] The recent drought led to 10,000+ lost jobs and $900M of gross crop revenue lost.[8]
WILDFIRES	The number of fires and amount of acres burning annually in California has roughly doubled since the 1970s.[9] In 2018, 400,000+ acres burnt – nearly 3 times the amount in the 1970s.[10]	Without action to curb climate change, there could be a 25% increase in the frequency of wildfires in the Southwest by end of century, along with a tripling of very large fires.[11]	Wildfires in California in 2017 and 2018 resulted in over $42 billion in damages.[12]
COASTAL FLOODING	Sea level has risen around 9 inches in San Diego over past century.[13] Scientists say 150+ coastal flood days in La Jolla over the past decade are 90% human-caused.[14]	Projected sea level rise by 2050 could make 100-year floods in La Jolla, Los Angeles, and San Diego 100 times more likely,[15] and coastal floods are expected to triple in these cities by 2050.[16]	Sea level rise and storm surge may erode two thirds of southern California beaches by 2100.[17]
EXPECTED DAMAGES[18] **IN CALIFORNIA BY 2100 WITHOUT CLIMATE ACTION**	At least 2,500 additional deaths per year San Bernardino county, currently home to 2 million people, expected to see around a 50% decrease in major crop yields relative to 2012 levels Imperial, Orange, Riverside, and San Bernardino counties are each expected to spend 10% more on energy relative to 2012 levels		

1 https://www.climatecentral.org/news/fastest-warming-cities-20535

- This analysis considered the top 200 largest metro areas in the U.S. and calculated their average annual temperature from 1981-2010. To determine which of those 200 cities have been warming the fastest, authors calculated how average annual temperatures have been changing since 1965.

[2] https://www.climatecentral.org/gallery/graphics/hottest-years-for-us-cities

- Data was gathered from the Applied Climate Information System. Average annual temperature was determined using the average of days (not the average of months). Years with more the 30 days of missing data were removed from the analysis. In case of a tie (22 occurrences), the most recent year is represented. Former Weather Channel meteorologist Guy Walton maintains a comprehensive records database, analyzing monthly, annual, and decadal records trends.

[3] https://www.climatecentral.org/news/sizzling-summers-20515#dangerdays

- "Dangerous" and "extremely dangerous" heat days are classified by the National Weather Service Heat Index, taking into account both temperature and relative humidity.

[4] https://nca2018.globalchange.gov/chapter/25/

- Compared to non-heat wave summer days, it is estimated that the event led to an additional 600 deaths, 16,000 emergency room visits, 1,100 hospitalizations in California, and economic costs of $5.4 billion (in 2008 dollars).

[5] https://nca2018.globalchange.gov/chapter/25/

- Impact of higher temperatures on the 2011-2016 drought outlined by Williams et al. 2015, Diffenbaugh et al. 2015, Griffin and Annchukaitis 2014, Luo et al. 2017, and Shukla et al. 2015; impact on low snowpack outlined by Mote et al. 2016, Berg and Hall 2017, Luo et al. 2017, and Belmecheri et al. 2016.

[6] http://assets.statesatrisk.org/summaries/California_report.pdf

- Severity of widespread summer drought is defined as the sum of soil moisture deficit (standard score) in the summer months for model grid cells where the standard score is less than -1, when at least 30% of grid cells in a state meet this criterion.

[7] https://nca2018.globalchange.gov/chapter/25/

- Evidenced by Williams et al. 2015, Berg and Hall 2017, Diffenbaugh et al. 2015, Mao et al. 2015, and Seager et al. 2015. Snow droughts can arise from a lack of precipitation, temperatures that are too warm for snow, or a combination of the two.

[8] https://nca2018.globalchange.gov/chapter/25/

- The California drought led to losses of more than 10,000 jobs and the fallowing of 540,000 acres (220,000 hectares), at a cost of $900 million in gross crop revenue in 2015.

[9] https://www.climatecentral.org/gallery/graphics/hotter-years-more-fires

- Authors analyzed 45 years of U.S. Forest Service records of large wildfires (those fires burning more than 1,000 acres) from the western U.S. in the new report, "Western Wildfires: A Fiery Future."

[10] http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[11] https://nca2018.globalchange.gov/chapter/25/

- The increased projected fire frequency is based upon a higher emissions scenario (SRES A2).

[12] https://www.ncdc.noaa.gov/billions/events/US/1980-2018

- This is a sum of the costs of Weather and Climate Billion-Dollar Disasters (NOAA data) stemming from California wildfires in 2017 and 2018.

[13] https://nca2018.globalchange.gov/chapter/25/

- Estimated by NOAA in 2017 ("Mean sea level trend: San Diego, California").

[14] https://www.climatecentral.org/news/climate-change-increases-sunny-day-floods-20784#dropdown

- This analysis is based on a broader February 2016 Climate Central analysis that looked at the human-caused sea level rise contribution to nuisance flooding over a 65-year period. That study focused on 27 tidal gauges with high quality hourly water level records dating back several decades.

[15] https://www.climatecentral.org/gallery/graphics/sea-level-rise-is-increasing-coastal-flood-risk

- Source data comes from the Intermediate High NCA Projection and Climate Central.

[16] https://www.climatecentral.org/gallery/graphics/climate-change-increasing-frequency-of-coastal-flooding

- Observed water levels were used to count present and past floods, which were driven by tides along with storm surges. Future hourly water levels are based on detailed tidal projections and sea level rise projections.

[17] https://nca2018.globalchange.gov/chapter/25/

- Estimated by Vitousek et al. 2017.

[18] http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/

- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5), and are aggregated to the state-level where appropriate.
- Mortality increases: county-level changes in all-cause mortality rates across all age groups, relative to 2012. Mortality rates are translated to absolute estimates based on 2012 county populations. As we do not project county populations to 2100, additional mortalities by 2100 are likely a conservative estimate.
- Crop yield declines: percent changes relative to 2012 for cotton, maize, wheat, and soybean yields are translated to proportional changes in the value of that sector's gross output by 2100.
- Increased energy expenditures: county-level changes in residential and commercial energy expenditures relative to 2012, as a result of climate change impacting energy demand.

4. COLORADO

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	Colorado has warmed 2.6°F since the 1970s[1] and over 3.5°F during the fall.[2] Fort Collins is 9th-fastest warming city in the U.S.[3] The number of days above 95°F each summer has approximately doubled in Denver since the 1970s.[4]	By midcentury, Colorado is projected to experience five times as many heatwaves each year,[5] and the number of dangerous heat days is projected to increase by 50%.[6]	The length of mosquito season has more than tripled in Grand Junction, CO since the 1980s.[7] By midcentury, several cities in Colorado could see up to a 30% reduction in electricity generation capacity during summers and are at risk of electricity shortages.[8]
DROUGHT	Increasing heat and decreasing snow have exacerbated recent droughts in the Colorado River Basin.[9] High temperatures are responsible for up to half of the record-setting Colorado River streamflow reductions between 2000 and 2014.[10]	By 2050, widespread summer drought severity in Colorado is projected to be among the worst in the country, tripling its severity compared to today.[11]	Declining snowpacks and runoff, along with a shift of spring runoff to earlier in the season, may reduce hydroelectric power potential by up to 15% by 2050.[12] During a low snow season, Colorado can observe a loss of over $150 million in ski resort revenue.[13]
WILDFIRES	The number of fires burning annually in Colorado has more than quadrupled since the 1970s.[14] An average year in the 2010s experienced 30 times more acres burned by large wildfires than in the 1970s.[15]	By end of the century in the Southwest U.S., fire frequency could increase by 25% and the frequency of large fires could triple without efforts to curb greenhouse gas emissions.[16]	Wildfires have previously degraded drinking water in Fort Collins with sediment and cancer precursors, requiring a multi-month switch to alternative water supplies.[17]
EXPECTED DAMAGES[18] **IN COLORADO BY 2100 WITHOUT CLIMATE ACTION**	8 counties currently home to over 200,000 people are each expected to spend over 10% more on energy relative to 2012 levels		

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[1] http://www.climatecentral.org/news/us-warming-trend-earth-day-20257

- Since the 1970s, the contiguous 48 states have been warming at a rate of 0.45°F per decade. This analysis draws on temperature data from the National Climatic Data Center's Climate at a Glance database.

[2] https://www.climatecentral.org/gallery/graphics/seasonal-warming-trends-across-the-us

- Trends for meteorological seasons are calculated using monthly average temperature data between 1970 and 2017 (data from the NOAA NCEI). For clarity and the ability to compare different seasons, authors omitted the annual data points and displayed only the linear trends over time.

[3] http://www.climatecentral.org/news/fastest-warming-cities-20535

- This analysis considered the top 200 largest metro areas in the U.S. and calculated their average annual temperature from 1981-2010. To determine which of those 200 cities have been warming the fastest, authors calculated how average annual temperatures have been changing since 1965.

[4] http://reportcard.statesatrisk.org/report-card/colorado/extreme_heat_grade

- Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of ⅛° (about 140 square kilometers per grid cell), and cover the conterminous United States and portions of Canada and Mexico.

[5] http://reportcard.statesatrisk.org/report-card/colorado/extreme_heat_grade

- Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of ⅛° (about 140 square kilometers per grid cell), and cover the conterminous United States and portions of Canada and Mexico.

[6] http://reportcard.statesatrisk.org/report-card/colorado/extreme_heat_grade

- "Dangerous" and "extremely dangerous" heat days are classified by the National Weather Service Heat Index, taking into account both temperature and relative humidity.

[7] http://www.climatecentral.org/news/more-mosquito-days-increasing-zika-risk-in-us-20553#dropdown

- The analysis of mosquito season length is based on the ideal temperature and humidity conditions for Asian Tiger Mosquitoes (*Aedes albopictus*), which is one of the species known to transmit the Zika virus. These mosquitoes have high mortality rates at temperatures outside the range of 50-95°F or at relative humidity below 42 percent.

[8] https://nca2018.globalchange.gov/chapter/25/

- Under a higher emissions scenario (SRES A2), heat-induced reduction of energy efficiency and reduced water flows would reduce summer energy generation capacity across the Southwest region. These projected reductions would increase risks of electricity shortages.

[9] https://nca2018.globalchange.gov/chapter/25/

- Highlighted by McCabe et al. 2017, Udall and Overpeck 2017, and Woodhouse et al. 2016.

[10] https://nca2018.globalchange.gov/chapter/25/

- Estimated by Udall and Overpeck 2017.

[11] http://reportcard.statesatrisk.org/report-card/colorado/drought_grade

- Severity of widespread summer drought is defined as the sum of soil moisture deficit (standard score) in the summer months for model grid cells where the standard score is less than -1, when at least 30% of grid cells in a state meet this criterion.

[12] https://nca2018.globalchange.gov/chapter/25#fig-25-8

- Under a higher emissions scenario (SRES A2174), heat-induced reduction of water flows would reduce summer energy generation capacity across the Southwest region.

[13] http://ecowest.org/tag/university-of-new-hampshire/

- Colorado has the highest employment of state winter tourism jobs and has the most visitors of any state for winter tourism. Both heat and drought can have an impact on this integral part of Colorado's economy.

[14] http://www.climatecentral.org/gallery/graphics/hotter-years-more-fires

- Authors analyzed 45 years of U.S. Forest Service records of large wildfires (those fires burning more than 1,000 acres) from the western U.S. in the new report, "Western Wildfires: A Fiery Future."

[15] http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[16] https://nca2018.globalchange.gov/chapter/25

- The increased projected fire frequency is based upon a higher emissions scenario (SRES A2).

[17] https://nca2018.globalchange.gov/chapter/25/

- Demonstrated by Hohner et al. 2016 and Writer et al. 2014.

[18] http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/

- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5).
- Increased energy expenditures: county-level changes in residential and commercial energy expenditures relative to 2012, as a result of climate change impacting energy demand.

5. FLORIDA

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	Temperatures in Florida have increased by nearly 2°F since 1970,[1] and by over 2.5°F during winter.[2] Florida is already home to 10 of the top 25 hottest cities in the U.S.; Miami is the hottest city in the U.S.[3]	Florida is expected to see nearly 8 times more heat wave days by 2050, from around 10 to nearly 80 days a year – an increase more than any other state.[4] Also more than any other state, Florida is expected to see 5 times more dangerous heat days in 2050.[5]	Mosquito season in Daytona Beach is now nearly a month longer than in 1980.[6] Some cities in southern Florida already have suitable conditions year-round for adult mosquitos that can spread dengue, chikungunya, and Zika viruses.[7]
COASTAL FLOODING	Hurricanes in the Atlantic have been stronger in the past couple of decades than during the 1970s/1980s.[8] Key West has had more than 6 times the amount of coastal flood days in the past decade than in the 1960s.[9]	Florida is expected to see up to 4 feet of additional sea level rise from 2000 levels by 2100.[10]	More than half a million people and 400,000+ homes accounting for $200B+ in property value are located within 4 feet of current sea level in Florida.[11] Florida has 3.5 million people at risk for a 100-year coastal flood;[12] these floods may become 100 times more likely by 2050.[13]
INLAND FLOODING	Florida has experienced a 20-30% increase in heavy downpours since 1950.[14]	By 2050, Florida's inland flooding threat is projected to increase by 50%.[15]	More than 150 gallons of sewage has spilled in St. Petersburg due to heavy rain events.[16] More than 1.5 million people in Florida are currently living in flood prone areas; this is more than in any other state.[17]
EXPECTED DAMAGES[18] **IN FLORIDA BY 2100 WITHOUT CLIMATE ACTION**	At least 8,100 additional deaths per year More than 1 million homes[19] at risk for chronic flooding, and nearly $9 billion of annual coastal damages 8 counties currently home to 700,000 people expected to see 20% decrease in major crop yields relative to 2012 levels		

[1] http://www.climatecentral.org/news/us-warming-trend-earth-day-20257

- Since the 1970s, the contiguous 48 states have been warming at a rate of 0.45°F per decade. This analysis draws on temperature data from the national Climatic Data Center's Climate at a Glance database.

[2] https://www.climatecentral.org/gallery/graphics/seasonal-warming-trends-across-the-us

- Trends for meteorological seasons are calculated using monthly average temperature data between 1970 and 2017 (data from the NOAA NCEI). For clarity and the ability to compare different seasons, authors omitted the annual data points and displayed only the linear trends over time.

[3] https://www.climatecentral.org/news/fastest-warming-cities-20535

- This analysis considered the top 200 largest metro areas in the U.S. and calculated their average annual temperature from 1981-2010. To determine which of those 200 cities have been warming the fastest, authors calculated how average annual temperatures have been changing since 1965.

[4] http://assets.statesatrisk.org/summaries/Florida_report.pdf

- The annual number of heatwave days is calculated as the average number of days each year on which the daily maximum temperature exceeds the 95th percentile of daily maximum temperature in the baseline (1991-2010) period for at least three consecutive days. While days above this temperature are not all potentially harmful to human health, an increase in hot days is an indicator of general warming.

[5] http://assets.statesatrisk.org/summaries/Florida_report.pdf

- "Dangerous" and "extremely dangerous" heat days are classified by the National Weather Service Heat Index, taking into account both temperature and relative humidity.

[6] https://www.climatecentral.org/news/more-mosquito-days-increasing-zika-risk-in-us-20553

- The analysis of mosquito season length is based on the ideal temperature and humidity conditions for Asian Tiger Mosquitoes (*Aedes albopictus*), which is one of the species known to transmit the Zika virus. These mosquitoes have high mortality rates at temperatures outside the range of 50-95°F or at relative humidity below 42 percent.

[7] https://nca2018.globalchange.gov/chapter/19/

- These climatic conditions specifically are suitable for adult mosquitoes of the species *Aedes aegypti*.

[8] https://www.climatecentral.org/news/atlantic-hurricane-season-major-storms-20682

- The incidence of major hurricanes (Category 3 or higher) has essentially doubled across the Atlantic basin since 1970, potentially linked to rising sea surface temperatures there.

[9] https://www.climatecentral.org/gallery/graphics/natural-human-caused-coastal-flood-days-in-the-us1

- Authors subtracted yearly estimates for human-caused global sea level rise based on Kopp et al. 2016, from hourly water level records at 27 tide gauges around the United States. They then compared how many days the water level exceeded the local threshold for nuisance flooding — with or without the subtractions.

[10] https://riskfinder.climatecentral.org/api/reports/state/florida.us/state-report?lang=en

- This analysis projects a main range of local sea level rise from 0.6-1.3 feet by 2050, and 1.7-4.7 feet by 2100, at Key West, using sea level in 2012 as the baseline. End-of-century projections at the seven other water level stations analyzed around the state range from about 3 inches lower (Apalachicola) to about 2 inches higher (Vaca Key). Projections align closely with the unified sea level rise projections of the Southeast Florida Regional Climate Change Compact (2011).

[11] https://riskfinder.climatecentral.org/api/reports/state/florida.us/state-report?lang=en

- 2120 square miles of land lie less than 3 feet above the high tide line in Florida. Some $145 billion in property value, and 300,000 homes, sit on that land. These figures jump to $544 billion and 1.4 million homes on 4660 square miles of land under 6 feet.

[12] http://assets.statesatrisk.org/summaries/Florida_report.pdf

- The sea level rise and coastal flood analysis aimed to delineate zones with 1% annual flood risk (100-year coastal floodplains), given baseline and projected sea levels in the years 2000 and 2050, and to tabulate the current population residing within them. Median sea level rise (SLR) projections from Kopp et al. (2014) are for 2050 under RCP 8.5 at 69 tide gauges along the U.S. coast. The projections take vertical land motion into account.

[13] https://www.climatecentral.org/gallery/graphics/sea-level-rise-is-increasing-coastal-flood-risk

- Source data comes from the Intermediate High NCA Projection and Climate Central.

14 https://www.climatecentral.org/news/heavy-rain-sewage-overflows-20718

- Data is retrieved from the Applied Climate Information System (rcc-acis.org).

15 https://www.climatecentral.org/gallery/maps/report-inland-flooding-to-increase-in-the-us

- Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of ⅛° (about 140 square kilometers per grid cell), and cover the conterminous United States and portions of Canada and Mexico.

16 https://www.climatecentral.org/news/heavy-rain-sewage-overflows-20718

- Authors conducted a survey of news reports of rain-related overflows from January 2015 through August 2016. For each of these events, they confirmed how extreme the rain was, and in the case of several record-breaking rain events, further examined the volume of sewage that was reported.

17 http://assets.statesatrisk.org/summaries/Florida_report.pdf

- Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of ⅛° (about 140 square kilometers per grid cell), and cover the conterminous United States and portions of Canada and Mexico.

18 http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/

- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5), and are aggregated to the state-level where appropriate.
- Mortality increases: county-level changes in all-cause mortality rates across all age groups, relative to 2012. Mortality rates are translated to absolute estimates and aggregated to the state-level based on 2012 county populations. As we do not project county populations to 2100, additional mortalities by 2100 are likely a conservative estimate.
- Coastal damages: increase in annual losses resulting from tropical cyclones and other coastal storms, either induced by higher local sea level or greater storm frequency. Cost estimates are translated to 2018 dollars.
- Crop yield declines: percent changes relative to 2012 for cotton, maize, wheat, and soybean yields are translated to proportional changes in the value of that sector's gross output by 2100.

19 https://www.ucsusa.org/global-warming/global-warming-impacts/sea-level-rise-chronic-floods-and-us-coastal-real-estate-implications

- Authors identify residential and commercial properties at risk of chronic inundation as sea levels rise, defined as experiencing at least 26 floods per year. The number of at risk properties in Florida only reflects homes already existing today.

6. NEVADA

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	The state of Nevada has observed 2.6°F warming since the 1970s.[1] Reno is the fastest warming city in the U.S. and Las Vegas is the 3rd.[2]	Heat wave days in Nevada are expected to quadruple by 2050.[3] Las Vegas is expected to experience nearly a month more of 'dangerous' heat days by midcentury.[4] Summers in Great Basin National Park are expected to increase by 12°F by the end of the century.[5]	Reno ranks 1st in U.S. cities with the largest increase in 'disease danger days' (risk of disease transmission by mosquitos), increasing by 52 days since 1970.[6] Areas suitable for certain crops are expected to shift by the end of the century due to increasing minimum average temperatures.[7]
DROUGHT	The Southwest U.S. is already the most arid part of the U.S., and research indicates that it is becoming even more dry.[8] Over the past 30 years, rainy patterns in the Southwest are becoming less frequent.[9]	The severity of Nevada's summer drought is expected to increase by more than 30% by 2030.[10] There's an 80% chance the Southwest could experience a megadrought lasting decades as the climate warms.[11]	Las Vegas's water supply is threatened by depletion of surface water reservoirs. At current rates, Lake Mead levels could drop low enough by 2020 that it would cut off most of Las Vegas's water supply.[12]
WILDFIRES	In the past 10 years, Nevada has experienced twice the amount of fires burning on U.S. Forest Service land compared to the 1970s.[13]	By midcentury, Nevada is expected to experience 20 additional high wildfire potential days compared to current rates.[14] Without action to curb climate change, the Sierra Nevada may see triple the area burned yearly by 2100.[15]	More than 1.2 million people living in Nevada – 46% of the state's population – are at elevated risk of wildfire.[16]
EXPECTED DAMAGES[17] **IN NEVADA BY 2100 WITHOUT CLIMATE ACTION**	Clark county, currently home to nearly 2 million people, is expected to spend over 15% more on <u>energy</u> relative to 2012 levels At least 350 additional deaths per year by the end of the century		

[1] http://www.climatecentral.org/news/us-warming-trend-earth-day-20257

- Since the 1970s, the contiguous 48 states have been warming at a rate of 0.45°F per decade. This analysis draws on temperature data from the national Climatic Data Center's Climate at a Glance database.

[2] http://www.climatecentral.org/news/fastest-warming-cities-20535

- This analysis considered the top 200 largest metro areas in the U.S. and calculated their average annual temperature from 1981-2010. To determine which of those 200 cities have been warming the fastest, authors calculated how average annual temperatures have been changing since 1965.

[3] http://reportcard.statesatrisk.org/report-card/nevada/extreme_heat_grade

- The annual number of heatwave days is calculated as the average number of days each year on which the daily maximum temperature exceeds the 95th percentile of daily maximum temperature in the baseline (1991-2010) period for at least three consecutive days. While days above this temperature are not all potentially harmful to human health, an increase in hot days is an indicator of general warming.

[4] http://www.climatecentral.org/news/sizzling-summers-20515#dangerdays

- "Dangerous" and "extremely dangerous" heat days are classified by the National Weather Service Heat Index, taking into account both temperature and relative humidity.

[5] http://www.climatecentral.org/news/national-parks-future-global-warming-20623

- Future temperatures for 47 National Parks were calculated based on the median of 29 spatially downscaled climate models (CMIP5) at 1/8 degree scale, then averaged within park boundaries. Temperatures for 2050 are based on the 20-year average of 2041-2060 and for 2100 are based on the period 2080-2099. Projected temperatures assume that greenhouse gas emissions continue at their current rate (RCP8.5).

[6] https://www.climatecentral.org/news/us-faces-a-rise-in-mosquito-disease-danger-days-21903

- Temperature trends were calculated using average daily temperature data from the Applied Climate Information System (rcc-acis.org). Years with more than 30 days of missing data were excluded from the analysis. The temperature range of disease transmission (61-93F) as well as the range for peak transmission (79-84F) were chosen based on the findings in Mordecai et al. 2017.

[7] https://nca2018.globalchange.gov/chapter/25/

- Under continued climate change, higher temperatures would shift plant hardiness zones northward and upslope. The U.S. Department of Agriculture plant hardiness zones indicate the cold temperature requirements of crops. Increases in temperature under the higher scenario (RCP8.5), would shift these zones northward and upslope, from the period 1976—2005 compared to projections for 2070—2099.

[8] https://www.climatecentral.org/news/southwest-drier-climate-change-19990

- Authors apply a weather type (WT) analysis to reanalysis data from 1979–2014 that characterize typical weather conditions over the contiguous United States, enabling them to assign precipitation trends within 1980–2010 to changes in WT frequencies and changes in precipitation intensities.

[9] https://www.climatecentral.org/news/southwest-drier-climate-change-19990

- Authors apply a weather type (WT) analysis to reanalysis data from 1979–2014 that characterize typical weather conditions over the contiguous United States, enabling them to assign precipitation trends within 1980–2010 to changes in WT frequencies and changes in precipitation intensities.

[10] http://assets.statesatrisk.org/summaries/Nevada_report.pdf

- Severity of widespread summer drought is defined as the sum of soil moisture deficit (standard score) in the summer months for model grid cells where the standard score is less than -1, when at least 30% of grid cells in a state meet this criterion.

[11] https://www.climatecentral.org/news/southwest-drier-climate-change-19990

- Ault 2012 ("Assessing the Risk of Persistent Drought using Climate Model Simulations and Paleoclimate Data") estimates the chances of a megadrought lasting 35 years or longer at up to 50 percent in the region.

[12] https://www.nytimes.com/2014/06/18/us/arizona-cities-could-face-cutbacks-in-water-from-colorado-river-officials-say.html?_r=0

- If upstream states continue to be unable to make up the shortage, Lake Mead, whose surface is now about 1,085 feet above sea level, will drop to 1,000 feet by 2020. Under present conditions, that would cut off most of Las Vegas's water supply.

[13] http://reportcard.statesatrisk.org/report-card/nevada/wildfires_grade

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[14] http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[15] https://nca2018.globalchange.gov/chapter/25/

- These increased burned area projections assume a higher emissions scenario (SRES A2).

[16] http://reportcard.statesatrisk.org/report-card/nevada/wildfires_grade

- Individuals living within the wildland-urban interface, where developed wild lands converge and intersperse, are at elevated risk for wildfire.

[17] http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/

- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5), and are aggregated to the state-level where appropriate.
- Increased energy expenditures: changes in county-level residential and commercial energy expenditures relative to 2012, as a result of climate change impacting energy demand.
- Mortality increases: county-level changes in all-cause mortality rates across all age groups, relative to 2012. Mortality rates are translated to absolute estimates and aggregated to the state-level based on 2012 county populations. As we do not project county populations to 2100, additional mortalities by 2100 are likely a conservative estimate.

7. SOUTH CAROLINA

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	The number of nights above 75°F in the Southeast U.S. have doubled since the 1980s.[1] Some cities, such as Columbia, SC, are experiencing 2 more weeks per year of days above 95°F.[2]	South Carolina is projected to observe four times as many heat wave days per year by midcentury.[3] Charleston is expected to experience 74 more dangerous heat days by midcentury.[4]	Mosquito season in South Carolina is now over a month longer than it was in the 1980s.[5] Agriculture is impacted by a lack of nighttime cooling.[6]
COASTAL FLOODING	Hurricanes in the Atlantic have been stronger in the past couple of decades than during the 1970s/80s.[7] The number of coastal flood days in Charleston has more than quadrupled since the 1950s – 80% have been attributed to climate change.[8]	Sea level rise is projected to increase up to 7 feet in Charleston by the end of the century.[9] By midcentury, a 100-year flood in Charleston may become 9 times more likely.[10]	South Carolina has nearly 230,000 residents at risk of a 100-year flood.[11] By 2050, South Carolina's coastal flood threat is projected to increase by 25%, putting an additional 55,000 people in the 100-year coastal floodplain.[12]
INLAND FLOODING	Heavy downpours have increased by 27% in the southeastern U.S. since the 1950s.[13] Charleston experienced all-time record high tide flood occurrences in 2015 and 2016.[14] [15]	South Carolina's inland flooding threat is projected to increase by 30% by midcentury.[16] Flood events in Charleston have been increasing, and by 2045 the city is projected to face nearly 180 tidal floods per year in comparison to 11 in 2014.[17]	Over 200,000 people in South Carolina live in flood-prone areas.[18] Record flooding in South Carolina due to extreme rainfall events has already cost billions of dollars and dozens of lives.[19] These events are expected to intensify.[20]
EXPECTED DAMAGES[21] **IN SOUTH CAROLINA BY 2100 WITHOUT CLIMATE ACTION**	At least 1,000 additional <u>deaths</u> per year 20 counties currently home to nearly 3 million people expected to see a 25 to 65% decrease in major <u>crop yields</u> relative to 2012 levels Nearly all counties are each expected to spend 10% more on <u>energy</u> relative to 2012 levels, for a total of 4.6 million people		

[1] https://nca2018.globalchange.gov/chapter/19#fig-19-1

- During the 2010s, the number of nights with minimum temperatures greater than 75°F was nearly double the long-term average for 1901–1960, while the length of the freeze-free season was nearly 1.5 weeks greater than any other period in the historical record.

2 http://www.climatecentral.org/news/sizzling-summers-20515#daysabove

- "Dangerous" and "extremely dangerous" heat days are classified by the National Weather Service Heat Index, taking into account both temperature and relative humidity.

3 http://reportcard.statesatrisk.org/report-card/south-carolina/extreme_heat_grade

- The annual number of heatwave days is calculated as the average number of days each year on which the daily maximum temperature exceeds the 95th percentile of daily maximum temperature in the baseline (1991-2010) period for at least three consecutive days. While days above this temperature are not all potentially harmful to human health, an increase in hot days is an indicator of general warming.

4 http://www.climatecentral.org/news/sizzling-summers-20515#dangerdays

- "Dangerous" and "extremely dangerous" heat days are classified by the National Weather Service Heat Index, taking into account both temperature and relative humidity.

5 http://www.climatecentral.org/news/more-mosquito-days-increasing-zika-risk-in-us-20553

- The analysis of mosquito season length is based on the ideal temperature and humidity conditions for Asian Tiger Mosquitoes (*Aedes albopictus*), which is one of the species known to transmit the Zika virus. These mosquitoes have high mortality rates at temperatures outside the range of 50-95°F or at relative humidity below 42 percent.

6 https://nca2018.globalchange.gov/chapter/19/

- Projected temperature increases pose challenges for crop production dependent on periods of lower temperatures to reach full productivity.

7 https://www.climatecentral.org/news/atlantic-hurricane-season-major-storms-20682

- The incidence of major hurricanes (Category 3 or higher) has essentially doubled across the Atlantic basin since 1970, potentially linked to rising sea surface temperatures there.

8 http://www.climatecentral.org/news/climate-change-increases-sunny-day-floods-20784

- This analysis is based on a broader February 2016 Climate Central analysis that looked at the human-caused sea level rise contribution to nuisance flooding over a 65-year period. That study focused on 27 tidal gauges with high quality hourly water level records dating back several decades.

9 https://nca2018.globalchange.gov/chapter/19#fig-19-10

- Maximum sea level rise based on the NOAA "High" sea level rise scenario.

10 http://www.climatecentral.org/gallery/graphics/sea-level-rise-is-increasing-coastal-flood-risk

- Source data comes from the Intermediate High NCA Projection and Climate Central.

11 http://assets.statesatrisk.org/summaries/SouthCarolina_report.pdf

- The sea level rise and coastal flood analysis aimed to delineate zones with 1% annual flood risk (100-year coastal floodplains), given baseline and projected sea levels in the years 2000 and 2050, and to tabulate the current population residing within them. Median sea level rise (SLR) projections from Kopp et al. (2014) are for 2050 under RCP 8.5 at 69 tide gauges along the U.S. coast. The projections take vertical land motion into account.

12 http://assets.statesatrisk.org/summaries/SouthCarolina_report.pdf

- The sea level rise and coastal flood analysis aimed to delineate zones with 1% annual flood risk (100-year coastal floodplains), given baseline and projected sea levels in the years 2000 and 2050, and to tabulate the current population residing within them. Median sea level rise (SLR) projections from Kopp et al. (2014) are for 2050 under RCP 8.5 at 69 tide gauges along the U.S. coast. The projections take vertical land motion into account.

13 http://www.climatecentral.org/gallery/maps/extreme-precipitation-events-are-on-the-rise

- Data retrieved from Kenneth Kunkel, Cooperative Institute for Climate and Satellites, North Carolina State University, and NOAA NCDC.

14 https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

- In order to bound the set of GMSL rise scenarios for year 2100, authors assessed the most up-to-date scientific literature on scientifically supported upper-end GMSL projections, including recent observational and modeling literature related to the potential for rapid ice melt in Greenland and

Antarctica. The projections and results presented in several peer-reviewed publications provide evidence to support a physically plausible GMSL rise in the range of 2.0 meters (m) to 2.7 m, and recent results regarding Antarctic icesheet instability indicate that such outcomes may be more likely than previously thought.

[15] http://www.ncdc.noaa.gov/monitoring-content/sotc/national/2016/may/sweet-marra-nuisance-flooding-2015.pdf

- High tide flooding, measured locally by National Oceanic and Atmospheric Administration (NOAA) tide gauges, is described as "nuisance", "sunny-day" and "recurrent". Such minor flooding is increasingly common with little or no storm effects (Sweet et al., 2014).

[16] http://assets.statesatrisk.org/summaries/SouthCarolina_report.pdf

- Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of ⅛° (about 140 square kilometers per grid cell), and cover the conterminous United States and portions of Canada and Mexico.

[17] https://nca2018.globalchange.gov/chapter/19/

- Tidal floods are defined as flooding in coastal areas at high tide. Estimates of projected increase drawn from the City of Charleston's 2015 Sea Level Rise Strategy report.

[18] http://assets.statesatrisk.org/summaries/SouthCarolina_report.pdf

- Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of ⅛° (about 140 square kilometers per grid cell), and cover the conterminous United States and portions of Canada and Mexico.

[19] https://nca2018.globalchange.gov/chapter/19#table-19-1

- Values are Consumer Price Index adjusted and are in 2017 dollars. Data source is NOAA NCEI 2017.

[20] https://nca2018.globalchange.gov/chapter/19#case-19_3

- Under future climate scenarios, the combination of extreme precipitation and higher tides due to local sea level rise will likely cause more frequent events of this intensity and magnitude (CISA 2016).

[21] http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/

- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5), and are aggregated to the state-level where appropriate.
- Mortality increases: county-level changes in all-cause mortality rates across all age groups, relative to 2012. Mortality rates are translated to absolute estimates and aggregated to the state-level based on 2012 county populations. As we do not project county populations to 2100, additional mortalities by 2100 are likely a conservative estimate.
- Crop yield declines: percent changes relative to 2012 for cotton, maize, wheat, and soybean yields are translated to proportional changes in the value of that sector's gross output by 2100.
- Increased energy expenditures: county-level changes in residential and commercial energy expenditures relative to 2012, as a result of climate change impacting energy demand.

8. UTAH

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	Average temperatures in Utah during spring and fall have warmed by over 3°F since 1970.[1]	Salt Lake City is expected to experience twice as many dangerous heat days by midcentury,[2] and summers that are 11°F hotter by 2100.[3] By 2100, summers in Zion national Park will feel like today's summers in Lower Valley, Texas.[4]	By 2050, some cities in Utah could see up to a 30% reduction in electricity generation capacity during summer.[5] Areas suitable for specific crops are expected to shift by the end of the century due to increasing minimum average temperatures that are required for certain crops.[6]
DROUGHT	The Southwest U.S. is already the most arid part of the U.S., and research indicates that it is becoming even more dry.[7] Over the past 30 years, rainy patterns in the Southwest are becoming less frequent.[8]	Summer drought in Utah is projected to increase in severity by about 225% by 2050.[9]	Past drought conditions in Utah have impacted a majority of ranch operations in the state, including major reductions in water supply, forage, and cattle productivity.[10]
WILDFIRES	Utah now sees about 20 times more acres burned by large wildfires annually in comparison to the 1970s and six times more large wildfires burning each year over the past ten years on US Forest Service land.[11]	By 2050, Utah is projected to observe 23 additional high wildfire potential days per year.[12]	Over 1.3 million people living in Utah – 45% of the state's population – are living in the wildland-urban interface and are highly vulnerable to wildfires.[13]
EXPECTED DAMAGES[14] **IN UTAH BY 2100 WITHOUT CLIMATE ACTION**	6 counties currently home to over 2 million people, including Salt Lake County, are each expected to spend over 10% more on energy relative to 2012 levels.		

[1] https://www.climatecentral.org/gallery/graphics/seasonal-warming-trends-across-the-us

- Trends for meteorological seasons are calculated using monthly average temperature data between 1970 and 2017 (data from the NOAA NCEI). For clarity and the ability to compare different seasons, authors omitted the annual data points and displayed only the linear trends over time.

[2] http://www.climatecentral.org/news/sizzling-summers-20515#dangerdays

- "Dangerous" and "extremely dangerous" heat days are classified by the National Weather Service Heat Index, taking into account both temperature and relative humidity.

[3] http://www.climatecentral.org/news/summer-temperatures-co2-emissions-1001-cities-16583

- Authors projected summer high temperatures for the end of this century for 1,001 cities, and then showed which city in the U.S. (or elsewhere in the world) is experiencing those temperatures today.

[4] https://www.climatecentral.org/news/national-parks-future-global-warming-20623

- Future temperatures for 47 National Parks were calculated based on the median of 29 spatially downscaled climate models (CMIP5) at 1/8 degree scale, then averaged within park boundaries. Temperatures for 2050 are based on the 20-year average of 2041-2060 and for 2100 are based on the period 2080-2099. Projected temperatures assume that greenhouse gas emissions continue at their current rate (RCP8.5).

[5] https://nca2018.globalchange.gov/chapter/25/

- Under a higher emissions scenario (SRES A2), heat-induced reduction of energy efficiency and reduced water flows would reduce summer energy generation capacity across the Southwest region. These projected reductions would increase risks of electricity shortages.

[6] https://nca2018.globalchange.gov/chapter/25/

- Under continued climate change, higher temperatures would shift plant hardiness zones northward and upslope. The U.S. Department of Agriculture plant hardiness zones indicate the cold temperature requirements of crops. Increases in temperature under the higher scenario (RCP8.5), would shift these zones northward and upslope, from the period 1976—2005 compared to projections for 2070—2099.

[7] https://www.climatecentral.org/news/southwest-drier-climate-change-19990

- Authors apply a weather type (WT) analysis to reanalysis data from 1979–2014 that characterize typical weather conditions over the contiguous United States, enabling them to assign precipitation trends within 1980–2010 to changes in WT frequencies and changes in precipitation intensities.

[8] https://www.climatecentral.org/news/southwest-drier-climate-change-19990

- Authors apply a weather type (WT) analysis to reanalysis data from 1979–2014 that characterize typical weather conditions over the contiguous United States, enabling them to assign precipitation trends within 1980–2010 to changes in WT frequencies and changes in precipitation intensities.

[9] http://reportcard.statesatrisk.org/report-card/utah/drought_grade

- Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of ⅛° (about 140 square kilometers per grid cell), and cover the conterminous United States and portions of Canada and Mexico.

[10] https://nca2018.globalchange.gov/chapter/25/

- In response to drought (1999–2004), 75% of Utah ranch operations reported major reductions in water supply, forage, and cattle productivity. Only 14% felt they were adequately prepared for the drought, which may be reflected in the high use of federal relief programs (Coppock 2011).

[11] http://www.climatecentral.org/gallery/graphics/hotter-years-more-fires

- Authors analyzed 45 years of U.S. Forest Service records of large wildfires (those fires burning more than 1,000 acres) from the western U.S. in the new report, "Western Wildfires: A Fiery Future."

[12] http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[13] http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf

- Trends for wildfires in the 11 western states of the contiguous U.S. are calculated on large wildfires (those larger than 1,000 acres) occurring on U.S. Forest Service land between 1970-

2015. These wildfires represent a significant percent of the total area burned each year in western wildfires, and thus they are a suitable representative of overall wildfire trends. Trends for Alaskan fires are based on large wildfires burning on both federal and state land across Alaska between 1950-2015.

[14] http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/

- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5).
- Increased energy expenditures: county-level changes in residential and commercial energy expenditures relative to 2012, as a result of climate change impacting energy demand.

9. VIRGINIA

	ALREADY OBSERVED CHANGES	ANTICIPATED FUTURE CHANGES	RISKS TO SOCIETY
HEAT	Annual temperatures in Virginia have increased by 2°F since the 1970s,[1] and over 3°F in the wintertime.[2] Bristol, VA now experiences more than two weeks of additional extreme heat days compared to the 1970s.[3]	The number of "dangerous" or "extremely dangerous" heat days in Virginia is expected to more than quadruple by 2050, currently averaging less than 10 per year.[4] By 2050, the number of heat wave days in Virginia is expected to increase by 6 times, from 10 to nearly 60 days per year.[5]	Mosquito season in Richmond is currently a month longer than in the 1980s.[6] Norfolk has experienced a 3°F increase in dew point temperature since the 1980s and the additional moisture in the air increases risk of heatstroke and heat exhaustion.[7]
COASTAL FLOODING	Hurricanes in the Atlantic have been stronger in the past couple of decades than during the 1970s/80s.[8] Sea level rise in Norfolk has increased the chance of exceeding flood advisory/warning thresholds by 4 times compared to the 1960s.[9]	By 2050, Virginia's coastal flood threat may increase by 75% putting an additional 140,000 people in the 100-year floodplain.[10] Sea level rise by 2050 may increase coastal flooding events by five times at the Chesapeake Bay Bridge[11] and make a 100-year flood 25 times more likely.[12]	During Hurricane Sandy, 18.3 million gallons of sewage was spilled in Suffolk due to equipment failure. As Atlantic hurricane season becomes more intense, the threat of similar spills increases.[13]
INLAND FLOODING	On average, Virginia has experienced a 20-30% increase in heavy downpours since 1950.[14]	By 2050, Virginia's inland flooding threat is projected to increase by more than 20%.[15] Without climate action, we expect double the number of heavy rainfall events and a 20% increase in the amount of rain falling during heavy downpours in the Southeast by 2100.[16]	265,000 people in Virginia are currently living in flood prone areas.[17] Intensifying extreme rainfall events is stressing already deteriorating infrastructure in the Southeast. Many transportation and storm water systems were not designed to withstand these events.[18]
EXPECTED DAMAGES[19] **IN VIRGINIA BY 2100 WITHOUT CLIMATE ACTION**	At least 700 additional deaths per year 17 counties currently home to over 400,000 people expected to see a 40 to 60% decrease in major crop yields relative to 2012 levels 100 counties currently home to over 6 million are each expected to spend 10% more on energy relative to 2012 levels		

[1] https://www.climatecentral.org/news/us-warming-trend-earth-day-20257

- Since the 1970s, the contiguous 48 states have been warming at a rate of 0.45°F per decade. This analysis draws on temperature data from the national Climatic Data Center's Climate at a Glance database.

[2] https://www.climatecentral.org/gallery/graphics/seasonal-warming-trends-across-the-us

- Trends for meteorological seasons are calculated using monthly average temperature data between 1970 and 2017 (data from the NOAA NCEI). For clarity and the ability to compare different seasons, authors omitted the annual data points and displayed only the linear trends over time.

[3] https://www.climatecentral.org/news/sizzling-summers-20515#daysabove

- The projections draw on 29 global climate models that have been downscaled across the continental U.S. to represent local climate conditions.

[4] http://assets.statesatrisk.org/summaries/Virginia_report.pdf

- "Dangerous" and "extremely dangerous" heat days are classified by the National Weather Service Heat Index, taking into account both temperature and relative humidity.

[5] http://assets.statesatrisk.org/summaries/Virginia_report.pdf

- The annual number of heatwave days is calculated as the average number of days each year on which the daily maximum temperature exceeds the 95th percentile of daily maximum temperature in the baseline (1991-2010) period for at least three consecutive days. While days above this temperature are not all potentially harmful to human health, an increase in hot days is an indicator of general warming.

[6] https://www.climatecentral.org/news/more-mosquito-days-increasing-zika-risk-in-us-20553#dropdown

- The analysis of mosquito season length is based on the ideal temperature and humidity conditions for Asian Tiger Mosquitoes (*Aedes albopictus*), which is one of the species known to transmit the Zika virus. These mosquitoes have high mortality rates at temperatures outside the range of 50-95°F or at relative humidity below 42 percent.

[7] https://www.climatecentral.org/gallery/graphics/summers-getting-muggier-as-dewpoint-temp-rises

- Dewpoint data was converted from vapor pressure. Vapor pressure data was obtained from the Daymet dataset at the Oak Ridge National Laboratory.

[8] https://www.climatecentral.org/news/atlantic-hurricane-season-major-storms-20682

- The incidence of major hurricanes (Category 3 or higher) has essentially doubled across the Atlantic basin since 1970, potentially linked to rising sea surface temperatures there.

[9] https://nca2018.globalchange.gov/chapter/19#fig-19-8

- This is compared to the National Weather Service high tide flooding threshold.

[10] http://assets.statesatrisk.org/summaries/Virginia_report.pdf

- The sea level rise and coastal flood analysis aimed to delineate zones with 1% annual flood risk (100-year coastal floodplains), given baseline and projected sea levels in the years 2000 and 2050, and to tabulate the current population residing within them. Median sea level rise (SLR) projections from Kopp et al. (2014) are for 2050 under RCP 8.5 at 69 tide gauges along the U.S. coast. The projections take vertical land motion into account.

[11] https://www.climatecentral.org/gallery/graphics/climate-change-increasing-frequency-of-coastal-flooding

- Observed water levels were used to count present and past floods, which were driven by tides along with storm surges. Future hourly water levels are based on detailed tidal projections and sea level rise projections.

[12] https://www.climatecentral.org/gallery/graphics/sea-level-rise-is-increasing-coastal-flood-risk

- Source data comes from the Intermediate High NCA Projection and Climate Central.

[13] https://www.climatecentral.org/news/11-billion-gallons-of-sewage-overflow-from-hurricane-sandy-15924

- Data for this analysis is provided by state agencies and individual plant operators. See full report, Sewage Overflows from Hurricane Sandy (here), for more detail.

[14] https://www.climatecentral.org/news/heavy-rain-sewage-overflows-20718

- Authors conducted a survey of news reports of rain-related overflows from January 2015 through August 2016. For each of these events, they confirmed how extreme the rain was, and in the case of several record-breaking rain events, further examined the volume of sewage that was reported.

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[15] https://www.climatecentral.org/gallery/maps/report-inland-flooding-to-increase-in-the-us

- Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of ⅛° (about 140 square kilometers per grid cell), and cover the conterminous United States and portions of Canada and Mexico.

[16] https://nca2018.globalchange.gov/chapter/19/

- This assumes a high emissions scenario (RCP8.5). Estimates from Easterling et al. 2017 and Allan and Soden 2008.

[17] http://assets.statesatrisk.org/summaries/Virginia_report.pdf

- Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of ⅛° (about 140 square kilometers per grid cell), and cover the conterminous United States and portions of Canada and Mexico.

[18] https://nca2018.globalchange.gov/chapter/19/

- By 2050, the Southeast is the region expected to have the most vulnerable bridges. Increasing precipitation and extreme weather events will likely impact roads, freight rail, passenger rail, and transit infrastructure.

[19] http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/

- County-level damages by sector are estimated using data available from the Climate Impact Lab. Damages represent the central estimate for average annual damage during 2080-2099 under a business-as-usual scenario (RCP8.5), and are aggregated to the state-level where appropriate.
- Mortality increases: county-level changes in all-cause mortality rates across all age groups, relative to 2012. Mortality rates are translated to absolute estimates and aggregated to the state-level based on 2012 county populations. As we do not project county populations to 2100, additional mortalities by 2100 are likely a conservative estimate.
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- Increased energy expenditures: county-level changes in residential and commercial energy expenditures relative to 2012, as a result of climate change impacting energy demand.