



Climate Change Projections & Vulnerability BUTTE-SILVER BOW, MONTANA



★ Climate Projections

What future changes do scientists expect to occur?

★ Community Vulnerability

How susceptible to harm is the community as a result of those changes?



Likely Climate Stressors



Higher average temperatures and more extreme heat



Increased winter and spring rainfall with drier summers and falls



Reduced snowpack and earlier snowmelt



Increased frequency/intensity of extreme precipitation and flooding



More frequent and/or more severe droughts



Larger, more frequent wildfires and a longer fire season







FACTORS TO CONSIDER:

- Trend direction ▲ ▼ –
- Magnitude of change
- Shifts in timing/variability



Air Temperature





HIGHER AVERAGE TEMPERATURES

METRIC	TREND	OBSERVED/PROJECTED CHANGES
Minimum temperature AVG DAILY MIN TEMP (°F)		28.1°F (+4.3°F) by 2050 and 34.2°F (+10.4°F) by 2100 ¹ COMPARED TO HISTORICAL AVERAGE OF 23.8°F FROM 1961–1990
Maximum temperature AVG DAILY MAX TEMP (°F)		54.7°F (+4.8°F) by 2050 and 60.9°F (+11.0°F) by 2100 ¹ COMPARED TO HISTORICAL AVERAGE OF 49.9°F FROM 1961–1990

MORE EXTREME HEAT

METRIC	TREND	OBSERVED/PROJECTED CHANGES
Days over 90°F # OF DAYS WITH MAX TEMPS >90°F		9.0 days (+1,025%) by 2050 and 39.2 days (+4,800%) by 2100 ¹ COMPARED TO HISTORICAL AVERAGE OF 0.8 DAYS PER YEAR FROM 1961–1990



Source: Climate Explorer

Precipitation (Rain & Snow)

SHIFTS IN AMOUNT/TIMING OF RAINFALL





METRIC	TREND	OBSERVED/PROJECTED CHANGES
Annual precipitation AVG INCHES PER YEAR		19.2 in (+3.8%) by 2050 and 20.0 in (+8.2%) by 2100 ¹ COMPARED TO HISTORICAL AVERAGE OF 18.5 INCHES PER YEAR FROM 1961–1990
Seasonality	AV	Significant increase in winter (+21%) and spring (+22%) precipitation, with slight decreases in summer (-7%) and fall (-5%) by 2100 ²

REDUCED SNOWPACK & EARLIER SNOWMELT

METRIC	TREND	OBSERVED/PROJECTED CHANGES
Snowpack APRIL 1 SNOW-WATER EQUIVALENT	$\mathbf{\nabla}\mathbf{\nabla}$	~20% decline in April snowpack from 1935 to 2015 (greater at low elevations) ^a 50% or greater decline in April snowpack by 2100 ³
Snowmelt timing		Earlier spring snowmelt due to warmer temperatures, increasing spring peak flows and reducing late-summer streamflows ³





Extreme Precipitation and Drought



MORE EXTREME PRECIPITATION

METRIC	TREND	OBSERVED/PROJECTED CHANGES
Frequency # of days with 1" rain in 24 hours		0.9 days (+12.5%) by 2050 and 1.4 days (+75%) by 2100 ¹ COMPARED TO HISTORICAL AVERAGE OF 0.8 DAYS PER YEAR FROM 1961–1990
Amount 20-year return period total		+16% increase in precipitation amount during 20-year events projected by 2100 ⁴



INCREASED DROUGHT

METRIC	TREND	OBSERVED/PROJECTED CHANGES
Frequency & severity		Likely increases in the frequency and severity of both seasonal and persistent (i.e., multi-year) droughts, largely due to rising temperatures ^{3,5}



Source: Climate Explorer; Easterling et al. 2017; Whitlock et al. 2017; Cook et al. 2014

METRIC TREND

MORE WILDFIRE ACTIVITY

OBSERVED/PROJECTED CHANGES

Significant increases in the length of the fire season, the frequency of large wildfires,⁶ and annual area burned⁷ in the Northern Rockies

Dependent on fuel availability and moisture, ignition sources, and weather conditions

NEXT UP: What kind of impacts will these climate changes have on Butte-Silver Bow?

Source: Westerling 2016; Parks & Abatzoglou 2020

Wildfire

Fire activity







Questions?











VULNERABILITY is the degree to which natural, built, and human systems are susceptible to harm



- LIKELIHOOD is the degree to which a community is exposed to significant changes in climate
- CONSEQUENCE is the degree to which a community is affected by exposure to a changing climate
- ADAPTIVE CAPACITY is the community's ability to adjust to climate change to minimize potential damages, take advantage of opportunities, or cope with consequences





Climate change vulnerability is not evenly distributed across communities!

Understanding disproportionate impacts is critical to ensuring just distribution of adaptation benefits





- People of Color
- Low-Income Residents
- Children under 5
- Seniors over 65
- Individuals with Disabilities
- Individuals with Limited English Skills
- At-Risk Workers
- Individuals with No Vehicle Access



EPA EJ Screen

https://ejscreen.epa.gov/mapper/



Examples:

- Low-income individuals: Lack of financial resources/insurance to respond to extreme events
- Children, elderly, people with chronic health conditions: Difficulty regulating body temperature or increased vulnerability to severe illness/disease
- Individuals with limited mobility: Reduced ability to evacuate during emergencies or access shelters







Examples:

- People with limited English: Less able to benefit from community resources or access information and receive alerts
- People of color, individuals with disabilities: Less able to utilize emergency shelters or other community spaces
- At-risk workers: Increased exposure to hazards, often without adequate precautions or paid time off









DIRECT IMPACTS OF CLIMATE STRESSORS

INTERACTIONS WITH PRE-EXISTING CONDITIONS

Public Health:

- Reduced air quality, exacerbating respiratory and cardiopulmonary illness
- Increased risk of water-borne or moldrelated problems due to flooding
- Overwhelm of emergency systems, blocked evacuation routes, or damage/disruption to shelters
- Increased vulnerability among those with existing chronic health conditions and people lacking access to health services and/or adequate health insurance









Water Resources:

- Reduced water availability, particularly in the late summer and during periods of drought
- Increased demand for groundwater as surface water sources dry up
- Reduced water quality due to warmer water temperatures
- Increased runoff during heavy rainfall events that follow dry periods, resulting in greater risk of landslides and flash floods

Contaminated Sites:

- Altered contaminant transformation/ degradation/volatility and increased sensitivity to contaminants
- Decrease in contaminated runoff and slowing of contaminant migration into groundwater during drought
- Potential for spread of contaminants by wildfires
- Increased dilution of contaminants due to wetter conditions and potential for erosion that undermines containment efforts







What additional climate change impacts are you concerned about?



Important Tools and Resources

- Northern Great Plains Chapter of the Fourth National Climate Change Assessment (<u>https://nca2018.globalchange.gov/chapter/22/</u>)
- 2017 Montana Climate Assessment (<u>http://montanaclimate.org/</u>)
- Climate Change and Human Health in Montana (<u>https://doi.org/10.15788/c2h22021</u>)
- Montana Wildfire Risk Assessment (<u>https://mwra-mtdnrc.hub.arcgis.com/</u>)
- Risk Factor for Butte, MT (<u>https://riskfactor.com/city/butte-mt/3011397_fsid/flood</u>)
- U.S. Climate Resilience Toolkit Climate Explorer (<u>https://crt-climate-explorer.nemac.org/</u>)
- Climate Change and Social Vulnerability in the US (<u>https://www.epa.gov/cira/social-vulnerability-report</u>)
- Cleveland Racial Equity Tool (<u>https://www.sustainablecleveland.org/racial-equity</u>)
- Climate Adaptation Knowledge Exchange (<u>www.cakex.org</u>)

Questions?



CAN'T STAND THE HEAT





