Crown of the Continent
Research Learning Center

National Park Service
U.S. Department of the Interior

Climate Change Fact Sheet

"Climate change will affect all of Montana's major economic sectors: agriculture, forestry, transportation and tourism, and energy supply."

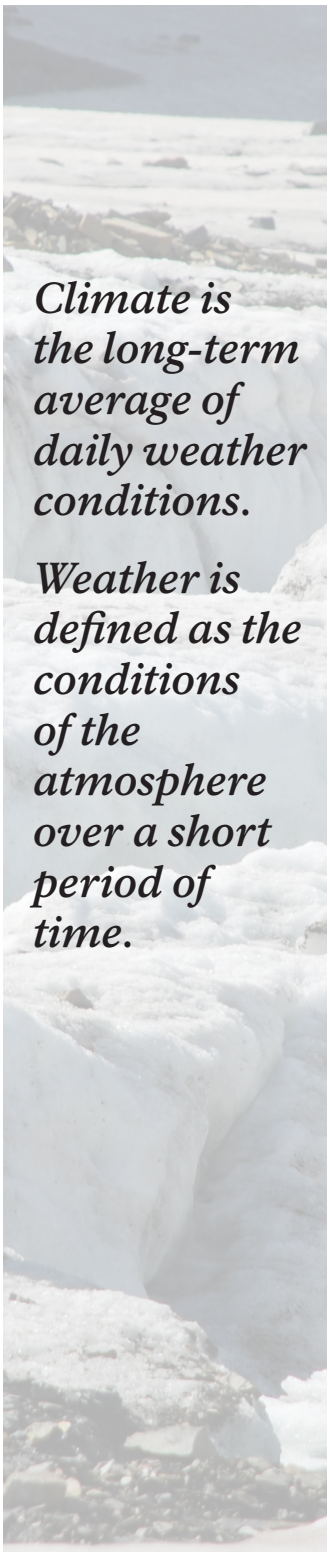
~ Montana Department of Environmental Quality website

THE BIG PICTURE

Although there has been much debate on the causes of global climate change, the fact that the earth's temperature is warming and that human influences are the primary cause of this change is undeniable. There is overwhelming scientific evidence that human activities, primarily from increases in greenhouse gases due to the burning of fossil fuels, are causing an increase in average global temperatures (see National Climatic Data Center website). This fact sheet focuses on climatic changes occurring in the western United States and specifically on changes occurring in western Montana and Glacier National Park.

Climate Changes to Western Mountains and Forests

- Observed climate changes in western mountains and forests include increased annual and minimum/maximum temperatures, altered precipitation patterns, and a shift toward earlier timing of peak runoff. [5]
- Climate changes are impacting terrestrial ecosystems through changes in phenology (seasonal timing of life-cycle events), primary production (plant growth), and distribution. [6]
- More observed and predicted frequent fires – less snowfall, earlier snowmelt, and the increasing number of hot days and length of season in which they occur provides environmental conditions conducive for increased frequency, size and duration of wildfires. [6]
- Predicted regional changes include an increase in average temperature of around .3°C (.54°F) per decade over the next 50 years. This increase in temperature will dramatically reduce snowpack accumulation in the mountains and reduce runoff and natural water storage. [6]
- Increased numbers and range of forest pests and pathogens are likely due to increases in temperature. Temperature controls life cycle development rates, influences synchronization of mass attacks required to overcome tree defenses, and determines winter mortality rates. [6,2]
- Impact to water resources – projected large-scale warming of 1-2°C (1.8-3.6°F) will significantly impact water resources. Mountain ecosystems provide up to 85% of the water humans depend on. A decreased snowpack will affect water users throughout the West. [6,7]



Climate Changes in Western Montana and Glacier National Park

- Temperatures in the Crown of the Continent Ecosystem (CCE) are experiencing the same general global warming pattern, but are warming at a faster rate…1.8 times the global average. Glacier National Park is on the fast track of change due to its location and climate dynamics. [7]

- You may also hear that *higher elevations* (above 6,000 feet) in the Northern Rockies have experienced three times the global average temperature increase over the past century. This faster rate of change in high elevations can be compared to the faster rate of change currently seen at higher latitudes, or latitudes further from the equator. [7]

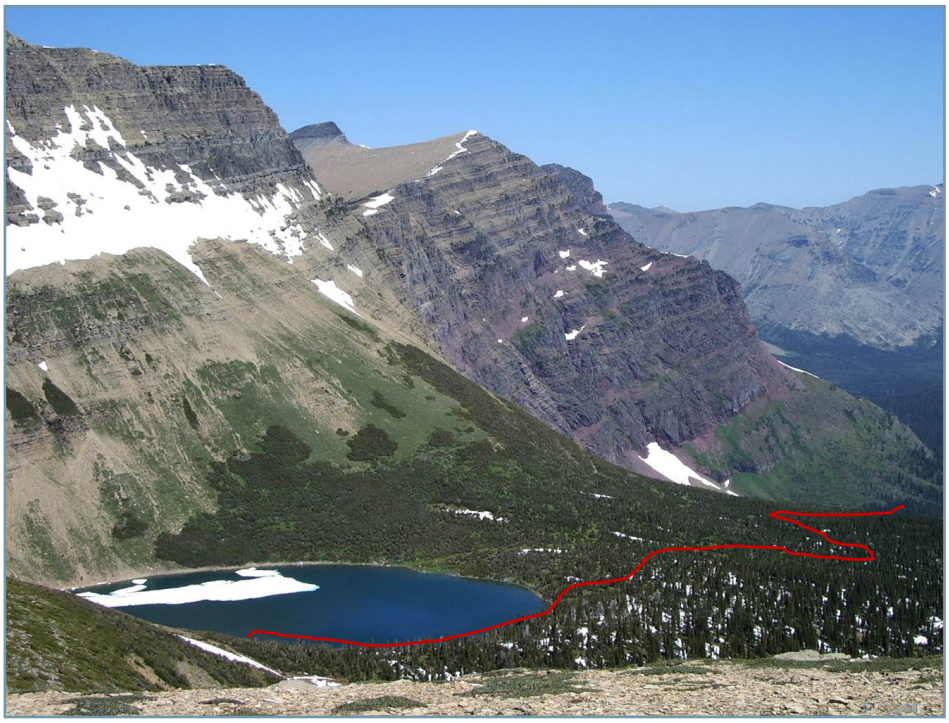
- Over the last 100 years, there has been a decline in days (roughly one month) below 0°F and a three-fold increase in extremely hot days over 90°F in western Montana. Not only is the number of 90°F plus days increasing, but they occur both earlier in the spring and later in the fall. [1]

- The number of frost-free days in western Montana has increased – we have lost an average of 16 days at or below freezing. Also, we are experiencing a later arrival of the first freeze day in the fall and an earlier thaw in the spring. [1]

- Currently snowpack is decreasing at mid to low elevations, but staying fairly consistent at higher elevations. As temperatures rise, snowpack levels at higher elevations are expected to decrease due to more precipitation falling as rain. [7]

- Increased temperatures and longer growing seasons also allow trees to move upslope, infringing upon alpine meadows and causing the loss of alpine habitat that some species are dependent on. [7]

- All the afore mentioned changes in temperature patterns allow for increased forest fires, longer growing seasons for plants, and possible increased frequency or longer duration of insect outbreaks (winter and spring warming and loss of extreme cold days may reduce winter kills, speed up life cycles, and lead to range expansion). [1]



Increasing air temperatures coincide with trees advancing upslope. The red line represents a "former" ecological threshold of treeline. The trees to the right of the line are 600 plus years old, whereas the trees to the left are younger than 80 years.

Glacier's Glaciers – Indicators of Climate Change

- Glaciers are a great resource to study climate change. Seasonal snowfall amounts vary from year to year, whereas the growth and reduction of glaciers indicates how the climate is changing. Since 1900, the CCE has lost 66% of its glacial and perennial snow and ice cover (Fountain, 2007). In addition, glaciers worldwide are melting as long term average temperatures increase. [7]

- The USGS Climate Change in Mountain Ecosystems Program studies and documents the amount and rate of glacial retreat within Glacier through a variety of methods including repeat photography,

USGS researchers measure glacier mass by inserting ablation (melting) stakes that will be read throughout the summer.

measuring mass lost or gained, aerial photos, area measurements using GPS, and measuring peak runoff (see Glacier Monitoring Studies page on USGS NOROCK site).

- An estimated 150 glaciers were present in Glacier National Park in 1850. Today, only 25 glaciers remain. If the current warming trend continues, climate models predict the park's glaciers will disappear by 2020. [5]

- There are many consequences to our ecosystem if the park's glaciers melt away. Glaciers can be compared to a bank, but instead of holding money, glaciers hold reserves of water. Seasonal snowfall deposited in the mountains during winter does not function the same as glacial ice since it melts earlier in the summer. Glaciers have a more even, continuous melt, which helps regulate stream temperatures and maintains streamflow during the late summer and drought periods when other sources are depleted. [5]

- Lower base flows, due to less glacial melt water and warmer temperatures, could change the aquatic habitat for many species. Temperature sensitive aquatic organisms such as the meltwater lednian stonefly could go extinct, disrupting the basis of the aquatic food chain. [3]

- Native species such as bull trout may also become extinct. Bull trout, already on the decline due to competition with non-native lake trout, need cold, connected habitats for growth, survival, and long-term persistence. If temperatures continue to warm, bull trout habitat will be impaired, making it even harder for them to survive. [7]

Staying Positive – We Can Do Something!

- Create educational programs and products that discuss climate change impacts to Glacier National Park.

- Educate other park staff and park partners about impacts to resources.

- Incorporate climate change related issues into park-based education programs.

- Be a good example – show the park's efforts to reduce greenhouse gas emissions as well as your own. Join the Green Team and help the park become a good role model for sustainable practices.

- Encourage visitors to reduce their carbon footprint.

- Listen to other points of view, but explain the National Park Service's message on climate change and the mitigation and adaptation methods we use to tackle climate change effects on Glacier's natural and cultural resources.

The principle greenhouse gas responsible for climate change is carbon dioxide.

Human causes of carbon dioxide result from fossil fuel use and landscape changes such as deforestation and associated agricultural practices.

Additional Resources

Documents Available on Park Intranet: Climate Change Communication – Reference Materials

[1]A Century of Climate and Ecosystem Change in Western Montana: What Do Temperature Trends Portend? Pederson et al. 2010.

[2]Climate Change Impacts on Insect Management and Conservation in Temperate Regions: Can They Be Predicted? Harrington et al. 2001.

[3]Climate Change Links Fate of Glaciers and an Endemic Alpine Invertebrate. Muhlfeld et al. 2011.

[4]Global Warming's "Six Americas" – An Audience Segmentation.

[5]"Retreat of Glaciers in Glacier National Park" Information Sheet. Northern Rocky Mountain Science Center, United States Geological Survey.

[6]Understanding the Science of Climate Change: Talking Points – Impacts to Western Mountains and Forests. Natural Resource Report 2009.

[7]USGS Climate Change in Mountain Ecosystems Program's Overview PowerPoint.

Websites

Department of Environmental Quality – Climate Change in Montana: http://deq.mt.gov/ClimateChange/default.mcpx

Do Your Part for Climate Friendly Parks! http://www.doyourpartparks.org/

Consortium of Integrated Climate Research in Western Mountains: http://www.fs.fed.us/psw/cirmount/

Intergovernmental Panel on Climate Change: http://www.ipcc.ch/index.htm

NASA's Eyes on the Earth – Global Climate Change: http://climate.nasa.gov/

National Climatic Data Center: http://www.ncdc.noaa.gov/faqs/index.html

National Park Service – Climate Change Response Program: http://www.nature.nps.gov/climatechange/

USGS Northern Rocky Mountain Science Center – Climate Change in Mountain Ecosystems Program: http://www.nrmsc.usgs.gov/research/global.htm