

Deschutes Basin and Its Glaciers



Glaciers in the Deschutes Basin provide the following resources/services to ecosystems & economies:

- 1) Maintain stream baseflow, particularly in the late summer after the snowpack has disappeared
- 2) Chill streams to allow salmon & trout spawning, avoiding temperature viability thresholds
- 3) Cool surrounding forests to reduce fire risk
- 4) Recharge the groundwater system, the other source of potable water
- 5) Offer recreation activities, particularly in the summer where they maintain fragile alpine ecosystems that are already at their survival threshold (elevation limited)
- 6) Provide a decade+ assessment of changing snowpack, allowing trend detection above year-to-year snowpack variability
- 7) Are the most visible indicator of climate change's impact on Oregon and the Deschutes Basin

By the numbers, the upper Deschutes Basin had 22 glaciers in the 1950s of which 13 were named and recognized on U.S. Geological Survey topographic maps. Today, only 11 of those glaciers remain; half of the glaciers within the upper Deschutes Basin have disappeared over the last 70 years. This large decrease in ice is visible in a comparison between the most recent U.S. Geological Survey topographic maps, which depict what the federal government recognizes as permanent snow and ice bodies, and satellite observations taken on Oct. 10, 2020, right before the first snowfall of the 2020/2021 winter season (Broken Top is shown in Fig. 1; the same is true for all the volcanos of the region). Basically, there is much less snow and ice in this region today than what the federal government recognizes. This is due to the warming that has occurred since the 1950s. For the upper Deschutes, temperature observations near glaciers only go back to the late 1980s/early 1990s. Nevertheless, summer temperatures (the main control on glacier size/health) have warmed by $\sim 3^{\circ}\text{C}$ ($5\text{-}6^{\circ}\text{F}$) over the last three decades (Fig. 2 is a representative example).

No agency (federal, state or local) is monitoring glacier change in Oregon. The Oregon Glaciers Institute (OGI) was founded this past May 2020 to address this pressing issue. OGI's mission is to document the health of Oregon's glaciers and their responses to climate change to determine their future viability and to educate the public on the role glaciers play in their environment and economy.

Consequently, OGI is setting up a glacier monitoring network for the Oregon Cascades to document the seasonal change in glacier "health" and the multi-year change in glacier area and volume. This network will use the "benchmark" glacier approach where one glacier in a region is manually monitored for winter snow accumulation and summer ice ablation. These two metrics determine the glacier's mass balance. Area changes of the glaciers surrounding the benchmark glacier are then documented annually to biennially, with thickness/volume measured every five years. Thus, change in glacier seasonal mass balance can be related to regional, multi-year change in glacier area and volume.

Within the upper Deschutes Basin, OGI envisions three benchmark glaciers on Broken Top and the east sides of the Three Sisters and Mt. Jefferson, with glacier area/volume monitoring on the 11 remaining glaciers. From these measurements, OGI will be able to project future glacier change, viability and potential disappearance. These data would also provide physical snowpack measurements and stream-headwater flow volumes within wilderness areas where automated measurements are not allowed.

The OGI glacier network would provide stakeholders within the Deschutes Basin critical data on coming changes in stream baseflow and water availability for drinking and irrigation. Likewise, information on the volume of 0°C meltwater available to cool streams in the late summer will aid in water use planning while sustaining fish habitat, and in forecasting fire risk. Future projections of glacier change, and associated snowpack changes, will allow winter and summer recreation industries to adapt to changing resources.

Glacier loss is the most obvious global-warming impact on Oregon. In monitoring glacier change and health, Oregon and the Deschutes Basin will determine how human actions are impacting its environment. As these glaciers go, so goes a crucial surface water source to the Deschutes Basin, its environment and its reliant industries.

Deschutes Basin and Its Glaciers

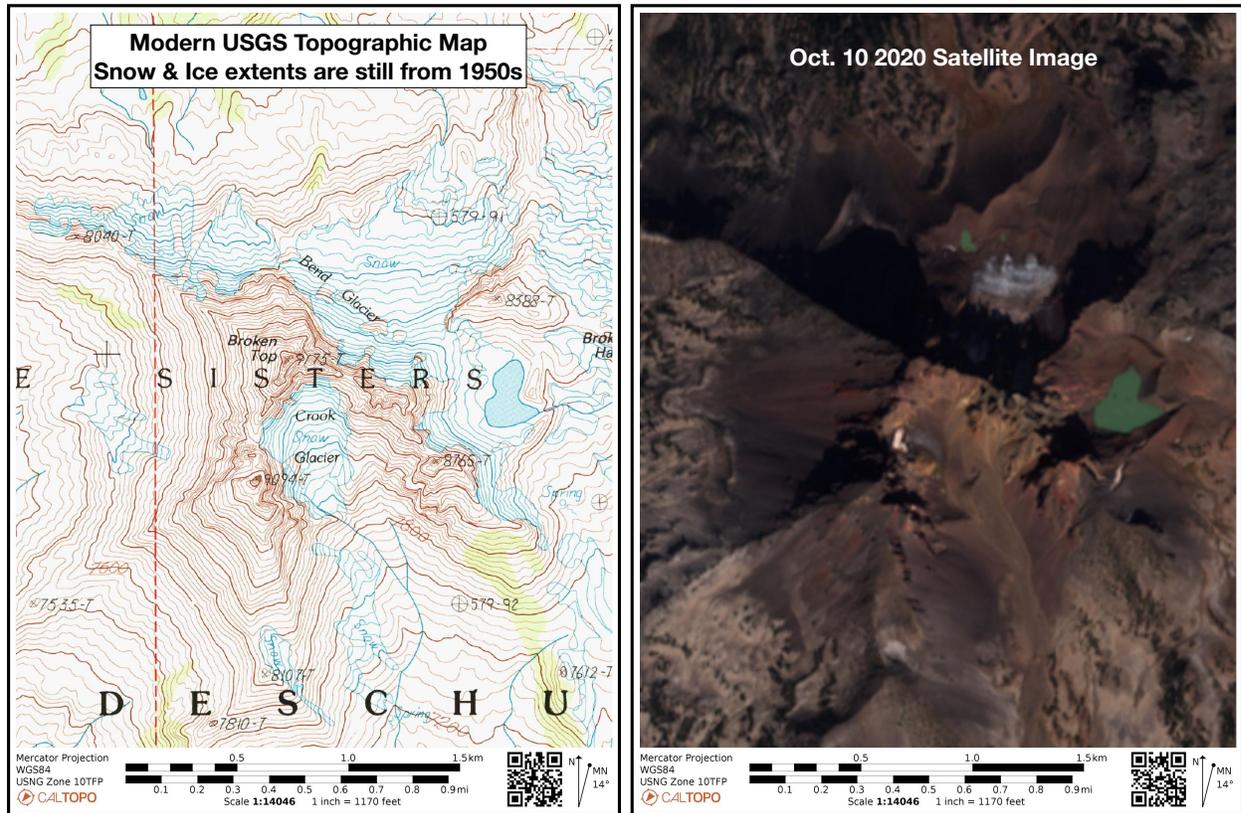


Figure 1. Left shows the most recent U.S.G.S. topographic map of Broken Top region. Right is the same area, but a satellite image taken on October 10, 2020.

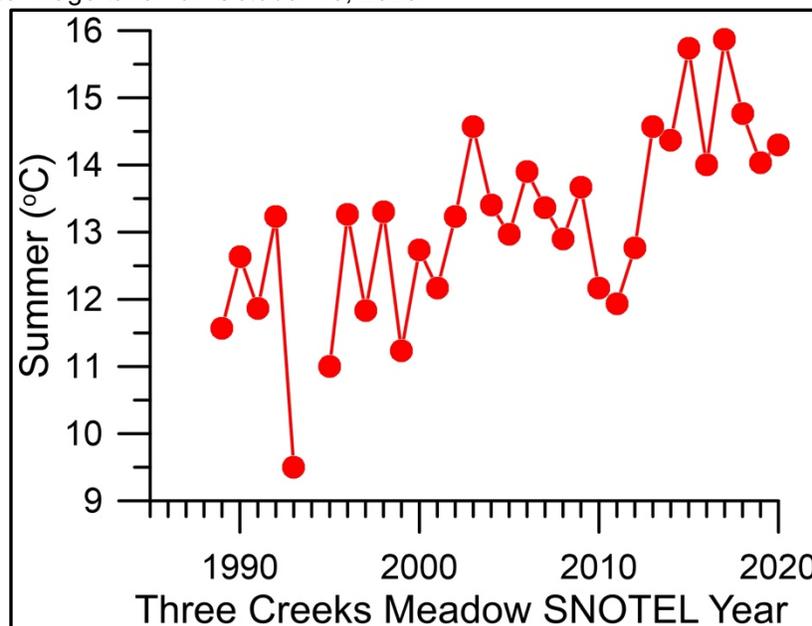


Figure 2. Summer temperature (June, July, August) observations from the Three Creeks Meadow Snow Telemetry (SNOTEL) station six miles north of Broken Top. The record extends back to 1989; the site was installed in 1981 but temperature sensors did not consistently work for the first eight years. Over this 30+ year period, summer temperatures have warmed $\sim 1^{\circ}\text{C}/\text{decade}$ ($\sim 2^{\circ}\text{F}/\text{decade}$). Note, measurements in 1994 were incomplete and not included.