

Mendenhall Glacier Facts And other Local Glaciers

(updated 3/13/14)

This document can be found at <http://www.uas.alaska.edu/envs/links.html>. Click on Mendenhall Glacier Facts. On that same site is a Google Earth map of the “Mendenhall and other glaciers in Google Earth.”

Mendenhall Glacier Size

- 2009 Estimated area 95.27 square km (36.8 square miles) (not including the Mendenhall Towers glacier).
- Length 21.9 km, (13.6 miles).
 - Widest cross section the upper South Branch 6.2 km (3.8 miles)
 - Ice height at terminus 3-20 meters, (10-70 feet).
 - Terminus width and narrowest part of the glacier 510 meters (0.4 miles) as the raven flies.
 - Terminus exposed to lake, a non-linear 865 meters, (2,835 feet).
- 2000 Elevation at the divide separating the Mendenhall and Taku Glaciers 1,580 meters (5,182 feet).
- Highest contiguous glacier ice 1,893 meters (6,210 feet).
 - Elevation of Mendenhall Lake 17 meters (56 feet).
 - Lowest bed elevation on the glacier >100 meters (328 feet) below sea level near the North Star Trekking camp elevation 432 meters (1,420 feet).³
 - Thickest ice 600 meters (1,968 feet) at the “Flux Gate,” mid-length on the glacier, below the confluence of the North and South Branches, elevation 680 meters, (2,230 feet).³
- 2008 Estimated depth of glacier below Mendenhall Lake level 65 meters (213 feet).

Glacier Health

Average Terminus Retreat Rates- Across the face of the glacier

2012-winter 2014 ~Unchanged on the lake, 78 meters on the rock outcrop at lake’s western edge

2011-2012	124 meters, 406 feet
2010-2011	133 meters, 437 feet
2009-2010	165 meters, 540 feet (255 meters or 836 feet in the center)
2008-2009	59 meters, 194 feet (most from the east side)
2007-2008	77 meters, 253 feet
2005-2007	126 meters, 413 feet
2004-2005	59 meters, 194 feet
2002-2004	169 meters, 554 feet
2000-2002	72 meters, 236 feet

1997-2012 1143 meters, 0.7 miles

1760 maximum Little Ice Age extent to 2011 5.12 km, 3.18 miles

Distance from Visitors Center to 2012 terminus 2.4 km, 1.5 miles

Average Retreat Rates

2005-2009	52 meters/year, 173 feet/year
2000-2005	58 meters/year, 190 feet/year ¹
1997-2000	66 meters/year, 216 feet/year ¹
1997-2009	48 meters/year, 158 feet/year

- Ice loss from calving 2.6-4% of total ablation (ice loss).¹
1997-2008 Ice loss area on lower glacier 0.91 square kilometers (0.35 square miles).

Mass Balance

A glacier's mass balance is the net amount of water equivalent snow and ice that is gained or lost yearly and quantifies "glacier health."

Surface Mass Balance (excludes calving)

2011	Depth -0.79 meters/year, volume -0.07 cubic km/year
2010	Depth -0.67 meters/year, volume -0.06 cubic km/year
2005	Depth -0.9
2004	Depth -1.2
2003	Depth -1.8
2000	Depth +1.4
1998	Depth -1.4
2001-2007	Depth -1.44 meters/year, volume -0.13 cubic km/year (-52,000 Olympic swimming pools/year). ²
1995-2001	Depth -0.93 meters/year, volume -0.08 cubic km/year (-32,000 Olympic swimming pools/year). ²

AAR & ELA

A "healthy" stable glacier that is neither advancing nor retreating has approximately >70% of its area at the end of the summer still covered by that prior winter's snowfall. This is called the Accumulation Area Ratio (AAR). The snow line that separates the snow above from the firm (1 yr old snow) or bare glacier ice below is the equilibrium line altitude (ELA). The end-of-summer elevation of the ELA is the best visual indicator of yearly health. Lower ELA's are better for the glacier.

2010	AAR 63% Average ELA 1036 m, 3,400 feet
2009	AAR 63%, ELA North Branch 915 meters, 3,000 feet; South Branch 1,160 meters 3,800 feet
2008	AAR 73%, ELA 915 meters, 3,000 feet
2007	AAR 45%, ELA 1,225 meters, 4,108 feet
2006	AAR 51%, ELA 1,170 meters, 3,838 feet
2005	AAR 47%, ELA 1,200 meters, 3,936 feet
2004	AAR 42%, ELA 1,250 meters 4,100 feet
2005	AAR 29%, ELA 1,370 meters 4,500 feet

2000	AAR 80%, ELA 820 meters 2,690 feet
1999	AAR 57%, ELA 1,100 meters 3,608 feet
1998	AAR 42%, ELA 1,250 meters 4,100 feet

Miscellaneous Characteristics

Surface Ice Speed

- Maximum ice velocity 160 meters/year, 525 feet/year at the “Flux Gate,” mid-length on the glacier, below the confluence of the North and South Branches, elevation 680 meters, 2,230 feet.³
- Ice velocity at the terminus 68-93 meters/year, 223-305 feet/year.³

Snow Accumulation

- High elevation snowfall >10 meters, 32.8 feet, water equivalent.³

Ice Thinning (Melt)

- Summer terminus melt – minimum 2 centimeters (.75 inches)/day, maximum 24 centimeters (9.5 inches), average 12 centimeters (5 inches)/day.¹
- Average annual terminus melt 13.3 meters (44 feet) of water at 100 meters (328 feet) elevation.¹

Taku Glacier

- 2001 Area 775 square km, 300 square miles⁶
Length ~60 km, 37.3 miles
- 1995 Thickest part of glacier 1,477 meters, 4,845 feet⁵
- 1995 Lowest bed elevation ~ 600 meters below sea level, 1,968 feet below sea level⁵
- 2009 Northeast and southwest portions of terminus show signs of thinning⁷. Center terminus likely still thickening and advancing.
- 2006-2010 Average terminus advance 21 meters/year, 68 feet
- 2001-2008 Average terminus advance 14 meters/year, 46 feet⁴
- 1948 Stopped calving as a push moraine (above sea level sediment) rose in front of glacier thus reducing mass loss.
- 1890-2009 ~7.3 km terminus advance, 4.5 miles
- ~1750 Advanced across Taku River and formed a glacier-dammed lake, dam bursts and retreat begins

Mass Balance

1993-2007 Depth -0.21 meters/year, volume loss -0.16 cubic km/year (-64,000 Olympic swimming pools/year).²

Norris Glacier

2001 Area 144 square km, 55.6 square miles⁶

Lemon Creek Glacier Vicinity

Lemon Creek Glacier

2001 Area 9.5 square km, 3.6 square miles⁶

Mass Balance

2000-2007 Depth -1.24 meters/year, volume loss -0.02 cubic km/year (-8,000 Olympic swimming pools/year).²

1995-2000 Depth -0.85 meters/year, volume loss -0.01 cubic km/year (-4,000 Olympic swimming pools/year).²

Ptarmigan Glacier (west of and adjacent to Lemon Creek Glacier)

2001 Area 1.3 square km, 0.5 square miles⁶

Thomas Glacier (viewable up Lemon Creek valley from Egan Drive)

2001 Area 2.9 square km, 1.1 square miles⁶

Nugget Creek Glacier

2001 Area 1.9 square km, 0.7 square miles⁶

Herbert Glacier

2001 Area 56.5 square km, 21.8 square miles⁶

2009-2012 Terminus retreat 37 meters, 120 ft

1998-2009 Average terminus retreat 430 meters, 1,430 feet, (39 meters/year, 130 feet/year)

1766-1949 3.29 km, ~18 meters/year⁹

1949-1969 0.55 km, ~27 meters/year¹⁰

1766 Little Ice Age Maximum to 2012 4.33 km, 2.69 miles

Eagle Glacier

2001 Area 40.2 square km, 15.5 square miles⁶

2009-2012 Average terminus retreat 160 meters, 530 feet.

1958-1967 700 meters ~37 meters/year¹⁰

1785-1949 2 km,

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¹Boyce, E.S., Motyka, R.J., and M. Truffer. 2007. Flotation and retreat of a lake-calving terminus, Mendenhall Glacier, southeast Alaska, USA. *Journal of Glaciology* **53**(181): 211-224.

²Larsen, C.F., Motyka, R.J., Arendt, A.A., Echelmeyer, K.A., and P.E. Geissler. 2007. Glacier changes in southeast Alaska and northwest British Columbia and contribution to sea level rise. *Journal of Geophysical Research* 112:F01007, doi:10.1029/2006JF000586.

³Motyka, R.J., O'Neel, S., Connor, C.L., and K.A. Echelmeyer. 2002. Twentieth century thinning of Mendenhall Glacier, Alaska, and its relationship to climate, lake calving, and glacier run-off. *Global and Planetary Change* **35**: 93-112.

⁴Courtesy of crevassezone.org, (2002-2008) and measurements made by Michael Hekkers and Roman Motyka (2002-2005).

⁵Nolan, M., R.J. Motyka, K. Echelmeyer and D.C. Trabant. 1995. Ice thickness measurements of Taku Glacier, Alaska, U.S.A., and their relevance to its recent behavior. *J. Glaciol.*, **41**(139), 541–553.

⁶National Snow and Ice Data Center, Global Land Ice Measurements from Space. <http://www.glims.org/>

⁷Based on 2009 photographs by Bruce Molnia, USGS.

⁸Motyka, R.J. and J.E. Beget. 1996. Taku Glacier, southeast Alaska, U.S.A.: Late Holocene history of a tidewater glacier. *Arct. Alp. Res.*, **28**(1), 42–51.

⁹Lawrence, D.B. 1950. Glacier Fluctuation for Six Centuries in Southeastern Alaska and Its Relation to Solar Activity. *Geographical Review* **40**(2), 191-223.

¹⁰Field, W.O. 1975. Mountain glaciers of the Northern Hemisphere: Hanover, New Hampshire, U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory. **1**, 698pp; **2**, 932pp.