

Snow Water Equivalence and Stratigraphy Records from White Glacier, Axel Heiberg Island, Nunavut: 1959-2023

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ABSTRACT

White Glacier on Axel Heiberg Island, Nunavut, is one of seven Canadian reference glaciers to the World Glacier Monitoring Service, with near-continuous mass balance observations spanning 1959-2023. While an important indicator of climate-driven changes in this region of the Arctic, these data also comprise a valuable record of snow accumulation and distribution patterns thus presenting an opportunity to investigate temporal trends and spatial patterns in regional snowfall over the last 60+ years.

The winter snowpack on White Glacier is measured annually in April/May at approximately 15 locations and includes measurements of snow water equivalence (SWE) and stratigraphy (Figure 1). From 1959 to 2022, we calculate an average annual winter snowpack SWE of 205 ± 114 mm w.e. from snow pits above 800 m a.s.l. ($n=748$). While accumulation increases weakly with elevation (approx. 54.5 mm w.e./km), SWE observations at the highest sites are found to be notably lower than the average accumulation rate of 371 mm w.e. a^{-1} measured in a snow/firn shaft spanning the years 1929-1962 on nearby Müller Ice Cap. No statistically significant trend in snowfall has been detected from these *winter* (September-May) snowpacks to support a hypothesized “warmer, wetter Arctic” at this location. However, mass balance stake measurements and snow depth sounder data suggest *summer* accumulation should no longer be considered negligible, as was once thought, in the calculation of glacier mass balance.



Figure 1. Snow pit analysis at White Glacier in 2012, expertly demonstrated by Miles Ecclestone.

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