Glacier Mass Balance

What is Mass Balance?

Mass balance is the gain or loss of glacier mass over a balance year. A balance year is from the beginning of winter (approximately October 1st) to the same date the following year. Regional trends in mass balance can be an indication of climate change. Glaciers gain mass when snowfall accumulates at the surface, usually during the winter. When melting (ablation) occurs during the summer mass is lost. Monitoring the difference between accumulation and ablation, mass balance aids scientists in determining the overall health of the glacier.

Long periods of change in mass balance could result in altering many aspects of the park's landscape, such as the hydrology, geology, and vegetation. For example, changes in mass balance can alter the amount of fresh water runoff or sediment discharge which could, inturn, affect the wildlife in these streams. Mass balance also has the potential to alter the landscape dramatically because it influences the advance or retreat of a glacier. If a glaciers has a positive mass balance it typically advances, whereas a glacier with a negative mass balance will typically retreat. Globally, long-term trends in mass balance can significantly alter sea level.

In 2009, park researchers installed stakes at different elevations in Exit Glacier to measure mass balance.

Each glacier is unique and has different characteristics such as the size, elevation range, aspect, slope, tributaries, geology, and the location of the terminus. These factors determine how a glacier will respond to changes in climate and mass balance.

NPS reasearcher preparing to measure snowpack.

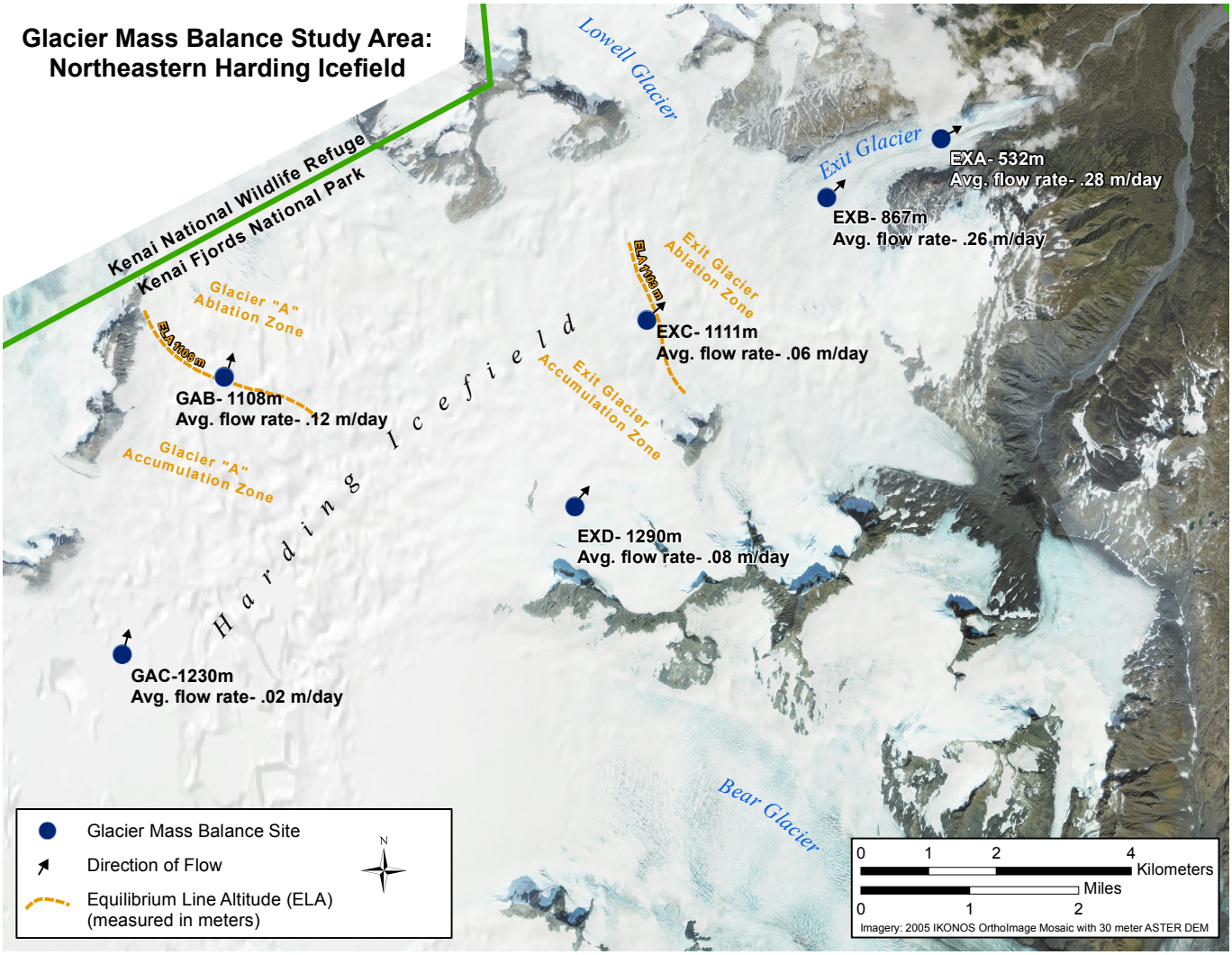
Researchers measuring ice ablation (melt) using a mass balance stake on Exit Glacier.

How is it Measured?

Field measurements are very important in monitoring long-term glacial change. In 2009, park researchers installed stakes at different elevations on Exit Glacier to measure mass balance. Twice a year researchers locate the stake and take measurements. Each spring they measure snow depth and snow density to determine the mass gained from snowfall accumulation. This is known as the winter balance.

Each fall, when the ablation season is complete, they measure the change of the ice or snow surface relative to the height of the stake. This measurement documents the amount of ablation and is known as the summer balance.

Once the measurements are taken, they are converted into water equivalent values (meters w.e.). The difference of the winter and summer balances equal the annual gain or loss and are known as the net balance for each particular stake. To determine the mass balance of an entire glacier, scientists extrapolate the data based on measured and estimated elevation.



The glacier mass balance study area in Kenai Fjords National Park.

Climate Change Connection

The loss of glacial mass is contributing to sea level rise. Currently, global sea level is rising at a rate of 1.3 inches (3.25 cm) per decade, with melting glaciers in Alaska and Western Canada accounting for approximately 9% of this rise. The majority (87%) of this rise is due to increasing sea temperatures (+.5- to +1.5 -degrees C in the Gulf of AK from 2000-2004) which cause the seawater to expand in volume. However, melting ice caps and ice sheets, such as the Greenland Ice Sheet, are becoming more significant sea level rise contributors as melting increases and global temperatures rise.

Looking to the future...

In addition to studies conducted by the park, the University of Alaska Fairbanks is researching glacier mass balance and how glaciers respond to climate change. Their mass balance estimates for the Harding Icefield can be found at http://gps.alaska.edu/chris/altimetry_text.html.

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