

Do Glacier Length Decrease Data (GLD) for Western Canadian Glaciers indicate a "Smoking Gun" for Global Warming?

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Introduction Glacier length decrease (GLD) is considered a symptom of global warming [1]. The objective of my project is to analyze GLD data for ten Western Canadian glaciers to see if these data indicate a "Smoking Gun" for global warming similar to recent CO₂ and temperature data.

Data GLD data for ten Western Canadian glaciers were retrieved using the Climate Time Series Browser (<http://climatemodels.uchicago.edu/timeseries/>). The ten glaciers are:

- Athabasca glacier
- Clendenning glacier
- Drummond glacier
- Fyles glacier
- Illecillewaet glacier
- Noeick glacier
- Peyto glacier
- Saskatchewan glacier
- Tsoloss glacier
- Victoria glacier

Length data were normalized by scaling the data so that the starting value was "0" for the first year that data are given. A composite GLD for these ten glaciers was calculated from the average for each year.

Temperature data for 10 weather stations in Western Canada were also analyzed for a "Smoking Gun" temperature increase by downloading, normalizing, and compositing the data as we did in the "Look for the Smoking Gun" Homework.

Results

Figure 1

Western Canadian Glaciers
Glacier Length Decrease Data (meters) vs Year

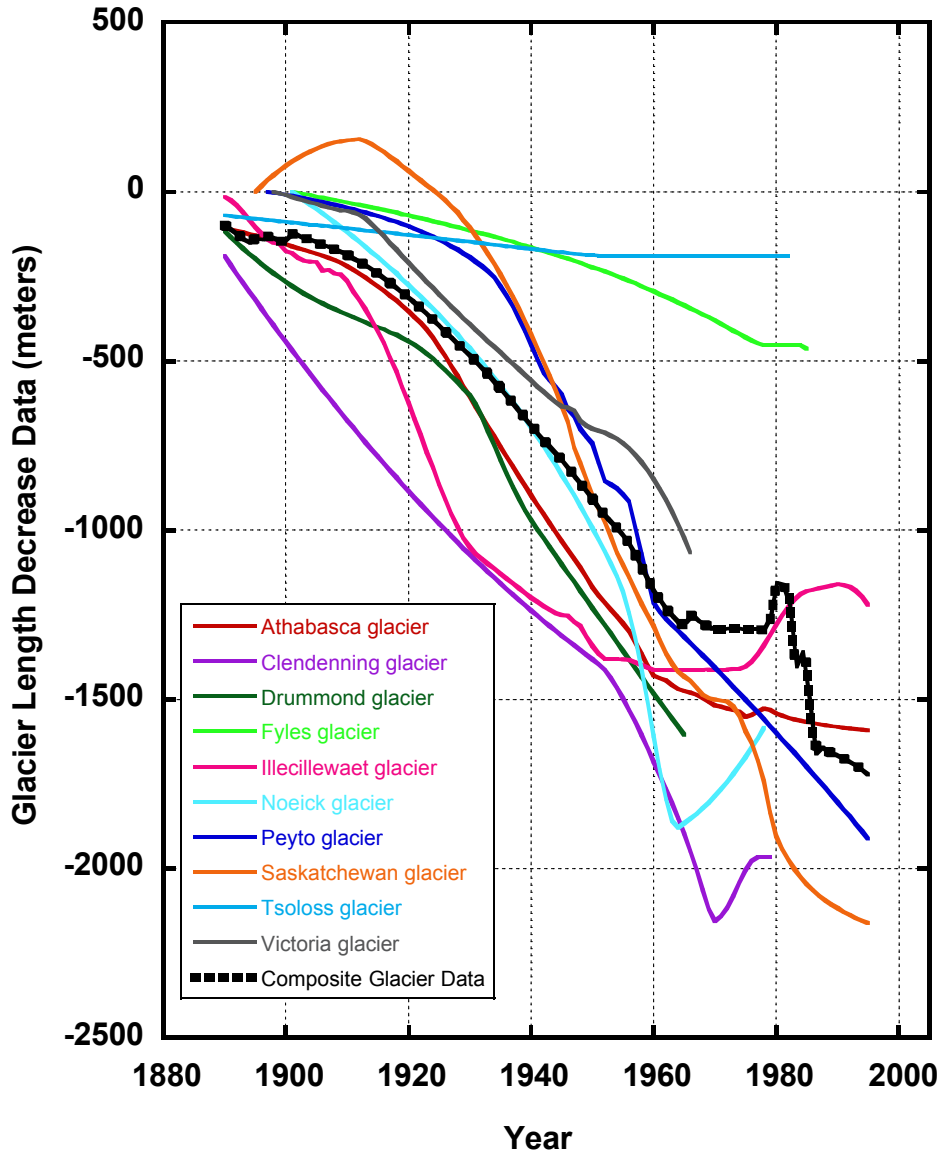


Figure 1 shows the scaled GLD for the ten glaciers; the thick black dotted line shows the composite GLD data. Note anomalous length increase in the data between 1960 and 1980 for several of the glaciers and the flat region for the composite line. The composite line then shows a steep drop between 1980 and 1987 before returning to a moderate decrease.

Figure 2

Western Canadian Glaciers
Composite Glacier Length Data (meters) vs Year

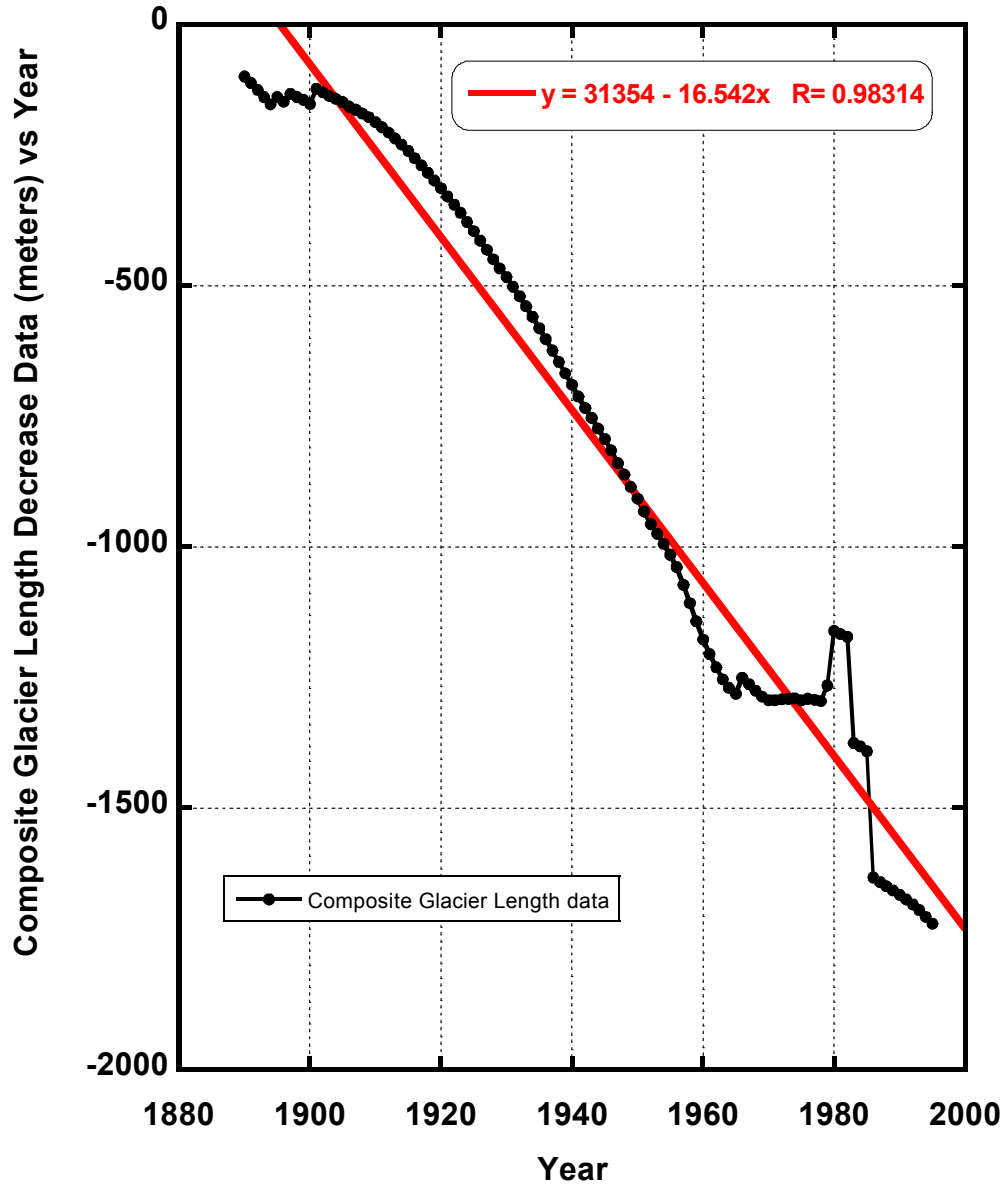
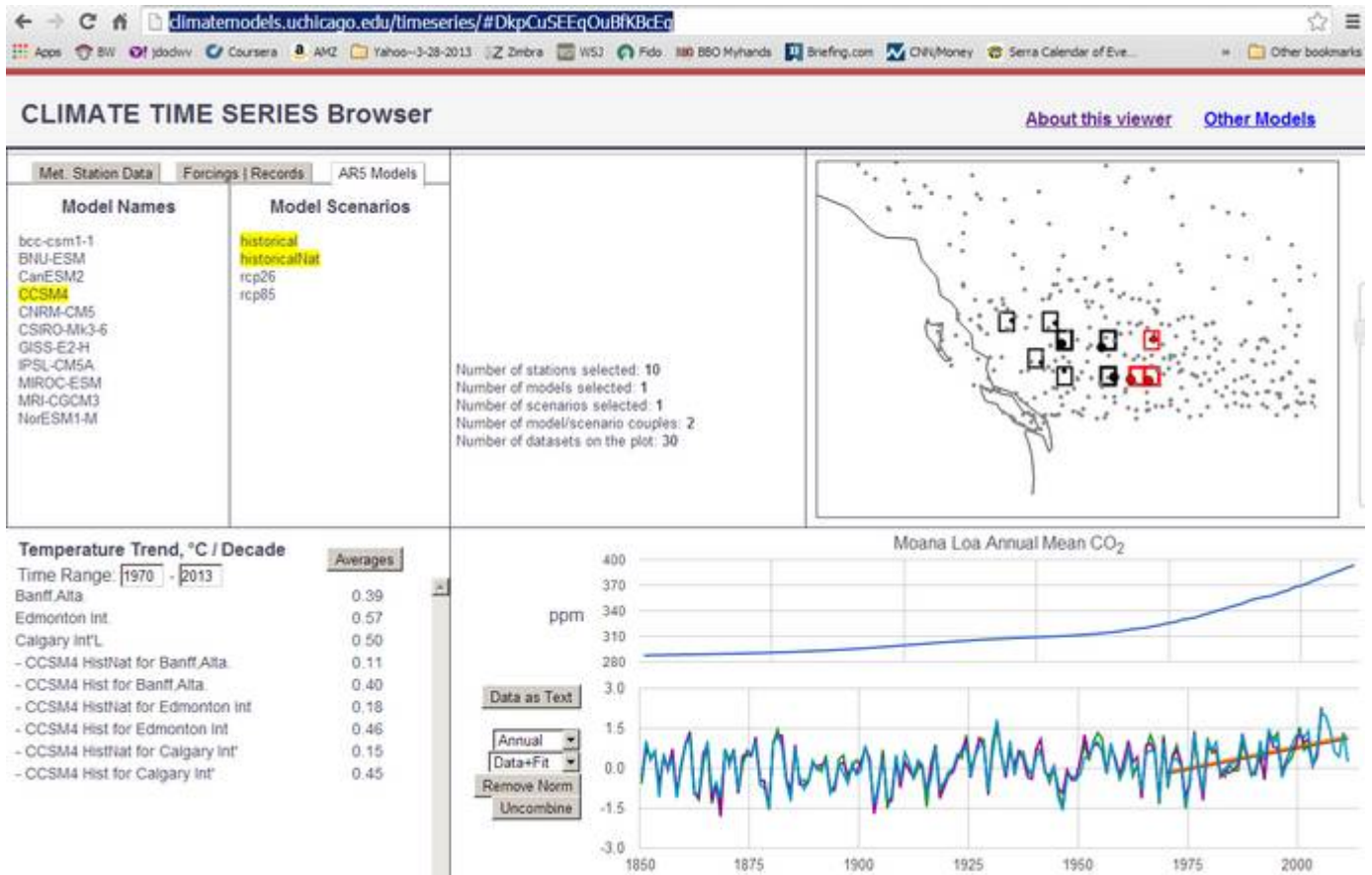


Figure 2 shows a linear fit to the composite GLD data which gives an overall decrease of about -16.5 meters/year and a high R^2 (coefficient of determination). This plot indicates no systematic increase in the rate of melting between 1970 and 1995; therefore, I conclude that these GLD data do not demonstrate a "Smoking Gun" in the same way that sets of 1970-2013 global temperature data confirm global warming.

Below is the Climate Time Series Browser plot of the temperature data for ten weather stations near the ten Western Canadian glaciers:



These temperature data demonstrate the "Smoking Gun" for global warming when compared to the NCAR climate model for human + natural forcings compared to the model for only natural forcings.

Discussion These ten glaciers from Western Canada do not exhibit an increase in melting between 1970 and 2013 even though temperature data for nearby weather stations do show a recent increase consistent with human climate forcings.

At the end of the Little Ice Age, glaciers began to melt. However, the mechanism of glacier melting is complex and subtle so that not all glacier length data show an acceleration in recent decades consistent with the 1970-2013 "Smoking Gun" of correlated CO₂ and temperature increases. An interesting analysis of Glacier National Park glacier melting data describes many local weather factors that affect glacier retreat [2].

Whatever the details of glacier melting, it is a still a serious problem for human communities that depend on glacier runoff as their water source.

References

- [1] Archer, D. *Global Warming Understanding the Forecast*. Hoboken, N.J.: John Wiley & Sons, pps 138-139, 2012.
- [2] Hall, M. P. and D. B. Fagre. "Modeled climate-induced glacier change in Glacier National Park, 1850-2100", *Bioscience* 53(2):131-140, 2003
http://www.nrmisc.usgs.gov/files/norock/products/GCC/Bioscience_Hall_03.pdf