The Cryosphere Discuss., 1, S173–S175, 2007
www.the-cryosphere-discuss.net/1/S173/2007/


The Cryosphere Discussions



# *Interactive comment on* "Reconstructing the glacier contribution to sea-level rise back to 1850" *by* J. Oerlemans et al.

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Received and published: 5 October 2007

This paper provides a succinct method for converting observed glacier retreat to sea level rise. It is an improvement on previous determinations of the contribution to sea level rise of glaciers. The use of glacier length is better constrained than use of climate records or shorter term mass balance records. The mass balance record I would argue is more accurate in the last 50 years.

Specific Comments:

79-8 Briefly explain how Meier (1984) extrapolated sea level rise contribution from 1900 to 1960 when the mass balance data did not exist.

80-10 Scaling theory for equating length to volume changes is good. However, a key



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reference testing an aspect of this idea is Schwitter and Raymond (1993). They examine the change in longitudinal profile of a glacier using a shape factor. Does this paper support the chosen methods?

81-10 The authors have made only a perfunctory attempt to include considerable updated material from Alaska and the Rocky Mountains region (which includes Cascades). A cursory perusal of even a few journals will identify a number of long terminus records. Alaska in particular is key, its volume renders the current calculations as uncertain without better control from the area. Recent publications have reported the terminus changes of Taku, Lemon Creek, LeConte, Pederson, Mendenhall, Bear, Exit, McCarty, Muir, Reid, Portage to name a few glaciers in Alaska. All of these records begin no later than 1909 (Field, 1975, Miller and Pelto, 1999, O’Neel et al., 2001 and Molnia, 2006). Since glacier volume change is the goal and this is the area with the largest alpine glacier volume, not having a better sample makes the entire calculation of glacier volume a bit flawed. I suggest that the paper will not be an important one without including this data, and will be quite important if it does. In the North Cascades a single publication Pelto and Hedlund (2003) contains the terminus change record for 38 glaciers.

84-2 That larger glaciers experience larger retreats because they are generally flatter and therefore more sensitive to climate is not accurate. On average they have a lower gradient near the terminus, certainly this could be easily demonstrated. However, it has been noted by many including Johanneson et al., 1989 that the longer a glacier the longer is its response time to climate change, and therefore larger glaciers are considered less sensitive to climate. To put it more accurately as the authors I am sure are aware, would be that to approach equilibrium to a change in climate requires a larger retreat by a larger glacier, simply to adjust its overall area altitude distribution.

Some mention must also be made regarding calving glaciers. These glaciers must be included as they often represent some of the largest alpine glaciers in several regions, and individual calving glaciers have experienced the largest retreats. Are the length



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volume assumptions likely to be the same for these glaciers?

It would be helpful to see a test of the length-volume method against two glaciers with good long term data, for example Grosser Aletsch Glacier and Muir Glacier.

86-1 The response time discussion must consider Johannesson et at, (1989) as a key initial reference on the topic. This paper also examines some of the volume change ideas in this paper.

86-22 I am not clear on the rationale for using sdm to calibrate v14. Is it simply to extend the record back to include periods prior to 1850?

87-17 Why is the value of scaling factor n not very critical? What does this suggest?

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