

Interactive comment on “Climatic interpretation of the length fluctuations of Glaciar Frías, North Patagonia, Argentina” by P. W. Leclercq et al.

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We thank the reviewers for their useful comments. Their comments and suggestions helped us to reanalyse our results and main conclusions. Following the reviewers' suggestions, we propose several improvements to the manuscript. Here we will give an overview of the most important points by addressing the major comments shared by the reviewers. More details as well as a point by point reply to all comments of each reviewer are given in the supplement.

Firstly, we have corrected the model code in *i*) the calculation of the precipitation such that the seasonality is kept at higher altitudes and *ii*) in the calculation of the SSC (where division by a factor 2 was missing). In addition, we have used an adjusted formulation of the atmospheric transmissivity τ . We used a constant value throughout the entire

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year, but based on measurements of the global radiation at Mocho Choshuenco (data kindly provided by M. Schaefer, CECS) we now introduce seasonal variability. In winter the atmospheric transmissivity appears to be lower than in summer, which is in line with the higher precipitation (more cloudy conditions) and the longer path through the atmosphere in winter. We superimposed a sinusoidal on the constant value: $\tau = 0.55 + 0.15\sin(t)$. As shown in Figure 1 in the supplement, this reproduces the monthly means of observed incoming radiation reasonably well. We have repeated all model runs with these improvements. The results are hardly different. Apparently the relative increase in winter precipitation compensates for the increased summer melt, that is a consequence of the higher atmospheric transmissivity in the summer months.

We extend the discussion of the climatic interpretation of the glacier length fluctuations, and the related uncertainties in particular. We include a more extensive description of the glacier length record. We have performed additional model runs to investigate the uncertainty that results from the fact that the reconstructions of *Neukom et al. (2010, 2011)* do not give precipitation and temperature anomalies for the spring and autumn months. We are also more careful in our statements on the difference between climate deduced from glacier length and the proxy reconstructions of *Neukom et al. (2010, 2011)* and *Villalba et al. (2003)*. These 'very precise' numbers are meant as (quantitative!) indication of the difference, by giving an adjustment to the reconstructions that would result in agreement between modelled and observed glacier length.

To conclude, we have added a short overview of the fluctuations of other North Patagonian glaciers, for as far as they are known. There is indeed more information of glaciers in the region. In a broad sense this supports the idea that the glacier fluctuations represent a regional climatic signal. Especially the glacier length record of Glaciar Esperanza Norte by *Ruiz et al. (2012)* shows a striking similarity with the record of Glaciar Frías. This suggests that both glaciers express the same variations in climate despite the 100 km distance between them. Besides, this reconstruction of Esperanza Norte makes the length record of Glaciar Frías no longer the only long and detailed length

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record of the region.

A detailed reply to the comments of the reviewers is given in the supplement.

Please also note the supplement to this comment:

<http://www.clim-past-discuss.net/7/C2784/2012/cpd-7-C2784-2012-supplement.pdf>

Interactive comment on Clim. Past Discuss., 7, 3653, 2011.

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