Review of
Glacier dynamics in the Western Italian Alps: a minimal model approach

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GENERAL

In this paper an attempt is made to predict the future state of a number of smaller glaciers in the western Alps. This is done by using a simplified approach in which the geometry of the glaciers is parameterized in a simple way, and observational data are used to calibrate models. A large number of meteorological forcing fields produced by the climate model EC-Earth are then used to go forward in time.
As specified below, I believe that the approach taken here has too many flaws to produce reliable results. I believe that the small glaciers can be handled with simple models, but it should be done carefully and with a balance between the quality/quantity of the input data and the methods used.

The paper in its present form is not suitable for publication. My recipe/advise would be to redo the calculations with a method that is based on:
(1)# The use of a minimal glacier model in which (for some of the glaciers) the width and/or slope is allowed to vary along the flowline, and (for all glaciers) the width is scaled with the glacier length (Oerlemans, 2011; chapter 8).
(2) The use of an energy balance model to relate changes in ELA to monthly precipitation and temperature anomalies.

In contrast to what is written frequently, in minimal glacier models there is no need to assume that the glacier thickness is constant along a flowline

SPECIFIC COMMENTS

p. 1480, line 21
Indicating the "health" of a mountain environment by the state of glaciers is a awkward statement. Is a mountain environment healthy when the glaciers are in steady state, unhealthy when the glaciers grow ?
Please remove this formulation.

p. 1480, line 26
'among the most important ones'.
Why not simply state that 'The response of glaciers to climate forcing is determined by a glacier's geometry and the climatic setting.' Then you have it all.

p. 1481, line 14-15
replace 'an order-of-magnitude for the glaciers "expiration data"' by something like 'a first picture of the future evolution of the glaciers'.

p. 1481, line 26
'best preserved'
What do you mean by that ? Have glaciers in the Wester Alps shrinked less than in the Eastern Alps ?

p. 1482, line 8-9
size and shape are physical properties !

p. 1483, line 1-4
How have the mass-balance measurements been converted to a net balance ? With respect to a reference hypsometry for the whole period ? If so, **can you estimate the errors due to a changing glacier geometry ?**

p. 1483, line 15-24
The study of Bonanno et al. (2013) is not readily available to me. Is this about statistics between weather data and glacier length ? So why is it relevant for assessing the relation between weather data and net balance ?
Many papers have been written about the relation between mass balance and seasonal/monthly meteorological data – none of this is mentioned…
Why not using monthly data anyway ?

p. 1484, line 1-12
The data used for projections are, as far as I know, not explicitly given in Hazeleger et al. (2012). Additional reference to source(s) needed !

p. 1484, line 16
'between glacier length and *mean ice thickness*'

p. 1484, line 20-24
In Oerlemans (2011), minimal models are discussed that have varying width, varying slopes (even with an overdeepening when applicable); applications are shown in which the width is scaled with the length. **In these models, an assumption that the ice thickness is constant is not needed and not used at all.**

p. 1485, Eq. (1)
Eq. (1) is not based on perfect plasticity, but on a large number of numerical experiments with a SIA flow-line model.

p. 1485, Eq. (2)
Eq. (2): why dealing with a varying width here when you have assumed it is constant ?
The obvious approach to be taken is to let W vary with x, and probably also scale it with the glacier length.

p. 1486, line 14-19
I do not understand the discussion on the 'instantaneously response to climate forcing'. Does this refer to the relation between the net balance and the

meteorological variables ? But then, why is this different for smaller and larger glaciers ?

p. 1487 -1488
The approach to model the mass balance, apart from the problems with a changing geometry, is really out of date and has too many uncertainties. Sometimes the coefficients from the regression analysis are impossible to understand and perpendicular to what we know about the processes of mass and energy exchange between glacier and atmosphere.
The obvious way to relate mass balance to meteorological forcing is to run an energy balance model, and calculate sensitivities of ELA to monthly perturbations of precipitation and temperature.

p. 1490 and further
** Based on the methodology discussed so far, the further analysis cannot be considered reliable.
** It would be interesting to see a more-to-the-point discussion about what step(s) in the analysis contributes most to the uncertanties. I guess overall it is the uncertainty in the meteorological input data and the relation between meteorological data and net balance.