

Interactive comment on “A model study of the energy and mass balance of Chhota Shigri glacier in the Western Himalaya, India” by F. Pithan

F. Pithan

felix.pithan@gmx.net

Received and published: 25 January 2011

Thank you for the comments and the detailed criticism and suggestions. There are many points where I agree the suggested changes would clearly improve the quality of the paper. I will respond to some points more specifically:

to Mauri Pelto: Thank you for the references to the work by Kulkarni et al that I was indeed unaware of. I will not discuss their results in great detail since I am trying to focus more on mass and energy balance and their sensitivities to climate variables than the overall regional glacier retreat, but I agree it should come up in the introduction.

summer accumulation: According to model results, some monsoon precipitation accumulates even at the lowest elevation on the glacier. Maybe adding a further elevation

C24

line to Fig. 4 will serve to visualize this.

108-5: My wording was misleading at this point - the statement should only refer to meltwater, since the model does not account for rainfall and its refreezing or runoff. However, a more detailed overview of the seasonal accumulation distribution at different elevations should answer at least that part of the question.

109-14: Other than the surface mass balance, the position of the transient snowline in the model is quite sensitive to changes in model parameters and the initial state (i.e. snow depth and temperatures when the model is started). I would therefore refrain from using these specific results without further constraints such as seasonal mass balance or snow depth measurements.

to Thomas Mölg:

A) Cloud extinction of short-wave radiation is computed based on the cloud-cover fraction. The respective parametrisation has been developed from observed cloud cover. I assume the reanalysis value for cloud cover of the entire atmospheric column (while of course associated with a large uncertainty) is in principle compatible with this.

The same cloud cover fraction is used for the parametrisation of long-wave radiation.

B and C) The subsurface model is not built on a specific pre-existing framework. What I named "surface temperature" actually is the temperature in the middle of the surface layer (implicitly assumed to be representative of the entire layer) - I can now see how this is misleading.

Since the model operates with a no-flux condition at the lower boundary, there is no prescribed bottom temperature. For most model runs, the initial temperature of the ice and snowpack was set to the annual mean temperature at the respective elevation.

D) The linear lapse rate mentioned in 103-17 is the dry adiabatic lapse rate $-0.0098 K * m^{-1}$. As an alternative to the glacier wind scheme, various constant lapse rates adopted from measurements in the region and the standard atmospheric lapse

C25

rate of $-0.0065K * m^{-1}$ have been tested, all failed to reproduce the actual mass balances.

E) Unless stated otherwise, model runs are based solely on reanalysis data.

F) The phrase "Superimposing those anomalies" indeed suggests the use of the annual mean changes, it should read "Superimposing the daily anomalies from PRECIS results". Since some of the change will already have occurred by 2002-2006, the approach probably overestimates the actual changes. On the other hand, using the PRECIS base period as a starting point for sensitivity experiments might raise other issues, since there is no mass balance verification for that time period and drawing conclusions for the present glacier regime and further changes would still be difficult. An attempt to directly use PRECIS results instead of anomalies clearly failed to reproduce plausible mass balance results, probably due to the lack of temporal resolution (daily data only).

G) and the respective comment by Mauri Pelto: I understand something like the attached (draft) figure, at least one further table on the sensitivity experiments conducted and a figure on the vertical gradients of different energy balance components would provide helpful information.

(note: the massive discrepancy of modelled and observed mass balances at the lower end of the glacier is due to debris cover not represented in the model)

Interactive comment on The Cryosphere Discuss., 5, 95, 2011.

C26

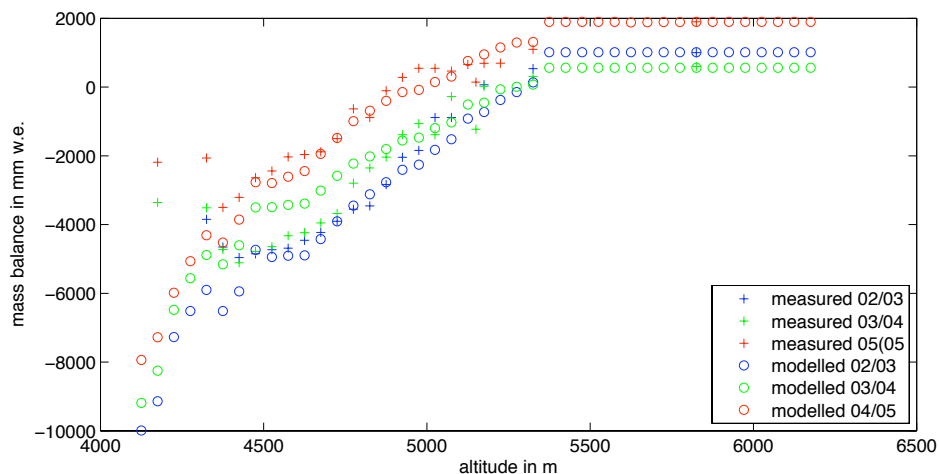


Fig. 1. modelled and measured mass balances for three hydrological years across the glacier

C27