

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

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This paper ambitions to provide a new insight into how Chhota Shigri glacier (and more generally Western Himalayan glaciers) is sensitive to variations of meteorological variables and thus to climate change, using an energy balance model fed by reanalysis data and daily data from Manali at 1900 m (about 50 km away from the glacier, on the southern wet slopes of Pir Panjal range compared to the glacier located on the northern dry slopes). This subject is of truly international interest as illustrated by the recent spectacular increase in publications dealing with Himalayan glaciers or seasonal snow cover, and their consequences on local and regional hydrology. Nevertheless, we have two comments regarding this paper by F. Pithan.

The first comment is related to the quality of the paper. According to us, as a whole,  
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the paper is lacking (i) a detailed analysis of input data, (ii) a thorough description of the model and its sensitivity to model parameters as well as (iii) a good validation of the results to provide confident conclusions regarding mass balance sensitivity to meteorological variables or future climate change. Getting accurate results of surface energy balance at glacier scale is a difficult task, especially when input data are reanalysis data or daily data recorded far away from the glacier. This paper should discuss in details the input data : reliability, spatial extrapolation and/or downscaling, ... (figures showing meteo data should be provided). Are reanalysis data or Manali data representative of glacier data? The author should list clearly the model parameters, and their sensitivity. Indeed, this process-based model working at 5 min-time step is obviously highly parameterized. Some parameters are briefly and uncompletely described in section 4.2 but many parameters are not listed or discussed (parameters used to derive albedo, Swin, wind speed... at the glacier scale and at 5-min time step). Finally, this model works like a black box and the good agreement between observed and simulated mass balance (Fig 3 :  $r=0.974$  even if this correlation is questionable because all data are not independent each other) means that the set of parameters can be efficiently tuned to fit both fields. But in any case, it cannot be considered as a physical model and studying the sensitivity of the glacier to climate change using this model is just unrealistic. Consequently, according to us, results provided in this paper (regarding energy balance at the glacier surface, sensitivity to meteorological variables or climate change) are not reliable. For instance, the author reports the highest seasonal value of latent heat flux ever recorded on glaciers with seasonal sublimation rates as high as 9 mm we day<sup>-1</sup> before the monsoon ( $LE = -300 \text{ W/m}^2$  page 116, line 3 over which time period, under which wind speed, which moisture conditions, we do not know) and annual rates of 3 mm we day<sup>-1</sup> over the whole glacier (Table 1 :  $LE = -95.8 \text{ W/m}^2$  mean annual value for three years over the whole glacier). These extremely high rates of sublimation are not in agreement with field observations where neither any strong winds, nor any extremely dry air, nor any big penitents have been observed. Due to this highly over-estimated latent heat flux, the glacier is obviously much more sensitive

to moisture than temperature (table 2) but how can we give confidence to this result? According to us, such an energy balance study cannot dispense with a validation on observations.

The second comment is more a question. Is it reasonable and acceptable to publish studies on glaciers in India without alerting national teams involved in the field and discussing with them? On a deontological point of view, this is already questionable, and for the quality of the research, it is highly prejudicial as explained above. Before submission, the author asked for field data, but we replied that the data will be available when published. The paper would have been much better if the author had waited to compare his results to field data.

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