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Interactive comment on "Snowfall in the Himalayas: an uncertain future from a little-known past" *by* E. Viste and A. Sorteberg

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We thank the reviewer for taking the time to read and comment on our manuscript. Our response is given for each comment below.

Comment 1: The authors in this study collate evidence that our present day knowledge of snowfall across the Himalayas is highly uncertain based on a variety of spatially explicit data sources. They extend this to include climate model projections from CMIP5 to make projections of snowfall in the region in the 2080s under climate scenarios RCP2.6 and RCP8.5. Overall, in my opinion the scope and aims of the manuscript are timely and of wide interest to the research community.

The first part of the manuscript focuses on present day snowfall. In my opinion this is a

good effort at understanding present day snowfall across the Himalayas and associated uncertainties, which are large. This in itself is a worthy result. The second part focuses on projected climate change. This is done using bias corrected climate data from CMIP5 simulations. The first question this raises, is why immediately bias correct? It seems the snowfall product provides an excellent basis for assessing the performance of the climate models at their original coarse resolution and snowfall data is available from CMIP5. A need for bias correction may become clear from this assessment, or this may already be clear to the authors.

Response 1: The resolution of the CMIP5 models varies from model to model, but is in general much lower than the MERRA data used as a basis for bias-corrections. We think it's reasonable to assume that the higher-resolution and observation-based MERRA reanalysis has a higher quality than the CMIP5 models. Thus we have used the present-day MERRA data as a basis and added the changes from the CMIP5 models, instead of using the CMIP5 models directly.

Comment 2: Further to this, in the bias correction for future change the authors use the absolute change in temperature and the 'fractional' change in precipitation. Thus implying that in the case of temperature the change is independent of any present day bias. However, in the case of precipitation a model with a high bias now will have a biased high precipitation change. The reasoning for this approach is not clear within the text – however it most likely breaks the physical consistency in the future climate projections, something the authors point to in the use of reanalysis data. I would like to see a plot of the anomaly against present day bias to justify the 'fraction' approach as well an attempt using the 'additive' approach consistent with temperature.

Response 2: Technically, both approaches could have been used. However, we do not know of any studies that use the additive change in precipitation and have considered it less appropriate also in our case. We're not sure we understand the comment that "a high bias now will have a biased high precipitation change." This may be true for an additive change, but for a fractional change the opposite seems more likely to us.

Adding an absolute change in precipitation to a model with a high amount of precipitation would result in a smaller fractional change than adding the same amount to a model with little precipitation. Also, with an additive change, we would get negative precipitation values at some time steps – values that would then have to be set to zero. In addition to changing the total, this would change the number of precipitation events, which must also then be corrected for.

Comment 3: I would also like to see the bias correction applied to a different baseline dataset sampling the low end uncertainty in snowfall. It may be that given this variety of approach and sampling of uncertainty leads to a larger uncertainty in future snowfall.

Response 3: We have done this. The effect of future changes in temperature and precipitation (Section 4) are presented both for the highest (MERRA) and the lowest (APHRODITE) present-day estimates.

Interactive comment on The Cryosphere Discuss., 9, 441, 2015.