

## ***Interactive comment on “21st century changes in snow water equivalent over Northern Hemisphere landmasses due to increasing temperature, projected with the CMIP5 models” by H. X. Shi and C. H. Wang***

**Anonymous Referee #2**

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GENERAL COMMENTS Shi and Wang address a topic that is of great interest to the readership of The Cryosphere. They performed a good deal of analysis of climate model output. However, problems in the presentation of their results, including inadequate descriptions of methods and results, make the results less useful to the reader. In addition, there is an overall tendency for an awkward and confusing use of language. I believe that the manuscript needs editorial support. As a result I recommend publication only after significant revision.

The methods employed in this analysis require more explanation. For example, p.

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2140, lines 14-20. how are spatial correlations calculated? These values are very sensitive to autocorrelation in the residuals, which is undoubtedly a problem in the snow cover field. Also, in the statement "by comparison", it is not clear what is being compared, and why or how the results are different. On p. 2146 lines 1-5 the authors discuss correlations and partial correlations. Are these performed on detrended time series? How do the trends affect these results, and do they result in autocorrelation in the residuals which contradicts one of the assumptions of regression analysis? Also, throughout the manuscript the authors focus on absolute rather than relative changes in SWE, but never explain the advantages / disadvantages of evaluating relative versus absolute changes. By choosing to evaluate absolute changes, one skews results to areas with much more snow.

The authors often provide results with little or no explanation (see comments below for additional specific examples), and little discrimination between minor or trivial results and significant results. For example, p. 2145, lines 8-9, "the reduction in SWE during the winter half-year exceeds that in the summer half-year, in keeping with the results shown in Fig. 3." Since there is so much more snow in winter than summer, is this a trivial statement? Also, winter half-years and summer half-years are never defined. Also, p. 2145, lines 26-27, the result "This pattern implies that decreasing SWE is attributable to increasing temperature and the minor increase in precipitation" requires explanation. Another example is the recurring mention of a threshold value at which the rate of SWE reduction decreases over time throughout the 21st century: no explanation is provided, in terms of whether this local or global, based on the freezing point of water, or based on some other physical principal.

Throughout the manuscript one finds confusing references to CMIP experiments and IPCC experiments. The discussion sometimes refers to CMIP and sometimes to the IPCC AR number. For example, p. 2144 line 14 says that their results are different than AR5 (Stocker et al., 2013). Aren't the authors using the same models as Stocker et al.? if so, how can the results be different? This requires clarification, and further

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explanation. Also, p. 2145 line 15 “which is consistent with the results in AR5.” If this is just a repeat of what has already been done for AR5, why is it of interest?

Clarity of presentation is a problem even in the introduction. First, in defining the questions asked in this manuscript (P. 2139, lines 6-7). How is question 2 different than question 1? Also, the phrasing of question 2 is entirely vague (“How about the link. . .”). Second, the authors must clarify (for example on p. 2139, lines 9-16) how this study complements previous studies of CMIP5 snow simulations.

#### SPECIFIC COMMENTS

Abstract, p2136, lines 10-13. Run-on sentence, should be split into two sentences

p. 2137, lines 15-18. Define what is meant by snow cover.

p. 2137, line 27, “shown” should be “show”

p. 2138, line 16, should “except” be changed to “in addition to”? “Topography” should not be capitalized

p. 2138, line 20. What is meant by “simulated SWE actually increase with altitude”? the discussion is about rates of change, and the relevance of this statement is unclear.

p. 2141, line 15. Define “relative-error ratio”.

p. 2141, line23-24, what is meant by “the extent of increased springtime SWE”?

P. 2143, lines 9-11. Regarding the unique difficulty of simulating snow over the Tibetan plateau, this requires further explanation and some reference to the literature on this issue.

2145, line 6, what is meant by “integration cumulative errors”?

p. 2146, line 14. “form” should be “from”

p. 2146, lines 14-19. Does this paragraph, which says that the sensitivity of SWE to temperature gradually increases during the 21st century, contradict previous state-

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ments?

p. 2147 line 27 – p. 2148 line 2. This is unclear and confusing.

p. 2150, lines 21-24 (last sentence of manuscript). The meaning and relevant of integration truncation and intermodal differences is not explained, was not previously mentioned, and is therefore confusing.

Figure 1, explain the axes, figure 2 specify which months are included

Figure 6, 7. for what region is this? I assumed the entire Northern Hemisphere.

Figure 8. Cannot see range of results for all three scenarios.

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