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The Cryosphere Discussions

Interactive comment on "A regional climate model hindcast for Siberia – assessing the added value of snow water equivalent using ESA GlobSnow and reanalyses" *by* K. Klehmet et al.

Anonymous Referee #1

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The objective of this study is to use dynamically downscaled regional climate model simulations (driven by reanalysis) to produce SWE information across Siberia, and compare these simulated fields with reanalysis (NCEP-R2 and ERA-int) and a state of the art satellite derived SWE data record (ESA GlobSnow). This is an important issue for this region, as Siberian snow anomalies have significant impacts on the northern hemisphere climate system, and there is poor agreement between various datasets on SWE distribution across Siberia. There are some weaknesses in the paper in the present form that I feel should be addressed before the paper is suitable for publication. Most importantly, the lack of a full spatial analysis of SWE fields (as opposed to regional averages) is a major shortcoming. I hope these comments constructively improve the

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manuscript. The manuscript also requires a thorough edit for grammar, word choice, etc. I have provided some editorial comments but this is far from exhaustive.

General Comments (note page and line references are from the 'print version' PDF)

1. Why is the term 'added value' used throughout the manuscript (including the title)? I see this study as an intercomparison of three approaches to deriving historical time series of SWE estimates: reanalysis, satellite derived, and downscaled RCM. I suppose if the RCM (driven by reanalysis) provides improved SWE information relative to standalone use of the reanalysis fields, then there is value added to the increased computational complexity of running the RCM. But is there added value to the RCM compared to GlobSnow? That case is not clearly made so I would change the terminology throughout the paper to reflect more of a dataset intercomparison as to identifying 'added value'.

2. Consider re-ordering and re-focusing the Introduction section. It's quite long currently – there is a lot of background before the objectives are finally spelled out on page 4643.

3. Page 4640 lines 20-21: clarify that wet snow results in increased microwave brightness temperature, while increases in snow grain size results in decreased brightness temperature.

4. I agree that station observations are sparse across the study domain. The discussion of in situ observations on page 4640 paragraph 1 should make mention of Russian snow depth and snow survey data which are available online (http://meteo.ru/english/climate/snow1.php and http://meteo.ru/english/climate/snow.php). The snow depth data were used as inputs to the GlobSnow retrievals, and the snow surveys were used to assess the GlobSnow product as noted later in Section 2.2.2. These snow survey measurements could also be used to assess the CCLM SWE fields.

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5. Additional details are required on the snow model used within CCLM. The description on page 4644 lines 20 – 28 lacks any references or information on the heritage, key parameterizations, and performance of this model.

6. What is the value in retaining the NCEP-R1? As mentioned on page 4646 there are some serious issues with the SWE fields which suggest there is no climatologically useful information to be gained. I think the poor results for NCEP-R1 as shown Figure 3 are a result of the issues described in Kanamitsu et al (2002) and are grounds for not bothering to include this product.

7. The description of the GlobSnow retrieval scheme on page 4648 lines 14-23 can be removed. The description is not accurate in places (for example, effective grain size is estimated from forward HUT model simulations using observed snow depth from climate stations to constrain the simulations. The effective grain size determined at the climate station locations is then converted to a spatially continuous field via kriging). Regardless, a full description of the retrieval is provided in the Takala et al (2011) citation, so I think it is sufficient to simply point the reader to that paper for full details.

8. Section 3.1: I suggest adding a statement that SCE validation using the GlobSnow SWE product is not ideal because of uncertainties in the wet/dry snow masking with microwave radiometer time series. Direct use of a SCE dataset would be preferred but the ideal choice – the NOAA IMS SCE product – is used within the reanalysis and so is not independent. Also, the description on pages 4651 and 4652 of the results in Figure 2 is very descriptive. This should be shortened, and if possible a quantitative comparison be provided (first re-project all the datasets to a common grid).

9. Section 3.2: Given the primary objective of this paper, I'm very surprised that SWE distribution was not assessed spatially. Instead of computing regional averages as shown in Figure 3, 4, 5, why not conduct a comparison of SWE patterns on a common grid? The regionally averaging serves to muddle the results that would be much clearer if maps of SWE were produced (as for frequency of SCE in Figure 2). This would also

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provide the necessary evidence for statements such as “ERA-Interim reproduces the regional SWE distribution of satellite-derived SWE but tends to overestimate SWE.” (page 4653 lines 13-14)

10. How was the GlobSnow error range derived as shown in Figure 3, 4, and 5? The GlobSnow uncertainty fields are the variance estimates produced from the combination of the background kriged snow depth field, and the radiometer derived estimates. At grid cells that contain a climate station, the variance is very low because the climate station measurement is assumed to be right (with just a small variance). As distance increases from a climate station, the variance increases as additional weight is put on the radiometer derived estimates. The variance field therefore does not necessarily reflect retrieval uncertainty, but statistical uncertainty based on the underlying assumptions of the assimilation process. Unpublished analysis with independent reference datasets do not show evidence that an increased uncertainty or variance is associated directly with higher ‘error’ in the retrieval. This needs to be an area of future assessment and development with the GlobSnow dataset.

Editorial Comments

I’m not sure the title is clear. How about ‘A regional climate model hindcast for Siberia – assessing simulated snow water equivalent with reanalysis and ESA GlobSnow’

Abstract line 1: define CCLM

Abstract line 9: I would not refer to the GlobSnow product as ‘observational’ since there are quite a lot of ‘non-observational’ components to the GlobSnow retrieval scheme. I suggest “Daily satellite derived reference data for the period 1987-2010 was obtained from the ESA DUE GlobSnow product, which enables a large scale assessment.”

Abstract line 14 (and 18): change “SWE of. . .” to “SWE from. . .”

Page 4638 line 24: remove ‘and’

Page 4639 line 23: change ‘freshwater supply’ to ‘freshwater budget’

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Page 4647 line 27: change to "...produced by the Finnish Meteorological Institute in collaboration with Environment Canada..."

Figure 2: Legend needs to be modified to show that white indicates missing data.

Figure 3: The points on this graph should not be connected by lines as there is no connection between these regions and this is not a time series. The caption should note that the correlation values in panel b were calculated with each dataset versus GlobSnow.

Interactive comment on The Cryosphere Discuss., 6, 4637, 2012.