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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.

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We thank Eric Brun for his detailed suggestions concerning the added value assessment. They are very helpful to improve the manuscript of the paper. Our replies to his comments are the following:

Comment:

We suggest to add the following points: A comparison with the in-situ observations of SWE and snow density, performed 3 times per month in many stations of the considered domain, from 1966 to 1996. The available data sets and the way to use them for evaluating a snow model are described in "Brun, E., Vionnet, V., Boone, A., Decharme,

B., Karbou, F., Morin, S., Peings, Y. and Valette, R., (2012). Simulation of northern Eurasian local snow depth, mass and density using a detailed snowpack model and meteorological reanalysis, in press doi: 10.1175/JHM-D-12-012." This comparison would make possible to confirm or not the overestimation of SWE in April, when compared with Globsnow. Indeed, we cannot exclude that Globsnow underestimates SWE during the melting period. As you mentioned in your paper page 4649 (lines 20-23), the estimation of SWE in Globsnow during the melting period is mainly based on the interpolation of in-situ snow depth observations. The density used in the Globsnow algorithm does not represent explicitely the systematic rapid increase in density due to the compaction of wet snow (see Fig 2 in the above-mentioned paper), which could lead to an underestimation of the estimated SWE. A comparison with quality-controlled in-situ snow depth observations, which are very numerous from 1948 to 1995 and easily accessible via the NSIDC portal, would allow an evaluation of the capacity of your hindcast to simulate the date of the onset of snow cover as well as the date of its melting out (see the abovementioned paper and Peings et al, 2012 / doi:10.1029/2012GL054083).

Response:

In order to confirm whether CCLM really overestimates SWE in April and to assess whether this finding is not due to the potential underestimation given by GlobSnow we will compare our model results with SWE observations provided by FSUHSS (Krenke 2004). We downloaded the second mentioned dataset (HSDSD Version 2, Armstrong 2001) for the purpose of snow-depth comparison. We agree that the station versus gridbox comparison would be useful to evaluate the model performance in simulating the onset of snow accumulation and end of snow ablation. Furthermore, this comparison can complement the large-scale evaluation using the satellite-derived SWE product of GlobSnow. Nevertheless, this station-based comparison is restricted to single point measurements being sparse especially in the northern parts of the model domain. Additionally, we have to keep in mind that we compare point-measurements with gridboxes representing an area of around 2500 km^2 and that snow measurements

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suffer from uncertainties as well, e.g. due to wind-induced losses.

Comment:

An evaluation of those hindcast meteorological fields which are the most informative with respect to the snow cover dynamics (winter snow falls, Fall and Spring temperatures, wind velocity, ...) would further strengthen the conclusions of your paper, as Troy et al. (2011 / doi:10.1175/2011JCLI3936.1) did for precipitation.

Response:

This suggestion is indeed useful when the whole snow cover dynamics of the snow parameterization (introduced by the German Weather Service) within the regional climate model CCLM is investigated. A full evaluation of the snow parameterization used in CCLM is not the scope of this study. To obtain meteorological fields, as e.g. SWE, we used the whole model system of CCLM including land-atmosphere interactions. Numerous factors play a role to evaluate the snow cover dynamics e.g. driving fields, atmospheric circulation, soil conditions, and fractional snow cover considerations. This would be an interesting issue for an extra study. The snow scheme used in the soil and vegetation model TERRA-ML of CCLM is less sophisticated than the Crocus snowpack model. For instance no blowing snow sublimation is taken into account which is also the reason why we did not specifically evaluate the wind velocity. For Siberia a more detailed snow scheme in CCLM would be desirable which should be followed in future work. But to derive a 60 year dataset we have to accept some model limitations to be in due proportion to the computing time. The suggested analysis with respect to fall and spring temperatures will be done in an extra study. The evaluation of snowfall based on observational point measurements or gridded observational datasets seems very random due to the above mentioned uncertainties in snow measurements.

In this study we are interested in the assessment whether our hindcast of 60 years of SWE gained by CCLM adds some informational value compared to the used forcing data and further global reanalyses. We want to highlight the ability of using the tech-

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nique of dynamical downscaling of reanalysis data in order to provide a more realistic SWE dataset than the reanalysis data itself can present for SWE. Using a regional climate model does not automatically lead to a more realistic representation of recent past climate despite the higher spatial resolution. Many variables are already well described by reanalyses. As written in the manuscript page 4642-4643 (lines 19-7) this depends strongly on the considered variable, model setup and used parameterizations (see also Di Luca et al., 2012, Feser et al., 2011). In the case of snow parameters it was already documented by Kanamitsu et al. (2002) that NCEP-R1 had some problems due to an erroneous snow analysis. But nevertheless, it is important to investigate if CCLM really provides a more realistic SWE dataset for the last 60 years than NCEP-R1. For the purpose of analyzing snow changes over Siberia it is necessary to get data with a temporal coverage as long as possible. That was the motivation to use NCEP-R1 as forcing. We compared the SWE information of CCLM against the SWE output of some newer reanalyses to make clear that the CCLM hindcast does not only add value to the erroneous SWE output of NCEP-R1 but shows a general good performance compared to those datasets when choosing GlobSnow as reference.

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