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Interactive comment on "Evaluation of *seNorge2*, a conventional climatological datasets for snow- and hydrological modeling in Norway" *by* Cristian Lussana et al.

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Dear Referee,

Thanks for helping us in improving the manuscript. Point-by-point answers to your comments follow.

Dataset. The dataset described in this article is available for public download at http://doi.org/10.5281/zenodo.845733 (30Gb). Users can also access fresher, more recent data for daily temperature at thredds.met.no (as indicated in the manuscript). Smaller junks of the same dataset are available here:

http://thredds.met.no/thredds/catalog/metusers/senorge2/seNorge2_download_datasets/release_17.08/catalog.html we will add this link in the paper.

Major comments:

1) We will revise the structure of the manuscript as suggested.

2) On your point about which dataset to trust: we will better answer this question in the revised manuscript. Short answer is that you can trust both versions, they are both based on a reasonably dense station network and documented statistical methods. Large deviations between them indicate uncertainty in the spatial interpolation that may originate from several reasons (station distribution, representativity errors, characteristics of the precipitation episodes,...). When accumulating precipitation over long time periods (such as in Fig. 6), seNorge2 is more likely to underestimate precipitation than seNorge1.1 (which overestimates it). However, seNorge2 is probably missing less precipitation events than seNorge1.1 and this explain the reduction in the spread along the regression line. In case an application can make use of a calibration procedure to post-process and adjust the precipitation dataset, then probably I would suggest to use seNorge2. However, given that the differences between seNorge v1.1 and seNorge2 are significant, we will make use of a third observational gridded dataset such as EOBS (Haylock et al 2008) in the evaluation, so to give the reader a further reference.

3) We will rephrase the statement "...without addressing any particular application.". We meant "without addressing the impact of uncertainties in the gridded dataset on a specific application". The evaluation of seNorge2 as input for hydrological and snow modelling shows the impact of seNorge2's uncertainty on such applications. The quality of a dataset should always be related to a specific applications. For instance, a dataset might be very good in representing wet-day frequency and at the same time not fitted to describe extremes, such a dataset might be useful for some hydrological applications but not that useful for the calculation of IDF curves.

4) The temperature dataset has been described and evaluated in a manuscript that is currently under revision. We will adapt the text as suggested by the reviewer. Indirect evaluation means that precipitation is compared with something that is not precipitation (runoff, snow,...).

Specific comments. In general, we will modify the text as suggested, thus avoiding repetitions and sentences that are not strictly needed. In particular:

L79-84: seNorge2 is an ongoing project, the manuscript describes the work and the results obtained so far.

L89-90: We will rephrase the statement. seNorge2 will include more ideas aiming at solving the issues mentioned in the manuscript.

L104: Conventional datasets is a term used in Simmons et al. (2016), to distinguish observational gridded datasets obtained by means of statistical interpolation techniques (that are the ones conventionally used in climatology) from reanalyses (which are also gridded datasets). We will make use more often of the term gridded datasets.

L104-110: Here we are describing elaboration taking place at station locations.

L114-115 / L118-122 / L233: The domain considered for seNorge2 is the one shown in Fig 2. However, we do use all the observation available (even outside the domain in Fig 2) to reduce border effects. We will make this point clear in the text.

L235: The spatial interpolation of temperature is currently described in detail in a manuscript under revision fro QJRMS, therefore we will cite that work, where your questions are also answered.

L248-249: The paper by Lussana et al 2010 deals extensively with Spatial Consistency Test and gross measurement errors (term that indicates “bad” observations, see Lorenc 1986 for example).

L248: Gross is correct.

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Referee: “Chapter 3: why the evaluation period was limited to 2000-15, as the entire period is substantially longer?” Answer: A period of 15 years has been considered long enough to have a robust and reliable statistics on the gridded dataset quality. Our evaluation focuses on the most recent periods because we consider this period the most interesting for the users.

Referee: “How the interpolation uncertainty has been estimated, as currently you present the accuracy of the model at stations’ locations? Should the equations 10 and 11 to be moved to material and methods sections (see my earlier comments of the ms structure).” Answer: “We use the CV-analysis, which is an estimate of the analysis quality obtained at station locations but valid for gridpoints because by construction is independent from the observed values.”

Referee: “Re3.2. Evaluating the precipitation fields using. . . First of all, is this actually evaluation or simply just description of the differences between the two datasets? Why old dataset needs to be evaluated again? Modis data should be described in material and methods, not in results.” Answer: “seNorgev1.1 is used as a reference dataset in the evaluation of seNorge2, to help the reader in understanding the pro/cons of seNorge2.”

L467: About the evaluation over long-term accumulation periods, seNorge2 points stay closer to the regression line compared to seNorge1.1 (especially for large runoff values), this means that seNorge2 is a more precise dataset. On the other hand, the slope of the regression line indicate that seNorge1.1 is more accurate. As stated before, accuracy can be adjusted by post-processing while a better precision is harder to recover with post-processing. We will better explain that in the revised version.

L 477: This a consistency check between two closely related quantities, such as precipitation and runoff. One should expect some sort of proportional relation between those two quantities.

L492-494: We will better explain this statement. Because the catchments are distributed over Norway, this evaluation address uncertainty variations in space too.

Referee: “Please open abbreviation SWE.” Answer: ”See line 64: SWE=Snow Water Equivalent. We will report the abbreviation here too.”

Referee: “On my opinion, this paper is not about snow modelling, so please consider moving the excess details about the snow model (chapter 3.3) to supplementary material. In addition, any description of data or methods should appear in material and methods section with appropriate subheadings.” Answer: “We address the impact of uncertainties in seNorge2 on snow simulations and in this sense we believe the evaluation is relevant for the paper.”

L628: Because the true precipitation value is unknown, we use cross-validation deviations from observed values as a proxy for the uncertainty estimation.

L634: We will better explain this point in the revised manuscript.

L664: We will provide examples.

Figure 3: CV-Analysis stands for Cross-Validation analysis as specified in the manuscript.

Figure 4: The Figure is described in the text. However, we will make it more clear in the revised version.

Figure 6: Please, refer to our previous comments on this point.

Figure 7: when evaluating precipitation fields against precipitation measurements there are some drawbacks. First, observation of precipitation are not perfect, they usually have a plus/minus 20% of uncertainty. Second, in a cross-validation exercise one must sacrifice some observations to be used as independent information (i.e. not used in the interpolation); given the importance of small spatial scales in interpolation of precipitation this might have an impact on the spatial interpolation performances. By comparing precipitation fields with a totally independent information, such as runoff, we

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get a second observed quantity to compare our results with and we gain information on the quality of the output as it is really available to the users (i.e. by using all the available data).

Figure 9-10: If a dataset misses most of the precipitation events, this would result in a small value for the correlation coefficient. On the other hand, a correlation coefficient greater than 0.6 and up to almost 1 shows that precipitation and runoff are actually well correlated, thus indicating that the seNorge2 dataset is able to reproduce most of the observed precipitation events. We will better describe this point in the text.

Figure 11: It shows that the situation is quite good for Eastern and Western Norway, though we have still to work on Northern Norway.

Figure 13: This is the hydrological rainfall-runoff model DDD model (as described in the paper). This plot tell us that the seNorge2 provides realistic result when used as input for the DDD model.

Figure 14: P_corr is defined in the paper at line 603.

References: Haylock, M.R., N. Hofstra, A.M.G. Klein Tank, E.J. Klok, P.D. Jones, M. New. 2008: A European daily high-resolution gridded dataset of surface temperature and precipitation. J. Geophys. Res (Atmospheres), 113, D20119, doi:10.1029/2008JD10201

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