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Interactive comment on "Representation of spatial and temporal variability in large-domain hydrological models: Case study for a mesoscale prealpine basin" *by* Lieke Melsen et al.

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We would like to thank the reviewer for the positive response on our manuscript. Here below we respond to the clarifications that were asked.

(1) Indeed the results could depend on the – subjective – choice to select the best 1% of the runs. This is why we have shown the effect of the complete sample in Figure 12. This Figure shows that the results are consistent among larger sample sizes. We do however agree that this could be discussed in more detail, and therefore we propose to add a discussion with a small sensitivity analysis on 2-5% sample size. This can be summarized in a figure in auxiliary material.

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[Discussion paper]

(2) This is an interesting suggestion; we actually did not investigate whether the distance between PDFs or CDFs could be informative for the degree of transferability. We could imagine that some information could be extracted from the agreement or disagreement in PDF or CDF, but we cannot directly think of a way to quantify the transferability based on this approach. In that sense, our current set-up is very clear and straight forward, although some subjectivity is involved in the size of the sample (as discussed under point 1).

(3) This is indeed the most critical point in this study. We would like to elucidate that indeed, the most sensitive parameters, i.e. the parameters that have been sampled, have been applied uniformly over the catchment, but all the other parameters (the soil parameters, land-use parameters, snow parameters) have been applied distributed. Some of these parameters, for example the bulk density of layer 2 and 3, did show relatively high sensitivity in our sensitivity analysis. Therefore, the models with higher spatial resolution could benefit from the distribution of these parameters. But indeed; our conclusion that spatial variability is underestimated is mainly the result of the uniformly applied most sensitive parameters, as shown in Section 5.3. This is, however, part of our conclusion and recommendation. As pointed out in L. 662 we constructed our model according to current day practices; many large scale models apply the calibrated parameters uniformly, there are even examples where fixed parameter values are used for a complete climate zone (see for example Nijssen et al., 2001, "Predicting the Discharge of Global Rivers"). We think that if we want to move towards higher spatial resolution models, eventually hyperresolution, we need to account for the poor representation of spatial variability before higher spatial resolution is of any added value. We will try to formulate this more clearly in the conclusion.

(4) The finding that parameter sensitivity did not change very much across scales is different from the finding that parameter values did not change very much across scales, since equal sensitivity for a certain parameter does not necessarily imply that the value of the parameter is the same. We do have the results of the sensitivity analysis and a

table with all the parameters that have been subject to the sensitivity analysis. We can discuss this in auxiliary material.

(5) It is indeed an effect of our method that, by choosing a fixed percentage rather than a minimum performance, not all the selected runs can or might be considered 'behavioral'. We think that the implications of this effect for our conclusions are limited; it does not necessarily negatively nor positively impact the transferability of the parameters across spatial or temporal resolutions. We will add this discussion to the manuscript. A small note we would like to make is that in a literature review that we performed during this study (see also http://www.hydrol-earth-syst-sci-discuss.net/hess-2015-513/) , we found that for large-scale studies NSE in the order of 0.4 are sometimes already considered as behavioral. . .

We think that, with the suggestions provided by the reviewer, we can increase the readability of the manuscript and make the conclusions clearer.

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