Response to Referee 1, A. Viglione

The paper shows how uncertainties in catchment rainfall and runoff measurement, interpolation and extrapolation propagate into uncertainties in hydrologic signatures, which are widely used in hydrology. The Authors use a methodology for uncertainty propagation based on Monte Carlo simulations. They consider sources of uncertainty and uncertainty models proposed in the literature. The methodology is applied to two small catchments in England and New Zealand.

I really liked reading this paper, which is well written and inspiring. I definitively see the need for more publications of this kind in order to build up a more generalised understanding of the uncertainties in the data (and in how the data are used) which are at the basis of hydrologic studies. I am therefore supportive for the publication of the paper in HESS.

Response: We thank Alberto Viglione for his helpful review and his positive comments about our paper.

I just have a couple of suggestions which may help to improve the paper and which require little additional work for the Authors:

- The amount of information provided in the paper is a lot and it would be nice to summarise it in tables. As in Table 1 the signatures are explained, it would be nice to have a table that lists all sources of uncertainty considered and the references in the literature where they have been discussed. More importantly, it would be nice to have a final table that summarises the major (dominant) sources of uncertainty for each signature as well as the relative uncertainty ranges found for the two catchments under study.

Response: Thank you for this suggestion, we agree that it is a good idea to have an overview of the uncertainty sources with references to the literature. We will include a new table that shows the sources of uncertainty we considered in this paper, the methods used to estimate them and literature references for the methods where applicable.

We will also include a final table at the end of the results section that summaries the dominant uncertainty sources and the uncertainty magnitudes and characteristics (see further details about the contents of this table in the next response below).

- Reading the title of the paper I would have expected more discussion on generalisation of results. I was involved in editing a book on runoff prediction in ungauged basins (Blöschl et al., 2013, already cited in the paper), where an assessment of uncertainty of regionalisation methods was attempted based on a literature review of many studies around the world. Let's assume that in the next years many researches will perform similar studies on uncertainty in hydrologic signatures and that the Authors will be asked to synthetise these works (and try to understand the effect of climate, catchment scale, dominant hydrologic processes, antropogenic influence, etc...). What information would the Authors like to find in these papers? How this information should be organised and presented? This may be discussed in the conclusion and the final table referred to in the previous point could be an example of what the Authors would like to find in other papers on the subject. In other words, I believe that this paper could aim at setting a standard for studies on uncertainty in hydrologic signatures.

Response: Thank you for this good suggestion. Observational uncertainties are in general highly dependent on local site conditions and measurement methods, therefore it is important to include such information (measurement equipment, metadata about station characteristics, out-of-bank levels, temporal changes in site characteristics, etc.) together with information about catchment size, scale, human impacts, dominant hydrologic processes, etc (as suggested). The place-specific nature of the uncertainties will likely impede the possibilities to draw general conclusions about some influencing factors; however, we believe that such generalisation attempts are important and that valuable insights could be gained in future review studies.

Regarding information about the magnitudes of the uncertainties we believe that is important to not only report information about upper/lower uncertainty bounds, but also information about the shape of the estimated uncertainty distributions, e.g. by using histograms or boxplots as in this study. Therefore we will calculate four summary statistics (mean, std, skewness and halfwidth of the 5-95 percentile range) describing the uncertainty distributions and report them together with the dominant uncertainty sources in the new summary results table described in the previous response . We will report the uncertainty magnitudes for one representative signature per category and catchment, to keep the table compact in terms of summarising the findings. We will note that other papers could follow this example in reporting signature uncertainties, recommending that statistics describing the shape of the uncertainty distributions are always reported.

Minor comments:

Page 4237, lines 21 and 24: I get confused here. "The main aim of this paper was..." refers to Juston et al. (2014) while "The objectives of this paper were:" refers to the present paper. Am I right? Maybe a rewording could help the reader here.

Response: The first part about the main aim of our paper we included to say up front that the results will be sensitive to the uncertainty estimation technique and the understanding of the uncertainty sources (also discussed by Juston et al). We will reword this section to clarify this and to introduce more discussion about the sensitivity of the results relating to the uncertainty estimation methods in the discussion section, as also suggested by the other referees.

Page 4238 line 15 and page 4239 line 6: why missing precipitation values have been infilled with two different procedures in the two catchments? I guess the reason is because that was done in previous works but the text doesn't state it. Moreover, methods of infilling rainfall data are not considered in the uncertainty analysis, why?

Response: Yes, in the New Zealand catchment they had already been infilled in a previous project, and we will note this in the text. Methods for infilling rainfall data could also have been considered, although we believe this would have had a small impact on the results since there were small differences between the different methods we tried.

Page 4251, lines 9-12: I do not understand why events defined using a threshold related to the mean or median flow are more sensitive to rating curve uncertainty than events defined using a flow percentile threshold. What percentile is preferable? In the end the median is also a percentile, why isn't it good?

Response: It is when the threshold is defined using a *multiplier* of the median value, instead of the actual flow percentile (or median) value itself, that it becomes sensitive to the rating-curve uncertainty. This is because the (uncertain) gradient of the rating curve greatly impacts on the

flow percentile equivalent to the threshold value. We explained this in better wording in the results section on P4247 Line 1-7, but will now revise the text in both sections to make sure that this is clear.

Figs. 1 and 2: I think that the reader would get more understanding on the two study areas if the Authors would add a sample of the hydrograph in the figures (or in an additional one). This would show how the runoff responses differ in the two catchments (e.g., difference in flashiness). I am thinking to something like Figure 1 in http://www.hydrol-earth-syst-sci.net/17/2263/2013/hess-17-2263-2013.pdf

Best regards, Alberto Viglione

Response: Thank you for this useful suggestion, we will add a figure describing the two hydrographs and the runoff response, as well as more text describing the differences in runoff response in Section 4.1.2.