Response to Comments of Reviewer 2 (comments in black, response in blue)

The paper analyses the important hydrological topic of catchment classification based on limited available data. It is well structured and well written, methods are well described, as well. Results of clustering streamflow characteristics are well linked to clusters based on catchment characteristics, enabling the analysis of control variables. Presentation of results as well as discussion is detailed and reveals the potential of the selected methods. The only significant deficit of the paper is citation and referencing. The authors are asked to carefully check the citations and the list of references! A huge amount of mistakes was found. A useful addendum would be to mention successful applications of cluster analysis in different fields of hydrology, as mentioned below in C2093

Thank you for your detailed corrections to the manuscript. As different versions of this manuscript have been written, it appears that these references are from another version. All issues regarding reference errors that you kindly list below will be addressed in the next iteration.

The specific comments relating to referencing issues have been removed from below with the understanding that they will be addressed in the revised version.

Specific comments

- P4500, L4ff (or P4506, L6ff): Before focusing on the specific value of this study I suggest to add a few words on the usefulness of cluster analysis in general in hydrological classification. A few studies could be cited having applied cluster analyses to identify similarity in different parts of hydrological research: Catchment classification (e.g., Ramachandra Rao and Srinivas, 2006), flow regime (e.g., Moliere et al., 2009), water quality (e.g., Panda et al., 2006; McNeil et al., 2005), climate (e.g., Raju and Kumar, 2007), hydrological behaviour of HRUs (e.g., Bormann et al., 1999), soil textural grouping (e.g., Bormann, 2010).

Some or all of the references that you have provided will be included to increase the representation of the breadth of classification in hydrology. One of the goals of this paper is to show the present state of catchment classification, and the references that you provide will strengthen this point.

- P4500, L23-25: Please explain cover type and eco-regions for those readers who do not know this classification.

A more complete explanation will be included so readers that are unfamiliar with these classifications will understand where they come from.

- P4506, L18ff: Please explain why you decided to use this kind of cluster analysis. What is the advantage compared to others?

We decided to use this particular method because it has been successfully applied to large problems in the past and because it allows for the inclusion of uncertainty in the clustering process. There are some comments on this in the text, but we will add explanation to clarify this reasoning. Instead of explicitly stating the difference between AutoClass and other methods (there are many), we explained more generally the differences between Bayesian clustering methods and other clustering approaches.

- P4507, L1: did you also standardise the variables? Not standardising may put different weights on the different signatures?!

The variables are standardized automatically by the AutoClass algorithm, and thus, weights of different signatures are not affected by variance or magnitude. This point will be made clear in the revision of this paper.

C2094- P4507, L13/16: ARI or ARO?

This should read as ARI, not as ARO. This error will be corrected in the revision.

- P4507, L22-24: repetition (correlation with other signatures): please delete.

We agree with this comment. The correlation between signatures will only be contained in the section entitled "Other signatures tested." The text that is referred to in this comment will be removed.

- P4513, L3-6: It can be expected that including catchments from different climatic zones in one analysis will result in climate variables dominating catchment classification.

This is not necessarily true. Local controls (topography, soil, geology, etc.) can have a large effect in the hydrologic response of a catchment. The catchments that were used in this study not only span a large climatic gradient, but also exhibit very different geology, soils, vegetation, and topography. This is not to say that eventually other characteristics might become controlling if you enlarge the area studied. This is a general limitation of empirical studies. To alleviate this limitation we ran a parallel study (Carrillo et al., in Review, HESS-D) in which we use a model to test impacts of ranges of parameters.

- - P4513, L25: IBF?

The abbreviation BFI should be IBF as you state. This will be corrected in the revision.

- P4516, L6: 11 or 9 clusters?

This is supposed to read as 9 clusters, and will be corrected in the revised manuscript.

- P4516, L9: do those landscape characteristics change slowly in space? Or are they distributed in a zonal way?

The landscape characteristics change at different spatial scales. Some landscape characteristics such as average slope, change gradually from high in the Appalachian Mountains to low as you move into the great plains region. Ecoregions show larger areas being part of the same regions, while soils vary over small spatial scales.

- P4516, L17-24: why do you predominantly focus on tracers as alternative? Hydrological modelling could serve as an at least similarly useful tool.

We agree that hydrologic models can serve as a useful tool, and we refer in the paper to parallel work, which is also currently in review for this special issue (Carrillo et al., HESS-D). We will also place a reference to this work where we mention the tracer data alternative.

- P4516, L25: for site models, see Bormann (2010) with respect to modelling experiments on soil texture characteristics, and Bormann et al. (1999) modelling experiments based on HRU (systematic combinations of soil, land use and topographic characteristics)

These references will be taken into consideration when this section is revised with a stronger mention of hydrologic modeling.

Literature

The references that you provide will provide a more complete picture as to the formation and application of classification systems. I will include either some or all of these references in the revision.

- Bormann, H., 2010. Towards a hydrologically motivated soil texture classification. Geoderma 157, 142-153.

- Bormann, H., Diekkrüger, B., Renschler, C., 1999. Regionalization concept for hydrological modelling on different scales using a physically based model: results andevaluation. Phys. Chem. Earth B. 24 (7), 799–804.

- McNeil, V.H., Cox, M.E., Preda, M., 2005. Assessment of chemical water types and their spatial variation using multi-stage cluster analysis, Queensland. Australia. J.Hydrol. 310, 181–200.

- Moliere, D.R., Lowry, J.B.C., Humphrey, C.L., 2009. Classifying the flow regime of data limited streams in the wet–dry tropical region of Australia. J. Hydrol. 367 (1–2),1–13.

- Panda, U.C., Sundaray, S.K., Rath, P., Nayak, B.B., Bhatta, D., 2006. Applicationof factor and cluster analysis for characterization of river and estuarine water systems: a case study: Mahanadi River (India). J. Hydrol. 331, 434–445.

- Raju, K.S., Kumar, D.N., 2007. Classification of Indian Meteorological Stations using Fuzzy Cluster Analysis, and Kohonen Artificial Neural Networks. Nord. Hydrol. 38 (3), 303–314.

- Ramachandra Rao, A., Srinivas, V.V., 2006. Regionalization of watersheds by hybrid cluster analysis. J. Hydrol. 318, 37–56