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Hydrology and Earth System Sciences Discussions

Interactive comment on "Catchment classification by runoff behaviour with self-organizing maps (SOM)" *by* R. Ley et al.

Anonymous Referee #3

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The topic of the paper is within the scope of the journal and in particular of the special issue: "Catchment classification and PUB"; the paper is synthetic, well organised and well written; therefore I recommend the publication of the paper after technical corrections.

General comments

Several approaches for quantification of catchment hydrologically similarity have been documented in the hydrology literature. In this study, the hydrological similarity of catchments with respect to their response behaviour is investigated exploiting the Self-Organizing Maps (SOM - unsupervised learning neural network algorithm) within the cluster analysis. The spatio-temporal variability of event-runoff coefficients and flow

duration curves is investigated; in particular 12 signature indices for each catchment are derived and are assumed as characteristics of catchment response behaviour; hydrological similarity of catchments is described by cluster analysis exploiting the Self-Organizing Maps; groups of catchments clustered by their response behaviour with clusters of catchments based on catchment properties are compared finding corresponding clusters of catchments. Identifying and categorizing dominant catchment functions as representative of hydrologic response characteristics, extracted for example from observed streamflow-precipitation-temperature datasets, is one strategy to quantify the degree of similarity or dissimilarity that may exist between catchments (Sawicz et al., 2011, Oudin et al., 2008, 2010); catchments having apparently similar physical characteristics are assumed to have a similar hydrological behaviour.

Specific comments

This work is well-organized and fits in the context of PUB classification procedures regarding the identification of hydrologic homogeneous regions (see Sivapalan et al., 2003) for the reduction of uncertainty with particular attention to the ungauged basins. In this field the statistical approach or the investigation of physical processes may be used for the identification of hydrological heterogeneity and similarity. In the context of defining regions to estimate hydrological extremes, the cluster analysis allows to group basins which are believed to be similar in terms of variables describing catchment properties as climate, topography, vegetation and geology. A limitation of cluster analysis derives from the fact that in some cases one may have a group of sites which not have physical interpretation; this limits the success of hydrological regionalization, because some catchments are outliers and not perform like the majority of catchments analyzed, probably due to specific hydrological causes. Oudin et al., 2010, compared a group of hydrologically similar catchments (by the use of the hydrological models) with a group of physically similar catchments (exploiting physiographic catchment descriptors); the results show that the overlap between the two pools is significant for only 60% of the catchments; in this case further research is needed in the collection of

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more relevant catchment descriptors to better describe the geological and lithological context in hydrological terms.

Technical corrections

The paper is well-organized; it is written in grammatical and clear English and contains some points to improve:

-Pag. 3054, the description of the three steps in which the methodology is divided, reported in the section 2.3, is redundant because already stated in the introduction;

-Pag. 3061, the authors should clarify why only 18 of 53 basins are reported in the Fig.2; -Pag. 3062, the decimals in the topological error are to many;

-Pag. 3062, line 21, should be “Fig. 4c”;

-Pag. 3063, line 1, a reference regarding the general quantisation error equal to 1.64, should be introduced;

-Pag. 3063, line 7, should be: ” Fig. 4b”;

-Pag. 3065, More attention should be devoted to the description of the definition of clusters related to catchment properties;

-Pag. 3076, in the legend of the Table 3, the word “characteristics” should be replaced by the word “properties”;

-Pag. 3078, Fig. 2., the y-axes should be labelled as “ERC”;

-Pag. 3078, Fig. 2., the labels a, b, c (see page 3061 line 2) should be introduced in the plots and in the caption;

-Pag. 3080, Fig. 4., the labels (b) and (c) are inverted;

-Pag. 3083, Fig. 7, in the legend should be: “medianWi”;

References

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Oudin, L., V. Andre′assian, C. Perrin, C. Michel, and N. Le Moine (2008), Spatial proximity, physical similarity, regression and ungaged catchments: A comparison of regionalization approaches based on 913 French catchments, Water Resour. Res., 44, W03413, doi:10.1029/2007WR006240. Oudin, L., A. Kay, V. Andréassian, and C. Perrin (2010), Are seemingly physically similar catchments truly hydrologically similar?, Water Resour. Res., 46, W11558, doi:10.1029/2009WR008887. Sawicz K., Wagener T., Sivapalan M., Troch P. A., and Carrillo G.: Catchment classification: empirical analysis of hydrologic similarity based on catchment function in the eastern USA; Hydrol. Earth Syst. Sci. Discuss., 8, 4495–4534, 2011 www.hydrol-earth-syst-sci-discuss.net/8/4495/2011/ doi:10.5194/hessd-8-4495-2011 Sivapalan, M., Takeuchi, K., Franks, S. W., Gupta, V. K., Karambiri, H., Lakshmi, V., Liang, X., McDonnell, J. J., Mendiondo, E. M., O'Connell, P. E., Oki, T., Pomeroy, J. W., Schertzer, D., Uhlenbrook, S. and Zehe, E.: IAHS Decade on Predictions in Ungauged Basins (PUB), 2003–2012: Shaping an exciting future for the hydrological sciences, Hydrolog. Sci. J., 48(6), 857–880, 2003

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