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Hydrology and Earth System Sciences Discussions

Interactive comment on "Relating climate change signals and physiographic catchment properties to clustered hydrological response types" *by* N. Köplin et al.

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Review comments

Relating climate change signals and physiographic catchment properties to clustered hydrological response types

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General comments

1. It is an interesting application of catchment classification and regionalisation in impact studies. It aims to provide estimation of impacts on clusters of catchments that

exhibit similarities rather than each individual catchment. The advantages are clear: it can reduce work load in a typical model cascade set up in impact studies; it can help identify catchments that are more sensitive to environmental changes and hence should be give more attention to; regionalisation can handle ungauged catchments.

2. Introduction section should include references, and provide background information and limitations about using cluster analysis in catchment classification and regionalisation, because the Ward's minimum variance clustering method is the main method applied in this study. Cluster analysis is a purely data mining exercise. The key issue is that it is hard to draw conclusion on the relationship between behaviour/response similarity and physiographic-climatic similarity based on clustering methods. Ultimately, people would be interested in similarities in functional responses of catchments. See discussions in e.g. Wagener et al (2007) Catchment classification and hydrologic similarity; He et al (2011) A review of regionalisation for continuous streamflow simulation. How would such methods really help, if the clusters identified do not necessarily mean a functional similarity in catchments' hydrological response?

3. Page 3167 L14-25, such climate impact studies use the so-called top-down approach. But this is not the only way to study impacts and also not the best way. Drawbacks associate with the top-down approach has been discussed by other people already. There have been an increasing number of papers that adopt the so-called bottom-up approach, see for example: Prudhomme et al (2010) Scenario-neutral approach to climate change impact studies: Application to flood risk; Wetterhall et al (2011) Using ensemble climate projections to assess probabilistic hydrological change in the Nordic region; van Pelt and Swart (2011) Climate Change Risk Management in Transnational River Basins: The Rhine. To put this study in perspective, it is necessary to cover the state-of-the-art of impact studies in the intro section.

4. The current generation of climate models have shown very limited skill at predicting (in hindcast even) changes in climate statistics on regional and local scales, as discussed in many papers, see e.g. Stephens et al (2010) Dreary state of precipitation

in global models; Anagnostopoulos et al (2010) A comparison of local and aggregated climate model outputs with observed data. The concern here is using these climate signals in impact studies does not prevent people from falling in the problems of uncertainties in climate model predictions. In other words, the clusters of catchments identified in this study could be subject to 'false alarm' if climate model outputs turned out to be wrong. Why these climatic variables are not divorced from catchment physiographic properties in the cluster analysis and RDA? The future climate signals could actually bias the clustering results.

5. Can authors explain why hourly simulations were performed using the PREVAH model but the cluster analysis only used monthly average values?

6. P3174, it is not clear what exactly 'hydro-climatological' variables are used in the cluster analysis. Table 1 lists physiographic properties, with the exception of 'gl_ctrl_rel', 'gl_near_rel', and 'gl_far_rel', which are climate related. Table 2 lists some climatic variables, but they are used in the RDA. A bit lost here...

7. I struggle to understand at times what the authors really wanted to say, due to for example long sentences or some unfamiliar terms used. It would help if a native English speaker can proofread and improve the text from the language point of view.

8. In general, the manuscript is well structured, methods are well explained, and results are properly analysed. It is a worthwhile study that contributes to climate impact studies. The results have particular values in other catchments in alpine regions, and the approach can be generally applied elsewhere. I recommend the manuscript be accepted for publication after some moderate revision.

Specific comments

P3168

L14: 'characteristic catchment properties'

Delete 'characteristic'

L20: 'modifying catchment characteristics'

Change to modified catchment properties

L24: 'classify the catchments'

Delete 'the'

P3169

L5: 'facilitate to designate prioritized regions which adaptation measures should be applied to, first.'

Change to 'facilitate identification of important regions where adaptation measures should be applied to with priority.'

L8: 'Switzerland provides a variety'

Change to: Switzerland has a variety

L9: 'over the flat and hilly Swiss Plateau'

Quite confusing here, flat or hilly?

L15: 'water balance basins'

What are 'water balance basins'?

P3170

L1: 'Model forcing is mainly based on the 76 highly resolved meteorological stations and is complemented with the less highly resolved data.'

Change to 'Model forcing is mainly based on the 76 meteorological stations with hourly data and complemented by other stations with data at lower temporal resolutions.'

L13: 'we arrived at a comprehensive set'

Change to 'we collated at a comprehensive set'

P3171

L1: ‘based on one distinct’

Change to ‘based on a single set’

L8: ‘cross validation approach that proved good model’

Change to: ‘cross validation approach that produced good model’

P3173

L1: ‘were superimposed’ what does this mean exactly?

P3174

L24: what do you mean by ‘ratio scale’?

P3175

L3-5: ‘Mean slope, mean available field capacity and mean soil depth are highly correlated among each other. Because available field capacity and soil depth are variables derived 5 from the soil map that is spatially less highly resolved.’

Change to: ‘Mean slope, mean field capacity and mean soil depth are highly correlated among each other. Because field capacity and soil depth are variables derived from the soil map that has a relatively low spatial resolution.’

L6: ‘are dispensed from’

Change to ‘are excluded from’

P3177

L24-25: ‘The variable catchment area is not discriminating between the clusters; the clusters mean values vary around the overall mean.’

Change to: ‘The variable catchment area does not differ much amongst the clusters.

In other words, the clusters mean values vary around the overall mean.’

P3179

L15: ‘because the catchments of a cluster’

Change to: ‘because the same catchments of each cluster’

P3180

L8: ‘here: dominant aspect and dominant land use’

Why ‘Centroids aspect’ and ‘Centroids land use’ are used in Fig. 6? Keep terms consistent.

P3181

L7: ‘compared to the hydrological change signals of the far future because’

Change to ‘compared to those of the far future because’

P3185 L18: ‘modelling is the climate model itself’

Change to ‘modelling comes from climate models’

P3186

L19: ‘will be foci of another study’

Change to ‘is the foci of another study’

P3191

L15-19: can this article that is still in preparation be cited?

P3201-3202

Fig.6 and 7: fonts are too small to read.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 3165, 2012.