



## Discussion of non-systematic behaviour in catchment response

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Physiographic and climatic catchment characteristics are supposed to be responsible for spatial variability of catchment response behaviour. If we relate catchment response behaviour and catchment characteristics, we will find an overlap between these two kinds of catchment descriptions, but also a number of catchments outside the overlap.

We look at these catchments outside of the overlap. Why are they outside? Did we select an insufficient set of properties for our comparison – or – are these catchments ‘individuals’ without similar catchments in our study region? Which properties are responsible for special and common response behaviour? Can we improve the overlap?

To analyse this problem, we use a data set of 53 small to medium sized catchments in the low mountain ranges of Rhineland Palatinate, Germany. Although the catchments are situated in a comparatively small region (linear distance maximal 170 km) they show a wide range of runoff behaviour and catchment characteristics.

These catchments were clustered using SOM and hierarchical clustering twice:

a) by their response behaviour based on different aspects of event runoff coefficients and flow duration curves for a period of 16 years

b) by important catchment characteristics based on parameters describing climate, slope, geology and soils.

A comparison of the two cluster sets a) and b) show an overlap of 67 % of the catchments. But for one third of the catchments, response behaviour cannot be based on clustered combination of catchment properties. The other way round: certain combinations of catchment properties involved in clustering b) don't cause the same response behaviour in any case.

For analysis we include catchment characteristics, not part of the clustering b) like flow length, catchment shape, river network density, land use, ground water productivity and catchment area.

The results show, that there is no indication for one catchment characteristic responsible for all outliers. Catchments outside the overlap show several different catchments properties compared to catchments of the same cluster a) inside the overlap. These differences affect as well clustered properties as additional properties. Most of the catchments outside the overlap show special values for two or more catchment properties.

For the studied catchments there are several reasons for outlier:

- extreme values of one or more catchment characteristic
- catchment property with an influence on runoff behaviour only for certain catchments or certain combinations of catchment properties
- individual combination of certain catchment properties or values
- number of cluster
- catchment property not apparent in data sets and therefore not included.

Catchments outside the overlap between cluster sets a) and b) usually have quite individual combinations of catchment characteristics or extreme values of important properties. Often these combinations cannot be covered by clustering. To work with similarity of catchments we have to consider that in the studied scale and region there are catchments with similar response behaviour but contrasting catchment characteristics. The analysis of reasons for outliers can help to understand catchment behaviour.