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What are the gains and losses of representative computation?

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Within hydrologic modelling for lower mesoscale catchments or intermediate systems, which contain both a relatively high degree of complexity and some degree of organization, still provides difficulty from a modelling perspective. This size of catchments is therefore too organized and too heterogeneous to be modelled on a conceptual/statistical basis, but too large to be modelled in a deterministic, process-based manner resulting in computation demand limitations. But to be able to resolve the hydrologic processes within a catchment one could make use of the existing organization within the catchment by applying representative computation to reduce this demand, meaning that hydrologically similar functional areas are identified, categorized and grouped. However, the question remains to what extent grouping elements of the model will result in quality or information loss in comparison to the model output where all model elements are computed.

Within the Wollefsbach catchment in Luxemburg we use hydrological similarity to obtain groups which display similar hydrological behavior. Each group has a representative which will be used within the model's computation using a distributed hydrological model based on the principles suggested by Zehe et al (2014) which is specifically designed for these size catchments. The paradigm of hydrological similarity we follow in the work presented here is that structurally similar model units (hillslopes in this study) behave similarly when starting from similar initial states and being exposed to similar forcing. For this study we simplify this by applying a time-invariant grouping and equal forcing for all elements resulting in the structure of hillslope elements as the distinguishing factor. To express this hillslope structure drainage timeseries are used which reflect not only hillslope extend and slope, but also soil properties and preferential drainage structures. To obtain these timeseries saturated hillslopes are drained without external forcing. These drainage timeseries are grouped based on specific parameters such as 'total storage', 'active storage', 'time to equilibrium' and 'curve shape' using K-means as a grouping method with a K (number of groups) varying from 1 until the maximum number of hillslopes. The representative of each group is the hillslope closest to the centroid of the parameter space. With all these grouping outcomes the discharge values at the catchment outlet for the same period are modelled. The information content of each time series can be quantified by measures from information theory. The effect of grouping and its information loss can then be assessed with respect to the full computation demand model output where all elements are computed.