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A similarity based approach to identify homogeneous regions for seasonal forecasting

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Seasonal runoff forecasting using statistical models is challenged by a large number of candidate predictors and a general weak predictor-predictand relationship. As the area of the target basin increases, often also the available data sets do, thus reinforcing the predictor selection challenge. We propose an approach which follows the idea of "divide and conquer" as developed in computational sciences and machine learning: First, the macroscale target basin is partitioned into homogeneous regions using all its gauged mesoscale subbasins. Second, one representative subbasin per homogeneous region is identified, for which models are fitted and applied. Third, the resulting forecasts are combined at the scale of the macroscale target basin.

This approach requires a suitable method to identify homogeneous regions and representative subbasins. We suggest a way based on hydrological similarity, as catchment similarity estimated with respect to physiographic-climatic descriptors does not necessarily imply similar runoff response. Each descriptor is derived from daily runoff series and aimed to reflect a specific catchment characteristic:

- autocorrelation coefficient, parameters of fitted Gamma distribution and low/high flow indices (based on daily runoff values)
- fluctuation of the standard deviation within the yearly cycle (based on weekly runoff values)
- dominant harmonics obtained from the discrete Fourier transform (based on monthly runoff values)
- long term trend (based on yearly runoff values)

Where necessary, the runoff series first need to be standardized, aggregated, detrended or deseasonalized.

As a preliminary study we present the results of a cluster analysis for the Swiss Rhine River as macroscale target basin, which leads to about 40 mesoscale subbasins with runoff series for the period 1991-2010. Problems we have to address include the choice of a clustering algorithm, the identification of an appropriate number of regions and the selection of representative subbasins per region. The results are finally discussed with respect to the runoff regimes as defined in the Hydrological Atlas of Switzerland.