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Catchment classification using unsupervised neural networks

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The first step for the implementation of hydrologic regionalisation methods is the partitioning of watersheds in homogeneous regions in which a similar hydrological behaviour is expected. The present work proposes the use of unsupervised neural networks of the Self Organising Maps (SOM) type for the classification of watersheds on the basis of the homogeneity of the attributes that govern the streamflow generation. SOM (or Kohonen) networks organise the input data vectors (formed by the attributes of each watershed) according to their similarity. The network, once it has been trained, activates one output node in correspondence of each input vector, determining the most similar node according to a distance measure: all the input vectors that activate the same node (or the same neighbourhood of nodes) belong to the same class. Lateral interaction between output nodes also ensures that learning is a competitive process, in which the network adapts to respond in different locations of the output layer for inputs that differ, while similar input patterns should activate units that are close together. In comparison with classical cluster analyses algorithms, SOM networks have the advantage to not require defining a priori the number of clusters in a data set, because, along with the grouping, it selects also the number of clusters, corresponding to the number of units (or neighbouring nodes) that are activated. Referring to a study area in northern-central Italy, for which several geomorphological and climatic catchment descriptors are available, networks with different architectures and distance measures are tested. The trained networks indicate, for any input vector, the class of the corresponding watershed along with the affinity with other classes (derived from the output topology). For comparison purposes, the results of the SOM analyses are evaluated against outputs from other classification techniques, verifying also how the classes derived from other algorithms are located in the space defined by the SOM output layer.