Identification and analysis of inland excess water inundations using an artificial neural network

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Inland excess water is a phenomenon where insufficient runoff, low infiltration capacity of the soil and slow evaporation result in accumulation of surplus water in local depressions on flat terrain. In Hungary, this phenomenon is frequently occurring on the Great Hungarian plain. With a total precipitation of 854 mm (compared to the long term average precipitation of 433 mm), the year 2010 was one of the wettest years in a century, causing exceptionally large areas to be flooded by inland excess water. The inundations covered a maximum total area of 355.000 ha and the estimated financial damage to the agricultural sector exceeded 500 million Euro.

To be able to understand the processes involved in the formation of the inundations and to develop opportunities for intervention, it is necessary to locate the inland excess water occurrences. Several techniques are being applied to identify the inundations. Broadly two approaches exist; the first method calculates the vulnerability to inland excess water by combining and weighing multiple factors that influence the formation of inland excess water, like precipitation, relief, soil type, ground water, land use and geology. The weighing factors are derived empirically and vary with time, location and scale. Another method uses remote sensing imagery and techniques to identify inland excess water, while it is occurring. Classification of aerial photographs or satellite images is then used to create thematic maps showing the inundations.

In this study, a new approach is demonstrated that uses thematic maps describing the factors involved in inland excess water formation and remote sensing data collected during the wettest periods. These data sources are combined in a Geographic Information System (GIS) - Artificial Neural Network (ANN) framework that integrates the strong geographic analysis capabilities of a GIS and the ability of ANNs to classify large, complex non-linear datasets. An advantage of this method over the traditional vulnerability mapping is the automatic adaptation of the weights of the different factors involved in the formation of the inundations, because this is an integral part of the training phase of the ANN computations.

The trained neural network can be used to identify inland excess water in regions similar to the training area and to create inland excess water vulnerability maps. The poster will describe the GIS-ANN framework, the data that is used during the ANN training and simulation phases and will show the results of the classifications.

Keywords: Inland excess water, artificial neural networks, risk mapping