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ORIGINAL PAPER

Potential of adaptive neuro-fuzzy inference system for evaluation of drought indices

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Abstract Drought as a natural hazard is characterized using quantitative measures named drought indices. Thus, accurate drought monitoring requires approaches for assessment of drought indices. This work investigates precision of an adaptive neuro-fuzzy computing technique (ANFIS) for drought index estimation through the obtained ANFIS-index. The input data was collected from six meteorological stations in Serbia during the period 1980–2010. Based on selected data, the drought indices such as the water surplus variability index (WSVI) and standardized precipitation index (SPI) for 12 month time scale were calculated. To approve the proposed approach, the ANFIS-index is statistically and graphically compared with SPI and WSVI values. The root-mean-square error ranged between 0.11 and 0.24. The ANFIS-index was highly correlated with SPI and WSVI. The results also show that ANFIS can be efficient applied for reliable drought indices estimation.

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1 Introduction

Drought is characterized by lack of precipitation that impacts agriculture, ecology, economy and water supply (Dracup et al. 1980; Wilhite and Glantz 1985; Tate and Gustard 2000; Mishra et al. 2009). Wilhite and Glantz (1985) categorized drought into the four distinct categories (agricultural, meteorological, socio-economic, and hydrological drought), which can be represented in terms of drought indices. Previous studies indicate major social problems in coming decades due to local change in precipitation, heat waves, wind storms and drought. Report from the Intergovernmental Panel on Climate Change Birch (2014) cautions against increasing global warming as it is causing irreversible environmental impact. Impacts of these changes are far reaching and at present moment researchers have limited understanding on ways it would impact today life.

Various drought indices have been developed to identify the intensity, duration and severity of drought (Mishra and Singh 2010; Vicente-Serrano et al. 2012). Furthermore, the drought indices can be used to overcome the uncertainties in assessing drought (Hong et al. 2014; Hu et al. 2014; Liu et al. 2014). Commonly used methods for characterizing drought are the standardized precipitation index (SPI) (McKee et al. 1993), the palmer drought severity index (Palmer 1965), and other derivatives of PDSI. In recent years, drought assessment requires considering not only precipitation but also an evapotranspiration. Thus, the standardized precipitation evapotranspiration index (SPEI), the reconnaissance drought index (RDI), and the water surplus variability index (WSVI) (Gocic and Trajkovic

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