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ORIGINAL PAPER

Streamflow drought time series forecasting: a case study in a small watershed in North West Spain

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Abstract Drought is a climatic event that can cause significant damage both in natural environment and in human lives. Drought forecasting is an important issue in water resource planning. Due to the stochastic behaviour of droughts, a multiplicative seasonal autoregressive integrated moving average model was applied to forecast monthly streamflow in a small watershed in Galicia (NW Spain). A better streamflow forecast obtained when the Martone index was included in the model as explanatory variable. After forecasting 12 leading month streamflow, three drought thresholds: streamflow mean, monthly streamflow mean and standardized streamflow index were chosen. Both observed and forecasted streamflow showed no drought evidence in this basin.

Keywords Streamwater · Drought · Forecasting · Time series · Caldas catchment

1 Introduction

Streamflow is a key hydrological process that summarizes various atmospheric, land surface and subsurface components of the hydrologic cycle (Pielke et al. 2005). In Spain, as in other countries, the availability of water for different uses from forested watersheds is a subject of concern. However, available long-term hydrological information, at watershed level, is still scarce in NW Spain (Gras 1992, 1993; Gras et al. 1993; Fernández et al. 2006).

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Projections for the current century from global change scenarios predict a decrease in annual precipitation in NW Spain of between 10 and 15% (De Castro et al. 2005). Iglesias et al. (2005) argue that this probable decrease in rainfall will affect runoff with a predicted reduction in water resources of about 20% in subsequent years. Long-term management must consider the potential effects of climate change on seasonal variability, and on extreme and mean values of hydrological processes. As pointed out by Ma and Fu (2003), the decrease in precipitation is not a drought signal due to the uncertainity of evaporation. Although the definition of drought is not clear, it is commonly classified as meteorological, hydrological and agricultural droughts, and many drought indices used for assessing drought severity (Keyantash and Dracup 2002). In this study, we used monthly streamflow to evaluate the existence or not of drought in a small forested watershed. As yet there is no such information available for the north west of the Iberian Peninsula.

Several studies have developed methods of analysing stochastic characteristics of hydrologic variables (e.g. Chung and Salas 2000; Kim and Valdes 2003; Mishra and Desai 2005) and particularly streamflow (Panu et al. 1978; Govindaswamy 1991; Yürekli et al. 2005; Modarres 2007) for drought forecasting. During the past decades, several studies have developed methods of analysing stochastic characteristics of hydrologic time series. The most widely used model is the ARIMA model.

The ARIMA models seem to offer a potential to develop reliable forecasts towards prediction of drought duration and severity (Mishra and Desai 2005; Modarres 2007). The ARIMA model approach has several advantages over other methods, in particular, its forecasting capability, its richer information on time-related changes, or the consideration of serial correlation between observations. Also, few