

Chapter 3

Identification of Dry Periods in the Dobrogea Region

Silvia Chelcea

National Institute of Hydrology and Water Management, Romania

Monica Ionita

*Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research,
Germany*

Mary-Jeanne Adler

National Institute of Hydrology and Water Management, Romania

ABSTRACT

The main objective of this study is to identify different types of drought (moderate, severe and extreme) in the Dobrogea region based on three indicators: the Standardized Precipitation Index (SPI), the Standardized Precipitation and Evapotranspiration Index (SPEI) and the Standardized Flow Index (SFI). The dry periods, from a meteorological point of view, were identified based on a drought index that takes into account only precipitation (SPI) and another one that takes into account both precipitation as well as mean air temperature (SPEI). To highlight the dry periods from a hydrological point of view we applied the procedure for calculating the SPI to monthly discharge time series, through the Standardized Flow Index (SFI).

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INTRODUCTION

Drought is one of the most complex phenomena which can have a strong impact on agriculture, society, water resources and ecosystems. One of the reasons for this is the spatial extent of drought and its duration, sometimes reaching continental scales and lasting for many years. Usually drought is defined as a period of deficient precipitation over a long period of time (e.g. a season or more). Typically there are four types of drought: a) *hydrological drought* (occurs when river streamflow and the water storages fall below long-term mean levels), b) *meteorological drought* (characterized by months to years with precipitation deficit), c) *agricultural drought* (this includes the soil drought and soil-atmospheric drought, and is characterized by dry soils as a direct effect of reduced precipitation) and d) *socio-economic drought* (occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply) (Ped, 1975; WMO, 2012; Wilthie & Glantz, 1985; Farago et al., 1989; Maracchi, 2000).

Because of the complexity of drought, no single index has been able to adequately capture the intensity and severity of drought and its potential impacts on such a diverse group of users. Comparing drought characteristics from region to region or event to event is facilitated by the use of a numerical standard. Unfortunately, the complexity of drought and the multiple drought definitions make it nearly impossible to capture drought intensity and severity in a single index. The most used drought index is the Palmer Drought Severity Index (PDSI) (Palmer, 1965); an index which is based on a supply-and-demand model of soil moisture and it enables the measurement of both wetness and dryness. The index has proven to be most effective in determining long-term drought — a matter of several months — and not as good with conditions over a matter of weeks (Alley, 1984; Weber & Nkemdirim, 1998). One of the main disadvantages of PDSI is that it has a fixed temporal scale and does not allow the identification of different types of drought (e.g. agricultural, hydrological or meteorological). This may act as a drawback because drought is considered a multiscale phenomenon (McKee et al., 1993, Vicente-Serrano et al., 2010). An improvement was made by McKee et al. (1993) with the development of the Standardized Precipitation Index (SPI), which takes into account the multiscale nature of droughts. SPI has also a major drawback: it is based just on precipitation data and does not take into account the effect of evapotranspiration, which has a strong impact on drought conditions. Recently, a new drought indicator, the Standardized Precipitation - Evapotranspiration Index (SPEI) (Vicente-Serrano et al., 2010) has been proposed to quantify the drought condition over a given area. SPEI takes into account both precipitation and evapotranspiration and can be computed on time scales from 1 to 48 months. SPEI combines the sensitivity of PDSI to changes in evaporation demand with the multiscale nature of SPI.

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