Chapter 27
Spatio-Temporal Variability of Seasonal Drought Over the Dobrogea Region

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

Silvia Chelcea
National Institute of Hydrology and Water Management, Romania

ABSTRACT

In this study we have examined the spatial and temporal variability of seasonal short-term drought over Dobrogea region over the period 1965 -2005. The dominant mode of spatial variability captures an in-phase relationship of drought conditions over the entire analyzed region, for all the seasons. We show that the Arctic/North Atlantic Oscillation patterns control a significant part of the interannual drought variability over the Dobrogea region in all seasons. Dry (wet) periods in Dobrogea region are associated with geopotential height anomalies at 850mb that project onto the negative (positive) phase of Arctic/North Atlantic Oscillation. Moreover, the SST anomalies from the Atlantic Ocean realm and potential evapotranspiration anomalies over the south eastern part of Romania play also a significant role on the variability of drought conditions over Dobrogea region.

INTRODUCTION

Drought is one of the most complex phenomena which may have a strong impact on agriculture, society, water resources and ecosystems. Drought affects many regions of the world and is the costliest climatic hazard globally (Wilhite, 2000). One of the reasons for this is the usually large spatial extent of droughts and their lengthy duration, sometimes reaching continental scales and lasting for many years. Generally, drought originates from a deficiency of precipitation over an extended period of time, usually a season or more. Investigations of drought are carried out all over the world. However, because of the complexity of this phenomenon, a uniform methodology for implementing drought studies has not been developed, although some indices of drought are widely used (Dai et al., 2004; Wells et al., 2004; Palmer, 1965).

DOI: 10.4018/978-1-5225-9621-9.ch027

Drought is viewed in different ways by different constituency of water users. Drought definitions are of two types: a) *conceptual* and b) *operational* (Wilhite, 2000). *Conceptual* definitions help to understand the meaning of drought and its effects. For example, drought is a prolonged period of deficient precipitation, which causes extensive damage to crops, resulting in loss of yield. These definitions do not provide quantitative answers to 'when", "how long", "how severe" a drought is and are often used as a startup in scientific papers and reports. *Operational* definitions help to identify the drought's beginning, end and degree of severity. To determine the beginning of drought, operational definitions specify the degree of departure from the precipitation average over some time period. This is usually accomplished by comparing the current situation with the historical average. An operational definition for agriculture may compare daily precipitation to evapotranspiration to determine the rate of soil-moisture depletion and express these relationships in terms of drought effects on plant behavior. These definitions are used to analyze drought frequency, severity and duration for a given historical period. Varied definitions, depending upon the influential factor used, of droughts are seen in the literature which can be grouped as follows: a) Precipitation based drought definitions; b) Evapotranspiration based drought definitions; c) Streamflow based drought definitions; d) Soil moisture based drought definitions; and e) Vegetation based drought definitions ((Ped, 1957; WMO, 1975; Wilthie and Glantz, 1985; Farago et al., 1989; Maracchi, 2000; Dai, 2011b). The groups in a) and b) refer to *meteorological drought* conditions, group c) refers to *hydrological droughts* and those in d) and e) refer to the *agricultural droughts*.

Drought propagation depends strongly on climate (Sheffield and Wood, 2011). At European scale, research on drought variability has been mainly focused on regional scales and/or over regions which are exposed to severe droughts [Iberian Peninsula (Estrela et al., 2000; Vicente-Serrano, 2011); the Mediterranean Region (Livada and Assimakopolous (2007) and south-eastern part of Europe (Koleva and Alexandrov (2008)]. Looking at other European regions, Briffa et al. (2009) showed that high summer temperatures in the western and central part of Europe are responsible for the large extent of summer drought conditions. Trnka et al (2009) emphasized that the drought conditions in the central part of Europe are triggered by different atmospheric circulation patterns and that the drought phenomenon is very pronounced in early vegetation period (April – June). Ionita et al. (2012a) showed that summer drought conditions over Europe are strongly influenced by previous winter SST anomalies and different ocean and atmospheric modes of variability (e.g. Atlantic Multidecadal Oscillation (AMO), Pacific Decadal Oscillation (PDO) and North Atlantic Oscillation (NAO)).

Large areas of Europe have been affected by drought during the 20th century. Severe and prolonged droughts observed mainly in the Mediterranean region have highlighted the vulnerability to this natural hazard and alerted the governments, stake holders, operational agencies to the disastrous effects of droughts on the society and economy and the need for mitigation measures (EEA, 2001). In this context, Romania is very likely to experience a wide range of impacts in response to climate change, mainly due to the temperature increases which in turn can perturb the hydrological cycle. In Romania, drought has a very strong impact on agriculture and affects 7.1 million ha, which represent 48% from the total agricultural land. The south, southeast and eastern parts of our country, where also Dobrogea region is located, are the most affected areas (< 600 m^3 water /hectare –extreme and severe pedological drought). During extremely dry years the average yields of various crops represent only $35\% \div 60\%$ of the potential yields. The climate evolution in Romania indicates a diminution of the annual precipitation especially over the south-eastern part of the country (Busuioc et al., 1995), the most affected area being Dobrogea region.