DROUGHT AND FLOOD BOTH SPELL DISASTER IN BULGARIA

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Abstract
In this paper we analyzed the extreme weather events and relation with the atmospheric circulation over Europe in 2005. Seasonal fluctuations in water levels as well as the flooding of riparian areas are natural features of running waters. Extreme weather events with the resulting large volume water flows can, however, cause enormous damage to lives and property, especially where flood plains are occupied and flooding interferes with human land-use activities.
We analyzed North Atlantic Oscillation (NAO) and relationships to regional temperature and precipitation in Bulgaria.The North Atlantic Oscillation (NAO) is a phenomenon associated with winter fluctuations in temperatures, rainfall and storminess over much of Europe.

Keywords: *flood, North Atlantic Oscillation (NAO), precipitation, extreme events*.

1. Information database

Utilised data: time-series (1961-2005) of the monthly temperatures and precipitation, from some surface synoptic stations have been used as initial data.

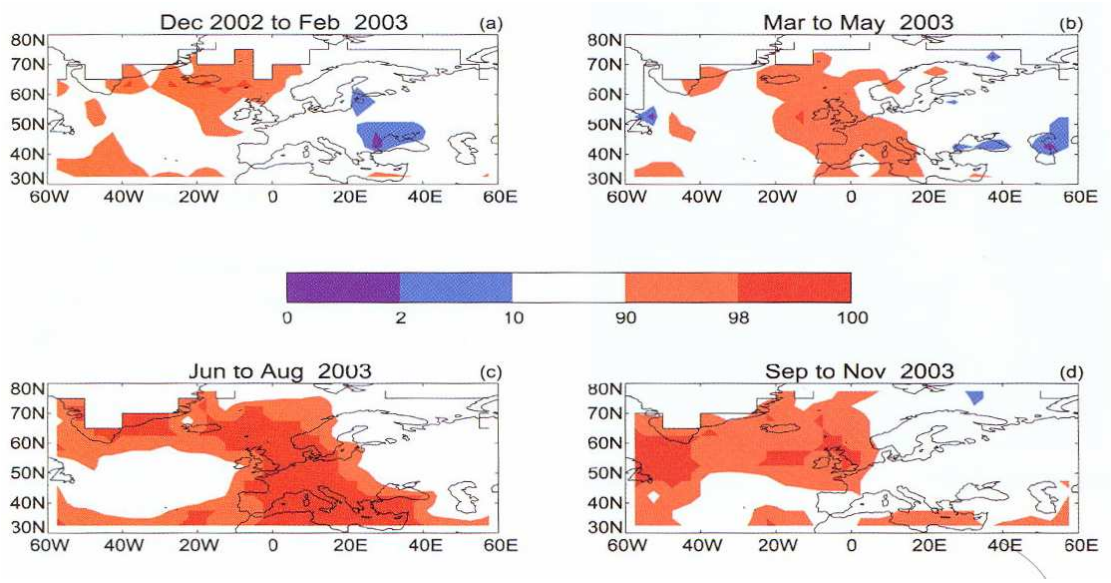
2.Overview

The trend seems to be continuing: according to the WMO statement on the status of the global climate in 2001 (WMO, 2001), in England and Wales the 24-months period ending in March 2001 was the wettest in the 236-year time series of precipitation. October 2000 to March 2001 precipitation was also exceptional in the Bretagne (France), where the normal annual rainfall was exceeded by 20 % to 40 % in parts of the region. A third consecutive year of severe flooding occurred in Hungary and parts of Eastern Europe in March - the Tisza river reached its highest level in more than 100 years, the previous record was set in 1888. The worst flooding in Poland since the 1997 floods occurred in July after two weeks of heavy rain caused flooding in the Vistula River. In August 2002 devastating and costly floods in the Elbe and the Danube rivers were observed, and further extreme precipitation and flooding in southern France, where almost half of the normal annual rainfall fell in just one day!

2.1.Summer heat wave

Annual temperatures in 2003 were well above average across Europe, especially in western regions. Although cooler than 2002, annual temperature anomalies averaged over land surfaces 45° – 65° N and 25° W- 60° E were 0.66° C above the 1961-1990 mean. There were however significant regional and seasonal variations Fig. 1. Temperatures across the Mediterranean, southern Adriatic and much of the north –western part of European continent, averaged over the entire year, were above the 98th percentile of 1961-1990 distributions.

Fig.1. European surface temperature in 2003 expressed as percentiles of 1961-1990, using two – parameter gamma distribution for (a) Dec 2002-Feb 2003; (b)Mar-May; (c) June-Aug; and (d) Sep-Nov. (Sources: Jones, at al.2001; Horton, Folland and Parker, 2001;Jones and moberg,2003)

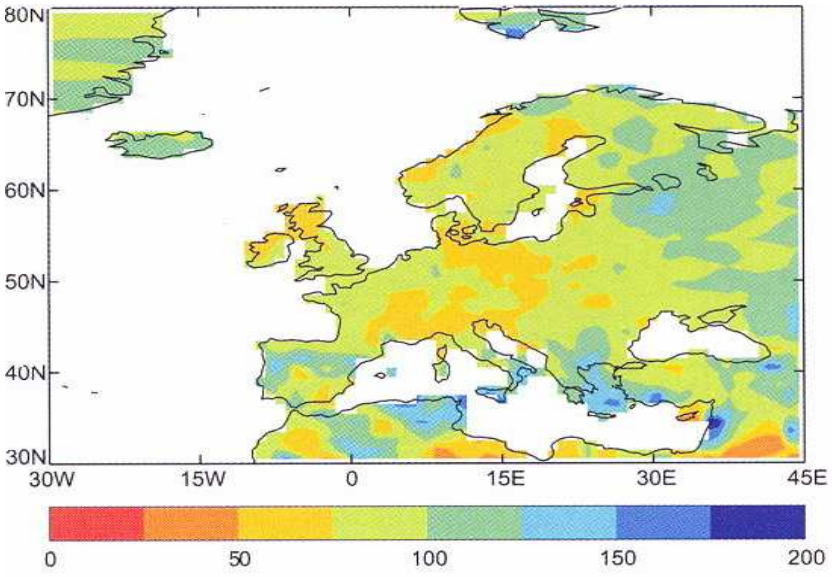


Surface temperatures were well above average across Europe throughout the April to August period, with anomalies in excess of +2.5 °C across central Europe and +1.5 °C across northern Europe.

2.2. Rainfall

Precipitation totals were also well below average during this period, with deficits of 75-100 mm observed throughout central Europe. Anomalous warmth was widespread in all four seasons, particularly in the summer. Fig.2.

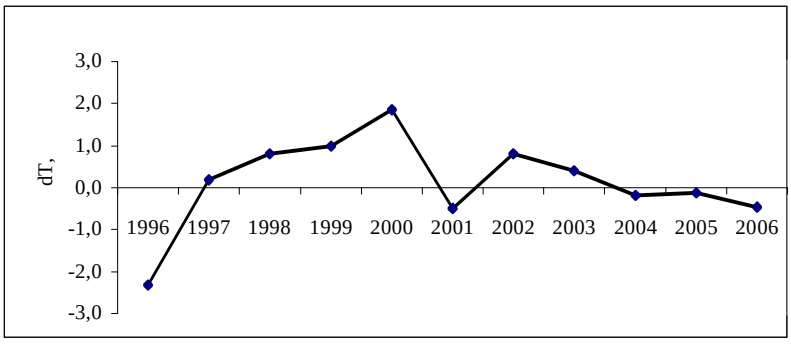
Fig.2. Precipitation anomalies for the European region for the period Dec 2002 –Nov 2003, expressed as a percentage with respect to 1961-1990 (Source: GPCC, 1998**)**



3. NAO Winter (DJFM) NAO index

We analyzed North Atlantic Oscillation (NAO) and relationships to regional temperature and precipitation in Bulgaria. The North Atlantic Oscillation (NAO) is a phenomenon associated with winter fluctuations in temperatures, rainfall and storminess over much of Europe. When the NAO is 'positive', westerly winds are stronger or more persistent, northern Europe tends to be warmer and wetter than average and southern Europe colder and drier. When the NAO is 'negative', westerly winds are weaker or less persistent, northern Europe is colder and drier and southern Europe warmer and wetter than average. One of the simplest definitions of the NAO is that it is the winter difference in pressure at sealevel between the Azores and Iceland. A useful winter season is the December to March average of these values (see Osborn et al., 1999), which is shown in the time series. Recent values of the DJFM NAO index are shown below.

Fig. 3 NAO Winter (DJFM) NAO index



4.Seasonal temperature regime in Bulgaria

We show on the Fig. 4(a,b) the winter during the period 2001-2006. The coldest winter is 2003. The warmest winter is 2001 and the warm period continued during the spring (Fig.5 (a,b)). The winter of 2005 was above norm about 0,5 °C and the spring was the same below norm. There was wide fluctuation in temperature values through the season *Andreeva T. (2002).*

Fig. 4 a. Winter in the North Bulgaria

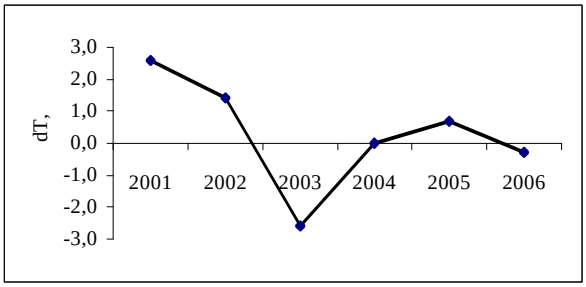


Fig.4. (b).Winter in the South Bulgaria

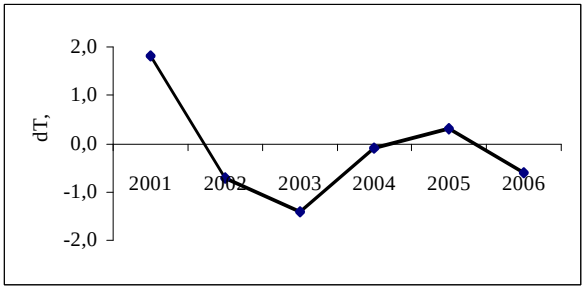


Fig. 5 (a). Spring the North Bulgaria

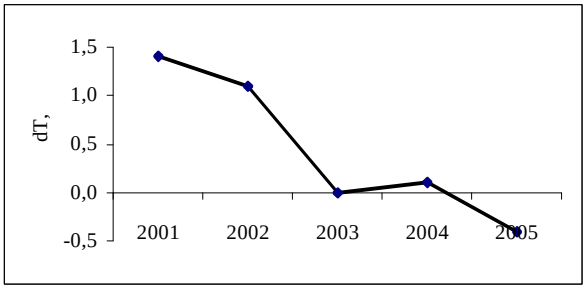
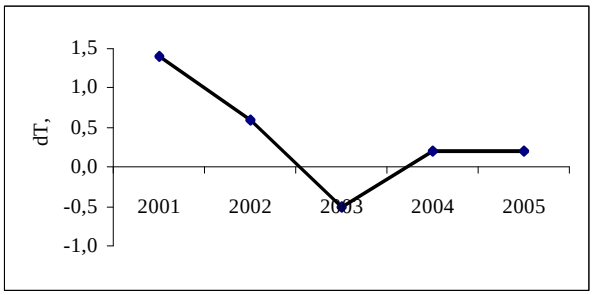


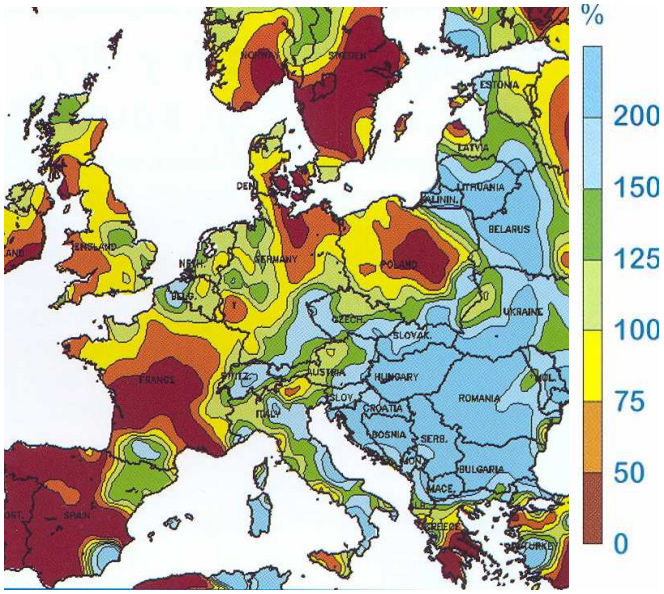
Fig. 5. (b). Spring the South Bulgaria



5. Rainfall in Bulgaria and the floods

Rainfall distribution across Europe during the summer months of 2005 was very unequal, with exceptionally dry weather in the southwest and over southern Scandinavia, while flooding followed some torrential falls in southeastern Europe. (Fig. 6).
Heavy rainfall affected many areas of Bulgaria during the period 4-6 August 2005 when the flooding of river Iskar (an affluence of Danube river) also affected areas of North Bulgaria. Flash floods are usually associated with isolated and localized very intense rainfall events covering in small and medium- sized basins.

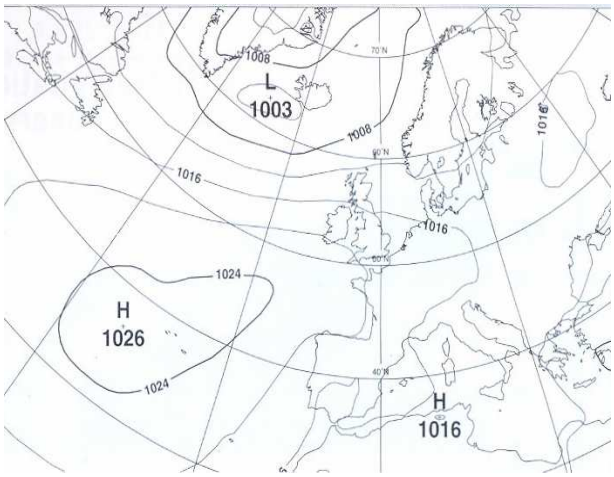
Fig. 6. August rainfall 2005 (percentage of 1961-1990 normal) by NOAA



The summer 2005 during large portions of Europe were battling torrential rainfalls and record flooding in Bulgaria. Rainfall distribution across Europe during the summer months was very unequal, with exceptionally dry weather in the southwest and over southern Scandinavia, while flooding followed some torrential falls in southeastern Europe. We show Summer Percentage of
normal rainfall. The damage in the economy is estimated in the end of August 2005 to be one billion leva ($625m; £346m) with huge amounts of farmland and vital infrastructure destroyed.

These conditions were associated with a large –scale anomalous circulation characterized by below average pressure.Fig.7.

Fig.7.Monthly mean MSL pressure, based of 1200 UTC value of August 2005



Moreover, any change in the average rainfall or temperature or other meteorological variable will be accompanied by a disproportionate shift in the expected extremes.
Opposite to excess of water, the summer drought of 2003 in large parts of Europe and the drought situation on the Iberian Peninsula from winter 2005 onwards clearly show the growing problem of droughts in Europe. There is strong scientific evidence that an increase in mean precipitation and extreme precipitation events on the one hand and water shortages for certain regions on the other hand are two sides of the same medal, implying an increased variability of climate in Europe with probably more frequent weather driven natural hazards in the future
We can see the distribution of the precipitation in north and south Bulgaria at the Fig 8(a , b).

Fig. 8 (a). Precipitation for period 1961-2005

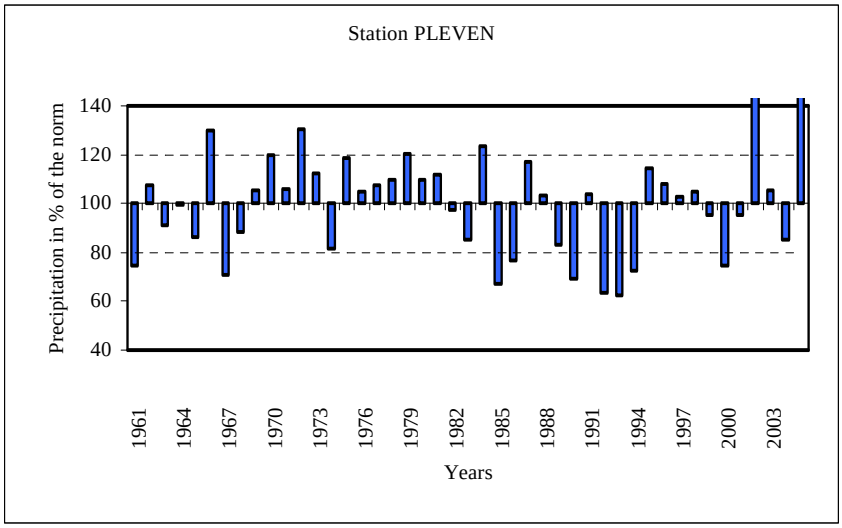
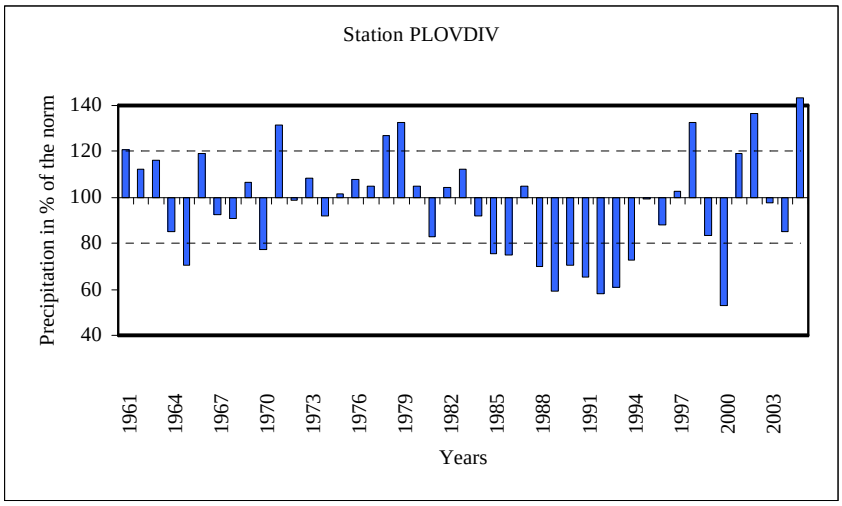


Fig. 8 (b). Precipitation for period 1961-2005



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