

## **CHANGES IN THE CARPATHIAN BASIN DROUGHTS FREQUENCY IN THE LAST THREE HUNDRED YEARS**

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**ABSTRACT.** – **Changes in the Carpathian Basin droughts frequency in the last three hundred years.** Examining the last three hundred years data (1710 and 2009) on droughts in the Carpathian Basin, approximately every second year was droughty, and it was severe drought, reaching serious proportions, on average, every tenth year. The frequency and intensity of droughts, more specifically the relative frequency, in the studied ten sub-periods varies surprisingly significantly: between 26% and 61%. Although the frequency of droughty years, in the second half of the study period, decreased slightly, studying combined the droughts intensity and frequency the most droughty period was between 1983 and 2009, in which the serious and the extremely severe droughts reached approximately 30% incidence. This is a serious warning signal for the future, because depending on the climate change in the future this could become even worse.

**Key-words:** droughts, frequency, changes, Carpathian basin,

Within, the much talked-about topic of climate change, one of the most interesting question is, that how will in the coming decades in the Carpathian Basin the hydro-climatical conditions change, those climatic conditions which determine or significantly influence the magnitude of floods and inland waters, the intensity of droughts and also the frequency of these phenomena. We can better emphasize this question, perhaps even better imagine the future, if we study how during the past several centuries these phenomena trend and fluctuation changed. This time - based on previous data processing and data collections work - we will show how the frequency of droughts in the Carpathian Basin were in the last three hundred years, i.e. 1710 and 2009, - nearly in same time sub-periods.

To determine the drought frequency for each year of the test period you should be aware if there was a significant drought in the year, and if so, what intensity did it have. The determining method was presented recently in the columns of *Riscuri și Catastrofe* (Pálfi 2007). The method essence is, the assessment of the drought-value-number, defined on a five-evaluation (rating) scales, as follows: the non-drought years, or occurred only in very mild form (0), moderately dry years (1), considerable drought years (2), severe drought years (3), very severe (extreme) devastating drought years (4).

To determine the drought-value-number, we used data, from the beginning of the regular meteorological observations that is the half part of the 19<sup>th</sup> century,

temperature and precipitation data and with some correction factors the drought-index (Pálfi 2004) national averages. These - proportionally - are acceptable as typical data around the entire Carpathian Basin. For the earlier period, we used mainly climate-history works (Érkövy 1863; Milhoffer 1897; Réthly 1925, 1970, 1998; Rácz 2001).

Year	Drought value number
2001	0
2002	2
2003	4
2004	0
2005	0
2006	0
2007	3
2008	0
2009	2

**Table 1.** Drought value assessment between 2001 and 2009

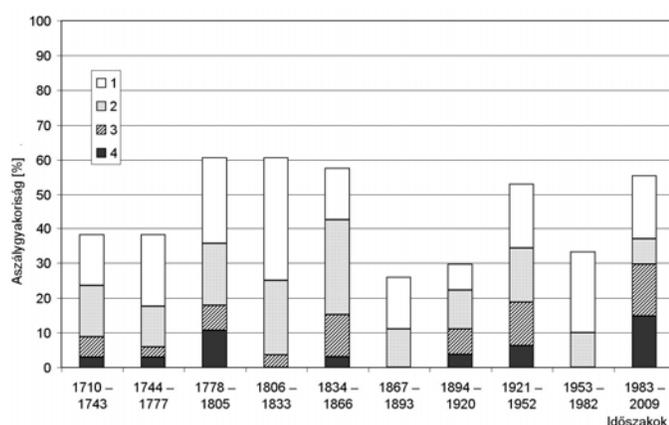
For the period between the 18<sup>th</sup> and 20<sup>th</sup> century the drought-value-numbers are presented in a tabular form in the cited 2007 year study, the 2001-2009 periods data is presented in the 1 Table. These were also determined with the available nationwide averages of the drought-index (Pálfi 2006, VITUKI-ATIKÖVIZIG 2006-2009).

To determine the relative drought frequency we selected approximately thirty years length sub-periods (climate periods), in total ten periods, and in such a way that, the initial and final year of each period is preferably a dry year. So, the droughty and less droughty periods are more different from each other, like we had studied round thirty-year periods. Accordingly the length of the selected periods varies between 27 and 34 years. The sub-periods and the entire three-hundred-year different intensity droughty years occurrence and relative frequency (in%) is presented in Table 2.

**Table 2.** A number of different intensity and relative frequency of drought years in the Carpathian Basin between 1710 and 2009

Period		Different intensity drought years (0 – 4 value)									
start - end	length (year)	number					relative frequency (%)				
		0	1	2	3	4	0	1	2	3	4
1710 - 1743	34	21	5	5	2	1	61,8	14,7	14,7	5,9	2,9
1744 - 1777	34	21	7	4	1	1	61,8	20,6	11,8	2,9	2,9
1778 - 1805	28	11	7	5	2	3	39,3	25,0	17,9	7,1	10,7
1806 - 1833	28	11	10	6	1	0	39,3	35,7	21,4	3,6	0,0
1834 - 1866	33	14	5	9	4	1	42,4	15,2	27,3	12,1	3,0
1867 - 1893	27	20	4	3	0	0	74,1	14,8	11,1	0,0	0,0
1894 - 1920	27	19	2	3	2	1	70,4	7,4	11,1	7,4	3,7
1921 - 1952	32	15	6	5	4	2	46,9	18,8	15,6	12,5	6,2
1953 - 1982	30	20	7	3	0	0	66,7	23,3	10,0	0,0	0,0
1983 - 2009	27	12	5	2	4	4	44,4	18,6	7,4	14,8	14,8
<b>1710 - 2009</b>	<b>300</b>	<b>164</b>	<b>58</b>	<b>45</b>	<b>20</b>	<b>13</b>	<b>54,7</b>	<b>19,3</b>	<b>15,0</b>	<b>6,7</b>	<b>4,3</b>

*Note:* the non-drought years (0), moderately dry years (1), considerable drought years (2), severe drought years (3), very severe (extreme) devastating drought years (4)



**Figure 1.** The relative frequency of droughts in the Carpathian Basin in the ten sub-periods between 1710 and 2009

(0 - non-drought years, or occurred only in very mild form, 1 - moderately dry years, 2 - considerable drought year, 3 - severe drought year, 4 - very severe devastating drought year )

From the data of the 2nd table we compiled the chart (Fig. 1) which presents the sub-periods droughts relative frequency evolution.

The study results show that the drought values of the ten defined sub-periods show surprisingly large fluctuations. The least dry season is in the 27 years between 1867 and 1893, when the droughty or slightly droughty year's relative frequency was 74.1%, and the droughty year's incidence was  $14.8 + 11.1 = 25.9\%$ . The driest period was between 1778 and 1805, and 1806 and 1833, thus two consecutive 28 years, when the non-droughty or slightly dry years, both relative frequencies were 39.3%, also the droughty years had a 60.7% frequency. There are also qualified as highly dry periods between 1834 and 1866, and also 1921 and 1952, and 1983 and 2009.

The drought frequency in the severe and very severe droughts group shows a striking discrepancy. In two sub-periods between 1867-1893 and 1953-1982, doesn't occur even a year (so the frequency is zero), but from 1983 to 2009 there were eight (!) year from this category, which was nearly a frequency of 30%. The severe and very severe droughts frequency increase between 1983 and 2009 is in line with the summer temperature time series positive deviations anomaly from the end of the 1980s (HMS 2009), but may be related also to the rising global temperatures (WMO 2009). This is a serious warning sign for the future and must be considered because it may disguise the droughts further aggravation.

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