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HAZARDOUS BIOCLIMATIC CONDITIONS IN THE DANUBE RIVER ADJACENT REGIONS DURING THE COLD PART OF THE YEAR (CALAFAT-VIDIN – TURNU MĂGURELE-NIKOPOL SECTOR OF THE DANUBE)

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INTRODUCTION

Cold-spells and heat-waves, severe floods, windstorms, etc., have affected the European Region during the last years. The political, social, environmental and health consequences of these episodes have stimulated debate on whether appropriate action can prevent at least some of the health effects of such extreme weather and climate events (K o p p e et al., 2004). Institutions at all levels are now developing strategies, by learning from recent events, to mitigate the future impact of extreme severe weather events on health.

The local climatic conditions of the border Romanian and Bulgarian territories adjacent on both sides to the Danube River are considerably influenced by the river which triggers modification of the main climatic elements and of their complex effect on the human bioclimatic comfort. The higher water vapor pressure in combination with the low air temperature and strong winds in the cold season, determines specific climatic conditions which enhance the human sense of wintryness and severity in the cold part of the year. These hazardous bioclimatic phenomena are strengthened additionally by the extreme weather manifestations accelerated by the climate change recently.

What are dangerously low temperatures from human bioclimatic point of view? At present the EU has no official meteorological definition of cold and extreme cold but a Dutch study defines a cold spell as a period of at least 9 consecutive days in which the lowest temperature reaches –5°C or lower, including at least 6 days in which the lowest temperature touches –10°C or lower.

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The human body protects itself against the cold by a series of thermoregulatory mechanisms. A deficient thermoregulatory system or an experience of cold stress can have serious health consequences. Cold weather can cause even more deaths than heat, although heat waves have recently received more media attention. Cold weather determined diseases claim more lives - coronary heart disease, strokes and respiratory diseases, are responsible for most part of excess winter deaths. Other contributing factors are influenza, social class and per capita gross national product. People suffering from flu and people from lower social classes / poorer countries are the most vulnerable (http:// ec.europa.eu/health/climate_change/extreme_weather/cold_weather/index en. htm).

METHODOLOGY

In the real environment, the organism feels the effect of weather in a complex manner expressed as an integral meteorological impact, resulting from the combination of all climatic elements. When cold loading of the body is concerned, a leading role for the thermal cooling of the body belongs to the coupling of air temperature and wind speed.

The basic criterion for analysis and assessment of the thermal risk for organism at cooling weather conditions is usually wind chill. Wind chill describes how fast the body loses heat under the combined effects of low temperature and wind: a 90km/h wind with an ambient temperature of –10°C gives the same sensation of cold as an ambient temperature of –30°C with no wind. Exposure to even low wind chills can be life threatening to both humans and animals (Public health..., 2004).

There are different ways of measuring the body chilling. Among the numerous complex indices, the "climate severity" index has been selected in this work, which reflects the combination of air temperature and wind speed, and the influence of temperature amplitude, air humidity and altitude are considered additionally too.

The index of climate severity is represented by the following equation (Kozlowska-Szczesna et al., 1985)

So=(1-0.06*t)*(1+0.20*v)*(1+0.0006*Hk)*Kf*At, where:

So – index of weather severity (by Osokin); t – air temperature (°C); v – wind speed (m/s); Hk – koefficient, depending by the altitude H (m); Kf – koefficient, depending by the mean diurnal relative humidity (F%); At – koefficient, depending by the mean diurnal temperature amplitude (A °C).

The weather severity is assessed according to the scale shown in the table 1.

The optimum conditions of the thermal environment of man are observed for climate severity values under 1.

The initial information base for calculating the climate severity index includes mean monthly values of the following climatic elements: temperature of the air (Ta, °C); wind speed; relative humidity; diurnal temperature amplitude.

For experimental purposes we have also processed the mean diurnal data for three met.stations (Vidin, Lom, and Oriahovo). Then we have calculated climate severity index for these stations day-by-day, for all the period 1998–2007. The results would be useful for assessment the extent to which the using of mean monthly values

T a b l e 1

Assessment scale of climate severity index (after Osokin (Kozlowska et al. , 1985, 1997) and of corresponding hazard classes

Threshold values and assessment degrees of index of severity	Classes of hazard
< 1.0 No severe	I Low
1.0 – 2.0 Slightly severe 2.1 – 3.0 Moderately severe 3.1 – 4.0 Very severe	II Moderate
> 4.0 Unusually severe	III High

is objective/or non-objective. On the other hand day-by-day values and their frequency parameters reveal much more details of the question under investigation, and are of greater practical importance.

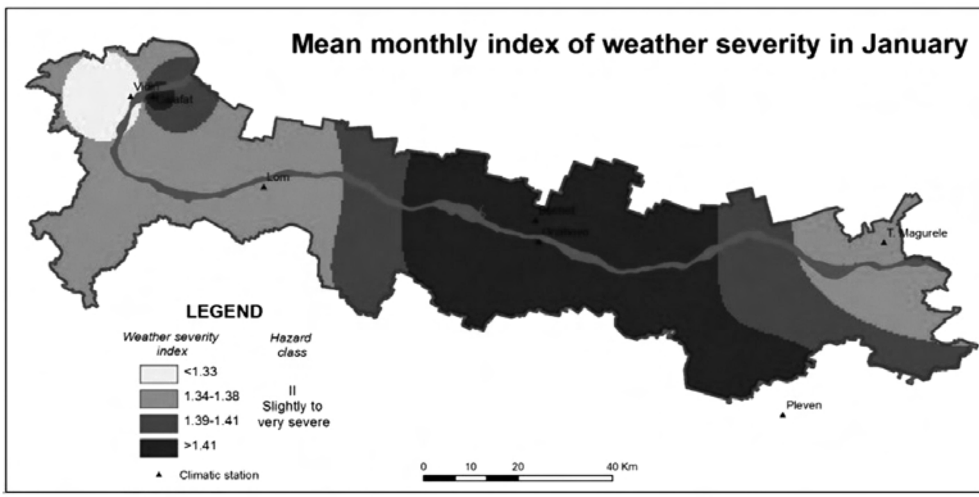
SPATIAL DISTRIBUTION

HOROLOGIC ASPECT

This aspect of the work considers the changes of the climate severity index on the territory of the explored region. The territorial differences in the index values are not significant. They are lower, about 0.1, during the less cold months (April and October) of the cold part of year. During the coldest month – January, the territorial differences of the weather severity rise to 0.3. In January the highest values are in the lowlands in the immediate vicinity of the Danube – stations Calafat, Bechet Turnu Magurele and Oriahovo, where the values reach 1.4–1.5. This classifies these territories in the category “moderate” according to the scale of climate severity hazard classes. The values of the Lom and Vidin stations are slightly lower – 1.3. The hilly-plain pre-Balkan areas more to the south (Vratza) show the smallest values in the coldest month January. These differences are even bigger when we speak about the maximum values. This allows the possibility of making some territorial differentiation, as it’s seen by the map 1. The territorial differentiation of weather severity varies with the years too, the lowest differences between the single stations being in 2000 and in 2007 (0.9) and the highest – in 2003 (1.1) (Table 2a, Table 3 and Fig.1).

By reason of methodic considerations January were studied also by frequencies of the mean diurnal values of severity index, for three Danube stations – Vidin, Lom and Oriahovo. The frequencies were calculated through day-by-day processing of data for the period 1998–2007 (2001–2007 in the case of Oriahovo). It turn out that the greatest frequency of the severity index is observed for the 1.0-2.0 group of index values (Table 2b). Correspondingly, these are 52% for Vidin, 44% for Lom and 36% for Oriahovo. This result confirms the results from the table 2a where the mean monthly values of the index were shown. The values from table 2a also fall in between 1.0 and 2.0. But, in the case with the frequencies we can also see that about 12% of the days are very severe, and still 12% are from the category “unusually severe”. Therefore the mean monthly values are reliable enough, but just for the purposes of a general orientation. When we want to deepen in the details we should use the “day-by-day” processing approach, to see what is the exact distribution of the values by the So categories.

It is quite a different approach if we use term values. They represent the conditions at an exact term of the day or the night and they should significantly alter the results in comparison to the mean diurnal values. It is strongly recommendable development of a separate study based on the term values of So. It will show the real values of So in the 24-day-and-night hours, in a contrast to the mean diurnal values. The last ones have an imaginary character while the term values are relevant to the real conditions. By this reason they are more suitable for practical-applied purposes. But, in many cases it is difficult to provide term climatic data.



Map 1. Territorial distribution of the climate severity index in the region under investigation (January, 1998–2007) (The map is elaborated by Dr.Stoyan Nedkov from the National Institute of Geophysics, Geodesy and Geography, BAS)

T a b l e 2a

Mean monthly values of index of severity (1998–2007)

Met. Stations	Months (cold part of the year)							Average
	I	II	III	IV	X	XI	XII	
Calafat	1.4	1.4	0.9	0.4	0.4	0.9	1.3	**1.0**
Vidin	1.3	1.2	0.9	0.4	0.4	0.9	1.3	**0.9**
Lom	1.3	1.3	0.9	0.3	0.3	0.9	1.3	**0.9**
Bechet	1.5	1.4	0.9	0.4	0.4	0.9	1.3	**1.0**

Oriahovo	1.4	1.3	0.9	0.4	0.3	1.2	1.3	**1.0**
T. Magurele	1.4	1.3	0.9	0.4	0.4	0.8	1.2	**0.9**
Pleven	1.4	1.4	1.0	0.4	0.4	1.0	1.4	**1.0**
Vratsa	1.2	1.2	0.8	0.4	0.4	0.9	1.2	**0.9**

T a b l e 2b

Frequency (%) of diurnal So values in January (1998–2007)

Assessment degrees of So	**Thresholds of So**	**Vidin**	**Lom**	**Oriahovo**
No severe	<1,0	10	14	9
Slightly severe	1,0 - 2,0	52	44	36
Moderately severe	2,1 - 3,0	24	18	23
Very severe	3,1 - 4,0	9	12	14
Unusually severe	>4,0	5	12	18

T a b l e 3

Mean monthly values of climate severity index for the coldest months of the period 1998–2007 year

Met. Stations	**Months (cold part of the year)**							**Average**
	I	**II**	**III**	**IV**	**X**	**XI**	**XII**	
Calafat	2.0	2.0	1.2	0.5	0.6	1.3	1.7	**1.3**
Vidin	1.7	1.6	1.1	0.5	0.5	1.0	1.6	**1.2**
Lom	1.8	1.8	1.1	0.5	0.4	1.1	1.7	**1.2**
Bechet	1.8	1.9	1.2	0.5	0.6	1.2	1.7	**1.3**
Oriahovo	1.9	1.7	1.2	0.4	0.5	1.6	1.7	**1.3**
T. Magurele	1.7	1.6	1.1	0.5	0.5	1.1	1.8	**1.2**
Pleven	1.7	1.9	1.4	0.5	0.5	1.3	1.8	**1.3**
Vratza	1.7	1.7	1.0	0.6	0.6	1.1	1.5	**1.2**

T a b l e 4

Mean values (average for the period October – April) of index of climate severity by the years of 1998–2007 observation period

Met. Stations	**Years**										**Average**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	
Calafat	–	1.0	0.9	1.0	0.9	1.1	0.9	1.1	1.0	0.8	**1.0**
Vidin	0.9	0.8	0.8	0.9	0.9	1.0	0.9	1.0	0.9	0.8	**0.9**
Lom	1.0	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.8	0.8	**0.9**

Bechet	-	0.9	0.9	0.9	0.9	1.1	1.0	1.1	1.0	0.9	**1.0**
Oriahovo	-	-	-	0.8	0.9	1.0	1.0	1.0	1.0	0.9	**1.0**
T.Magurele	-	0.9	0.8	0.9	0.9	1.0	0.9	0.9	0.9	0.8	**0.9**
Pleven	-	1.0	-	1.0	0.9	1.1	0.9	1.0	0.9	0.8	**0.9**
Vratza	0.8	0.8	0.7	0.8	0.8	1.1	1.0	1.0	1.0	0.8	**0.9**
Average	**0.9**	**0.9**	**0.8**	**0.9**	**0.9**	**1.1**	**0.9**	**1.0**	**0.9**	**0.8**	**0.9**

SEASONAL ASPECT

The seasonal aspect of the present work considers the monthly course of the climate severity index during the cold season of the year – from October to April. The highest severity values are registered during the three winter months – December, January, and February, when they reach on an average 1.4 and 1.3 (1.8–1.7 for the maximum values), respectively for the explored territory and studied period of observation. The feeling for cold weather in the winter is still more significant during some individual years, such as 2003, of the period 1998–2007. The mean severity values for each weather station in January during the coldest year of this period are still higher and exceed 3.0. This classifies these months to the "very severe" category according to the scale of the climate severity index.

The lowest severity values in the cold part of the year are observed in April and October – on the average 0.4, falling within the range of the "no severe" category according to the scale of the studied index. The tenor to January exhibits well expressed uniform rising, passing via the "slightly severe" categories, for November and De-

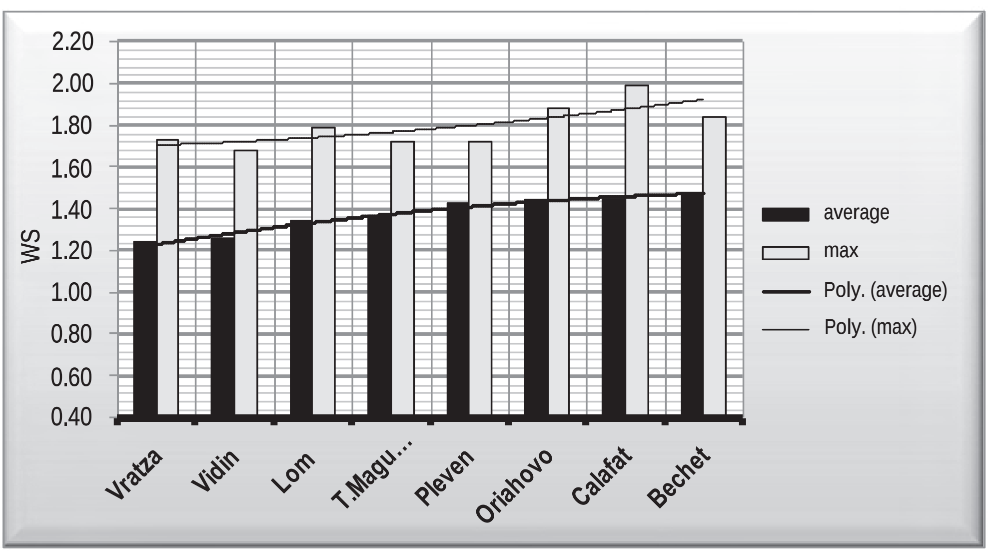


Fig. 1. Territorial course of index of climate severity (WS) for the region under investigation (January, 1998–2007)

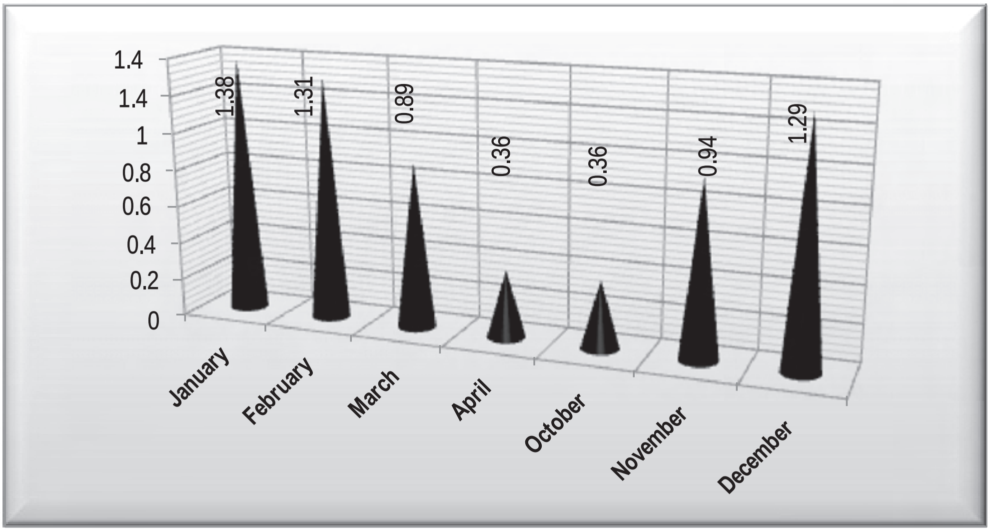


Fig. 2. Monthly course of climate severity index (WS) during the cold part of the year (October-March, 1999–2007 , Calafat-Vidin – T.Magurele-Nikopol sector of the Danube river)

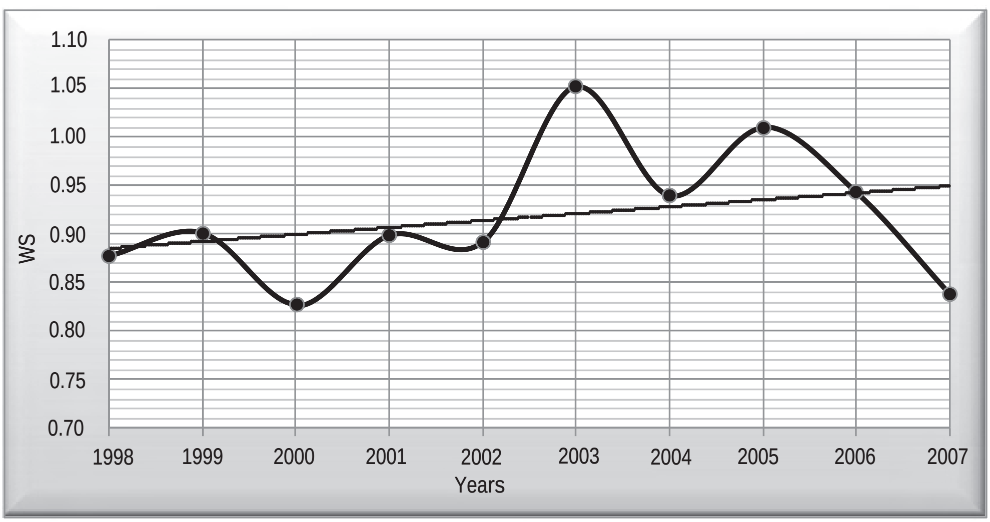


Fig. 3. Yearly course and corresponding logarithmic trend of climate severity index (WS) during the 1998–2007 observation period (average values for October-January, Calafat-Vidin – T.Magurele-Nikopol sector of the Danube river)

cember, respectively. From January to April the values are gradually decreased in a smooth manner like in the period October – January. The amplitude in the seasonal tenor of climate severity is much more expressed than in the chorological aspect (Table 2, Table 3, Fig. 2).

CHRONOLOGICAL ASPECT

The chronological aspect of this work considers the changes in the climate severity index during the years of the investigated period – from 1998 to 2007. The average trend of the values' change with the years is towards very slight increasing, which is more significant in the first part of the period (till 2003) while at the end of its second part shows even negative tendency. The changes between the years are small – about 0.1, which is less than the monthly changes within the frames of the cold part of the year (Table 4, Fig. 3).

PRACTICAL APPLICATION

THE PEOPLE MOST AFFECTED

Although anyone can suffer cold-related health effects, some people are at greater risk. Those most vulnerable during cold spells include elderly people, infants, children and teenagers, and people who have chronic diseases or physical or mental limitations, are taking certain medications or are malnourished.

Individuals' and families' economic and social status also play an important role: cold weather affects people who are poor, homeless or marginalized more severely.

Workers in some occupations, such as agriculture, fishing and construction, may endure greater cold exposure, so they must be vigilant for injuries and other health effects and should wear adequate protective gear.

Additionally, certain behavior – excess use of alcohol, some outdoor leisure activities and inappropriate clothing – can put people at increased risk from cold exposure (The people most affected...).

What health and social services can do? (What health and social...)

○ Foresee and plan for potential pressures on infrastructure
○ Ensure coordination among authorities and with providers of care
○ Ensure continuous service delivery
○ Reach out to and take care of particularly vulnerable populations
○ Ensure that enough heated shelter is available if needed
○ Offer vaccination
○ Ensure that trained health professionals are available
○ Provide information and phone helplines for the public and vulnerable groups
○ Coordinate with local communities and social services
○ Monitor and carry out surveillance of health effects

It is necessary to: shift the emphasis from post-disaster intervention to pre-disaster planning; identifying and protecting vulnerable groups is particularly important; organize effective and timely coordination and collaboration among public health authorities, meteorological services and agencies (national and international), emergency response agencies and civil societies to develop local, regional and national monitoring/surveillance systems for rapid detection of extreme weather events and their effects on the public's health; to develop civil emergency and intervention plans, including activities to prevent morbidity and mortality due to weather and climate extremes; and to improve public awareness of extreme weather events, including actions that can be taken at individual, local, national and international levels to reduce the impacts (Extreme weather ..., 2004).

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x x x What health and social services can do. http://www.euro.who.int/en/what-we-do/health-topics/noncommunicable-diseases/chronic-respiratory-diseases/news/news/2013/02/how-cold-weather-affects-health/what-health-and-social-services-can-do

x x x http:// ec.europa.eu/health/climate_change/extreme_weather/cold_ weather/index en.htm

ОПАСНИ БИОКЛИМАТИЧНИ УСЛОВИЯ В ПРИЛЕЖАЩИТЕ НА Р. ДУНАВ ТЕРИТОРИИ ПРЕЗ СТУДЕНАТА ЧАСТ ОТ ГОДИНАТА (КАЛАФАТ-ВИДИН – ТУРНУ МЪГУРЕЛЕ НИКОПОЛ)

З. Матеева, К.-С. Драгота , И. Григореску

(Резюме)

Работата представя някои резултати от съвместния Румънско-Български проект „Оценка на природните и техногенни рискове в прилежащите общини на р. Дунав в участъка Калафат-Видин – Турну Мъгуреле-Никопол. Този район има специфични климатични условия, формирани при модифициране на основните климатични елементи и на техния комплексен биоклиматичен ефект под влиянието на р. Дунав. През студената част от годината влажността на въздуха, в комбинация с ниските температури и високата скорост на вятъра, обуславя възникване на неблагоприятни климатични условия от гледна точка на биостатуса на човешкия организъм. В настоящата работа тези условия са изследва-

ни чрез индекса „суровост на климата“, който оценява степента на климатична мразовитост и съответния стрес за човека.

Получените резултати са полезни за планиране на човешката дейност на открито в областта на рекреацията и туризма, строителството, селското стопанство, климатопрофилактиката и климатотерапията и др. Въз основа на резултатите от изследването е възможно очертаване на стресовите биоклиматични периоди с оглед избягване на биоклиматични инциденти.

Значението на настоящото изследване нараства и поради факта, че през последните години, в условията на променящ се климат, се повишава интензивността, честотата и продължителността на екстремни климатични прояви, вкл. на студените нахлувания.