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GIS UTILIZATION IN CLIMATIC RISKS' INVESTIGATION

BY

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Abstract. Climatic risks' intensity and frequency growth in the past few decades demands using a vast informational database that would allow identifying their regional manifestation particularities adequately In this sense, Geographical Informational Systems ensure simultaneous access to informational database on different level (world, regional, local), obtaining operatively complex analysis of risks under investigation. Keeping in mind that in most cases climatic risks have regional character of manifestation, the actual investigations are of great scientific interest, as they can be useful for comparison with the researches executed abroad.

Key words: GIS, database, virk analysis climatic.

1. Introduction

Climatic risks evaluation on the actual stage are of great interest, as in last few decades they have a bigger intensity and frequency of manifestation. Experts of United Nations' Development Programme (UNDP), that have elaborated united definition of natural disaster's *risk* (Disaster Risk Index, DRI) state that it's a probability of negative consequences and possible losses, that result from interaction of natural and anthropogenic dangerous phenomena with vulnerability conditions.

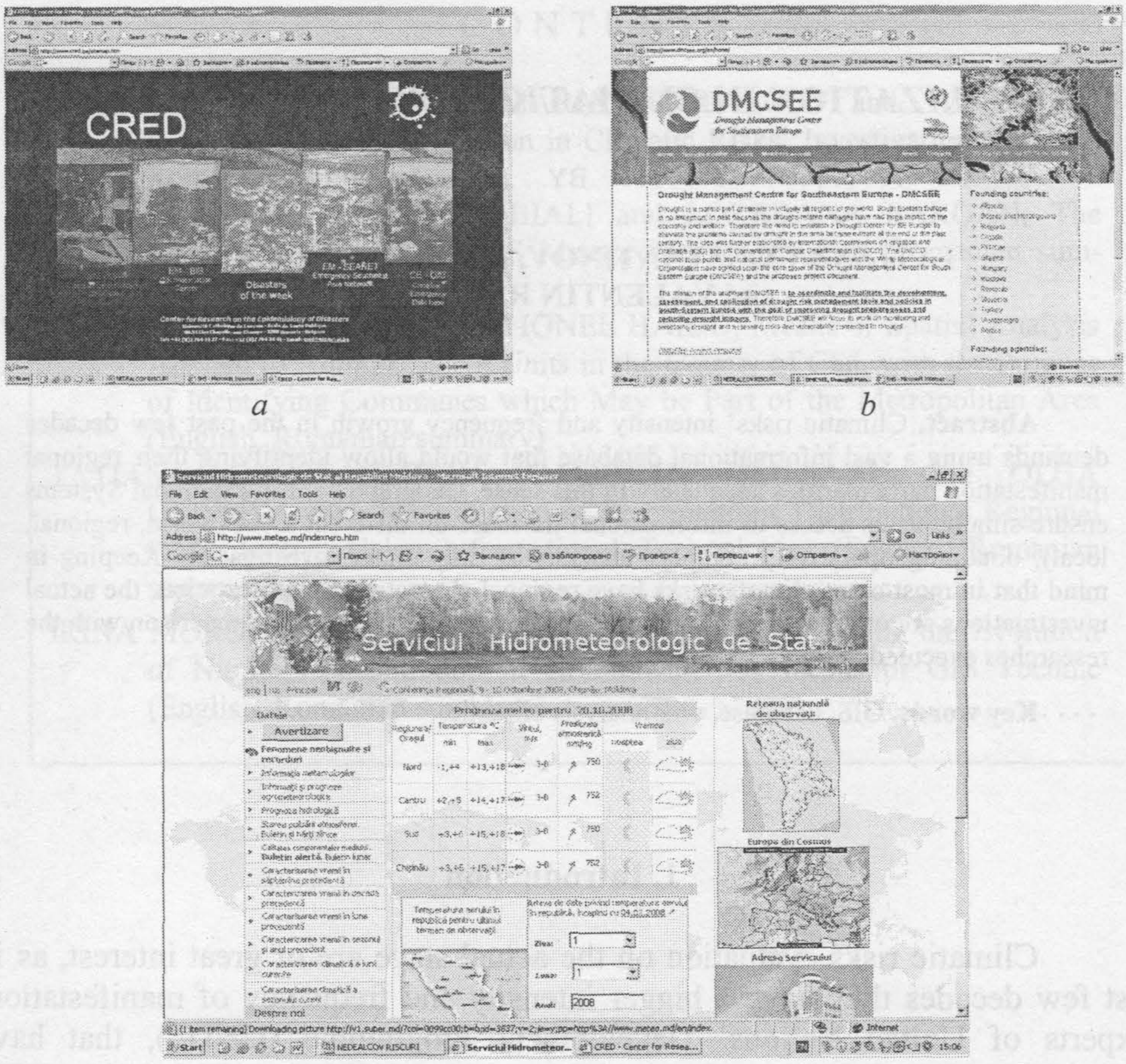
Vulnerability - *conditions* determined by natural, social, economical, ecological factors or processes that intensify the receptivity of certain

community to hazards' influence (Reducing Disaster Risk, global report, 2005).

These notions will be the basis for identifying climatic risks manifested on Republic of Moldova's territory.

2. Materials and Methods

Thus, natural risks' intensity and frequency growth in last decades demands using unique identification criteria and scientific informational base for local (State Hydrometeorological Service data) as well as world (Centre for Researches of Epidemiological Disasters from Luviana University, Belgium CRED), or regional Drought Management Centre from South-Eastern Europe - DMCSEE) data (Fig.1).



a *b* *c*

Fig. 1 – Informational database of world (*a*), regional (*b*) and local data (*c*) on climatic risks manifestations on Republic of Moldova's territory.

In this context, Regional Informational Systems became an operative

and trustworthy instrument for storing, processing and graphical presentation of this data.

We also would like to mention, that the most prestigious organization working with natural risks identification is Centre for Researches of Epidemiological Disasters from Luviana University, Belgium **(CRED)**, which stores in world database risks that correspond to the following criteria:

a) 10 or more people reported;
b) 100 people reported affected;
c) a call for international assistance;
d) declaration of a state of emergency.

Some of natural hazards can be monitorized separately. Thus, Drought Management Centre from South-Eastern Europe (DMCSEE) identifies droughts in the regions on the basis of precipitations standardization. Information taken from world and regional databases were confirmed by local data collected by State Hydrometeorological Service from Republic of Moldova. The latter have contributed to cartographical models development by concretization of the intensity and areas of these risks' manifestations.

3. Obtained Results

Comparative analysis of natural hazards on Earth manifested in the first semester of year 2008 and average multiannual in last decade (1998-2007) shows us that their consequences have increased essentially in 2008, provoking significant material losses, human victims and affected (Table 1).

Table 1

Comparative Analysis of World Natural Hazards Manifested in the First Semester of Year 2008 and in the First Semester of Last Decade (1998-2007)

Natural hazards and consequences	2008 1 semester	1998–2007 1 semester
Number of natural hazards	101	174
Number of people reported killed	**229,043**	8,768
Number of affected people	**130,505,312**	105,897,081
Economical losses (mln. $USA)	**34,934**	15,076

Source: CRED CRUNCH

In regional aspect, for the above mentioned period (1998–2007) floods have provoked highest material losses. Because of extreme temperatures in winter 2006 there were registered victims, and drought in 2007 had caused a large number of affected people (Table 2). According to the number of people affected by drought, by CRED Republic of Moldova occupies second place in Europe after Macedonia [1], the fact that demonstrates that this phenomenon

has a wide range of manifestation (Fig. 2).

Table 2

Net Estimation (Period 1998-2007) of Natural Hazards Manifested on Republic of Moldova's Territory and their Consequences

Type of hazard	Number of events	Number of human victims	Total number of affected people	Material losses (000s)
Droughts	2000 2007	2 –	210 394	– –
Extreme temperatures	2006	14	–	–
Floods	1999 2002 2005	– 1 –	6,500 1,713 500	– 4,000832 7,752

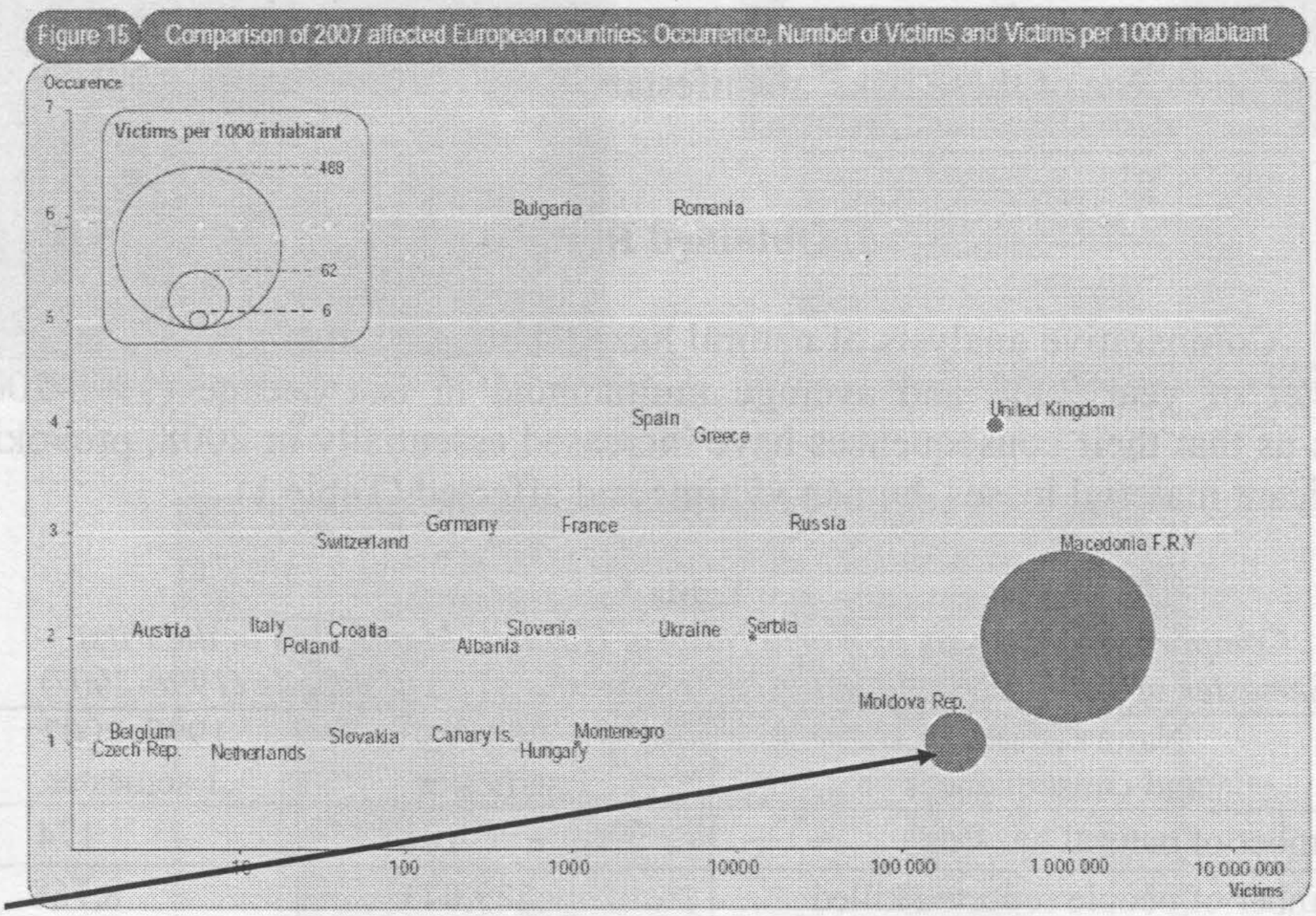


Fig. 2 – Number of people affected by drought 2007 in Europe (Source: CRED CRUNCH).

Drought manifestation growth in South-Eastern Europe is conditioned by using common indexes for all regions' countries in order to evaluate area and level of intensity. Presently, it is widely used the so-called Standardized Precipitations Index (SPI) formulated by Makee and others [2]. From the conceptual point of view it represents an equivalent to standardized anomaly of random value (in present case that of precipitations) from norm:

$$\text{SPI} = (x_i - x)/\sigma \quad (1)$$

where x_i represents concrete precipitations value, x – climatic norm and σ – standard deviation.

The values of this index ranging in the limits of $0.99 < SPI < -0.99$ indicate that humidification conditions are near the norm. Drought as atmospheric phenomenon begins when SPI evaluation reaches value of –1.0. Correspondingly, moderated drought is observed when indexes deviation from norm are within limits of $-1.0 < SPI < -1.49$, severe one when they are within $-1.5 < SPI < -1.99$ and when is $SPI < -2.0$ drought is considered extreme.

As we mentioned before, Drought Management Centre from South-Eastern Europe (DMCSEE) has an informational database [3] with data that characterizes this index in the region during past decades. The analysis of drought manifestation in 2007 by months apart (May, June, July) shows us that more than 50% of republic's territory in June and July where affected by the drought that was considered extreme according to SPI. Moreover, this qualificative in June is attributed to the Northern part of Republic, which is conditioned by the predominance in its South-Eastern part of cyclonic masses penetrated from Black Sea basin (Fig.3).

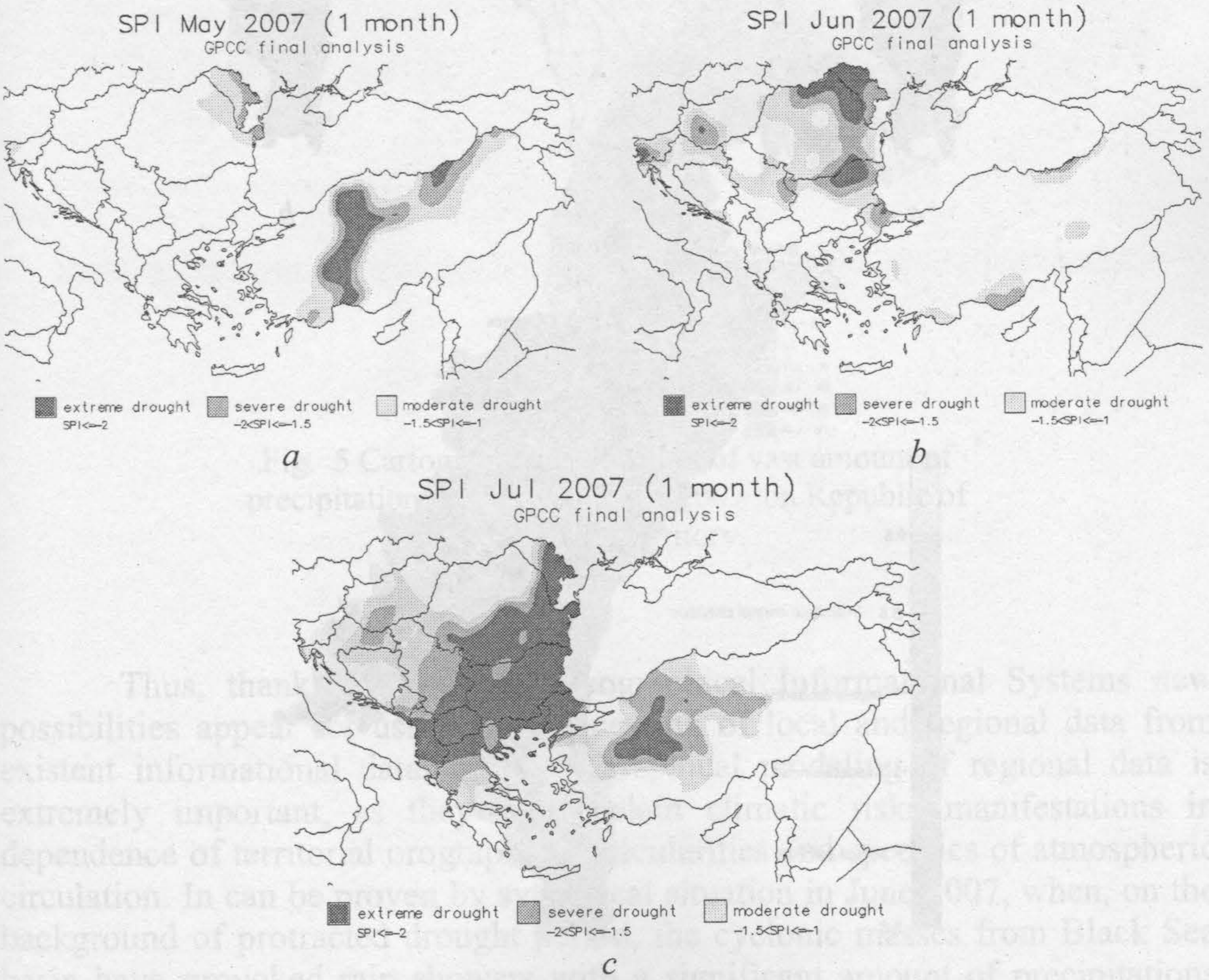
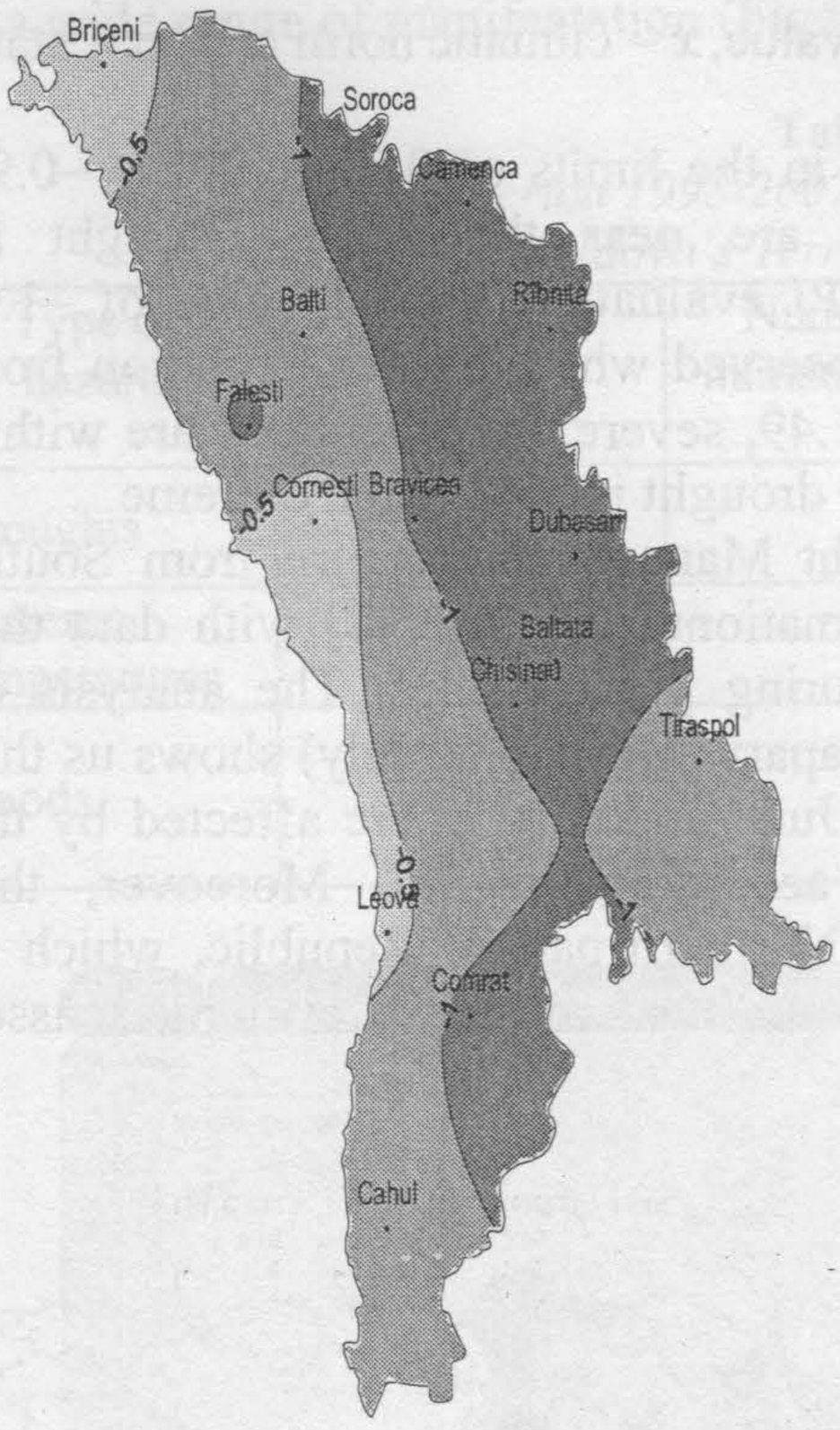


Fig. 3 – Drought phenomenon's spatial distribution (*a* – May, *b* – June, *c* – July) in year 2007, in South-Eastern Europe (Source: Drought Management Centre from South-Eastern Europe).



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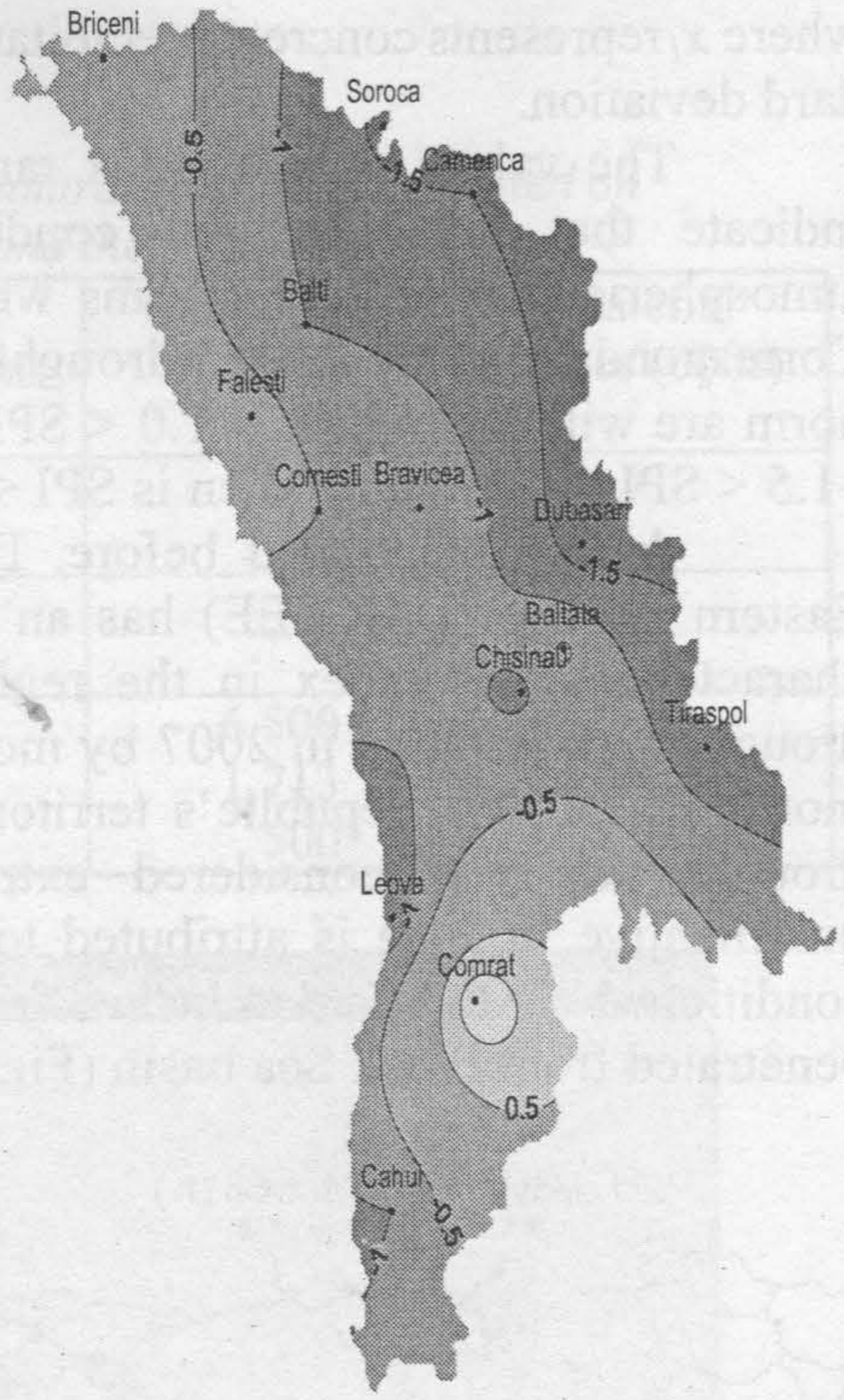

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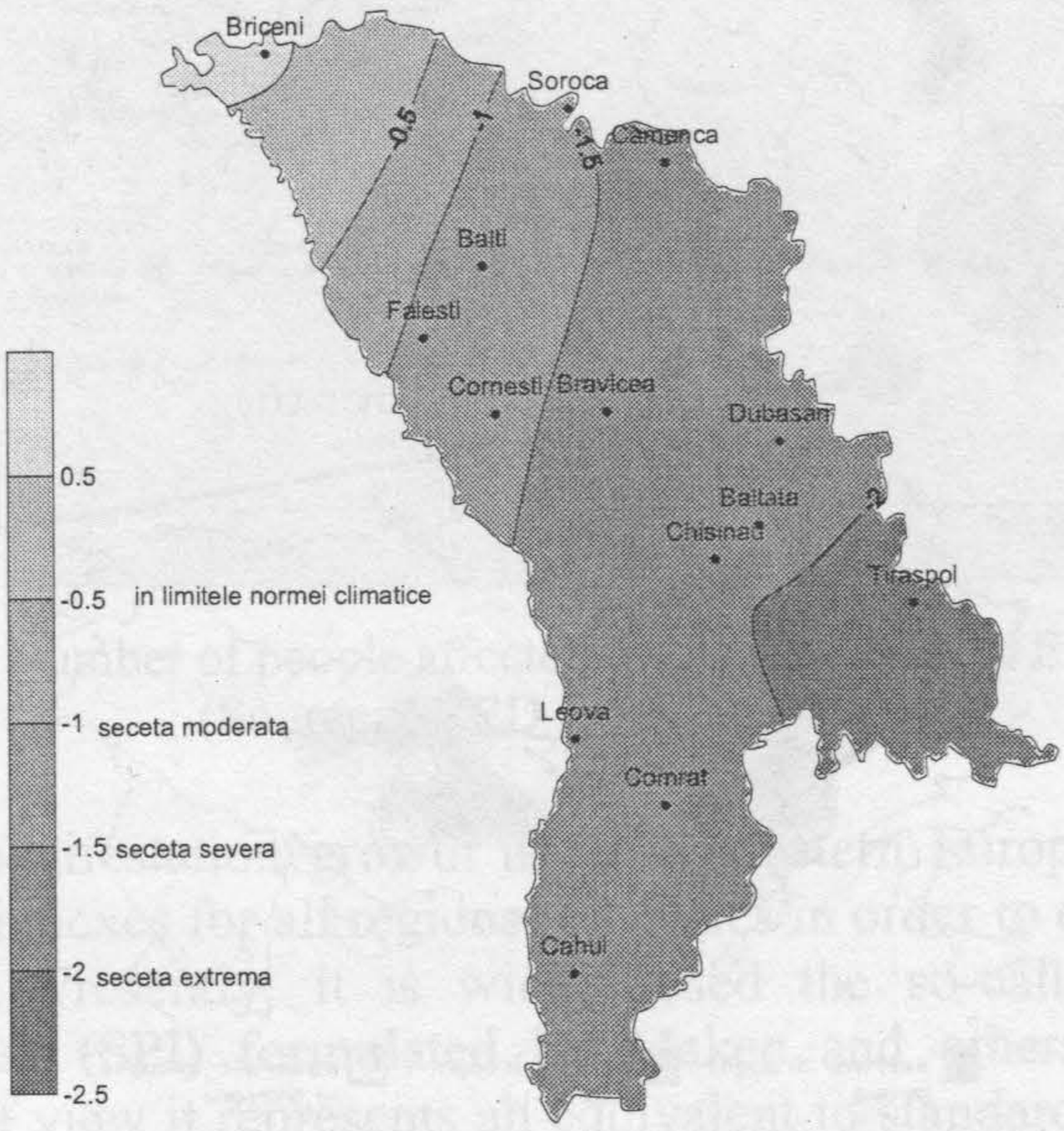


c

Fig. 4 Drought phenomenon's spatial distribution (*a* – May, *b* – June, *c* – July) in year 2007, on Republic of Moldova's territory.

Cartographical modeling of Republic's data (using software Surfer), specifies SPI's level of intensity (Fig. 4) on Republic's territory. Humidification conditions that are near the norm can be distinguished in June (Fig. 4*b*) in South-Eastern part of Republic, determined mainly by vast amount of precipitations in June, 4th (Fig. 5), the amount that greatly exceeded mean monthly norm (73 mm).

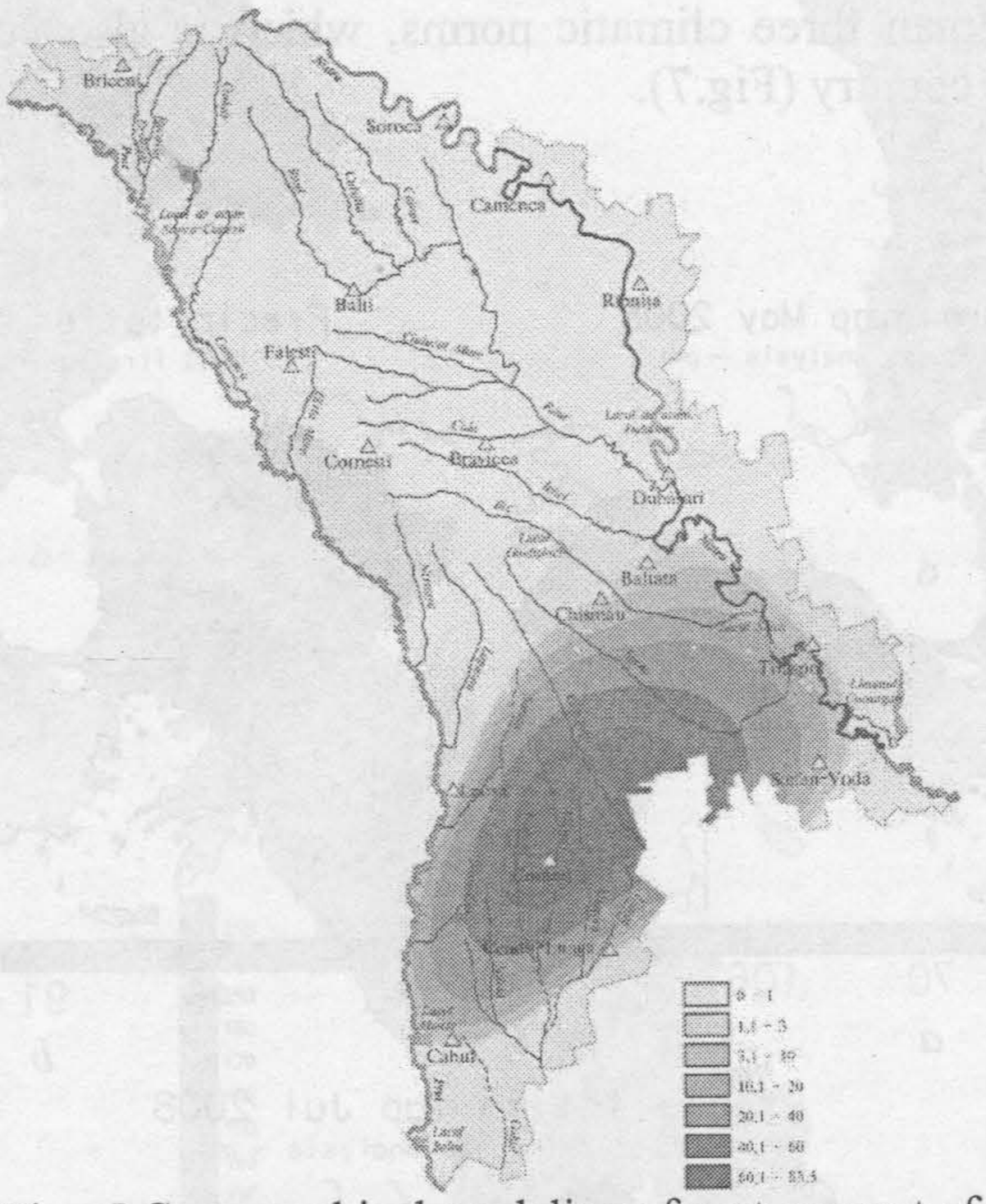


Fig. 5 Cartographical modeling of vast amount of precipitations in June, 4th, year 2007 on Republic of Moldova's territory.

Thus, thanks to Regional Geographical Informational Systems new possibilities appear for using and processing of local and regional data from existent informational database. Cartographical modeling of regional data is extremely important, as they can explain climatic risks manifestations in dependence of territorial orographic particularities and specifics of atmospheric circulation. In can be proven by synoptical situation in June 2007, when, on the background of protracted drought period, the cyclonic masses from Black Sea basin have provoked rain showers with a significant amount of precipitations that exceeded essentially monthly climatic norm for the region and have "deregulated" zonality principles in extreme droughts manifestation.

A specific feature of humidification regime for the last years is frequent alternation of "drought-humid" antipodal periods during the year and in their manifestation from year to year.

Thus, if year 2007 was very droughty, year 2008 was characterized by abundant precipitations (Fig.6). The analysis of schematic maps that characterize the aspect of precipitations' spatial distribution in May, June, July 2008 in South-Eastern Europe, not excluding Republic's territory, shows us that rain showers in July in some localities of Northern parts of Republic have amounted more than three climatic norms, which is also confirmed my data modeling for the country (Fig.7).

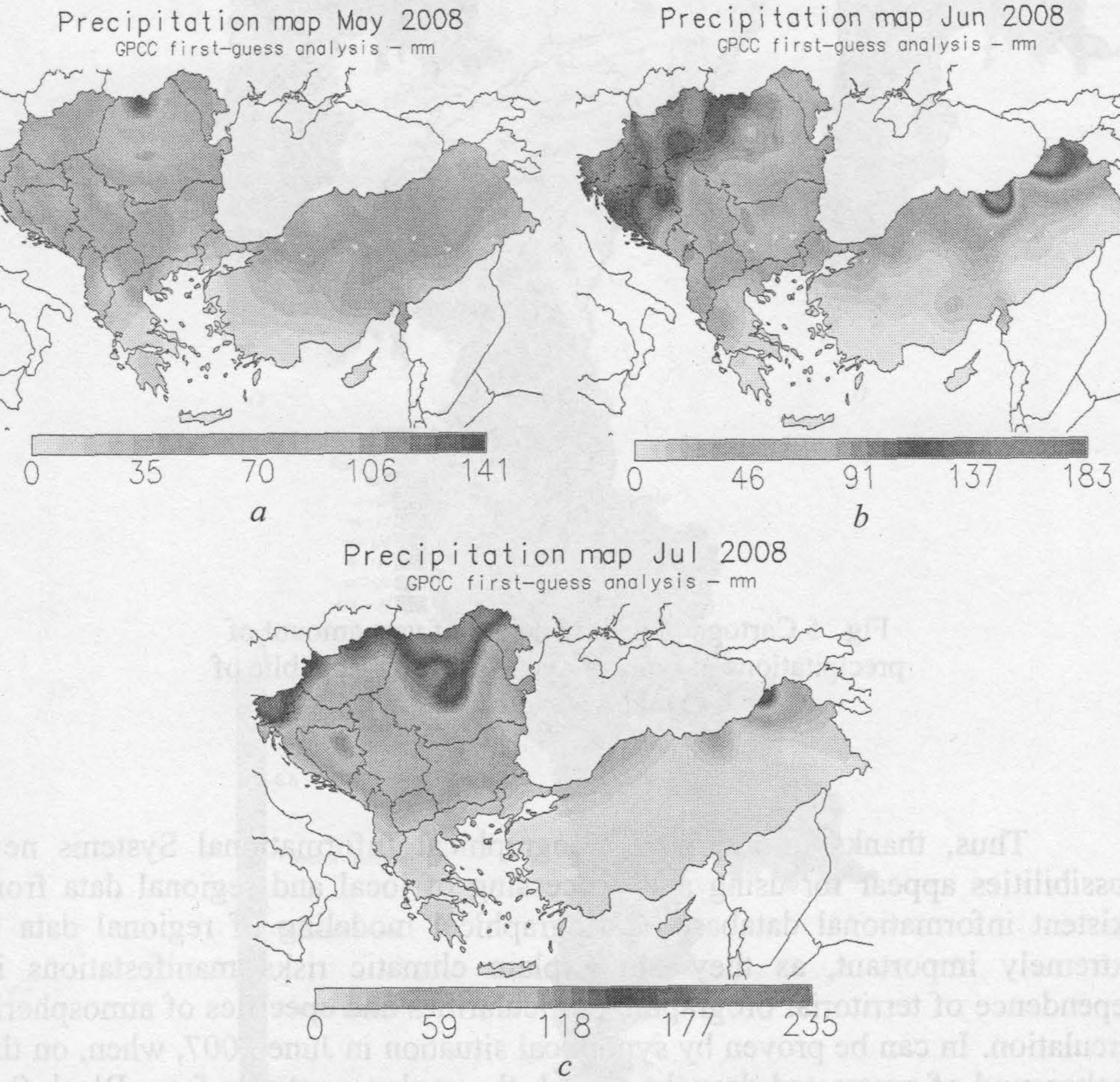
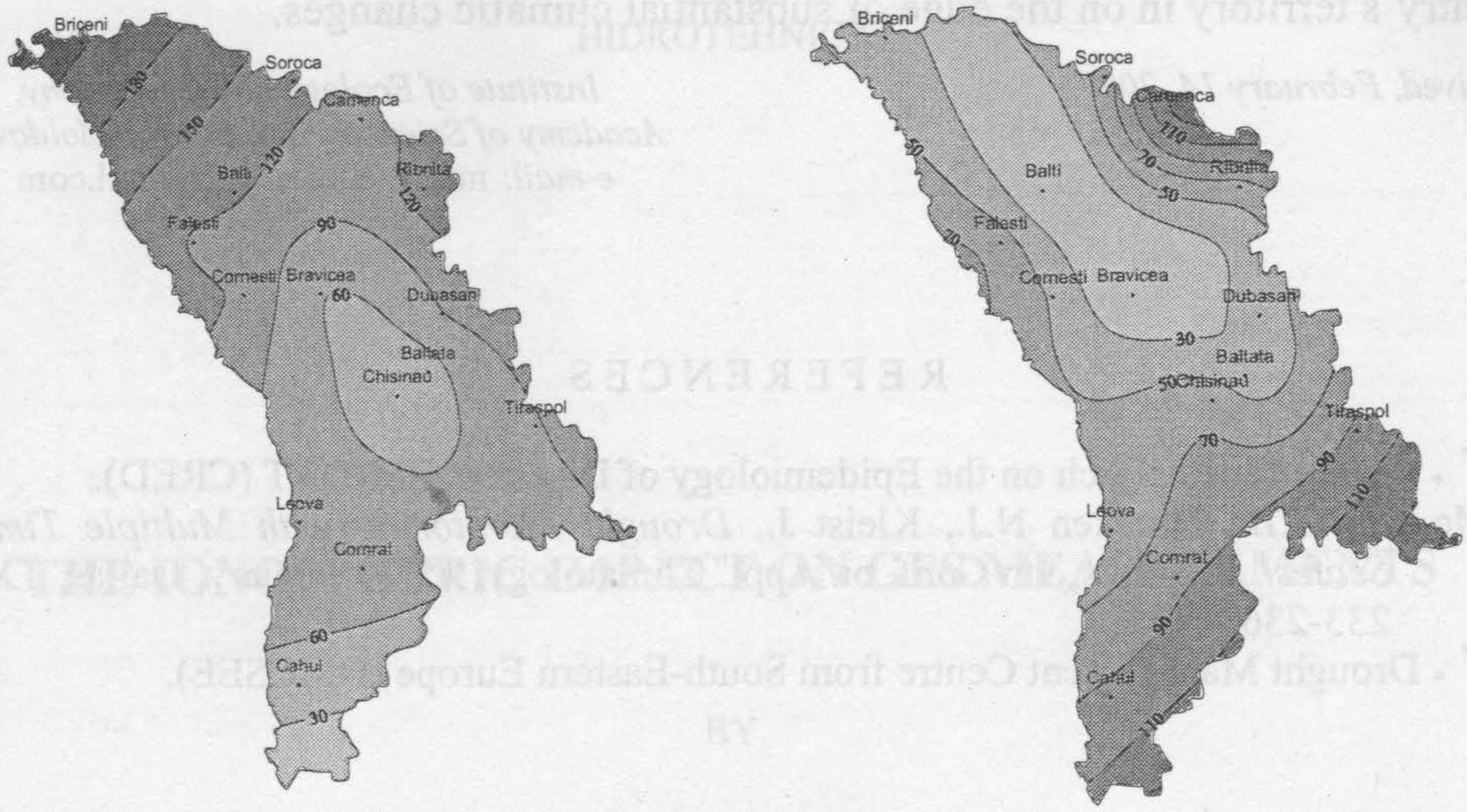


Fig. 6 Monthly precipitations' spatial distribution (*a* – May, *b* – June, *c* – July) in year 2008, in South-Eastern Europe (Source: Drought Management Centre from South-Eastern Europe).



a *b*

c

Fig. 7 Monthly precipitations' spatial distribution (*a* – May, *b* – June, *c* – July) in year 2008, on Republic of Moldova's territory.

4. Conclusions

In conclusion we'd like to add, that Geographical Informational Systems, while being a quick instrument that can be used for informational databases with different scale (local, regional or world), and it also reveals

frequent manifestations of rain showers and droughts. Frequent alternations of droughts and abundant precipitations that provoke floods shows us that the country's territory in on the edge of substantial climatic changes.

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UTILIZAREA SIG ÎN STUDIUL RISCURILOR CLIMATICE

(Rezumat)

Sporirea intensităţii şi frecvenţei riscurilor climatice din ultimele decenii necesită utilizarea unei baze informaţionale ample de date ce ar putea permite evidenţierea adecvată a particularităţilor regionale de manifestare ale acestora. În acest context, Sistemele Informaţionale Geografice, asigură accesarea concomitentă a bazei informaţionale de diferit nivel (mondial, regional, local), obţinând în mod operativ analiza complexă a riscurilor supuse studiului. Ţinând cont de faptul, că riscurile climatice în cele mai dese cazuri pot avea un caracter regional de manifestare, investigaţiile propuse prezintă un interes ştiinţific deosebit, deoarece acestea pot fi utile în compararea cu studiile efectuate peste hotarele republicii.