

# ASPECTS OF USING GIS IN THE COMPLEX ANALYSIS OF THE THERMICAL ANOMALIES AND OF THE TYPE OF ATMOSPHERICAL CIRCULATION

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## ABSTRACT

The optimal instrument to identify links that characterizes inter-secular climatic fluctuations according to Vanghengehem-Ghirs type of circulation can be Informational Systems. This instrument allows operative access to databases in Access, Excel and Statgraphics Plus programs where data is stocked and processed statistically as well as interpolation of thermal anomalies in regular cartographic network in Surfer, MapInfo, ArcView programs and others. Investigations results obtained through informational Systems allow claiming that thermal regime variability is in close connection with changes in thermal anomaly "warm-cold" frequency correlation and circulation's type transfer from one period to another.

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## 1. INTRODUCTION

Synoptic or dynamic climatology studies climate as a result of the processes in the general circuit of the atmosphere and estimates the climatic conditions which correspond to certain types of circulation. At present, different types (classifications) of the synoptic processes are known and are taken into consideration when elaborating methods for forecasting meteorological phenomena. At the same time, their effective use become possible along with GIS elaboration, with whose support, databases can operatively, veridical and qualitatively be used and cartographic models elaborated. We would mention in this context, the use of the programs Statgraphics Plus and ArcView.

## 2. MAIN RESULTS AND DISCUSSIONS

The Territory of the Republic of Moldavia, according to Vanghengehem [1] classification, belongs to the Atlantic-Eurasian sector, 60<sup>0</sup> west longitude and 120<sup>0</sup> east longitude. According to this classification, the peculiarities of the circulation which predominates over a long period of time and which is characterized by the development of a homogenous synoptic process are to be analyzed. These Vanghengehem periods are attributed to three forms of atmospheric circulation: one type of areal displacement and two

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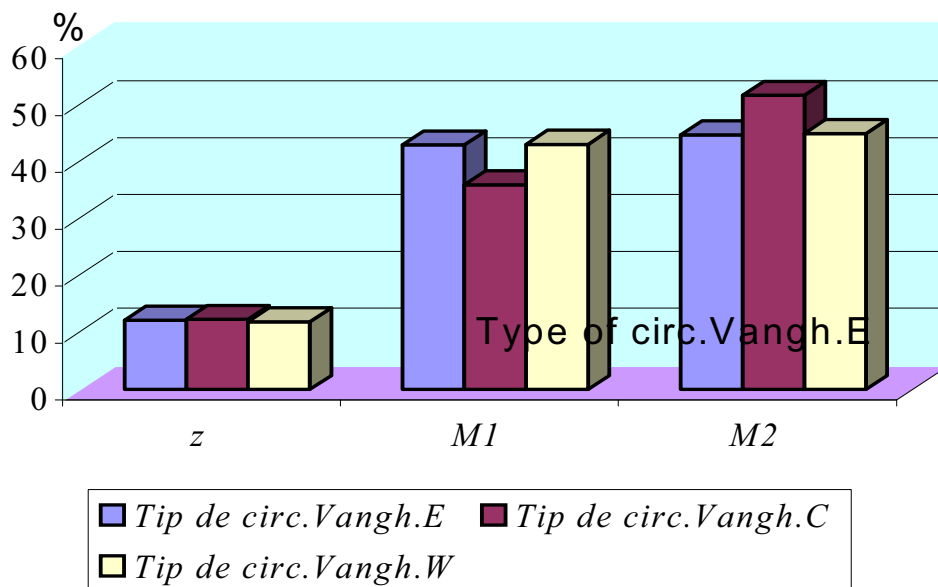
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types of meridional displacement dependent on the situation of altitude crests. The areal displacement (*W*-western type) is characterized by quasi-areal fluxes of low frequency waves, which move from west to east. Meridional forms of circulation include the meridional type *C* (central) and *E* (eastern). The central type of meridional circulation is generated by the localization of the crests of altitude over the Eastern Atlantic and of the depression high over the Eastern Europe during the winter season. The eastern type (*E*) of the meridional circulation is characterized by localizing the crests of altitude in the eastern Europe and by forming two depressions of height over the Atlantic and over the West Siberia.

One should mention that similar to this classification, Ghirs previously proposed analogical forms for the atmospheric circulation of the Pacific-American sector. By using the same principles of typifying as Vanghengheim, Ghirs proposed 3 types of atmospheric circulation: western *Z* and two meridional ( $M_1$  and  $M_2$ ), with the localization of the crests of altitude over the Pacific Ocean –  $M_1$ , and over the western seacoast of the North America –  $M_2$ .

Due to the fact that atmosphere represents the most dynamic component of the geographical crusts, evaluating atmospheric circulation requires to be effectuated at global scale; there exists a significant concordance between the two classifications, as confirmed by fig. 1.



**Fig.1.** The degree of concordance (%) between the types of circulation Vanghengheim and Ghirs (1973-1993, winter season)

The monthly registries of Vanghengheim – Ghirs type are drawn up for the period 1900-2005 (table 1). The analysis of this registry, indicates that the shift of the epochs (areal-meridional, meridional-areal) takes place each 70 years. The study of the repeating areal type of circulation (during winter months) demonstrates that the stable character of the areal circulation characterizes the end of this epoch (1925-1928). At present, starting with the year 2000, during the winter months, the areal type of atmospheric circulation

predominates. The fact that the meridional stable type registered a period of influence much longer (1952-1976) is very interesting. The period of predominance of one or another type of atmospheric circulation has a significant influence over the regional climatic system.

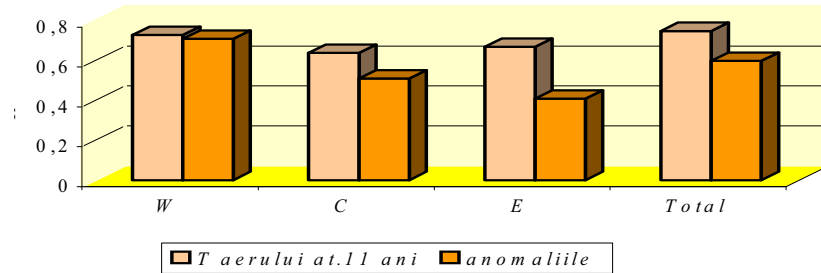
To date, long time-series data are gathered, which allow performing research in connection to the climate variability and to the types of circulation for other seasons too.

*A fragment of the registry of the types of atmospheric circulation (winter months)  
according to Vanghengheim – Ghirs classifications*

Table 1

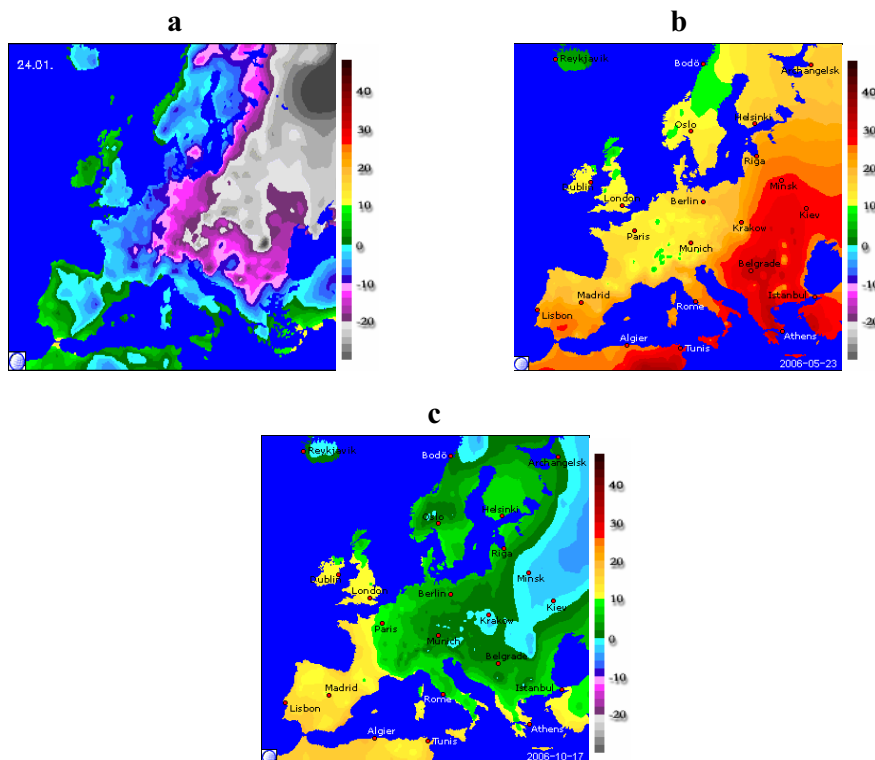
TYPE OF CIRCULATION	PERIOD	Period phase	XII	I	II
AREAL (W)	W	1900-1902	Cz+m2		
		1903-1907	Wz+m1		
		1908-1911	(E+C)z+m1		
		1912-1915	Wm2		
		1916-1920	Em2		
		1921-1924	(W+C)m1	Ez	
		<b>1925-1928</b>	<b>(W+C)z+m2</b>	<b>Wz+m2</b>	
MERIDIONAL (E+C)	E	1929-1933	Ez+m2		Cm1+m2
		1934-1937	Em2		
		1938-1939	Em2		(C+W)m2
	C	1940-1942	Cz+m1	Cm2	
		1943-1944	Em2	(W+C)m2+m1	
		1945-1948	(C+E)m2+m1		
	E+C	1949-1951	(C+W)m1		(E+W)m1
		<b>1952-1956</b>	<b>Em1+z</b>		<b>(E+C)m1+z</b>
		<b>1957-1960</b>	<b>(C+E)z</b>		
		<b>1961-1968</b>	<b>Cm1+z</b>		
		<b>1969-1971</b>	<b>(E+C)m1</b>		<b>Ez</b>
	E	<b>1972-1976</b>	<b>Ez+m1</b>		
		1977-1980	(W+C)z	Ez	
		1981-1984	Wz	(E+C)z	
		1985-1987	Cz		
1988-1995		C+W	W		
AREAL (W)	W	1996-1999	W+C		
		<b>2000-2003</b>	<b>W</b>	<b>W+C</b>	
		<b>2004-2005</b>	<b>W</b>	<b>W</b>	<b>C</b>

Taking into account that in the last years (table 1) the areal atmospheric circulation predominates and from [1,2], it results that the given type is characterized by close correlative relations with the thermal regime as well as with thermal anomalies (fig. 2).



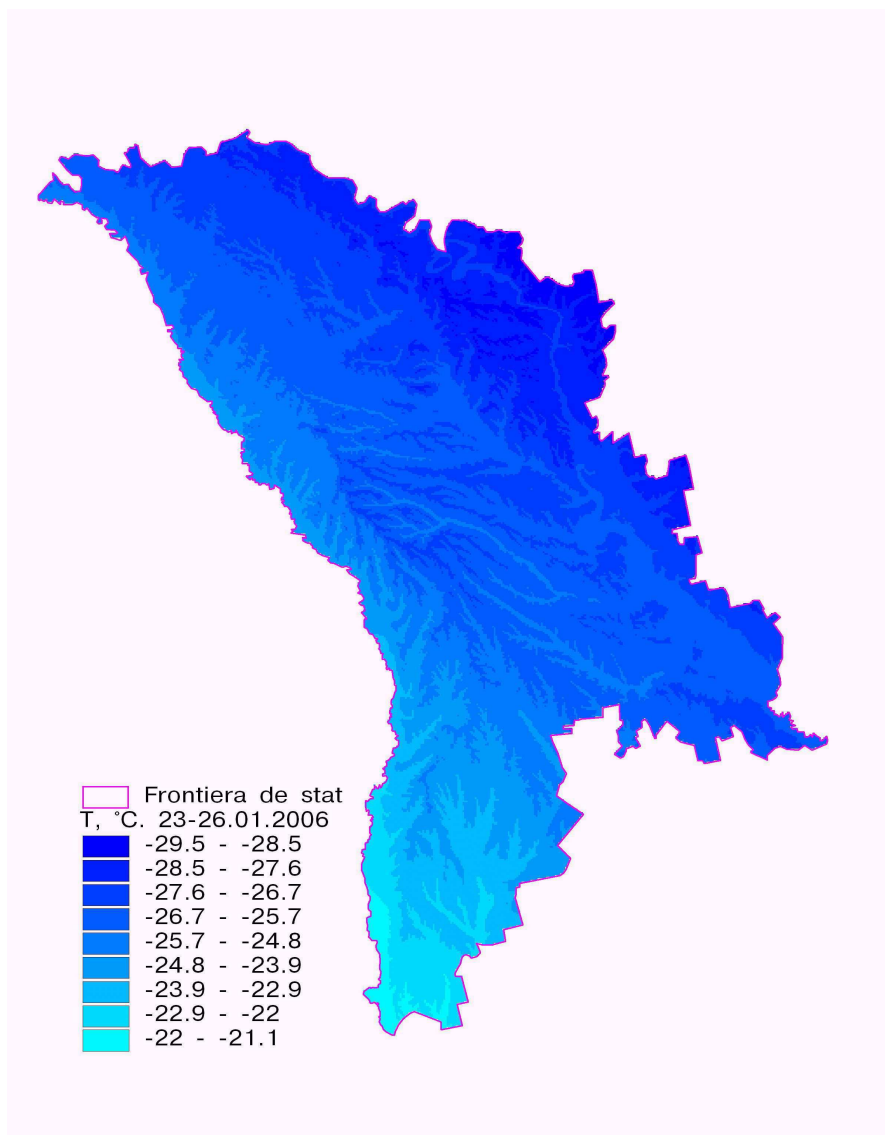
**Fig. 2.** The significance of the correlation between the longevity of a certain type of atmospheric circulation (after Vanghengheim) with gliding air temperature (11 years) and thermal anomalies for the period 1950-1993

As a confirmation of the related facts, at regional level we could use the significant thermal anomalies, registered in different seasons of the year 2006 and generated by the quasi-areal fluxes with low frequency waves (fig.3).



**Fig. 3.** Thermal anomalies and the type of areal atmospheric circulation (extreme temperatures from: a-January, b-May, c-October, 2006)

The geo-morphological conditions of the territory of the Republic of Moldavia, especially in the cold period of the year, „diversify” the distribution of the extreme temperature at spatial aspect. Using regional GIS, it became possible to outline te re-distribution of the extreme temperatures dependent on the local factors (fig. 4),



**Fig. 4. Redistributing extreme temperatures in the period 23.01-26.01.2006 on the territory of the Republic of Moldavia**

Leaving aside the warming tendency of winters, the thermal extremes mentioned above are catalogued climate risks [3]. The South of Moldavia registered in the winter of

the year 2006 the most extreme thermal anomalies, surpassing even the absolute minimum of the coldest winter of the century – that of the year 1963 (fig.5).

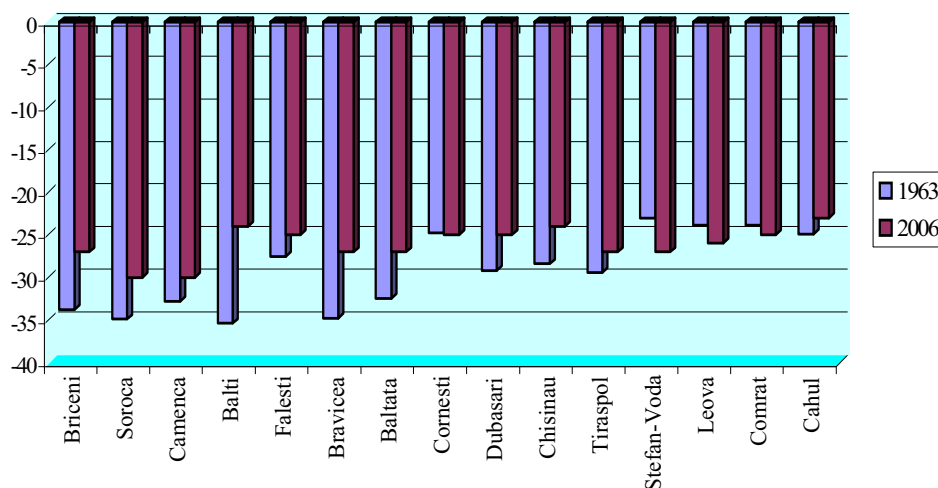


Fig. 5. Thermal anomalies (years 1963 and 2006) on the territory of Rep. of Moldavia

In the end, it can be mentioned that with the transition from the period of the meridional atmospheric circulation to the areal one, the frequency of negative anomalies in the cold period of the year will increase. The increase of the frequency of thermal anomalies conditioned in great part by the types of circulation opens new possibilities in conceiving methods for elaborating forecasts of meteorological extreme phenomena.

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