

# THE INCIDENCE OF HYDROLOGICAL WARNINGS AT NATIONAL LEVEL – INTENSITY AND SPATIAL DISTRIBUTION IN 2009



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**ABSTRACT.** – **The incidence of hydrological warnings at national level - Intensity and spatial distribution in 2009.** The hydrological warnings and alerts are instruments used to show the imminent production of hazardous hydrological phenomena at national or regional scale, revealed by exceedence of rivers defense levels of Danube and interior rivers. Also, the warnings contain associated phenomena including leaks down the hillsides, torrents and creeks. In 2009 were issued 26 warning messages regarding the formation of hazardous hydrologic phenomena, most of them concerning the river courses from the western part of the country respectively the catchment areas of the streams from Banat, Crișana, Maramureș and the lower sector of Mureș River. The temporal analysis revealed that the maximum frequency is associated with the cold season months and with the beginning of spring. The intensity of the predicted phenomena was generally moderate with several peaks recorded in January, March and November.

**Keywords:** hydrological warning, floods, river safety levels, color codes.

## 1. INTRODUCTION

Hydrological warnings are issued by the National Institute of Hydrology and Water Management, according to the specific observations and prediction assessment. The content of these messages relate to the presentation of the concerned phenomena's, their intensity and possible effects that may affect different geographical areas, the start of their time and duration. The coding procedures are using two distinct concepts: hydrological warning and hydrological alert.

*Hydrological warnings* are issued when is predicted the exceedence of defense river levels or the possibility of other phenomena or dangerous water to occur in near future (major slope leaks, water torrents, non-permanent streams with unusual behavior) based on weather forecasts. *Hydrological alerts* are issued when is predicted the inevitable exceedence of river defense levels and / or the formation of other hazardous fluid phenomena (major leaks down a hillside, water torrents, non-permanent streams with high discharge) based on weather forecasts and rivers status (Order 823/MMGA and 1427/MAI).

Hydrological warnings and alert messages are issued with a certain time of anticipation that enables decision makers in emergency management to take steps to defend human life and properties and other socio-economic objectives. The time

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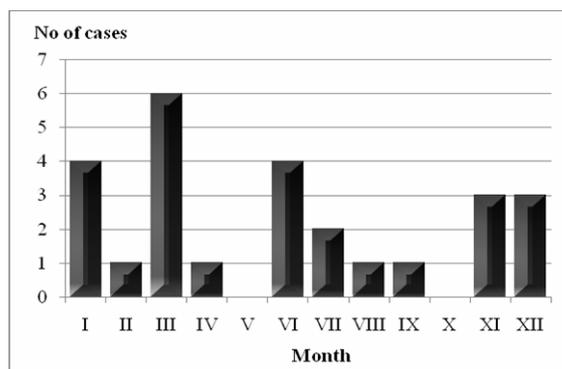
prediction is at least 24 hours for the watercourses that react quickly to falling rain and at least 2 to 3 days for a watercourse that react more slowly to falling rain or for flood events, which are spreading in the upper catchment areas.

Hydrological warnings and alerts include a message in which are presented the concerned affected areas along with the phenomena's which are expected to occur, their intensity and the forecast time for their duration. A map that shows the affected areas or river sections, which are colored according to certain codes used in assessing the intensity of dangerous phenomena (yellow, orange and red), completes the message. Thus, for marking the intensity of floods production, corresponding to a given area or a river sector will be use the following color code described in the following legislation orders: 823/MMGA and 1427/MAI respectively 638/2005 of MAI or 420/2005 of MMGA:

- *Yellow code*: Flooding risks or rapid increases in water level not leading to significant damages, which requires an increased vigilance on outdoor seasonal activities exposed to flooding events; this code is associated with the first defense water level;
- *Orange code*: Flooding risks which could generate significant water rises likely to have significant impact on the lives of communities and the safety of goods and people; this code is associated with the second defense water level;
- *Red code*: Major flooding risks; direct threat to the general safety of persons and goods. This code is associated with the third and most serious water defense level.

## 2. TEMPORAL ANALYSIS

During 2009, at national level were issued around 26 hydrological warnings, developed primarily for reporting imminent dangerous phenomena such as flash floods and inundations. By analyzing the warning issuing time, we can notice that the maximum frequency of these messages (eight posts) have occurred in winter, during melting snow periods, caused by the alternation of high positive



**Fig. 1. The monthly distribution of hydrological warning in 2009**

temperatures, with those specific to the cold season. Similar values, close to those recorded in winter season, were associated with spring and summer seasons (seven messages each). The least dangerous situations were identified in the autumn season, with only four cases.

A more detailed temporal distribution is shown in Figure 1. Thus, analysis of monthly incidence of hydrological warnings, shows that the most messages are



associated with the month of March (six cases), followed by January and June (four cases). The month of May and October were the most stable in terms of water hazards, with no single event associated with hydrological warnings.

Regarding the duration validity of the warnings have been recorded values that varied between 19 hours (hydrological warning of January 28) and 370 hours (hydrological warning of April 6). The mean time interval observed for these warnings was about 51 hours and 37 minutes.

### 3. SPATIAL ANALYSIS

Regarding the spatial analysis of hydrological warnings incidence we observed a higher tendency of some river basins, explained by the higher frequency of floods and inundations, due to the dominant occidental atmospheric circulation. Thus, the basins of the western half of the national territory were more frequent under hydrological warning messages in relation to those located in the east side (Table 1).

**Table 1. The frequency of major basins included in hydrological warning messages in 2009**

Message No. / Hydrogr. basins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Sum	
Tisa	*	*											*			*	*							*	*	*	8	
Someș	*												*	*	*			*	*					*	*	*	9	
Crișuri		*				*	*	*	*	*			*	*	*			*	*					*	*	*	14	
Mureș	*												*	*	*		*		*		*		*	*	*	*	10	
Banat					*	*	*	*	*	*			*		*	*	*	*	*	*	*	*	*	*	*	*	*	17
Jiu			*	*		*	*	*					*		*	*	*	*	*	*	*	*	*	*	*	*	16	
Olt			*			*	*						*	*	*	*	*			*	*	*	*				12	
Argeș-Vedea						*	*						*	*	*	*	*										7	
Buzau-Ialomița						*	*	*					*	*	*	*	*										8	
Siret		*			*								*	*			*			*							6	
Prut					*								*				*			*							4	
Dobrogea																				*							1	
Dunăre									*	*	*	*															4	
<b>Total</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>6</b>	<b>6</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>10</b>	<b>8</b>	<b>8</b>	<b>5</b>	<b>8</b>	<b>6</b>	<b>4</b>	<b>5</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>116</b>

If we exclude the two major basins with area centered at the national level (Mureș and Olt basin), we can notice that in the west were recorded 64 cases compared with 30 cases in the east part of the country (Fig. 2).

Through the direct analysis of watercourses exposed to hazard, we have notice a high variability regarding the number of rivers under threat hydrological alerts, with different degrees of intensity. The largest number of rivers, founded in a single alert was 24 streams, according to message no. 13 (issued in 02 June 2009) and in the message no. 16 (issued June 22, 2009). The minimum value of one



stream (Danube), was marked into message no. 11 (issued March 13, 2009) and 12 (issued on 06 April 2009). The average number of streams included in a hydrological warning was 12 units (Fig. 3).

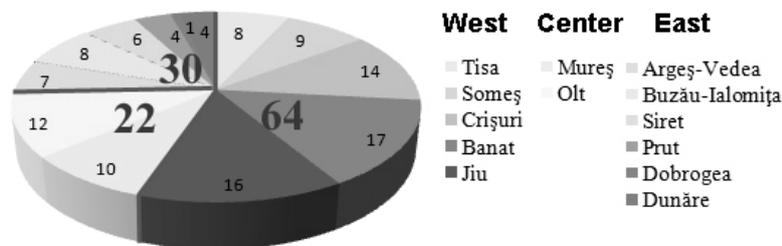


Fig. 2. The frequency of hydrological warnings on major hydrographic basins in 2009

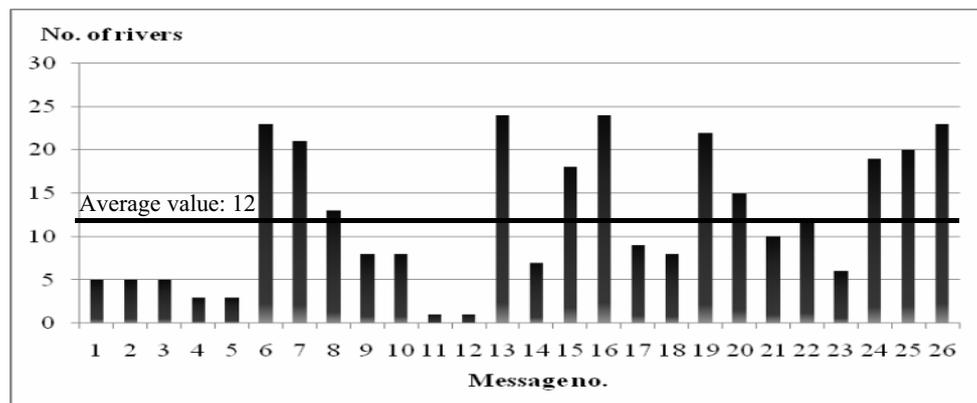
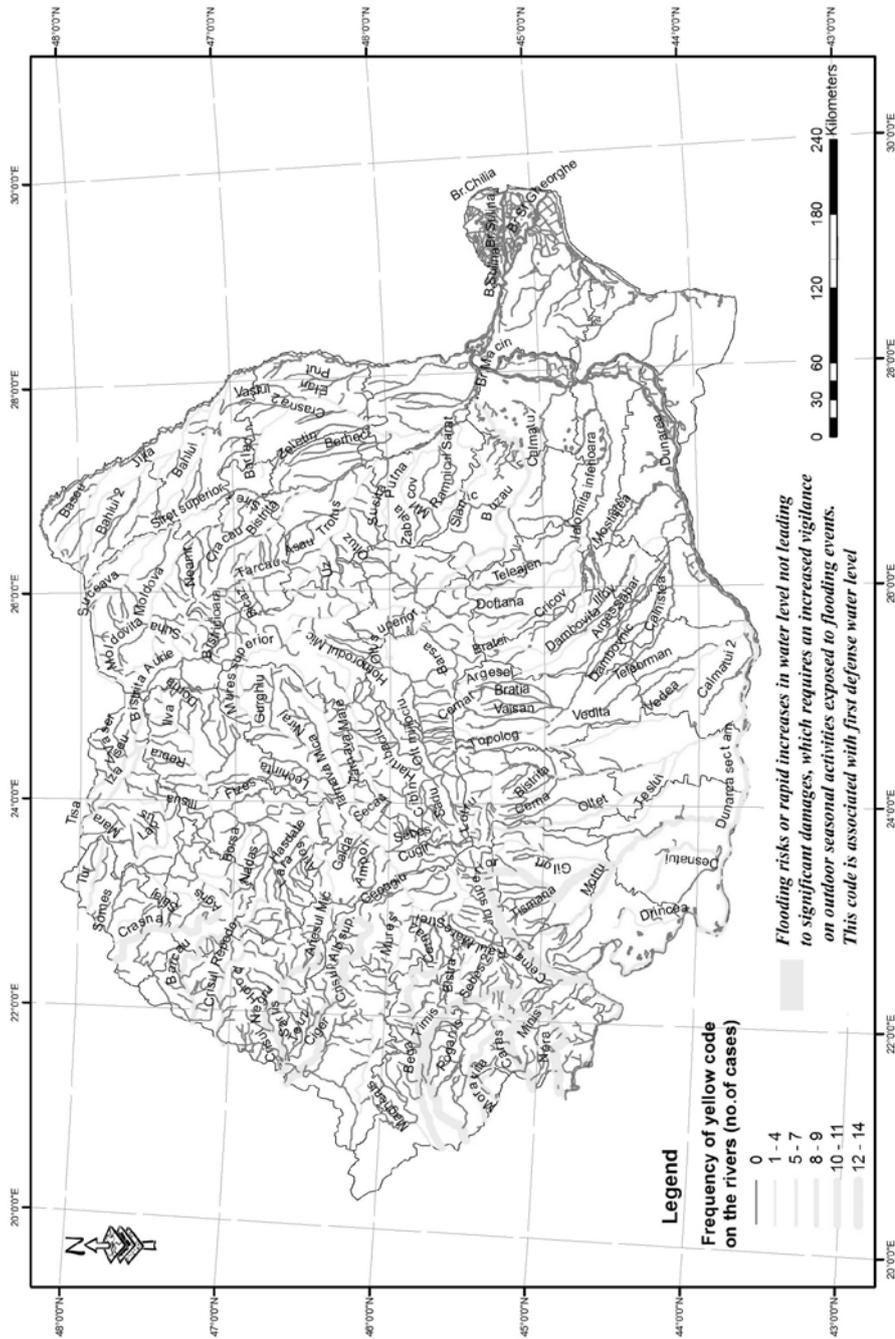


Fig. 3. The number of hydrographic basins included in the hydrological warnings

The territorial distribution of watercourses found under the incidence of hydrological warning messages based on the intensity of phenomena bound to take place is represented in figures 4 and 5. High frequencies regarding the incidence of the yellow code were recorded in the case of the following watercourses: Nera (14 cases), Carașul, Jiul on the upper sector and Cerna (13 cases each), Timișul (12 cases), Crișul Alb – upper sector, Bega and Crișul Negru (11 cases each), respectively Crasna (with 10 cases). High frequencies regarding the incidence of the orange code were recorded in the case of the following watercourses: Bârzava (five cases), Motrul – upper sector (4 cases), Jiul – lower sector (3 cases), Moravița and Jiul n the upper sector (two cases each).

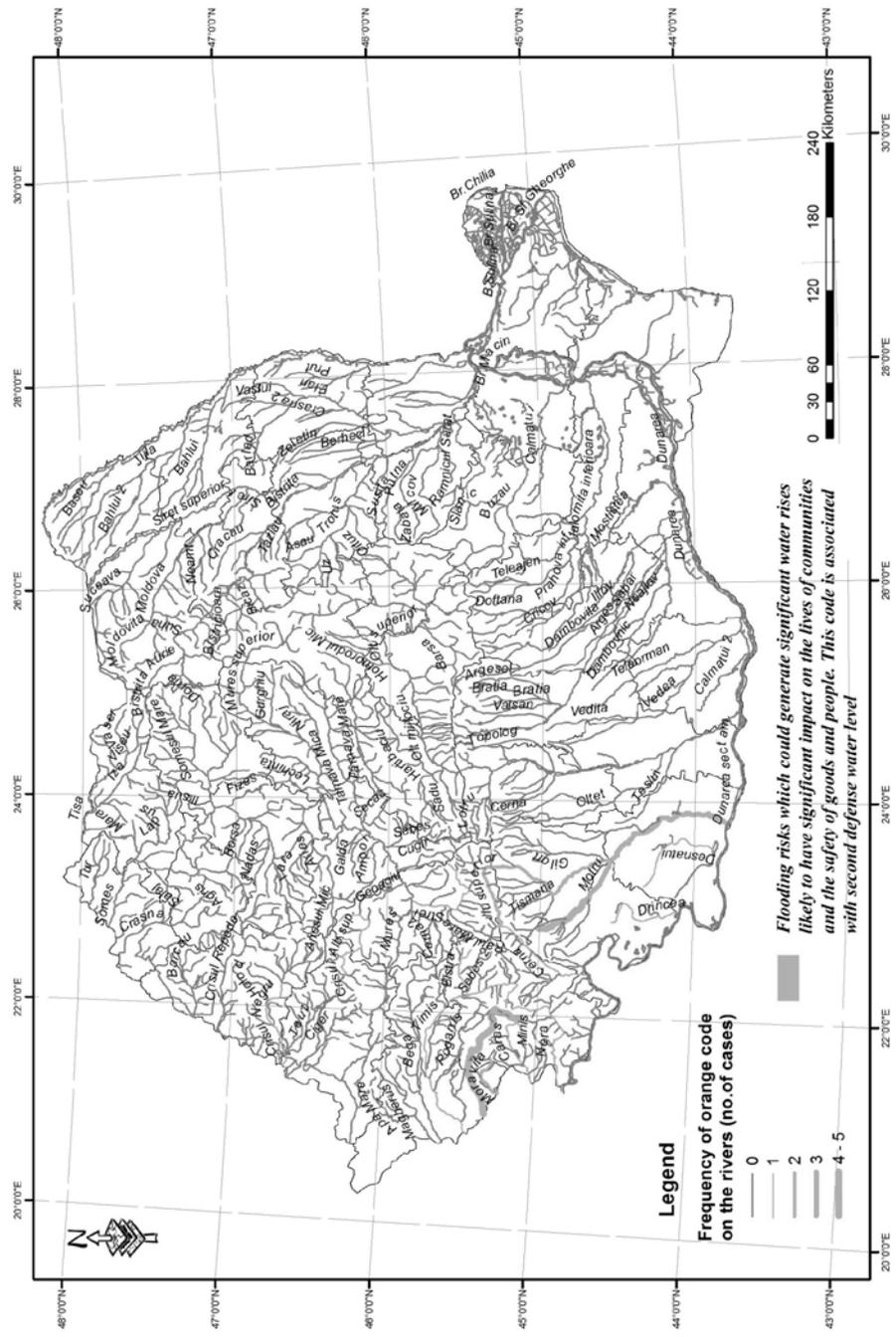
From the administrative point of view, the counties most frequently found under the incidence of major hydrologic warning messages were: Timiș, Caraș-Severin, Gorj and Dolj. On the other hand, throughout the year 2009, at national level, has been noticed that a few counties (Ialomița, Călărași, Giurgiu, Constanța and Tulcea) were avoided by hydrological hazards and were not include in threat alerts.



Flooding risks or rapid increases in water level not leading to significant damages, which requires an increased vigilance on outdoor seasonal activities exposed to flooding events. This code is associated with first defense water level

Fig. 4. The frequency of yellow code used in hydrological warnings issued in 2009





**Fig. 5. The frequency of orange code used in hydrological warnings issued in 2009**



#### 4. THE ANALYSIS OF THE PHENOMENA AND ITS INTENSITY

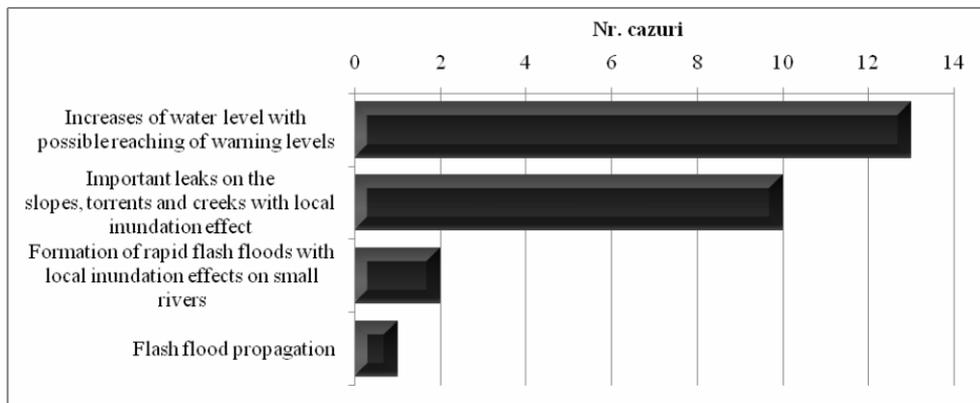
The phenomena for which the hydrological warning messages were emitted had a variable genesis being generally determined by heavy rainfall or by rain with low intensity, but with large accumulation over time, rapid melting of the snow layer, abnormal warming of air temperature that facilitated the formation of floes and ice blocks.

The majority of the hydrologic phenomena took place along the natural watercourses being connected mostly to the excedentary water volume, which led to overflowing from the riverbed, usually resulting in: high waters, flash flood and inundations.

Through the analysis of the phenomena bound to take place within the hydrographic basins at national level, three major categories can be detected:

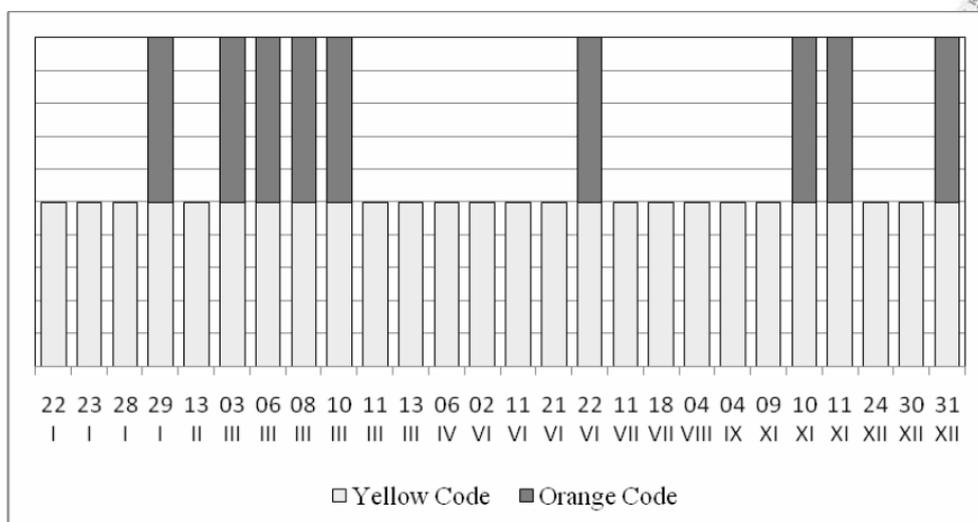
- Increases of water level with possible reaching of warning levels;
- Flash flood propagation;
- Formation of rapid flash floods with local inundation effects on small rivers;
- Important leaks on the slopes, torrents and creeks with local inundation effect.

For highlighting the first category 13 messages were emitted, one for the second one, two for the third one and 10 messages for the last category. (Fig. 3)



**Fig. 3. Phenomena types for the hydrologic warnings emitted in 2009**

The intensity of the phenomena was highlighted through the chromatic expression mentioned above, correlated with the probability of reaching or over passing of defense limits (warning inundation and danger level). This way, from the intensity frequency of the phenomena through color-coded quantification, we can conclude that in most of the cases low intensity phenomena was signaled, expressed through a yellow code (Fig. 4).



**Fig. 4. Chromatic code occurrence in hydrologic warnings throughout**

In just nine of the emitted warning messages were predicted phenomena with medium amplitude intensity that had to be associated with the orange code. There were no exceptional situations signaled that would impose the use of the red code for high intensity phenomena. With only one exception (the message from 22 June), all other orange code messages were related to the cold period of the year correlated with the presence of the snow layer (January, March, November, December).

## 5. CONCLUSIONS

Hydrologic warnings throughout 2009 were expressed through chromatic evidence (color codes) regarding hydrological risk phenomena with effect on water levels in correlation with society goods. Their analysis shows the fact that the west side of the country is exposed to higher inundation risks, on the account of triggering factors that sit at the basis of these hydrological hazards.

The prevalence of the watercourses on the west side of the country is justified by the genesis of hydrological risk phenomena, which is expressed by relatively rich pluviometric status in this area, imposed by the Mediterranean cyclones, and by the western circulation fronts. Thus, warnings refer to major watercourses that accumulate surplus water from the hills and by collecting the water volumes drained by tributaries.

The intensity of hydrological phenomena was moderate to high, nine from the total of 26 warnings emitted were orange coded. From the particular analysis of the river studied, we can observe the fact that four of them had an equal or superior average with the total of the messages emitted (Nera, Carașul, Jiul – upper sector and Cerna).



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