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## **AWARENESS POPULATION WITH INSTRUMENTS USED IN DANUBE WATER**

Danube is the most international river on Earth and the largest river of the European Union in terms of length, basin surface, water and sediment discharge (6470 mc/s and 1555 kg/s, respectively; McCarney-Castle, 2012). As it flows over 2870 km from the source in Germany to the delta at the Black Sea coast, Danube crosses 10 countries and collects its waters from 19 countries in a basin covering 817,000 km<sup>2</sup>. The variation in stage is large (i.e., 10.5 m), placing the Danube immediately after the Mississippi river in this respect (Vidrașcu, 1921). After its emergence from the Iron Gates Dam, an extensive natural floodplain bordered the Danube along its lower course, studded with many lakes rich in fish and other wildlife.

Danube's floodplain varies in extent along its lower course. Immediately downstream of the Iron Gates Dam, which is the upper limit of Danube's lower course, the floodplain is narrow and occurs only sporadically. At Ostrovul Mare the floodplain starts to broaden preferentially on the left bank (Romania) with the width of the floodplain varying between ~200 m near Calafat and ~30 km in Balta Brăilei. On the right bank, in Bulgaria, the floodplain appears as a narrow fragmented strip that was largely embanked before World War II. In Romania, about 75% of Danube river length is embanked.

In Romania, the National Hydrological Forecasting Center acting in the frame of the National Institute of Hydrology and Water Management (NHFC - NIHWM) is responsible for issuing hydrological warnings and forecasts for short, medium and long terms, activities aimed mainly to avoid casualties and reduce the damage caused by dangerous hydrological phenomena.

Hydrological warnings and alerts consist of a national map accompanied by a text message specifying the forecasted period, river areas/sectors that may be affected by dangerous hydrological phenomena and the intensity of the phenomenon for each river area/sector.

In order to point out dangerous hydrological phenomena intensity corresponding to a river sector / area hydrologic warnings and alerts use the following color codes: Yellow (above WARNING LEVEL), Orange (above FLOODING LEVEL), Red (above DANGEROUS LEVEL).

In 2014 the National Hydrological Forecasting Center of the National Institute of Hydrology and Water Management issued in the eligible area 19 warnings and 55 alerts for internal rivers and also for the Danube river. The frequency of hydrological warnings in 2014 on the main rivers sectors within the catchments in the eligible area

was calculated to know which are the prone flooded area and to see how many people have been warned (fig. 1).

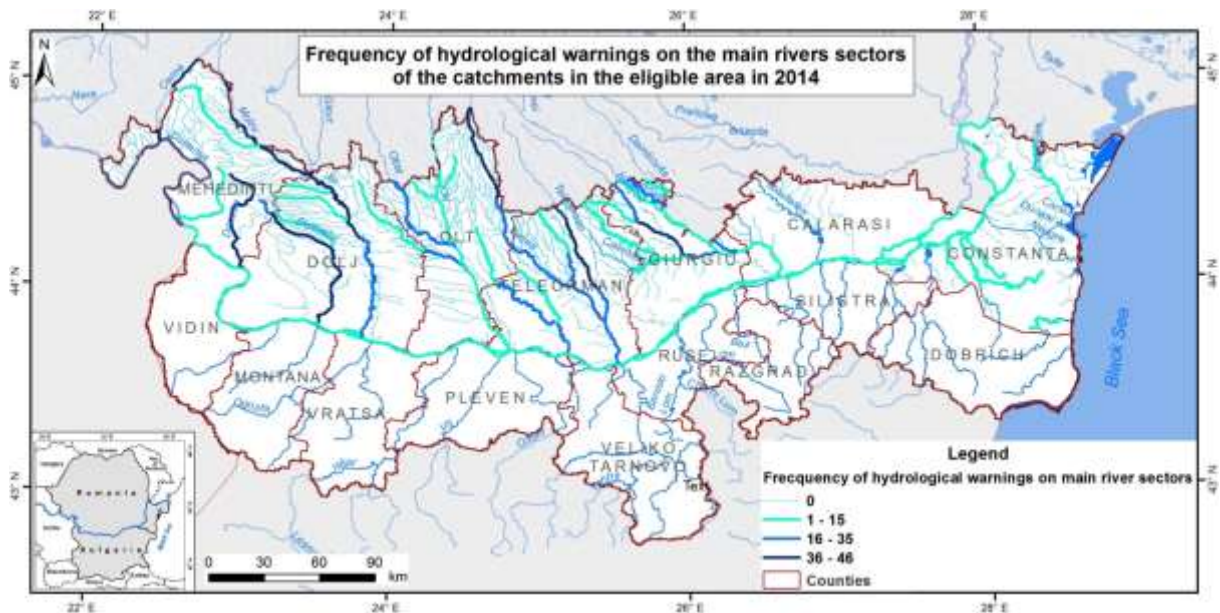


Fig. 1 – Frequency of hydrological warnings and alerts in 2014

In 2014 were issued 5 hydrological alerts on the Danube river where the recorded levels exceeded the DEFENSE LEVELS.

In May 2014 the discharge values recorded at the entrance into the country (Baziaş section) were increasing from 7,400 m<sup>3</sup>/s on the first day of the month to 9000 m<sup>3</sup>/s on May 9, down to 7400 m<sup>3</sup>/s on 14 and 15 May (monthly minimum), increasing to 13,200 m<sup>3</sup>/s on 22 May (monthly maximum), then decreasing to 10100 m<sup>3</sup>/s on the last day of the month.

Between 12 and 16 May 2014 significant rainfall quantities were recorded mainly on the tributaries of the Danube from Croatia, Bosnia-Herzegovina and Serbia, which have frequently exceeded locally 200-220 mm, respectively 100-170 mm on extended catchment areas.

Due to these particularly significant rainfall quantities recorded during this period, especially in the basins of the main tributaries of the Danube (Sava and Morava), exceptional floods occurred in many river basins. They have reached or even exceeded historical values and, as a result of these extremely dangerous hydrological phenomena which were extremely severe, authorities in Serbia and Bosnia - Herzegovina instituted State of Emergency.

The propagation and composition of these floods determined a significant increase of discharge on the Danube entering the country, with a maximum discharge value of 13,200 m<sup>3</sup>/s (recorded on 22.05.2014). Due to the propagation of this flood on the Romanian Danube sector, the recorded levels exceeded the DEFENSE LEVELS (fig. 2). Tables 1 and 2 show the situation of maximum recorded level and discharge values at the main hydrometric stations on the Romanian Sector downstream the Iron Gates Dam, as a result of the propagation of the flood on the Romanian Danube sector.

Table 1 - Exceeding of Flood and Danger Levels in May 2014 on the common Danube River sector

River	Hydrometric Station	County	Maximum Level (cm)	Maximum Discharge (mc/s)	Day	Difference compared to FLOOD LEVELS	Difference compared to DANGER LEVELS
Danube	Calafat	DJ	688	12290	23.05.14		680+8
Danube	Bechet	DJ	694	12280	23-24.05.14	600+94	
Danube	Corabia	OT	616	12220	24.05.14	550+66	
Danube	Tr. Măgurele	TR	635	12820	25.05.14	550+85	
Danube	Zimnicea	TR	679	12701	24-25.05.14	610+69	
Danube	Giurgiu	GR	663	13010	24-25.05.14	640+23	
Danube	Oltenița	CL	651	12520	25.05.14	630+21	
Danube	Călărași	CL	622	13122	26-27.05.14	620+2	

Table 2 - Exceeding of Attention Levels in May 2014 on the common Danube River sector

River	Hydrometric Station	County	Maximum Level (cm)	Maximum Discharge (mc/s)	Day	Difference compared to ATTENTION LEVELS
Danube	Călărași	CL	622	13122	26-27.05.14	620+2

In terms of monthly extreme maximum flows recorded in 2014, we can emphasize the fact that the maximum discharge of 13200 m<sup>3</sup>/s recorded in May 2014 is the historical value, equal to the one recorded in May 2006). In April 2006, the Danube levels reached historical values and caused significant damage. Floods occurred downstream of the Iron Gates Dam not because water overtopped the levels but because of their natural failure through pipping.

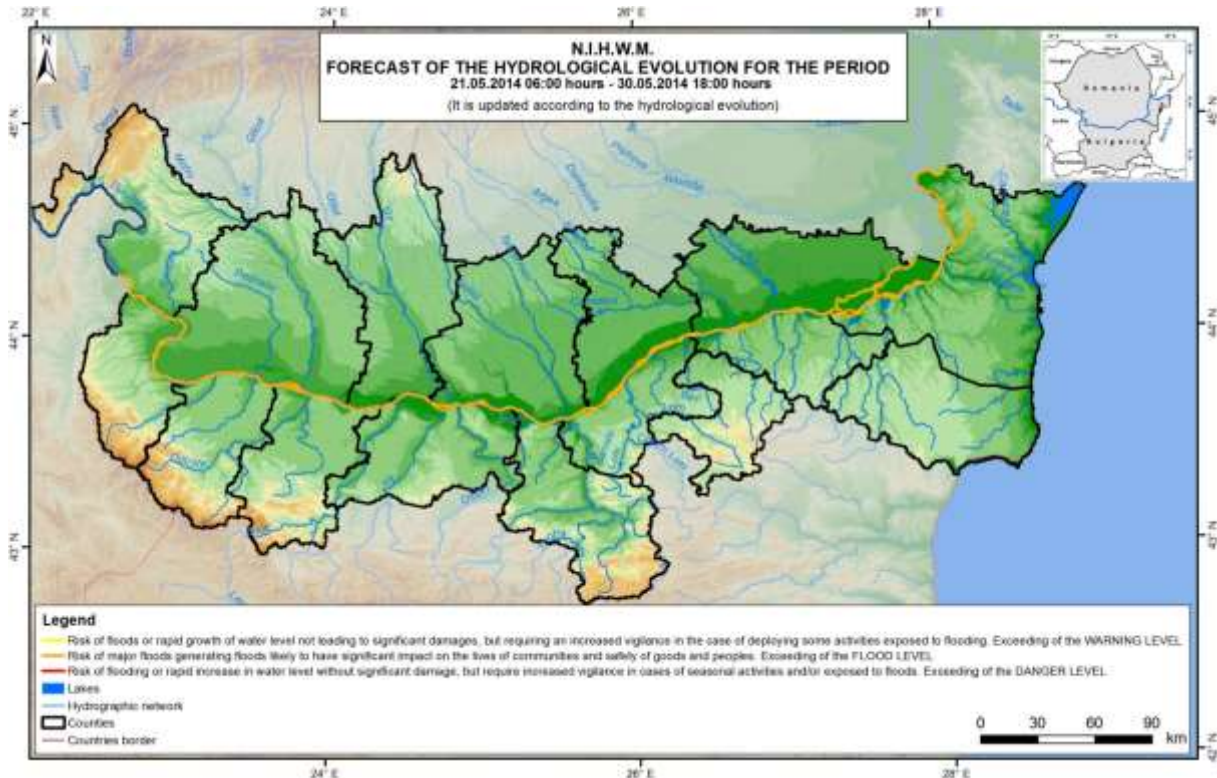


Fig. 2 - Hydrological alert map for 21-30 May 2014

The casualties and the damages recorded in 2014 in the seven counties of the eligible area are shown in the table below.

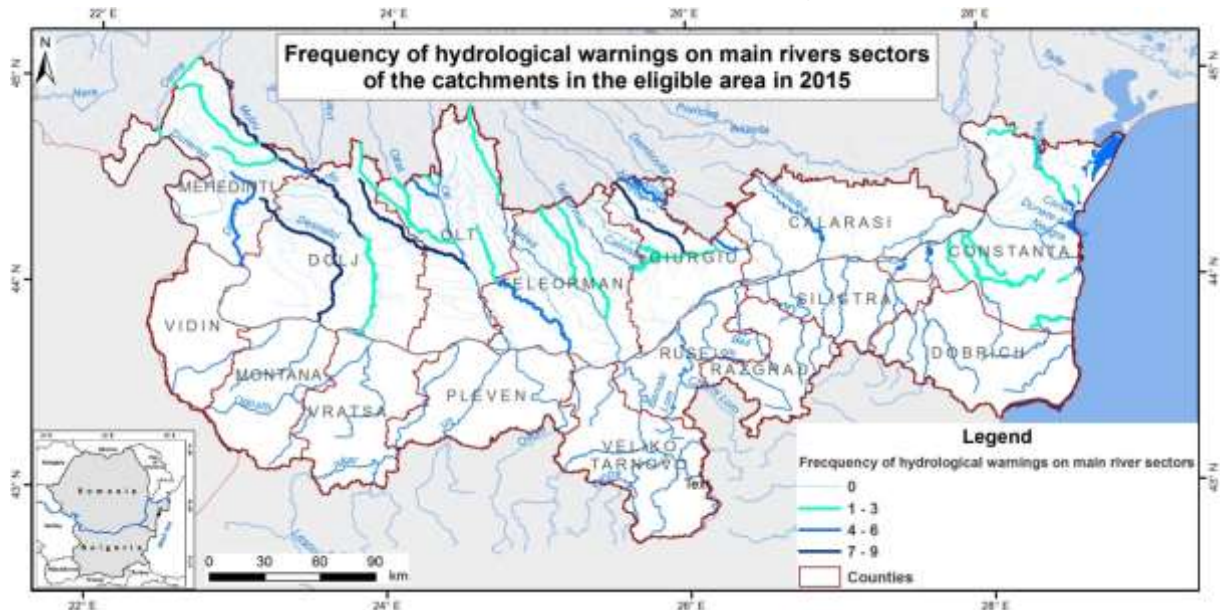
County name	No. affected localities	Casualties	Houses	Household annexes	Socio-economic objectives	Bridges	Main roads (km)	Secondary roads (km)	Railroad (km)	Agricultural land (ha)	Fountains	Grassland (ha)	Forest (ha) Hydro. constructions	Water supply	Other damages Mii Lei	Total Mii lei	
Calarasi	2		284	57						492,52						1117	
Dolj	79		443	1387	1	29	77			8052	512	3590	7271				
Giurgiu	28		134	11	6	14	2			6412,006			378		6294	455689	
Mehedinti	199	3	196	207	11	142	884	239	1	5450	88	2670	16	20	12227	139576	
Olt	218		2226	662	50	476	396	452	1	56465,92			3	24	7	25218	223984
Teleorman	123		360	1447	7	680	169	186	14	15.073,68	1466	3026	5418	22	249	96227	
Constanta	35		30		3	1		26		13.480,15					83	22338	
<b>TOTAL</b>	<b>684</b>	<b>3</b>	<b>3673</b>	<b>3771</b>	<b>78</b>	<b>1342</b>	<b>1359</b>	<b>903</b>	<b>16</b>	<b>105426</b>	<b>2066</b>	<b>9286</b>	<b>5799</b>	<b>62</b>	<b>27</b>	<b>44102</b>	<b>528811</b>

These hydrologic warnings and alerts issued in 2014 for the eligible area were posted on the website of the project <http://danube-water.eu/ro/> creating a link with “Romanian Waters” National Administration website [www.rowater.ro](http://www.rowater.ro). **Until now the project site has registered 500 visitors since August 2015.**

Towards the end of 2014 an external portal was created [www.danube-water.ro](http://www.danube-water.ro) through external consultancy services: contract no. 686/28.07.2014 for implementation of an information integrated system for Danube WATER project.

Since the beginning of this contract several hydrologic warnings and alerts for the eligible area were made public on the external portal: 16 hydrologic warnings and 4 hydrologic alerts in 2015.

Frequency of the hydrological warnings in 2015 for the main rivers sectors of the catchments in the eligible area was calculated to know which are the prone flooded area and to see how many people have been warned (fig. 3).



*Fig. 3 - Frequency of hydrological warnings and alerts in 2015*

In Romania 94 hydrological warning and alerts were analyzed at river sector level.

**In Annex 1 are listed all the settlements that have been warned both in 2014 and 2015. The activity accomplished in the mentioned period was very helpfully for people information regarding the forecasting bulletins posted on the project portal (in total 871.559 inhabitants, from Mehedinti, Dolj, Olt, Teleorman, Giurgiu, Calarasi and Constanta counties).**

Romanian hydrological forecast was reconfigured starting this project due to the Bulgarian hydrometric gauging stations from which we get the hydrological forecast as input in Romanian forecast models.

**Until now the project portal has registered 200.000 visitors.**

The National Institute of Meteorology and Hydrology is the Bulgarian National Hydrometeorological Service (BNHMS).

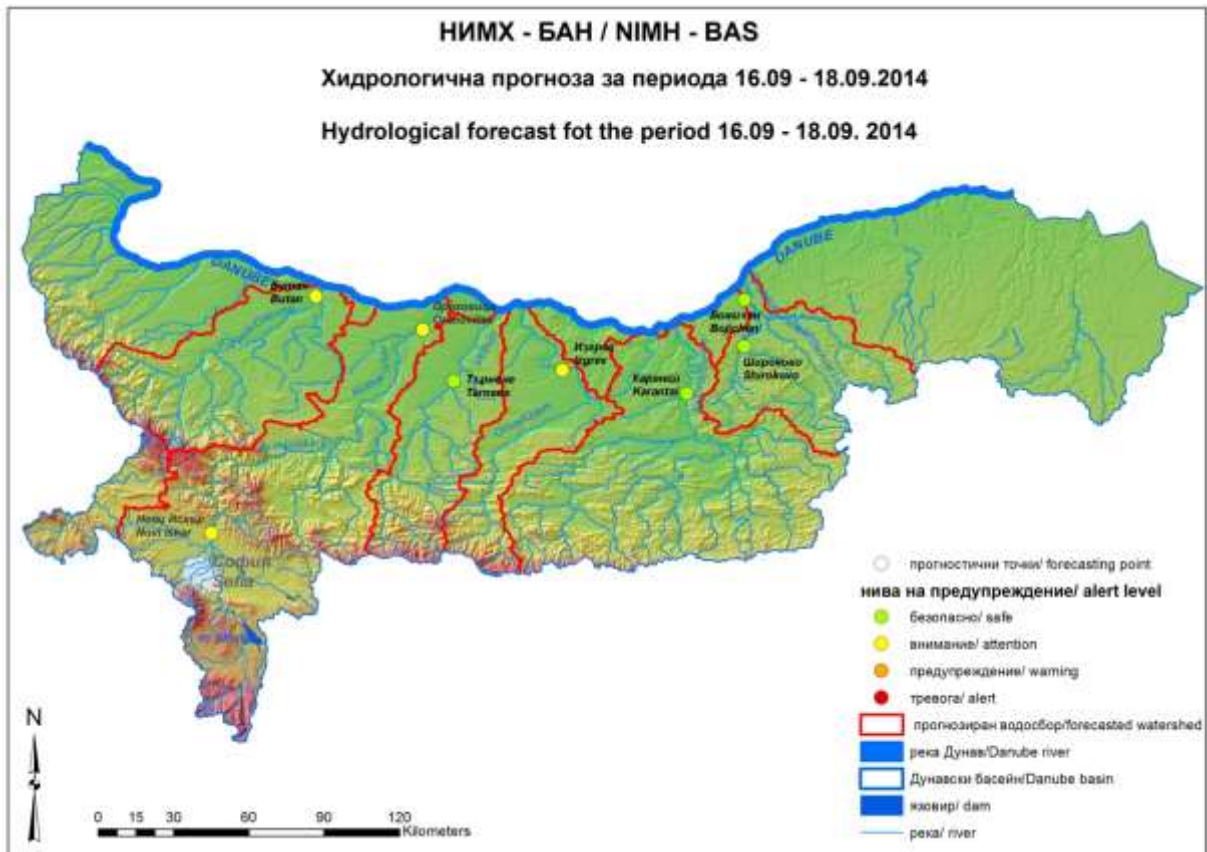
The primary mission of the NIMH-BAS is to provide meteorological and hydrological information and services to different organizations and users in Bulgaria, covering the territory of the country and the Black Sea.

Meteorological and hydrological observations, data acquisition and telecommunication, monitoring of chemical components of surface, marine and ground water and air quality, meteorological, hydrological and marine forecasts, assistance to special sectors as marine transport, tourism, offshore activities and marine ecology, maintenance of data base and data exchange, scientific research, numerical and statistical modelling and many other tasks are part of the duties of the NIMH-BAS.

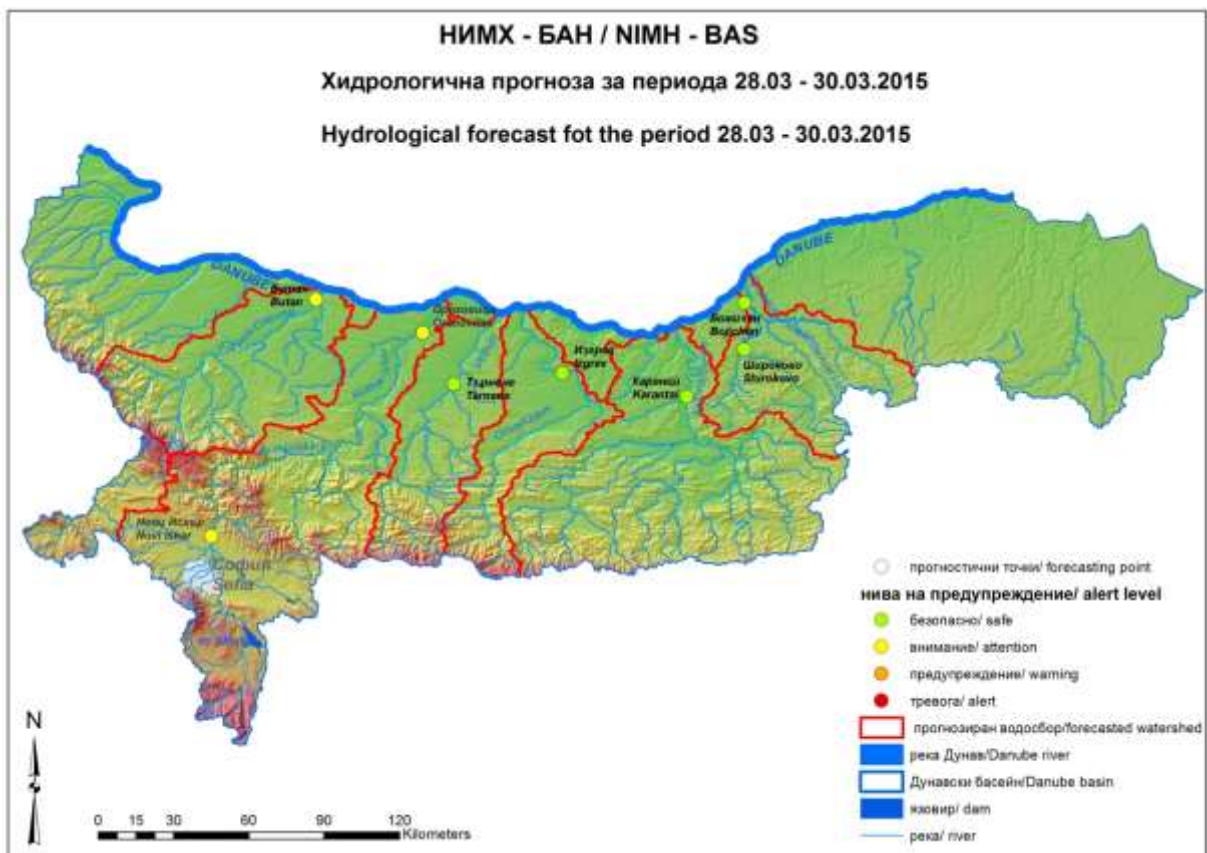
Core elements of the NIMH-BAS are Central Body in Sofia and four Regional Centers.

Each of the Regional Centers manages the activity of its part of the national observing system. They collect the data from the observing stations and exchange it with the Communication center in Sofia.

Bulgarian partners from the National Institute of Meteorology and Hydrology selected 3 main significant hydrological warnings for the period 2014-2015 (fig. 4-6). This hydrological warnings were on the main tributaries of the Danube river and the maps highlight the importance of this tributaries in the current hydrological forecast activity.



*Fig. 4 - Hydrological warning map for 16 - 18 September 2014*



*Fig. 5 - Hydrological warning map for 28 - 30 March 2015*

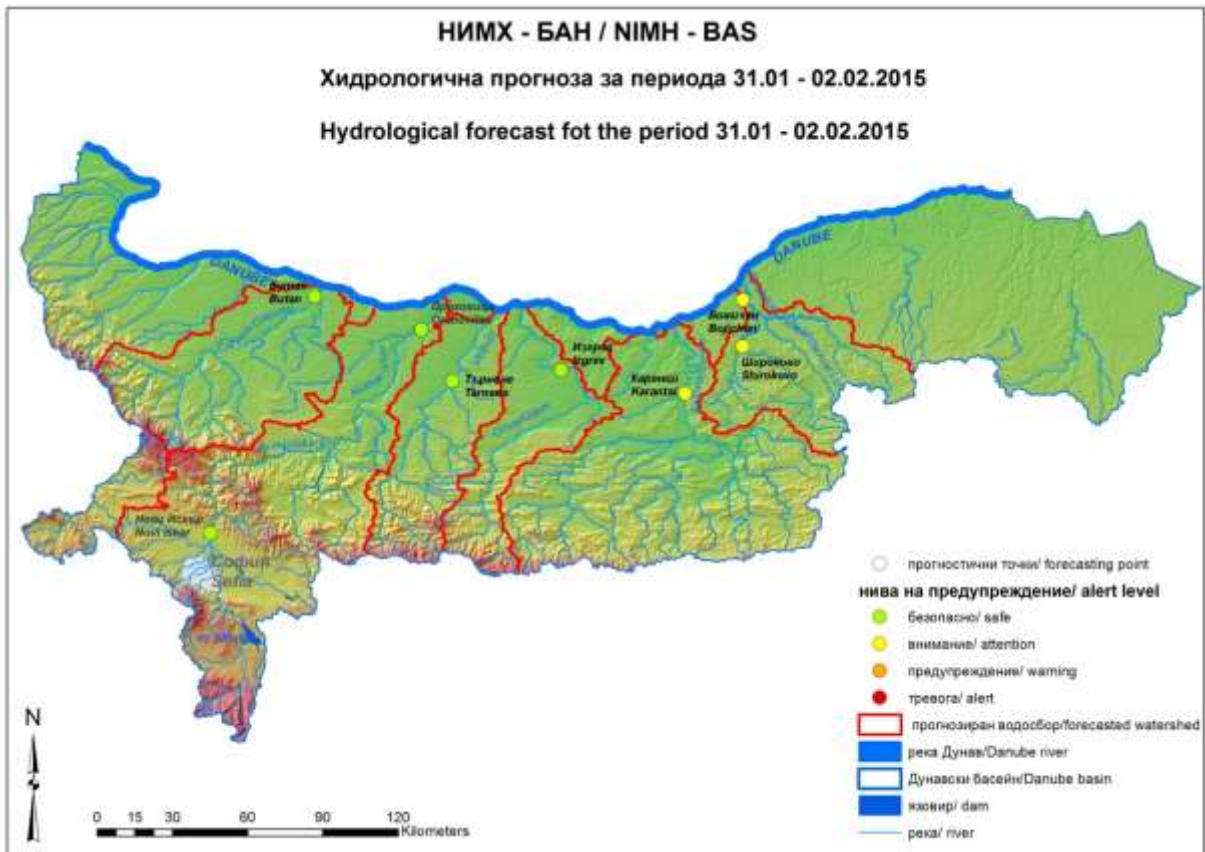


Fig. 6 - Hydrological warning map for 31 January – 2 February 2015

The Danube WATER project was aimed to improve the forecasting methods by developing a common model, and warning through increased accuracy and reliability based on modern means of communication between the two countries.

**In conclusion for the whole eligible area of 71544 square kilometers for 36324,4 square kilometers were issued basin hydrological forecasts in Romania and for 15521 square kilometers were issued basin hydrological forecast in Bulgaria, meaning 72,5 % from the total eligible area (fig. 7).**

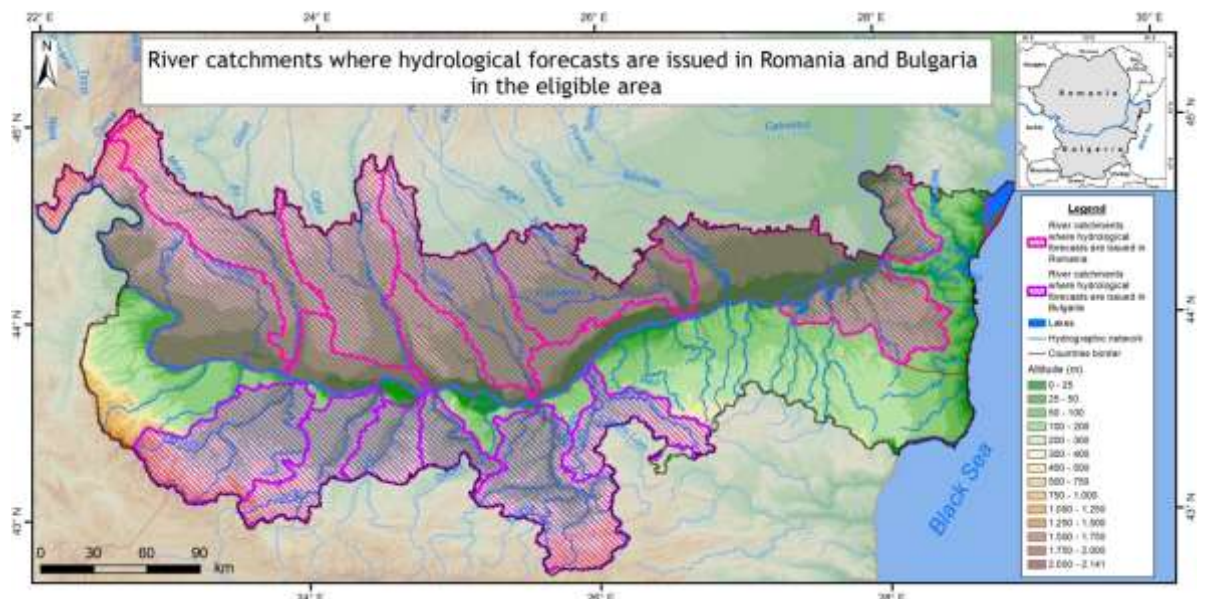


Fig. 7 – River catchments where hydrological forecasts are issued for the eligible area

In Romania for the rivers flowing to Black Sea hydrological forecasts are issued but were not included in this analysis (3041,9 km<sup>2</sup>).

Table 3 – River catchments where hydrological forecasts are issued in Romania and Bulgaria for the eligible area

No. Crt.	Forecasted watershed	Area (kmp)	Country
1	Dunare	19886,5	Romania
2	Cerna	79,5	
3	Nera	0,15	
4	Jiu	3967,7	
5	Olt	4326,6	
6	Vedea	3897,5	
7	Arges	4144,9	
	<b>TOTAL</b>	<b>36324,3</b>	
1	Ogosta	4223,9	Bulgaria
2	Iskar	2425,8	
3	Vit	1457,3	
4	Osam	1145,7	
5	Yantra	4320,2	
6	Rusenski Lom	1948,6	
	<b>TOTAL</b>	<b>15521,6</b>	

For the Bulgarian territory hydrological forecasts for the Danube river catchment are not issued. For the eligible area there are only 6 river catchments where hydrological forecasts are issued (table 3).