



“NETWORK OF DANUBE WATERWAY ADMINISTRATIONS”

South-East European Transnational Cooperation Programme

**STATUS QUO REPORT ON HYDROLOGICAL
ACTIVITIES**

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LIST OF ABBREVIATIONS

ABBR.	Abbreviation
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AFDJ	River Administration OF the Lower Danube
ANM	National Meteorological Administration
DC	Donau Commission
GSM	Global System for Mobile Communications
INMH	National Institute of Meteorology and Hydrology
MT	Ministry of Transport

SCOPE OF DOCUMENT

This document , in the NEWADA project, describes the main hydrological activities of AFDJ , on the Romanian section of the Danube. The report contain information about measuring activities, gauging equipments, applying data processing, hydrological conditions and forecasting, extreme flows and flood disasters

The document , within Activity 3.1, improve methods, process and procedures for hydrophical activities and will contribute for the strategy plan for intensification of cross-border activities.

3 MONITORING NETWORK

3.1. Description of water gauge station

As part of a highly important hydrological monitoring the evolution has a water level. For this there are water stations that are equipped to help groom hydrometric daily water level readings (figure 1).

Opening requirements of Maritime Navigation was preceded by the Danube's mouth when making a scientific research program on knowledge of basin and hydrologic conditions in the Danube Delta.

When conducting such research, in the months December 1856 - August 1857 are the first measurements of the Black Sea at the mouth of arms Sulina and Saint George, fixing the reference plane "Zero" Black Sea-Sulina, materialized on the foundation of central headlamp Sulina (still existing) with a metallic marker at the rate of 4.88 feet (1.4874m) above the reference plane respectively. Compared to the reference plane were reported all topo-hydrographic work carried out then and later in the Danube Delta Danube.

After national independence in 1878, the Romanian State surprise move to install new gauging

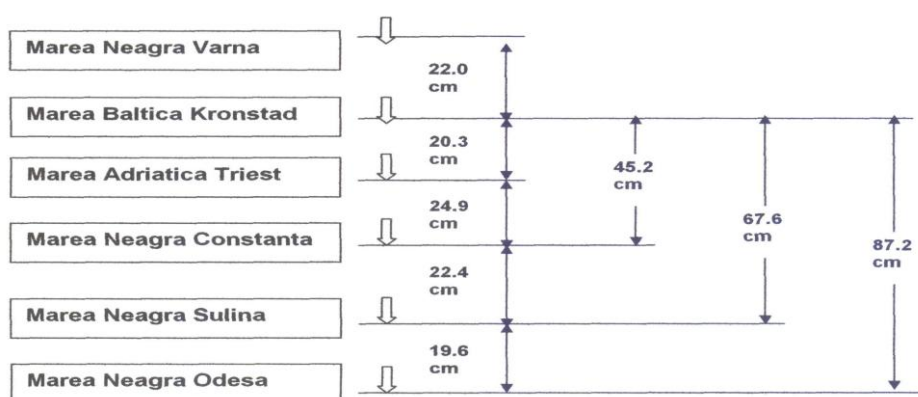
Figure 1. Hydrometrical inclined gauge station Giurgiu



the economic importance of all points on the river at that time. In the years 1879-1880 to install hydrometric levels groom 8 ports Drobeta-Turnu Severin, Calafat, Bechet, Turnu Magurele,

Zimnicea, Giurgiu, Oltenita and Calarasi, systematic measurement and observation levels glaciers. Next to install other groom gauging the Danube (at Moldova Veche in 1893, the Svinița in 1893, at Gruia in 1898 , the Bistret in 1899, at Cernavoda in 1896, the Hârsova in Isaccea in 1898 and 1895).

Figure 2. Reference system plan



How to obtain such data and items of hydrological regime of the Danube, observation changes the system used for measuring levels of graduated rulers, called wonder hydrometric, installed on foundations established with other relevant systems improved. (figure2).

Using hydrometric groom could accumulate in the last 150 years an important background data on the system accurate water level Danube Delta and Black Sea. For the reference contour's maps in the Danube basin, three systems were adopted by reference Adriatic, Baltic and Black Sea. The Black Sea basin system plans to exit several references, Sulina, Constanta, Varna, Odessa, Sevastopol, Kerch, Poti, Batumi and others (table 1).

Table 1. Particulars of the main surprise gauging the Danube on the Romanian bank.

Gauge station	Year of establishment	Distance to Sulina km	catchment area	share groom absolute gauging relative origin of the reference systems				
				United North Sea	Adriatic Trieste Sea	Baltic Sea Kronstad m	Black Sea Sulina m	Black Sea Varna m
Bazias	1874	1072	-	-	63,87	63,56	64,17	-
Moldova Veche	1893	1049	-	-	62,39	62,38	63,02	-
Drencova	1854	1015,8	573412	-	59,62	59,47	60,11	-
Svinita	1893	995	-	-	49,59	49,28	50,06	-
Orsova	1838	955	576232	-	43,87	43,91	44,36	-
Turnu Severin	1879	931,1	578300	-	33,67	33,36	34,13	-
Gruia	1898	851	-	-	-	28,07	29,10	-
Cetate	1899	811	-	-	-	26,46	27,79	-
Calafat	1879	794,4	588620	-	-	25,94	26,68	-
Bistret	1899	725	-	-	-	23,11	23,88	-
Bechet	1880	679	-	-	-	21,31	22,08	-
Corabia	1879	630	623350	-	-	19,49	20,12	-
Turnu Magurele	1879	597	-	-	-	18,34	19,13	-
Zimnicea	1879	554	658400	-	-	15,29	16,22	-
Giurgiu	1879	493	676150	-	-	12,58	13,06	-
Oltenita	1879	430	684900	-	-	9,53	10,01	-
Calarasi	1879	364,8	-	-	-	6,79	7,31	-
Parjoaia	1951	348,5	-	-	-	5,34	5,87	-
Unirea	1952	341(70)	-	-	-	-	6,00	-
Cernavoda	1896	300	707000	-	-	4,36	4,87	-
Harsova	1898	252 ,3	709100	-	-	2,58	3,08	-
Vadu Oii	1953	238	-	-	-	-	2,63	-
Braila	1874	170	726700	-	-	0,45	1,08	-
Galati	1874	150	-	-	-	0,28	0,86	-
Isaccea	1895	103,5	-	-	-	0,09	0,63	-

Ceatal Ismail	1928	80	-	-	-	-	0,57	-
Tulcea	1879	71,3	807000	-	-	0,00	0,56	-
Chilia Noua	1919	47,0	-	-	-	- 0,33	0,36	-
Sulina	1857	0,00	817000	-	-	- 0,69	0,00	-

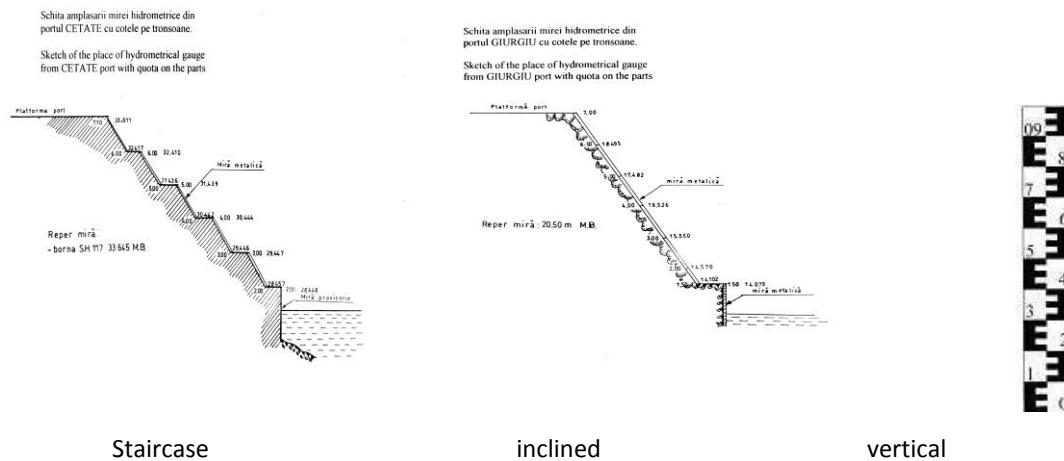
During the cold season of the year, in winter when frost phenomenal occur, when measurements of levels are observed and the nature of ice (ice or fixed bridge) measuring the thickness of the ice near shore. In case of ice jams in the hydrometric groom, which affect natural drainage system, corrections are made to wonder local levels, using correlation levels with neighboring points uninfluenced by ice. For monitoring the water level along the Danube, there are a number of 29 gauges mounted usually in the ports area, with next characteristic values (table 2).

Table 2. Characteristic values of annual minimum annual levels and their trends for the years 1931-2004, the groom gauging the Danube

Gauge station name	position km	Maximum cm	year	average cm	minimum cm	year	1931 cm	Tendency cm/an
Gruia	851	178	1955	-11,6	-196	1985	- 8,2	- 0,092
Cetate	811	200	1955	29,6	-111	1954	32,7	- 0,08
Calafat	794,4	195	1955	20,3	-128	1985	37,6	- 0,46
Bechet	679	169	1955	25,1	- 90	1954	23,8	0,035
Corabia	630	202	1955	10,9	-138	2003	22,0	- 0,295
Turnu Magurele	597	160	1955	20,7	- 71	1954	14,4	0,17
Zimnicea	554	213	1955	33,0	- 86	1954	31,7	0,035
Giurgiu	493	202	1955	- 9,35	-309	1954	15,1	- 0,65
Oltenita	430	214	1955	103	-120	1954	0,82	0,245
Calarasi	364,8(94,4)	183	1955	- 28	-141	2003	- 24,7	- 0,084
Cernavoda	300	148	1955	- 67,7	-245	1969	- 43,8	- 0,605
Harsova	252,3	257	1955	6,7	-125	2003	12,4	- 0,144
Braila	170	275	1955	59,4	- 61	1954	23,5	0,909
Isaccea	103,5	212	1955	44,9	- 35	1946	19	0,657
Tulcea	71,3	178	1955	37,2	- 24	1947	-16,5	0,55

Depending on ground conditions, there are three types of gauges : vertical, inclined and staircase (figure 3).

Figure 3. Types of the gauges



3.2. Gauge equipments

For the measurement requires a set of equipment and instruments available in equipping each station. Within these stations is harvested a number of parameters: water level, water temperature, air temperature, minimum temperature, maximum temperature, wind speed, wind direction, humidity, atmospheric pressure, cloud, precipitation.

The reading for water level is visual where they are located groom and automatic stations (figure 4) for tide gauge where there are groom with automatic recording (Galati, Giurgiu, Tr. Severin) – resolution of 1 cm , auto logging and averaging period up to 24 hours and sensors for pressure and water temperature, wich use a modem /GSM to transmit the data.



Figure 4. E-sea tide gauge Marimatech

In order to measure the water levels the gauge stations are equipped with cast iron pegels which are mounted on the quay walls and are ruled in 2 cm intervals and in some ports there are used the limnograph wich record the level on the paper (figure 5).



Figure 5. limnograph

The water temperatures are measured with mercury thermometers with a precision of 0.1°C. Others parameters for meteorological information are registered by classical and electronic instruments (figure 6) .



Figure 6. Weather station (Davis Vantage Pro)

Other parameter which is recorded is the appearance of ice in the river waters. The observations are done visual and take into account the percentage of water surface that is covered with ice.

3.3. Quantity and quality of measurements

The water levels are measured once a day and in periods of extreme levels (small and large) twice daily or whenever necessary. In periods of flood levels are registered in one or two hours and transmitted to those interested.

Each gauging station maintained by a person who harvested their data and communicate more. Data are checked and then pooled to make public (on site AFDJ and radio communication). Annual tests are made on the physical and the zero plane of the grom with topographical instruments. All apparatus and equipment is calibrated annually or whenever necessary.

3.4. Elaboration of data

The data collected (water levels, meteorological information, discharge, etc) are used for statistics, making models, forecasts, transmitting the Danube Commission, for navigation, topohydrographical measurements (figure 7). Informations for debts collected are stored in a database in different formats that can be analyzed and processed for different purposes.

Figure 7. Hydrographer for water level

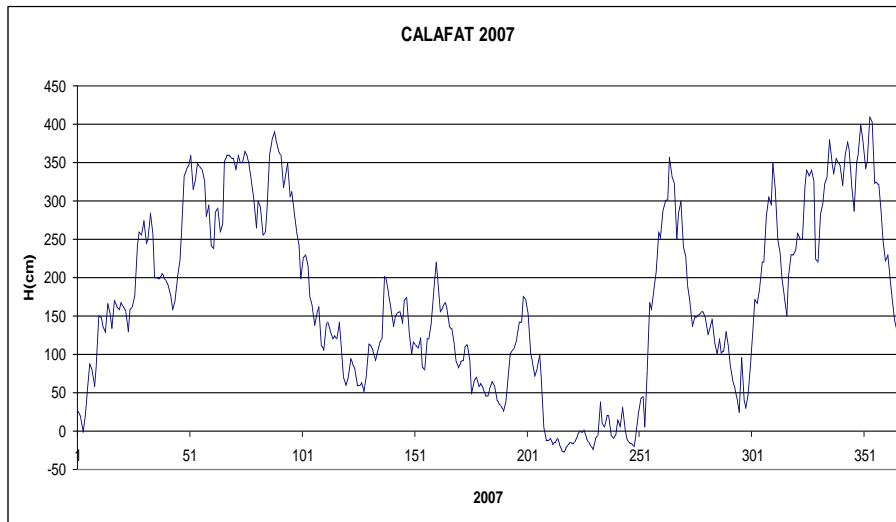
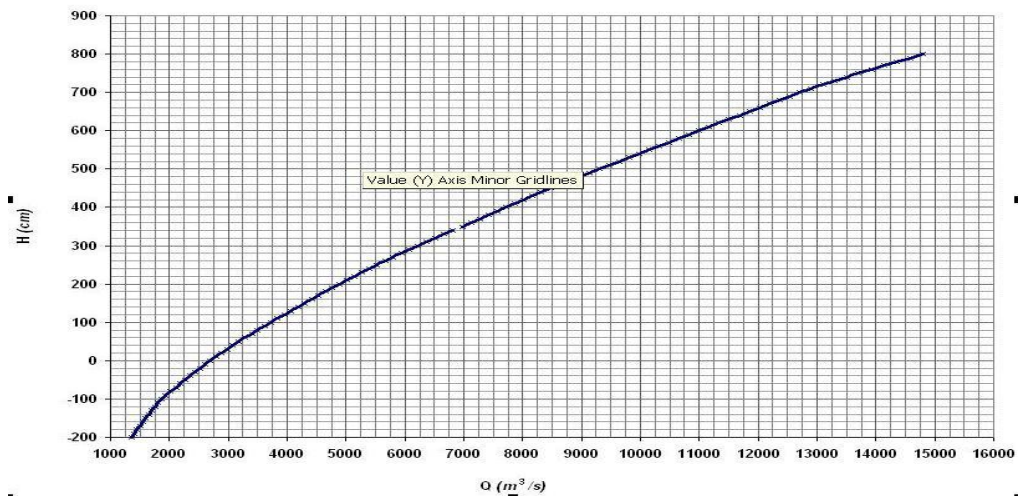


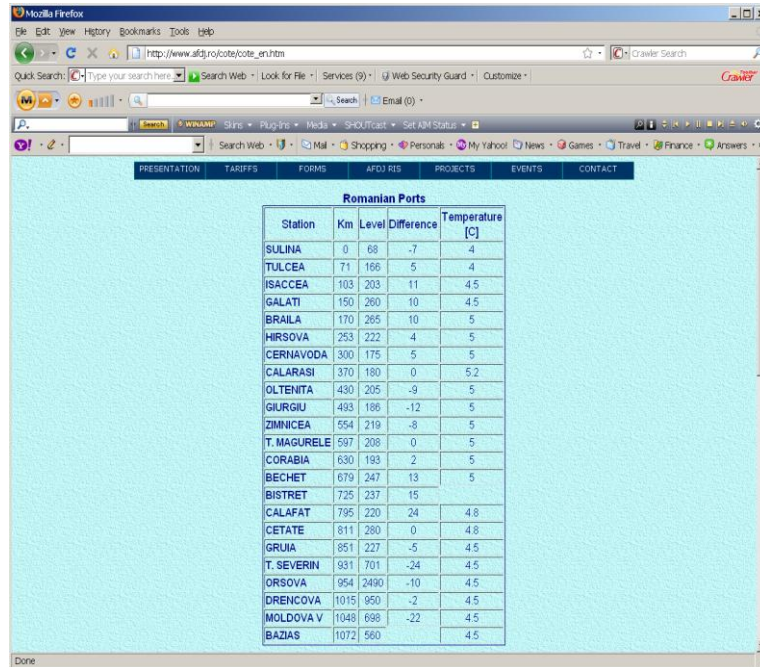
Figure 8. Discharge in Calafat area



The information and results of measurements collected in the field are processed, analyzed, validated and submitted by the departments of hydrology and hydrography.

Annual verifications and calibrations are tests, if necessary by the team at gauging stations basin.

Information about the levels and forecasts are made public on site AFDJ Galati at <http://www.afdj.ro/cote/cote.htm> (figure 9).



The screenshot shows a web browser window displaying a table titled "Romanian Ports". The table has five columns: Station, Km, Level, Difference, and Temperature [C]. The data is as follows:

Station	Km	Level	Difference	Temperature [C]
SULINA	0	68	-7	4
TULCEA	71	166	5	4.5
ISACCEA	103	203	11	4.5
GALATI	150	260	10	4.5
BRAILA	170	265	10	5
HIRSOVA	253	222	4	5
CERNAVODA	300	175	5	5
CALARASI	370	180	0	5.2
OLTENITA	430	205	-9	5
GIURGIU	483	186	-12	5
ZIMNICEA	554	219	-8	5
T. MAGURELE	597	208	0	5
CORABIA	630	193	2	5
BECHET	679	247	13	5
BISTRET	725	237	15	
CALAFAT	795	220	24	4.8
CETATE	811	280	0	4.8
GRUIA	851	227	-5	4.5
T. SEVERIN	931	701	-24	4.5
ORSOVA	954	2490	-10	4.5
DRENCOVA	1015	950	-2	4.5
MOLDOVA V	1048	698	-22	4.5
BAZIAS	1072	560		4.5

Figure 9. web site AFDJ

Situation and forecast for the tributary rivers are disseminated by the National Administration Romanian Waters (ANAR).

4 HYDROLOGICAL CONDITIONS

4.1. Regime and operative data

On Romanian sector, Danube has a length of 1075 km and the leakage scheme is divided into two Romanian sector: upstream lake regime Iron Gates Hydropower System (situated at 863 river km and 943km) and the free flow downstream.



Figure 10. hydroelectric power station – km 943 /Iron Gate 1

Because settlement catchment , the contact between the temperate oceanic climate of western and eastern temperate continental Baltic influences in the north, the Danube hydrological regime is characterized by the existence of large variations in the level and flow in the year and over the time. Spring high waters occur as a result of melting snow and heavy rains, taking place in the months from April to May.

Danube temperature water is under the direct influence of air temperature. Water heating begins in March and take up in august followed by cooling process. Ice may occur in the first decade of December to early March. Spring thaw phenomenon occurs most frequently in a period of several days. Throughout its tributaries river has a number of important issues affecting the drainage system: Olt, Jiu, Arges, Siret, Prut that an intake of about 400 cubic meters and also having a large input of silt contributing to changes in hydrological regime..

4.2. Discharge series and designed data

Data is processed and transmitted by those concerned and also are used to create models, maps, forecasts and other information. They are published as instructions of Danube Commision Budapest.

It is submitted to interested users upon request in the order determined by the Ministry of Transport.

The data collected are processed by the experts in charge of the AFDJ. Data can be analyzed and interpreted, can be used for statistics, forecasts and providing conditions for navigation. The hidrographer of levels shows the evolution of values – higer , lower ,duration and together with other data sets can be used to make forecasts.

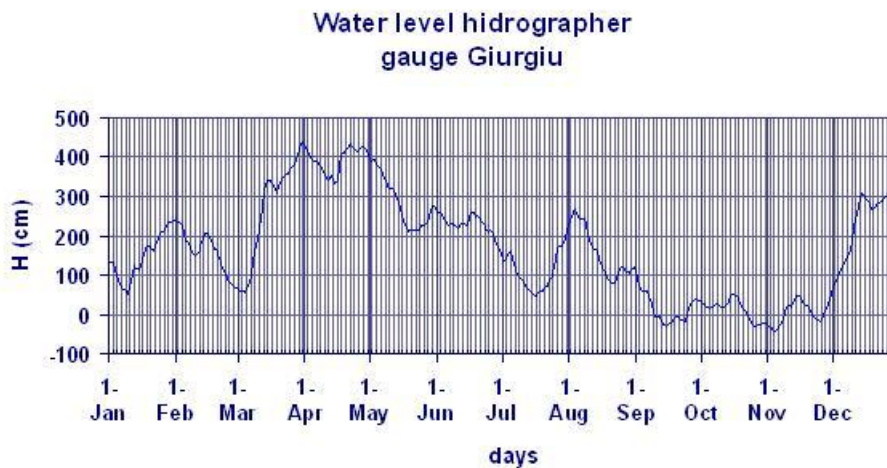
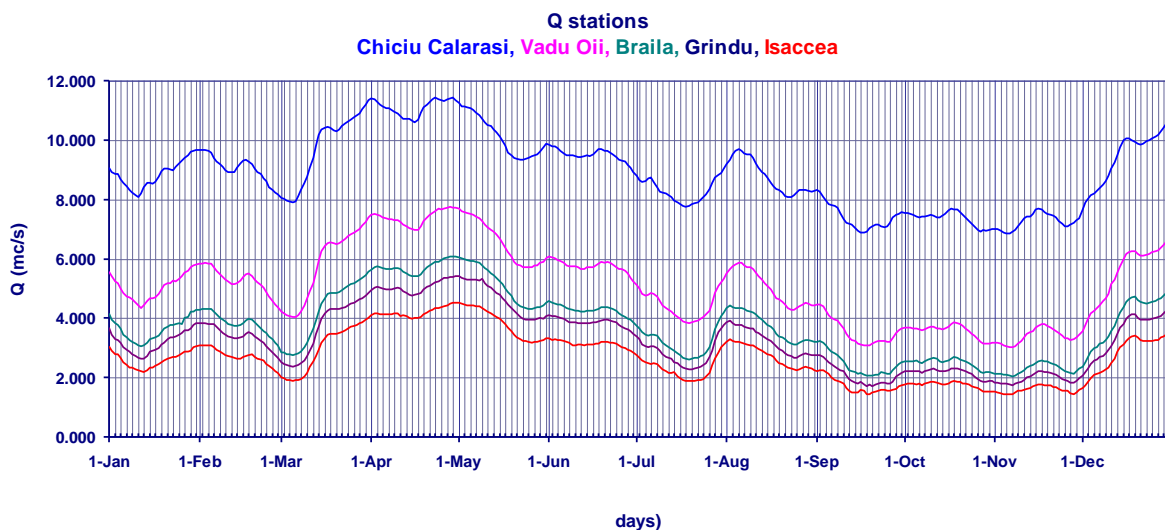


Figure 11. water level hydrograph

An overview of discharge in a few stations along the Danube (figure 12) , wich is useful for discharges relevant for navigation, for calculation of RNW and HSW, etc.

Figure 12. Q hydrograph of the year 2007



All these data are stored in a well managed database .

5 EXTREME FLOWS AND FLOOD DISASTERS

5.1. Floods regime

Depending on the evolution of water, thickened observations taken every two hours starting with the level of attention, following the flood danger and when to ensure permanent. A permanent connection is supported with authorized institutions: Civil Defense, National Water Administration, Inspectorate for Emergency Situations, etc.

On the Romanian sector of the Danube the historic high level was recorded in 2006 in April, when a number of riparian countries have been affected when water flow rates were recorded by 16000mc/s.



Figure 13. Flood 2006 Danube

In case of flood phenomenon, AFDJ organize commands , ensure permanent observation stations , collaborates with all institutions involved and keep a permanent connection with EAEMDR Bulgaria.



Figure 14: flood 2006 Giurgiu

5.2. Drought regime

During the period of drought, to ensure navigation conditions and needs, because water flows are low, multiply the observations and measurements. In Romania, in 2003, there has been historically low level.

Towards an annual average flow of 4500-5500mc / s during that time was about 2000 cubic meters / s.

In terms of navigation gauges, these periods are registered in most areas with low depth - critical. In these conditions are imposed operational restrictions, it measures how often and to signal the appropriate sailing line.

If appropriate notices are issued to skippers and continuously updated information on the Website- minimal depth of the Danube, signalisation, trajectory fairway.

6 HYDROLOGICAL FORECASTING AND WARNING

6.1. Forecasting services

Daily forecasting of the expected water levels is done for Giurgiu , Cernavoda and Braila. These are short term forecasts – concerning the next two days and are published on the AFDJ web site <http://www.afdj.ro/cote/cote.htm>.

For the tributary the forecast is made by INHGA – National Institute of Hydrology and Water management on the web site <http://www.hidro.ro>.

6.2. Meteorological forecasting

In Romania, information and meteorological forecasts are provided by the responsibility carried by National Meteorological Administration (ANM) on the web site <http://www.inmh.ro>.

The main activities of the National Administration of Meteorology is the work of meteorology and climatology .

ANM elaborate forecast for three days for Romania.

Data is updated daily at 15.30.

The information is public and can be downloaded by interested users.

6.3. Hydrological forecasting and forecasting methods

Daily forecasting of the expected water levels is done for Giurgiu , Cernavoda and Braila. These are short term forecasts – concerning the next two days and are published on the web site.

Daily, these trends are published and updated water level probably taking into account the highest forecast.

Waters levels are forecasted by taking into account the water level, slope and distance of the groom based on the information from gauge stations (Romanian and Bulgarian) introduced a mathematical method .

6.4. Forecasting action plan

Adapting an optimal procedure, specific forecasts on short and long term. Establishing mutual forecast consultants on long-term users of their products and to improve forms of dissemination for forecasts.

6.5. Dissemination of information

Through the Internet, by phone, by e-mail, to the skippers by harbour authorities, by radiostation.

Also, this information is disseminated to all concerned and are made available for the headquarters emergency situations (in the winter headquarters, floods, etc.).

7 TRANSBOUNDARY COOPERATION

7.1. Exchange of data among the countries

There is a cross border cooperation and exchange data, information and joint work. Between the Danube riparian countries, there are several working committees to which Romania participates annual and collaborates with other European countries (border/Ukraine-Moldavia, etc).

Romania is member of the Budapest Danube Commission. For keeping permanent connection and exchange of information with partners in neighboring countries (Bulgaria, Serbia), AFDJ has made available a server .

Daily, according the Danube Commission Recommendations.

7.2. Navigation

Transboundary cooperation is based on the fact that Romania is a member of the Danube Commission, with a rich experience and on agreements with countries bordering the Danube, on the fairway maintenance:

Romania-Serbia /Belgrad 1955;

Romania-Bulgaria /Sofia 1955;

Thus, it was agreed that the Danube sector located between 0 km and 1075 km to be maintained, as follows:

- Romania 375 km 0-km, 610 km-845 km;

-Bulgaria 610 km 375 km;

-Serbia/Romania Km 845-km 1075;

From this point of view there is a permanent connection with them, making the daily exchange of information, or whenever any-any change of gauges of navigation, hydrological data and any other information of interest.

Also, the Danube Commission annual communicate all the information on maintenance sectors of the Danube.

Romania participates and is member of the EU-project “IRIS Europe II” , wich is based on the work of experts representing the 9 Member States for cooperation partners to support providers RIS, traffic and navigation authorities in order to implement RIS logistics.

7.3. Inventory of data transmission and communication system

Every day is transmitted by AFDJ hydrometeorological bulletin for Danube ports and on the AFDJ web site are published RIS information: water levels, forecasts for water level, electronic chart, notice to skippers, fairway, vessels traffic, etc. The information about weather for all country is published daily by the National Institute of Meteorology and Hydrology on the web site <http://www.meteoromania.ro> .

The information about daily status of the Romanian rivers: hydrological forecast , alerts and warnings, is available on the Romanian waters National Company web [site http://www.rowater.ro](http://www.rowater.ro).

For communicating information AFDJ use the Internet and telephone connection. The Administration website – <http://www.afdj.ro>.

Telephone number +40 0236 460016/+40 0236 460150 and the Internet. E-mail address – dg@afdj.ro/dcn@afdj.ro.

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