Flood Protection Expert Group

Assessment of Flood Monitoring and Forecasting of the Republic of Bulgaria

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Institutional framework

A single body – “Ministry of Environment and Water” through its Water Directorate has overall competence to deal with water management. Bulgaria has agreements with most of the neighbouring countries sharing river basins. In the framework of the International Commission for the Protection of the Danube River, and in line with the requirements of the EU Water Framework Directive, Bulgaria is participating in the development of an international Danube River Basin Management Plan. (http://www.moew.government.bg)

The responsibility to collect data about natural and other large-scale disasters and accidents, including floods, to advice prevention activities and to solve resulting consequences for the human life and environment belongs to the “State Agency for Civil Protection”. This institution was formally created in the framework of the Ministry of Defence, thus a large part of collected data including floods and related damages are under special regime of access. The provided data about flooded area and damages (Fig 2 and Table 3) are taken from the web site of the agency: http://www.cp.government.bg

“Agency for Investigation and Maintenance of Danube River” (Water Ways) is responsible for the measurements and maintenance of Danube River gauging stations at *Novo Selo*, *Lom*, *Oriahovo*, *Svishtov*, *Ruse*, *Silistra*, as well for the dissemination of the relevant information. It insures the security of the water transport via Danube River. (http://www.appd-bg.org/)

“National Institute of Meteorology and Hydrology” is managing the hydrological and meteorological networks of Bulgaria. NIMH is collecting, processing and analysing hydrological and meteorological data. The hydrological network is managed and data are collected under the supervision of “Ministry of Environment and Water”. (http://www.meteo.bg/)

“National Electricity Company” EAD and his department “Dams and Cascades Enterprise” deal with operation and maintenance of dams and hydropower facilities. So all data about dams water budget are collected and stored in their own database. (http://www.nek.bg/)

NIMH as hydro-meteorological service and expert body

- Structure: Headquarters in Sofia, Dept. of Meteorology, Hydrology, Weather forecasting, Chemical composition of Hydrosphere and Atmosphere, Information centre, others. (Figure 1)
- Four branches in Plovdiv, Varna, Pleven, Kjustendil
- Observatories and hydro-meteorological stations all over the country
- Represent Bulgaria in the World Meteorological Organisation, EUMETSAT, EcoMet

Provide wide range of expertise in the field of Hydrology and Meteorology; participate in a number of projects financed by the EC 4,5,6thFP, Phare, Intereg, NATO, World Bank and other international and national donors

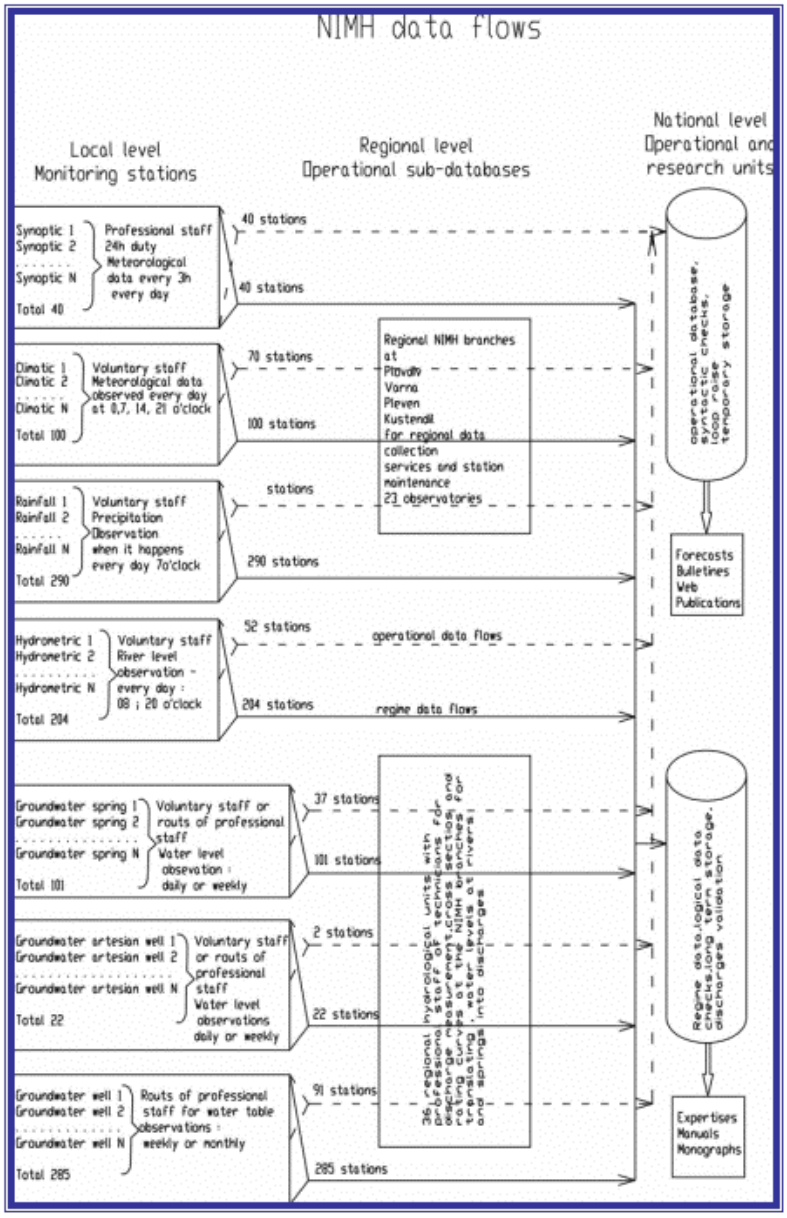

Figure 1: The scheme shows the real time data flow (for operational purposes) and the off line data flow (for resource estimation purposes and other expert tasks)

1. Flood monitoring system

1.1. Description of the meteorological monitoring network

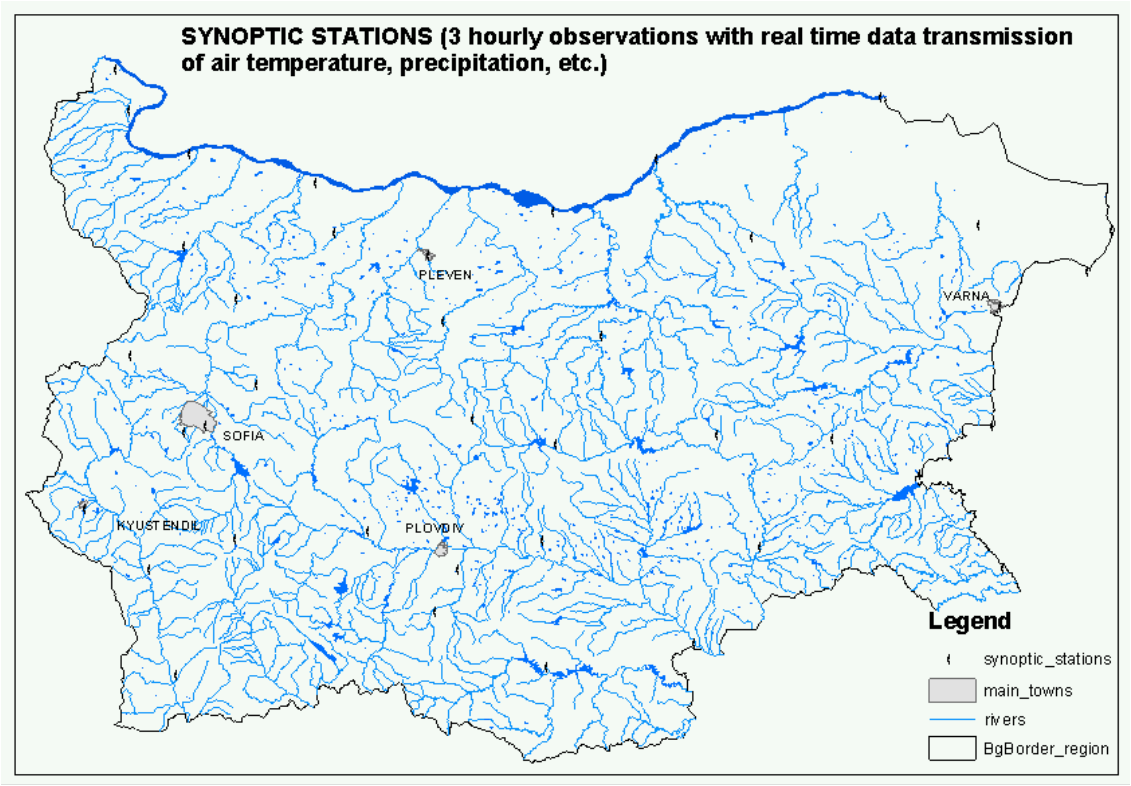

Figure 2: Network of synoptic stations

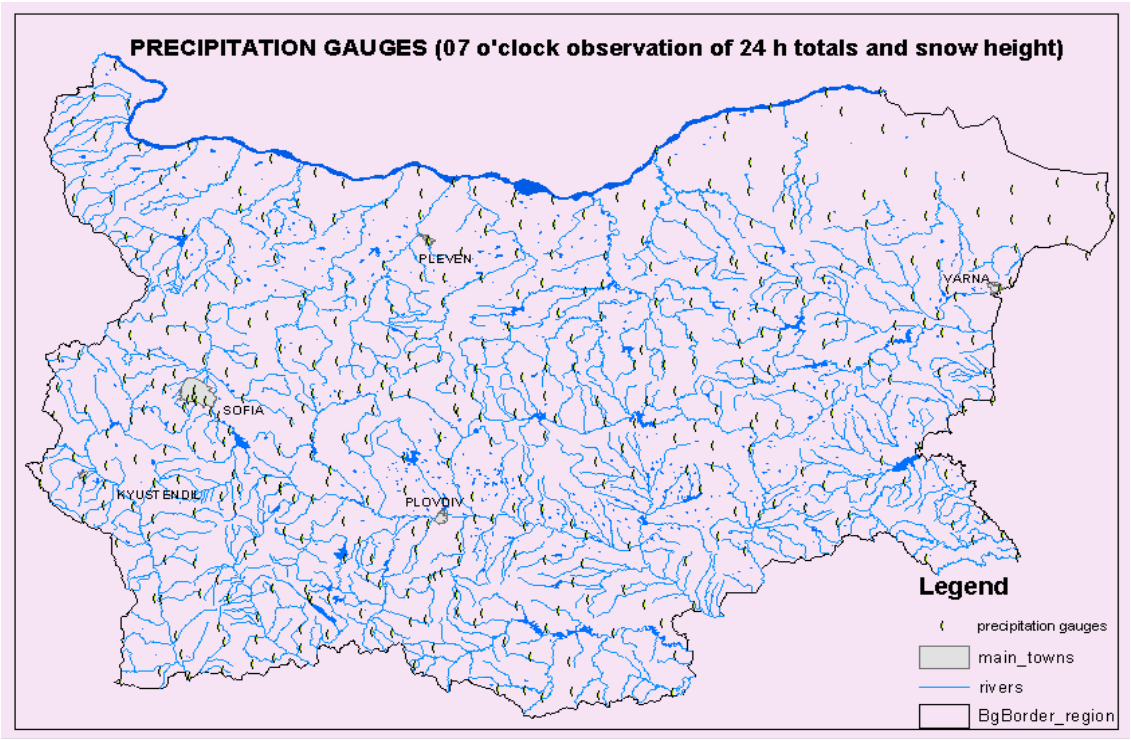

Figure 3: Network of **500** rain gauge stations – operated by volunteers

1.2. Description of the hydrological monitoring network

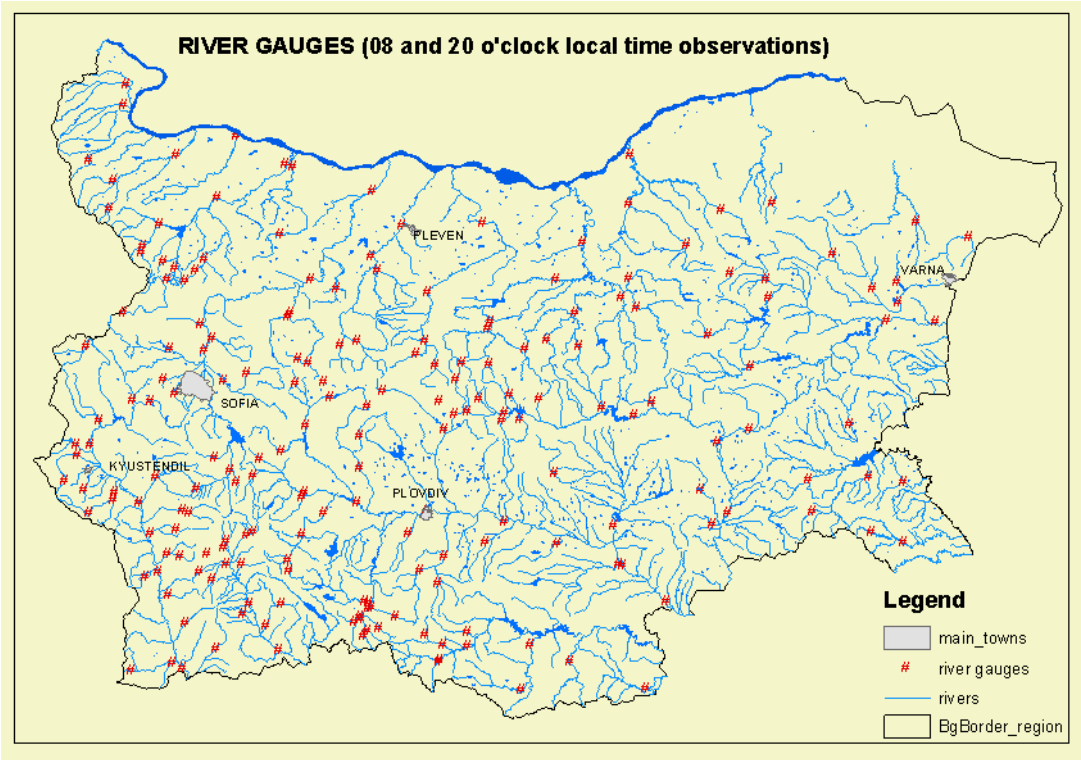

Figure 4: Network of river-gauge stations

6 automatic transmitting river gauge stations are available and operational. The total number of stations operated by volunteer observers is about **215** (Figure 4).

1.3. Use of Meteorological Radar

NIMH uses meteorological radar situated near the town of Pazardjik in the upper Thrace valley. It covers a region with radius 200 km. It shows (by their reflectivity) the movement of precipitating clouds; indices of hail and storm danger etc (Figure 5).

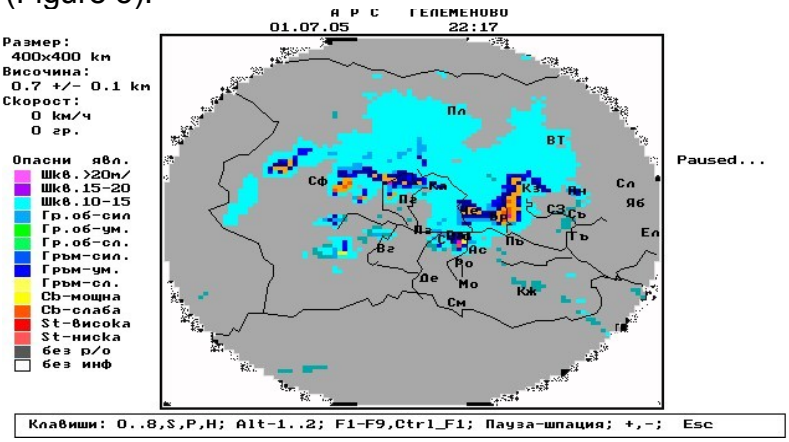

Figure 5: Radar reflectivity image

2. Development of the flood forecasting service

2.1. Inventory of methods and practices of meteorological and hydrological forecasting and warnings. Hydrological and meteorological products, modelling tools

2.1.1 The ALADIN model

The bases for the hydrological forecasting are the measured precipitation fields and meteorological forecasts from the High Resolution Limited Area Model (HIRLAM) Aladin. The short-range NWP model has been operating at the NIMH since May 1999. The numerical weather prediction model ALADIN (http://www.cnrm.meteo.fr/aladin/) - has been used as operational model in Bulgaria since June 1999. The weather forecast for 48 hours over the Balkan Peninsula is computed twice a day using as initial conditions the predictions for 12 and 00 UTC of the French global model ARPEGE (Action de Recherche Petite Echelle Grande Echelle). The horizontal resolution of ALADIN is approximately 12 km, with 31 levels vertically. The model is widely used in Europe.

On the following Figure 6 are presented the measured precipitations and forecasted precipitation fields for the event of 5-08-2005.

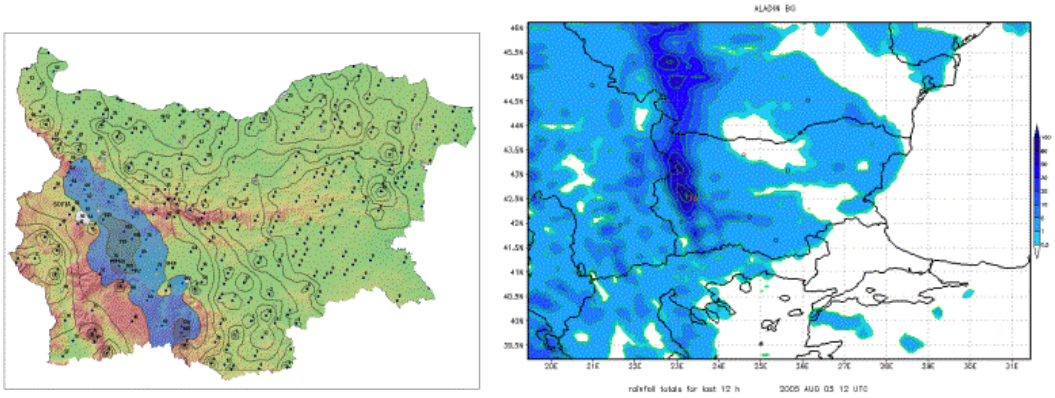

Figure 6: Comparison between measured and forecasted precipitation fields.

2.1.2. HBV river flow modelling tools:

The model is calibrated for Struma basin (Figure 7) in the frame of EC 5th FP – EFFS project, but not yet available operationally.

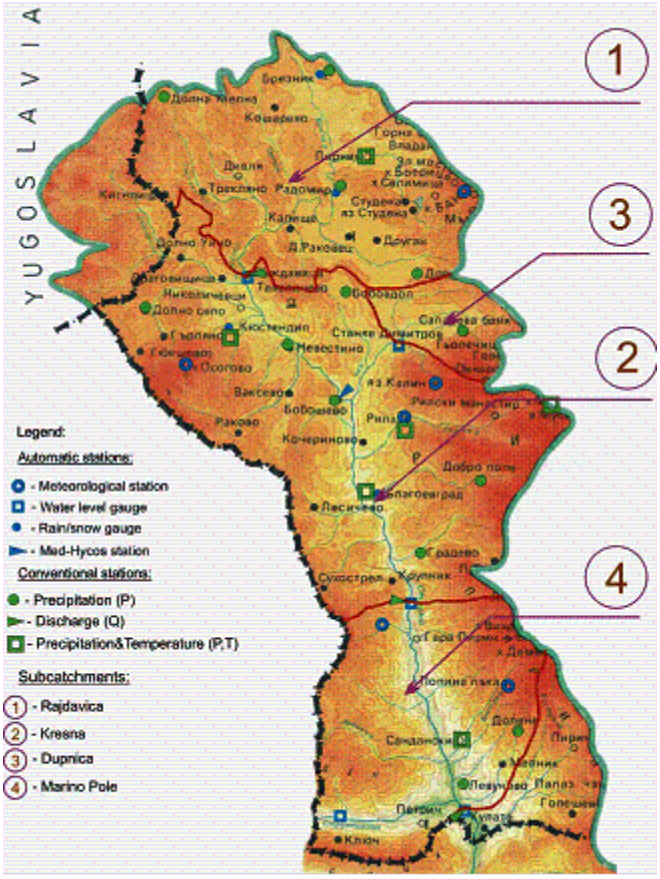

Figure 7: Struma river basin, river gauges and meteorological stations.

Table 1: Summary of accuracy criteria achieved for HBV:

Callibration period	Struma river sub-basins							
	Rajdavitza		Dupnitza		Kresna		Marino pole	
	R2	AccDiff	R2	AccDiff	R2	AccDiff	R2	AccDiff
Obs. 1990-99	0.58	-21.8	0.263	-111.0	0.61	-12.1	0.54	-82.6
Obs. 2001-03	0.433	-6.3	0.044	89.8	0.502	-29.2	0.57	-55.5
Forecast t+24	0.31	7.1	0.16	-18.3	0.1	-130	0.43	-51.6
Forecast t+48	0.38	-2.	-0.13	-68	0.06	-107	0.46	-11.1

2.1.3. ISBA – MODCOU modelling tools (used for the Maritza river basin – Figure 8):

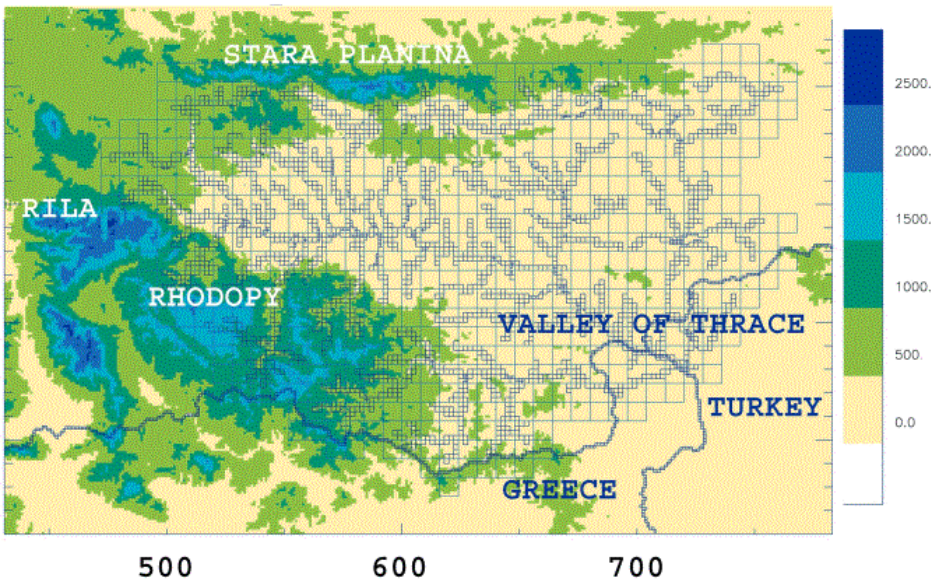

Figure 8: The Maritza river basin

- ISBA (Interface Soil Atmosphere Biosphere) computes energy and water transfers in the soil. Evapo-transpiration and snowmelt are evaluated and two fluxes of water in the soil are computed: a surface runoff and drainage.
- MODCOU as a distributed hydrological and hydrological model computes the surface and underground flow until the basin outlet (Figure 9).

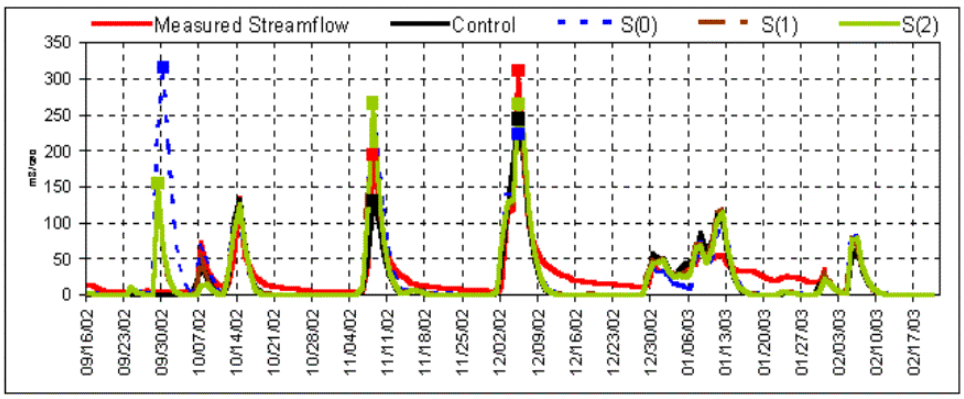

Figure 9: Results of daily stream flow simulation and forecast for the Arda River catchments at Vehtino location in the South part of the region.

Table 2: Accuracy criteria achieved for MODCOU on Maritza river basin:

R^2	Catchment Surface [km^2]	Measured Streamflow	Control Simulation	S0 Simulation	S1 Simulation	S2 Simulation
Maritza Svilengrad (anthropogenized)	20840	1.0	0.64	0.27	0.43	0.39
Tundja Elhovo (anthropogenized)	5551	1.0	0.36	0	0.10	0.07
Chepelarska Bachkovo (natural)	825	1.0	0.65	0.09	0.44	0.44
Arda Vehtino (natural)	857	1.0	0.82	0.44	0.77	0.75

2.1.4. EFAS reports

In September 2005, NIMH started to receive the EFAS reports with indicative hydrological forecasts (Figure 10):

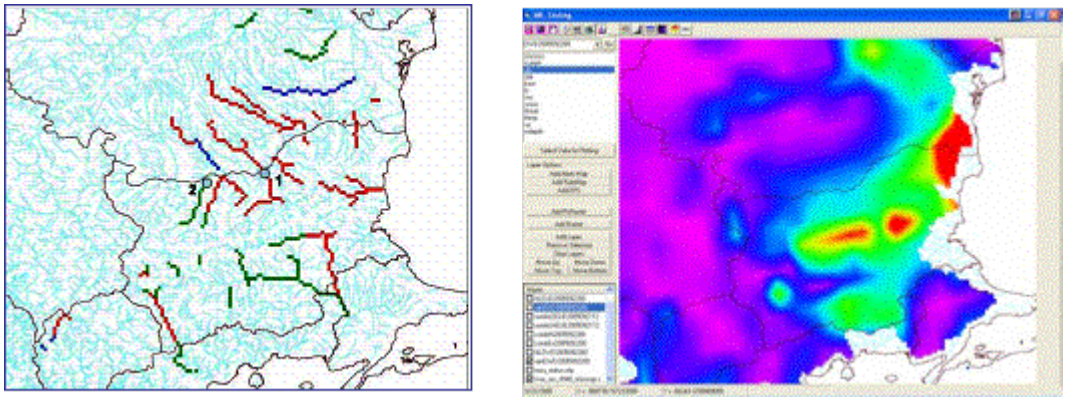

Figure 10: Examples from the EFAS reports with indicative hydrological forecasts

2.2 Transmission and communication of flood warnings.

After the flooding events during august 2005 the communication between NIMH and the Ministry of Environment and Water Resources was enhanced through a special Web site, where are published the near-real time data from the rain gauge and hydrological stations.

The information is also directly submitted to the Civil Protection Agency structures by telephone and fax in case of extreme events.

3. Lessons learned, present needs of NIMH to serve better the society

3.1. Capacity building and improvement of information flows:

- Prompt delivery of data and products;
- increasing the lead-time of precipitation forecast, NIMH started a procedure to become a member of the European Center for Medium-range Weather Forecasting;
- hydrological models in use need to use hydraulic routing and ability to evaluate the flooded areas.

3.2. Equipment needs:

- Urgent restoration of the 27 totally destroyed hydrometric stations during the floods during 2005;
- hourly observation of precipitation and river levels by automatic telemetric stations;

References:

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