Republic of Serbia
Ministry of Agriculture, Forestry and Water Management
Directorate for Water

Water Monitoring and Control in Serbia

UNESCO Workshop

Thessaloniki, 27,28 June, 2008.

SERBIA

Area: 88.361 km²

Population: 9.500.000

Republic Hydrometeorological Service of Serbia

- Governmental institution responsible

-for water quantity monitoring

Institute for health protection of Serbia

- Governmental institution overall responsible

for water quality monitoring

Republic Hydrometeorological Service of Serbia

Founded in 1988.

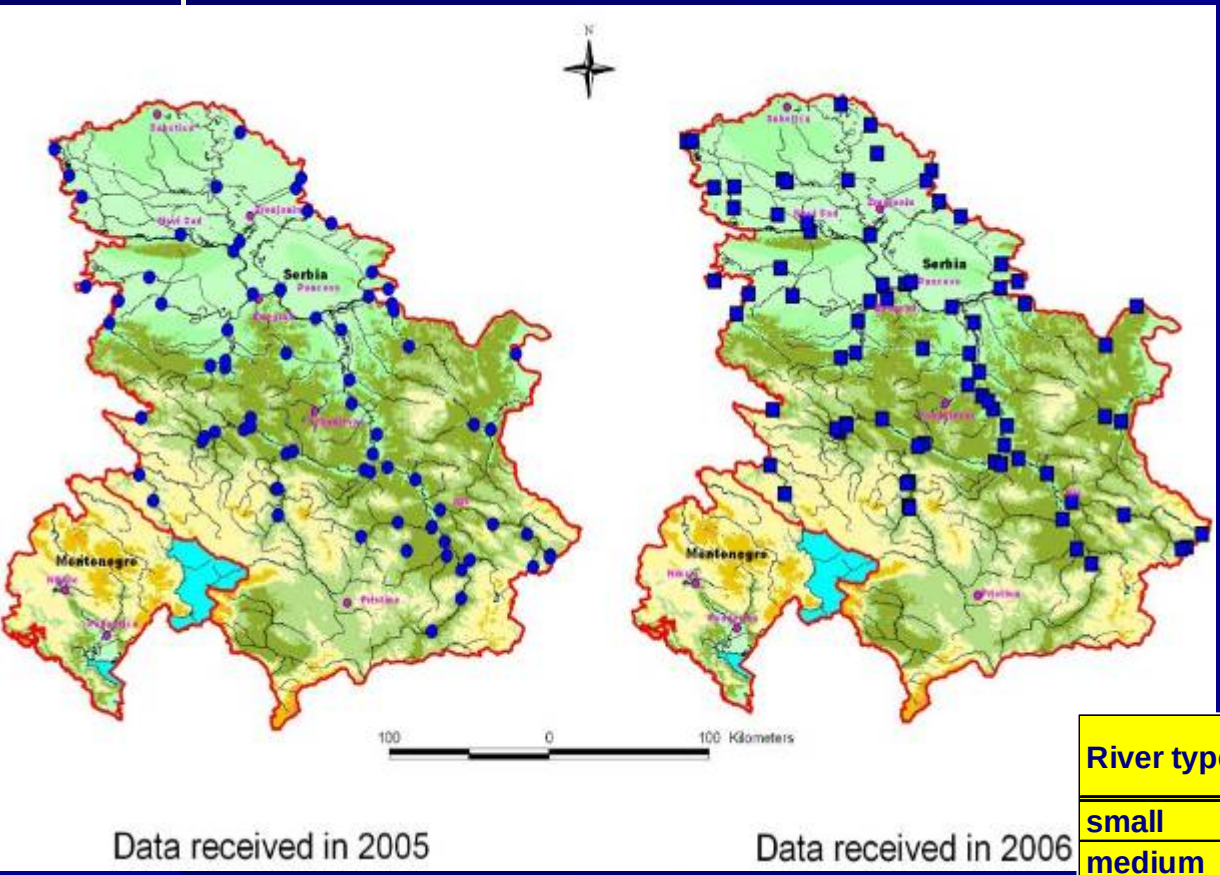
Member of WMO since 1947.

Meteorological observing system in Serbia /
30 climate stations / Hundreds of Rainfall stations

Hydrological observations and measurement

- First systematic observations on the territory of Serbia started in the first half of XIX century. First water gage station in our country was established in 1812 near military fortification Petrovaradin - Novi Sad, on the Dunav right bank. After that, follows the establishing of series of water gage stations like Bezdan (1856), Zemun (1859), Slankamen (1888), Novi Becej (1855), Senta (1860) etc. Before establishing of this station, observations of water stage were performed, but these observation were not connected with permanent water gage station.
  In the period before the World War II, for the ilustration, on the Danube 12 water gage stations existed on which term water stage observations were mainly performed. First water flow measurements on the Danube, for which writing documents existed, started in 1924.

Hydrological Observation Network



Data received in 2005

Data received in 2006

River type	Reference Station	Representative Station	Impact Station	Unknown type
small				1
medium				6
large		2		22
very large		7		10
largest		23		19
unknown		6		38


Subotica
Sombor
Veliki kanal
Krivaja
Bečej
Tisa
Zlatica
St. Begej
Begej
Novi Sad
Dunav
Tamiš
Vršački kanal
Moravica
Vršac
Mesić
Karaš
Nera
V. Gradište
Beograd
Sava
Smederevo
Požarevac
Pek
Kučevo
Petrovac
Mlava
Vitovnica
Žagubica
Donji Milanovac
Porečka
Kladovo
Prahovo
Crna reka
V. Morava
Moravica
Aleksinac
Toplička
Južna Morava
Niš
Prokuplje
Toplica
Kosanica
Pusta
Nišava
Temštica
Pirot
Visočica
Lužnica
Jerma
Jablanica
Veternica
Vlasina
Vranje
Banjska
Krva
Gnjilane
Južna Morava


Република Србија
РЕПУБЛИЧКИ ХИДРОМЕТЕОРОЛОШКИ ЗАВОД
МРЕЖА ХИДРОЛОШКИХ СТАНИЦА
ХРС НОВИ САД
ХРС ВАЉЕВО
ХРС ПОЖАРЕВАЦ
ХРС КРАЉЕВО
ХРС НИШ
ХРС ПРИШТИНА
Нови Сад
Сента
Земун
Београд
Смедерево
Шабац
0 10 20 30 40 50 60 70 80 90 100 км

MREŽA HIDROLOŠKIH STANICA PODZEMNIH VODA

U **2006**-oj godini praćenje režima podzemnih voda vrši se na ukupno **431**-oj stanici u okviru **13** područja:

TABELARNI PRIKAZ

1 VELIKA MORAVA
- 1 glavna stanica
- 76 stanica I reda
- 19 stanica II reda

2 ZAPADNA MORAVA
- 1 glavna stanica
- 9 stanica I reda
- 12 stanica II reda

3 JUŽNA MORAVA
- 1 glavna stanica
- 15 stanica I reda
- 21 stanica II reda

4 VETERNICA
- 7 stanica II reda

5 KOLUBARA
- 21 stanica I reda
- 4 stanice II reda

6 MLAVA
- 5 stanica II reda

7 MAČVA
- 1 glavna stanica
- 17 stanica I reda
- 30 stanica II reda

9 PANČEVAČKI RIT
- 4 stanice II reda

12 METOHIJA
- 9 stanica II reda

14 PODUNAVLJE
- 1 glavna stanica
- 4 stanice II reda

18 BAČKA
- 17 stanica I reda
- 34 stanica II reda

19 BANAT
- 27 stanica I reda
- 60 stanica II reda

20 SREM
- 9 stanica I reda
- 13 stanica II reda

Republic Hydro-Meteorological Service of Serbia









April 2005- Case and effect of floods

Sečanj (1,2,3,4), Jaša Tomić (5,6,7) and Međa (8,9)

Republic Hydro-Meteorological Service of Serbia

Belgrade, April 2006

Republic Hydro-Meteorological Service of Serbia

The current state of Observational network, Services and Forecast quality

Categories	The density of the observational network	Specialized Hydro-Meteorological Services	Forecast quality	Total
Very bad				
Bad	☹	☹		☹☹
Satisfactory	Maybe 😐	Maybe 😐	😐	😐
Good				
Excellent				

” Strenghening of NMHSs must not be seen as an expenditure, but as an investment”

Republic Hydro-Meteorological Service of Serbia

Investment needs for modernization of weather and hydrological forecasting services of RHMS.

Main lines of modernization	Additional Equipment	Pieces	Amount (€)
New observation system	Automatic Weather Stations	60	1.800.000,00
	Automatic Raingauge	450	450.000,00
	Weather radars (Doppler) + LCWR	1+3	2.300.000,00
	Lighting location system	1	600.000,00
	Radio sounds and other vertical profiling equipment	1	110.000,00
	Automatic Hydrological Stations	60	400.000,00
	Acoustic Doppler Current Profiler	3	75.000,00
New fast telecommunication system	Integrated telecommunication and observing system (equipment, leased lines…)		1.000.000,00
New forecasting System	Hardware & Software		1.000.000,00
Training and education of staff			300.000,00
Maintenance	Maintenance of equipment, vehicles, spare parts, etc.		500.000,00
TOTAL			8.535.000,00

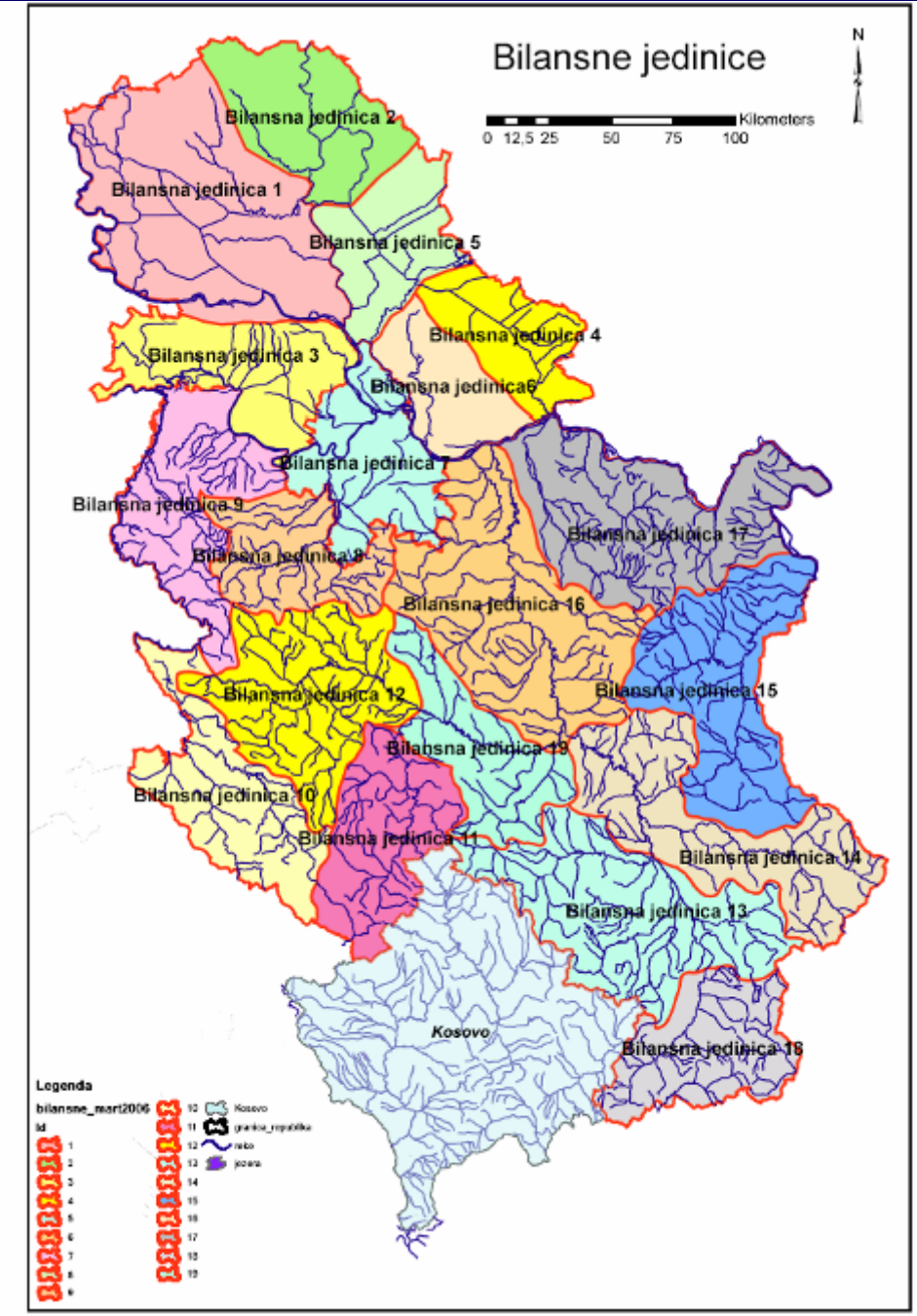
Eionet

Waterbase - Quantity: Summary of number of all monitoring stations by type

Number of stations	Total	Station type: Precipitation	Station type: Reference	Station type: Flux
Austria	51	30	20	1
Belgium	37		13	24
Bulgaria	72	33	26	13
Croatia	114	35	69	10
Denmark	501	467	8	26
Estonia	48	18	20	10
Finland	141	62	56	23
Germany	149		46	103
Hungary	54	22	11	21
Ireland	81	14	50	17
Italy	37	37		
Latvia	14	5	3	6
Liechtenstein	1			1
Lithuania	43		43	
Luxembourg	7	3	1	3
Macedonia; former Yugoslav Republic of	12	6	4	2
Norway	153	50	31	72
Serbia and Montenegro	159	27	132	
Slovakia	35	15	9	11
Slovenia	19		19	
Spain	164	120	26	18
Sweden	24		24	
United Kingdom	133	75	30	28

☐ Remove rows and columns that have no values

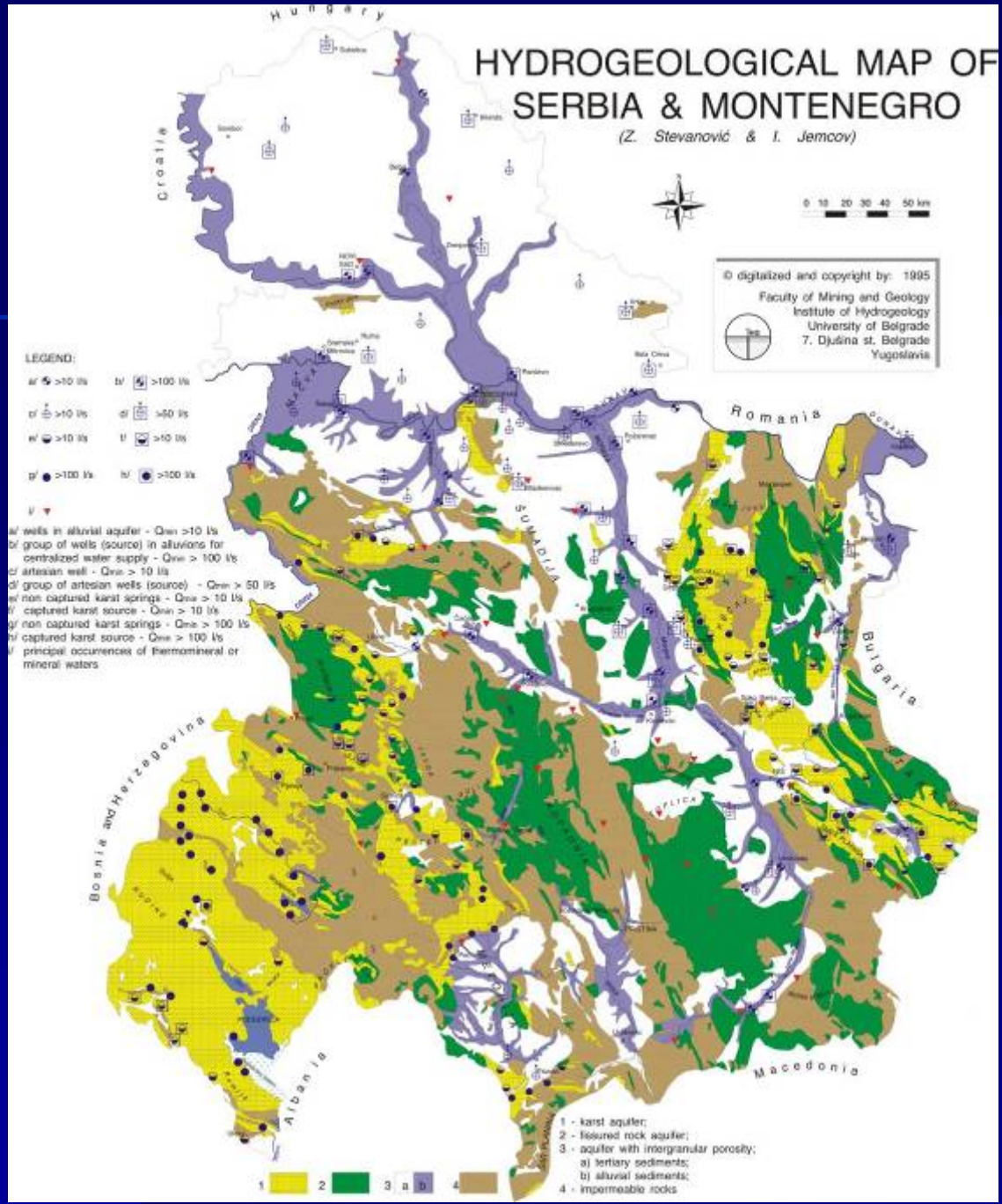
Water budget units



Institute for health protection of Serbia

Together with Regional Institutes for Health is responsible for:

- Control sampling and analyses of centralized waterworks in accordance with Water Law and acts.
- Water protection regulation and measures.



- The complex geology of Serbia, hydrogeological heterogeneity and in aquifer systems and groundwater distribution.

- Paleozoic formations, magmatic and metamorphic rocks, Jurassic and Cretaceous flysch or deeper and thick sedimentary complexes mostly represent aquitards or aquicludes.
- Recent alluvial deposits and fans of major rivers such constitute by far the richest aquifers.
- Karst aquifers with abundant reserves are in Dinaric karst of Western Serbia and Carpatho Balkanic karst of Eastern Serbia.
- Neogene and Pleistocene sediments tapped by many boreholes are the main sources of water supply for the cities within the Pannonian Basin.

- Although groundwater abstraction dates back to Roman times, the beginning of organized public use of groundwater (excluding tapping of minor springs) is associated with the year 1850 when an »artesian well« was bored in Vojvodina. By the end of the 19th century artesian wells were drilled in Subotica, Sombor, Smederevo, Mladenovac, and Negotin. Abstraction and use of groundwater for modern water supply systems began in 1892, when the Makiš water source was developed in Sava alluvium for Belgrade's water supply.
- Since the beginning of XX ct.when public water supply systems in Serbia, served only about 10% of the population, until the mid-eighties percentage increased to about two-thirds of the population.
- About 759 public water distribution systems in Serbia cover about a thousand communities. There are plus about four thousand rural systems. Specific water consumption is about 220 l/day/capita.

Groundwater use in Serbia

HG Unit	Alluvium	Main aquifer, Lower Quater.	Neogene	Karst	Fissured	Total
Bačka and Banat	1454	3570	431	0	_	5455
Srem, Mačva, Sava/ Tamnava	6974	340	506	30	_	7850
Central Serbia	2585	_	845	430	_	3860
Eastern Serbia	620	_	60	1711	_	2391
SW Serbia	242	_	140	1614	_	1996
Western Serbia	1051	_	60	397	17	1525
Total	12926	3910	2042	4182	17	23077

Water supply of 15 major cities

City	Popu-lation	Rate of abstraction (l/s)							Average, GW	Average, SW
		Groundwater origin				Artif. rech.	Surface water / reservoirs			
		Quater.	Neog.	Karst	Max.		Aver.	Max.	%	%
Belgrade	1638643	4700			5500		2000	5000	70	30
Novi Sad	306306	1200			1500		-	-	100	-
Niš	240734			1052	2432	600	-	-	100	-
Kragujevac	180796	191.5			300		616.5	650	24	74
Leskovac	161086		320		400		-	-	100	-
Subotica	152278	162.5			505		-	-	100	-
Pančevo	131938	475			600		-	-	100	-
Kraljevo	126364	165			440	165	-	-	100	-
Čačak	119378	90			100		0	0	100	0
Sombor	99949	130	30		200		-	-	100	-
Valjevo	99208			142	585		80	180	64	36
Vranje	89591	44			200		30	50	60	40
Užice	84086	-			-		250	300	-	100
Požarevac	83097	210			275		-	-	100	-
Trstenik	51925	70			200	40	-	-	100	-

Groundwater potential

- Based on to date conducted research, the current yield of groundwater sources is roughly 30% out of the groundwater potential which could be used in the future (67 m^3/s). This estimate is based on the volume of groundwater, excluding the application of artificial recharge methods or regulation of karstic springs. The largest groundwater reserves, which are not being exploited, are exist in alluviums near the confluences of powerful watercourses (Drina/Sava, Morava/Danube, Drava/Danube, and Sava/Danube) and within karstic aquifers.

	Alluvial	BWC	Neogene	Karst	Fissured	Total
Bačka and Banat	9390	4913	547	0	0	14850
Srem, Mačva, Sava/Tamnava	21108	550	991	100	0	22749
Central Serbia	9930	0	1725	1475	180	13310
Eastern Serbia	1055	0	240	2977	0	4272
Southwestern Serbia	572	0	330	7277	0	8179
Western Serbia	1735	0	120	1887	26	3768
Total	43790	5463	3953	13716	206	67128

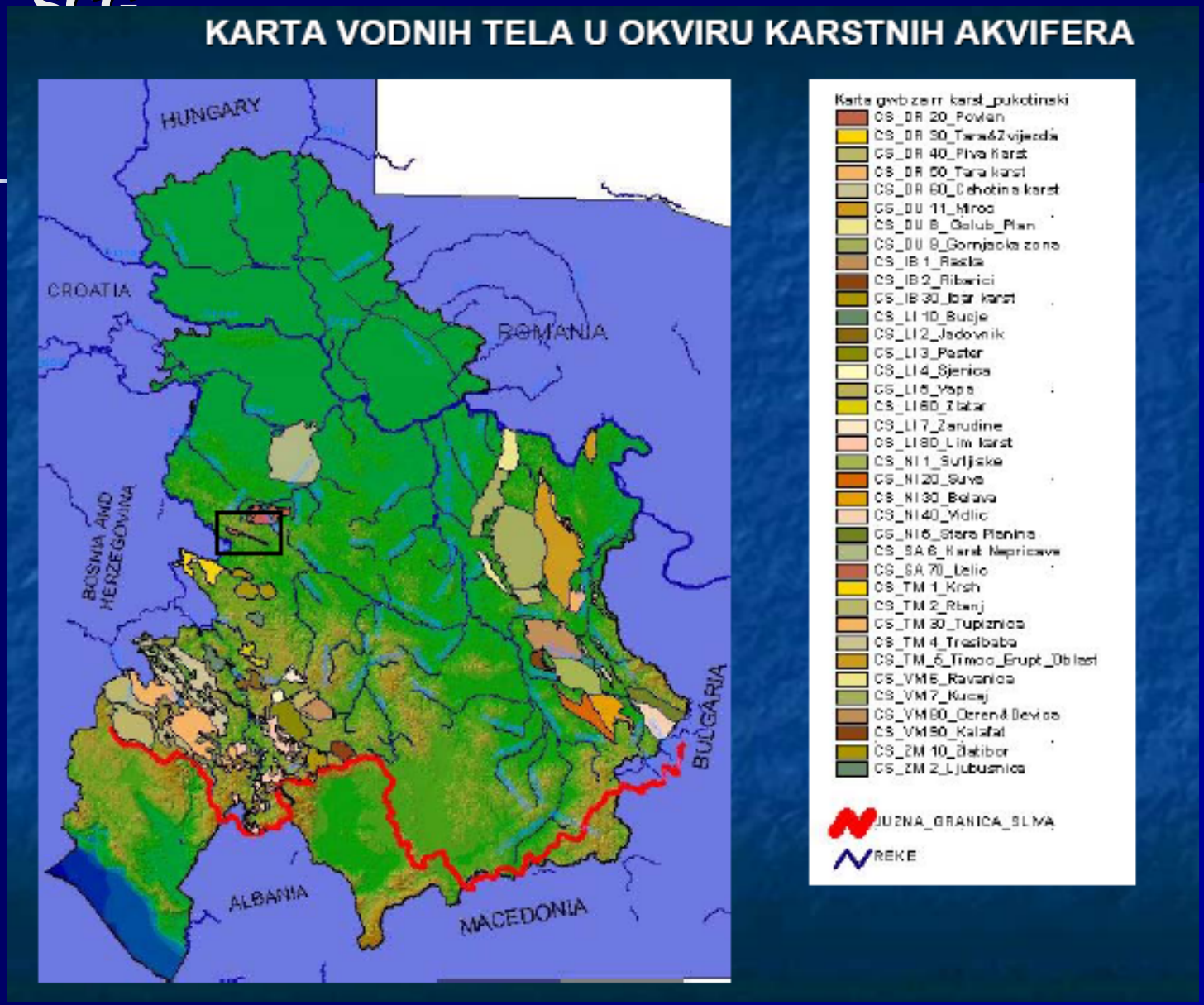
EU WFD 2000/60 Application
Towards Monitoring of WB and Improvement of Ecological Status

- Characterization of SfWB
- Characterization of GWB

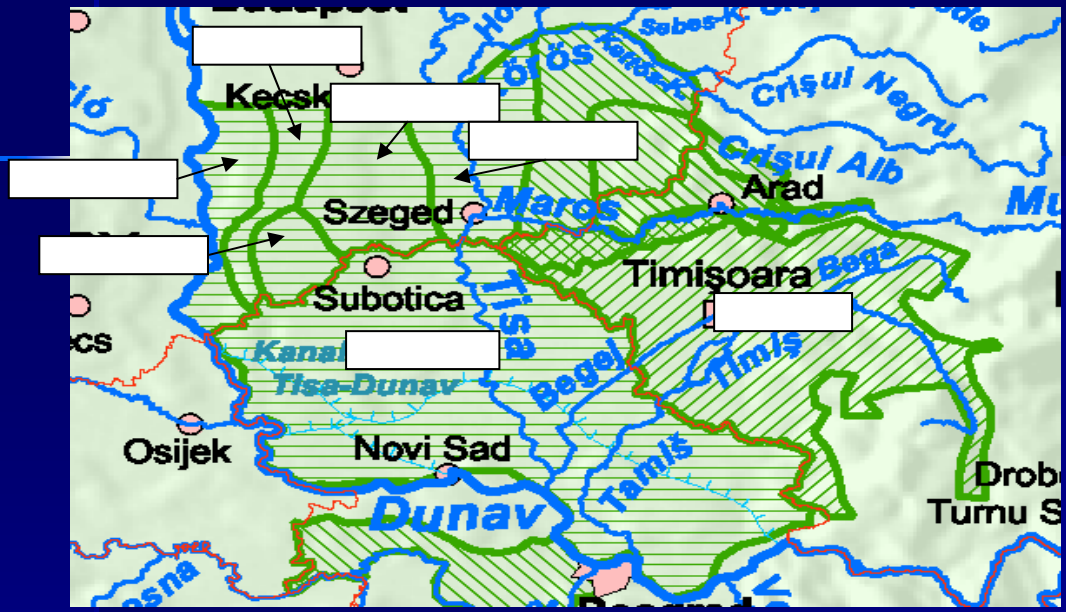
ICPDR 2004 Roof report Serbia

102 GWB's have been identified in the Serbian part of the DRB. For the purpose of characterization, 17 groups of GWB's and 58 GWB's were delineated, all GWB's were divided into: porous (Quaternary and Neogene), karstic and fissured. The preliminary delineation of bodies of groundwater within the various aquifers was based on geological and hydraulic characterization.

Karst GW bodies in Danube catchment of SCG

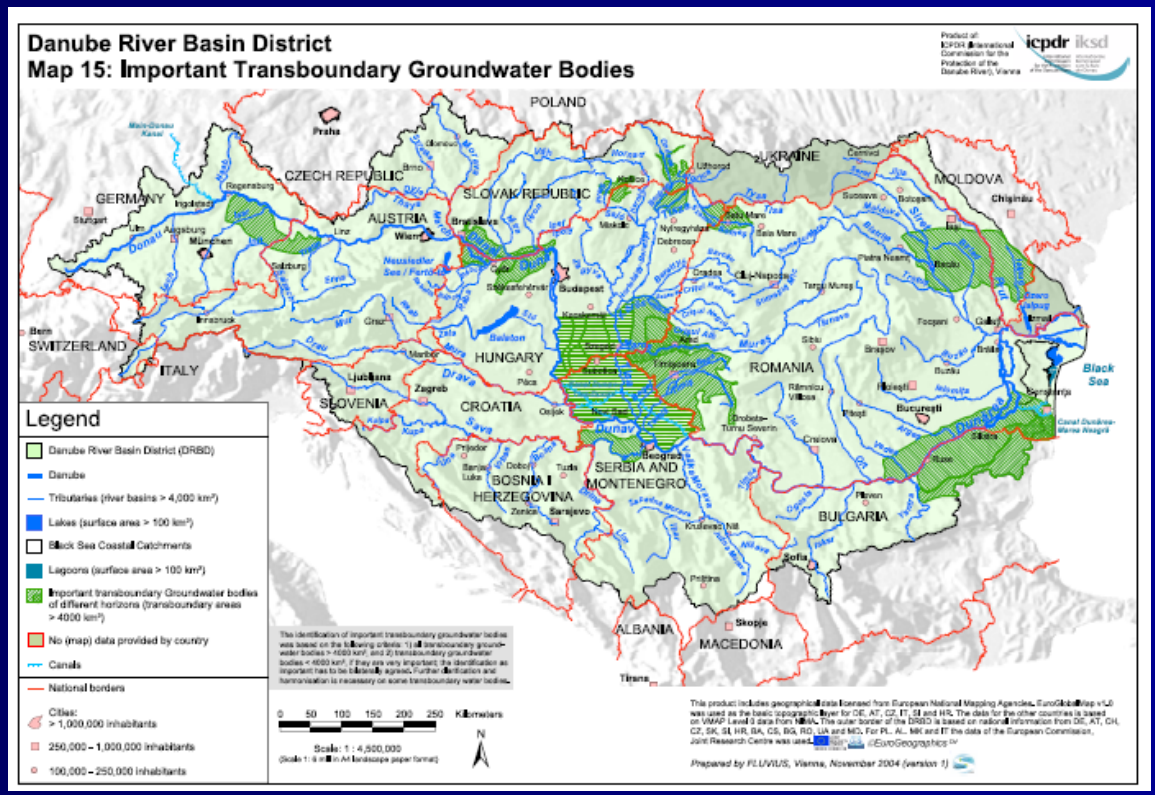


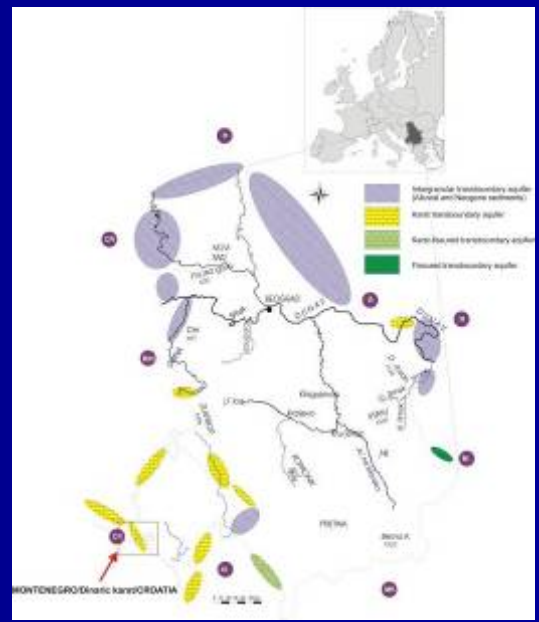
How to achieve good status ?



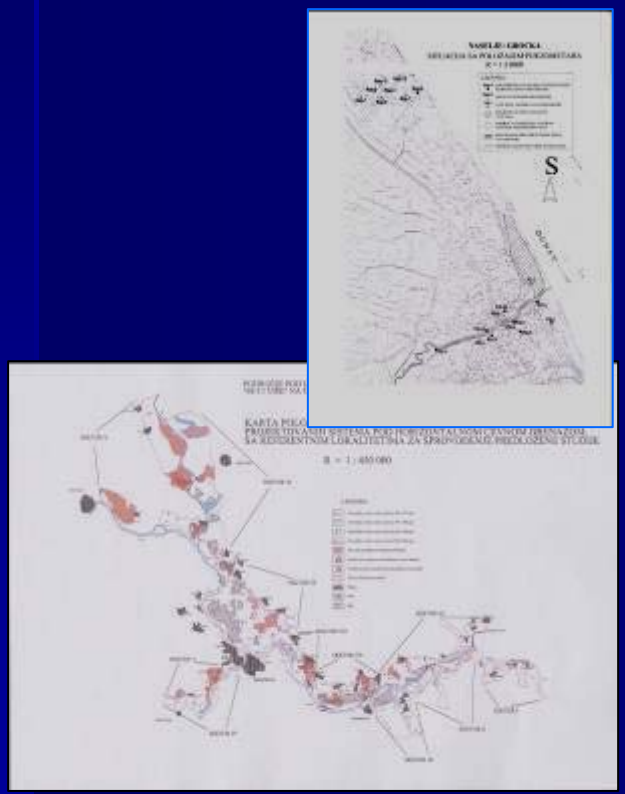
- A preliminary assessment of the risk of failing to achieve good status by the year 2015 suggests that 16 water bodies (groups of water bodies) are at risk of failing to achieve good chemical status, and 11 are at risk of failing to achieve good quantitative status. A lack of data prevented a risk assessment for 14 water bodies.

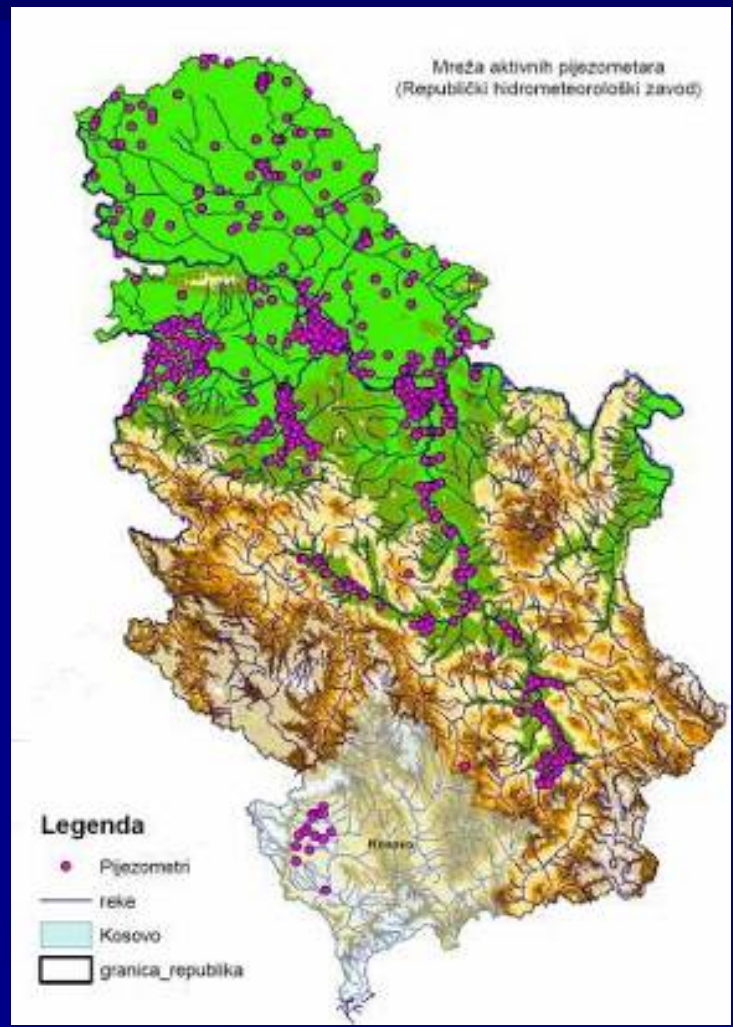
Still Inadequate transboundary water management





- Monitoring of groundwater resources is undertaken at several levels: national level, city level, and water supply source level, as well as in a portion of riparian lands of the Danube, Sava, and Tisa rivers which are within the backwater zone of the Iron Gate Dam. The current Water Law requires the Hydrometeorological Survey of Serbia to monitor groundwater regime only in alluvial sediments and shallow aquifers.





Current National groundwater projects and their objectives:

Institute for water management "J.Cerni"
Faculty of Mining & Geology
Geological Institute of Serbia

- Assessing GW resources
- Assessing GW Quality
- Aquifer vulnerability assessment
- Introducing GW control solutions
- Establishing monitoring for all aquifer types
- Ensuring adequate source sanitary protection
- Strengthening the institutions
- Increasing awareness of sustainable water use
- Adapting legislative concerning groundwater
- Providing base for Water Master plans and Strategic National Development plans

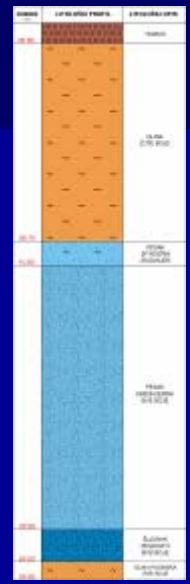
Tasks:

GW database;

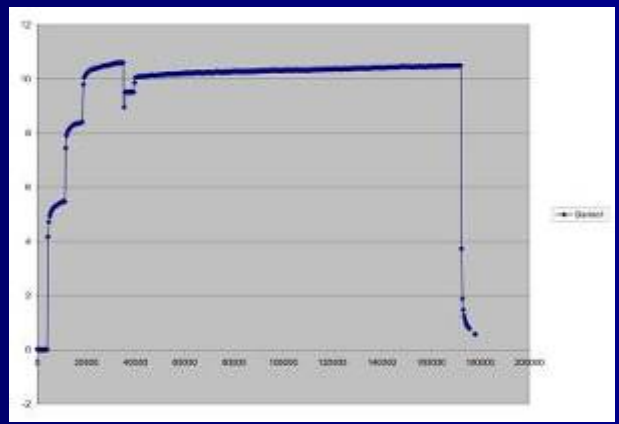
New monitoring system involving RHMS and Geol. Survey of Serbia;

Vulnerability maps as base for Master plans;

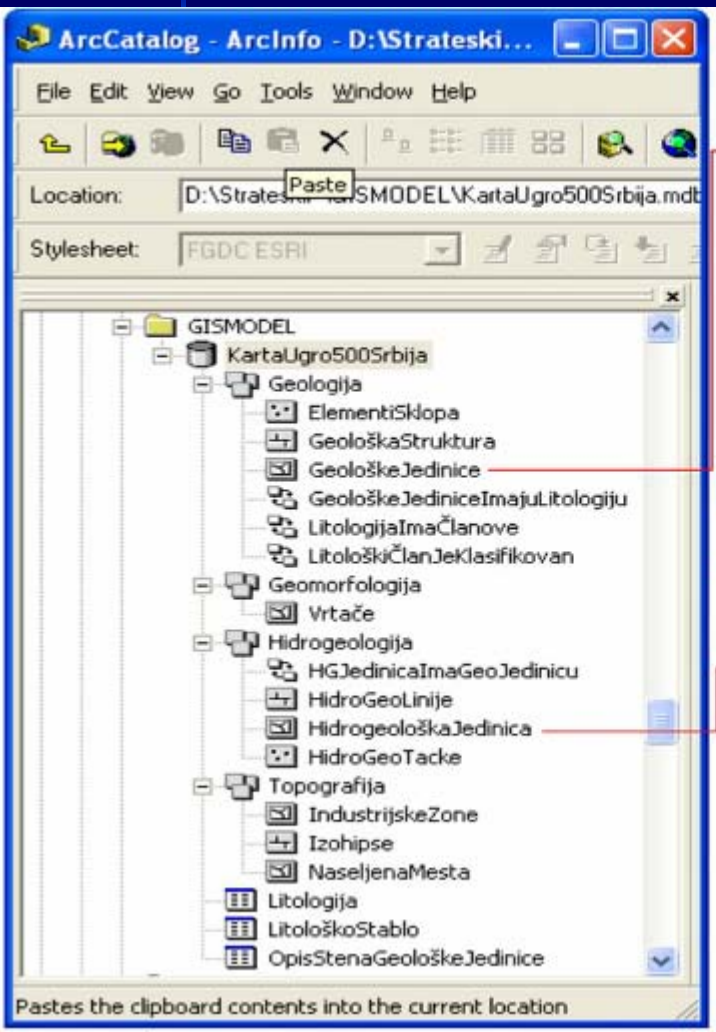
Achieve targets of WFD;

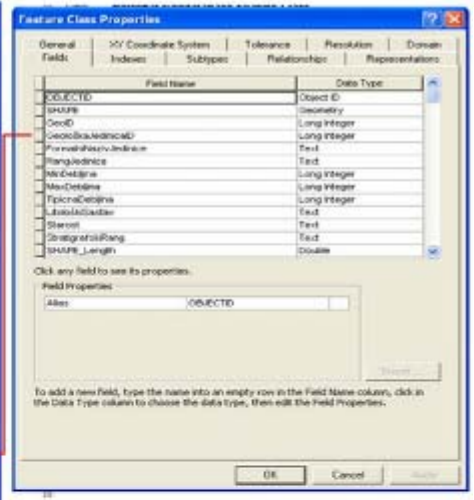


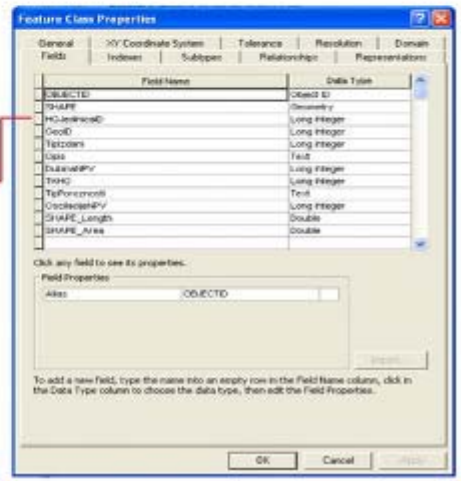
Automatic recording wherever and whenever possible…

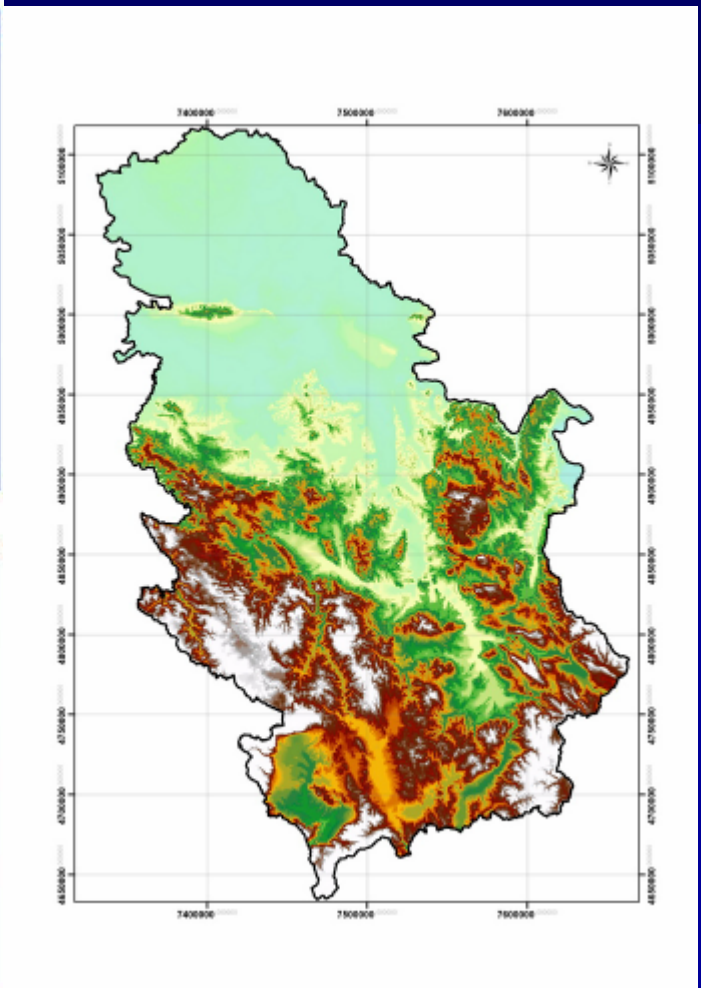


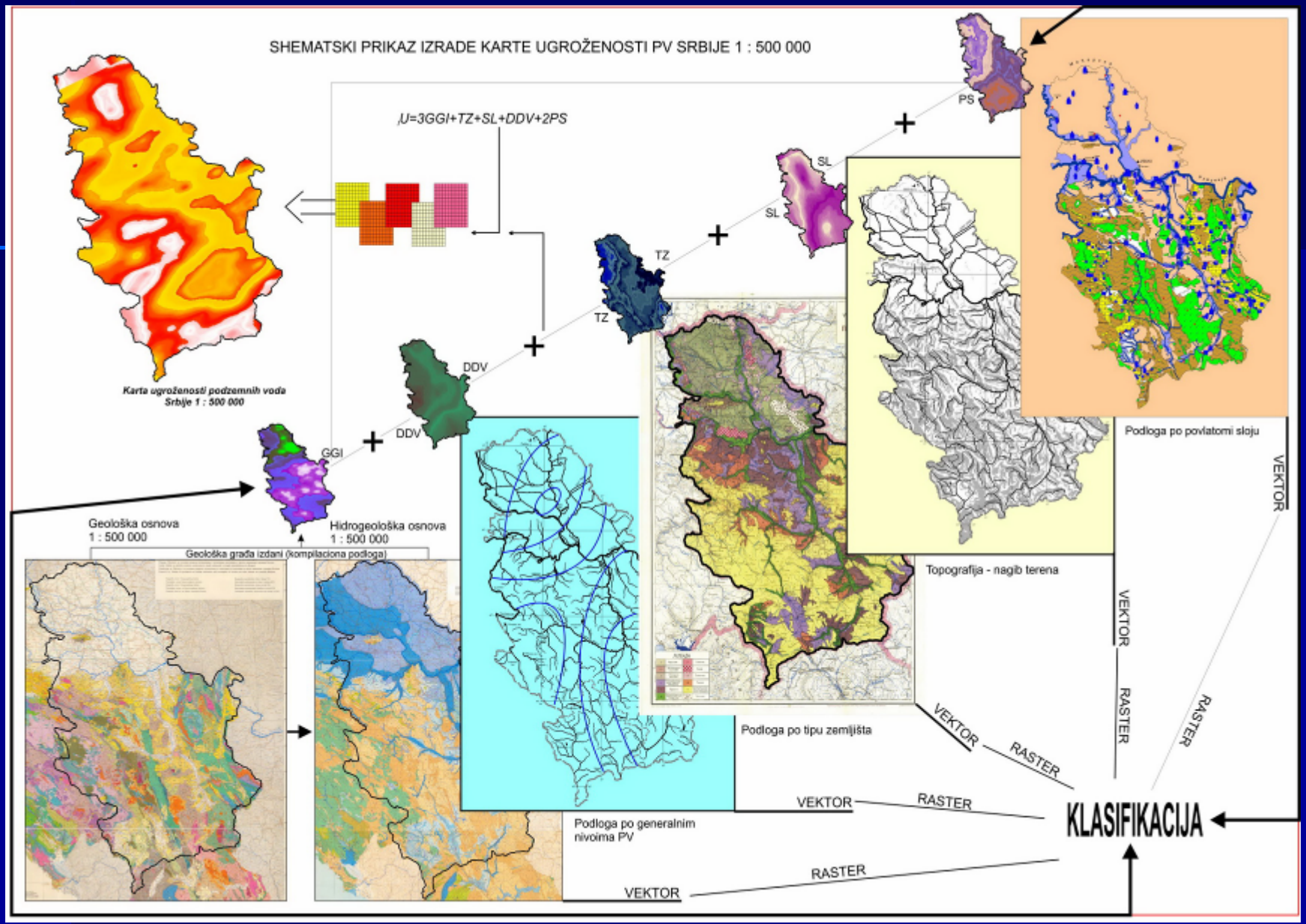
Vulnerability map of Gw in Serbia
Layers & DEM










SHEMATSKI PRIKAZ IZRADE KARTE UGROŽENOSTI PV SRBIJE 1 : 500 000
U=3GGI+TZ+SL+DDV+2PS
Karta ugroženosti podzemnih voda Srbije 1 : 500 000
GGI
DDV
DDV
TZ
TZ
SL
SL
PS
Podloga po površinskom sloju
Topografija - nagib terena
Podloga po tipu zemljišta
Podloga po generalnim nivoima PV
Geološka osnova 1 : 500 000
Hidrogeološka osnova 1 : 500 000
Geološka građa izdani (kompilaciona podloga)
VEKTOR
RASTER
KLASIFIKACIJA

Thank you for your attention