



# *Hydrological Information System of the Sava River Basin – Sava HIS*

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**Capacity Building Workshop on Hydrological Data Exchange,  
standardization, and Interoperability in WMO's Region VI**

25-26 January 2024, Online

29-30 January 2024, Zagreb, Croatia

# Sava HIS within the Agenda

## Online Session, 25<sup>th</sup> January 2024

13:20–13:50	SAVA HIS	Mirza Sarač, ISRBC
13:50–14:15	WHOS and SAVA HIS (data protocols and tools, data, metadata)	Mirza Sarač, ISRBC Silvano Pecora, WMO INFCOM Vice-President and Chair JET-HYDMON

## Physical Session, 29<sup>th</sup> January 2024

9:30–10:40	SAVA HIS (data interoperability and Tools)	Mirza Sarač, ISRBC
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## Physical Session, 30<sup>th</sup> January 2024

15:00–15:30	Open Discussion: Improvement of SAVA HIS	Mirza Sarač, ISRBC
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## Workshop output






Among others, to set-up background for **further developments of Sava HIS and its interconnectivity with the WMO systems and tools**

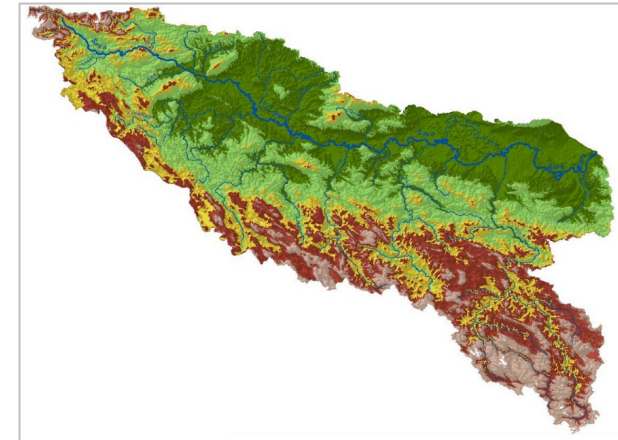
# Sava River Basin

## Key facts

- ❖ **Area:** 97 713 km<sup>2</sup> (the second largest Danube sub-basin; share: 12%)
- ❖ **River length:** 940 km (594 km of which is the waterway)
- ❖ **Population:** approx. 9 million

- ❖ **Average annual air temperature:** approx. 9.5°C
- ❖ **Mean monthly water temperature:** lowest January: -1.5°C / highest July: 20°C
- ❖ **Average annual rainfall:** approx. 1,100 mm
- ❖ **Long-term average annual precipitation:** 600 mm up to 2,300 mm
- ❖ **Average flow of the Sava at the mouth:** approx. 1700 m<sup>3</sup>/s (the largest Danube tributary)
- ❖ **Spatial distribution of runoff:** 150 mm/year (under 5 l/s/km<sup>2</sup>) up to 1,200 mm/year (almost 40 l/s/km<sup>2</sup>)
- ❖ **Long-term average unit-area-runoff:**
  - Complete catchment area: 18 l/s/km<sup>2</sup>
  - Tributaries:
    - Una River - 23 l/s/km<sup>2</sup>
    - Vrbas River - 19 l/s/km<sup>2</sup>
    - Bosna River - 19 l/s/km<sup>2</sup>
    - Ukrina River - 12 l/s/km<sup>2</sup>
    - Tinja Rivers - 12 l/s/km<sup>2</sup>
    - Drina River - 40 and 50 l/s/km<sup>2</sup>

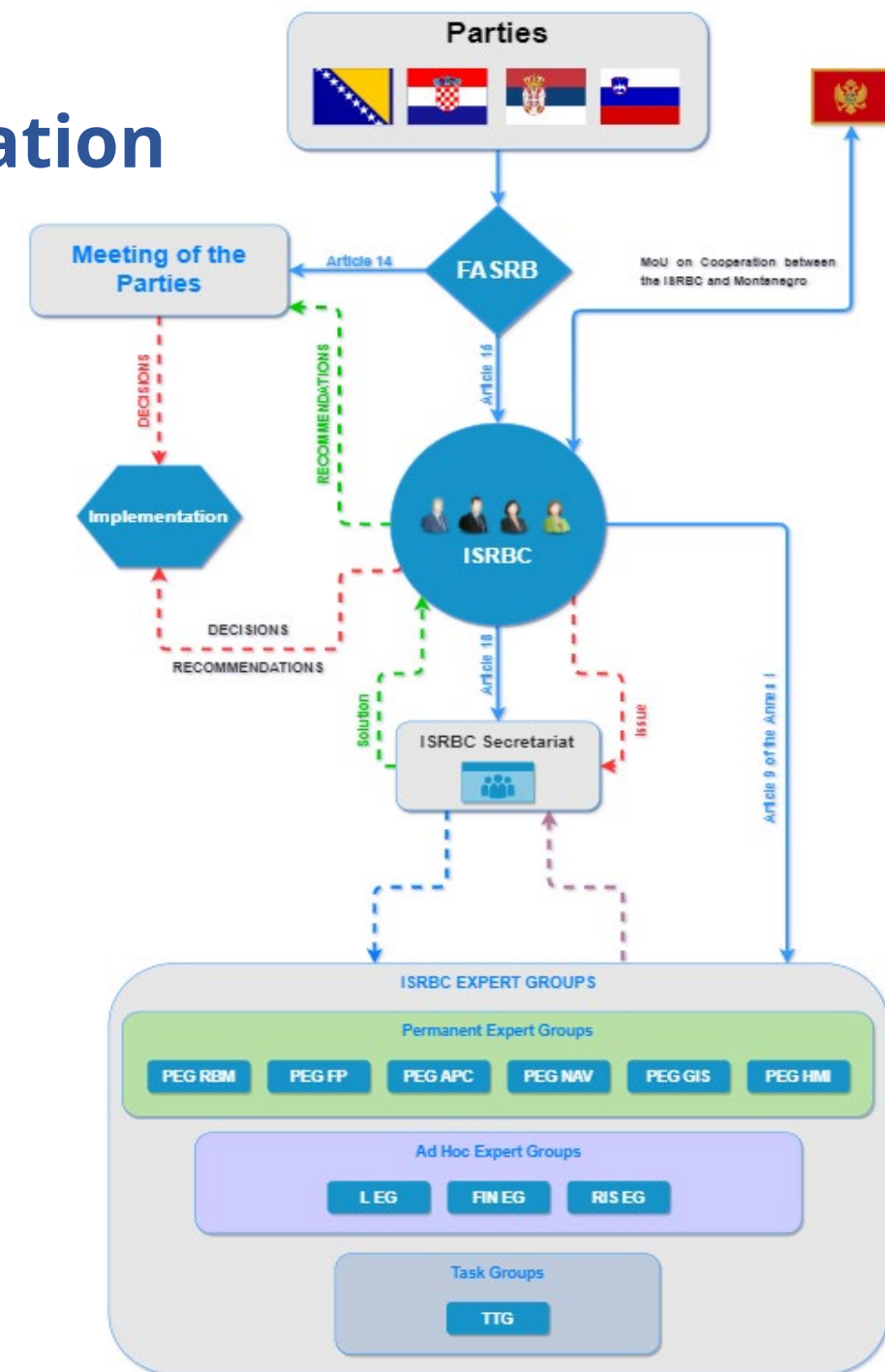
Country		Share of the basin (%)	Share of the territory (%)
Bosnia and Herzegovina		39.2	75.8
Croatia		26.0	45.2
Serbia		15.5	17.4
Slovenia		12.0	52.8
Montenegro		7.1	49.6
Albania		0.2	0.6



# Background of cooperation

- ❖ **FASRB:** Framework Agreement on the Sava River Basin
- ❖ **Parties:**
  - Bosnia and Herzegovina
  - Croatia
  - Serbia
  - Slovenia

(Montenegro – cooperation on technical level until full membership)
- ❖ **Implementation coordinated by:**  
the International Sava River Basin Commission
- ❖ **Key objective:** Sustainable development of the region through transboundary water cooperation
- ❖ **Particular objectives** – to establish:
  - International regime of navigation
  - Sustainable water management
  - Sustainable management of hazards (floods, droughts, accidents involving water pollution, etc.)





# ISRBC Scope of cooperation



**Management plans** (river basin, flood risk, sediment, climate change adaptation)

**Integrated systems** (information, modelling, forecasting)

**Economic activities** (navigation, river tourism)

Harmonization of **regulation** (national → EU)

**Protocols** to the FASRB:



Issue

Signed

Ratified / in force

**Navigation Regime**

3 Dec. 2002

29 Dec. 2004

**Prevention of Water Pollution caused by Navigation**

1 June 2009

8 Oct. 2017

**Flood Protection**

1 June 2010

27 Nov. 2015

**Sediment Management**

6 July 2015

8 Oct. 2017

Emergency Situations

Final harmonization expected

Transboundary Impact

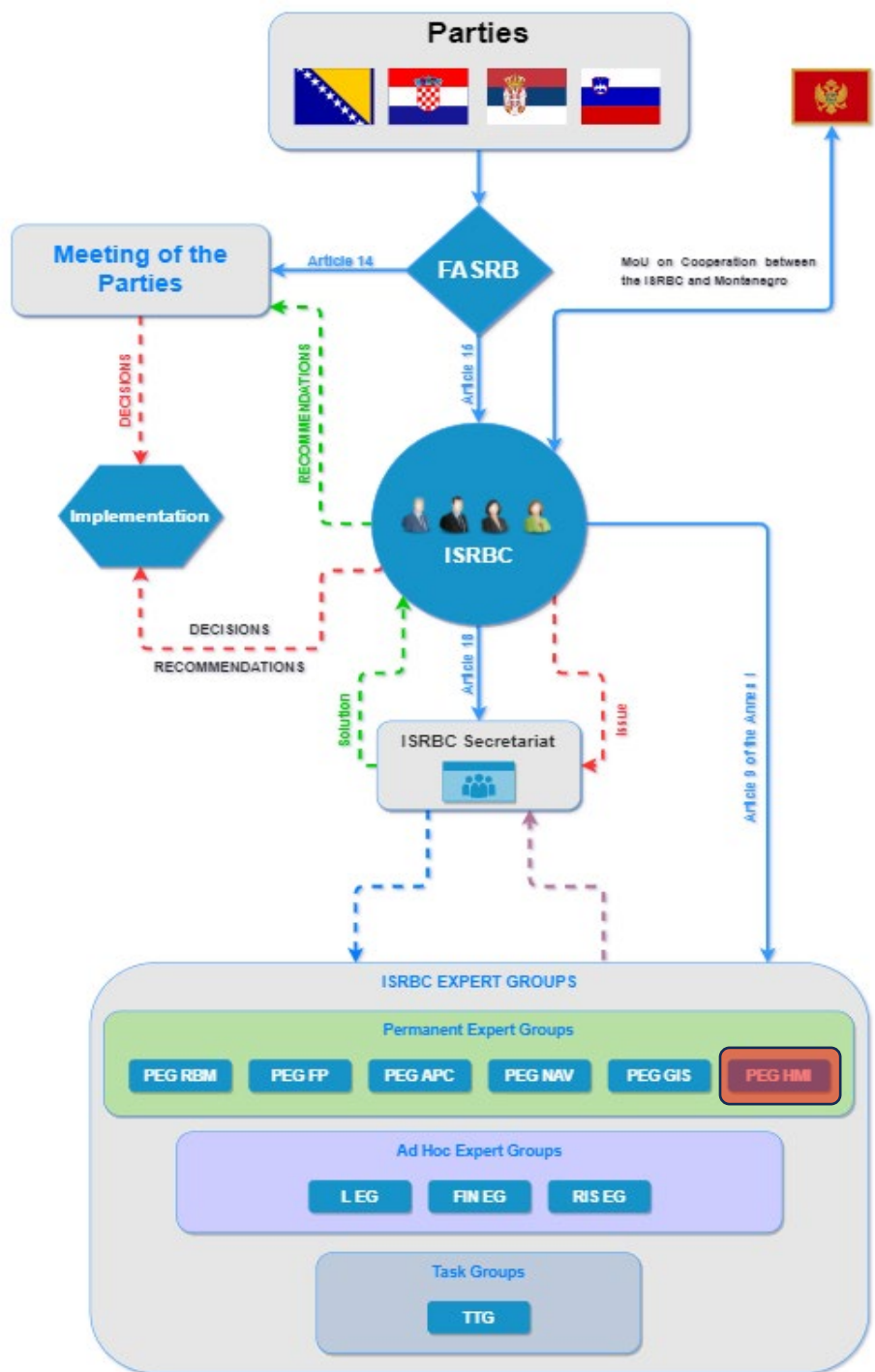
Draft under reconsideration

### The FASRB stipulates:

- ❖ „...the Parties shall, **on a regular basis, exchange information on the water regime** of the Sava River Basin...”

### The Protocol on Flood Protection to the FASRB stipulates:

- ❖ „The Parties shall, **through the hydro-meteorological services and institutions responsible for flood protection, ensure timely exchange of meteorological and hydrological data**, analyses and information important for flood protection, especially the timely forecast of high waters, in line with the agreed procedure.”



# Coordination of the HM Data Exchange

## PEG HMI - Permanent Expert Group for Hydrological and Meteorological Issues

- ❖ Providing support to exchange of HM data within the Sava River Basin, especially in relation to:
  - creation of a HM database for the whole Sava River Basin
  - preparation of hydrological yearbooks of the Sava River Basin
- ❖ Development of strategy and action plans of the ISRBC and providing support and assistance in performing the specified activities

## Meeting of Directors of the NHMSs from the Sava River Basin countries



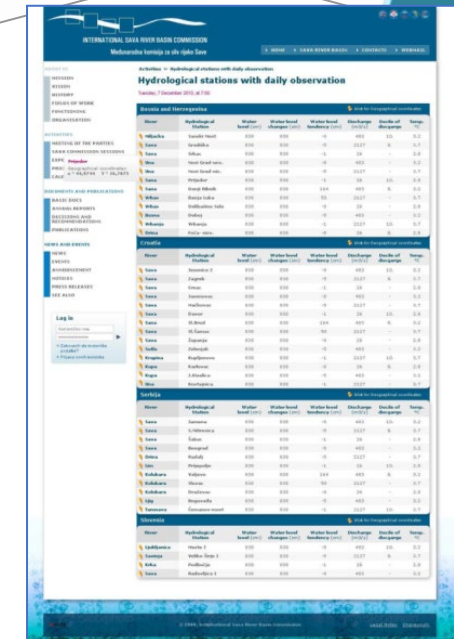
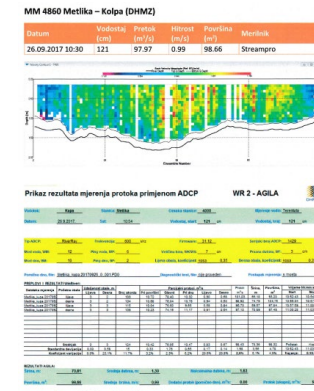
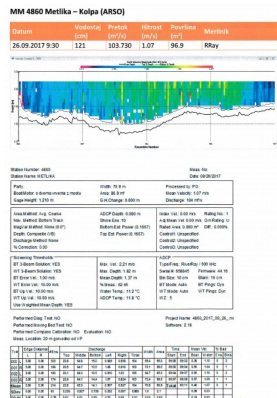
# Initial HM Data Exchange

## ❖ Hydrological Yearbooks

- Water levels (daily values, min, aver, max, frequency and duration)
- Water discharges (daily values, min, aver, max, duration)
- Water temperatures (daily values, min, aver, max)
- Suspended sediment discharge/turbidity (daily values, min, aver, max)
- Overview of the characteristical water levels and discharges
- Precipitations (monthly values, totals)
- Overview of the characteristical air temperatures and precipitations

## ❖ A web portal for the real-time data exchange

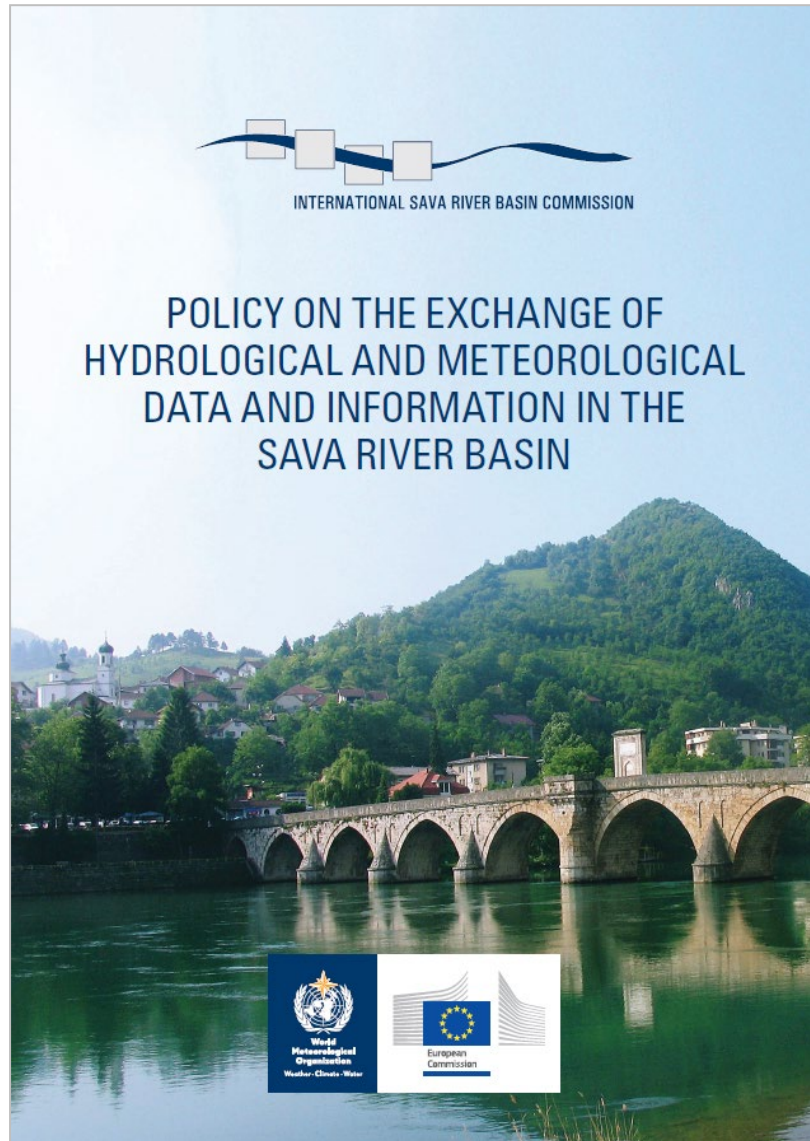
## ❖ Joint measurements at border sections





# Policy on the HM Data Exchange

## A legal background for establishment of Sava HIS



- ❖ Signed by the NHMSs directors in 2014
- ❖ WMO resolutions transposed
  - Resolution 25 (Cg-XIII) - Exchange of Hydrological Data and Products
  - Resolution 40 (Cg-XII) - Policy and Practice for the Exchange of Meteorological and Related Data and Product
- ❖ Principles (organizations, monitoring locations, data to be exchanged)
- ❖ Routes (procedures, timetable, quality standards, use and redistribution, ownership, charging, future harmonization)
- ❖ Organizations (data providers/receivers)
  - Hydro-meteorological services
  - Water / environment agencies
  - Hydropower companies (still pending)
- ❖ International legal framework
- ❖ National legal framework

# Policy on the HM Data Exchange

## Annex A: Organisations covered by the Policy

**A.1** International Sava River Basin Commission (ISRBC)

**A.2** *Signatory organisations:*

State	Name of organisation	Abbreviation
Bosnia and Herzegovina	Federal Hydrometeorological Service	FHMZFBiH
	Sava River Watershed Agency	AVPSAVA
	Republic Hydro-Meteorological Service of Republic of Srpska	RHMZRS
Montenegro	Institute of Hydrometeorology and Seismology	IHMS
Republic of Croatia	Meteorological and Hydrological Service	DHMZ
Republic of Serbia	Republic Hydrometeorological Service of Serbia	RHMZ
	Agency for Environmental Protection	
Republic of Slovenia	Slovenian Environment Agency	ARSO

**A.3** *Other organisations:*

State	Name of organisation	Abbreviation

❖ The Signatories to this Policy should normally include, but are not limited to, the States' national hydrometeorological institutions - or equivalent organisation responsible for the collection and/or management and distribution of a States' national hydrological (and meteorological) data or information.

**Additional organisations** which operate in one (or more) of the States, **in connection with the management of the Sava River Basin, may become a Signatory** to the Policy at the invitation of the Commission.

## Annex B: Data types covered by the Policy

### B.1 List of data and information types covered by the Policy:

Parameter	Temporal Resolution (Statistic <sup>3</sup> )	Units
River, Lake or Reservoir Level/Stage	Daily (Mean) Hourly	cm
River Discharge	Daily (Mean) Hourly	m <sup>3</sup> s <sup>-1</sup>
Water Temperature	Daily (Mean)	°C
Suspended Sediment Discharge	Daily (Mean)	kg s <sup>-1</sup>
Groundwater Level	Daily Every 5/10th Day	cm
Ice Condition	Daily	% of river cross section or text description
Precipitation	Annual (Total) Monthly (Total) Daily (Total) 6/12 Hourly (Total) Hourly (Total)	mm
Air Temperature	Daily (Mean) Hourly	°C
Relative Humidity	Daily Hourly	%
Wind (Speed and Direction)	Daily Hourly	m/s
Snow Depth	Daily	cm
Evaporation	Daily (Total)	mm
Solar Radiation	Daily	J m <sup>-2</sup>
Sunshine	Daily (Total)	Hours
Atmospheric Pressure	Daily	hPa

# Policy on the HM Data Exchange

## Annex D: Minimum level of agreed data exchange

### C.1 Purpose

C.1.1 This Annex outlines a minimum level of agreed data and information exchange to be concluded under this Policy.

### C.2 General

C.2.1 *Signatories* will make the data and information outlined in this Annex available without charge to all other organisations covered by the Policy for the management of the Sava River Basin.

C.2.2 Unless otherwise specified, data and information exchanged under this Annex is done so in line with the principles and procedures outlined in the Policy.

C.2.3 All data and information listed in this Annex shall be in compliance with Clause 5.1.

C.2.4 The data and information detailed in Section C.3 of this Annex includes, but is not limited to, all data published by the Commission in the Hydrological Yearbooks of the Sava River Basin.

### C.3 Data to be exchanged

C.3.1 All data and information outlined in the following table, which are currently collected or held by the *Signatories* for the monitoring locations specified in C.4, will be exchanged:

Parameter	Temporal Resolution (Statistic)	Units	
P1	Water Stage	Daily (Mean)	cm
P2	River Discharge	Daily (Mean)	m <sup>3</sup> s <sup>-1</sup>
P3	Water Temperature	Daily (Mean)	°C
P4	Suspended Sediment Discharge	Daily (Mean)	kg s <sup>-1</sup>
P5	Precipitation	Daily (Total)	mm
P6	Air Temperature	Daily (Mean)	°C
P7	Water Stage	Current Stage	cm
P8	River Discharge	Current Discharge	m <sup>3</sup> s <sup>-1</sup>
P9	Water Temperature	Current Temperature	°C

### C.4 Monitoring stations included

C.4.1 Full period of record, data and information from the monitoring stations in the following table will be exchanged:

Hydrological Stations	BA	HR	ME	RS	SI	Total
	34	22	2	18	17	93

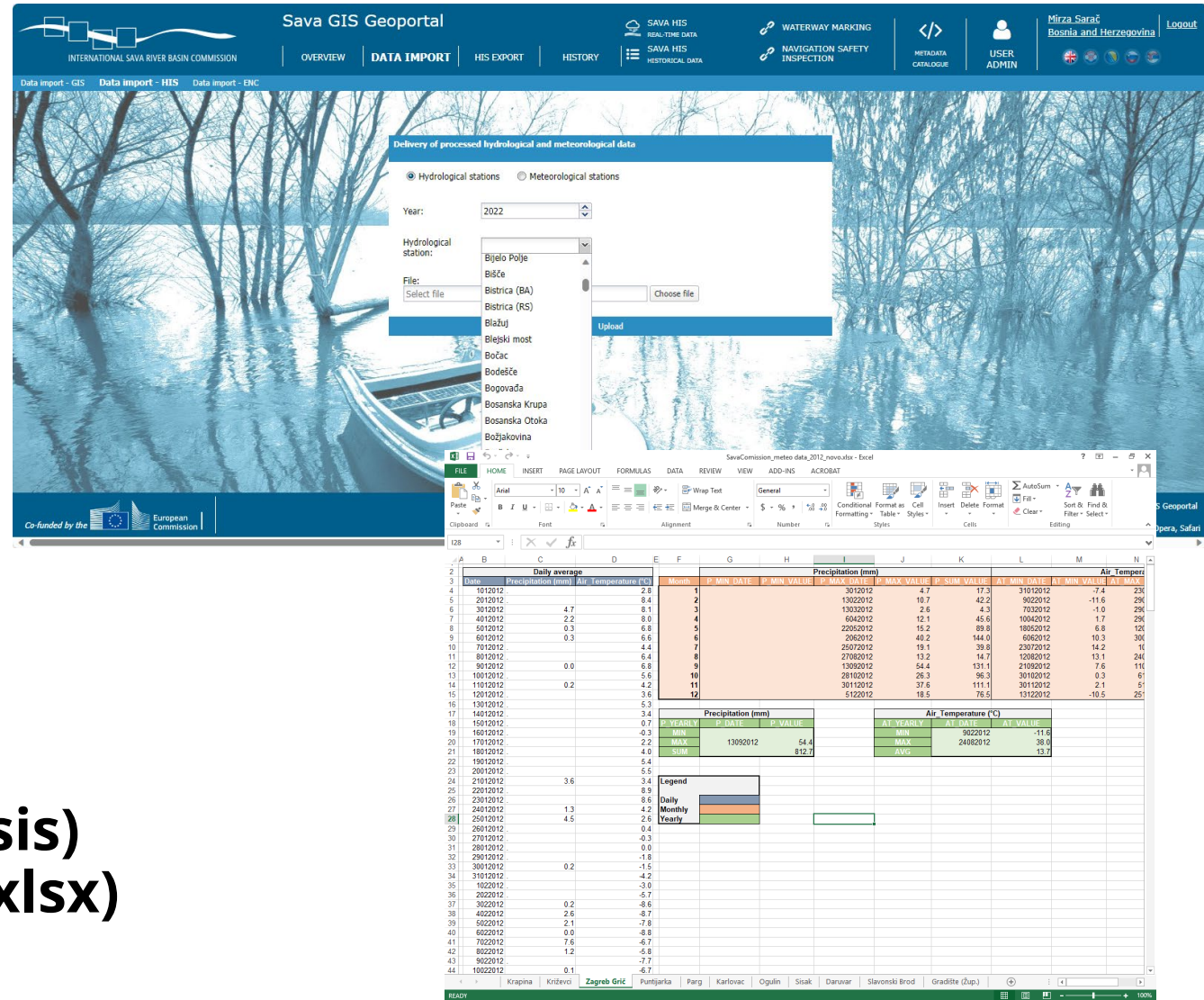
Meteorological Stations	BA	HR	ME	RS	SI	Total
	28	11	3	6	5	53



# Sava HIS data providers and exchange format

## Daily (processed data)

- ❖ Slovenia:
  - Slovenian Environment Agency
- ❖ Croatia:
  - Croatian Meteorological and Hydrological Service
- ❖ Bosnia and Herzegovina:
  - Federal Hydrometeorological Service
  - Republic Hydro-Meteorological Service of RoS
- ❖ Serbia:
  - Republic Hydrometeorological Service
- ❖ Montenegro:
  - Institute of Hydrometeorology and Seismology



The screenshot shows the Sava GIS Geoportal interface. The top navigation bar includes 'Sava GIS Geoportal', 'INTERNATIONAL SAVA RIVER BASIN COMMISSION', and various menu items like 'OVERVIEW', 'DATA IMPORT', 'HIS EXPORT', and 'HISTORY'. There are also links for 'SAVA HIS REAL-TIME DATA', 'WATERWAY MARKING', 'NAVIGATION SAFETY INSPECTION', 'METADATA CATALOGUE', 'USER ADMIN', and 'Logout'. The main content area displays a 'Delivery of processed hydrological and meteorological data' dialog box with options for 'Hydrological stations' and 'Meteorological stations'. A dropdown menu for 'Hydrological station:' lists various locations like 'Bijelo Polje', 'Bišće', 'Bištica (BA)', etc. Below the dialog box, an Excel spreadsheet is visible, showing a table with columns for 'Date', 'Precipitation (mm)', 'Air Temperature (°C)', and 'Month'. The table contains data for the year 2012, with monthly averages and a legend for 'Daily', 'Monthly', and 'Yearly' data.

Daily average			Precipitation (mm)						Air Temperature (°C)	
Date	Precipitation (mm)	Air Temperature (°C)	P. MIN VALUE	P. DATE	P. MAX VALUE	P. SUM VALUE	AT MIN VALUE	AT DATE	AT MAX VALUE	
10/12/2012	2.8	2.8	1.7	30/12/2012	4.7	17.3	3/10/2012	-7.4	23.6	
20/12/2012	8.4	8.4	2	13/02/2012	10.7	42.2	9/02/2012	-11.6	29.6	
30/12/2012	4.7	8.1	3	13/03/2012	2.6	4.3	7/03/2012	-1.0	29.6	
4/01/2012	2.2	8.0	4	30/04/2012	12.1	45.6	10/04/2012	1.7	29.6	
5/01/2012	0.3	6.8	5	22/05/2012	15.2	89.6	18/05/2012	6.8	12.1	
6/01/2012	0.3	6.6	6	2/06/2012	40.2	144.0	6/06/2012	10.3	30.6	
7/01/2012	4.4	4.4	7	25/07/2012	18.1	39.6	23/07/2012	14.2	11.1	
8/01/2012	6.4	6.4	8	27/08/2012	13.2	14.7	12/08/2012	13.1	24.6	
9/01/2012	0.0	6.8	9	13/09/2012	54.4	131.1	21/09/2012	7.6	11.1	
13/01/2012	5.6	5.6	10	28/10/2012	26.3	96.3	30/10/2012	0.3	6.1	
14/01/2012	0.2	4.2	11	30/11/2012	37.6	111.1	30/11/2012	2.1	5.1	
15/01/2012	3.6	3.6	12	5/12/2012	18.5	76.5	13/12/2012	-10.5	25.1	
16/01/2012	5.3	5.3								
17/01/2012	3.4	3.4								
18/01/2012	0.7	0.7								
19/01/2012	-0.3	-0.3								
20/01/2012	2.2	2.2								
21/01/2012	4.0	4.0								
22/01/2012	6.4	6.4								
23/01/2012	5.5	5.5								
24/01/2012	3.6	3.4								
25/01/2012	8.9	8.9								
26/01/2012	8.6	8.6								
27/01/2012	1.3	4.2								
28/01/2012	4.5	2.6								
29/01/2012	0.4	0.4								
30/01/2012	-0.3	-0.3								
31/01/2012	0.0	0.0								
32/01/2012	-1.8	-1.8								
33/01/2012	-1.5	-1.5								
34/01/2012	-4.2	-4.2								
35/01/2012	-3.0	-3.0								
36/01/2012	-5.7	-5.7								
37/01/2012	-6.6	-6.6								
38/01/2012	-8.7	-8.7								
39/01/2012	-7.8	-7.8								
40/01/2012	-8.8	-8.8								
41/01/2012	-6.7	-6.7								
42/01/2012	-5.8	-5.8								
43/01/2012	-7.7	-7.7								
44/01/2012	-6.7	-6.7								

**Data delivery (import at yearly basis) using a unique exchangeable file (xlsx)**

# Sava HIS data providers and exchange formats

## Hourly (real-time raw data)

### ❖ Slovenia:

- Slovenian Environment Agency
  - ❑ xml / web service

### ❖ Croatia:

- Croatian Meteorological and Hydrological Service
  - ❑ xls&xml / ftp (initially: csv&xml / ftp)

### ❖ Bosnia and Herzegovina:

- Federal Hydrometeorological Service
  - ❑ xml / ftp (initially: csv&xml / ftp)
- Republic Hydro-Meteorological Service of RoS
  - ❑ zrx / ftp (initially: json / web service)
- Sava River Watershed Agency
  - ❑ zrx / ftp (initially: csv / ftp)

### ❖ Serbia:

- Republic Hydrometeorological Service
  - ❑ zrx / ftp (initially: csv / web service)

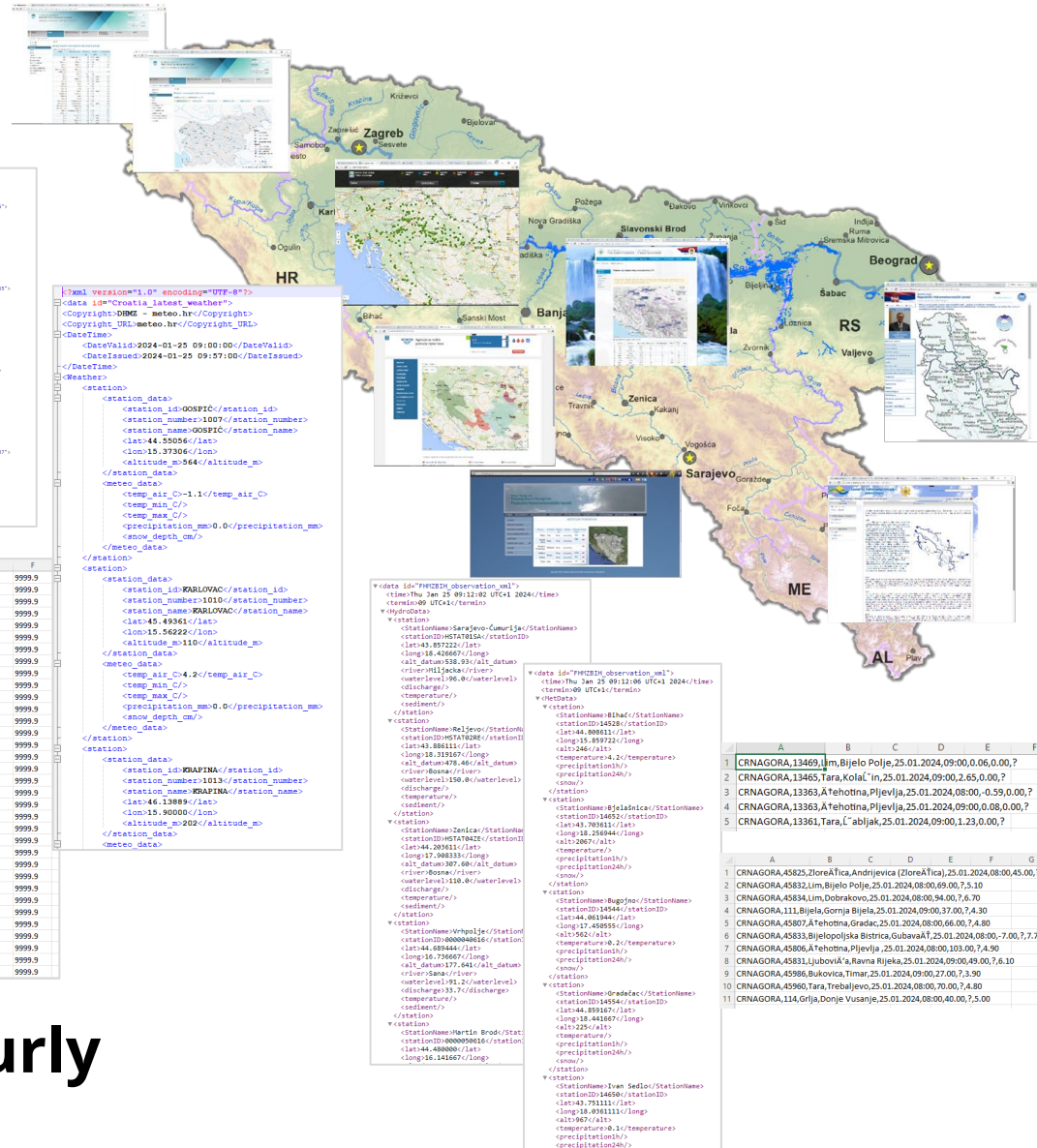
### ❖ Montenegro:

- Institute of Hydrometeorology and Seismology
  - ❑ csv / ftp

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5	AKUMULACIJA PAKRA	3399	24.1.2024 4:00	284	9999.9	9999.9
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17	AKUMULACIJA PAKRA	3399	24.1.2024 16:00	9999.9	9999.9	9999.9
18	AKUMULACIJA PAKRA	3399	24.1.2024 17:00	284	9999.9	9999.9
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34	AKUMULACIJA PAKRA	3399	25.1.2024 9:00	284	9999.9	9999.9



The map displays the Sava River Basin across several countries: Slovenia (SI), Croatia (HR), Bosnia and Herzegovina (BA), Serbia (RS), Montenegro (ME), and Albania (AL). Major cities like Zagreb, Belgrade, and Sarajevo are marked. The map is overlaid with numerous station locations and data exchange format examples.

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	A	B	C	D	E	F	
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2	CRNAGORA, 13465, Tara, Kolač	in	25.01.2024	09:00	2.65	0.00	?
3	CRNAGORA, 45834, Lim, Dobrova	25.01.2024	08:00	94.00	7.6	30	
4	CRNAGORA, 13363, A, Tehotina, Pijevlja	25.01.2024	09:00	0.08	0.00	?	
5	CRNAGORA, 13361, Tara, Čabljak	25.01.2024	09:00	1.23	0.00	?	

	A	B	C	D	E	F	G
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3	CRNAGORA, 45834, Lim, Dobrova	25.01.2024	08:00	94.00	7.6	30	
4	CRNAGORA, 111, Bijela, Gornja Brijuni	25.01.2024	09:00	37.00	7.4	30	
5	CRNAGORA, 45807, Bjelopoljska Bistrica, Gubavac	25.01.2024	08:00	7.4	30		
6	CRNAGORA, 45833, Bjelopoljska Bistrica, Gubavac	25.01.2024	08:00	7.4	30		
7	CRNAGORA, 45806, A, Tehotina, Pijevlja	25.01.2024	08:00	103.00	7.4	30	
8	CRNAGORA, 45831, Ljubovnja, Ravna Rijeka	25.01.2024	09:00	49.00	7.6	10	
9	CRNAGORA, 45806, Bukovica, Timar	25.01.2024	09:00	27.00	7.3	30	
10	CRNAGORA, 45890, Tara, Trebaljevo	25.01.2024	08:00	70.00	7.4	30	
11	CRNAGORA, 1114, Grij, Donje Vusanje	25.01.2024	08:00	40.00	7.5	00	

## Data delivery (import at near real-time, hourly basis) using different exchangeable files



# Sava HIS

## Hub for observed data

### 1. Standards

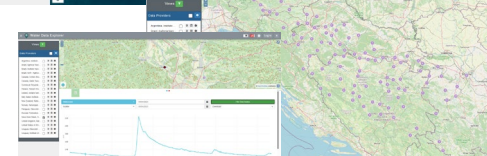
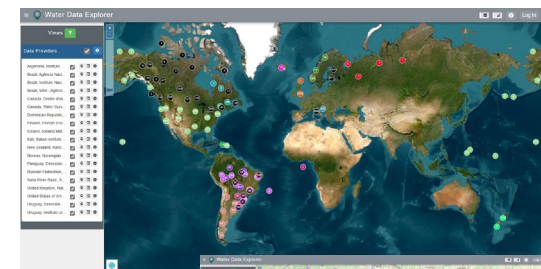
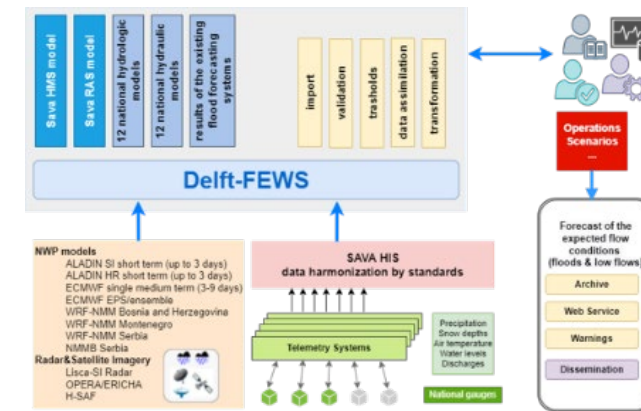
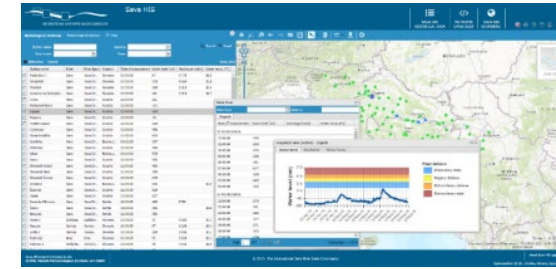
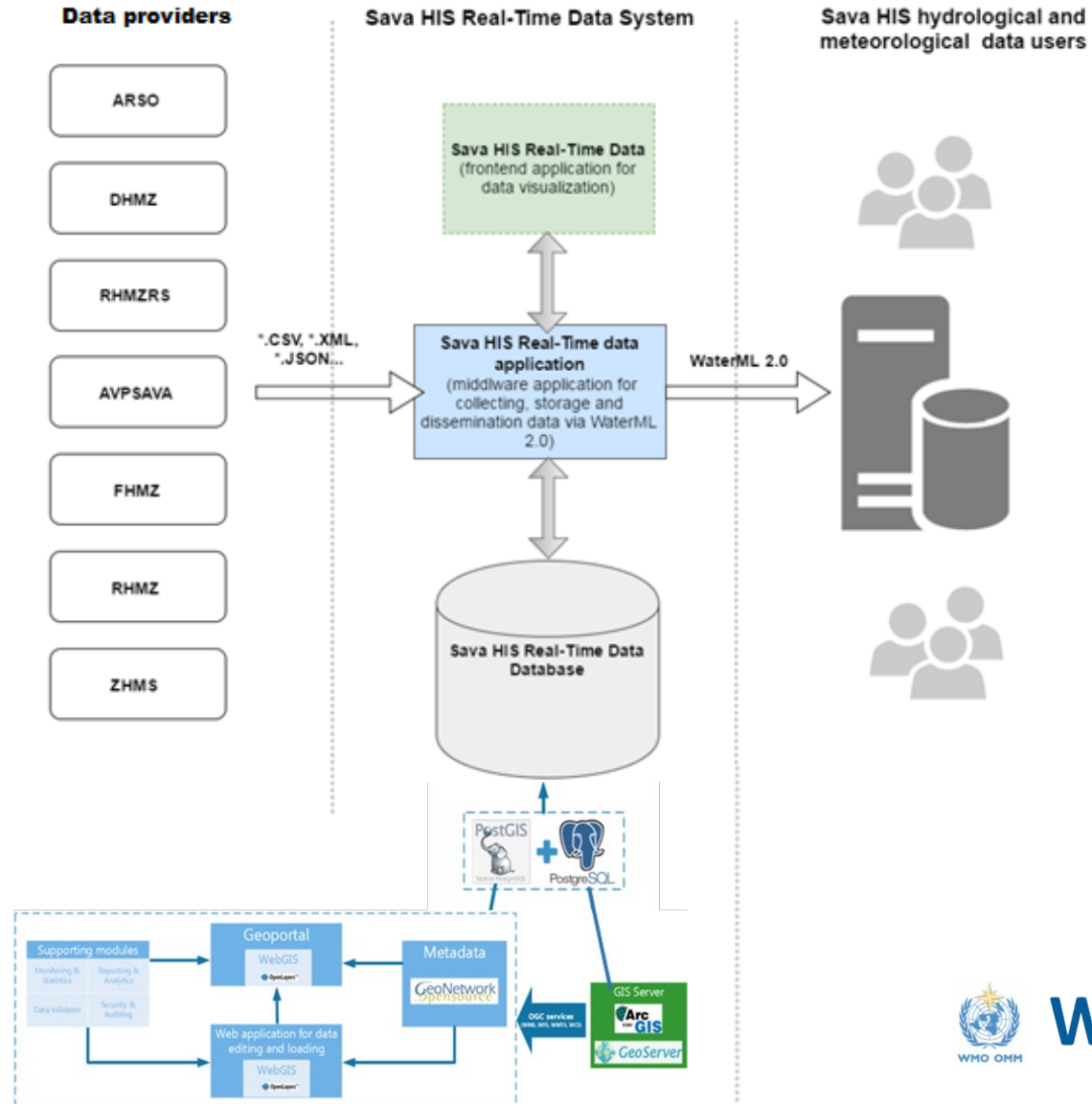
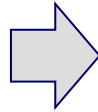
WaterML 2.0 language for describing water data

### 2. Services

Catalog of water data sources – web services

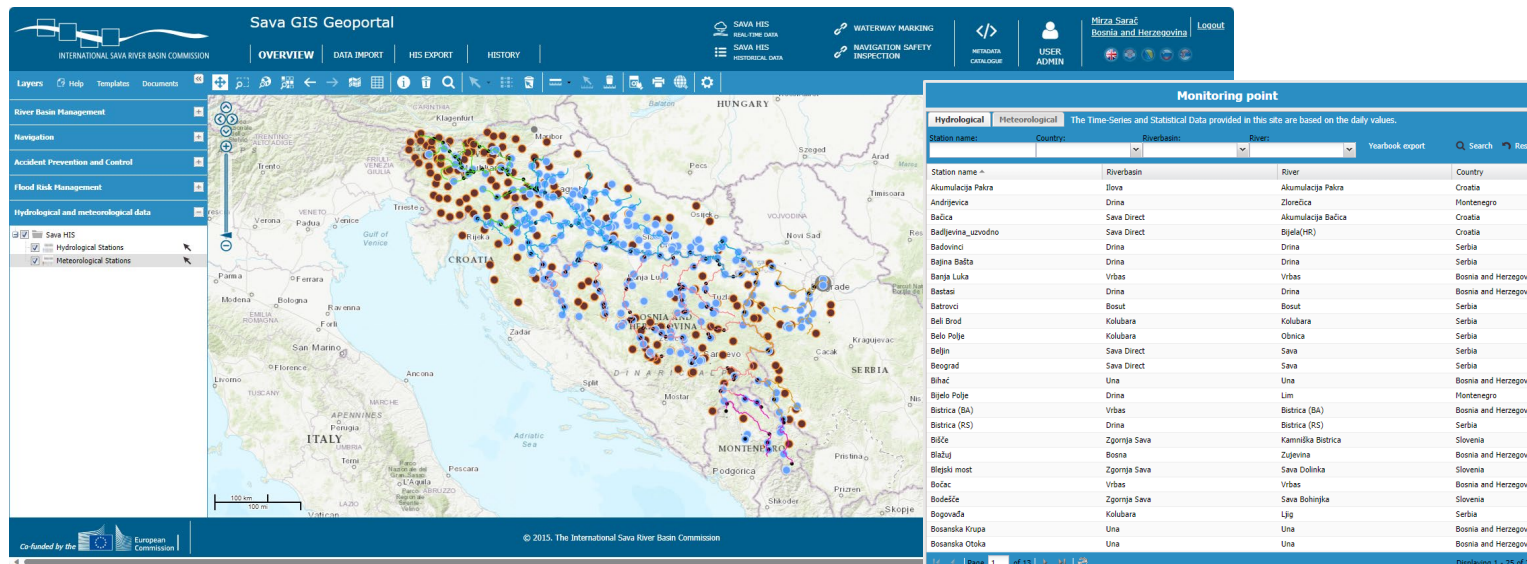
### 3. End user applications

Web apps and desktop software for data access



# Sava HIS visualization

## Sava GIS Geoportal



**Sava GIS Geoportal**

INTERNATIONAL SAVA RIVER BASIN COMMISSION

OVERVIEW | DATA IMPORT | HIS EXPORT | HISTORY

SAVA HIS HISTORICAL DATA | WATERWAY MARKING | NAVIGATION SAFETY INSPECTION | METADATA CATALOGUE | USER ADMIN | Mirza Saraić Bosnia and Herzegovina | Logout

Layers | Help | Templates | Documents

River Basin Management | Navigation | Accident Prevention and Control | Flood Risk Management | Hydrological and meteorological data

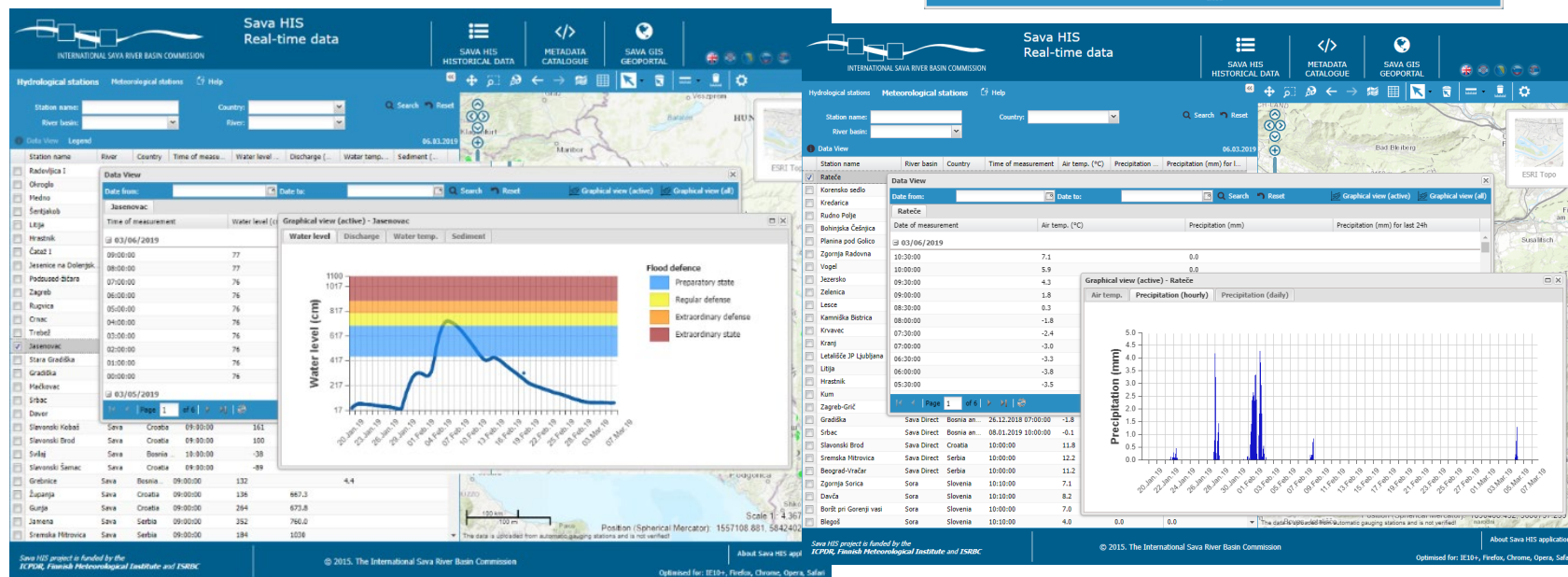
Hydrological Stations | Meteorological Stations

**Monitoring point**

The Time-Series and Statistical Data provided in this site are based on the daily values.

Station name	Country	Riverbasin	River	Yearbook export	Search	Reset
Akumulacija Pakra	Slova	Akumulacija Pakra	Croatia			
Andrijevica	Drina	Zlatica	Montenegro			
Bačica	Sava Direct	Akumulacija Bačica	Croatia			
Badjevska_uzvodno	Sava Direct	Bijela(HR)	Croatia			
Badovinci	Drina	Drina	Serbia			
Bajina Bašta	Drina	Drina	Serbia			
Banja Luka	Vrbas	Vrbas	Bosnia and Herzegovina			
Bastasi	Drina	Drina	Bosnia and Herzegovina			
Batrovci	Bosut	Bosut	Serbia			
Bel Brod	Kolubara	Kolubara	Serbia			
Bela Polje	Kolubara	Obina	Serbia			
Beljin	Sava Direct	Sava	Serbia			
Beograd	Sava Direct	Sava	Serbia			
Bihac	Una	Una	Bosnia and Herzegovina			
Bijelo Polje	Drina	Lim	Montenegro			
Bištica (BA)	Vrbas	Bištica (BA)	Bosnia and Herzegovina			
Bištica (RS)	Drina	Bištica (RS)	Serbia			
Biče	Zravnica Sava	Kamniška Bistrica	Slovenia			
Blažuj	Bosna	Zugjevina	Bosnia and Herzegovina			
Blejski most	Zravnica Sava	Sava Dolinka	Slovenia			
Bočac	Vrbas	Vrbas	Bosnia and Herzegovina			
Bodeže	Zravnica Sava	Sava Bohinjka	Slovenia			
Bogovača	Kolubara	Ujg	Serbia			
Bosanska Krupa	Una	Una	Bosnia and Herzegovina			
Bosanska Otoka	Una	Una	Bosnia and Herzegovina			

## Sava HIS Real-time data



**Sava HIS Real-time data**

INTERNATIONAL SAVA RIVER BASIN COMMISSION

SAVA HIS HISTORICAL DATA | METADATA CATALOGUE | SAVA GIS GEOPORTAL

Hydrological stations | Meteorological stations | Help

Station name:  Country:  River basin:  Search | Reset

Date View | Legend

Station name	River	Country	Time of measur.	Water level	Discharge	Water temp.	Sediment
Badjevska 1							
Orngica 1							
Medno							
Serajebuk							
Litja							
Hrastnik							
Čačak 1							
Jasenica na Doležak							
Područje Otara							
Zagreb							
Naupca							
Ornc							
Trebiš							
Jasenovac							
Stara Gradiska							
Gradiska							
Mačkovac							
Sibac							
Dover							
Slavonski Ribari	Sava	Croatia	09:30:00	141			
Slavonski Brod	Sava	Croatia	09:30:00	100			
S-Id	Sava	Bosnia	19:30:00	-38			
Slavonski Šamac	Sava	Croatia	09:30:00	-89			
Grbitvice	Sava	Bosnia	09:00:00	132	4.4		
Lupanja	Sava	Croatia	09:00:00	136	667.3		
Gurje	Sava	Croatia	09:00:00	264	673.8		
Zamena	Sava	Serbia	09:00:00	352	765.0		
Šrenjska Plovnica	Sava	Serbia	09:00:00	194	1036		

**Graphical view (active) - Jasenovac**

Water level (cm)

Discharge

Water temp.

Sediment

Flood defence

- Preparatory state
- Regular defense
- Extraordinary defense
- Extraordinary state

**Hydrological stations**

Station name	River basin	Country	Time of measurement	Air temp. (°C)	Precipitation (mm)	Precipitation (mm) for last 24h
Rateče						
Korensko sedlo						
Andrijevica						
Rudna Polja						
Bohinska Cerkva						
Planina pod Golico						
Zravnica Radovna			10:30:00	7.1	0.0	
Vogel			10:00:00	5.9	0.0	
Jezersko			09:30:00	4.3		
Zelenica			09:00:00	1.8		
Lesce			08:30:00	0.3		
Kamniška Bistrica			08:00:00	-1.8		
Krvavec			07:30:00	-2.4		
Kranj			07:00:00	-3.0		
Letališče JP Ljubljana			06:30:00	-3.3		
Litja			06:00:00	-3.8		
Hrastnik			05:30:00	-2.5		
Kum			05:00:00	-3.5		
Zagreb-Grč						
Gradiska	Sava Direct	Bosnia an...	26.12.2018 07:00:00	-1.8		
Sibac	Sava Direct	Bosnia an...	08.01.2019 10:00:00	-0.1		
Slavonski Brod	Sava Direct	Croatia	10:00:00	11.8		
Šrenjska Plovnica	Sava Direct	Serbia	10:00:00	11.2		
Beograd-Vratar	Sava Direct	Serbia	10:00:00	11.2		
Zravnica Sorica	Sava	Slovenia	10:10:00	7.1		
Davča	Sora	Slovenia	10:10:00	8.2		
Borč pri Gorenc vasi	Sora	Slovenia	10:00:00	7.0		
Blagot	Sora	Slovenia	10:10:00	4.0		

**Graphical view (active) - Rateče**

Air temp. | Precipitation (hourly) | Precipitation (daily)

© 2015, The International Sava River Basin Commission



# Available stations and data in Sava HIS

## By Data Policy (2014)

❖ 93 **hydrological** stations

## Sava HIS (2024)

Hydrological Stations	BA	HR	ME	RS	SI	Total
	104	125	13	31	26	<b>299</b>

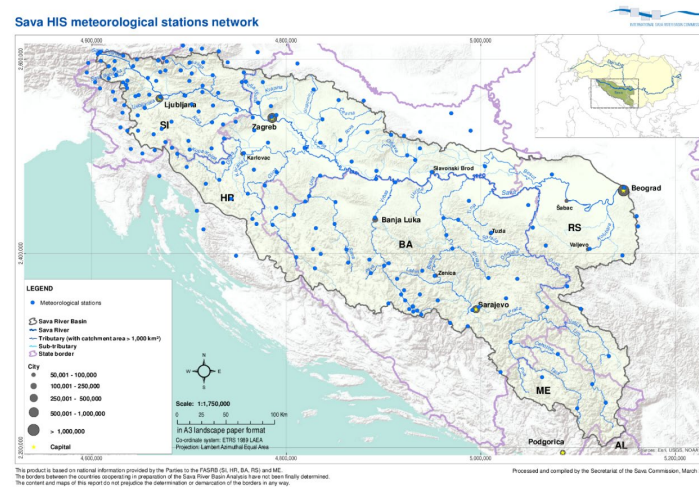
## By Data Policy (2014)

❖ 53 **meteorological** stations

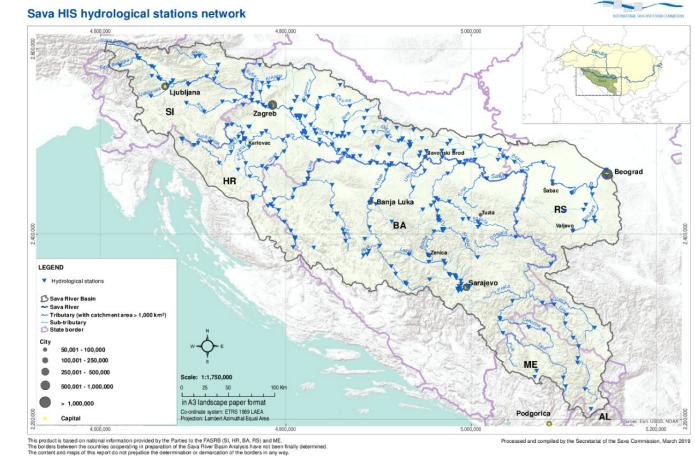
## Sava HIS (2024)

Meteorological Stations	BA	HR	ME	RS	SI	Total
	66	49	5	14	78	<b>212</b>

Parameter	Temporal Resolution
River, Lake or Reservoir Level/Stage	Daily (Mean) Hourly
River Discharge	Daily (Mean) Hourly
Water Temperature	Daily (Mean)
Suspended Sediment Discharge	Daily (Mean) Hourly (Turbidity)
Ice Condition	Daily



Parameter	Temporal Resolution
Precipitation	Annual (Total)
	Monthly (Total)
	Daily (Total)
	6/12 Hourly (Total)
Air Temperature	Hourly (Total)
	Daily (Mean)
Relative Humidity	Hourly
Wind (Speed and Direction)	Daily
Snow Depth	Hourly
Evaporation	Daily
Solar Radiation	Daily (Total)
Sunshine	Daily
Atmospheric Pressure	Daily



# Available stations and data in Sava HIS

## Station details (metadata), statistics and in-situ measurements

**Station details**

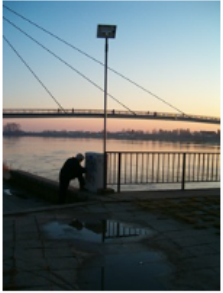

Basic data | Additional data | Statistical data | Discharge measurements | Yearbooks | Documents

Station name: Sremska Mitrovica  
 Station number: RS45090  
 Country: Serbia  
 Riverbasin: Sava Direct  
 River: Sava  
 Authority: RHMZ Belgrad

River kilometer: 139.24  
 Catchment area - km<sup>2</sup>: 87996  
 Bank: Left  
 Start of measuring: 12/31/1877  
 Parameters: Water Level, Discharge, Water Temperature

Station history:  
 Valid from 01/01/1878 72.22 m a.S.I.

Gauge zero - m asl: 72.22  
 Longitude - WGS84: 19.6  
 Latitude - WGS84: 44.97

Close

**Station details**

Basic data | Additional data | Statistical data | Discharge measurements | Yearbooks | Documents

Station number - National: 45090  
 River EU code:   
 Station classification: Basic network station  
 Station equipment:   
 Time step of measuring: HOURLY  
 End of measuring:   
 Level 1 Flood Protection:   
 Level 2 Flood Protection: 650  
 Level 3 Flood Protection: 750  
 Level 4 Flood Protection:   
 Reference Vertical Datum for Gauge Zero: Trieste  
 Cross section:   
 Rating curve:   
 Water levels - cm  
 Maximum: 866 05/17/2014  
 Minimum: -19 08/19/2003  
 Flows - m<sup>3</sup>/s  
 Maximum: 6596 05/17/2014  
 Minimum: 194.0 10/05/1946  
 Water temperatures - °C  
 Maximum: 28.2 07/26/1987  
 Minimum: 0.0 12/28/1948  
 Inserted when: 01/17/2022

Close

**Station details**

Basic data | Additional data | Statistical data | Discharge measurements | Yearbooks | Documents

New Edit Details on selected station Delete

Date	Flow	Water level	Operator
09/23/2020	511.064	54	RHMZ-Republic Hydrometeorological Service of Serbia
07/07/2020	693.187	113	RHMZ-Republic Hydrometeorological Service of Serbia
06/29/2020	1240.784	250	RHMZ-Republic Hydrometeorological Service of Serbia
10/29/2020	1671.59	305	RHMZ-Republic Hydrometeorological Service of Serbia
10/22/2020	2376.026	425	RHMZ-Republic Hydrometeorological Service of Serbia

**Details**

Date: 09/23/2020  
 Flow - m<sup>3</sup>/s: 511.064  
 Water level - cm: 54  
 Cross section width - m: 195.43  
 Cross section area - m<sup>2</sup>: 1611.055  
 Wetted perimeter - m:   
 Depth maximum - m: 10.56  
 Velocity maximum - m/s: 1.073  
 Velocity average - m/s: 0.317  
 Water temperature - °C: 22.1  
 Equipment: f) Acoustic Doppler Current Profiler (ADCP)  
 Institution: RHMZ-Republic Hydrometeorological :Xr

Close

**Station details**

Basic data | Additional data | Statistical data

**Long-term Flows – m<sup>3</sup>/s**

New

Statistical parameter	Value	Period begin position	Period end position
100-year maximum	6900	1926	2015
Average	1535	1946	2006
95% monthly minimum	273	1946	2006

Page 1 of 1 | Displaying 1 - 3 of 3

Close

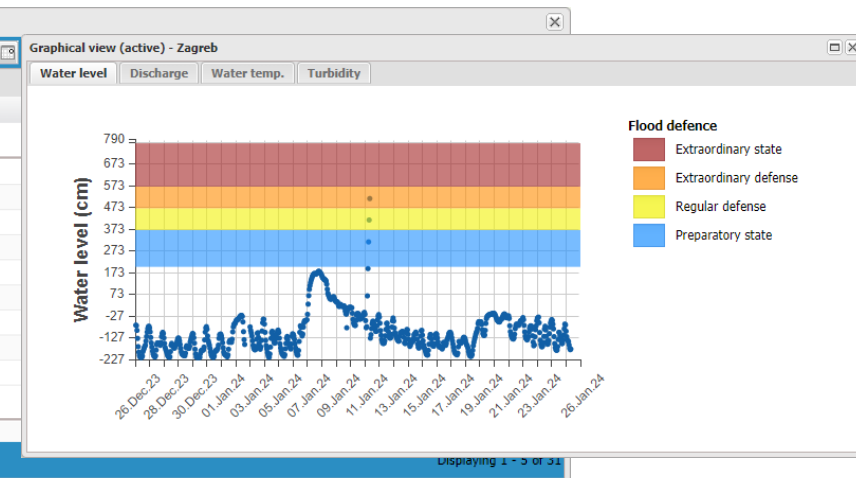
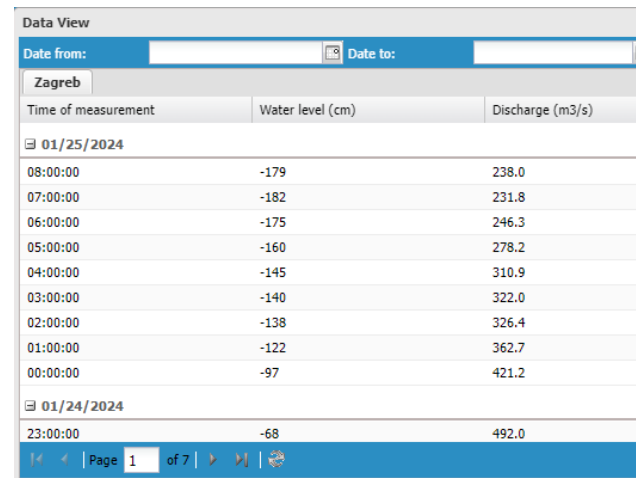
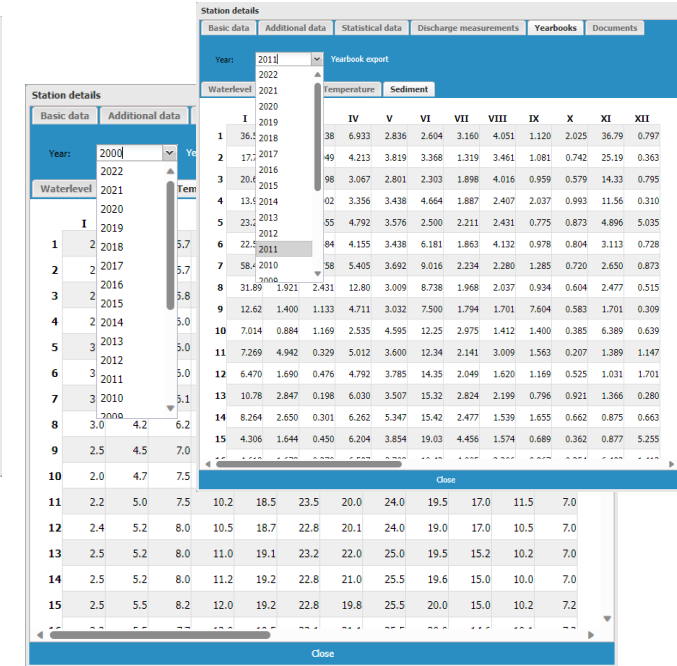
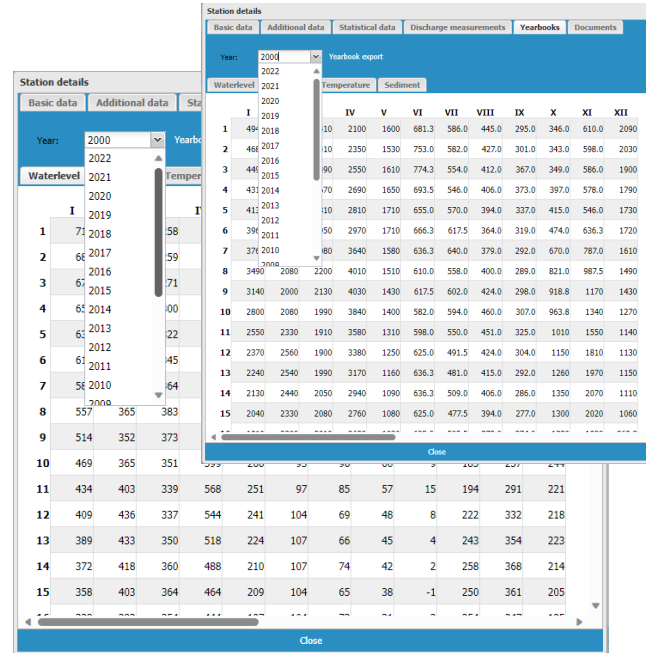
# Available stations and data in Sava HIS

## Time-series data

Daily processed data (2000-2022)

- ❖ Water discharge
- ❖ Water level
- ❖ Water temperature
- ❖ Sediment discharge
- ❖ Precipitation
- ❖ Air temperature

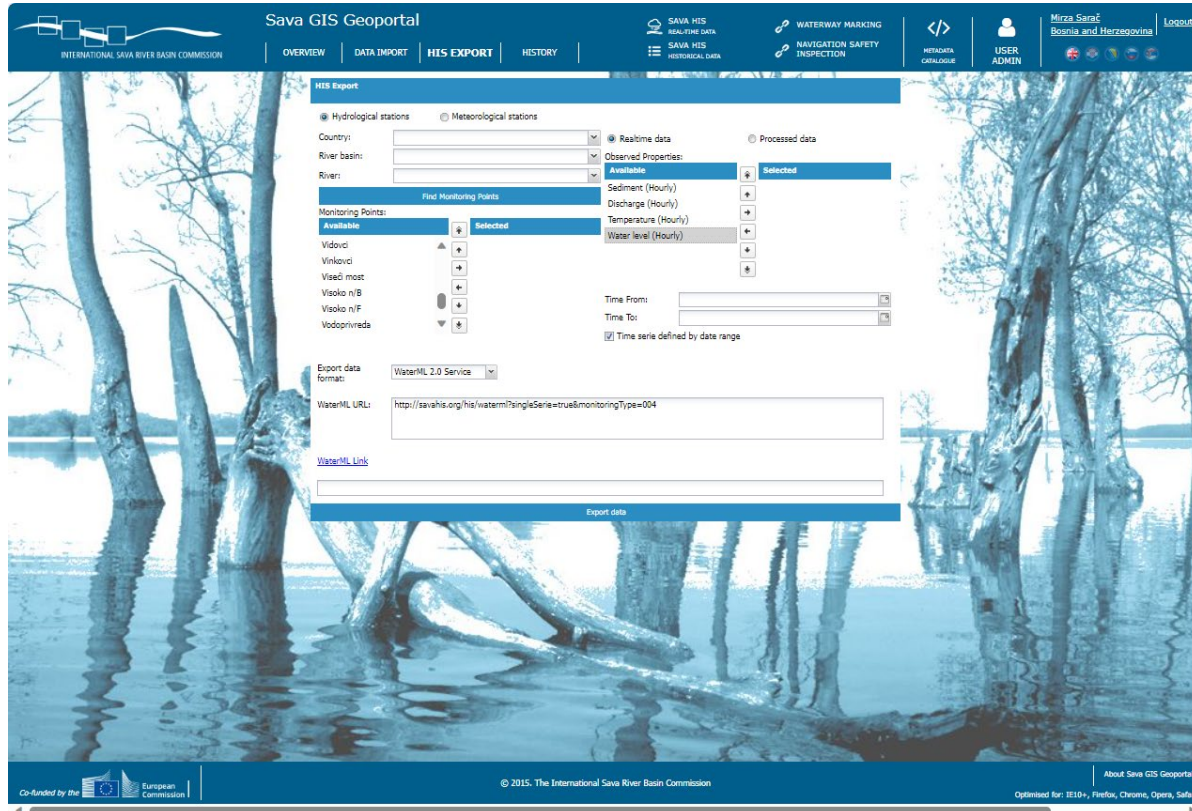
Hourly raw data (last 30days)





## WML 2.0 Webservice

### Example timeseries call



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xmlns:om="http://www.opengis.net/om/2.0" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:sa="http://www.opengis.net/sampling/2.0" xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.opengis.net/waterml/2.0
http://schemas.opengis.net/waterml/2.0/waterml2.xsd">
  <gml:description>Igea WaterML2.0</gml:description>
  <wml2:observationMember>
    <om:OM Observation gml:id="Ig.OM.Obs.hydro.27.H.HHourly">
      <om:phenomenonTime>
        <gml:TimePeriod gml:id="Ig.resTime.27.H.HHourly">
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      <om:resultTime>
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          </gml:TimeInstant>
        </om:resultTime>
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        <om:featureOfInterest>
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            <gml:description>Sava at Zagreb</gml:description>
            <gml:name>Zagreb</gml:name>
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          <sams:shape>
            <gml:Point gml:id="Ig.P.hydro.HR3121">
              <gml:pos srsName="urn:ogc:def:crs:EPSG:4326">15.95000000 45.78000000</gml:pos>
            </gml:Point>
          </sams:shape>
        </wml2:MonitoringPoint>
      </om:featureOfInterest>
    </om:result>
  </wml2:MeasurementTimeseries gml:id="Ig.Ts.hydro.27.H.HHourly">
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      <wml2:DefaultTVPMeasurementMetadata>
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    </wml2:defaultPointMetadata>
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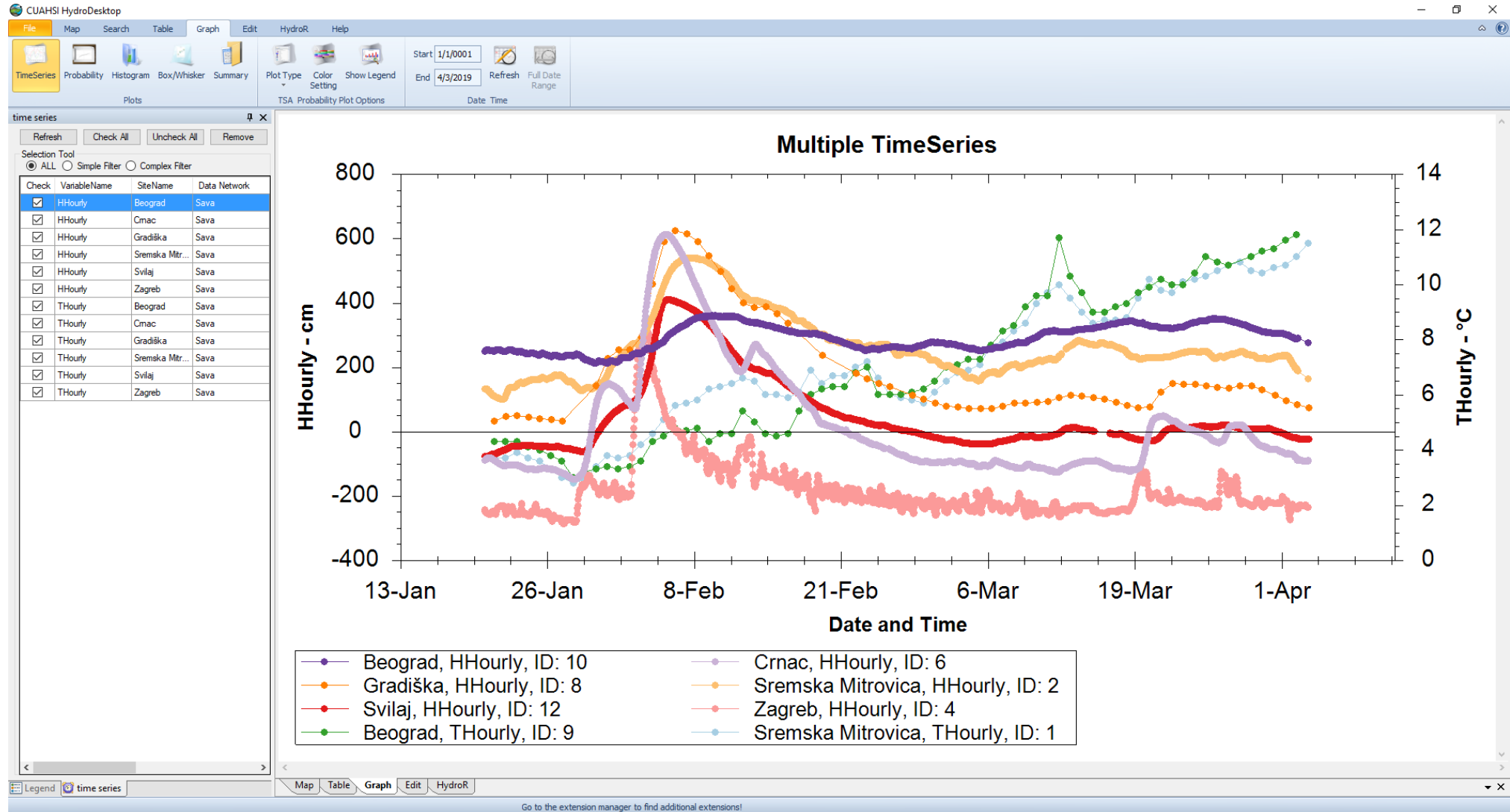
variable  
period

location

time series

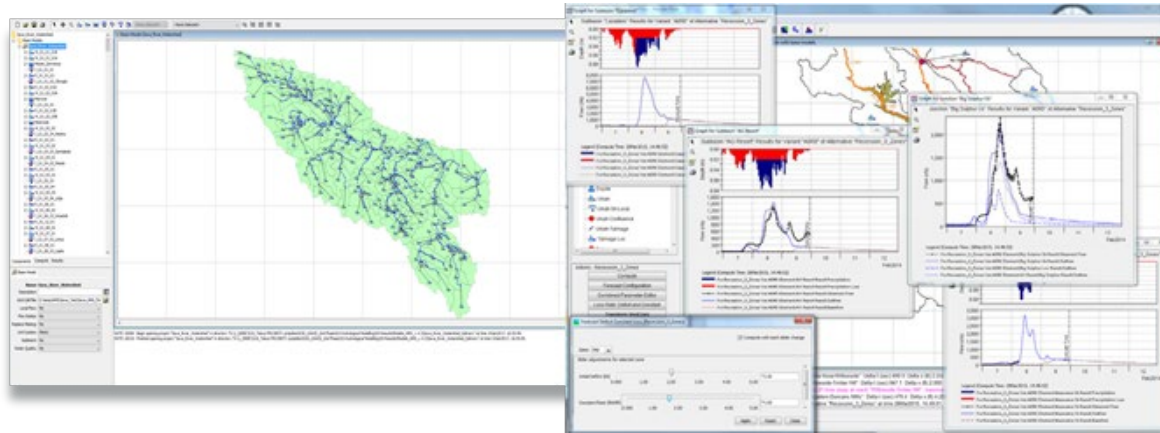
# Sava HIS interoperability

It will be demonstrated as a hands-on exercise (Jan 29th)



# Sava HIS as input to the modelling

Simulation models operational under the forecasting system



## Hydrologic model (HEC-HMS)

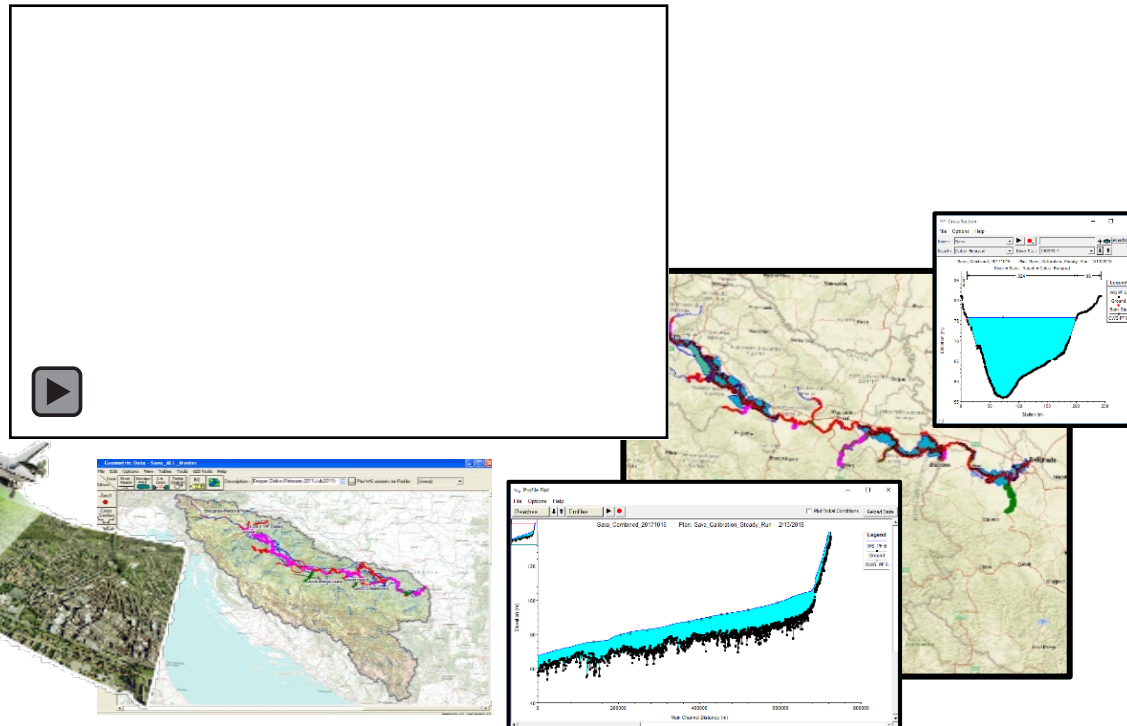
of the Sava River Basin (2010, 2014, 2016, **2021**)

- ❖ 19 integrated models
- ❖ 235 subbasins
- ❖ 174 junctions
- ❖ 22 dams locations for the reservoirs analysis
- ❖ calibrated (as event-based) and re-calibrated (for long-term simulations)

## Hydraulic model (HEC-RAS)

of the Sava River (2012, 2018, **2022**)

- ❖ accurate terrain model (LiDAR)
- ❖ 1D/2D simulation possibilities
- ❖ levee breach analysis
- ❖ calibrated (as event-based) and re-calibrated (for long-term simulations)





# Sava HIS interoperability

It will be demonstrated as a hands-on exercise (Jan 29th)

sava.dss - HEC-DSSVue DSS-7 Developmental Version

File Edit View Display Groups Data Entry Tools Collections Advanced Help

File Name: C:\Users\ISRBC Secretariat\Desktop\sava.dss

Pathnames Shown: 6 Pathnames Selected: 6 Pathnames in File: 21 File Size: 164 KB File Version: 7-CM Library Version: 7-CM Library Date: 13 December 2016 x64

sava.dss x

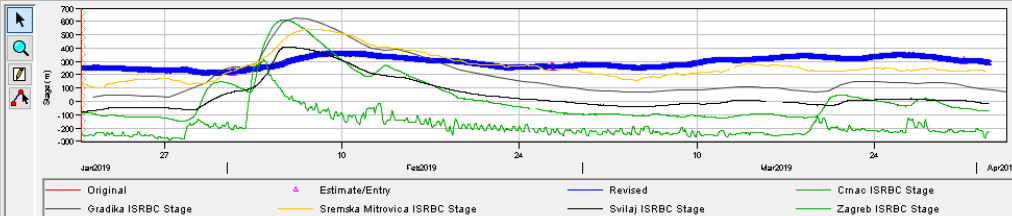
Search A: C: E: By Parts: B: D: F:

Number	Part A	Part B	Part C	Part D / range	Part E	Part F
1	Sava	Beograd	Stage	01Jan2019 - 01Apr2019	1Hour	ISRBC
2	Sava	Crnac	Stage	01Jan2019 - 01Apr2019	1Hour	ISRBC
3	Sava	Gradika	Stage	01Jan2019	R-Year	ISRBC
4	Sava	Sremska Mitrovica	Stage	01Jan2019 - 01Apr2019	1Hour	ISRBC
5	Sava	Svilaj	Stage	01Jan2019 - 01Apr2019	1Hour	ISRBC
6	Sava	Zagreb	Stage	01Jan2019 - 01Apr2019	1Hour	ISRBC

Graphical Editor

File Edit View Help

Selected Data Set: /Sava/Beograd/Stage/01Jan2019/1Hour/ISRBC/



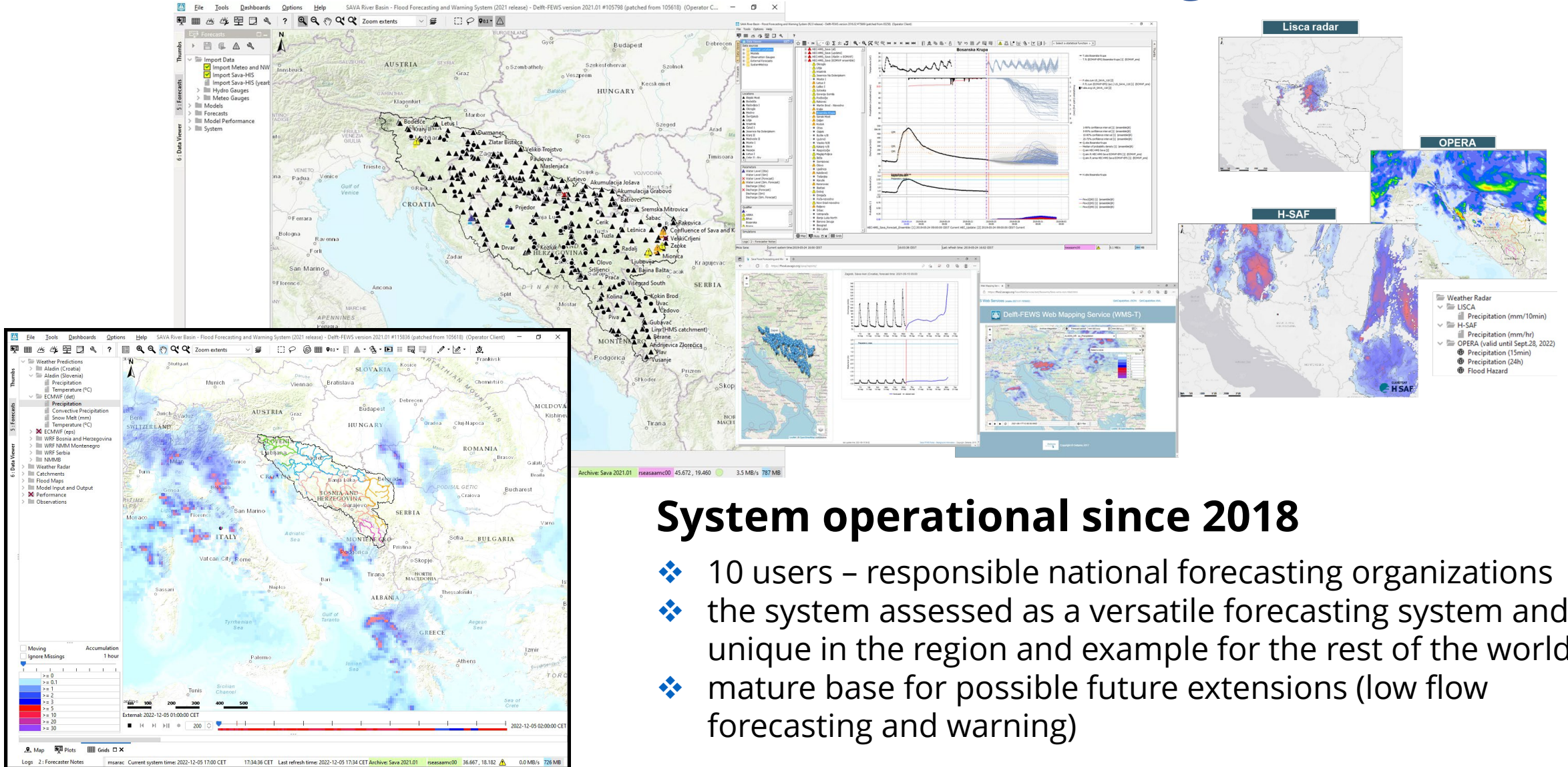
Date/Time (%S)	Original Stage (m)	Estimate/Entry Stage (m)	Revised Stage (m)
20Jan2019, 11:00	249.00		249.00
20Jan2019, 12:00	250.00		250.00
20Jan2019, 13:00	252.00		252.00
20Jan2019, 14:00	253.00		253.00
20Jan2019, 15:00	253.00		253.00
20Jan2019, 16:00	253.00		253.00
20Jan2019, 17:00	253.00		253.00
20Jan2019, 18:00	253.00		253.00
20Jan2019, 19:00	253.00		253.00
20Jan2019, 20:00	253.00		253.00
20Jan2019, 21:00	252.00		252.00

Buttons: Estimate, Estimate Missing, Estimate All, Accept, Accept All, Add Data, Delete Data

Select De-Select Clear Selections Restore Selections Set Time Window

No time window set.

# Sava HIS as a hub of the observed real-time data in the forecasting

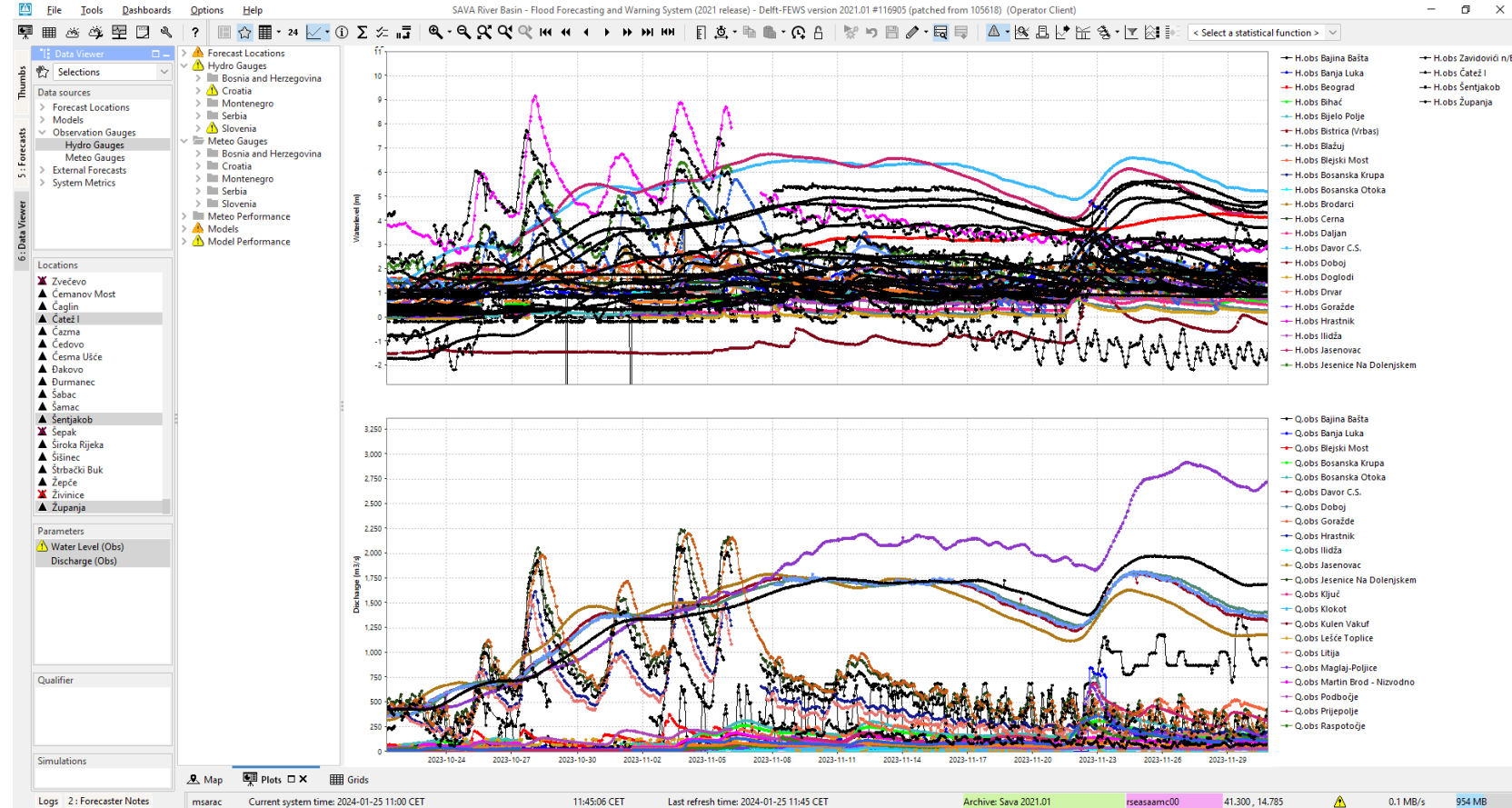
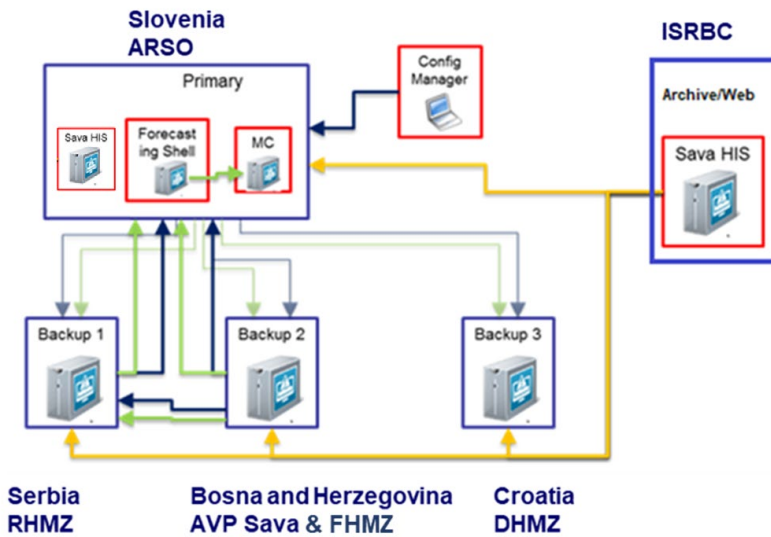


## System operational since 2018

- ❖ 10 users – responsible national forecasting organizations
- ❖ the system assessed as a versatile forecasting system and unique in the region and example for the rest of the world
- ❖ mature base for possible future extensions (low flow forecasting and warning)

# Sava HIS as a hub of the observed real-time data in the forecasting

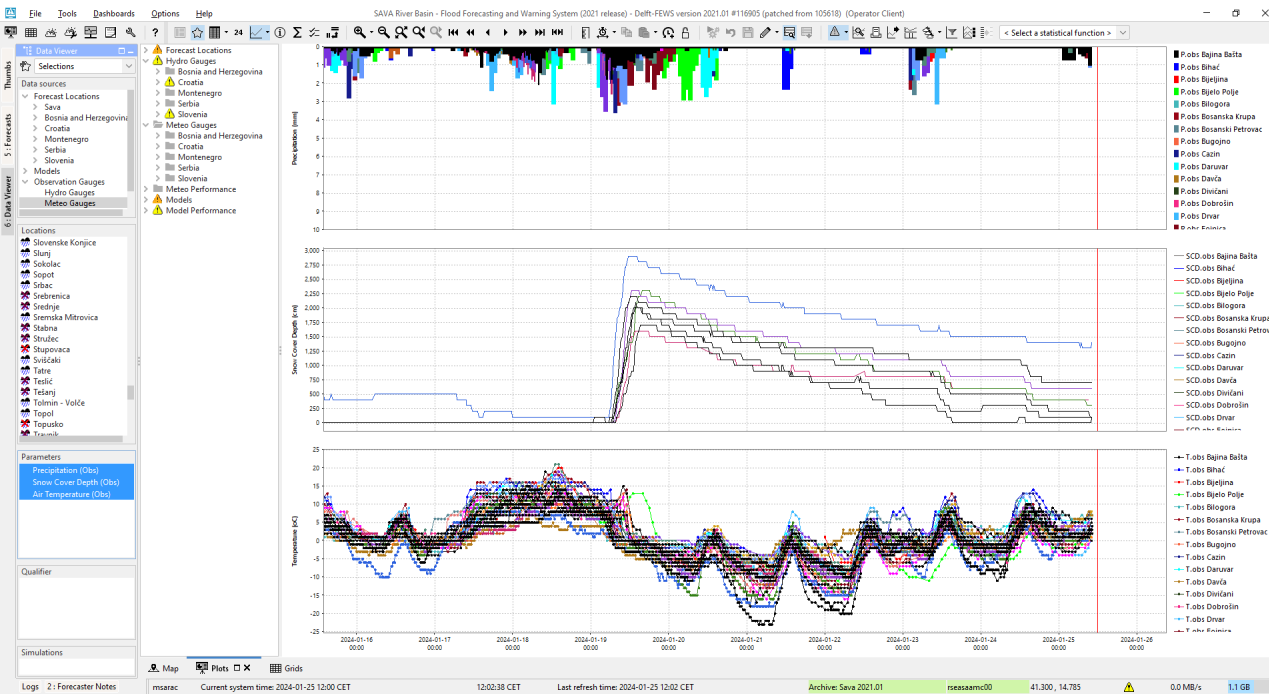
## Hourly raw data (from 2010)



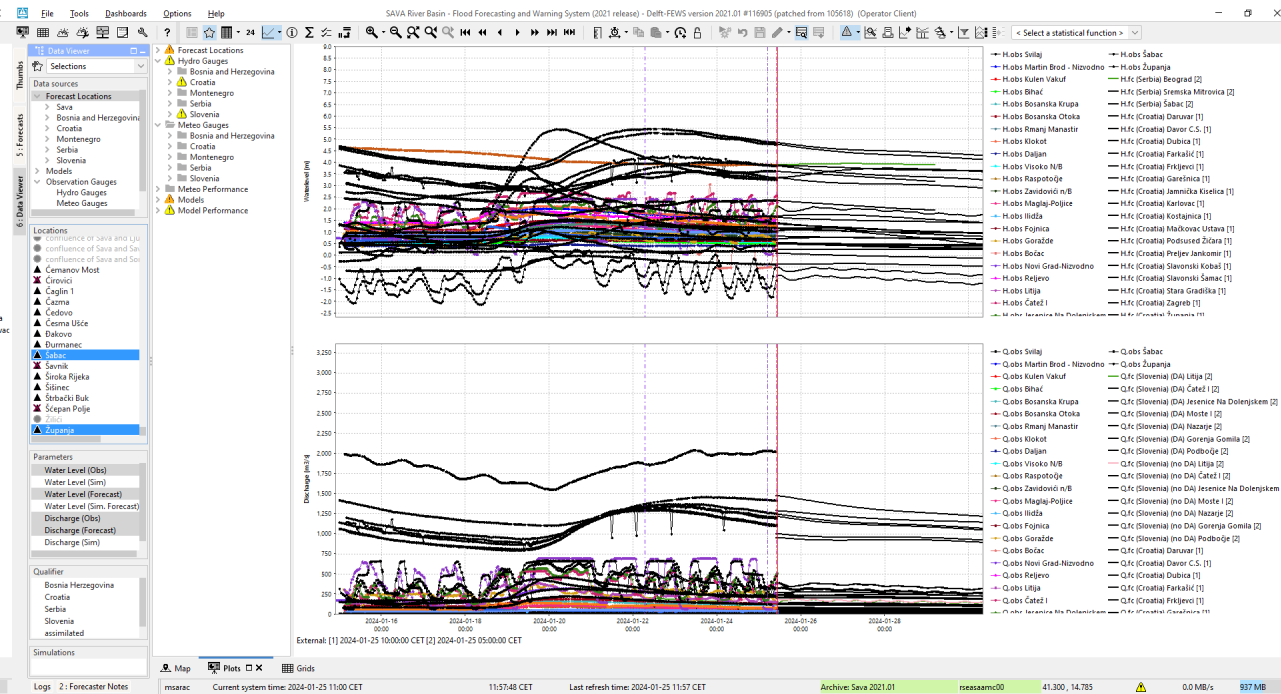


# Sava HIS as a hub of the observed real-time data in the forecasting

## Latest meteo data

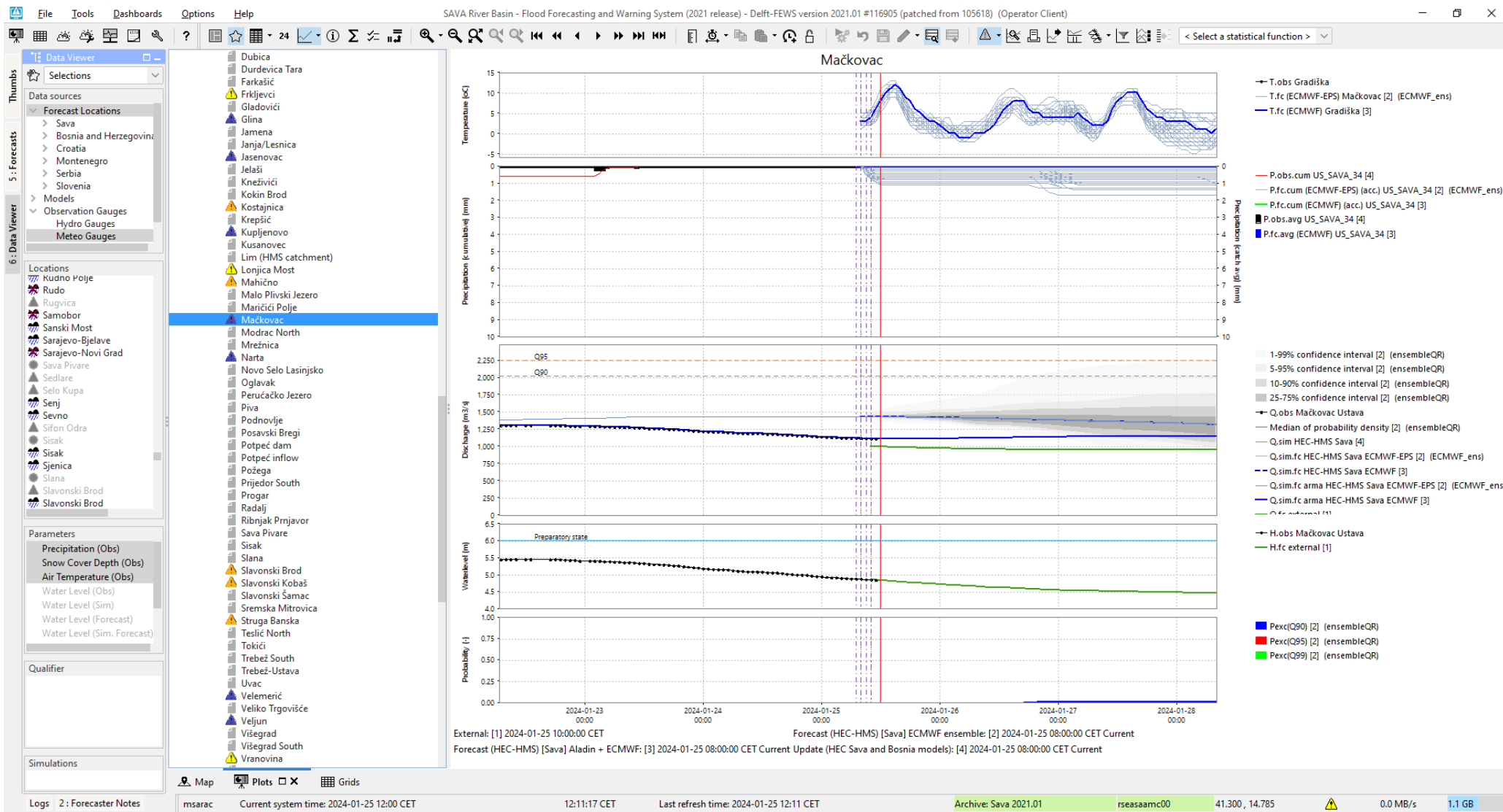


## Latest hydro data and forecasts



# Sava HIS as a hub of the observed real-time data in the forecasting

## Contribution of the observed data



# Sava HIS as a hub of the observed real-time data in the forecasting



**NWP models**

- ALADIN SI short term (up to 3 days)
- ALADIN HR short term (up to 3 days)
- ECMWF single medium term (3-9 days)
- ECMWF EPS/ensemble
- WRF-NMM Bosnia and Herzegovina
- WRF-NMM Montenegro
- WRF-NMM Serbia
- NMMB Serbia

**Radar & Satellite Imagery**

- Lisca-SI Radar
- OPERA/VERICHA
- H-SAF

**SAVA HIS data harmonization by standards**

↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑

**Telemetry Systems**

- Precipitation
- Snow depths
- Air temperature
- Water levels
- Discharges

**National gauges**

**Forecast of the expected flow conditions (floods & low flows)**

- Archive
- Web Service
- Warnings
- Dissemination

data set	area	source	archive time	time step	start	end	file size (MB)
External_Historical_WaterLevel_H_Import_Telemetry...	Sava	SAVA-HIS	2022-12-20 12:00:01	...	2020-08-01 02:00:00	2020-08-01 01:00:00	9.54
External_Historical_WaterLevel_H_Import_Telemetry...	Sava	SAVA-HIS	2022-12-20 12:00:01	...	2020-08-01 02:00:00	2020-08-01 01:00:00	9.54
External_Historical_WaterLevel_H_Import_Telemetry...	Sava	SAVA-HIS	2022-12-20 12:00:01	...	2020-08-01 02:00:00	2020-08-01 01:00:00	9.54
External_Historical_WaterLevel_H_Import_Telemetry...	Sava	SAVA-HIS	2022-12-20 12:00:01	...	2020-08-01 02:00:00	2020-08-01 01:00:00	9.54

**Delft-FEWS Web Services**

PI REST Web Service

The PI REST Web Service provides a REST based interface to Delft-FEWS and can be accessed by the REST protocol over HTTPS). As response format PI-XML is fully supported and PI-JSON is partially supported.

[Test page](#) [Documentation](#)

Web Mapping Service with time support (WMS-T)

The Delft-FEWS Web Mapping Service with time support is the FEWS implementation of the WMS-T OGC standard. It allows requesting images for plots that have been configured in the FEWS grid display.

[Test page](#) [Documentation](#)

Schematic Status Display Service

The Schematic Status Display Service.

[Test page](#) [Documentation](#)

PI SOAP Web Service (deprecated)

The PI SOAP Web Service provides a SOAP web service provided by Delft-FEWS and can be accessed by the SOAP protocol over HTTPS) using the PI-XML format.

[Test page](#) [Documentation](#)

WaterML Web Service

The WaterML2 Web Service provides a HTTP based interface to Delft-FEWS and can be accessed by the WaterML protocol over HTTPS).

[Test page](#) [Documentation](#)

Digital Delta Web Service

The Digital Delta Web Service provides a HTTP based interface to Delft-FEWS and can be accessed by the REST protocol over HTTPS).

[Test page version 2.0](#)

Umaquo Web Service

The Umaquo Web Service provides a HTTP based interface to Delft-FEWS and can be accessed by the SOAP protocol over HTTPS).

[Test page](#)



# Sava HIS as a hub of the observed real-time data in the forecasting

## PI REST Webservice

### Example timeseries call

[https://ffws2.savagis.org/FewsWebServices/rest/fewspiservice/v1/timeseries?locationIds=SAVA\\_5](https://ffws2.savagis.org/FewsWebServices/rest/fewspiservice/v1/timeseries?locationIds=SAVA_5)

Delft-FEWS Web Services (stable-2021.01-109506)



Delft-FEWS PI REST Web Service

Get timeseries that are part of the default filter, filtered by the query parameters.

GET [https://ffws2.savagis.org/FewsWebServices/rest/fewspiservice/v1/timeseries?locationIds=SAVA\\_20&parameterIds=Q.obs](https://ffws2.savagis.org/FewsWebServices/rest/fewspiservice/v1/timeseries?locationIds=SAVA_20&parameterIds=Q.obs)

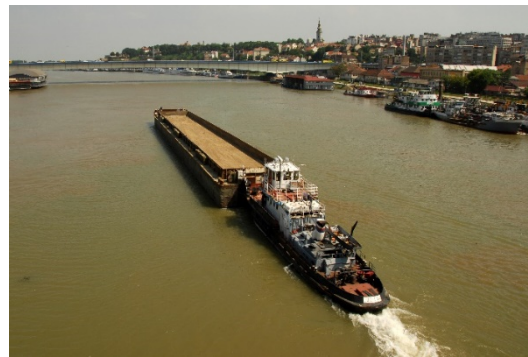
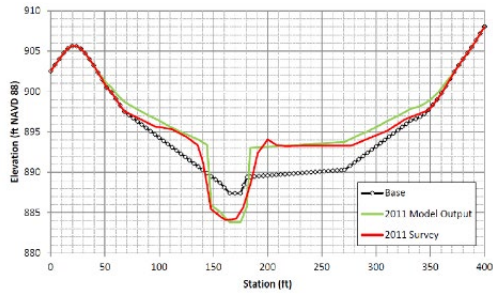
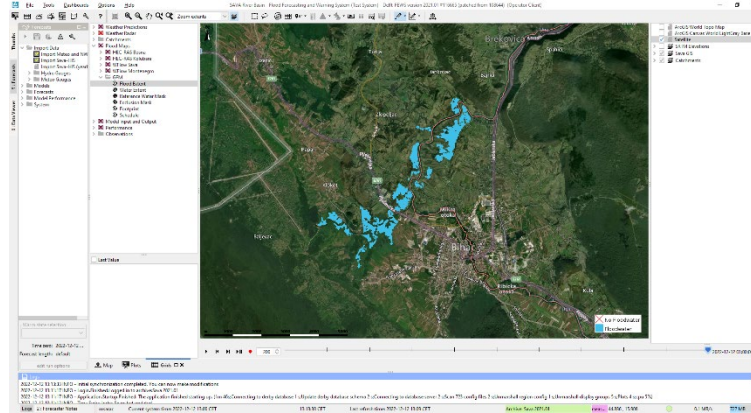
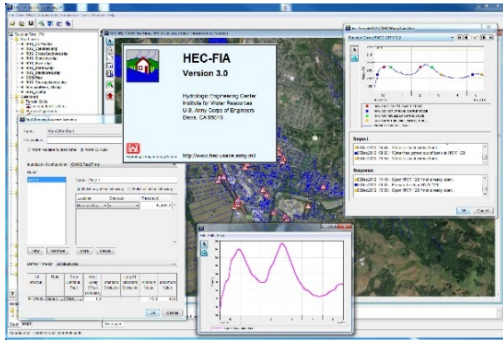
Method parameters	GET timeseries	Description
filterId		An existing subfilter of the default filter id
locationIds	SAVA_20	One or more location ids
parameterIds	Q.obs	One or more parameter ids
moduleInstanceIds	moduleinstanceid1[;moduleinstanceid2;...;moduleinstanceidn]	One or more module instance ids
qualifierIds	qualifierid1[;qualifierid2;...;qualifieridn]	One or more qualifier ids
taskRunIds	taskRunid1[;taskRunid2;...;taskRunidn]	One or more taskRunIds
startTime	yyyy-MM-dd HH:mm:ss	Start time. Format: yyyy-MM-ddTHH:mm:ssZ
endTime	yyyy-MM-dd HH:mm:ss	End time. Format: yyyy-MM-ddTHH:mm:ssZ

```

<TimeSeries xmlns="http://www.wldelft.nl/fews/PI"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:fs="http://www.wldelft.nl/fews/fs" xsi:schemaLocation="http://www.wldelft.nl/fews/PI
http://fews.wldelft.nl/schemas/version1.0/pi-schemas/pi_timeseries.xsd" version="1.29">
  <timeZone>1.0</timeZone>
  <series>
    <header>
      <type>instantaneous</type>
      <moduleInstanceId>Import_Telemetry</moduleInstanceId>
      <locationId>Zagreb</locationId>
      <parameterId>Q.obs</parameterId>
      <timeStep unit="nonequidistant"/>
      <startDate date="2024-01-22" time="11:00:00"/>
      <endDate date="2024-01-23" time="12:00:00"/>
      <missval>-999.0</missval>
      <stationName>Zagreb</stationName>
      <lat>45.7845001</lat>
      <lon>15.9533005</lon>
      <x>15.9533005</x>
      <y>45.7845001</y>
      <z>112.26</z>
      <units>m3/s</units>
    </header>
    <event date="2024-01-22" time="11:00:00" value="454.99" flag="0"/>
    <event date="2024-01-22" time="12:00:00" value="474.63" flag="0"/>
    <event date="2024-01-22" time="13:00:00" value="482.06" flag="0"/>
    <event date="2024-01-22" time="14:00:00" value="479.58" flag="0"/>
    <event date="2024-01-22" time="15:00:00" value="445.26" flag="0"/>
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    <event date="2024-01-22" time="18:00:00" value="269.62" flag="0"/>
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    <event date="2024-01-22" time="22:00:00" value="482.06" flag="0"/>
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    <event date="2024-01-23" time="00:00:00" value="568.62" flag="0"/>
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    <event date="2024-01-23" time="02:00:00" value="584.34" flag="0"/>
    <event date="2024-01-23" time="03:00:00" value="517.18" flag="0"/>
    <event date="2024-01-23" time="04:00:00" value="406.93" flag="6" flagSource="ROF"/>
    <event date="2024-01-23" time="05:00:00" value="324.2" flag="0"/>
    <event date="2024-01-23" time="06:00:00" value="284.67" flag="0"/>
    <event date="2024-01-23" time="07:00:00" value="263.23" flag="0"/>
    <event date="2024-01-23" time="08:00:00" value="258.98" flag="0"/>
    <event date="2024-01-23" time="09:00:00" value="271.76" flag="0"/>
    <event date="2024-01-23" time="10:00:00" value="302.09" flag="0"/>
  </series>
</TimeSeries>

```

# Awareness and looking for future products and users



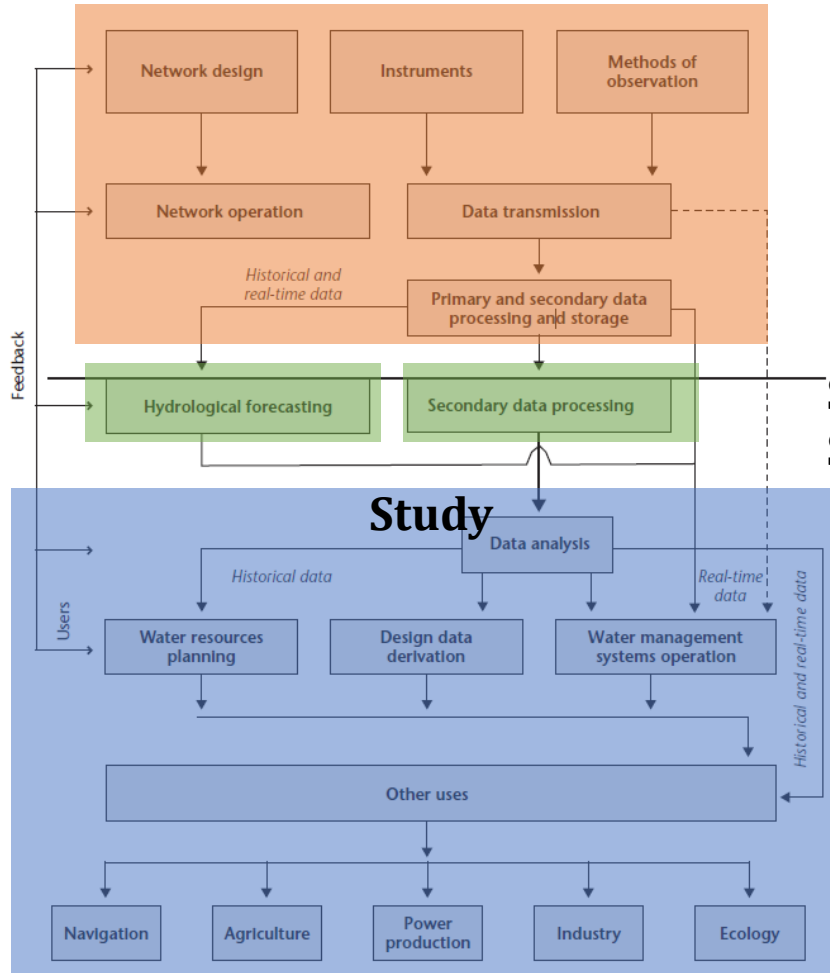
## ONGOING Sava and Drina River Corridors Integrated Development Program (GEF / World Bank)

- ❖ 2 phases ~ 10 years
  - phase 1: 2022-2026 in implementation
  - phase 2: 2026-2030 in preparation
- ❖ Sava HIS data providers actively involved as one of the main beneficiaries

- Hydrological Study development**
- Sava HIS upgrade** and improvement including innovative data exchange and interoperability
- Flood forecasting improvements
- Low flow forecasting establishment (navigation purposes and drought analysis)
- Warnings
- Sediment transport modeling
- Climate change analysis

# Sava HIS as the basis for the basin-wide Hydrological Study

## Different purposes



## ...and analysis

- Precipitation distribution (in space and time)
- Temperature distribution
- Evaporation distribution
- Wind distribution
- Snowpack distribution
- Series of monthly and annual volume of stream flow
- Mean daily discharge series
- Low flow frequency distribution
- Depth–discharge relationship for important points
- Frequency distribution of high discharges
- Rates of high water rise
- Time lag between rises at different points along the streams
- Frequency distribution of large-volume floods
- Shapes of typical flood hydrographs
- Travel times of floods
- Time lag between precipitation and runoff
- Flood synchronization at different tributaries
- Ice cover information
- Sediment transport and deposition
- Aquifer extent and characteristics
- Series of water levels of relevant aquifers



# Sava HIS as the basis for the basin-wide Hydrological Study

## History



### Hydrological Study of the Sava River Catchment (1969)

- ❖ period: 1926-1965
- ❖ stations: 38 hydro and 20 meteo

### Hydrological Study of the Sava River (1976)

- ❖ period: 1926-1974
- ❖ stations: 65 hydro and 61 meteo

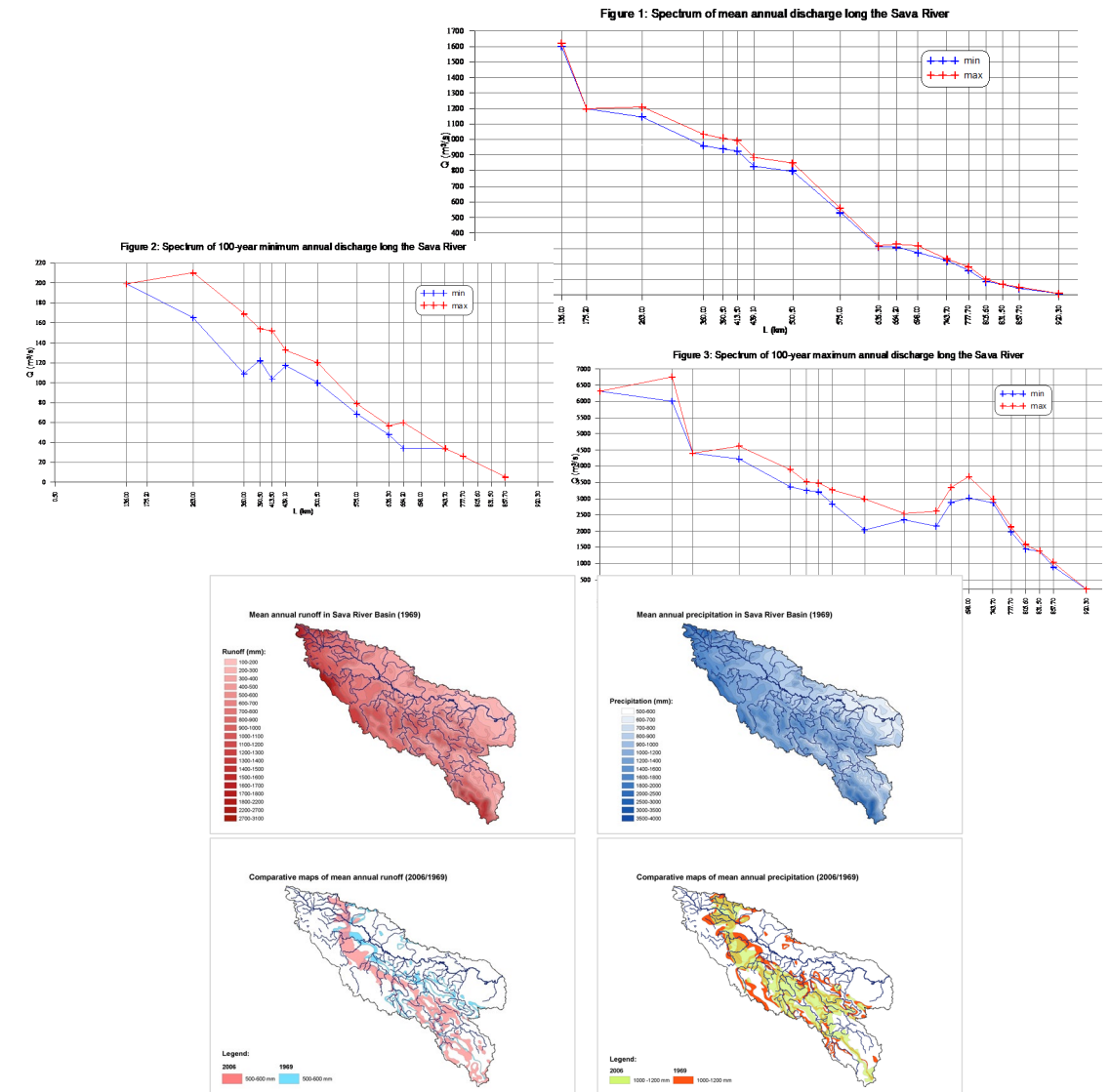
Hydrology Balance of the Danube River (1977)

Hydrology of the Danube River (1988)

# Sava HIS as the basis for the basin-wide Hydrological Study

**Main objective:** to enhance knowledge of the water cycle components and their spatial and temporal distribution in the Sava River basin through a synopsis of different hydrological topics of special importance for a better assessment of development activities

- ❖ Development of the methodology for preparation of the Hydrological Study
- ❖ Preparation of the Study
- ❖ Establishment of the web-based application for presentation and use of the Study
- ❖ Knowledge transfer and capacity building
- ❖ Recommendations for future studies and developments



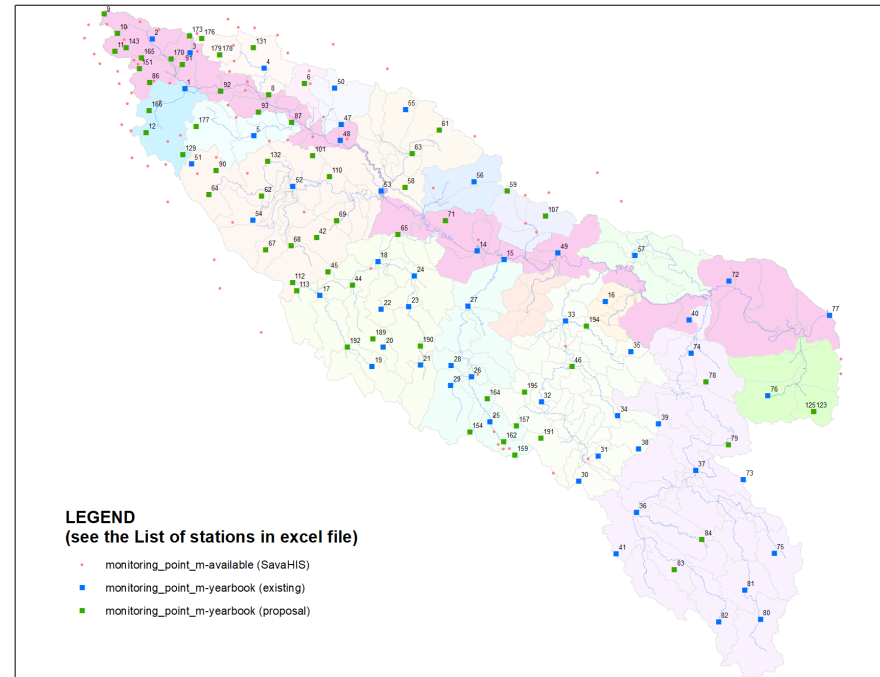
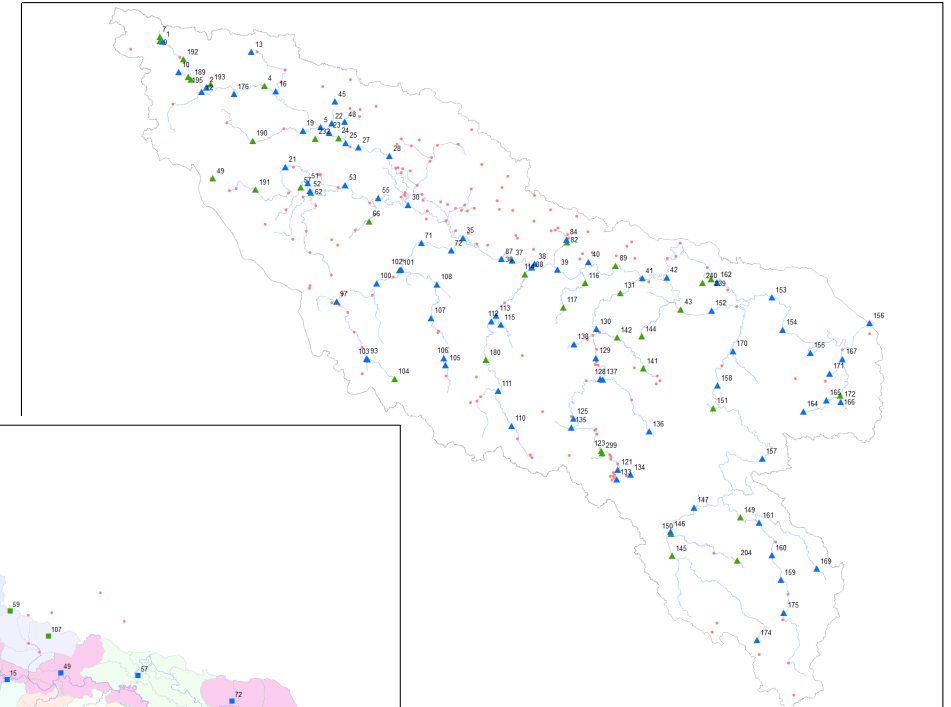
# Sava HIS as the basis for the basin-wide Hydrological Study

## Sava HIS – stations relevant for the Study (agreed through the PEG HMI)

### ❖ Hydro: 120

- Sava: 26
- tributaries: 94

### ❖ Meteo: 115



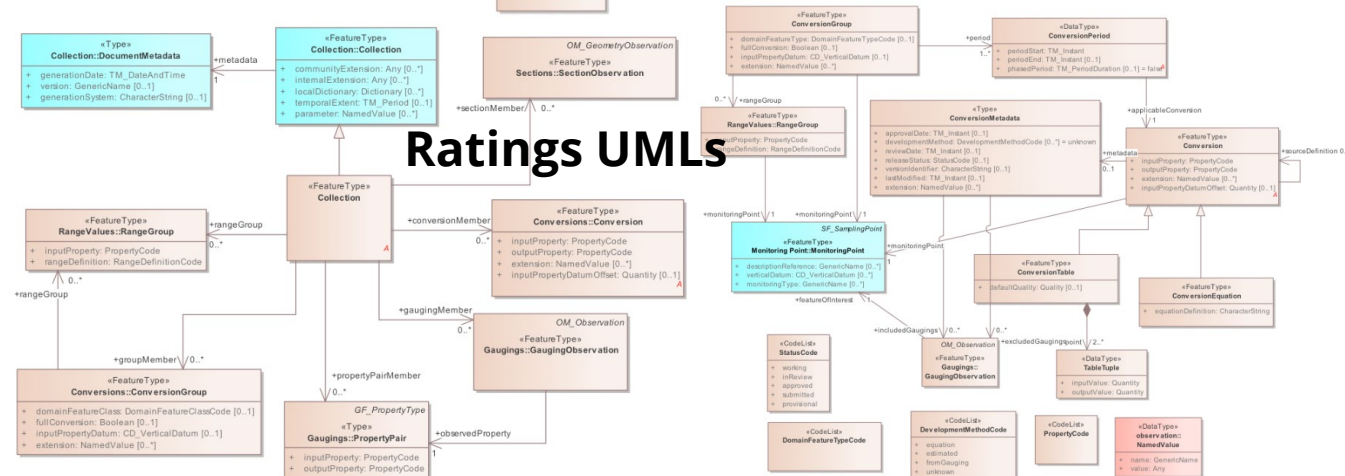
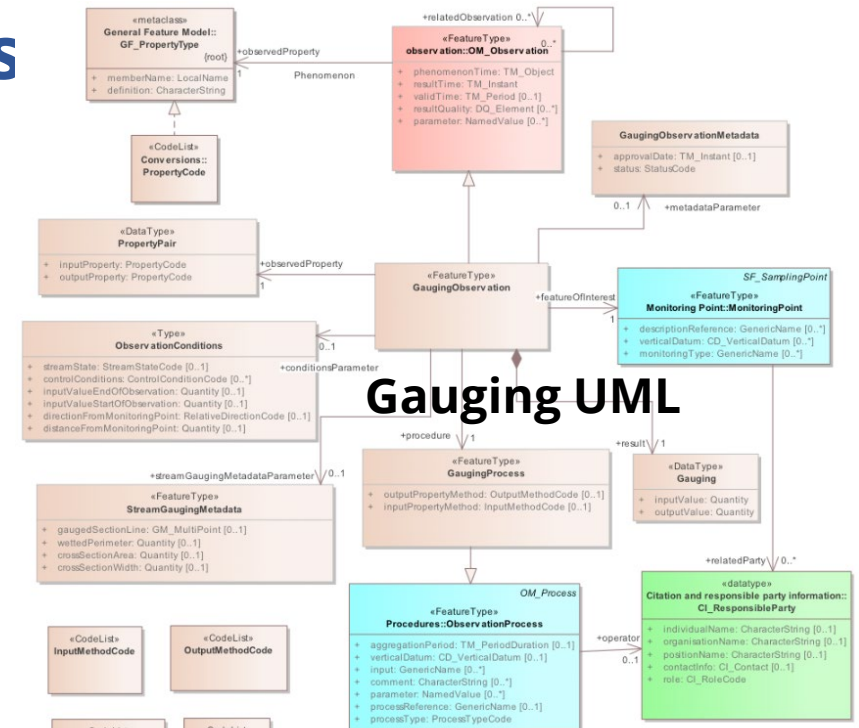


# Sava HIS as the basis Hydrological Study

## Statistical data standardization

Data models: WaterML 2 & OGC/ISO19156  
 Observation, Measurements and Samples  
 Web services: OGC SensorThings API

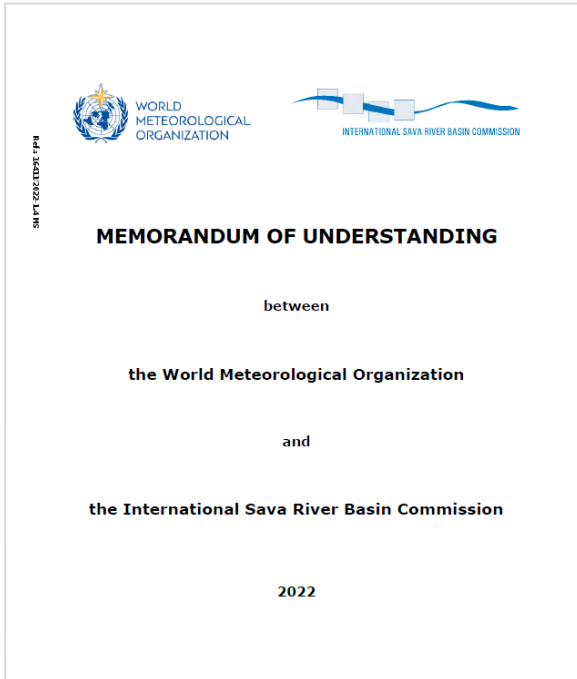
## WaterML 2: Part 1 – Timeseries WaterML 2: Part 2 – Ratings, Gaugings and Sections



# Sava HIS and WHOS



WMO OMM



- ❖ The MoU between the WMO and the ISRBC signed on September 15<sup>th</sup>, 2022
  - activities related to cooperation in joint projects and initiatives' planning and implementation
  - exchange of knowledge, experiences, good practices and results of scientific, research and development projects and
  - joint work to promote the exchange of data and information at the regional and global level

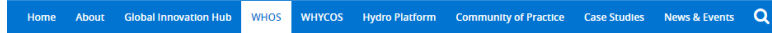




# Sava HIS as the WHOS pilot



Enhancing water monitoring systems worldwide



Home / WMO Hydrological Observing System (WHOS)

## WMO Hydrological Observing System (WHOS)



The WMO Hydrological Observing System (WHOS) facilitates hydrological data sharing. It is a multi-scale (local, national, regional and global) registry of hydrological data and information services catalogued using the standards and procedures developed by the Open Geospatial Consortium (OGC) and the WMO.

WHOS is being developed and implemented in two phases:

**Phase 1** provides a map interface with links to those NMHSs that make their real-time and historical hydrological data available online.

**Phase 2** provides a services-oriented framework linking hydrological data providers and users through a hydrological information system of systems enabling data registration, data discovery and data access.

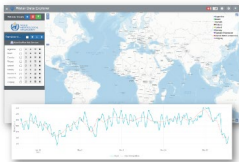
Find out more on the [WHOS Community site](#).

Two regional WHOS prototypes located in the La Plata Basin in South America (WHOS-Plata) and in the Arctic Region (WHOS-Arctic) have now reached their final stage of implementation.

To easily leverage common WHOS functionalities such as data discovery and data access on the web by means of common web browsers, WHOS web portals are available online:

### WHOS-Global Portal

WHOS-Global Portal provides all hydrometeorological data shared through WHOS. WHOS-Global Portal is implemented using the Water Data Explorer application.



### WHOS-Arctic Portal

WHOS-Arctic Portal provides hydrometeorological data shared by Canada, Finland, Denmark (for Greenland), Iceland, Norway, Russia and the United States of America for the Arctic-HYCOS Basic Network of Hydrological Stations (BNHS). WHOS-Arctic Portal is implemented using ArcGIS Online for the map interface and USGS GWIS (Graphing Water Information System) for the time-series plots.



### WHOS-Plata Portal

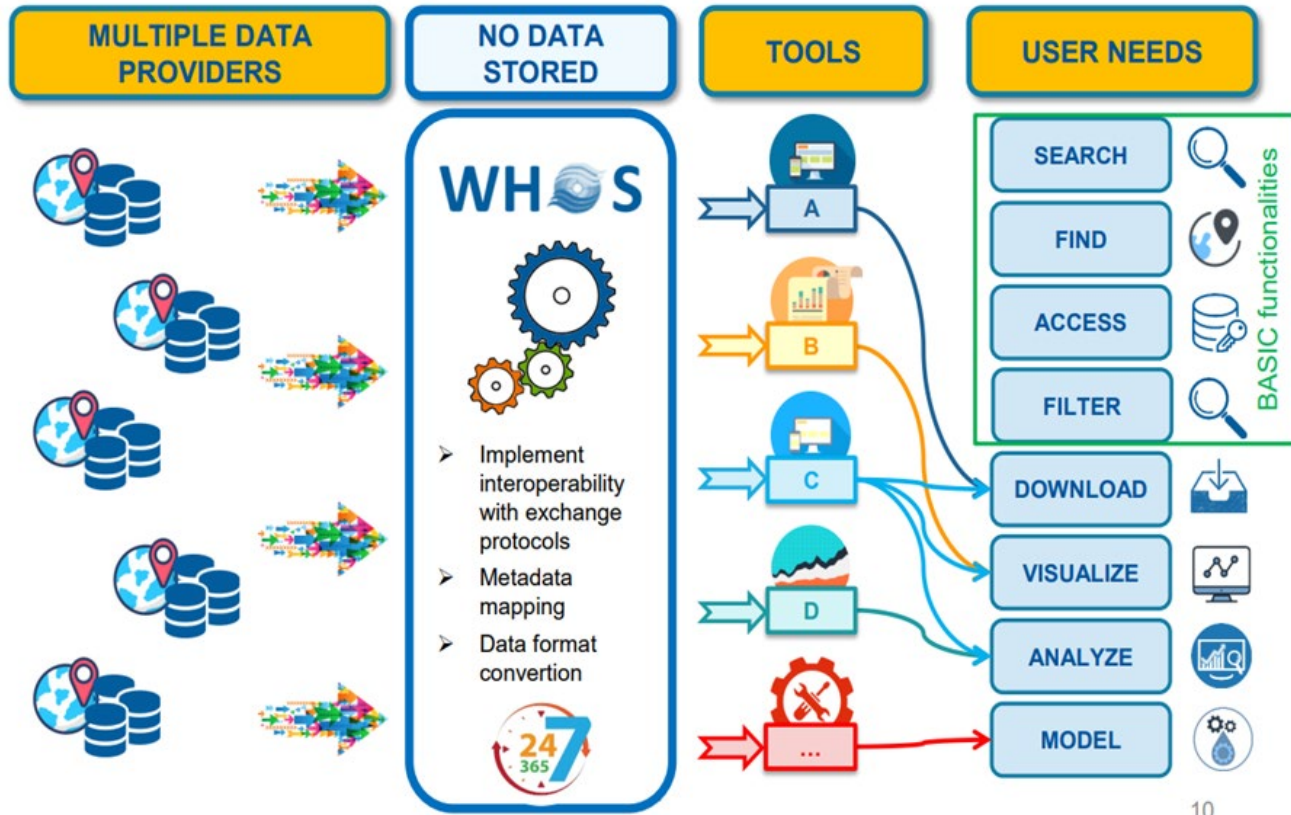
WHOS-Plata Portal provides hydrometeorological data collected in the La Plata river basin and shared by Argentina, Bolivia, Brazil, Paraguay and Uruguay. WHOS-Plata Portal is implemented using the Water Data Explorer application.



WMO OMM

- ❖ Initiative earlier presented at the 15<sup>th</sup> meeting of ISRBC's PEG HMI, January 24<sup>th</sup>, 2019, by the WMO Commission for Hydrology (CHy)
- ❖ The ISRBC at its 60<sup>th</sup> Session, June 30<sup>th</sup> – July 01<sup>st</sup>, 2022, expressed interest to collaborate in a pilot of WMO Hydrological Observing System
- ❖ The WMO informed the NMHS Directors on the WHOS initiative, September 20<sup>th</sup>, 2022

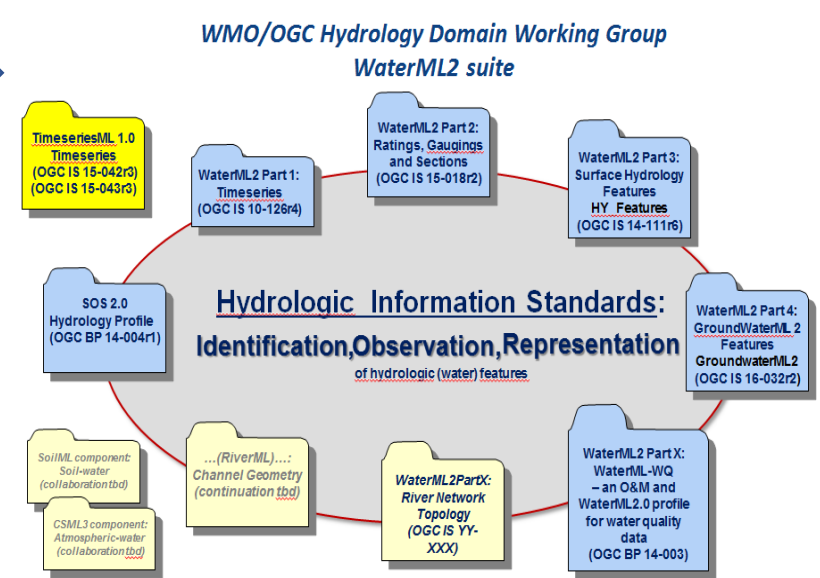
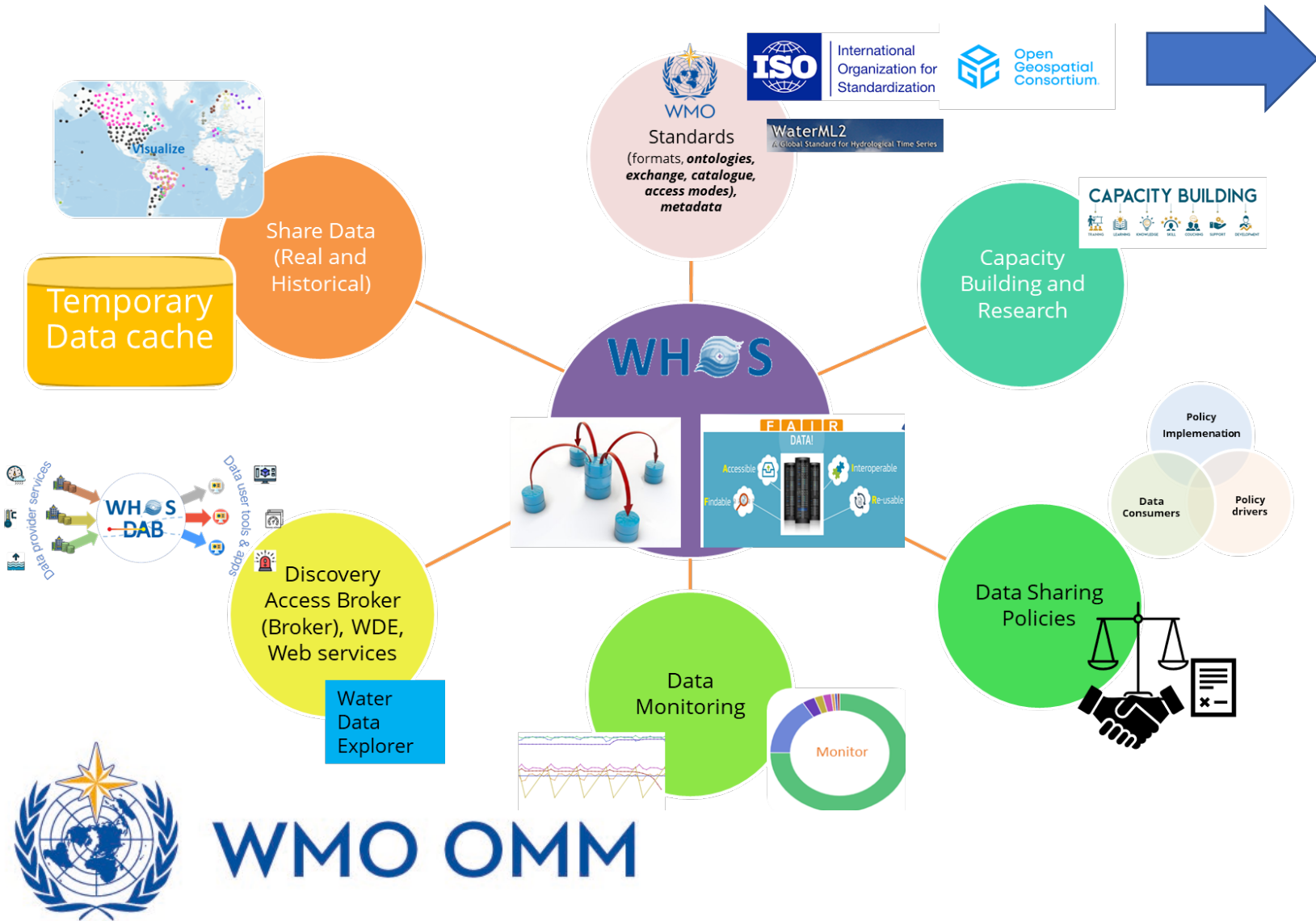
# WMO Hydrological Observing System (WHOS)



- ❖ WHOS is the hydrological component of the WMO Integrated Global Observing System (WIGOS) and World Information System (WIS)
  - the main aim is to ensure the quality and comparability of observations within WIGOS and facilitate hydrological data sharing
  - the WHOS shall comprise hydrological observations, initially focusing on water level and discharge
  
- ❖ WHOS is a solution supporting reliable hydrological data exchange using open standards and web services by linking hydrological data providers (heterogeneous sources) and users (multiple uses) making the data discoverable, interoperable, accessible and retrievable



# WMO Hydrological Observing System (WHOS)



## WHOS Standardization Approach

1. Data Providers implement standards
2. WHOS brokering approach (Discovery and Access Broker, DAB) builds on standardization





# WMO Hydrological Observing System (WHOS)

## WHOS-Plata



## WHOS-Arctic



## ONGOING

- ❖ WHOS-PROHMSAT
- ❖ WHOS-FEWS
- ❖ WHOS Dominican Republic
- ❖ **ISRBC's SAVA HIS**
- ❖ New Zealand
- ❖ Cambodia and Lao
- ❖ NIGER Basin
- ❖ Togo
- ❖ Global Runoff Data Centre (GRDC)
- ❖ Groundwater (IGRAC)

(Argentina, Bolivia, Brazil, Canada, Denmark, Finland, Iceland, Norway, Paraguay, Russia, Sweden, Uruguay, the United States, and United Kingdom)



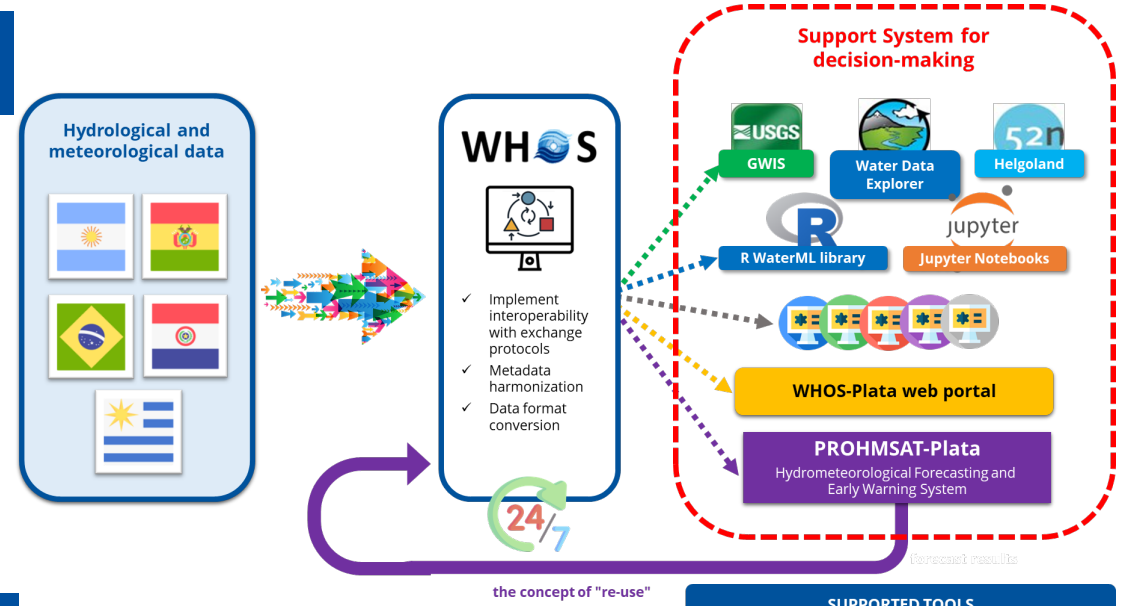
WMO OMM

freely exchanging and reusing hydrometeorological data  
in an interoperable way

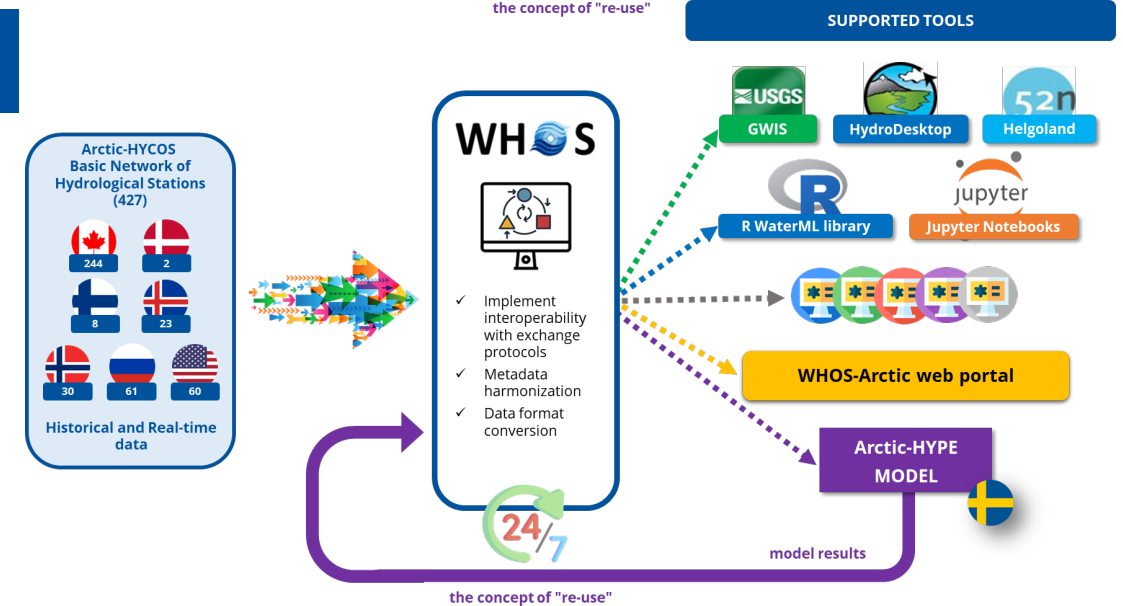
# WMO Hydrological Observing System (WHOS)

**WHOS implementation: Interoperability with some applications**

## WHOS-Plata

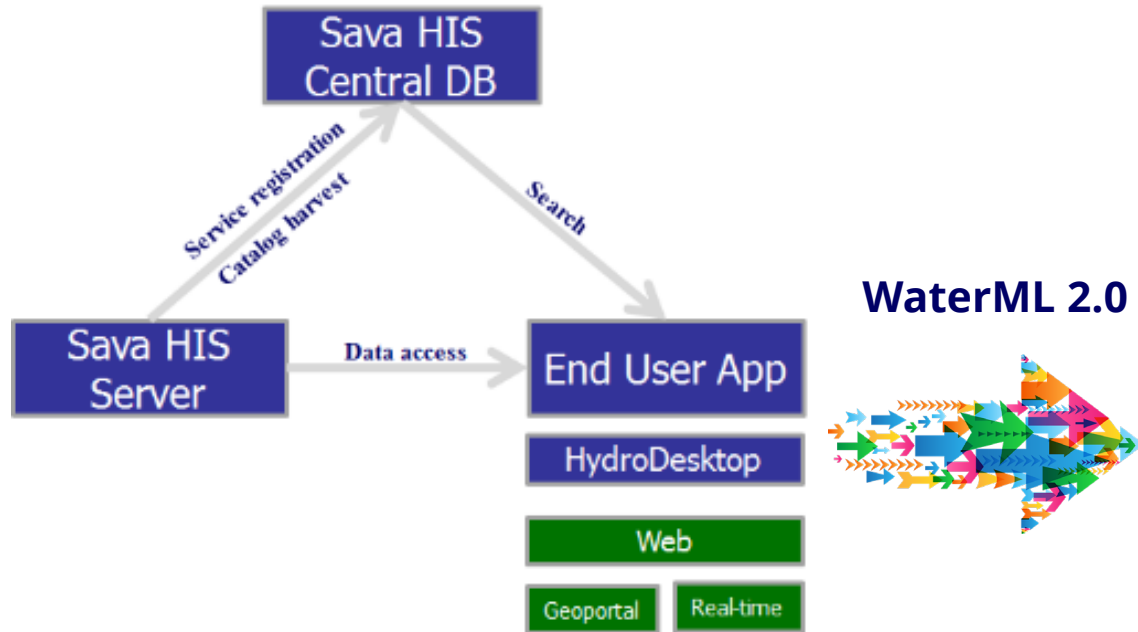


## WHOS-Arctic





WMO OMM

## WHOS-Sava implementation Interoperability under the testing



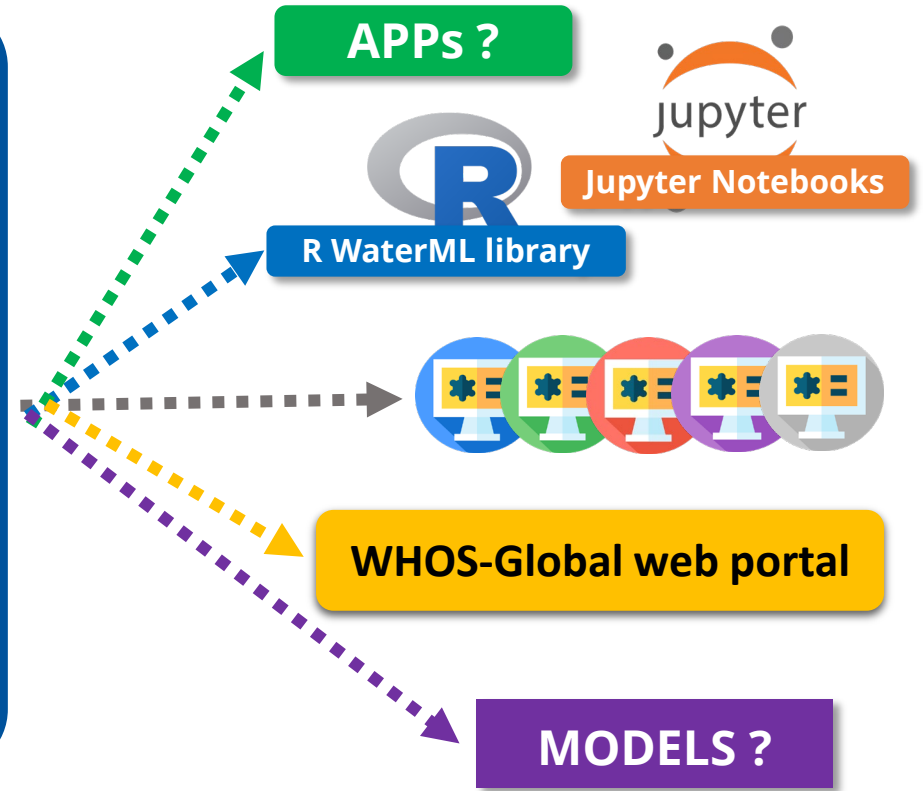
WaterML 2.0

### WHOS

- ✓ Implement interoperability with exchange protocols
- ✓ Metadata harmonization
- ✓ Data format conversion

### SUPPORTED TOOLS

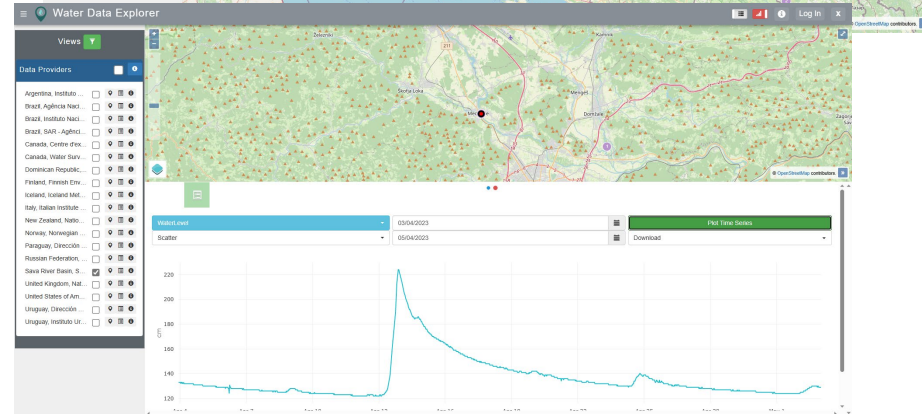
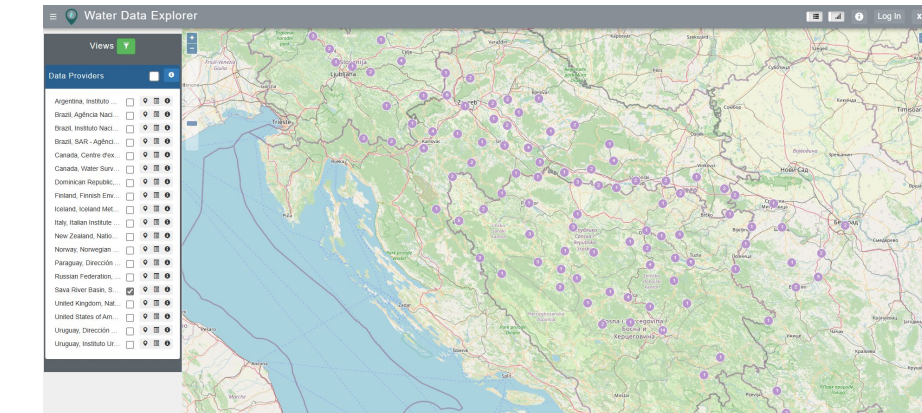
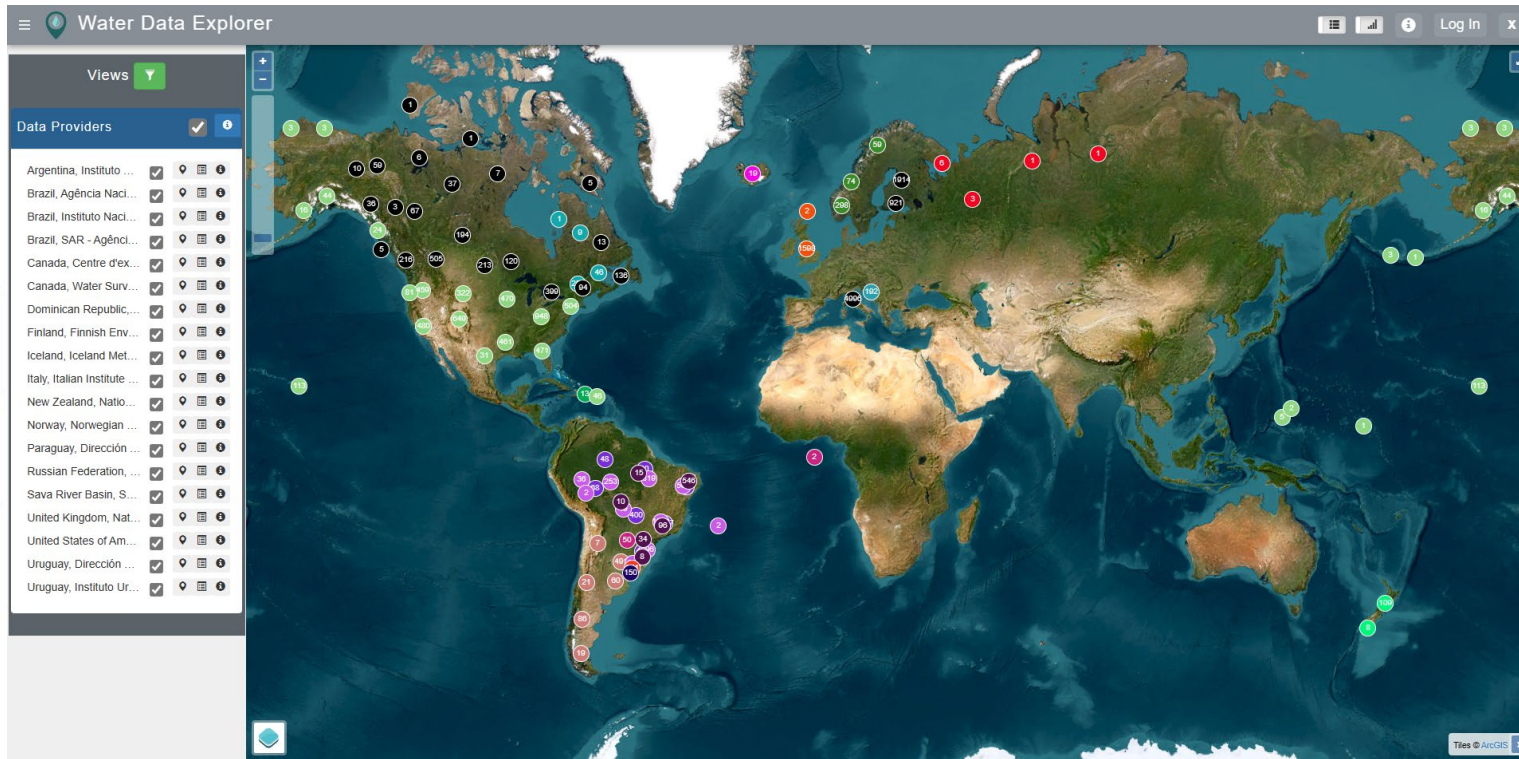


WMO OMM

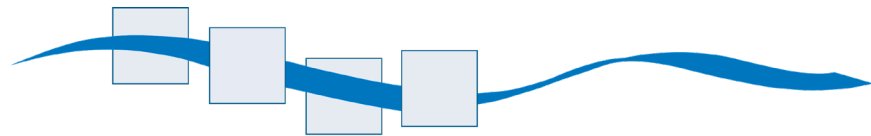


## WHOS-Sava implementation

❖ Functionalities tested by the ISRBC's PEG HMI



WMO OMM



INTERNATIONAL SAVA RIVER BASIN COMMISSION

**THANK YOU FOR YOUR  
ATTENTION**

Mirza Sarač

Advisor for protection against detrimental effects from  
waters and extraordinary impacts on the water regime

**International Sava River Basin Commission**

[msarac@savacommission.org](mailto:msarac@savacommission.org)