
Analysis of catastrophic floods affecting Croatia in May 2014

**Meteorological and Hydrological Service
Zagreb, Croatia**
<http://meteo.hr>

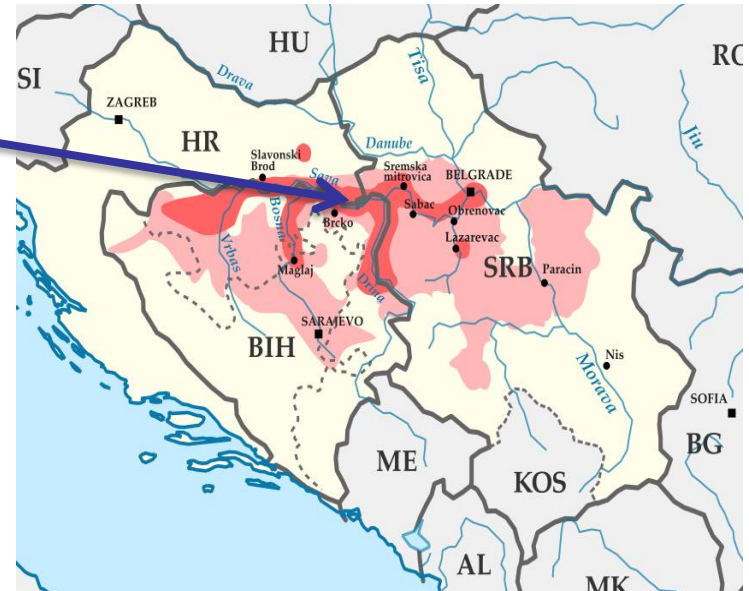
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The most affected areas are along the **Sava river**

Croatia

- the economic impact is enormous (297.629.000 EUR)
- the floods forced the evacuation of ~20.000 people in eastern Croatia
- there have been 3 casualties
- ~ 4.500 housing units have been flooded (around 30% of them need to be demolished)



What causes floods?

Extreme hydrological conditions
or
dam failure

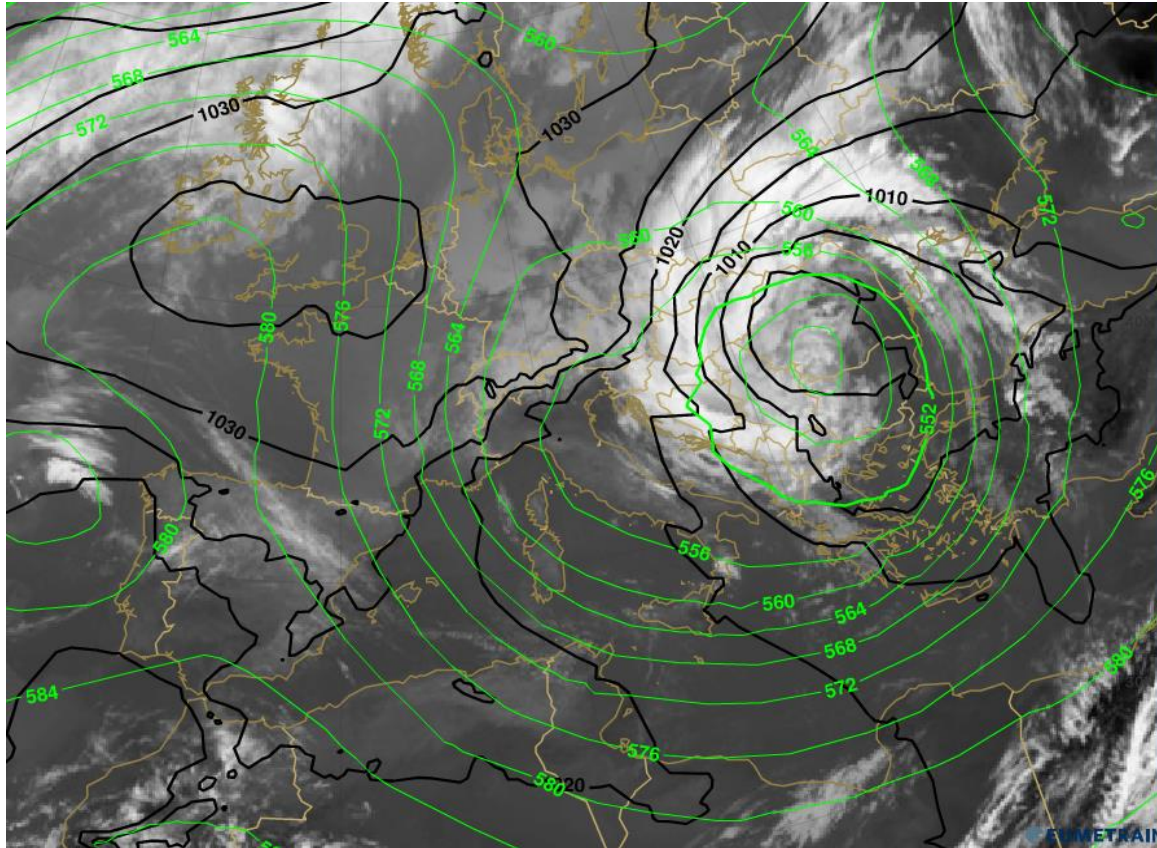


in Eastern Croatia
both of them were the cause



Continuous and heavy rainfall for almost two months has resulted in extensive flooding in Croatia, Serbia, Bosnia and Herzegovina.

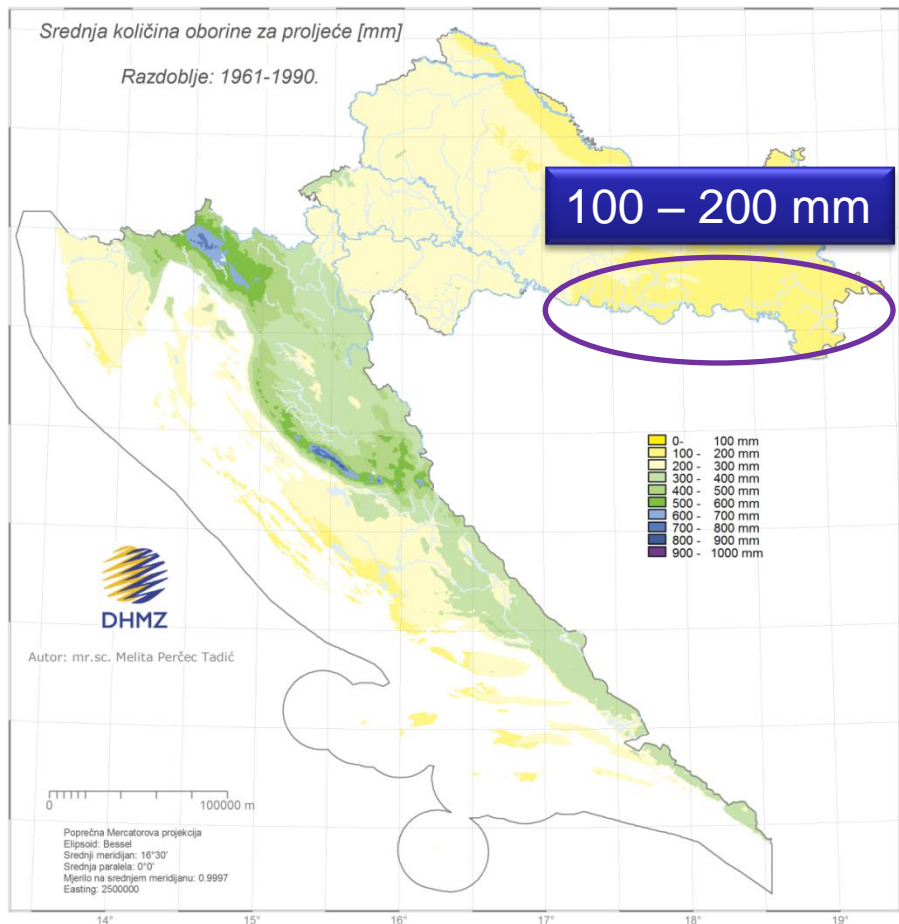
Weather conditions



Geopotential height of 500 hPa surface (green) and surface air pressure (black) on METEOSAT satellite image, 15th May 2014, at 06 UTC.

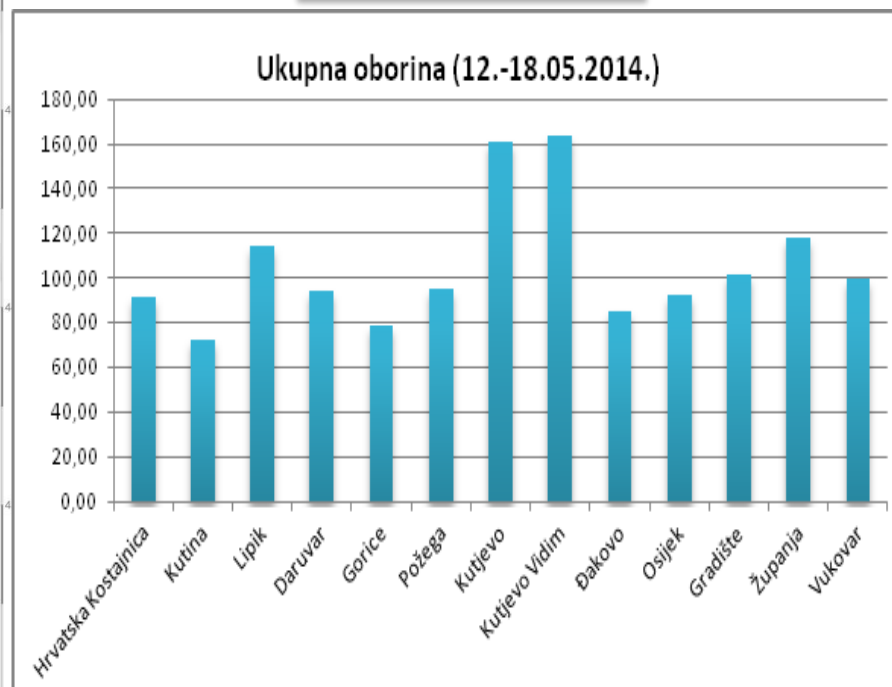
Weather conditions

Average Spring precipitation, 1961-1990



Total precipitation for the period 12th – 18th May 2014

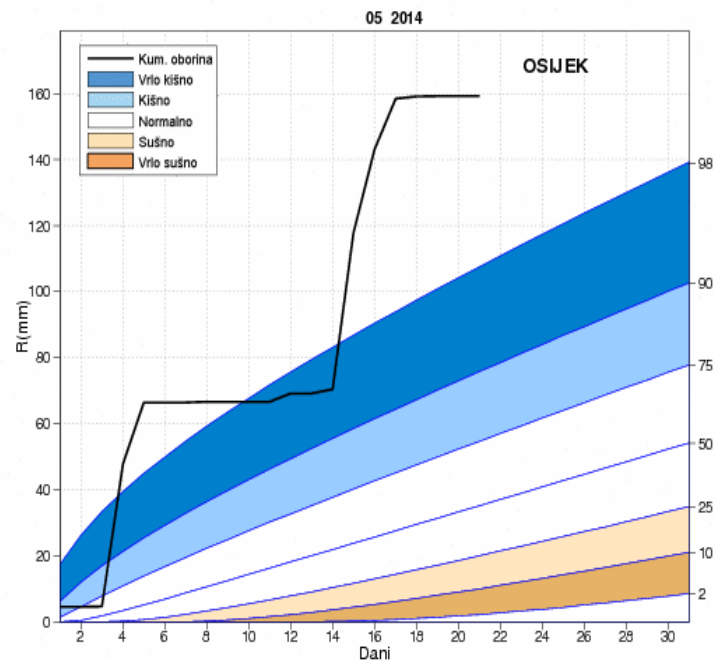
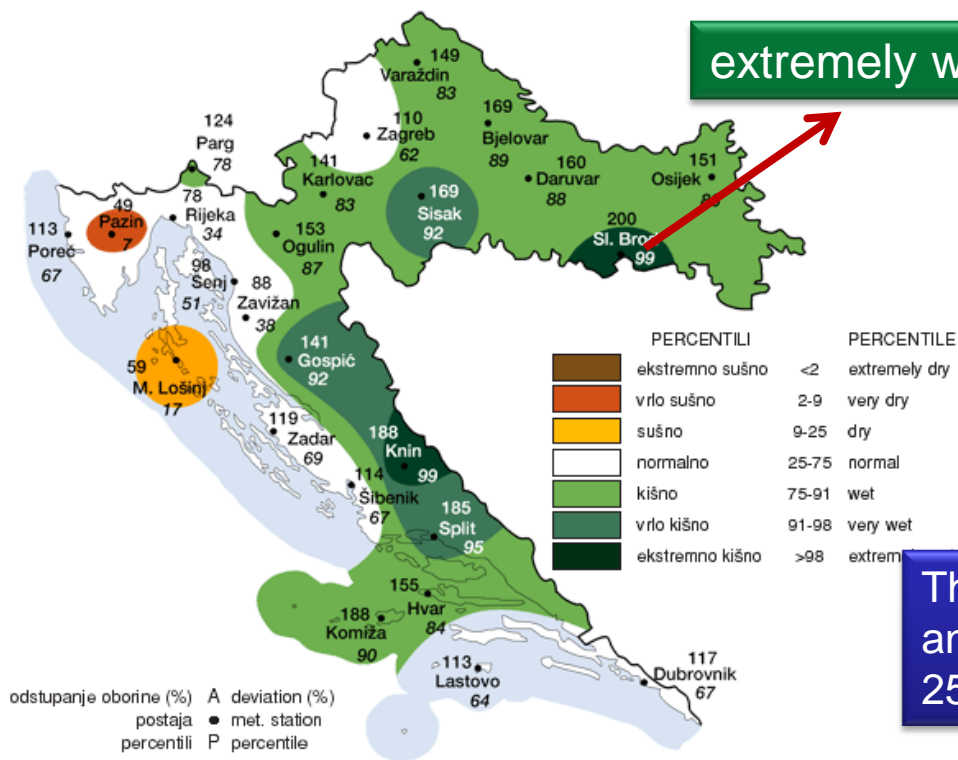
100 – 160 mm



Weather conditions

Deviation of precipitation from the climatological average in April 2014

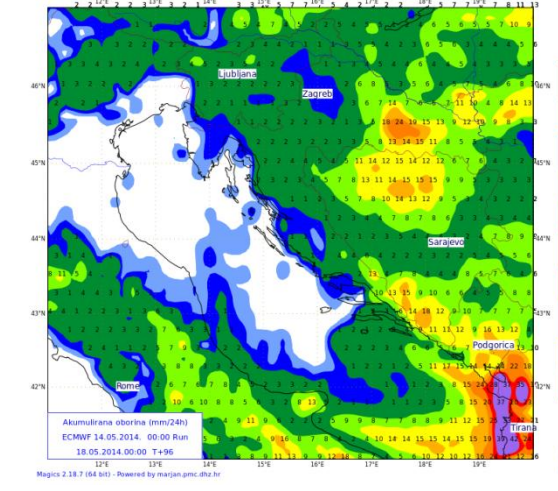
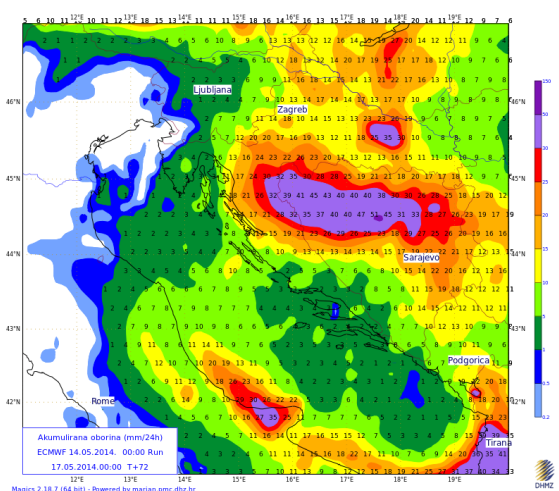
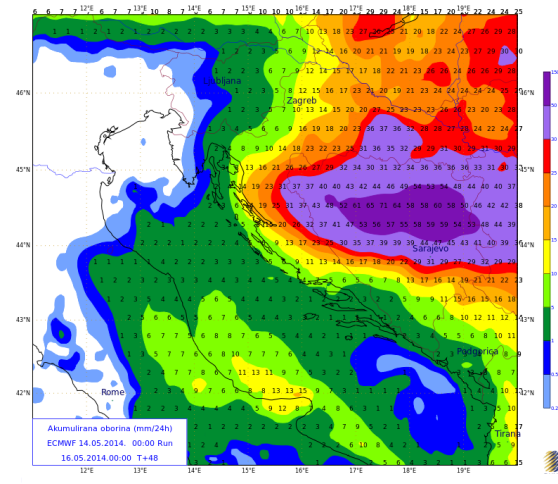
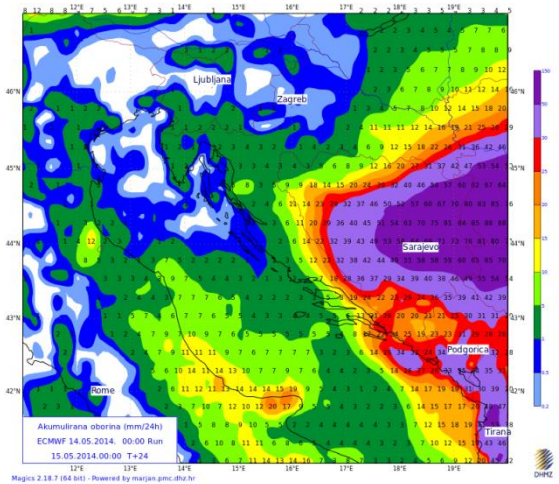
extremely wet



The cumulative precipitation (mm) for May 2014 and the curves of theoretical percentiles (2, 10, 25, 50, 75, 90 and 98) for the period 1961-2000.

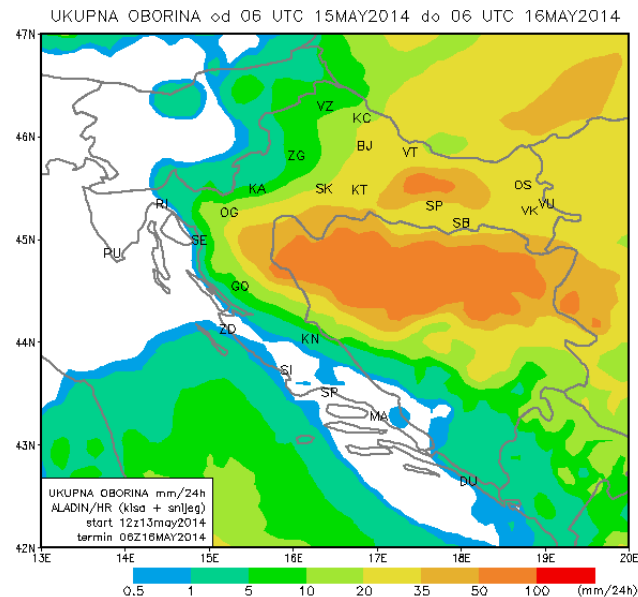
Weather forecasts and warnings

The ECMWF forecast of 24-hour precipitation for 14th, 15th, 16th and 17th May



Weather forecasts and warnings

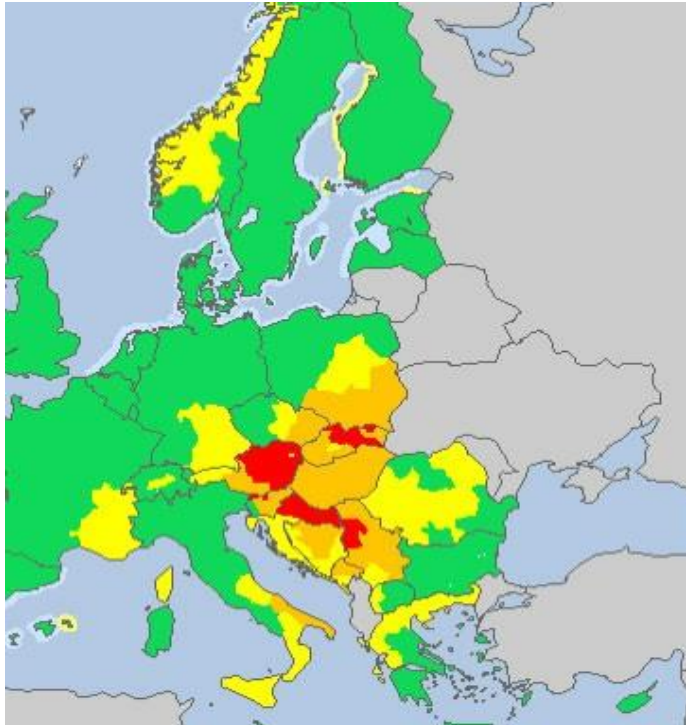
ALADIN/HR forecast of 24-hour precipitation
for the period from 06 UTC 15th till 06 UTC, 16th May








































































The event had been forecasted on time!

Weather forecasts and warnings

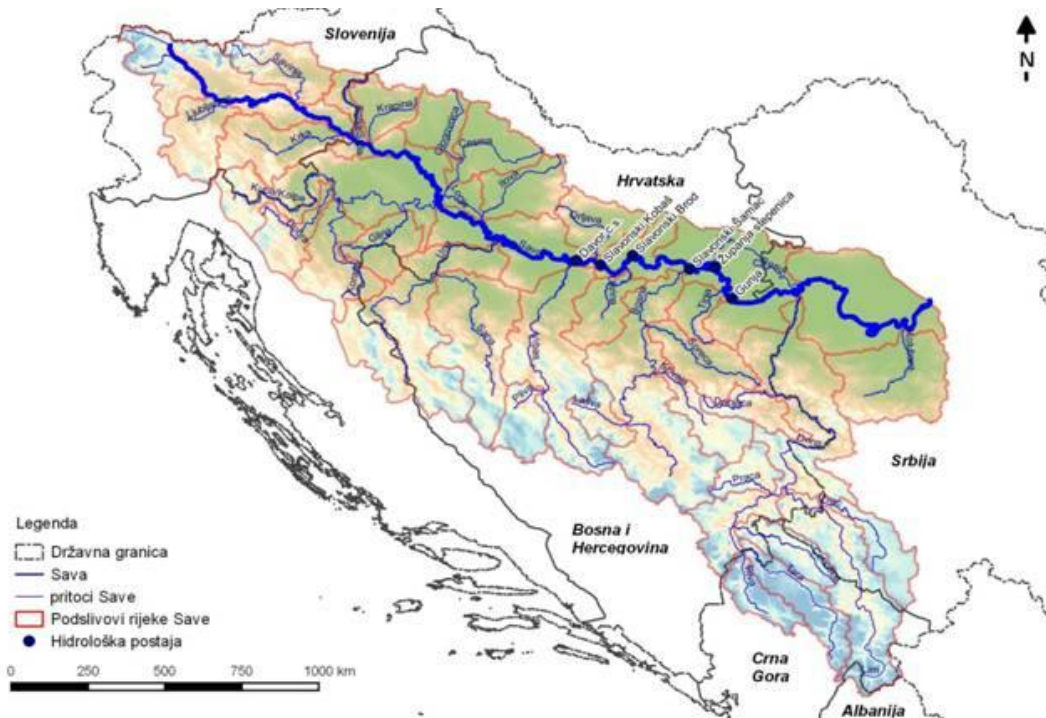
METEOALARM alerts for 15th May 2014



Awareness Reports - You can find detailed information and warnings in the awareness reports issued for each country, the relevant country.

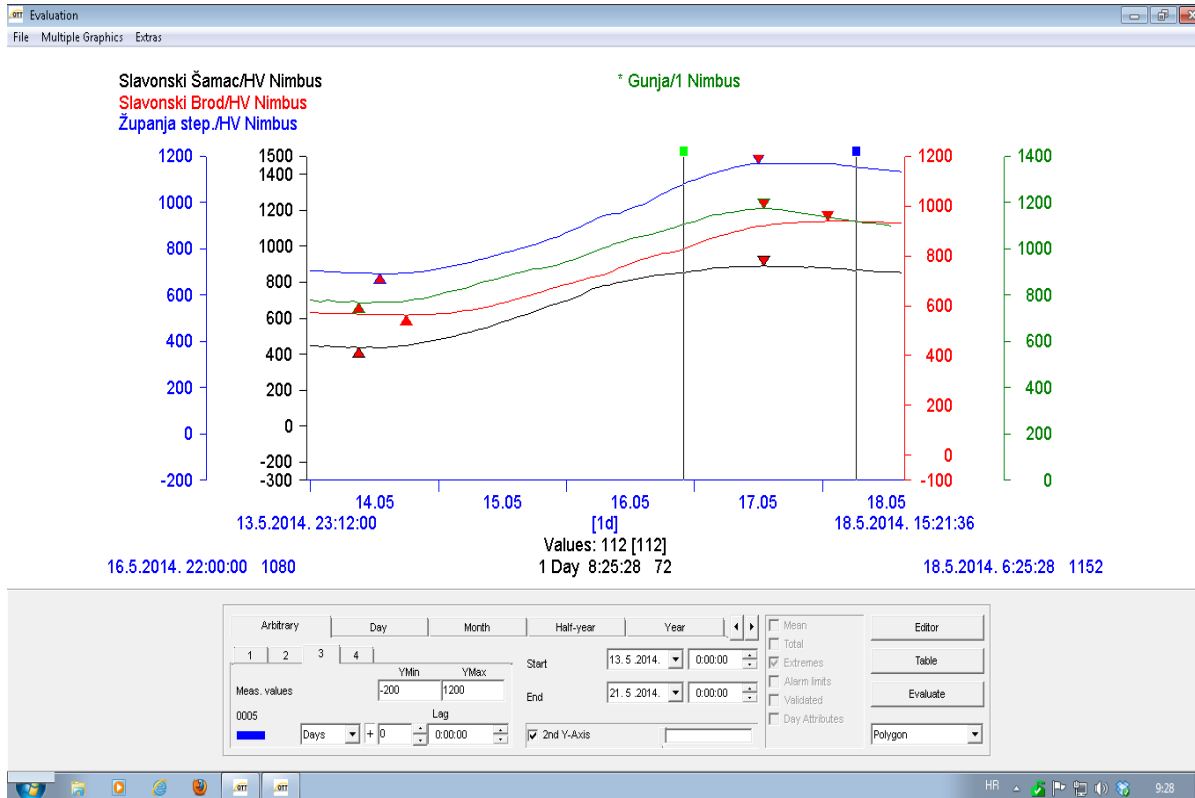
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ES						PT					
FI						RO					
FR						RS					
GR						SE					
HR						SI					
HU						SK					

Hydrological aspects



- soil was saturated with water
- rivers were full
- water spills over the river banks
- river banks bursts on several places
- victims and damages (people, animals, crops, properties, infrastructure)

Hydrological aspects



Drowned Gunja hydrological station

Water level data on hydrological stations Slavonski Šamac, Slavonski Brod, Županja and Gunja, 13 to 18 May 2014

Hydrological aspects

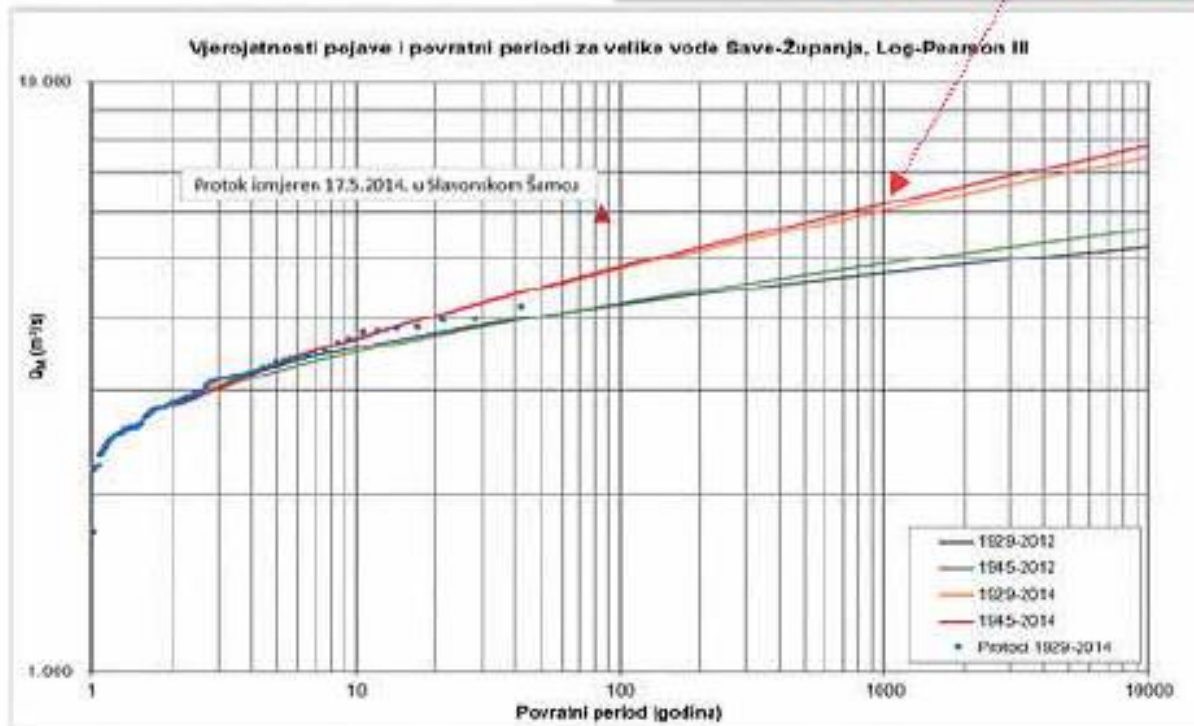
Hydrological station	STAGE 2014	STAGE MAX	FLOW RATE 2014 m ³ /s	FLOW RATE MAX m ³ /s
Slavonski Brod	939 cm 18.5.2014.	882 cm 30.10.1974.		3476
Slavonski Šamac	891 cm 17.5.2014.	762 cm 21.3.1981.	6007 17.5.2014	
Županja	1168 cm 17.5.2014.	1046 cm 19.1.1070.		4161
Gunja	1173 cm 17.5.2014.	938 cm 9. 4. 2013.	4625 16.5.2014.	

Since nowadays the order of magnitude of the highest discharge values for the lower Sava region was 3500 to 4000 m³/s approximately.

On May 17, 2014 DHMZ has performed the discharge measurement at the location of Slavonski Šamac getting the discharge of **Q=6007** m³/s, the value exceeding the above mentioned discharge values by 50 per cent.

Hydrological aspects

Discharge 6.007,96 m³/s



Return period (RP) = 1000 years

The incorporation of recorded flow rate maxima in the calculations of project parameters for flood protection systems should correct the existing parameters for this area and ensure the relevant values.

Meteorological and Hydrological Summary

Meteorological data

- strong precipitation during 14-18 May on Sava River Catchment, east Croatia, north BiH and Serbia
- very to extremely wet previous month

Hydrological data

- maximum recorded water levels
- water flow rates exceeded the maximum recorded for almost a double
- strong flow rates on Bosnia, Vrbas and other confluents on Sava river

Flood protection in Croatia

Low on Water (*Official Gazette 153/09*) – **CROATIAN WATERS** is the responsible governmental organisation for the flood monitoring, flooding risk management and assessment and flood defense planning

National Flood Protection Plan - CROATIAN WATERS coordinates the implementation of the Plan

COORDINATION:

NATIONAL PROTECTION AND RESCUE DIRECTORATE – leading organization for the protection and rescue, ensuring effective emergency management in case of major disasters – **CROATIAN PROTECTION AND RESCUE HEADQUARTERS** (members from key stakeholders and decision makers)

METEOROLOGICAL AND HYDROLOGICAL SERVICE - production, collection and dissemination of high-quality meteorological and hydrological information



Flood protection in Croatia - May 2014

CROATIAN WATERS *coordinates the implementation of the National Flood Protection Plan*

NATIONAL PROTECTION AND RESCUE DIRECTORATE – *system integrator in the flood protection activities*

- CROATIAN PROTECTION AND RESCUE HEADQUARTERS
- 112 center of NPRD warning the general public

METEOROLOGICAL AND HYDROLOGICAL SERVICE – *produce national and international hydrological and meteorological data (real-time, historic and forecasts)*

Flood protection in Croatia - May 2014

Croatia has been able to address the immediate humanitarian relief needs in the flooded areas on its territory with its own capacities.

All relevant line ministries have introduced measures for immediate relief, e.g. shelter, food and care for the displaced, books for the children, chemical (disinfection) and physical (removal of carcasses) decontamination of the area, feed for the evacuated cattle etc.

Disinfection of vehicles on border with Bosnia and Herzegovina and Serbia – preventive measure



Flood protection in Croatia - May 2014

In a coordinated effort, the Ministry of Social Policy and Youth, with the Ministry of the Interior, Ministry of Defence and Red Cross collected humanitarian aid from citizens and have sent in-kind assistance as well as monetary and psychosocial assistance to evacuated families.

Over 4000 officials and even a larger number of volunteers have been activated directly in activities related to rescue and protection.



Questions for the discussion

What did we learn from this as scientists?

The ***international exchange of quality controlled data*** and information is an essential element for the undertaking of basin-wide activities ranging from flood forecast and warning to the various aspects of water resources management.

This issue has to be addressed from several points of view:

- *Establishment of arrangements on the data and information exchange policy,*
- *Improvement and optimization of the current data exchange mechanisms,*
- *Consistency of the measurements carried out at hydrological stations situated at the state borders.*

Questions for the discussion

How could we overcome such tragic events in the future?



flooded



dry phase

Kopački rit – natural park

To protect swamp area!



Thank you!