Meteorological and hydrological antecedents and forecasts of Danube flood 2013

Hungarian Meteorological Service

Hungarian Hydrological Forecasting Service

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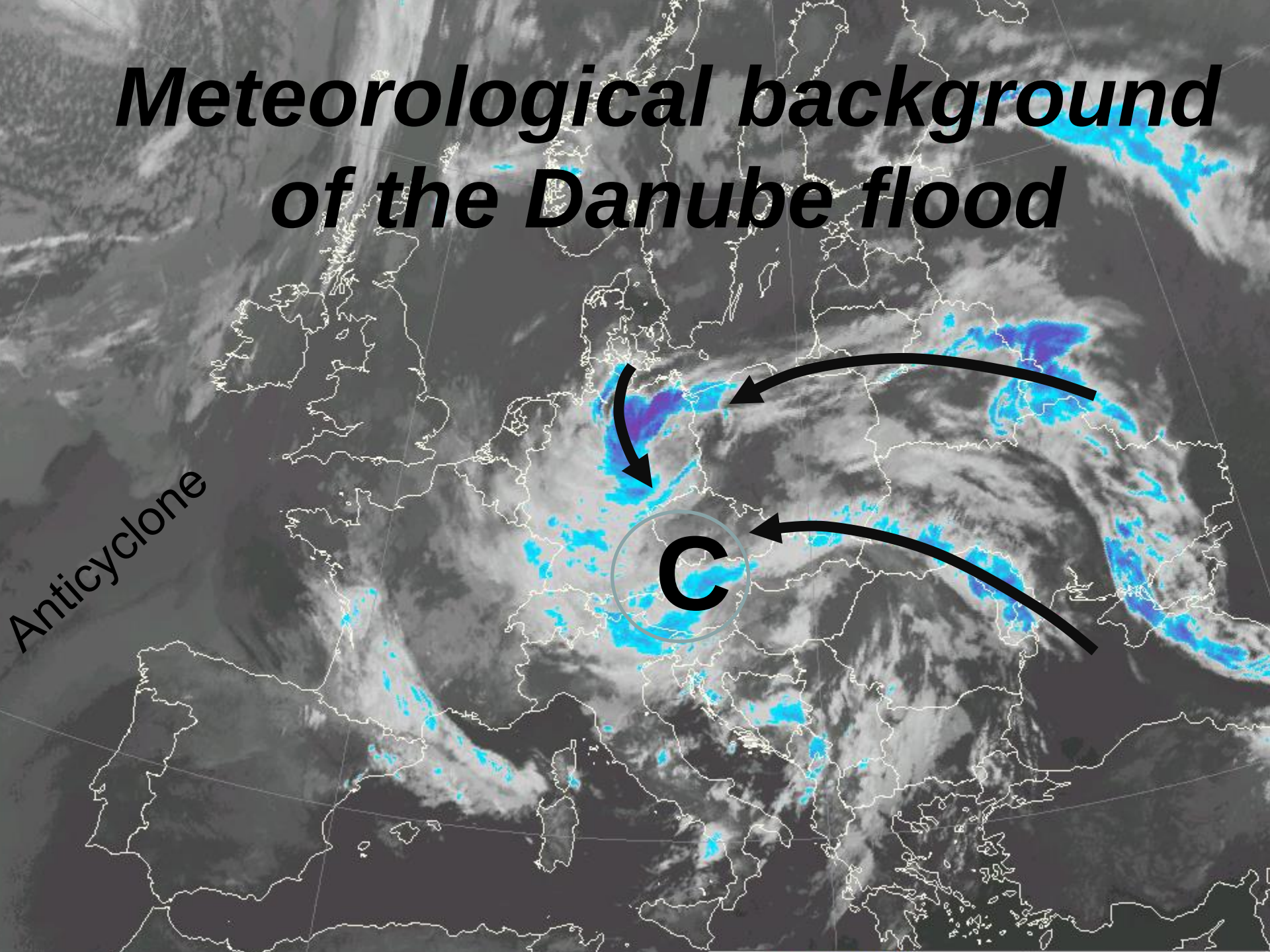
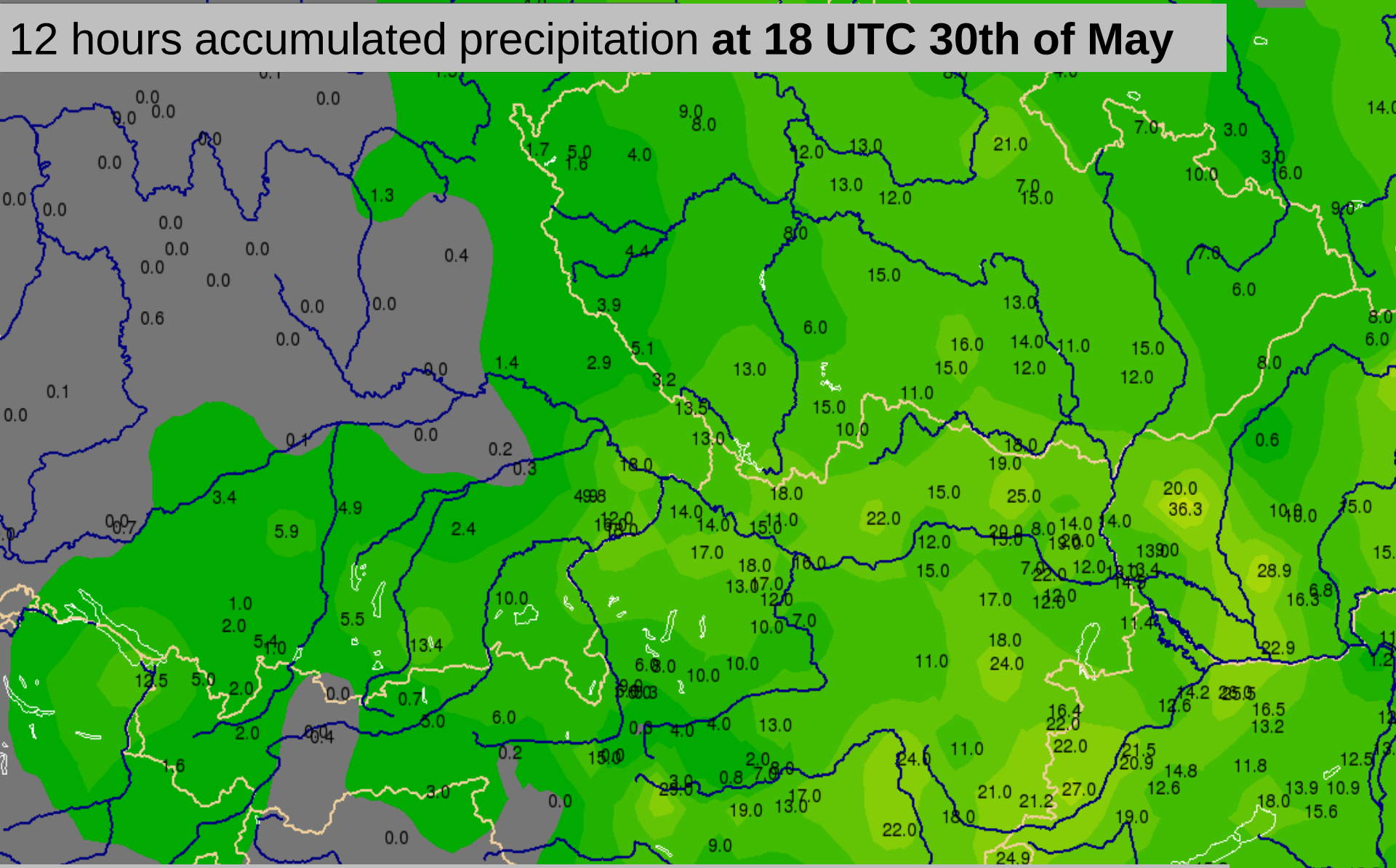
Budapest, 12 September 2013

Meteorological background of the Danube flood



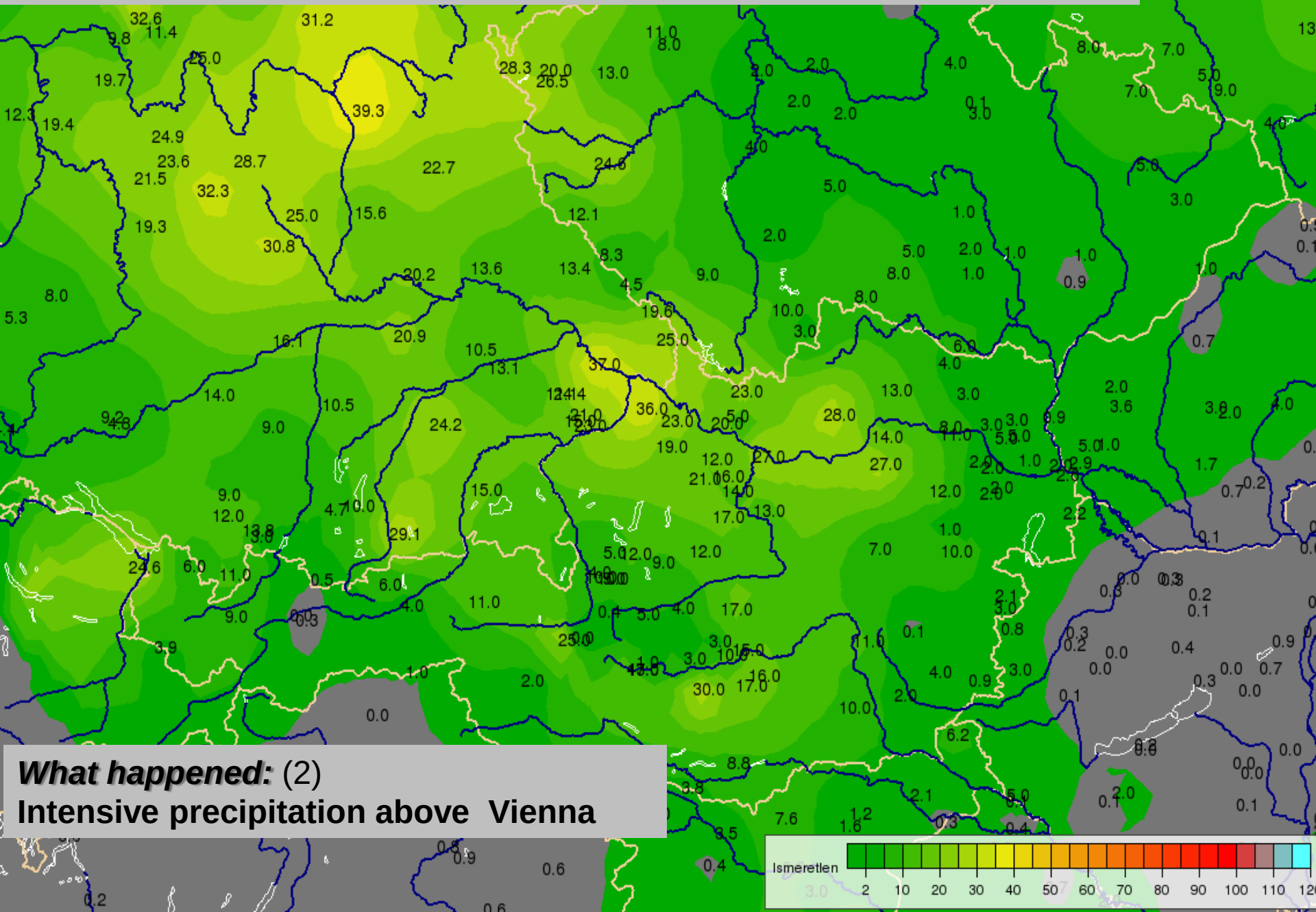
12 hours accumulated precipitation **at 18 UTC 30th of May**



What happened:

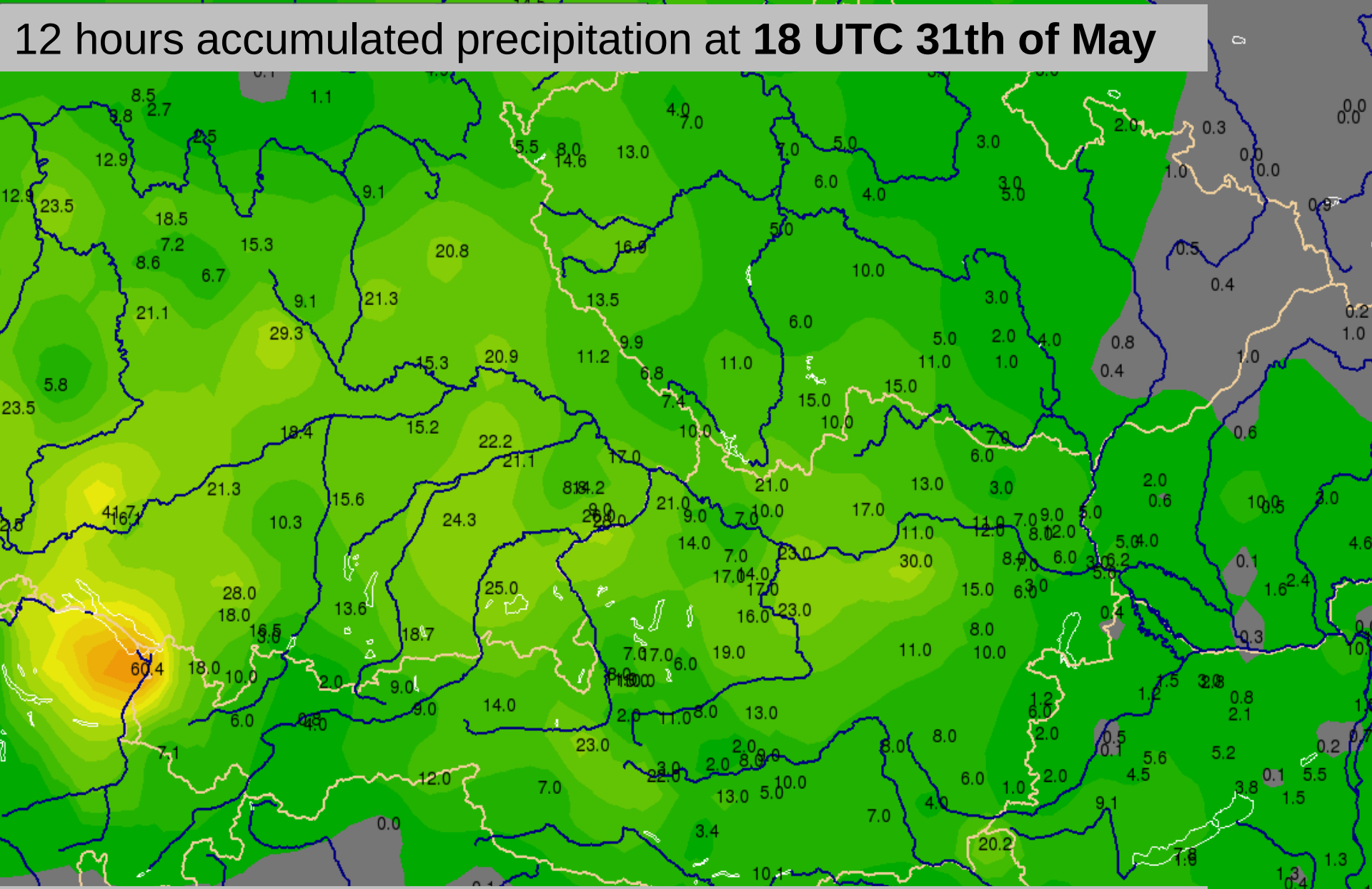
(1) Intensive precipitation between Linz and Győr

12 hours accumulated precipitation **at 06UTC 31th of May**



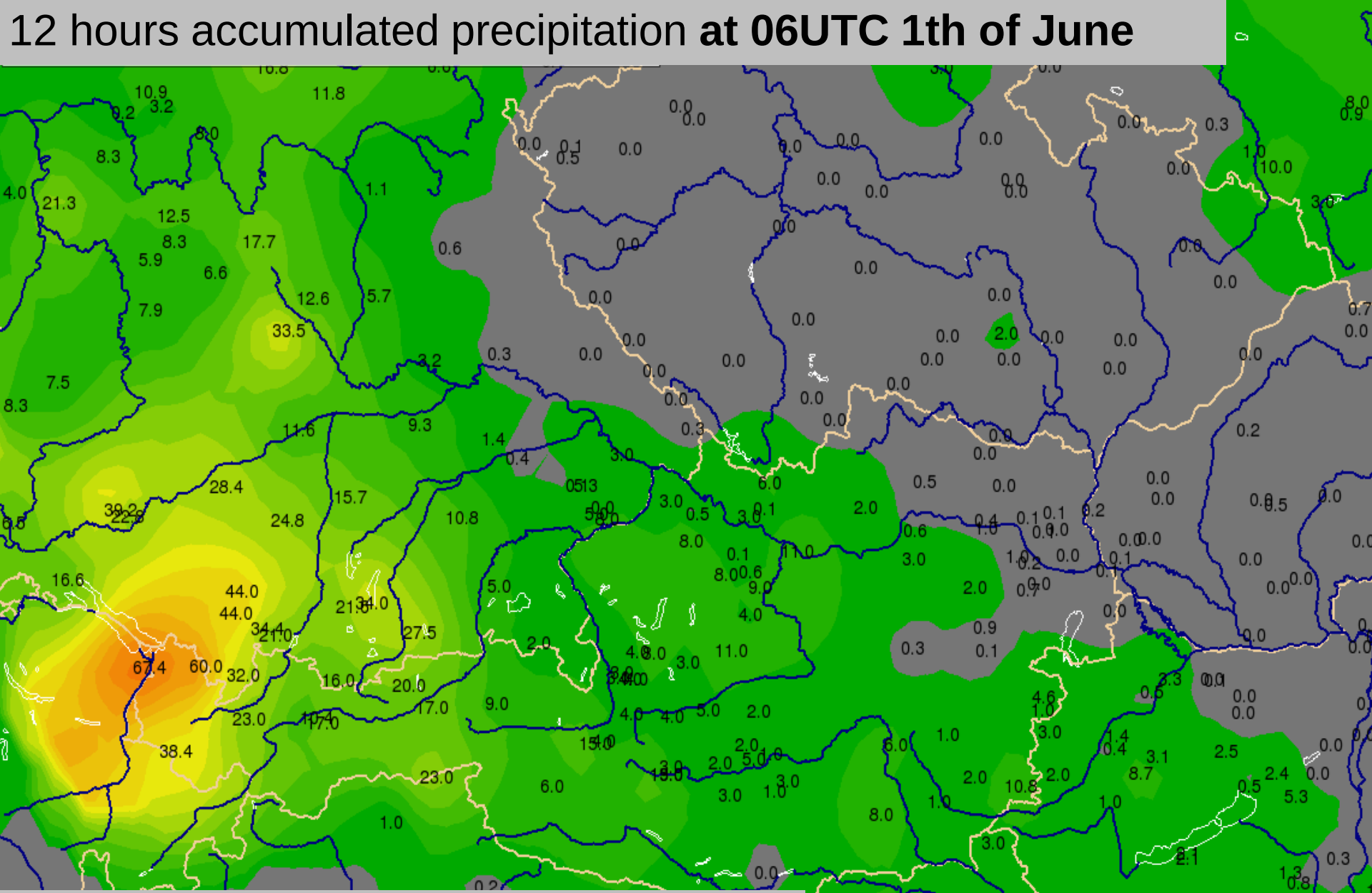
What happened: (2)
Intensive precipitation above Vienna

12 hours accumulated precipitation at **18 UTC 31th of May**



What happened: (3) Continuing rain above Vienna

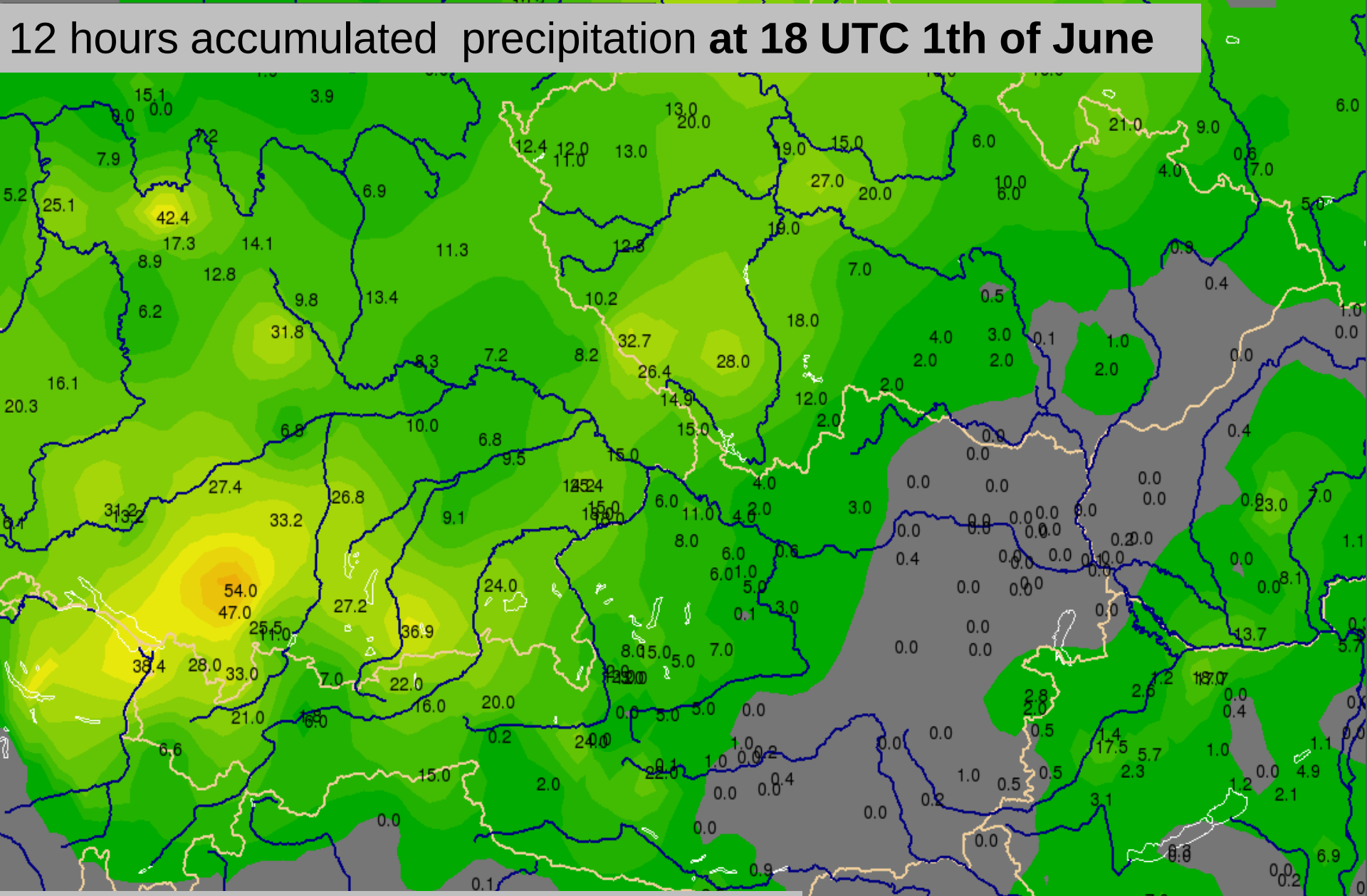
12 hours accumulated precipitation **at 06UTC 1th of June**



What happened (4):

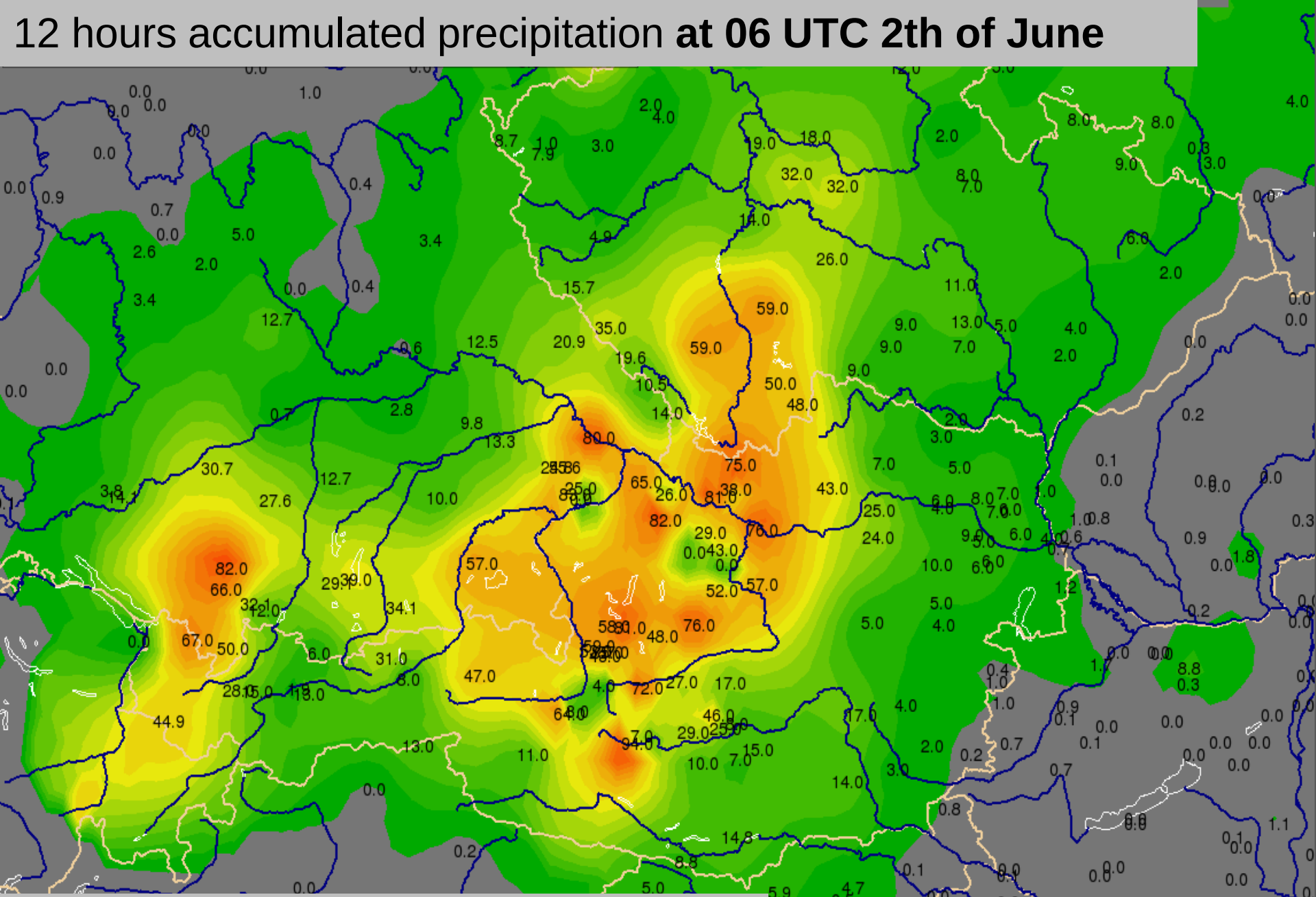
Short relief: only limited areas have intensive rain

12 hours accumulated precipitation **at 18 UTC 1th of June**



What happened (5):
Raining continues at upper sectors

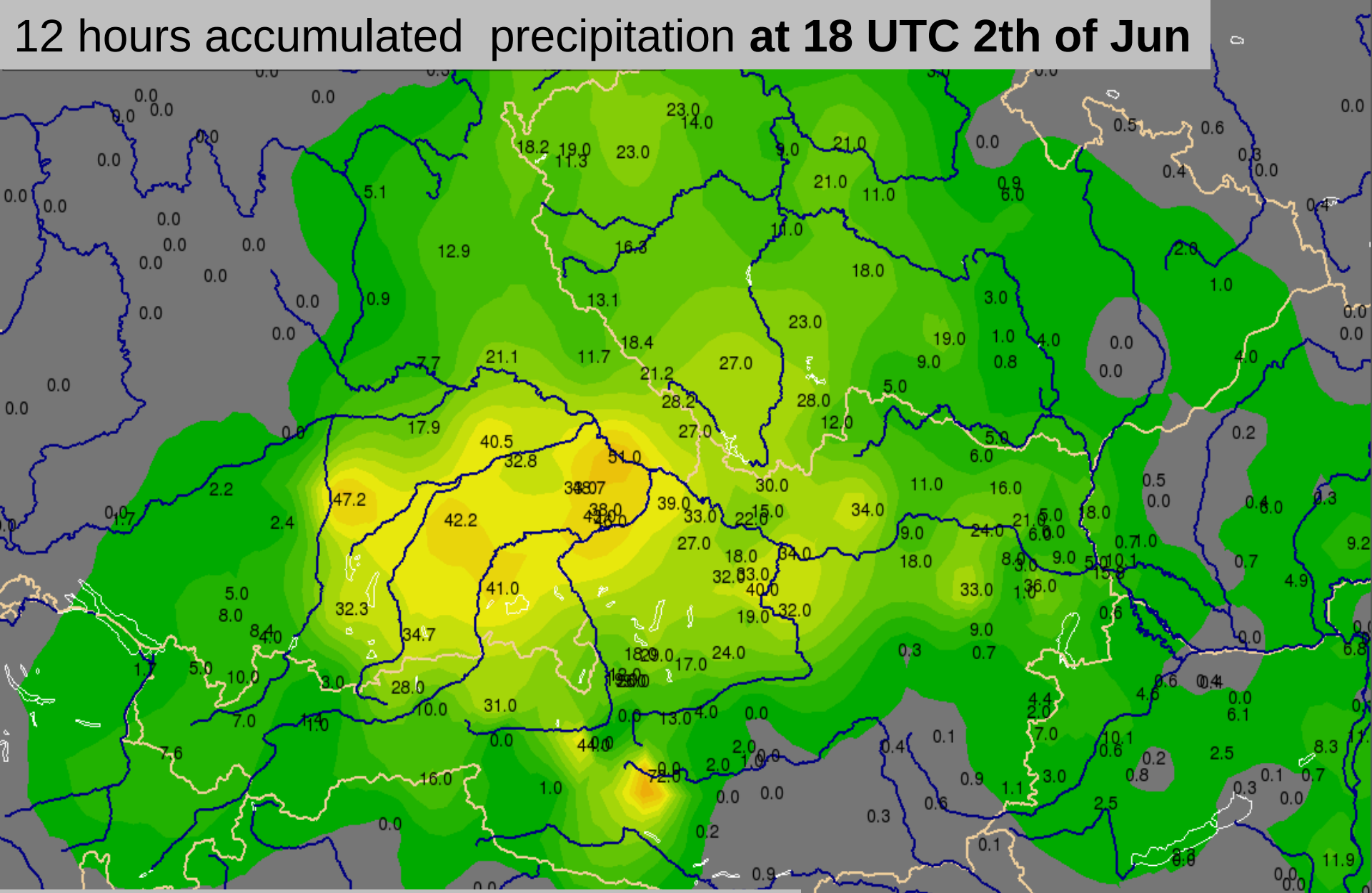
12 hours accumulated precipitation **at 06 UTC 2th of June**



What happened (6):

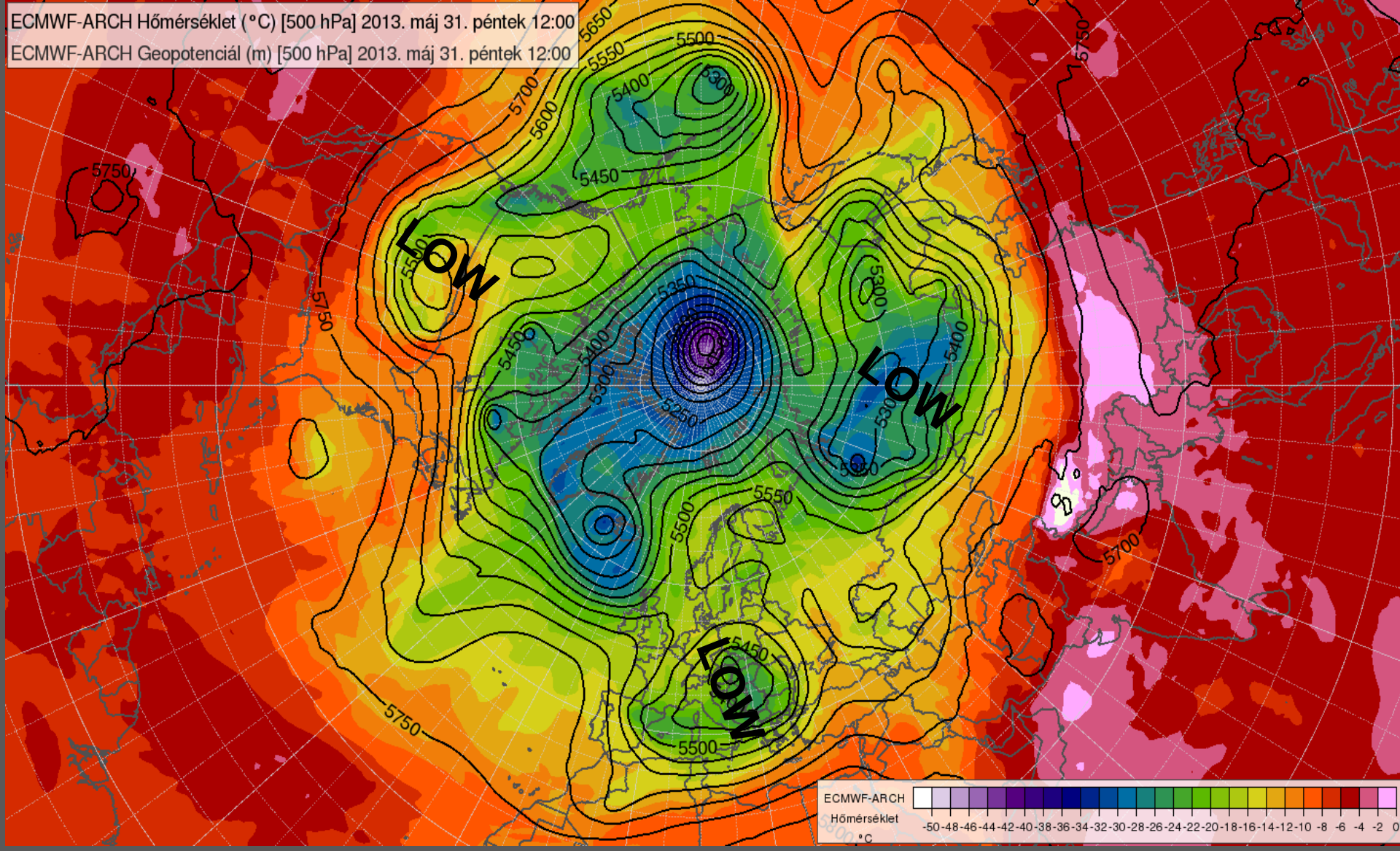
A new period of extreme precipitation

12 hours accumulated precipitation **at 18 UTC 2th of Jun**

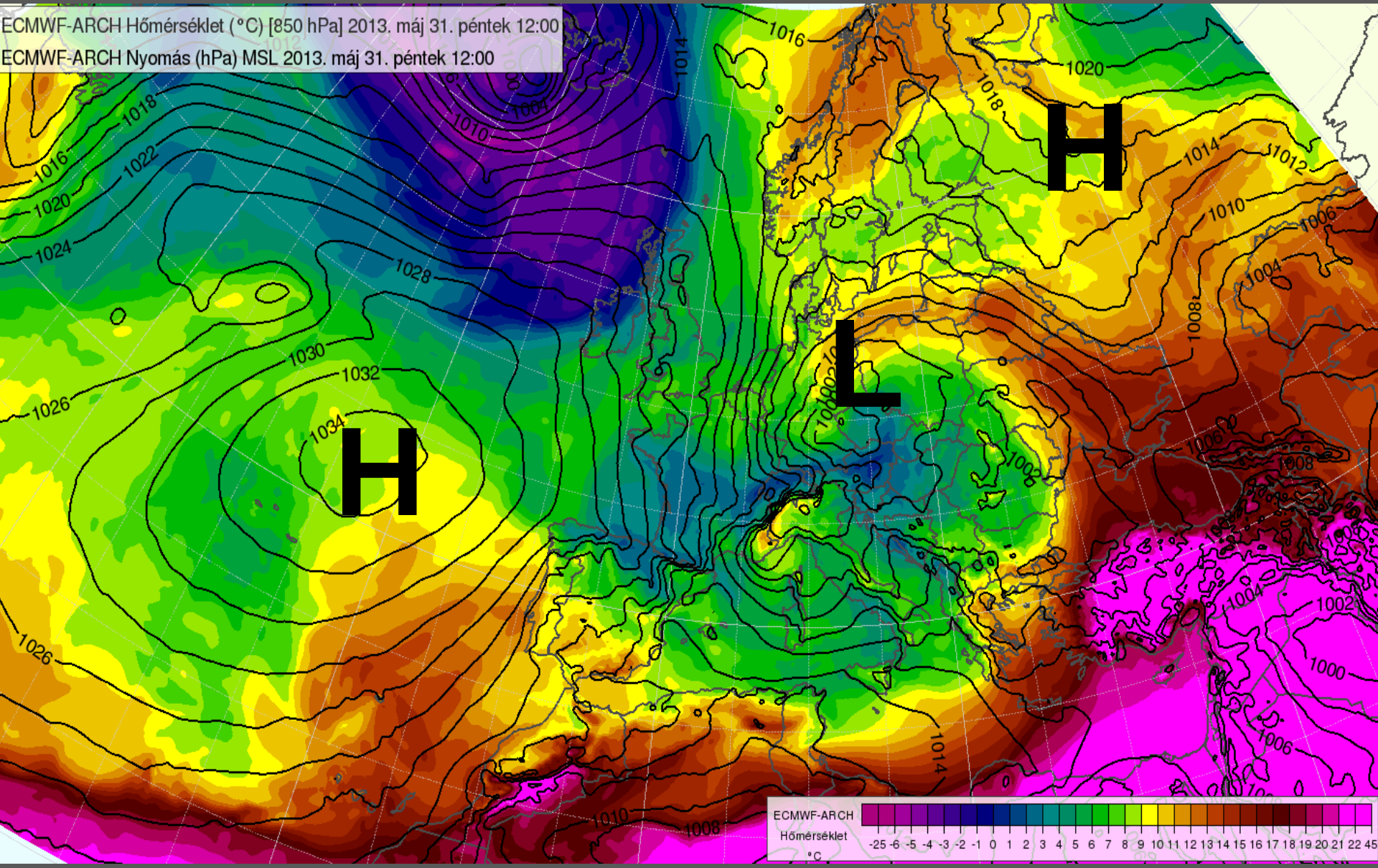


What happened (7):

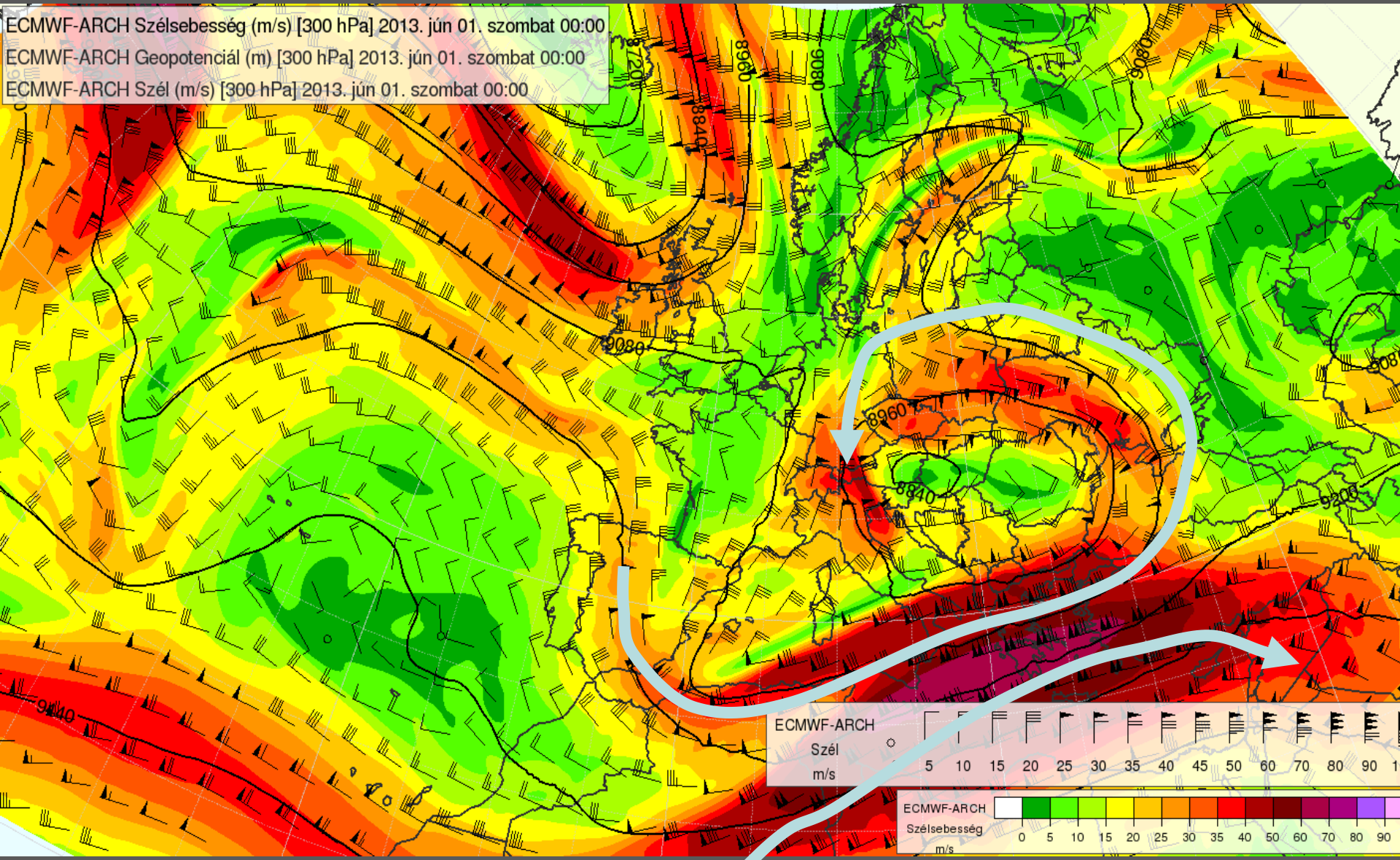
Last period of the intensive precipitation: immediate flood…



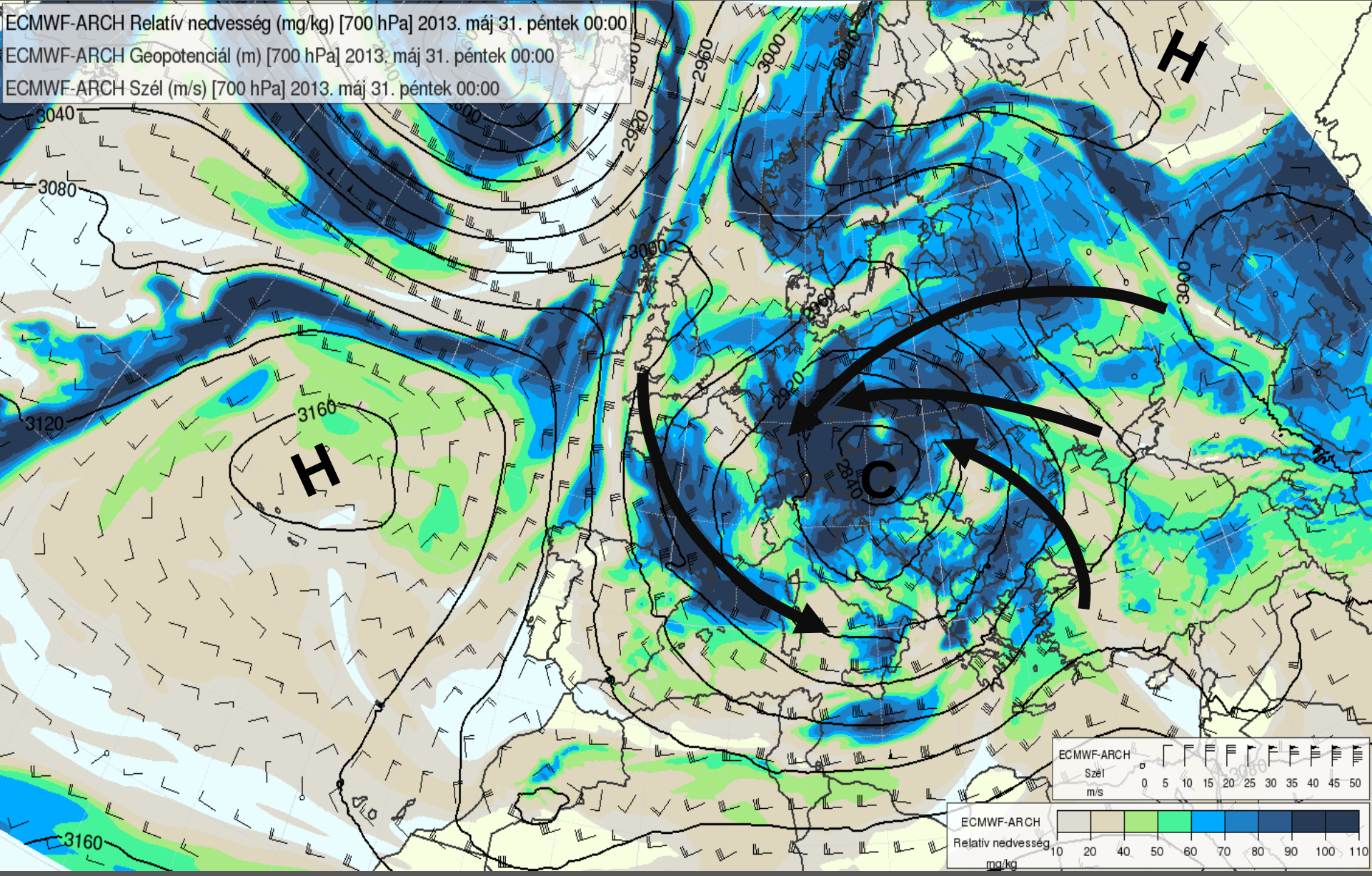
Indirect reason: the meridional circulation. Blocking anti-cyclones and slow moving cyclones responsible for extreme weather



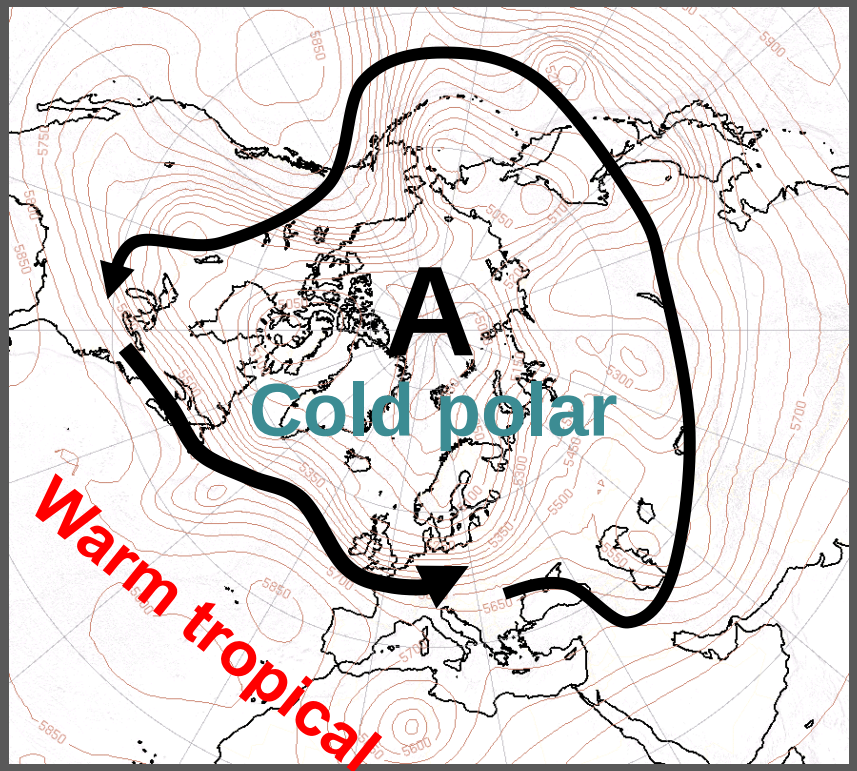
Slow moving cut off cyclone above Europe



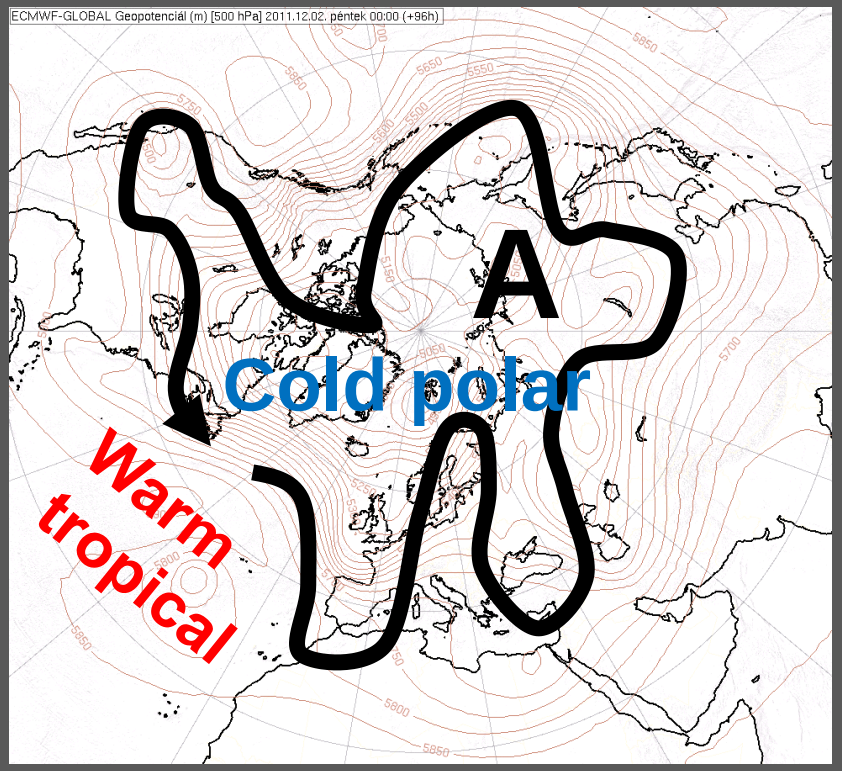
Bending jet-stream over the Alps: extra heavy convergence and upstream



Wet conveyor belts of the cut off cyclone concentrate to the western part of the cyclone, which stays above the Alps → extreme humidity concentration



Zonal type



Meridional type

frequency of meridional circulation type is raising →

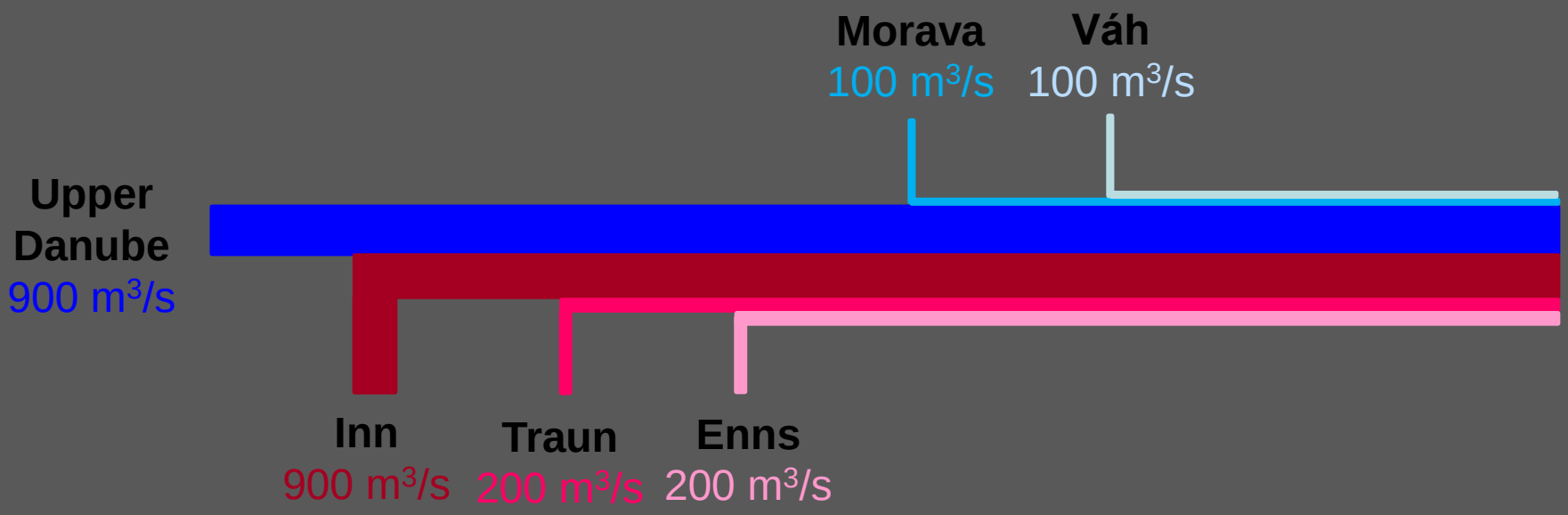
chance of extreme weather is growing

Hydrological antecedents and forecasts of Danube flood 2013

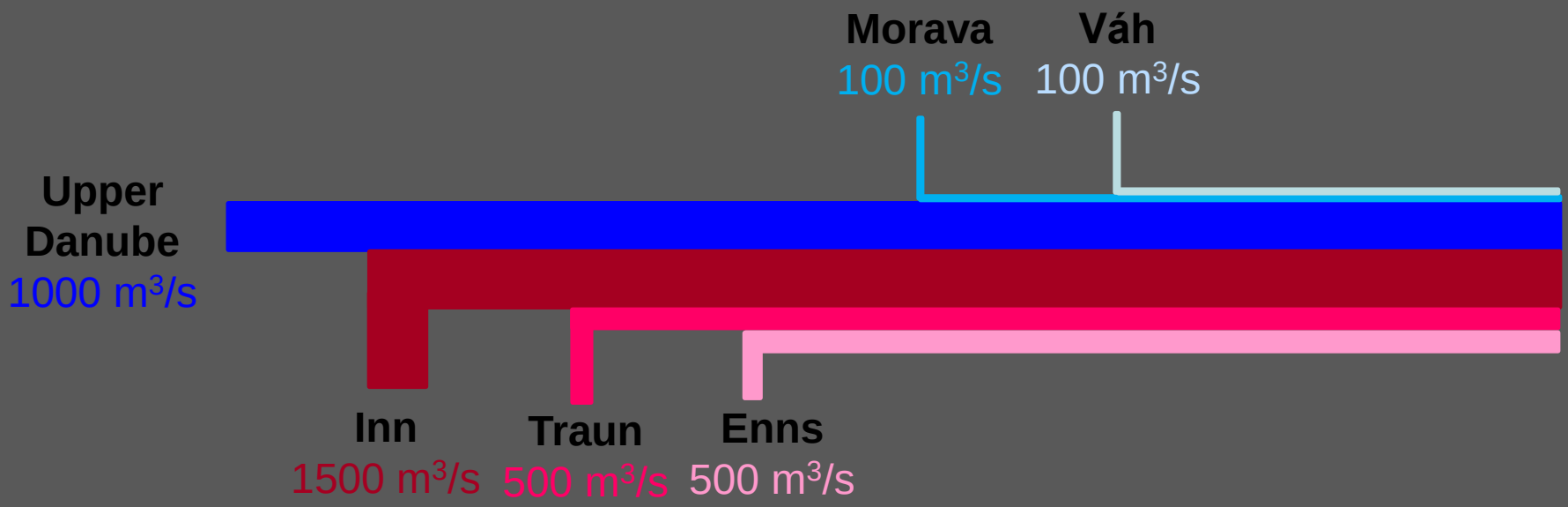
Budapest, 12 September 2013

Discharges of the Danube and its tributaries during the flood period in June 2013

30 May 2013



31 May 2013



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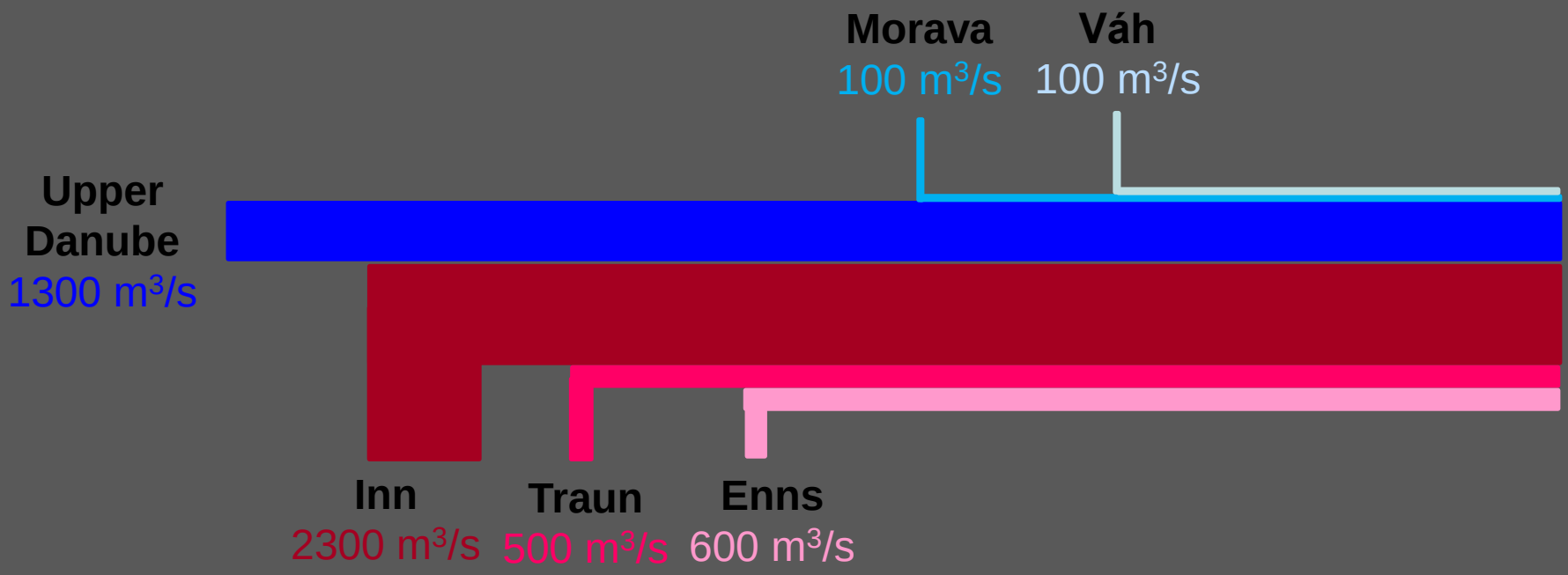
01 June 2013



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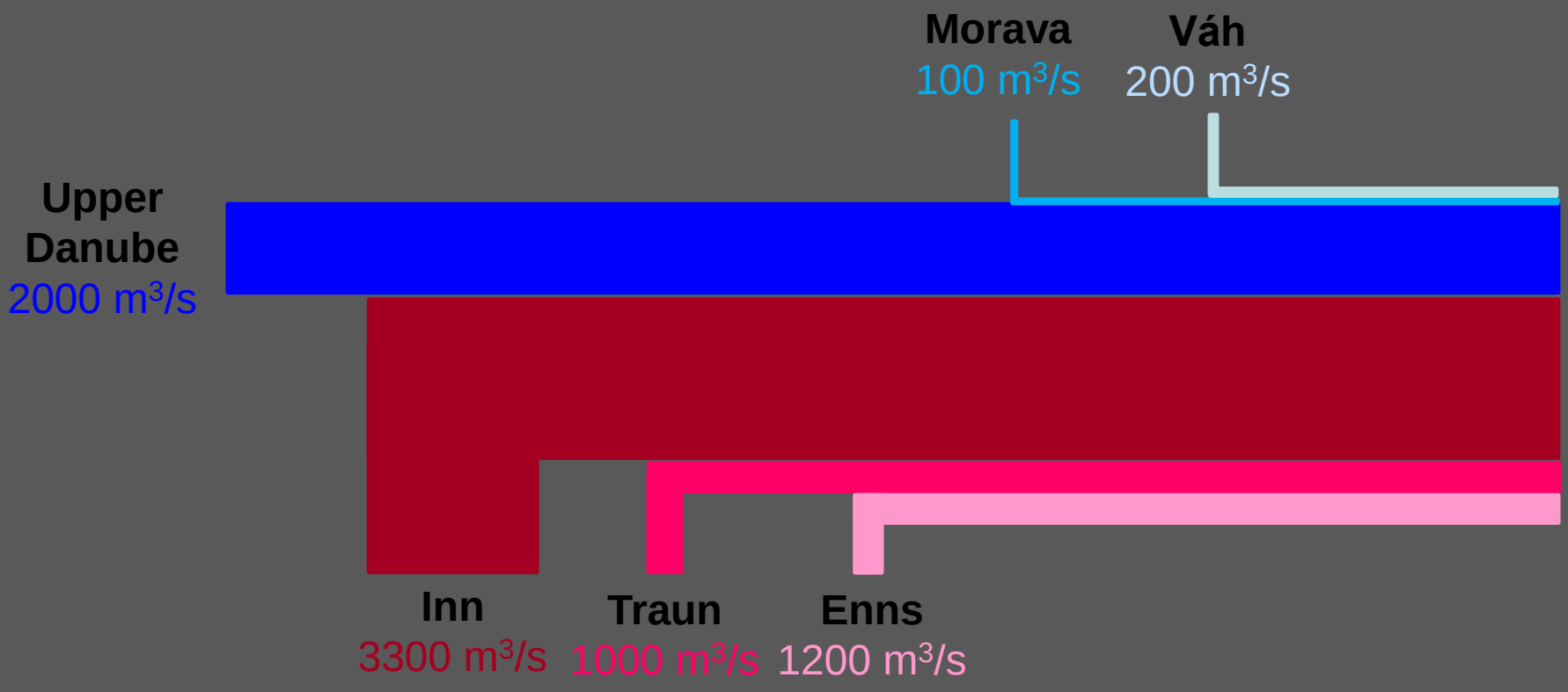
02 June 2013



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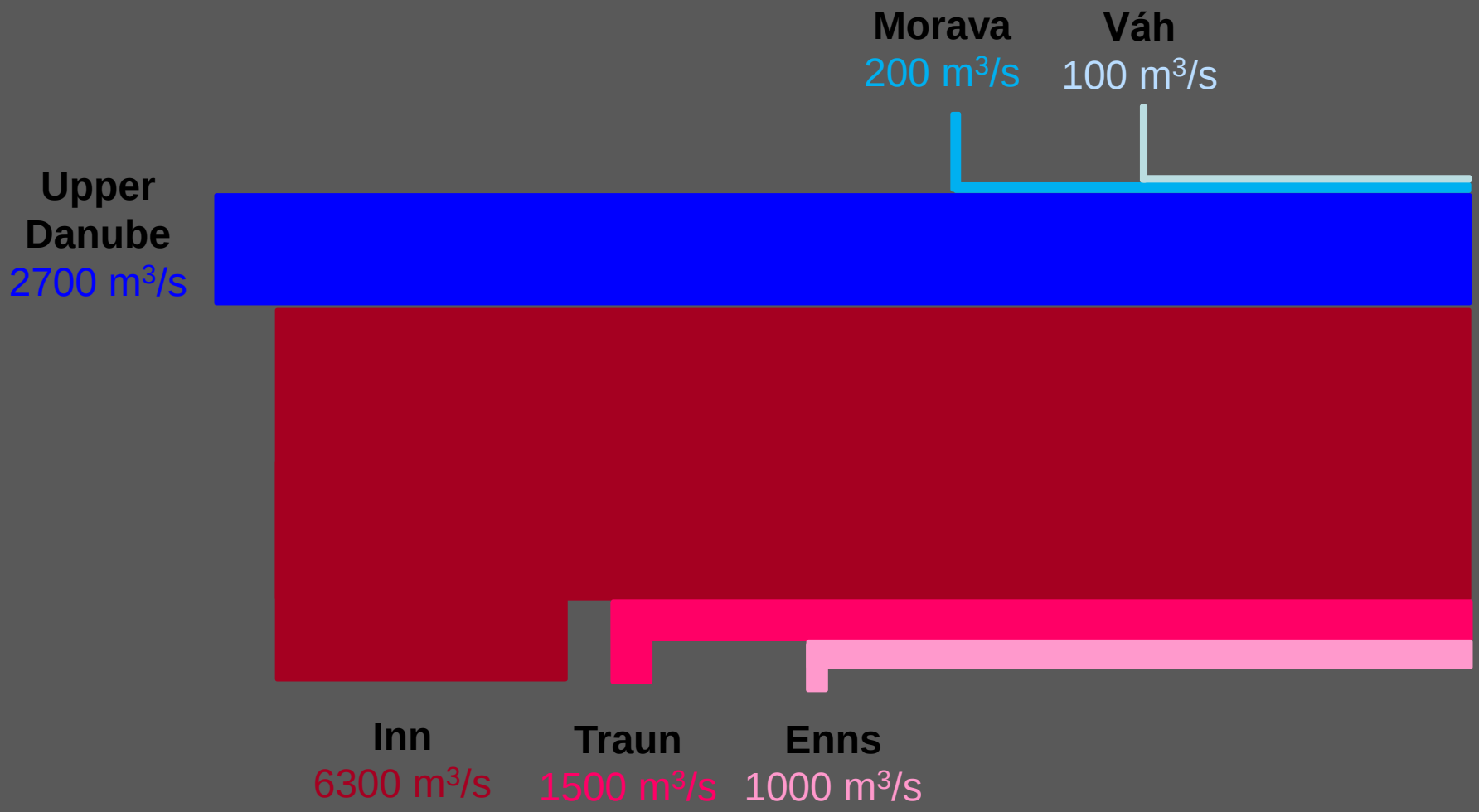
03 June 2013



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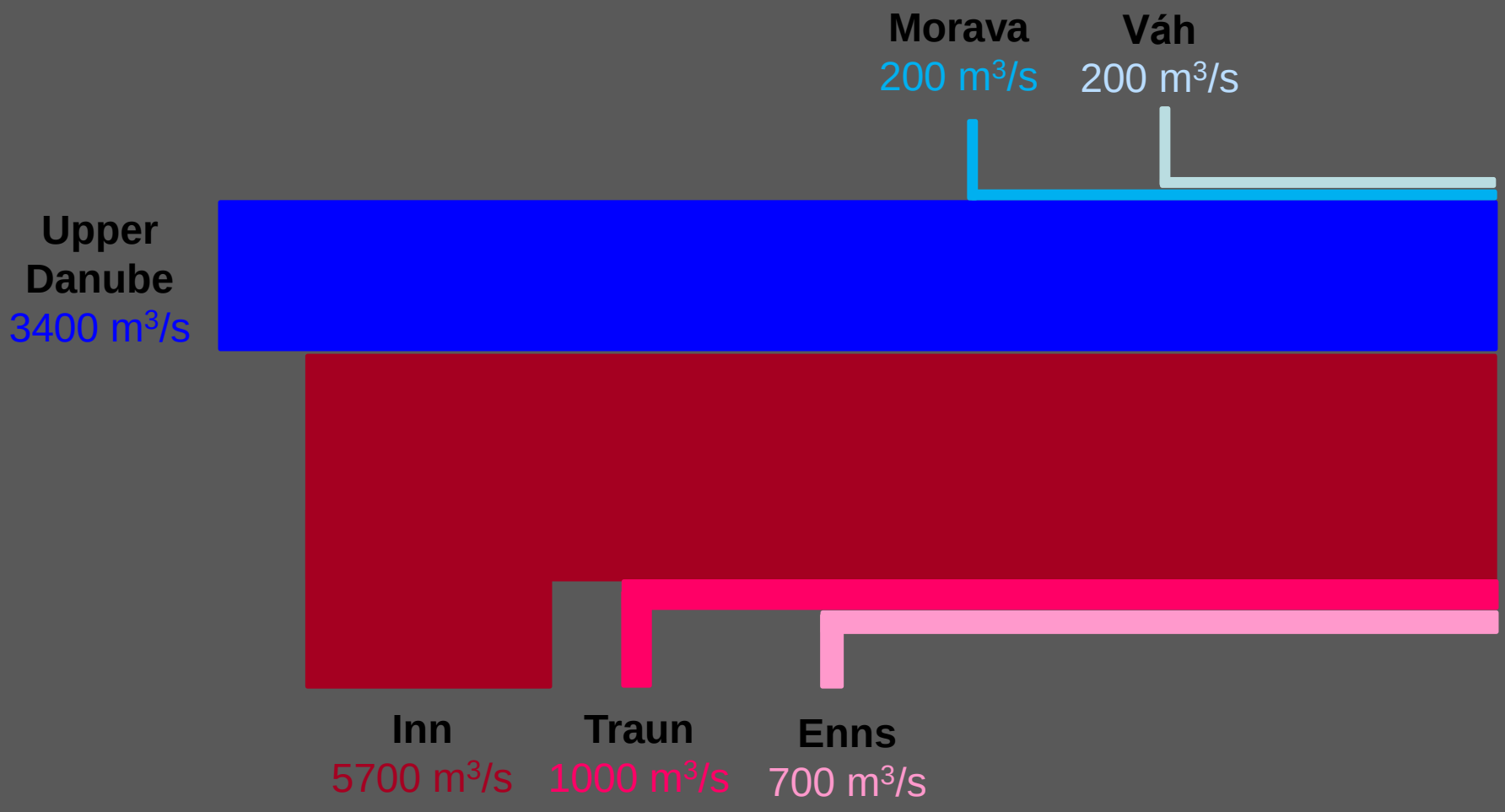
04 June 2013



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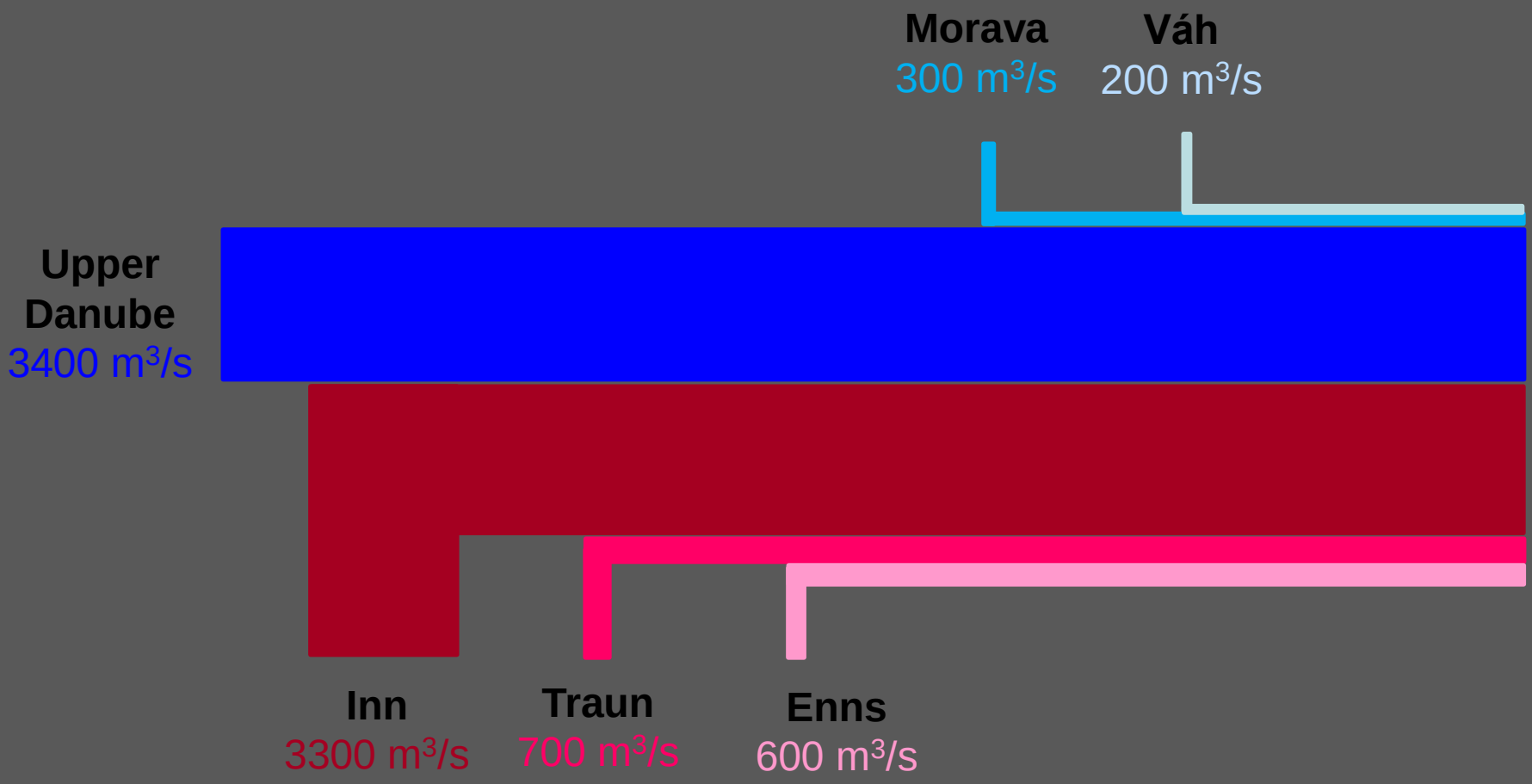
05 June 2013



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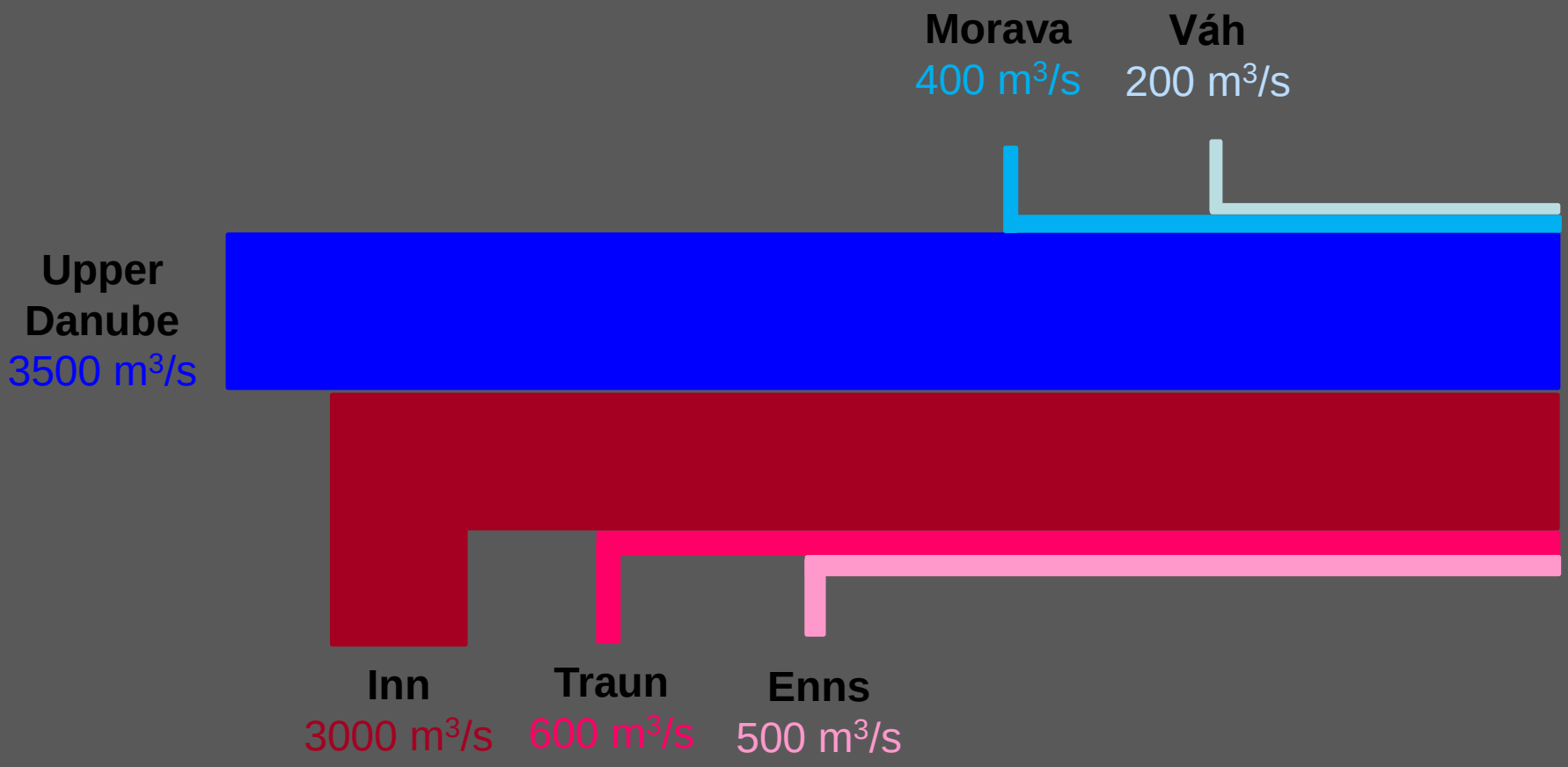
06 June 2013



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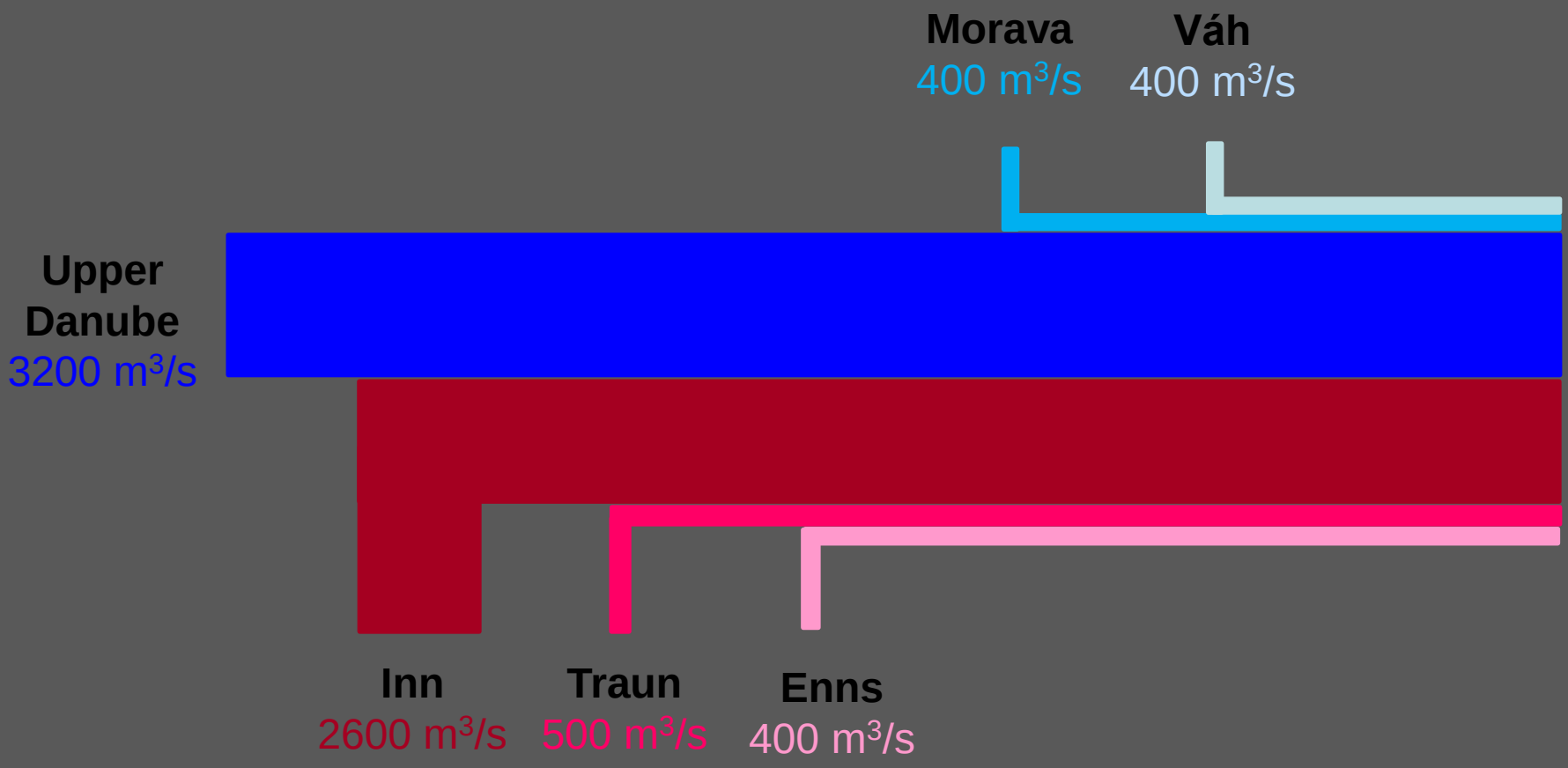
07 June 2013



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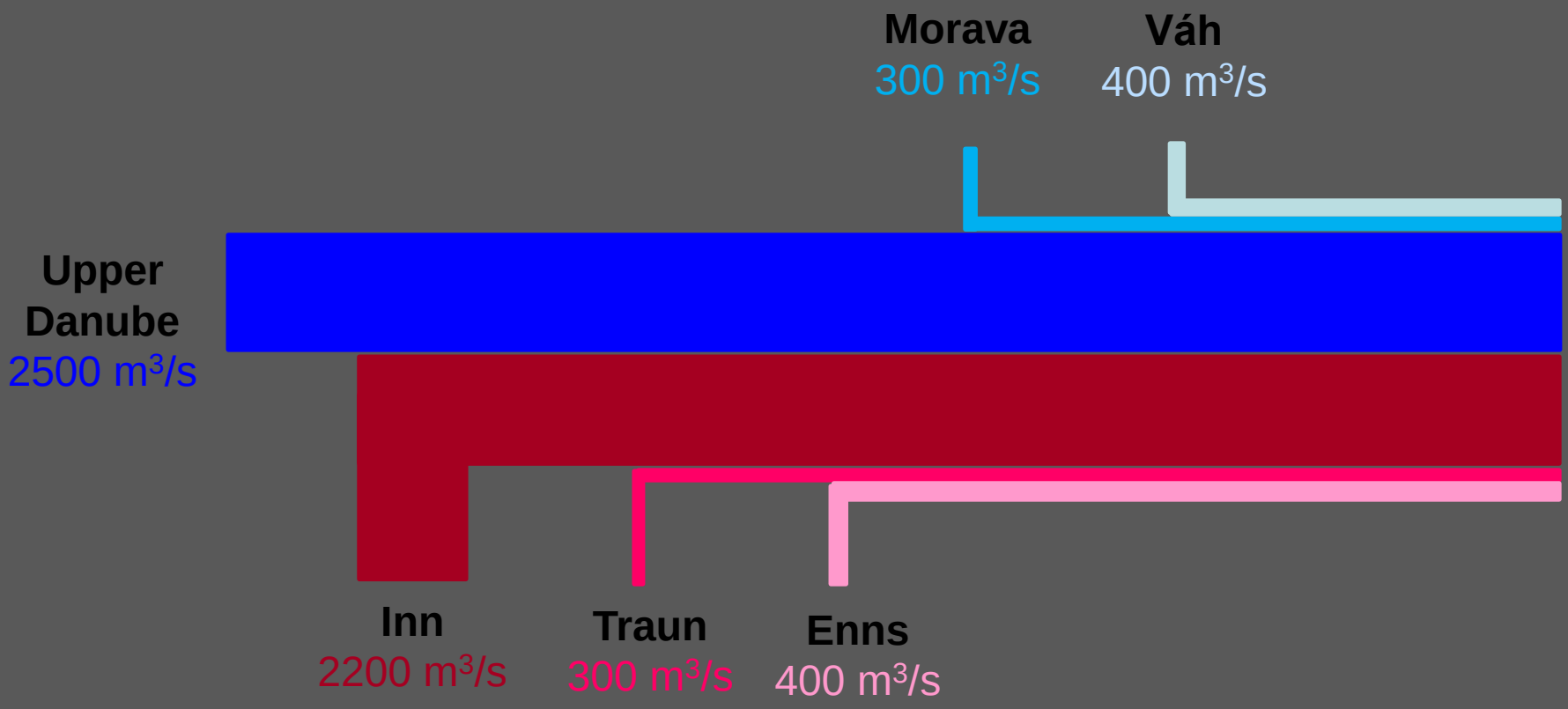
08 June 2013



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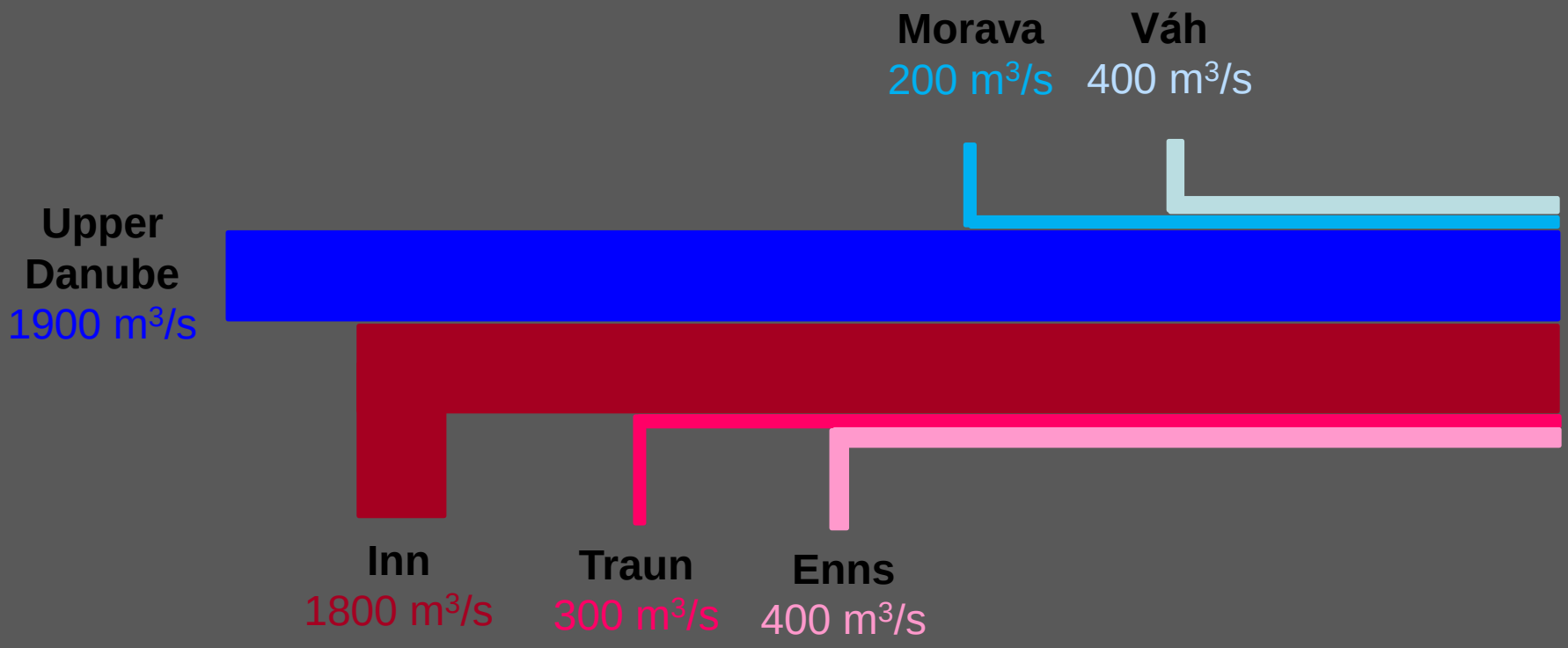
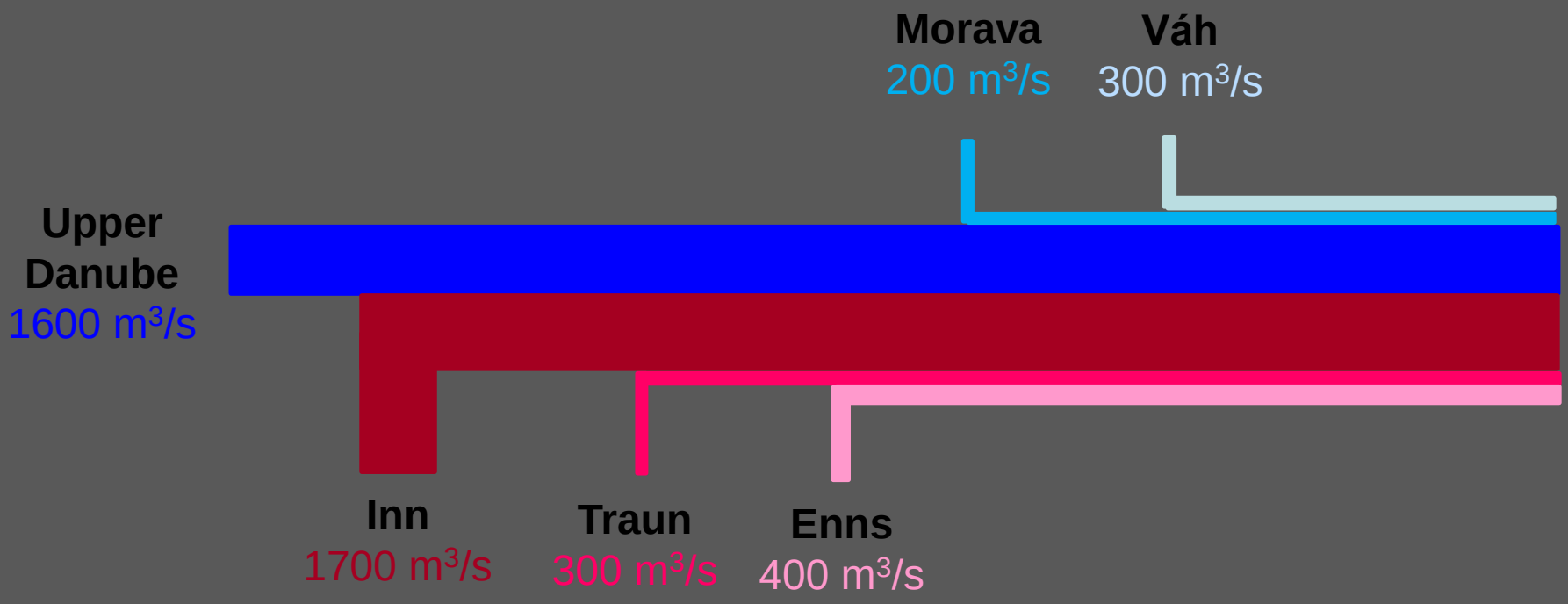
09 June 2013



Budapest, 12 September 2013

10 June 2013



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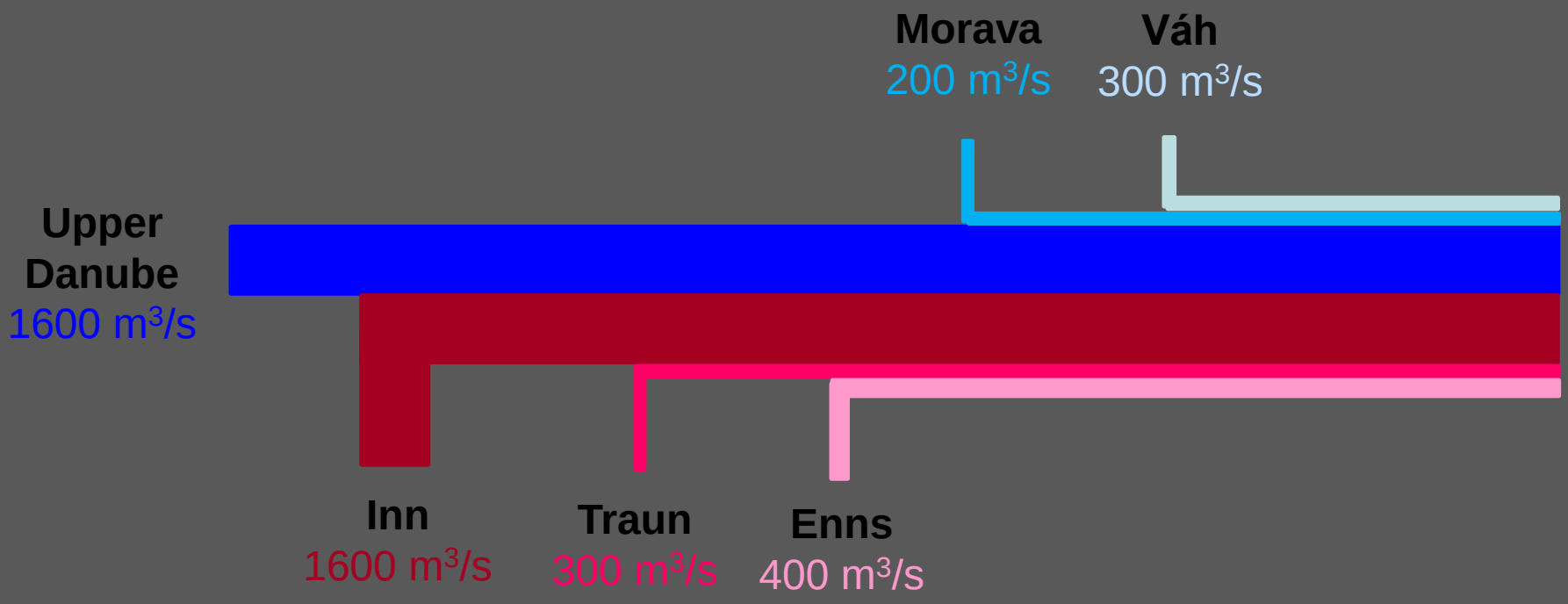
11 June 2013



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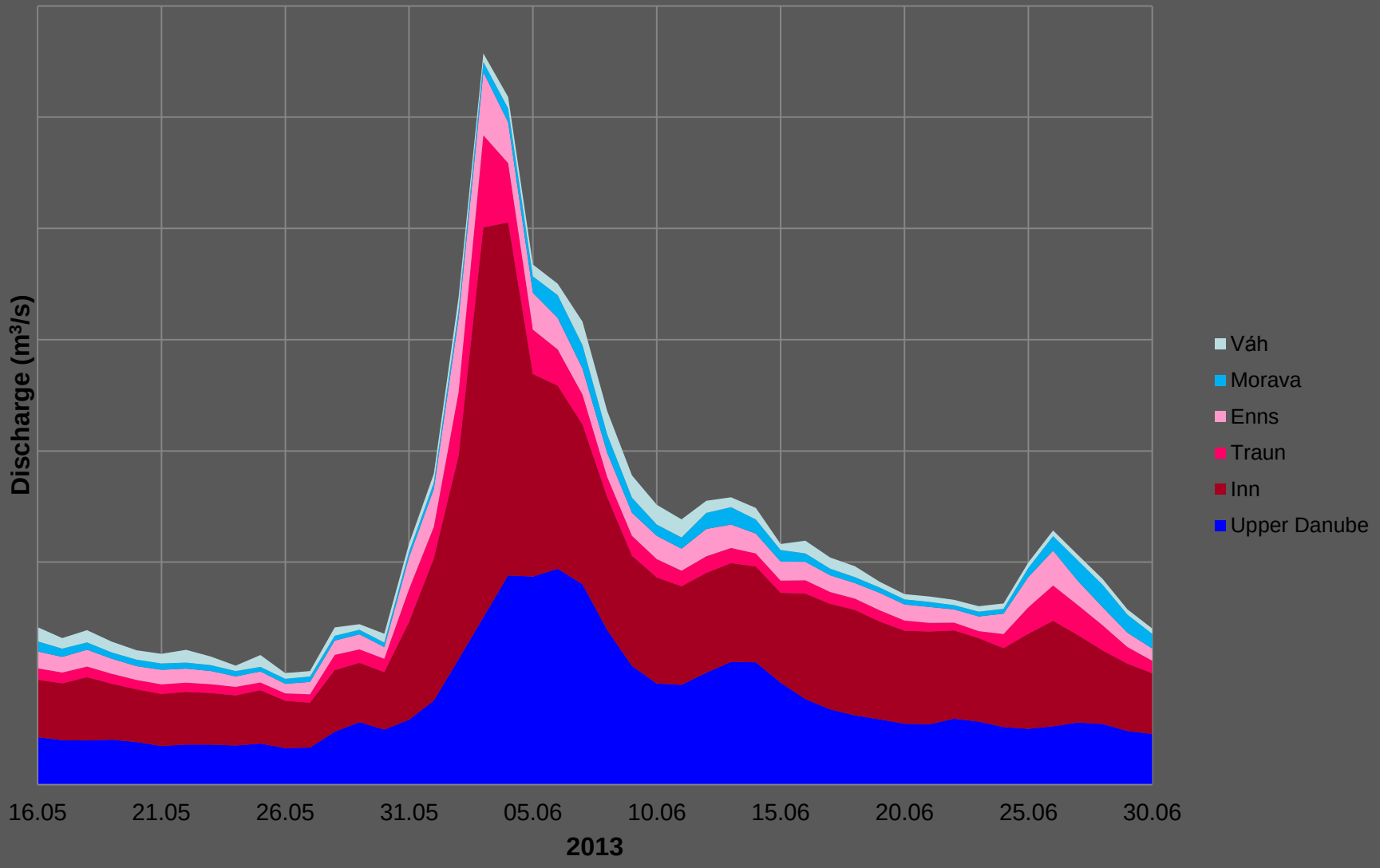
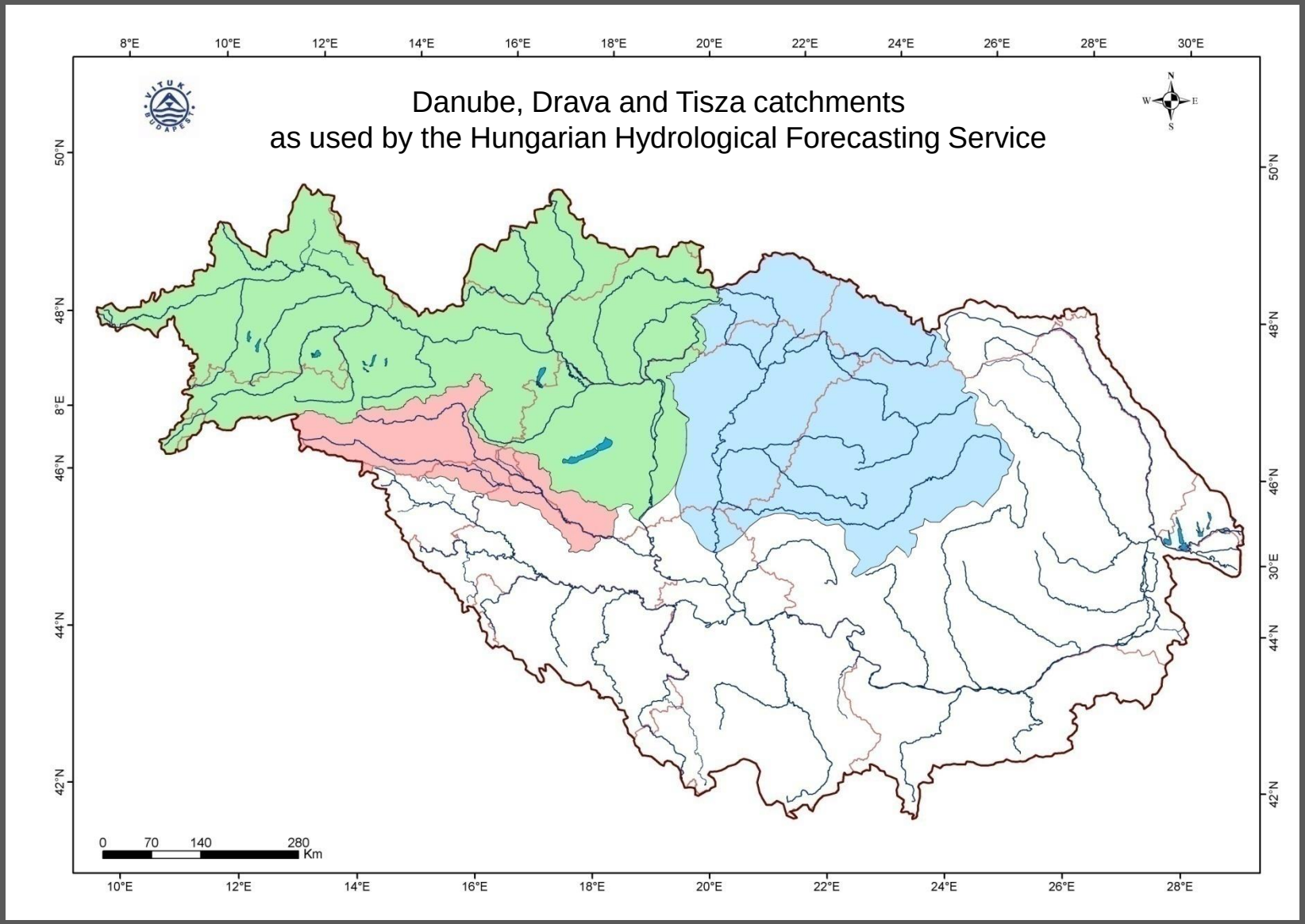
Discharges of the Danube and its tributaries during the flood period in June 2013



Catchments used in the forecasting system of HHFS



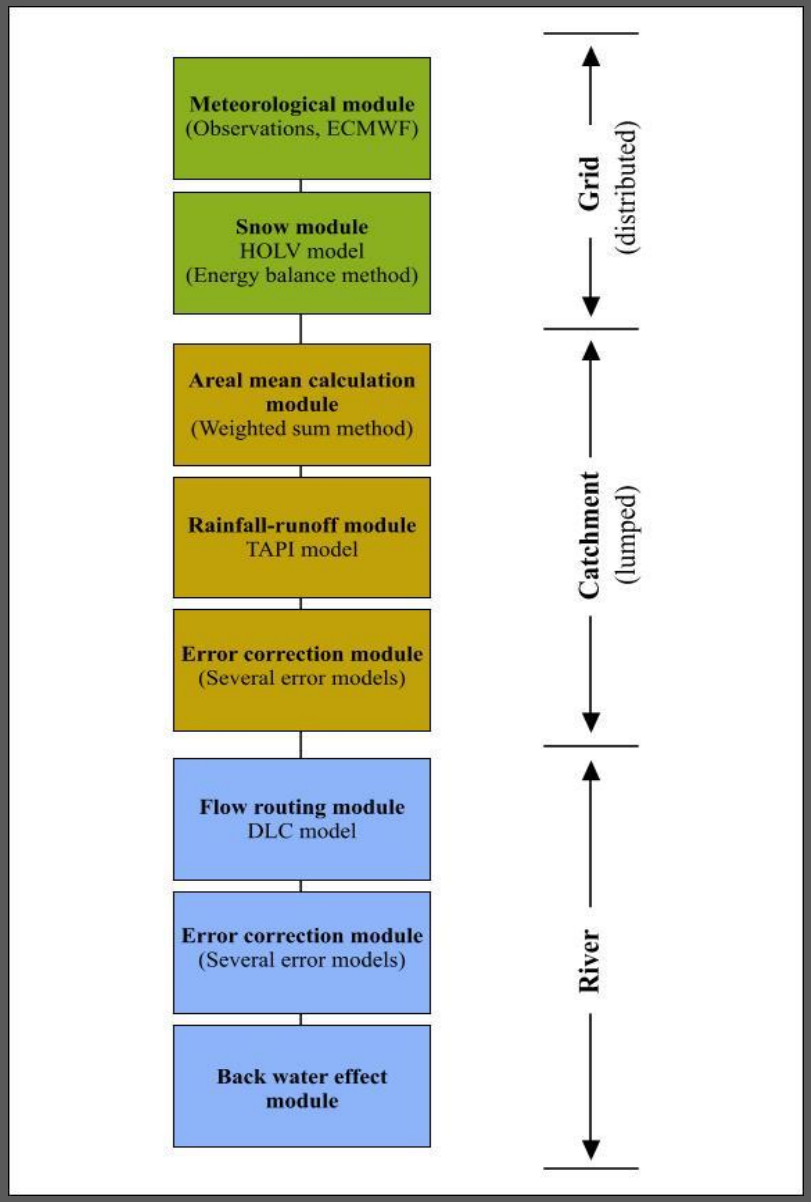
Technical background of the HHFS

Software:

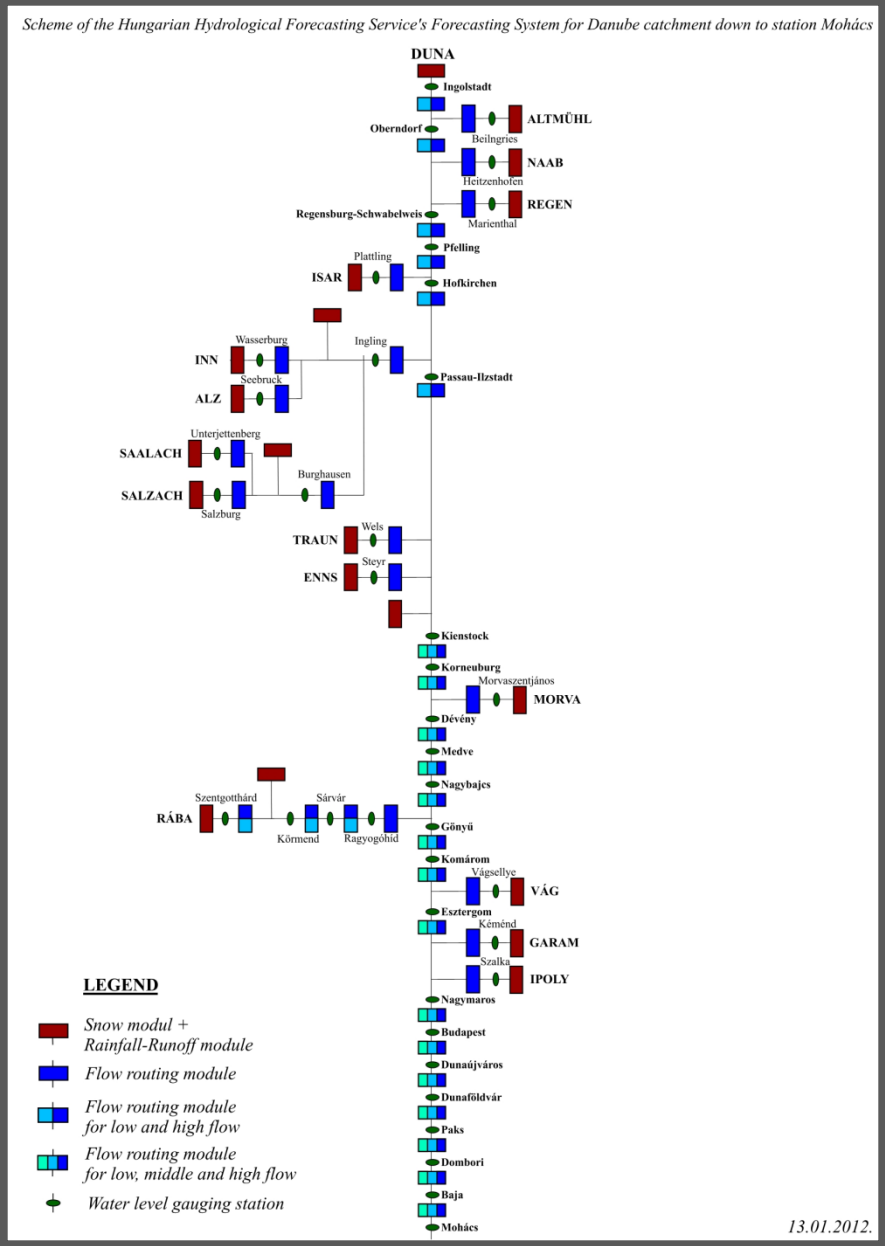
- Self developed software and software packages (almost exclusively)
- Continuous development

Forecasting and modelling system:

- Data processing, error correction, archiving systems and databases
- Operative Runoff Simulation and Forecasting System
- Publications, software for creating forecast products



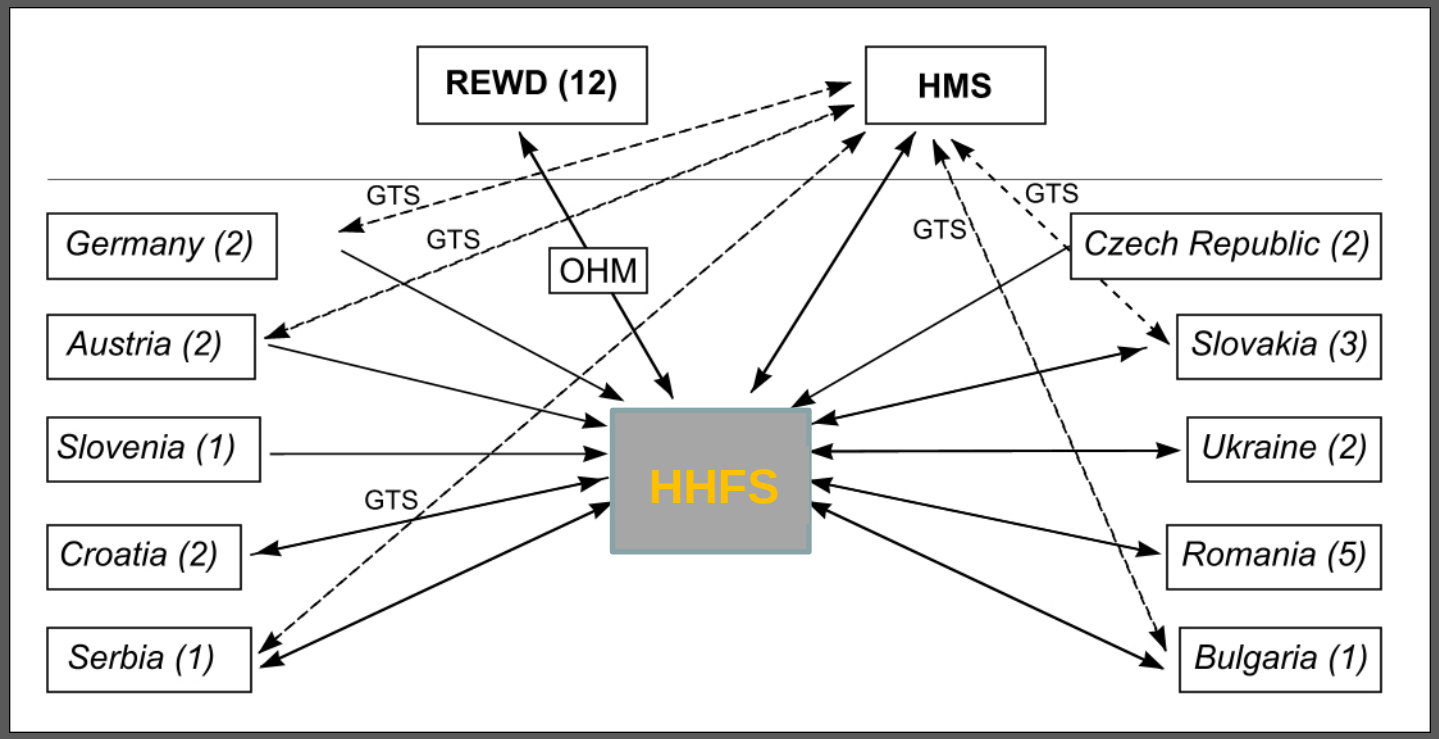
Scheme of the HHFS forecasting system (Danube river)



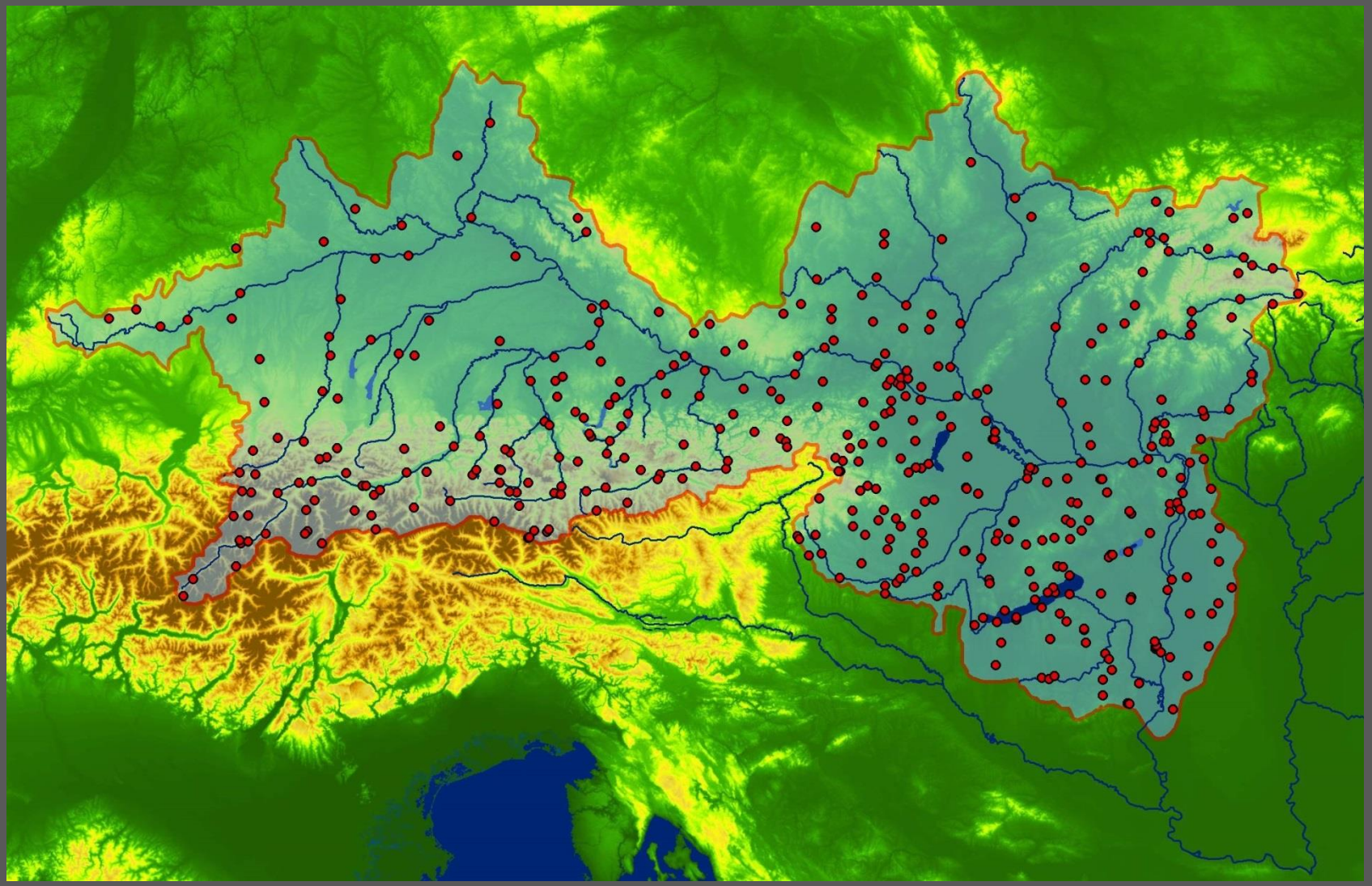
Technical background of the HHFS

Data exchange:

- Operative Hydrological Module – OHM (direct connection)
- Regional Water Directorates – RWD (e-mail, FTP)
- Hungarian Meteorological Service – HMS (e-mail, FTP, GTS)
- International hydrological and meteorological institutions (e-mail, FTP, WMO Global Telecommunication System – GTS)



Meteorological stations on the Danube catchment



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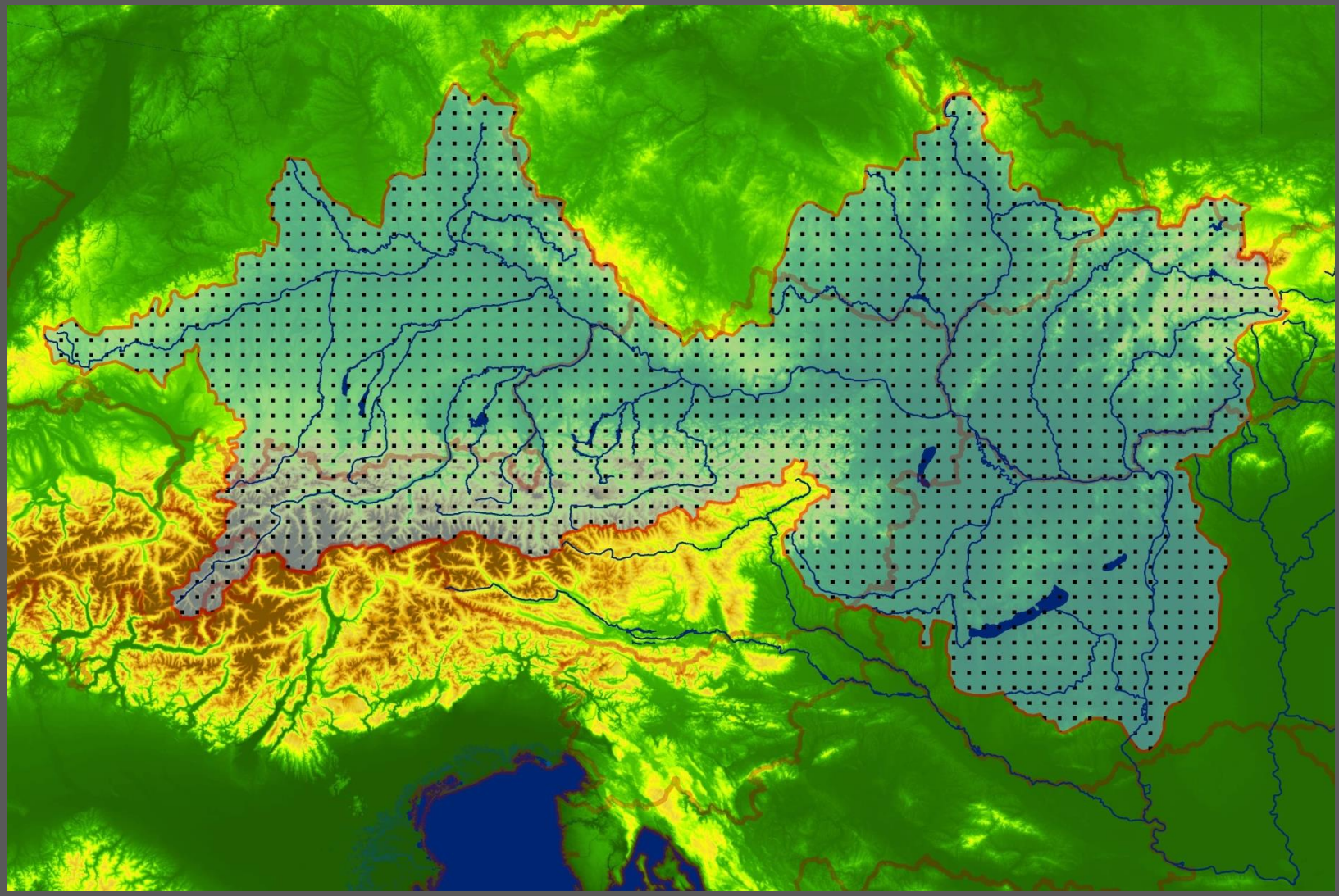
Gridpoints used for calculations on the Danube catchment



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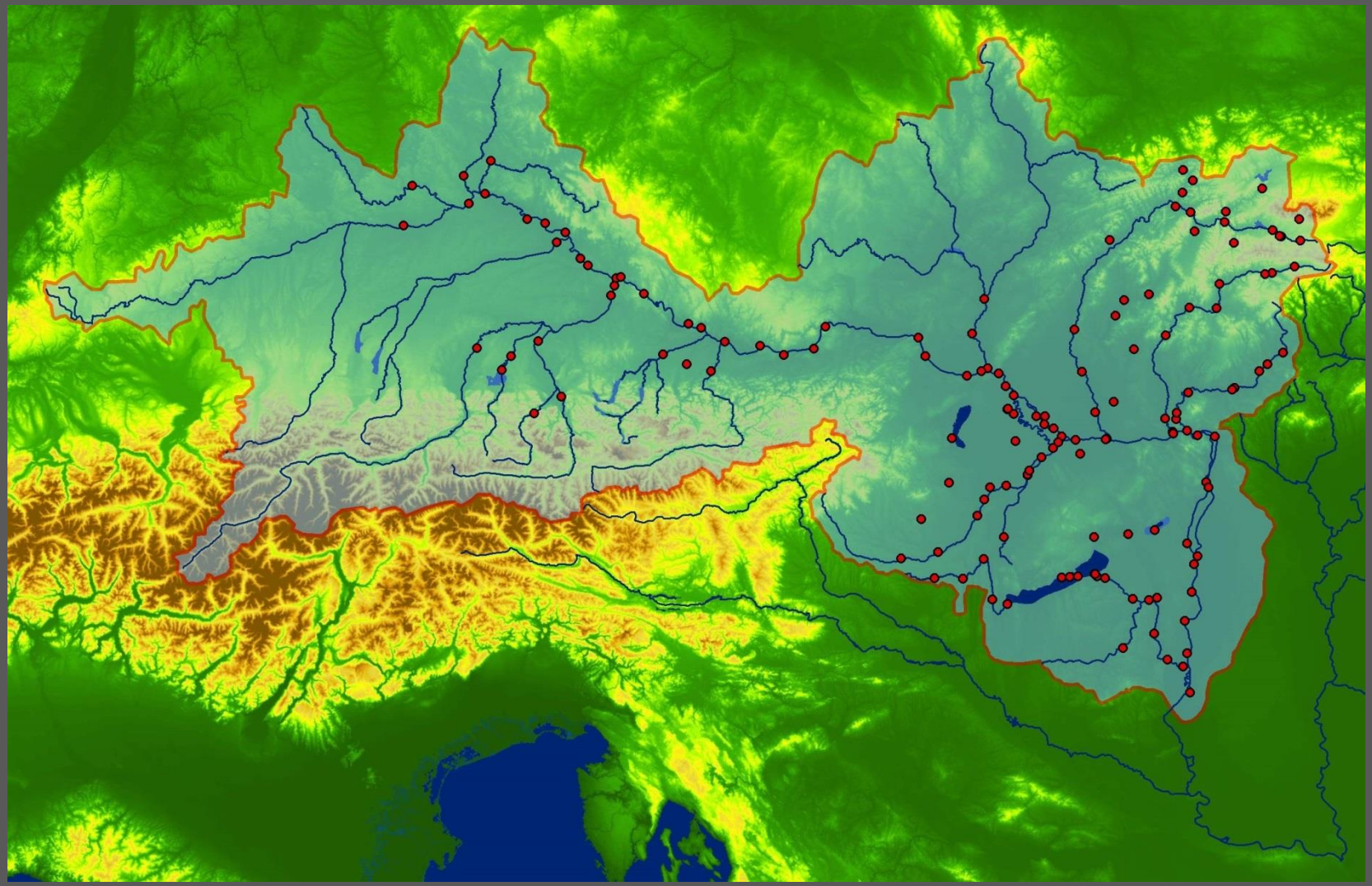
Hydrological stations on the Danube catchment



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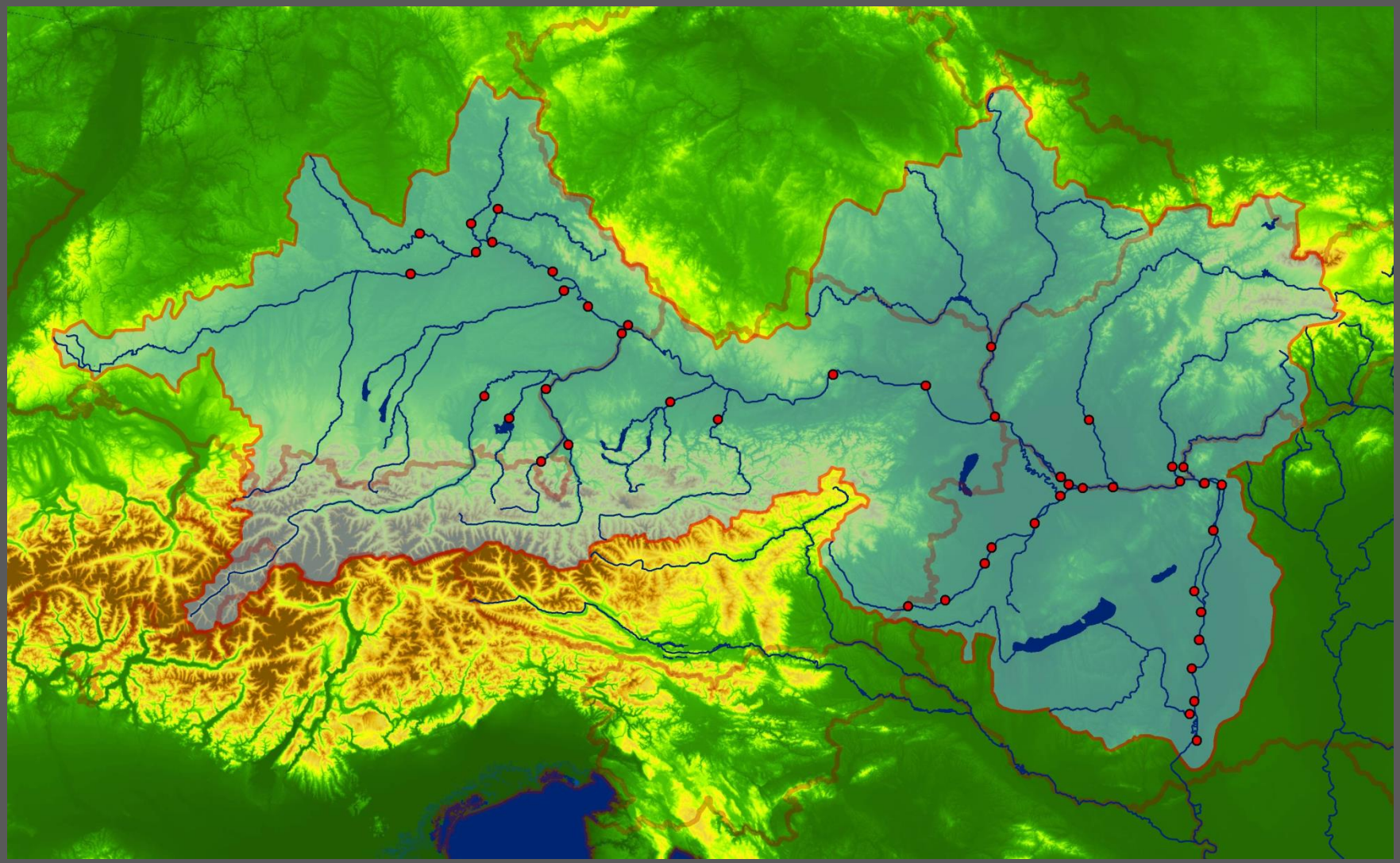
Hydrological forecasting stations on the Danube catchment



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HHFS products

Daily water level and discharge forecast

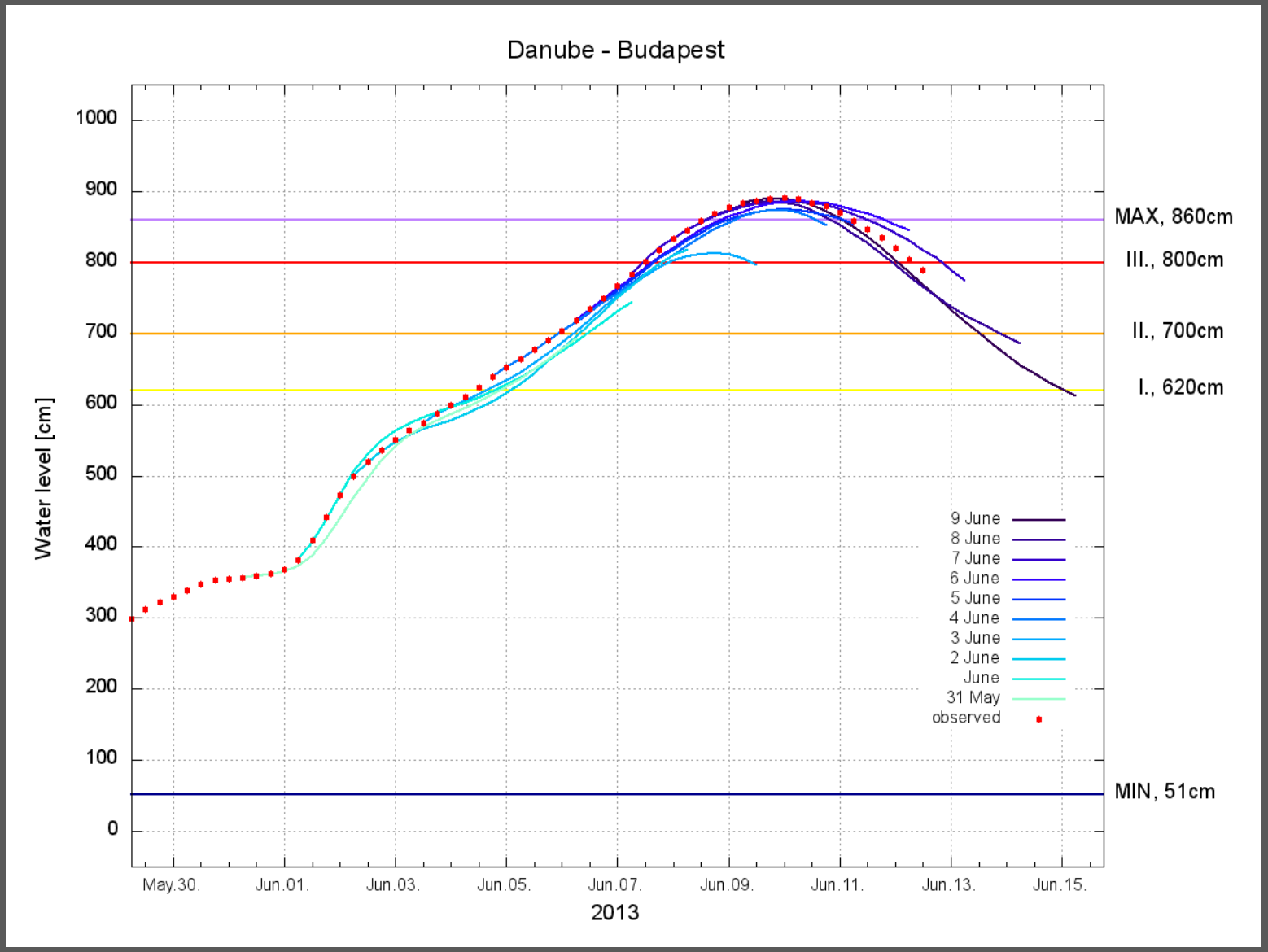
- http://www.hydroinfo.hu

- Number of forecast stations on the Danube in Hungary: **21**

- Forecast lead time (for every station): **144 hours**

- The forecast system is under continuous development
  - Improvement of the accuracy
  - More forecast stations
  - Applying of new methodologies

Hydrological forecasts by HHFS



Hydrological forecasts by HHFS

	Forcasted maximum water level (cm)											Observed maximum water level	
Gauge station	2 June	3 June	4 June	5 June	6 June	7 June	8 June	9 June	10 June	11 June	12 June	Water level (cm)	Date
Nagybajcs	840±20	865±20	890±20	890±20	900±10	910±10	-	-	-	-	-	907	7 June 9.00 pm - 8 June 05.00 am
Komárom	780±25	810±25	820±25	820±25	830±10	840±10	845±5	-	-	-	-	945	8 June 05.00 - 11.00 pm
Esztergom	740±25	775±25	785±25	785±25	795±15	805±10	810±10	-	-	-	-	813	9 June 04.00 - 07.00 am
Nagymaros	685±30	715±30	730±30	730±30	740±15	740±15	740±15	752	-	-	-	751	9 June 01.00 - 04.00 pm
Budapest	830±30	860±30	875±30	875±30	885±20	885±20	885±15	885-895	-	-	-	891	9 June 8.00 pm - 10 June 03.00 am
Dunaújváros	-	-	-	740±30	750±25	750±25	750±20	750±10	742-745	-	-	755	11 June 01.00 am
Dunaföldvár	-	-	-	-	710±25	710±25	710±20	720±10	710±5	721	-	721	11 June 04.00 - 11.00 am
Paks	-	-	-	-	880±30	880±25	880±20	890±15	885±10	895-900	-	891	11 June 07.00 am - 04.00 pm
Dombori	-	-	-	-	-	900±30	900±20	915±15	910±10	920±5	-	916	1 June 6.00 pm - 12 June 03.00 am
Baja	-	-	-	-	-	970±30	970±25	990±20	985±15	995±10	-	989	12 June 05.00 am
Mohács	-	-	-	-	-	-	950±25	965±20	955±15	965±10	958-963		

	RMSE (cm)									
Gauge station	2 June	3 June	4 June	5 June	6 June	7 June	8 June	9 June	10 June	11 June
Nagybajcs	67	42	17	17	7	-3				
Komárom	65	35	25	25	15	5	0			
Esztergom	73	38	28	28	18	8	3			
Nagymaros	66	36	21	21	11	11	11	-1		
Budapest	61	31	16	16	6	6	6	1		
Dunaújváros				15	5	5	5	5	12	
Dunaföldvár					11	11	11	1	11	0
Paks					11	11	11	1	6	-6
Dombori						16	16	1	6	-4
Baja						19	19	-1	4	-6

Lead time (hours)							
192-216	168-192	144-168	96-120	72-96	48-72	24-48	0-24

860±30	The forecast (mean of the confidence interval) exceeds the Highest Water Level (HWL) at first time.
830±30	The max of the confidence interval of the forecast exceeds the Highest Water Level (HWL) at first time.

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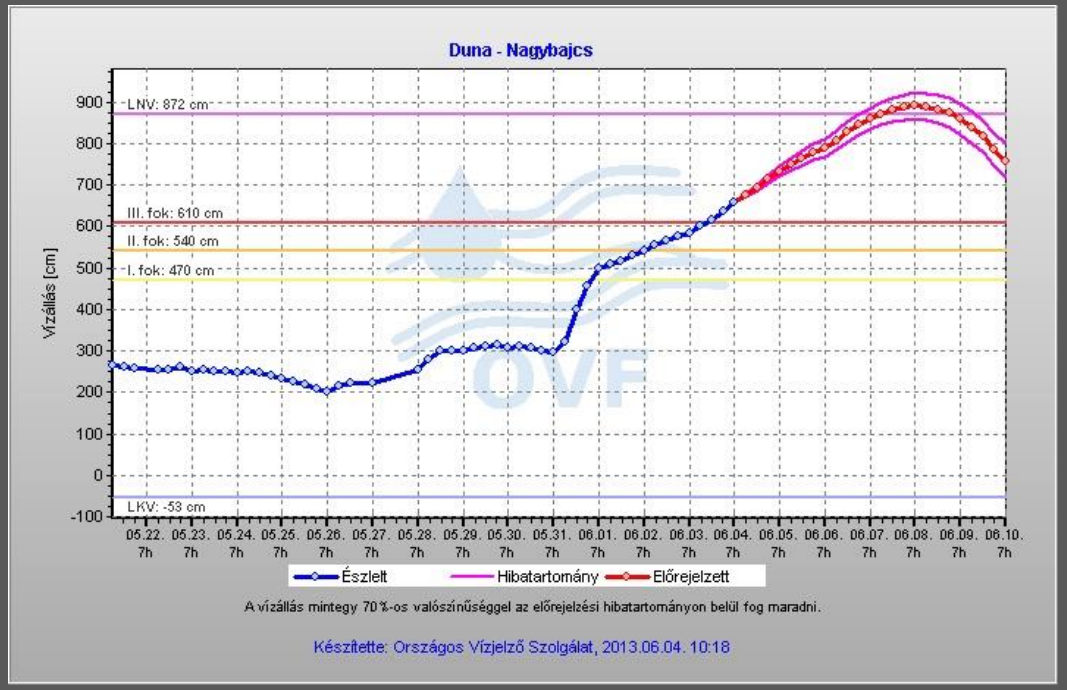
EFAS forecast

EFAS predicts a high probability of flooding for Hungary - Danube (Danube basin) **from Thuesday 4th of June 2013 onwards**.
According to the latest forecasts (2013-06-03 12 UTC) up to **100% EPS** (VAREPS and COSMO) are exceeding the high threshold **(> 5 year simulated return period)** and up to **0% EPS** (VAREPS and COSMO) exceeding the severe threshold **(>20 year simulated return period)**.
Compared to the VAREPS mean, the ECMWF deterministic forecast is comparable and the DWD deterministic forecast is comparable.
The higher resolution COSMO-LEPS forecasts indicate the same risk for flooding than VAREPS.
The **earliest flood peak** is expected for Wednesday **5th of June** 2013.

This message is only an EFAS FLOOD **WATCH** because: less than 48 hours



Water level forecast of HHFS for the 1st gauging station at the same time (on 4th of June)


Thank you for your attention!