

# On the planned use of the NEC Aurora System at CHMI

*Radmila Brožková*

*Numerical Weather Prediction Department*

*CHMI*

# About Czech Hydrometeorological Institute (CHMI)

- **Mission** – to provide high level professional data, information and services in the fields of:
  - Meteorology;
  - Climatology;
  - Hydrology and water quality;
  - Air quality.
- **CHMI** is part of the critical infrastructure of the state.
- Since 2025: new Act on the hydrometeorological service; ensuring among other the principle of “single voice” for alerts.



*CHMI headquarters at Prague*

# Climate change brings other type of weather

The Sixth Assessment Report (AR6) of the United Nations (UN) (AR6 Physical Science Basis - 2021):

- Extreme weather is becoming more frequent and more severe
- Heat waves have occurred more frequently and become more intense since 1950
- Extreme rainfall has become heavier and more frequent since the 1950s. Globally, heavy rain will increase by 7% in intensity per 1°C warming
- The probability of coincident events increases - Storm surge and heavy rainfall cause flooding; heat, drought and wind create a risk of forest fires



***Meteorological phenomena for which the society is not ready and having low predictability become more frequent.***

# Floods in Central Europe, storm Boris, September 2024



*Flooded main railway station in Ostrava, Czech Republic*

# Motivation to move to higher resolution in NWP

There is a trend to go toward hecto-metric scales in the regional models;

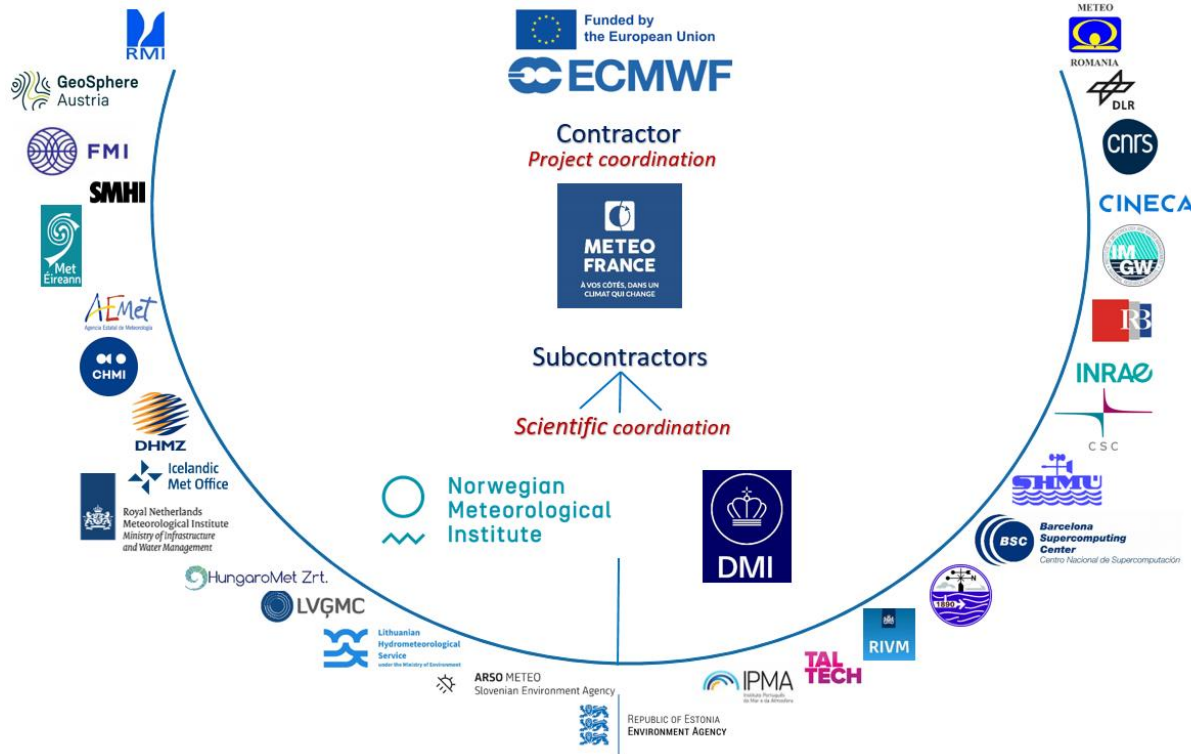
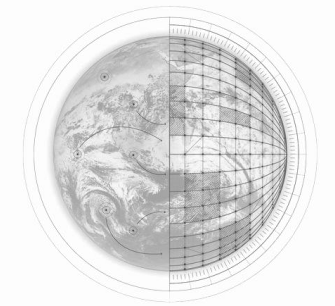
There is the European Initiative named “**DESTINation Earth (DESTINE)**” financed by the EC

- Build up of the so-called Digital Twins of the Earth for extreme weather and climate;
- The three institutions to steer the initiative: ECMWF, EUMETSAT and ESA.

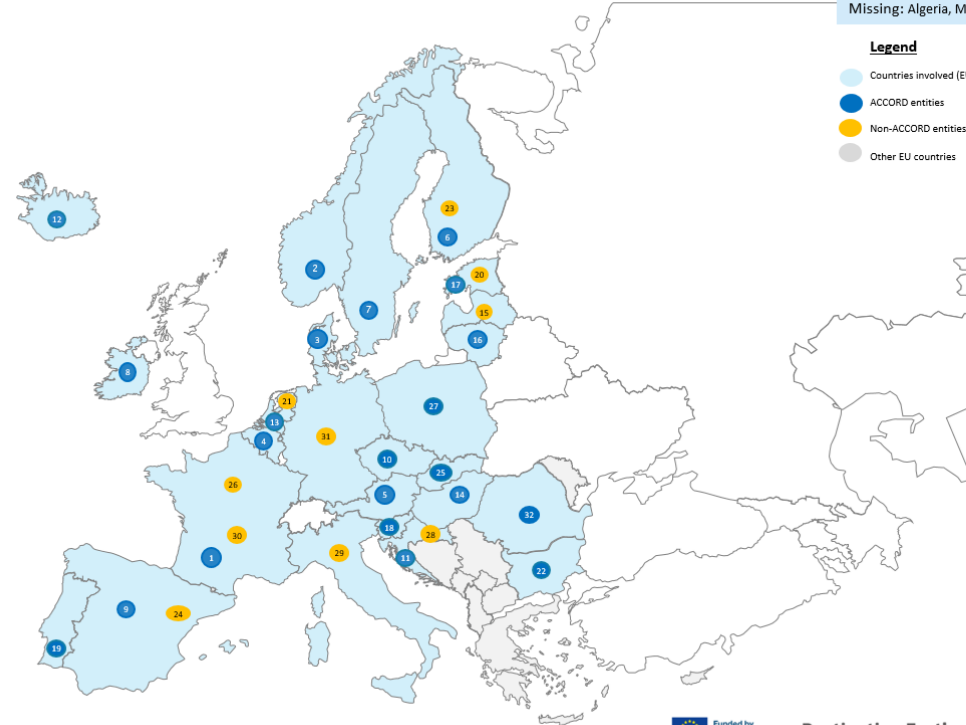
## **Involvement of CHMI:**

- Project named DE\_330\_MF to have the so-called “on demand very high resolution runs” ;
- Typically it is a 500 m resolution in a simple forecast mode coupled to the global Digital Twin.

# DE\_330\_MF consortium



## Entities involved in DE\_330



22 out of 26 ACCORD entities involved in DE\_330  
Missing: Algeria, Morocco, Tunisia, Turkey

- Legend**
- Light blue: Countries involved (EU and/or DEP)
  - Dark blue: ACCORD entities
  - Yellow: Non-ACCORD entities
  - Grey: Other EU countries

1	Météo-France	FR
2	Met Norway	NO
3	DMI	DK
4	KMI-IRM	BE
5	GeoSphere Austria	AT
6	FMI	FI
7	SMHI	SE
8	Met Éireann	IE
9	AEMET	ES
10	CHMI	CZ
11	DHMZ	HR
12	IMO	IS
13	KNMI	NL
14	OMSZ	HU
15	LEGMC	LV
16	LHMS	LT
17	ESTEA	EE
18	ARSO	SI
19	IPMA	PT
20	TalTech	EE
21	RIVM	NL
22	NIMH	BG
23	CSC	FI
24	BSC	ES
25	SHMU	SK
26	INRAE	FR
27	IMGW	PL
28	IRB	HR
29	CINECA	IT
30	CNRS	FR
31	DLR	DE
32	NMA	RO

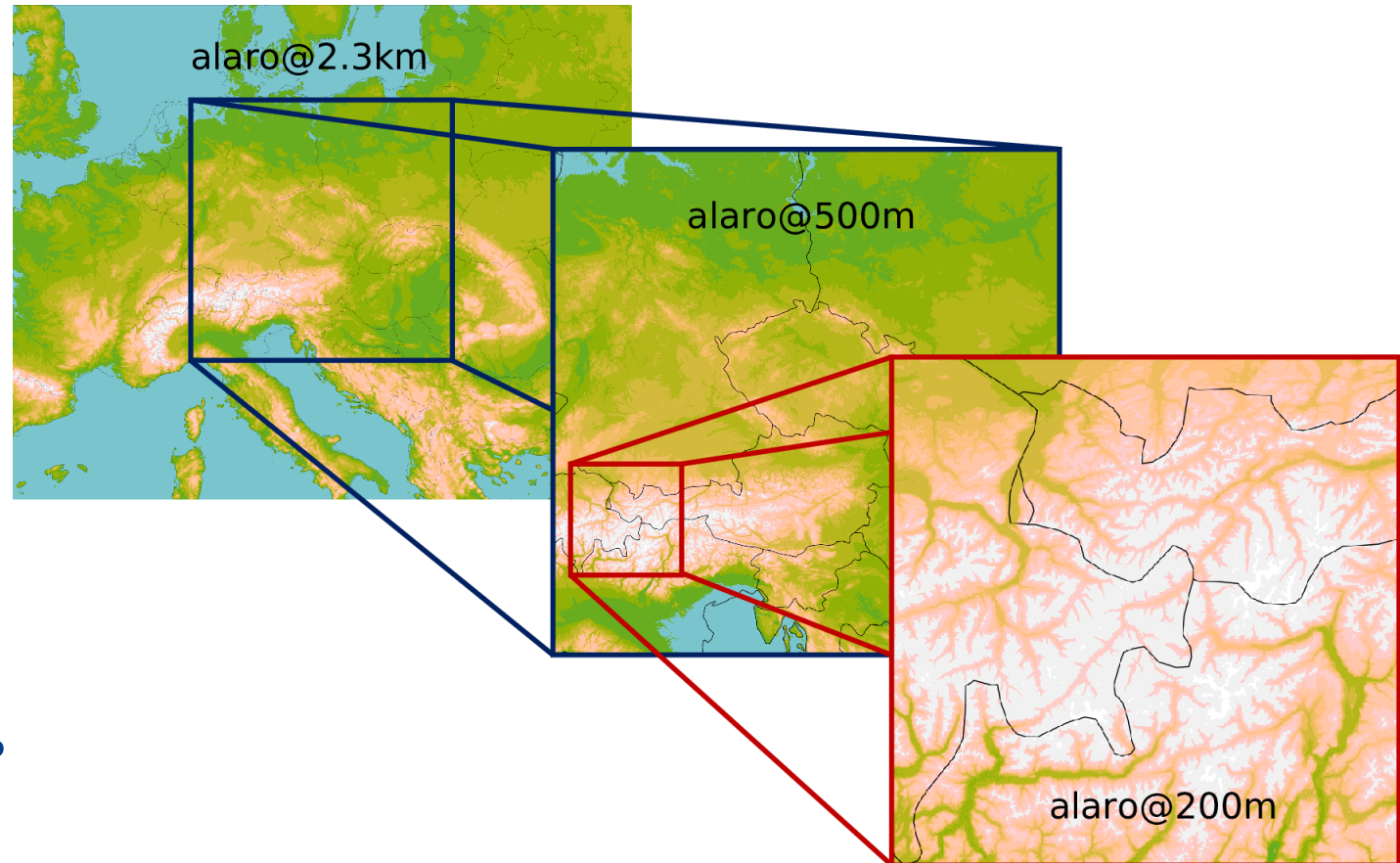
Funded by the European Union Destination Earth implemented by ECMWF esa EUMETSAT



Funded by the European Union

# The idea of the on demand high resolution runs

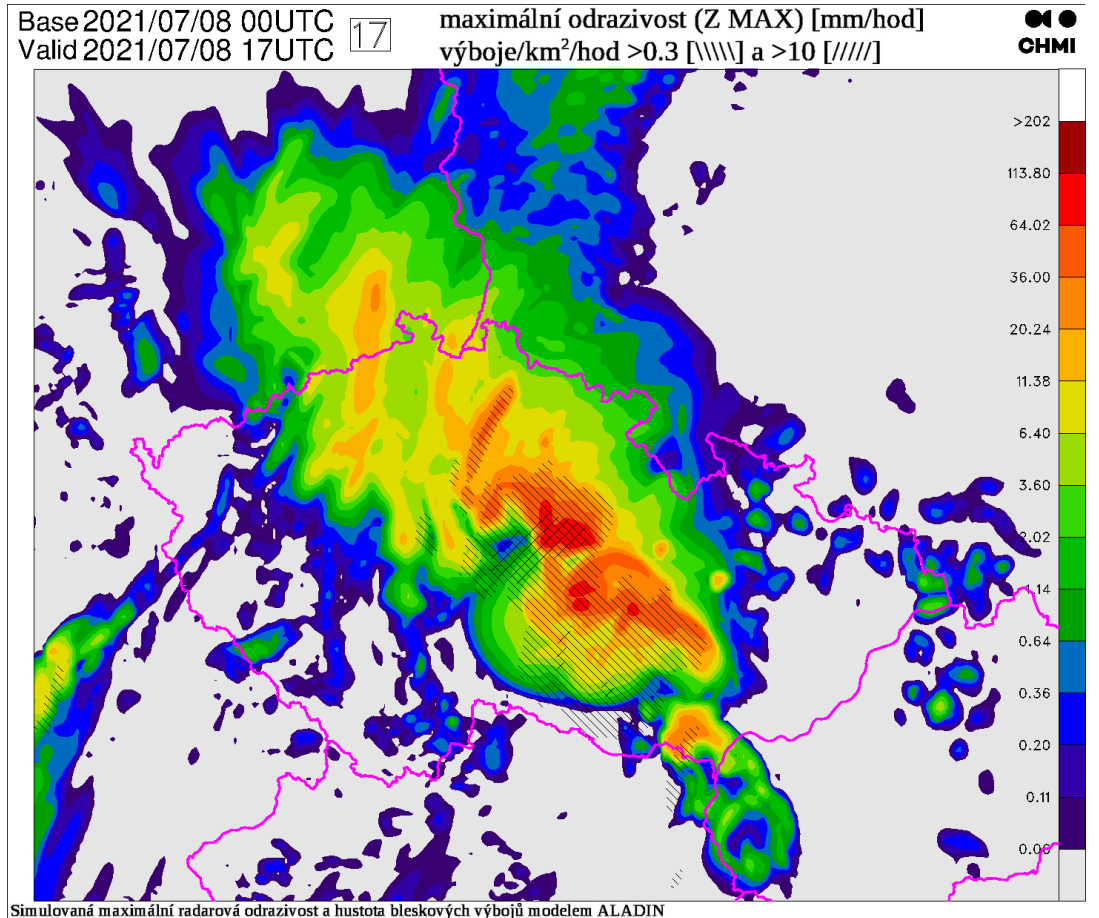
- All Digital Twins should use the EuroHPC compute clusters;
- These are however mostly equipped by GPUs: despite the recent re-factorization of our codes the performances are not competitive;
- There is no priority for time-critical jobs and availability is not ensured;
- *Therefore runs of Digital Twins are realized mostly on the classical NWP devoted clusters.*



# Project of the HPC renewal at CHMI (1)

## Goals:

- Replacing the aging cluster;
- Increasing compute performance in the limits of the electricity power and budget;
- Use of more compute power to go to higher resolution (hectometric scales);
- Focus on high impact weather.



*Example of model forecast of radar reflectivity and lightning density.*

# Project of the HPC renewal at CHMI (2)

## Time-line:

- 2023 – preparation of the project to renew the old cluster based on the standard CPUs.
- 2024 spring – Invitation to Tender;
- 2024 – selection of the new system;
- **2025 (current)** – dismantling the old system, installation and operational service.



*Old cluster with 320 compute nodes based on Intel CPUs, operational in 2018*

# Meanwhile - Current operational equipment at CHMI

**Mainly for climate, now a temporary host for NWP**

- The NEC-SX Aurora Tsubasa
- 48 compute nodes
- 384 vector engines 20B
- 2Pb shared storage



# Selection procedure

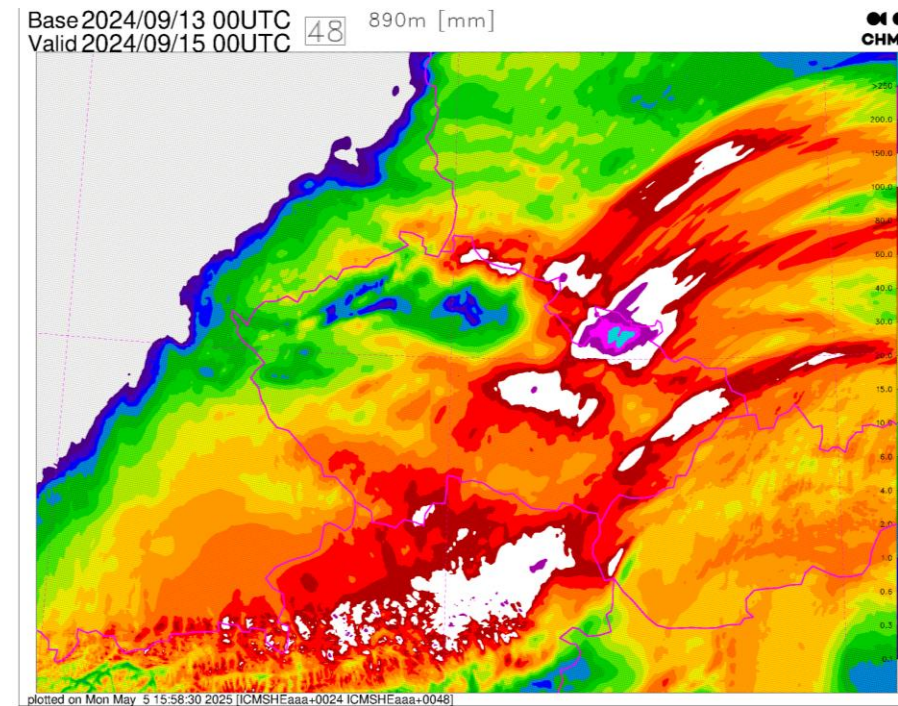
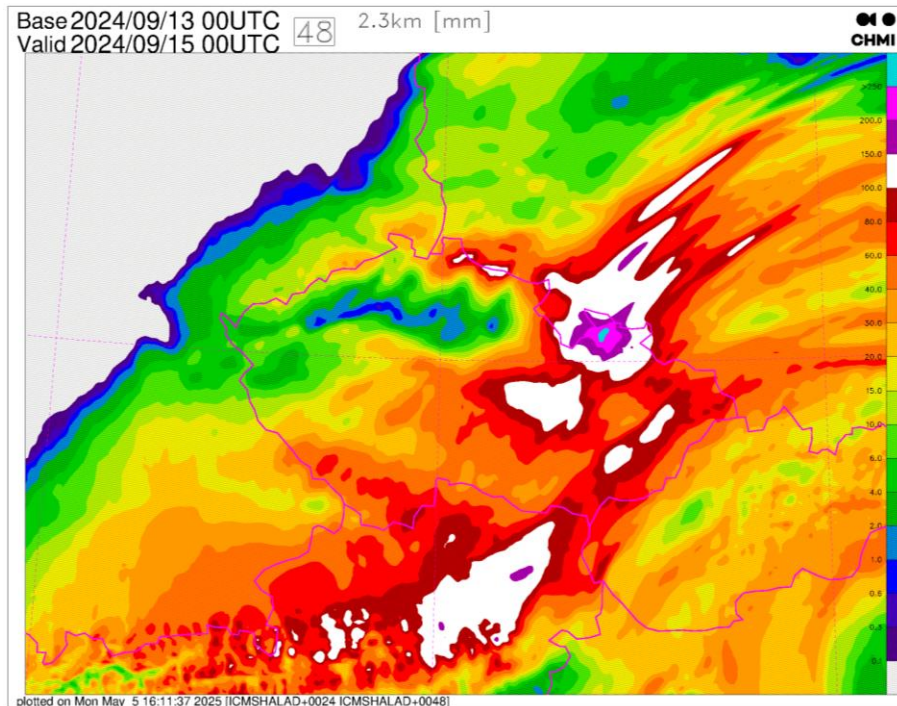
**Based on the benchmark of the forecast model ALADIN & infrastructure limitations (power, cooling)**

- 24h forecast completed till 1800 s; with a gain factor calculated in function of number of the forecast job copies completed within an hour.
- Model configuration:  $dx=890$  m (1536 x 1250 points) & linear truncation, 87 levels,  $dt=36$  s, ALARO physics;
- Infrastructure power limitation: 110 KW for the compute part.

# Selected system (now under installation)

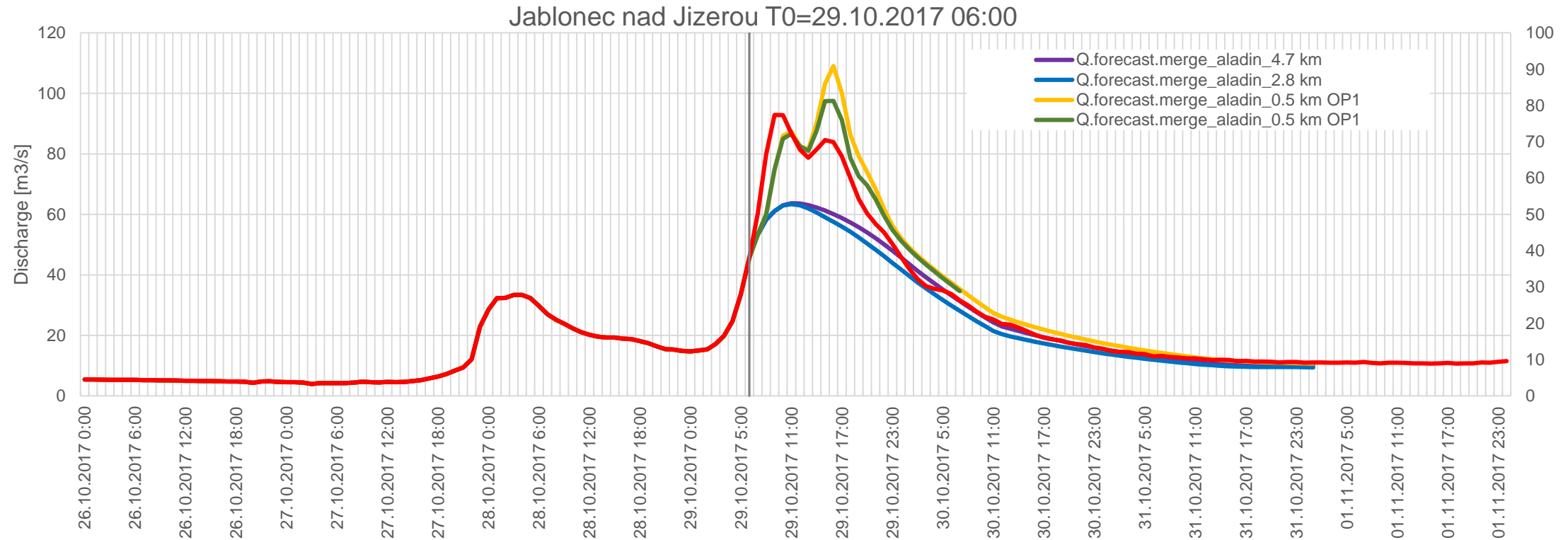
- The NEC-SX Aurora Tsubasa
- 56 compute nodes, vector engines 20B
- 2.4 Pb shared storage for works, with 100 TB of SSD
- Committed performance: 5 times than the previous CPU cluster
- Based on the experience with the current Aurora cluster, we expect less than 80 KW power consumption when used for our codes.

# Meteorological quality goals – the storm Boris



*24 hour precipitation accumulation forecast from the analysis 2024-09-13 at 00 UTC, forecast ranges from +24 to +48 h. Left: operational forecast at 2.3 km, right: experiment at 890 m.*

# Meteorological quality – impact on hydrology, storm Herwart



*Discharge flow forecast of the Jizera river at the town Jablonec nad Jizerou. Hydrological model is coupled with the model ALADIN having various resolution. Comparison w.r.t. observations clearly shows added value of the ALADIN versions with 500 m resolution.*


# Short summary

- High resolution runs clearly show the added value when tested for the cases of recent important flood events;
- Real time operational forecast need a dedicated HPC platform;
- The configuration of the ALADIN model that we shall exploit on the new NEC-SX Aurora cluster is still under discussions.

# Thank you for your attention

*Radmila Brožková*

✉ *radmila.brozkova@chmi.cz*

  
Czech  
Hydrometeorological  
Institute