Use case success stories: from forecasts to impacts

Estíbaliz Gascón

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

ECMWF

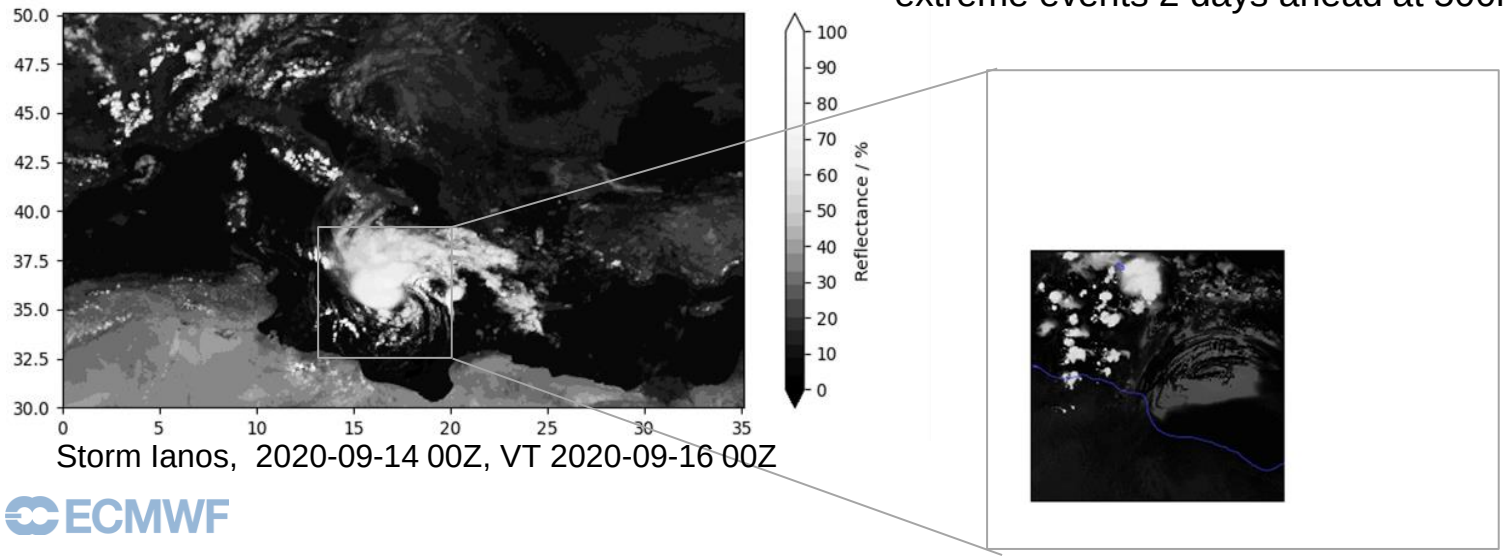
DETECTION / TRIGGERING

Medicane Ianos is approaching. What will be the state of rivers in 48 hours?

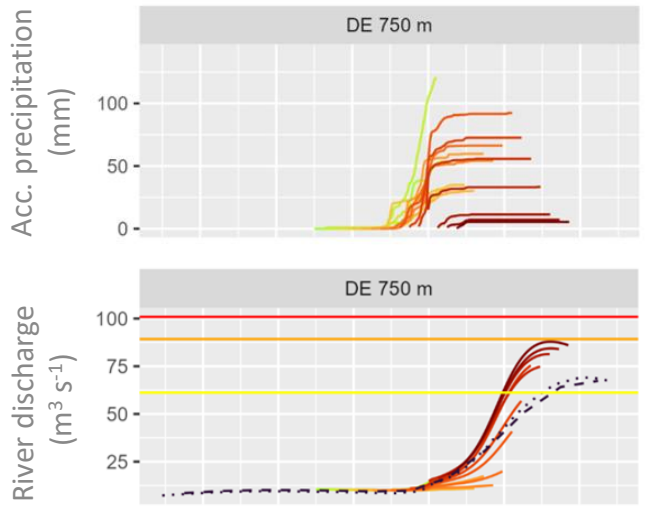
Daily and global monitoring of extreme events 4 days ahead at 4.4km

On-Demand regional forecasts of extreme events 2 days ahead at 500m

Impact-sector models:
Forecast evaluation for societal impacts



Storm Ianos, 2020-09-14 00Z, VT 2020-09-16 00Z



early ini

late ini

ECMWF

1. End-to-end demonstration : predicting wind power during storm Eunice

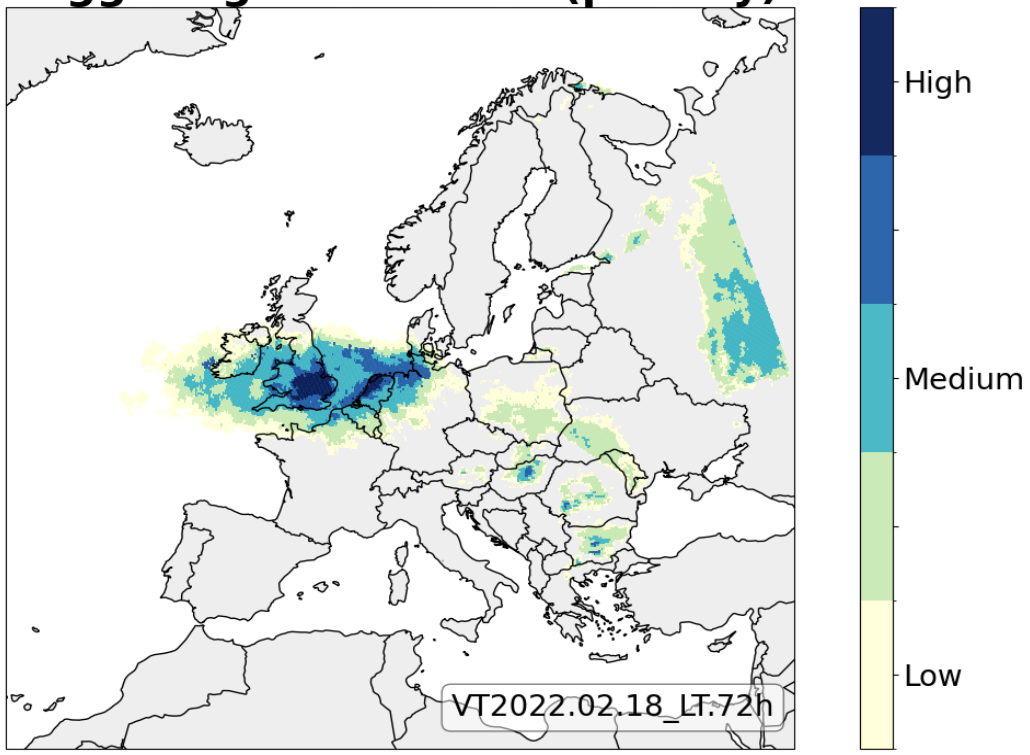
Feb 6th, 2022 : Belgian offshore wind farms generated 94,400 MWh and set a record!

Feb 18th 2022 : Storm Eunice, one of the strongest in 30 years, led to good production but not as good as the mark set a few days before… why?

… this situation was successfully predicted by the prototype Extremes DT!

1. End-to-end demonstration : predicting wind power during storm Eunice

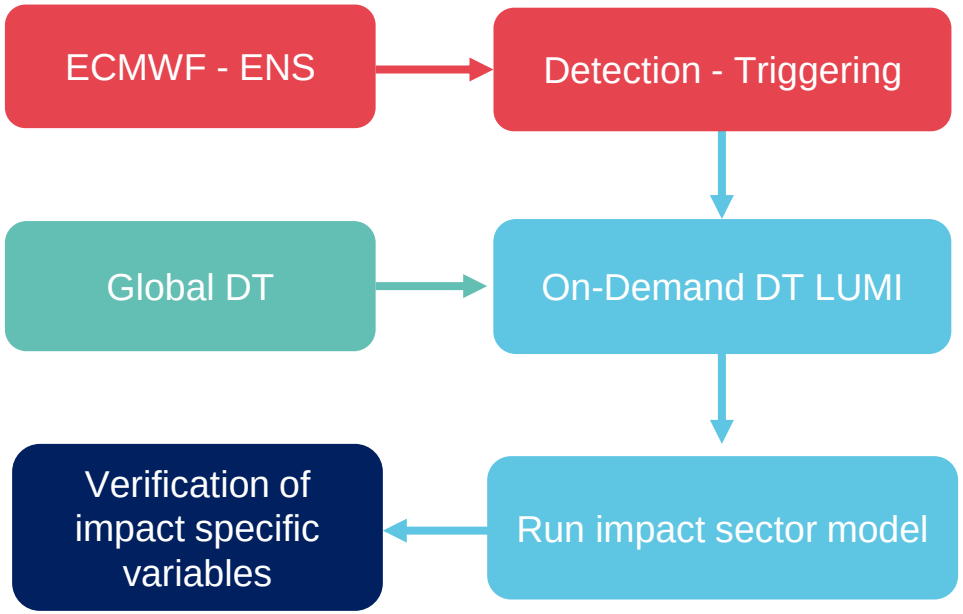
Triggering information (priority)



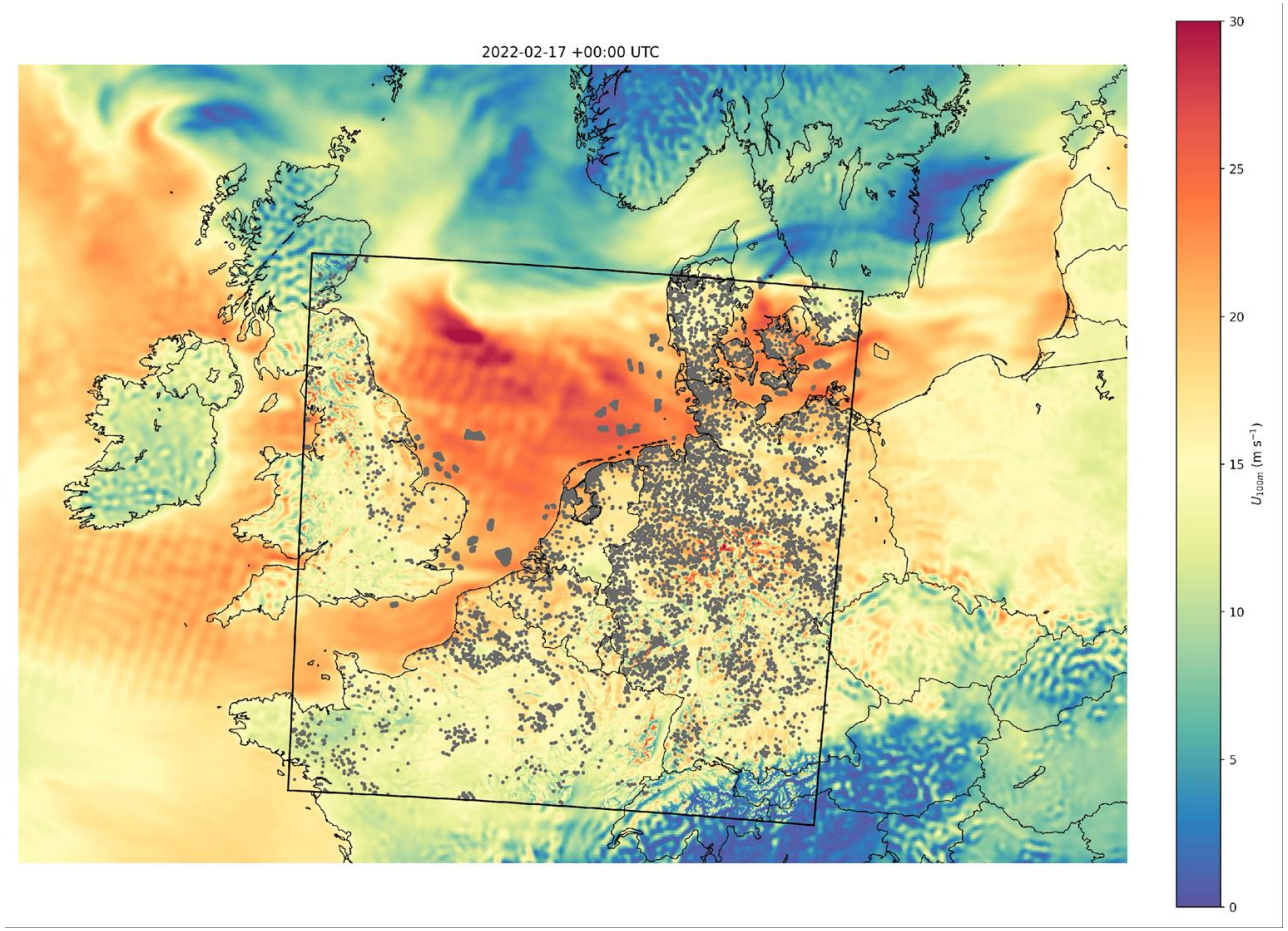
10m day max wind gust,
Base time 2022-02-16 00Z
VT 2022-02-18 (Step 48-72)

Every day **extreme detection diagnostics**. Alerts for :

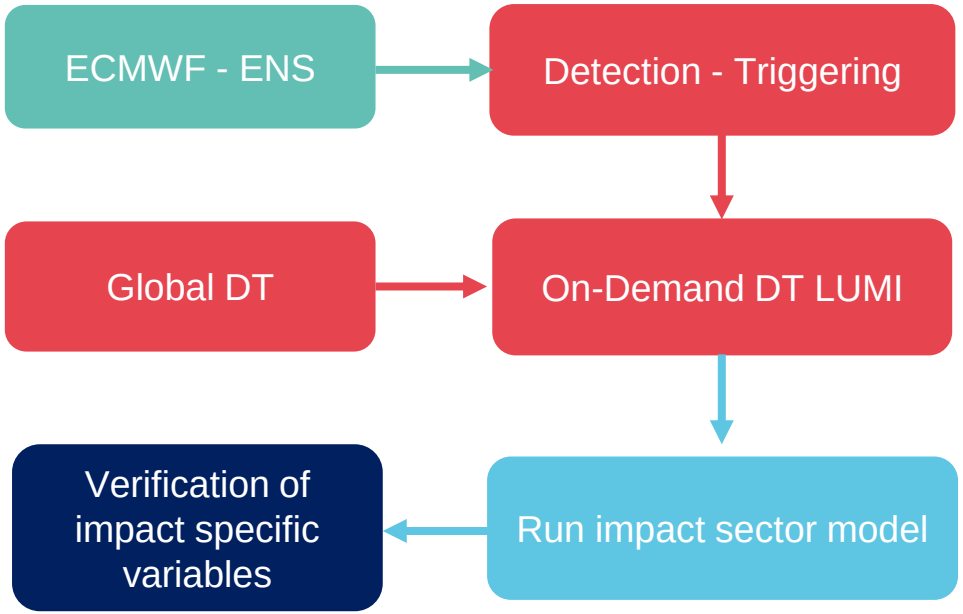
- total precipitation
- CAPE shear
- 10m-wind gust



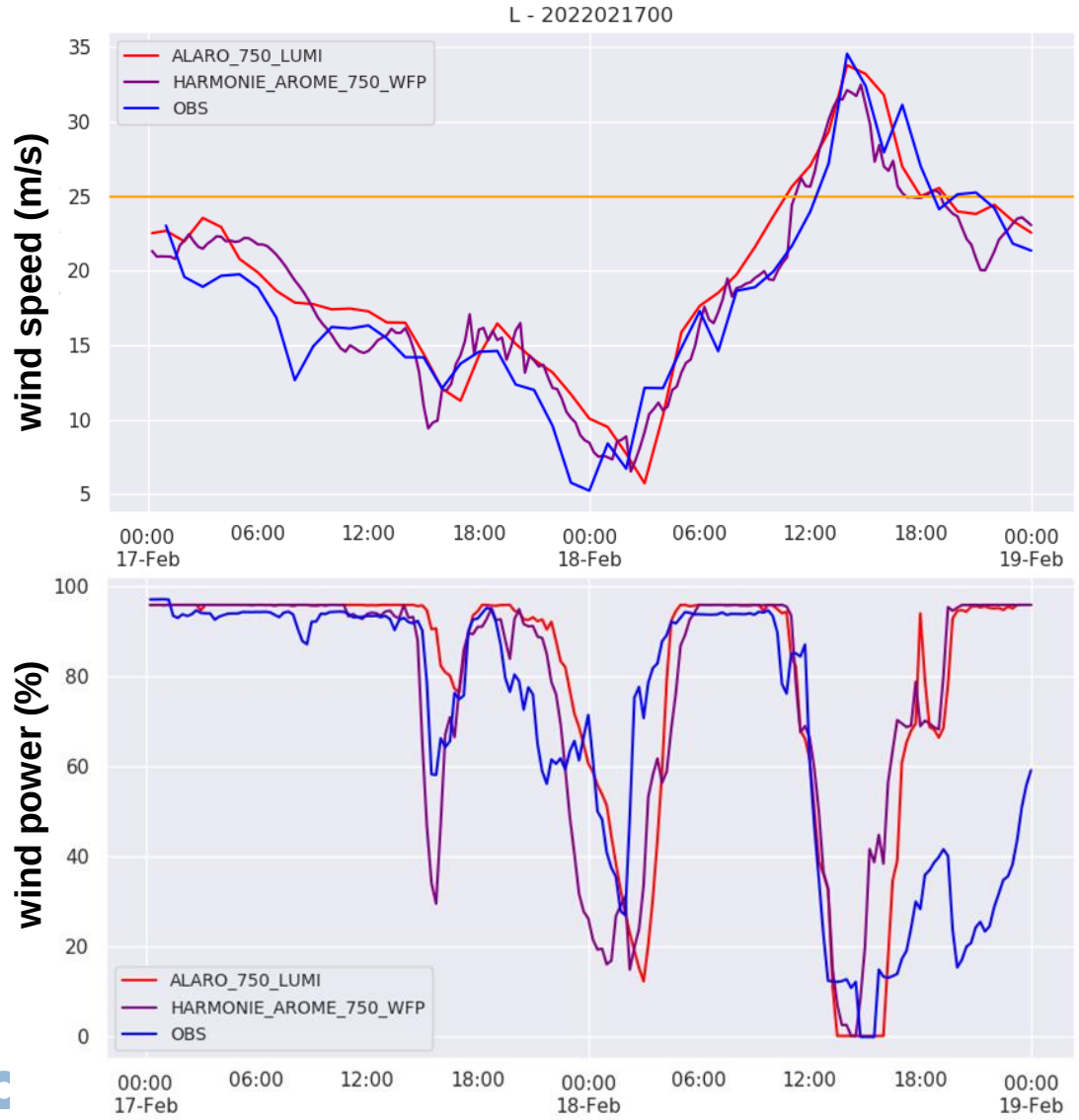
1. End-to-end demonstration : predicting wind power during storm Eunice



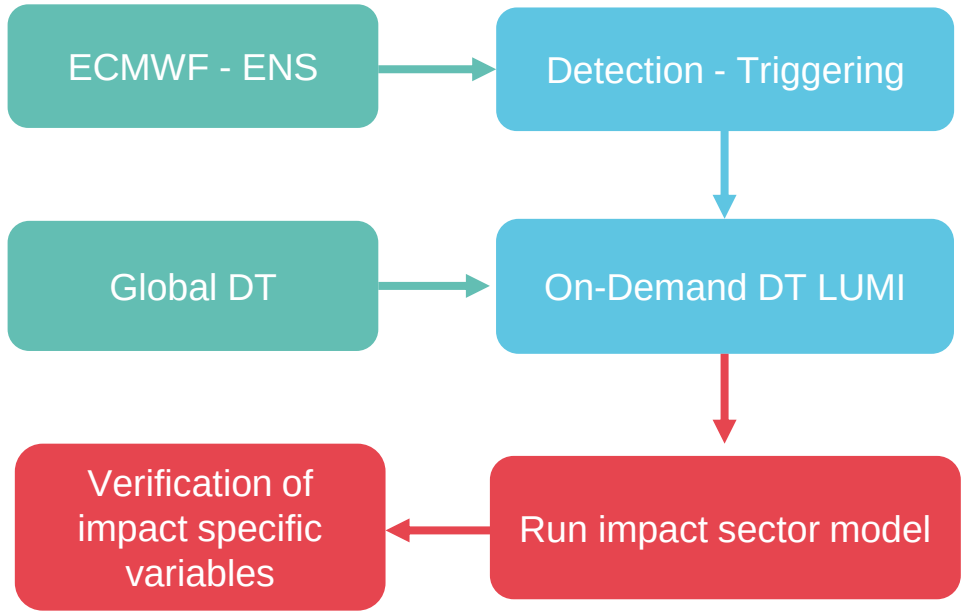
100m wind speed
Base time 2022-02-17 00Z
lead time T+0 to T+48



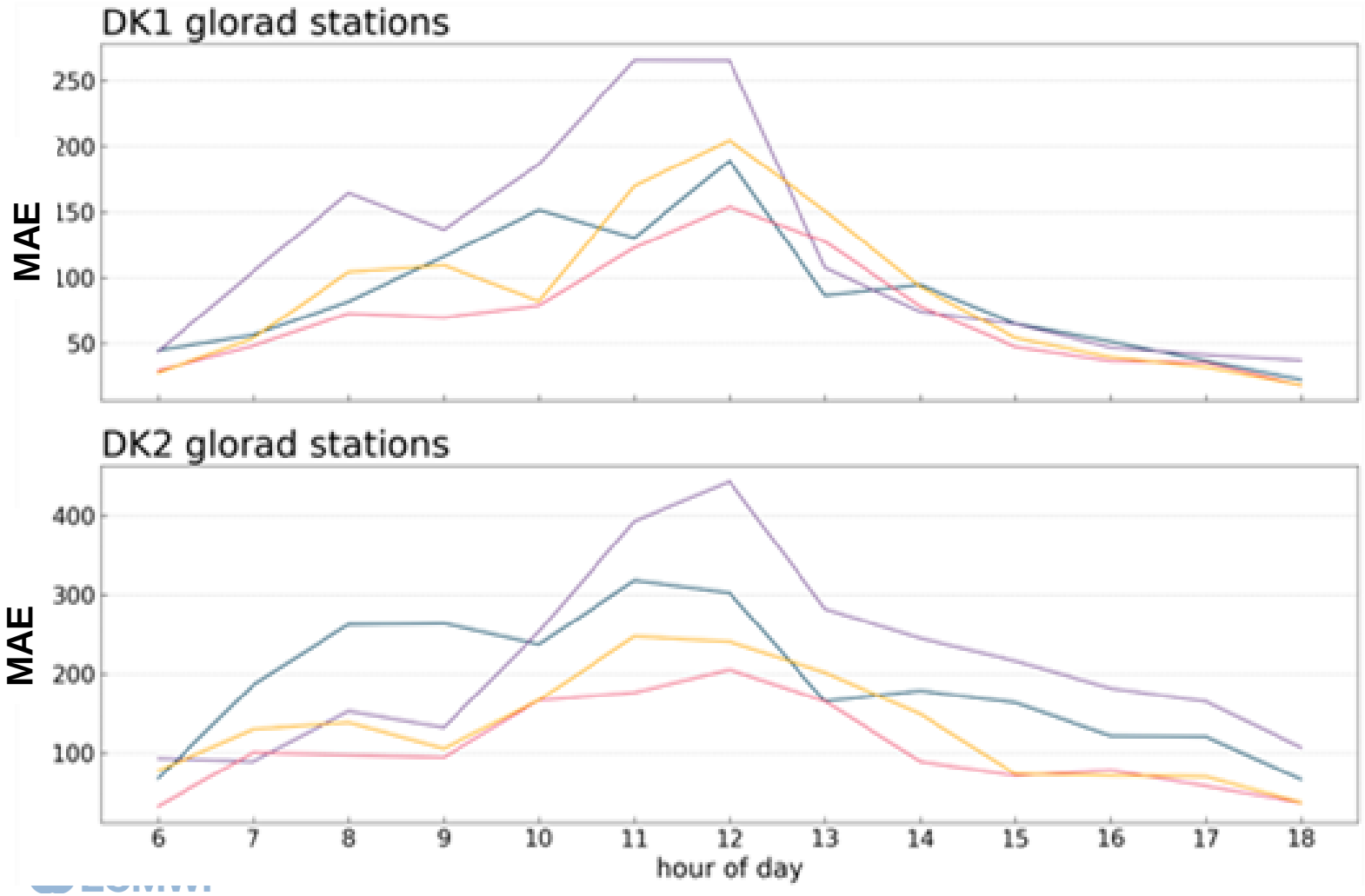
1. End-to-end demonstration : predicting wind power during storm Eunice



Base time 2022-02-17 00Z
lead time T+0 to T+60



2. Added value higher resolution : solar radiance energy production

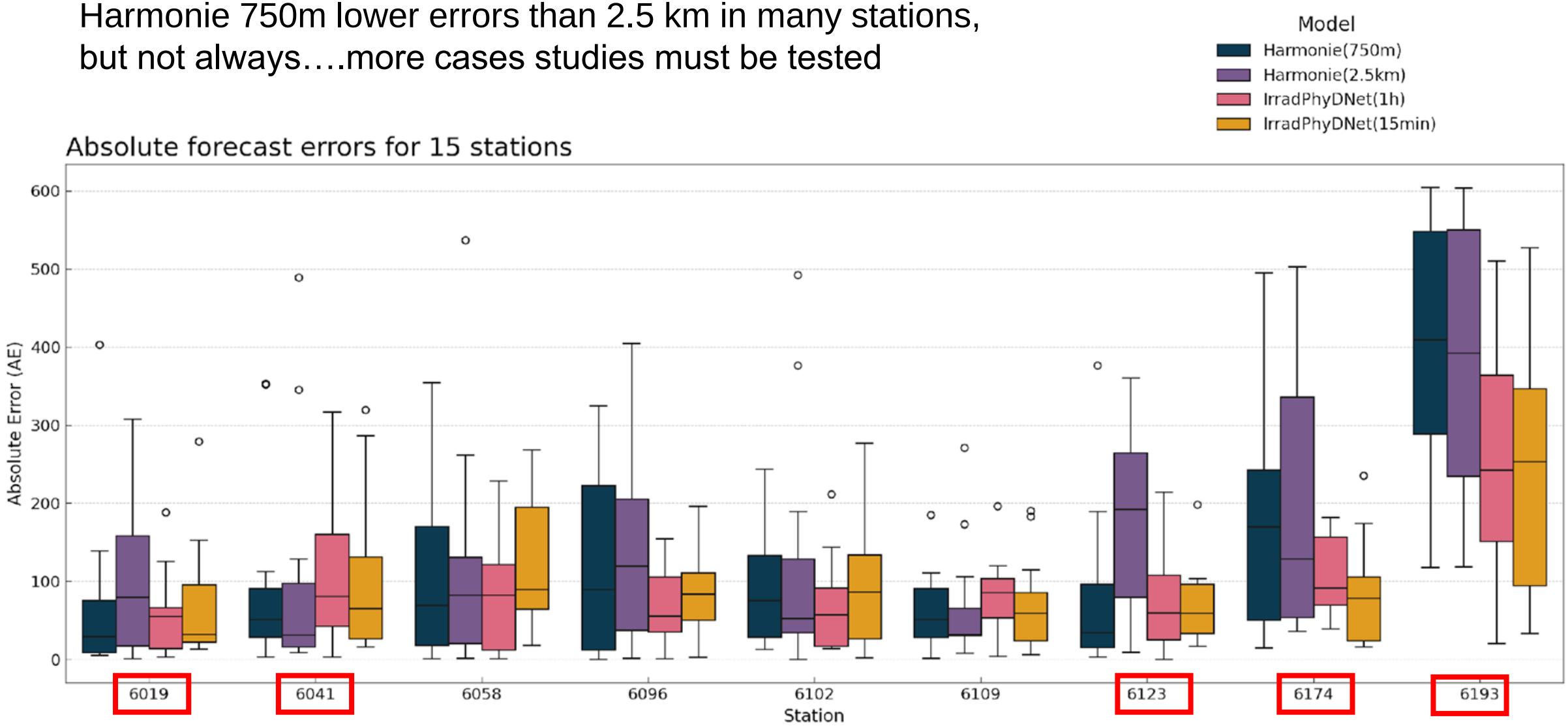


Mean Absolute Error (MAE) forecasts from Harmonie (with HARMONIE-AROME CSC) and IrradPhydNet variants aggregated by regions DK1 and DK2, forecasts from 6:00-18:00 12.6. 2019

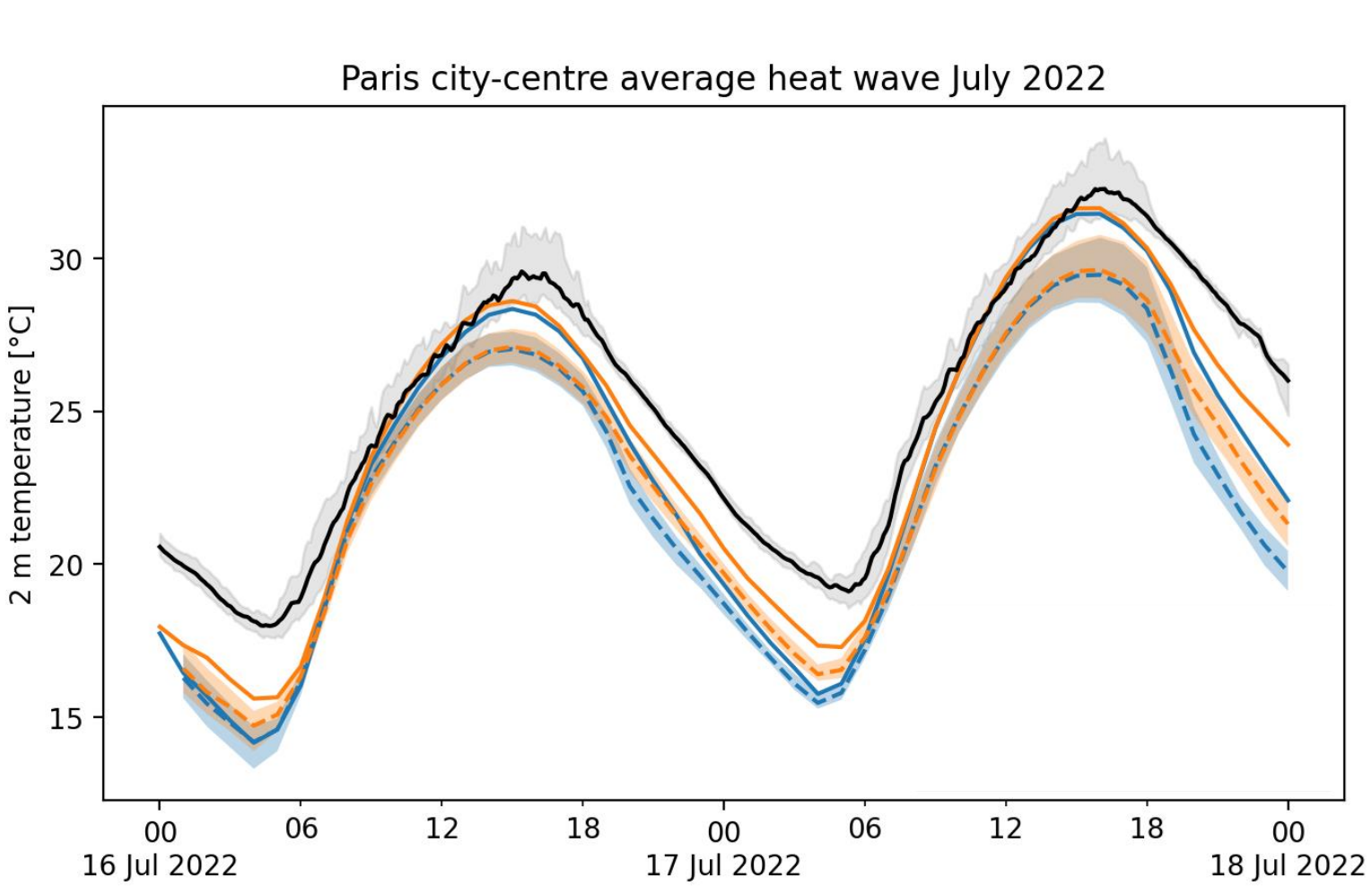
- **Harmonie (750m)**
- **Harmonie (2.5km)**
- **IrradPhyDNet (1h-lead)**
- **IrradPhyDNet (2h-lead)**

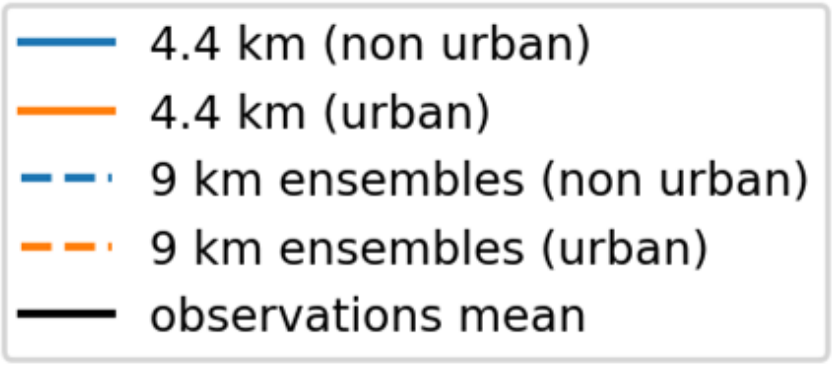
2. Added value higher resolution : solar radiance energy production

Harmonie 750m lower errors than 2.5 km in many stations,
but not always….more cases studies must be tested



3. Paris Olympics RDP project: improving 2m temperature forecast in urban areas



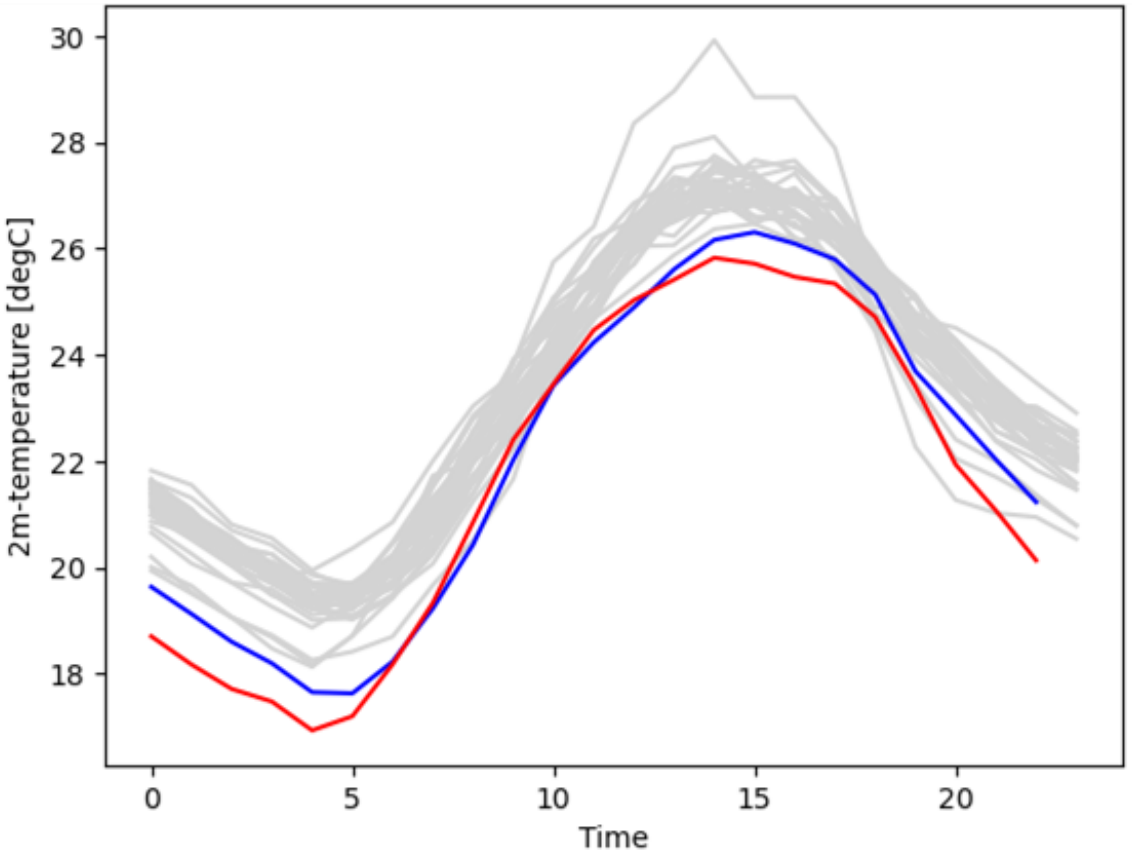


- **Urban tile** included in the model (IFS cycle 49r1) improves the prediction of urban 2m temperature

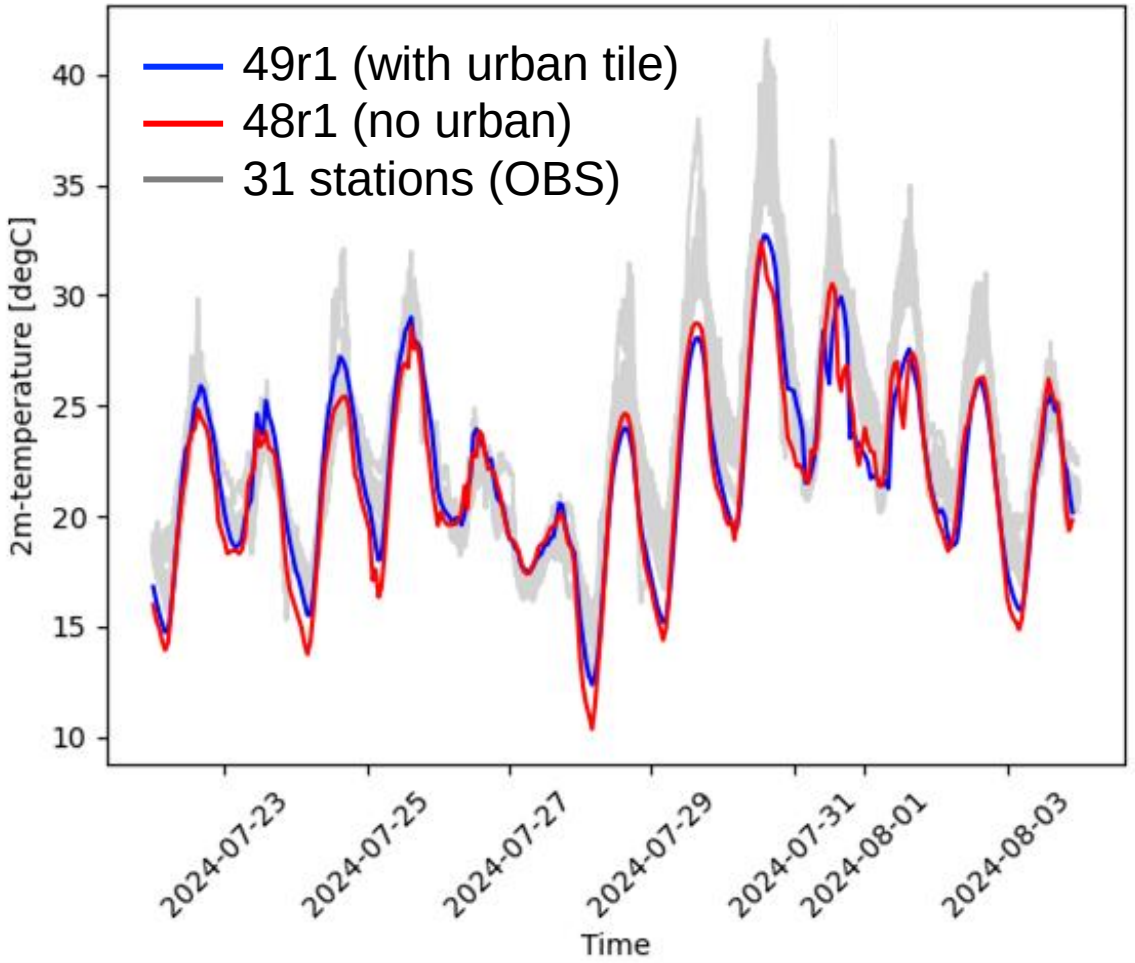
- **Resolution** also plays a key role in better predicting the 2m temperature in urban areas(4.4 km deterministic forecast better than any ensemble member with 9 km)

3. Paris Olympics RDP project: improving 2m temperature forecast in urban areas

2m temperature forecast on day 2



2m temperature forecast on day 2

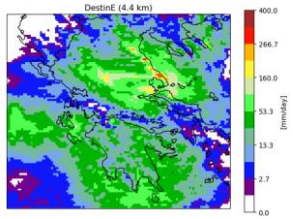


4. Added value Global DT and On-Demand DT for Extremes

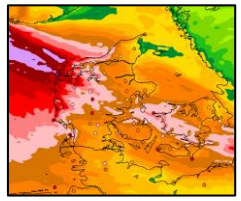
Extreme precipitation
(03/08)
Austria

TC Lee
(08/09)
Atlantic

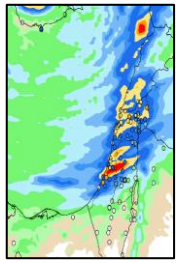
Storm Daniel
Precipitation in Greece
(06/09)
Flooding in Libya
(10/09)

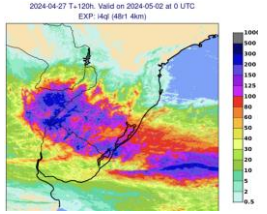


Storm Pia
(20/12)
Wind gust in
Denmark

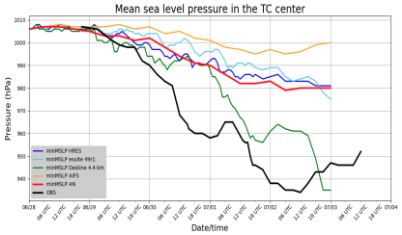


Heavy rain
(27/01) Israel





Floods
(28/04-02/05)
Brazil

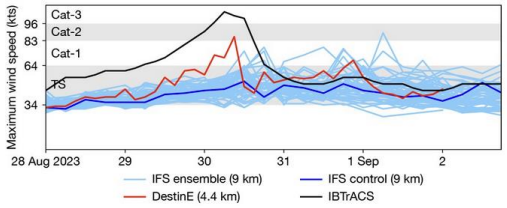


TC Beryl
(26/06-06/07)
Caribbean

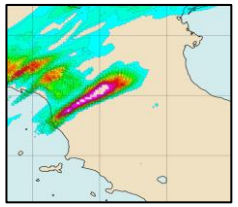
Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July

2023 **2024**

TC Idalia
(30/08)
Florida

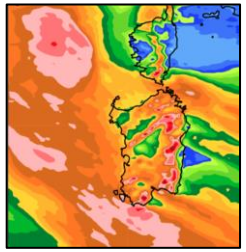


TC Otis
(24/10)
Mexico

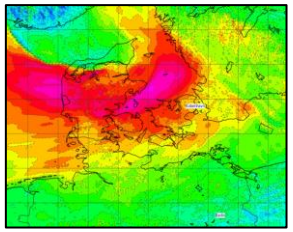


Storm Ciaran
Wind gust in
Brittany
(01/11)
Floods in Tuscany
(02/11)

Wind gust
(23/12)
Corsica



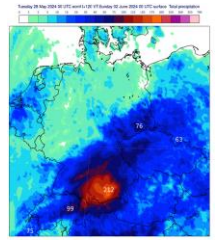
TC Belal
(14/01)
La Réunion



Storm Rolf
(23/02)
Denmark

Floods
(10/03)
South of France

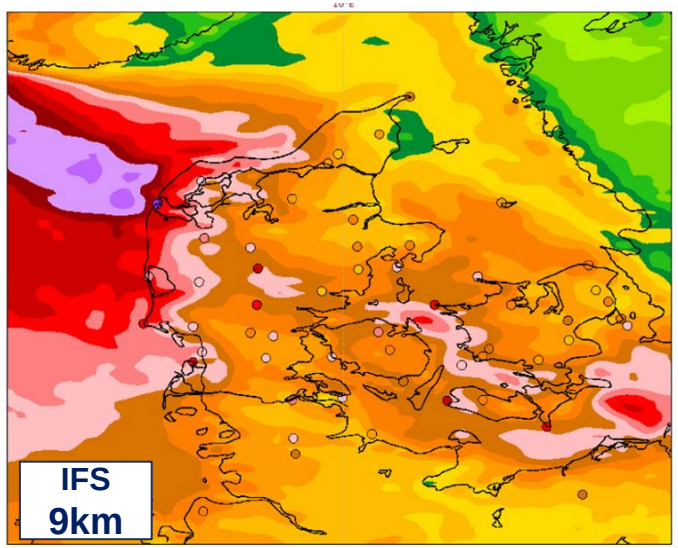
Extreme precipitation
(01/06)
South Germany

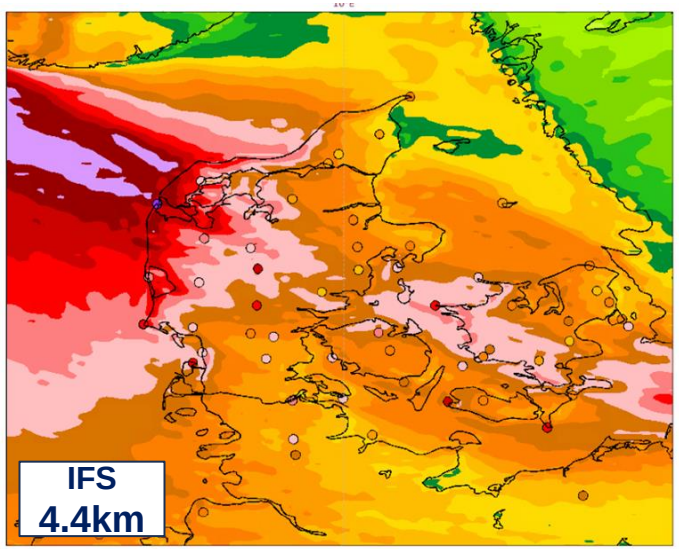


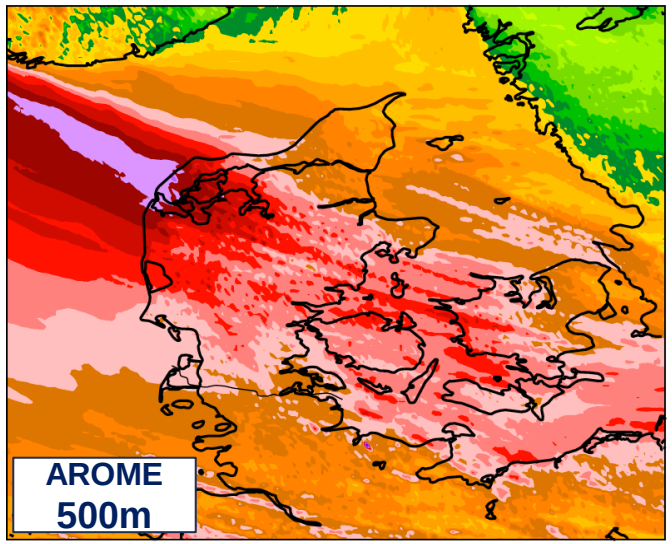
Strong wind gusts and floods
(24/06)
Italy and Croatia

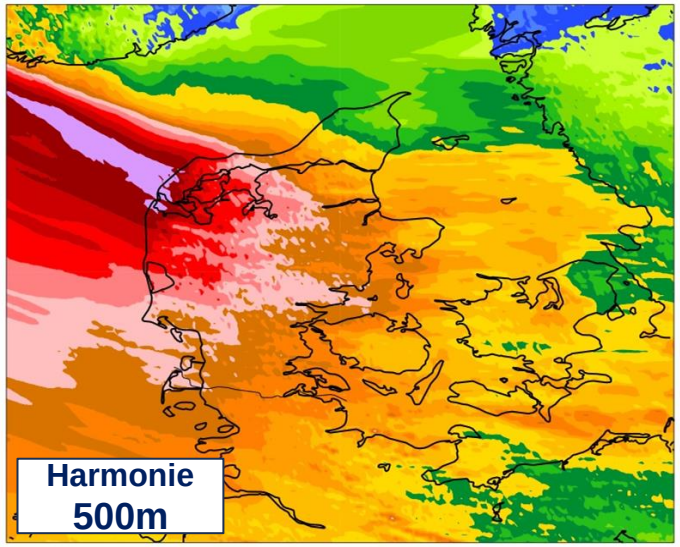
Evaluated in both in Global DT and On-Demand DT

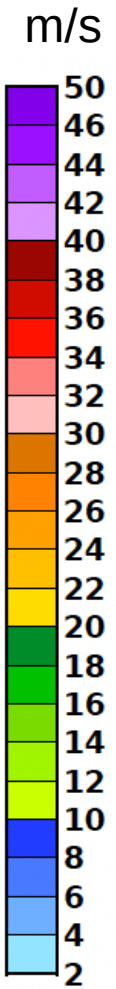
4. Added value Global DT and On-Demand DT for Extremes

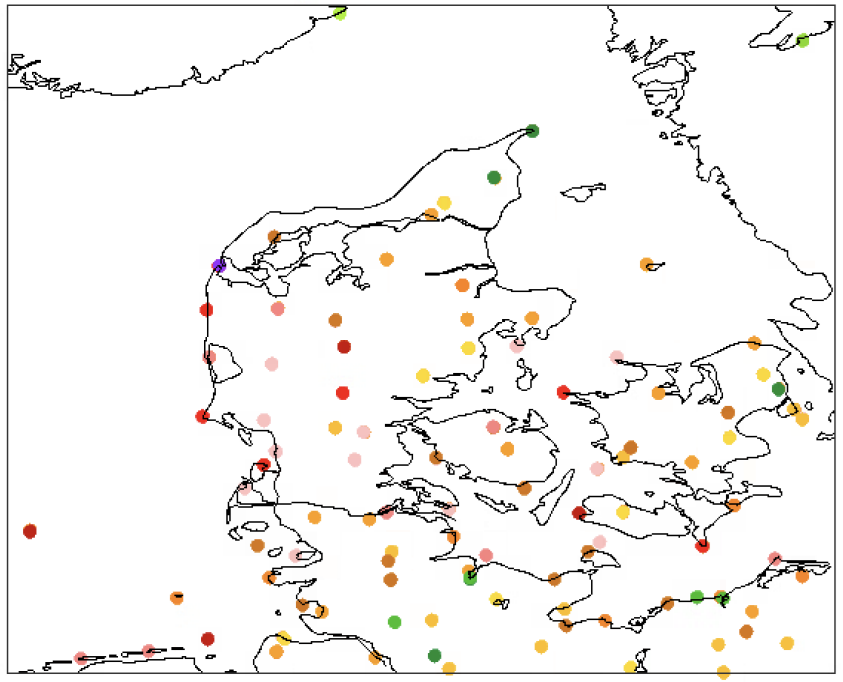












Storm Pia

48h-max 10m-wind gust.

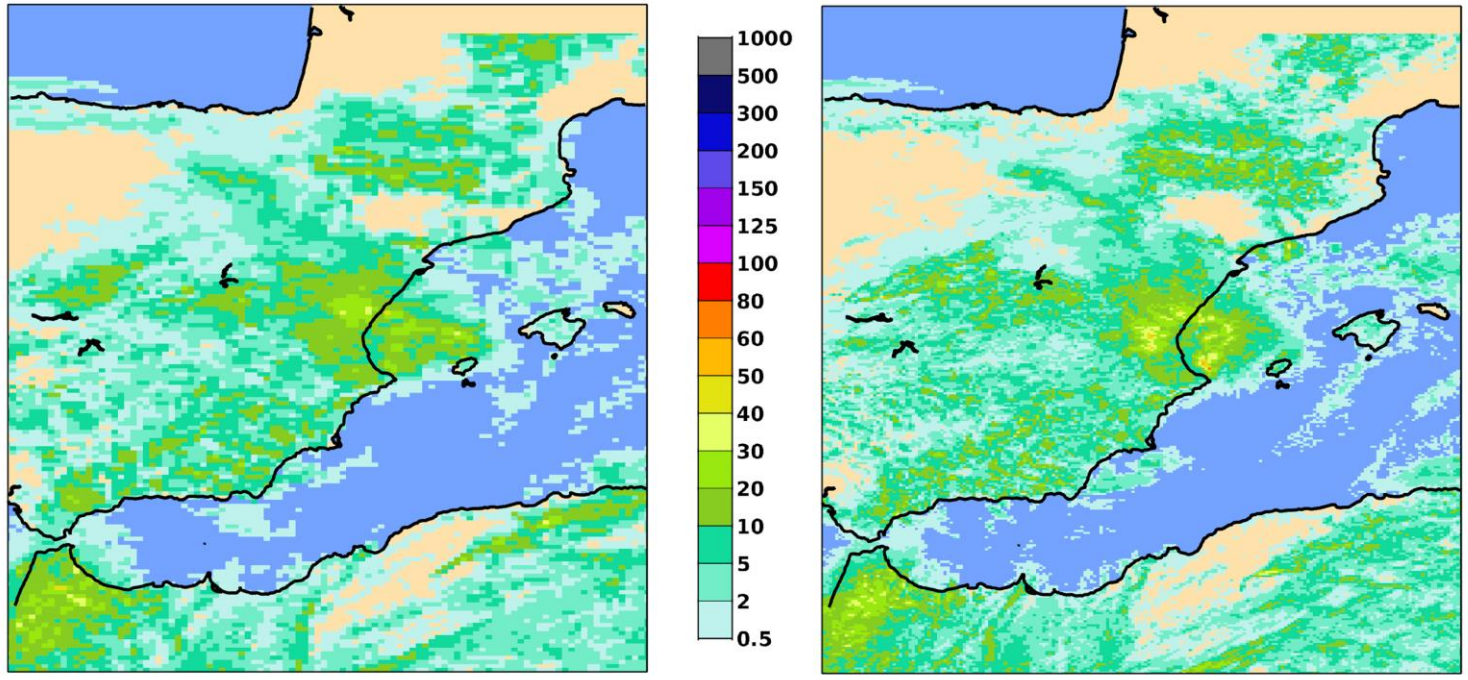
2023-12-20 00Z

VT 2023-12-22 00Z

4. Added value Global DT and On-Demand DT for Extremes

24h precipitation. Urban floods Valencia.
2022-05-01 00 UTC at T+72h

Localised extreme precipitation in Valencia city **> 150 mm/24h**



IFS 9 km

IFS 4.4 km

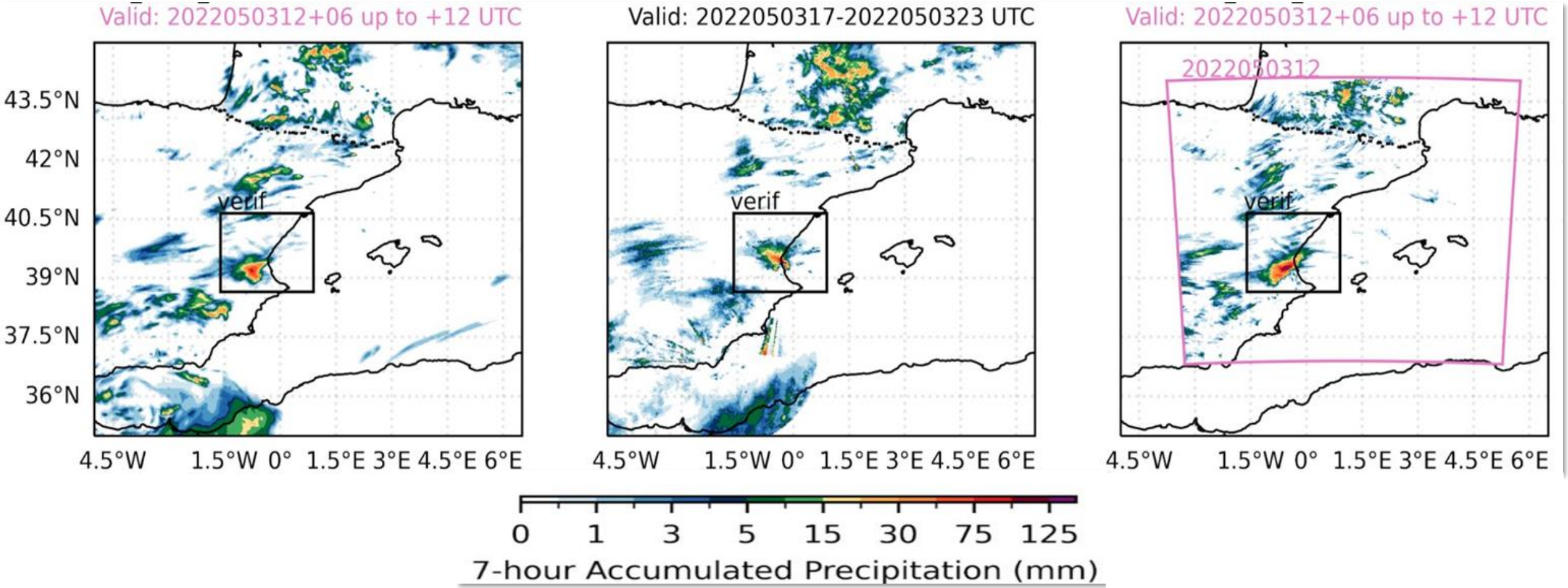
Observations

4. Added value Global DT and On-Demand DT for Extremes

On-Demand DT (2.5km)

OPERA radar

On-Demand DT (500m)



Conclusions from success stories and beyond…

➔ **Clear added value** observed in certain **extremes** when increasing resolution from IFS 9 km to **4.4 km** for:
- ◆ Intensification of Tropical cyclones/medicanes
- ◆ Orographic precipitation, other surface variables in complex orographic areas

➔ **Less clear added value** was observed for surface variables and local convection in **flat areas** with the 4.4 km.

➔ ACCORD NWP sub-km added value: from **2.5 km to 500 m** resolution (Harmonie-Arome) shows added value in specific cases, but needs to be further explored. Benefits from IFS 4.4 km to ACCORD sub-km is observed in various (high impact) events but we continue evaluating common severe events to obtain more clear conclusions**.**

➔ The lack of an **ensemble** and specific **data assimilation** at sub-km scales may partly explain the absence of added value in certain cases. Efforts are ongoing to **quantify uncertainty** in Phase II through ensemble approaches.

Join at

slido.com

#ExtremeDigitalTwin