# Concept to Application: Addressing Weather Extremes with Destination Earth in Norway

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AI for Preparedness: Building capacity for AI-powered Disaster Risk Management
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Norwegian Meteorological Institute

Photo: Cornelius Poppe/NTB

# Local Heavy Precipitation Bø July 22, 2024

**Unexpected downpour**: A sudden and intense rainfall hit Midt-Telemark on July 22, 2024, causing flooding, evacuations and significant damage. No warning was issued in advance

**Severe impact**: Around 350 people were evacuated, roads collapsed and homes were damaged. The Hørte River exceeded a 50-year flood level

**Local reactions**: Campground owners and residents were surprised by the lack of warnings, while the mayor trusted experts but acknowledged forecasting challenges

**Difficult to predict**: Meteorologists stated that forecasts did not indicate such extreme rainfall in Bø, making it nearly impossible to foresee

**Lessons learned**: The event highlights the need for improved simulations, understanding and communication of highly localized weather extremes

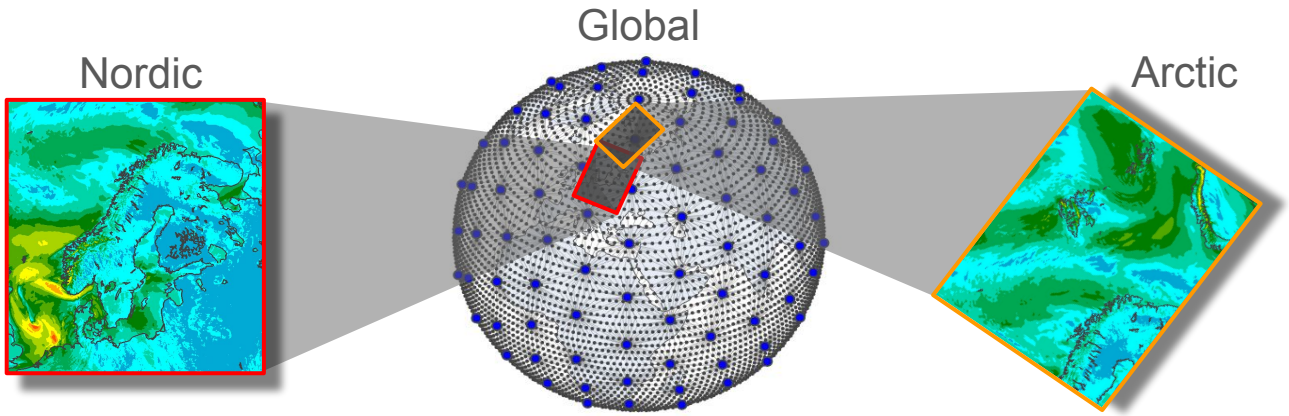
Source: https://www.nrk.no/vestfoldogtelemark/styrtregnet-i-bo-var-umulig-a-forutse_-mener-meteorologene-1.16974508

# The Water Cycle: A Key Driver of Extreme Weather

- Increased intensity of rainfall and longer dry spells are two manifestations of the same systemic response
- Precipitation systems are becoming smaller in scale, more intense and harder to predict
- Different types of extremes are driven by diverse atmospheric and hydrological processes
- Impacts depend strongly on location, infrastructure and level of preparedness

# Bris [bri:s] AI-WP

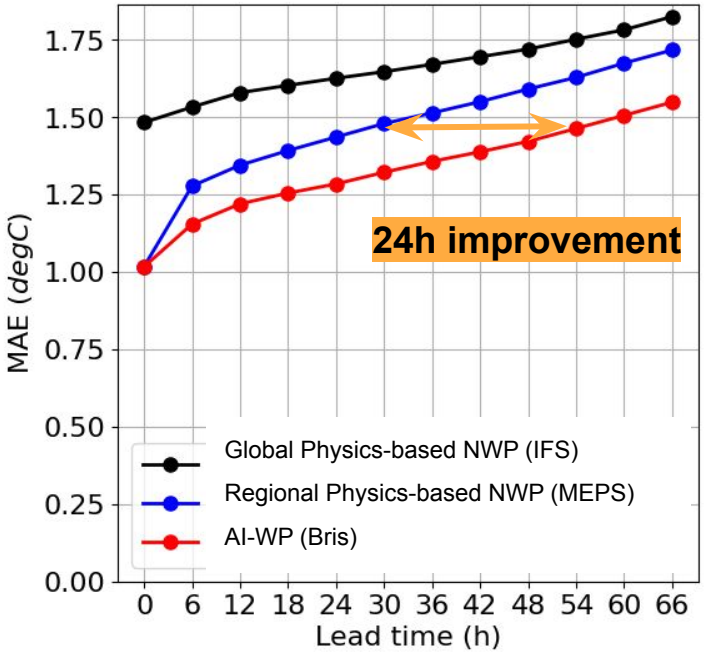
- A global AI-based model with high resolution over our **focus area(s)**
- Idea and initiated by Met Norway
- Developed in **collaboration** with European partners
- **Seamlessly** covering nowcasting (next hour) to long-range (next 21 days)
- Based on ECMWF **AIFS**
- Developed within the **Anemoi** framework



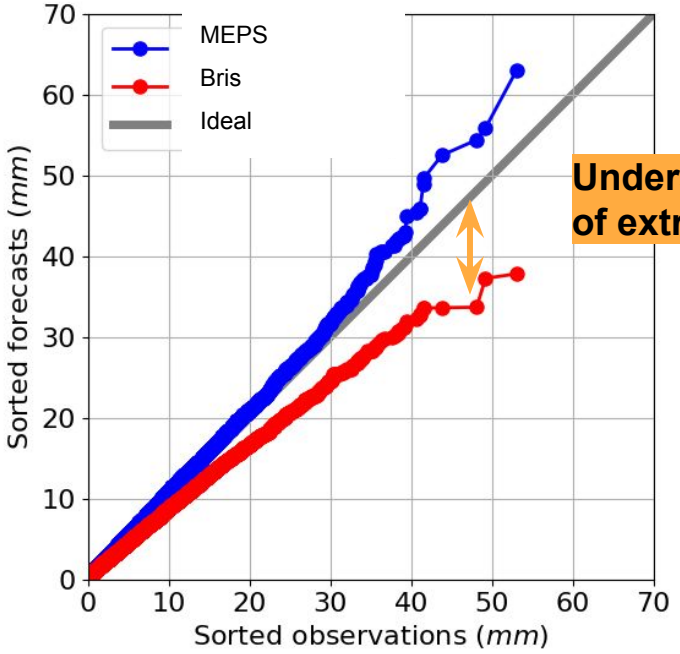
# Deterministic Bris forecasts



## Temperature forecasts



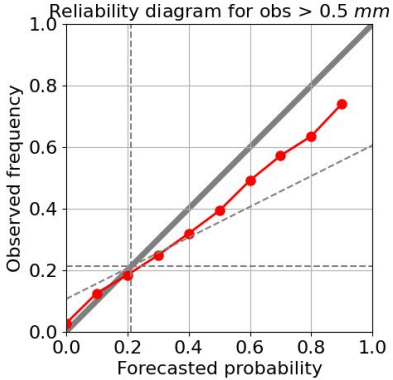

## Precipitation forecasts

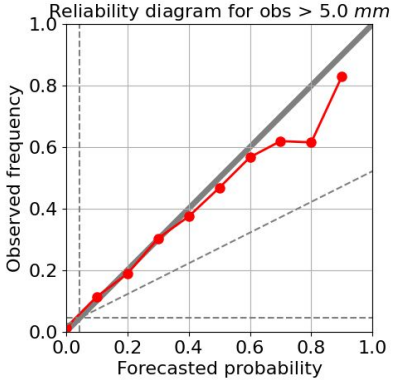


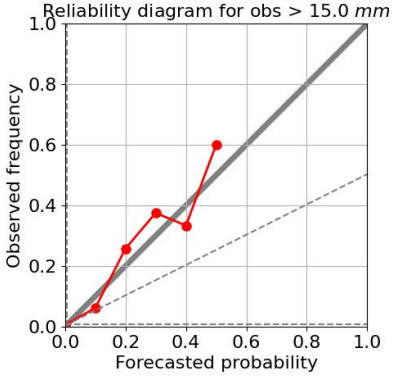
# Generating Reliable (and Accurate) Simulations

Verification against point observations over Norway (lead times 24h-96h)

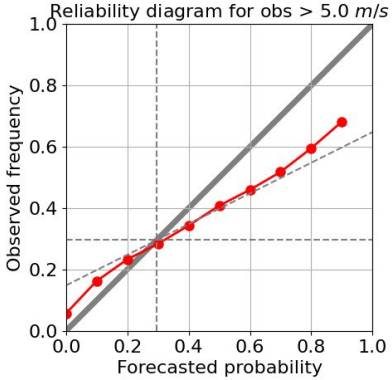
Precipitation

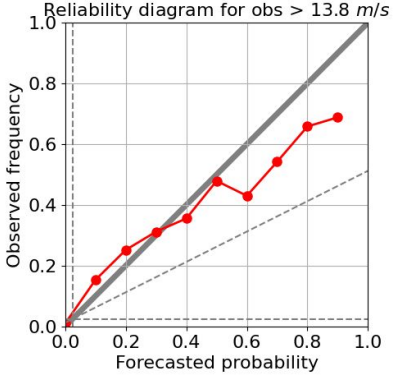


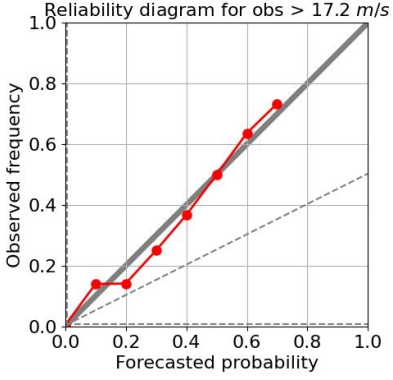




Wind speed



# Data-driven modelling in Destination Earth



- Developing an AI-WP model in the On-demand Extremes Digital Twin project
- Probabilistic, high-resolution, on-demand, extremes
- We need a model that generalizes to new domains

## Multi-domain dynamical graph training

**The architecture is made grid-independent such that multiple regional datasets can be alternated as batch input**

**Advantages:**

- **Flexibility:** Support handling datasets from different **domains**, **grid-sizes, temporal sizes** and **resolutions**
- Increase the **generalizability** of the model
- Preventing **catastrophic forgetting**

From Sophie Buurman (KNMI)

Funded by the European Union **Destination Earth**

# Training data

**1**

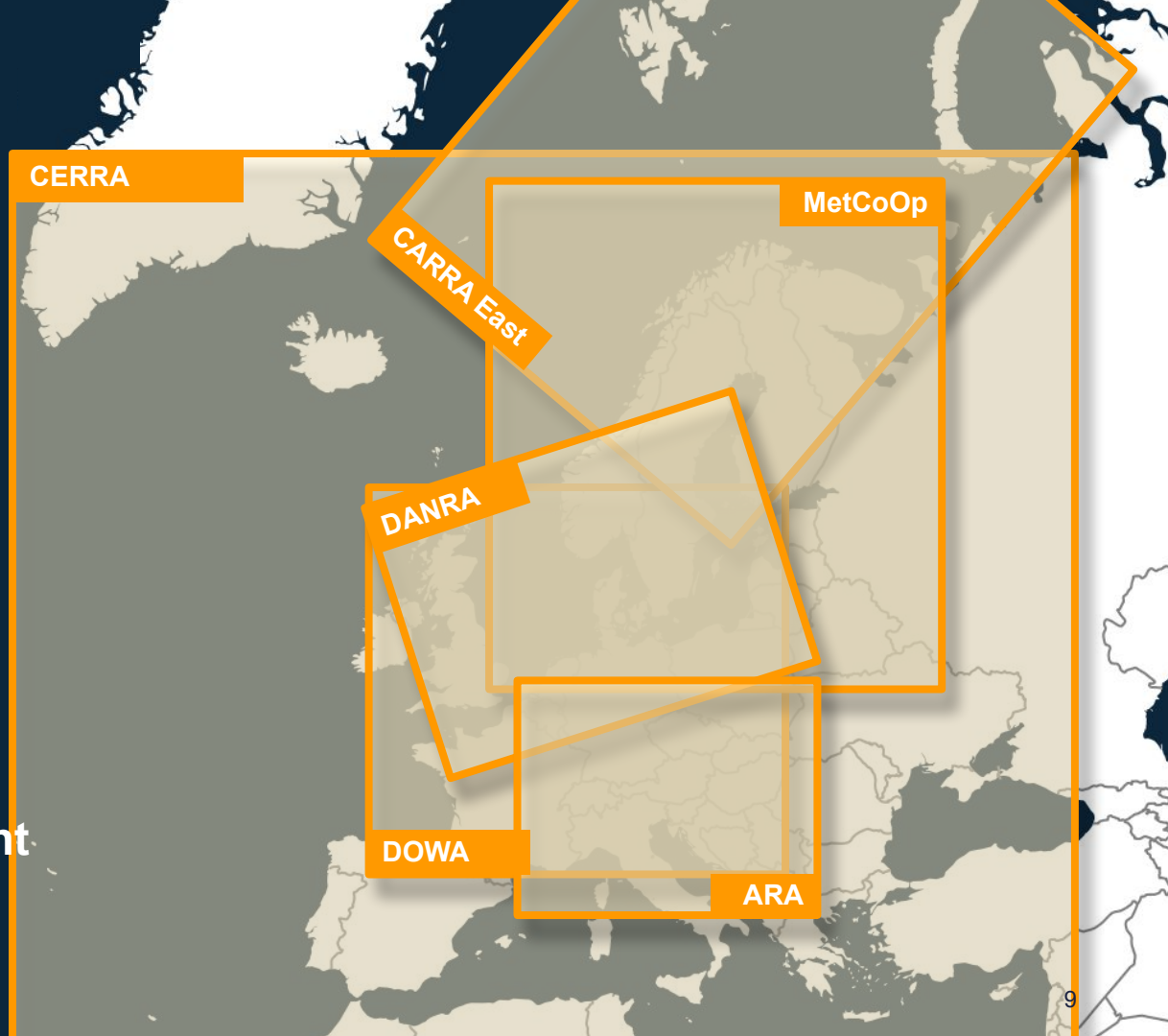
**European reanalyses**
5.5 km

**5**

**Regional reanalyses**
2.5 km

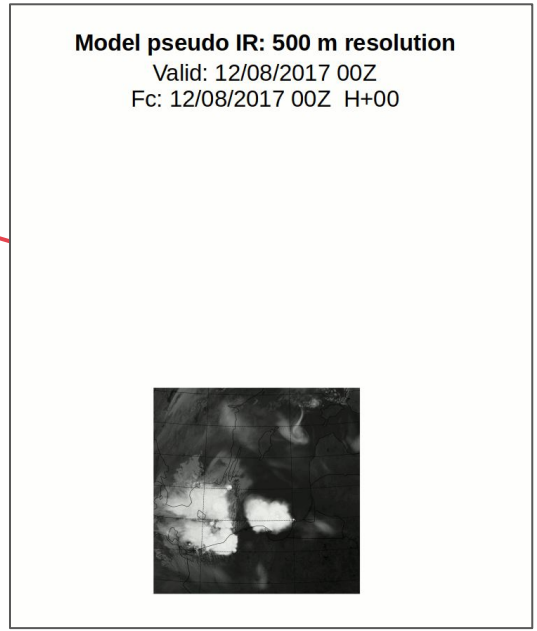
**400+**

**DE330 extreme event simulations**
250-750m



# EXTREMES DT : A MAGNIFYING GLASS ON EXTREME WEATHER EVENTS


**Global daily** simulations of extreme weather **4 days** ahead at **4.4km**




**Local (on-demand) 2-day simulations at 500m**

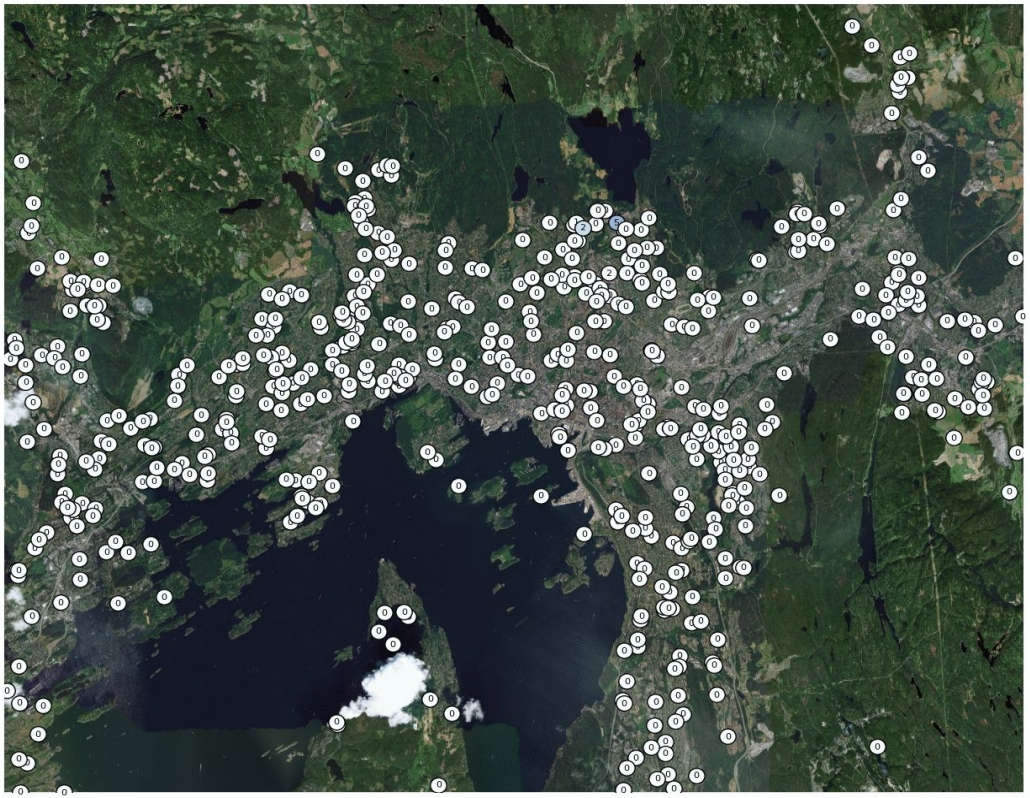
Enhances and complements existing national and European systems, providing improved situational awareness, data, understanding, learning and support to national authorities responsible for early warnings and long-term preparedness

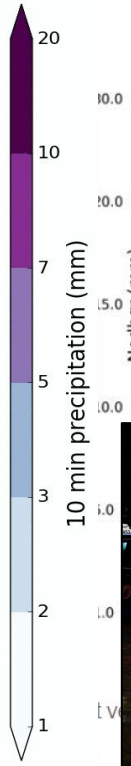
Funded by the European Union

Storylines

# Se hvordan styrtregnet splittet Oslo

Langt nok vest eller øst regnet det lite eller ingenting i Oslo natt til søndag. Bygen kom nordfra, og fosset bokstavelig talt gjennom byen før den bar mot Østfold og Sverige.



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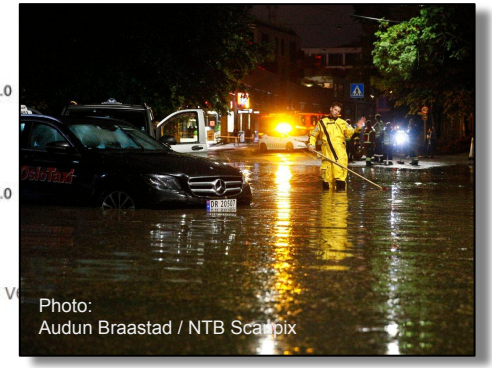

Photo:
Audun Braastad / NTB Scanpix

# Summary

- Climate change is increasing the frequency and severity of extremes
- Perceptions of “extreme” vary by context and experience
- The Extremes DT enables high-resolution simulations including impacts
- Storylines and “what if” scenarios support learning, preparedness and adaptation
- Challenging cases in the present help improve understanding and communication
- Collaboration and validation ensure trust and usability
- DestinE complements existing capabilities at the national met services — not replaces them
- Domain expertise is essential to interpret and apply DT outputs; met services act as brokers connecting data to decisions