WEPS

A Wave Ensemble Prediction System for the Nordic Seas

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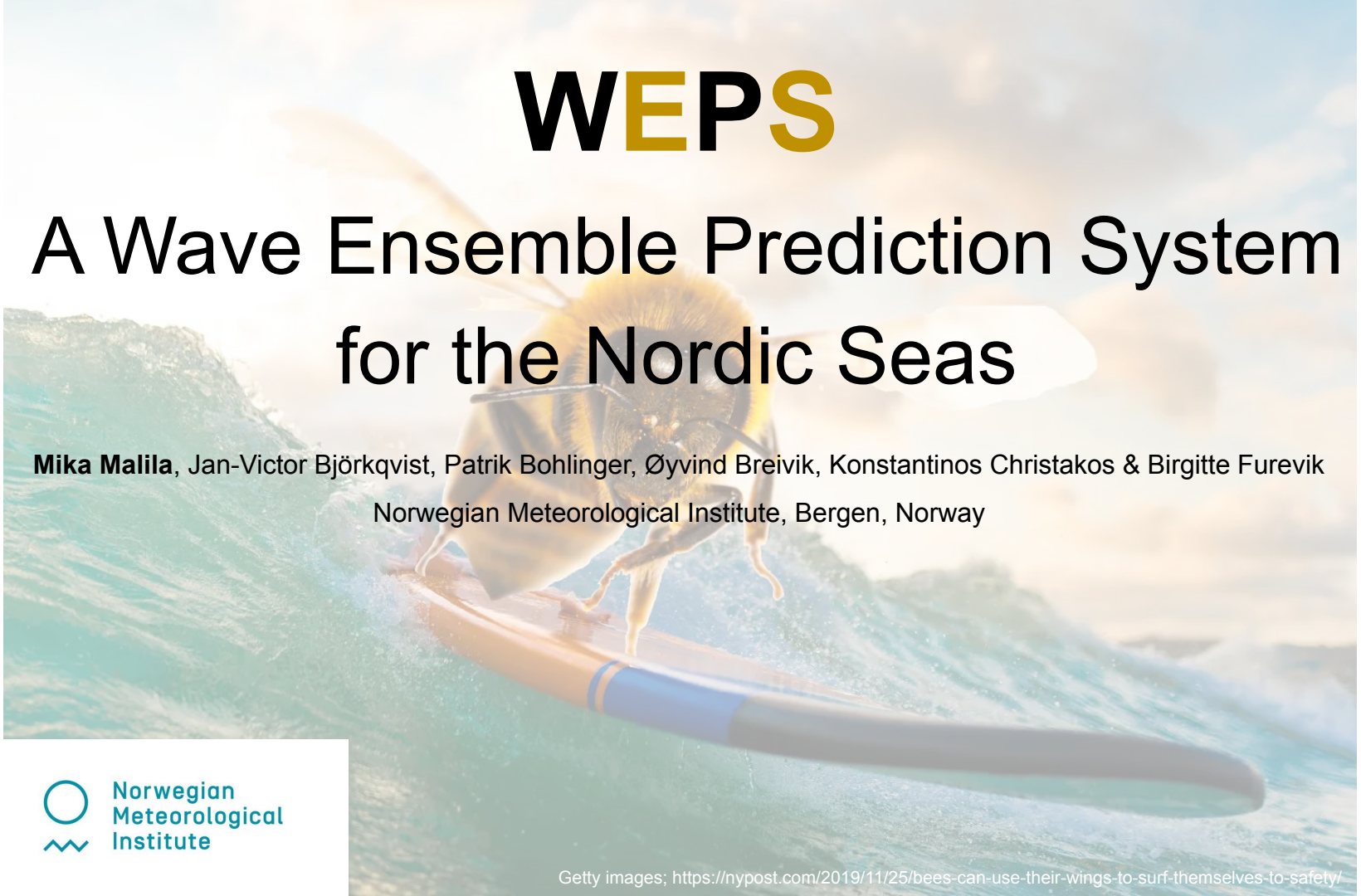
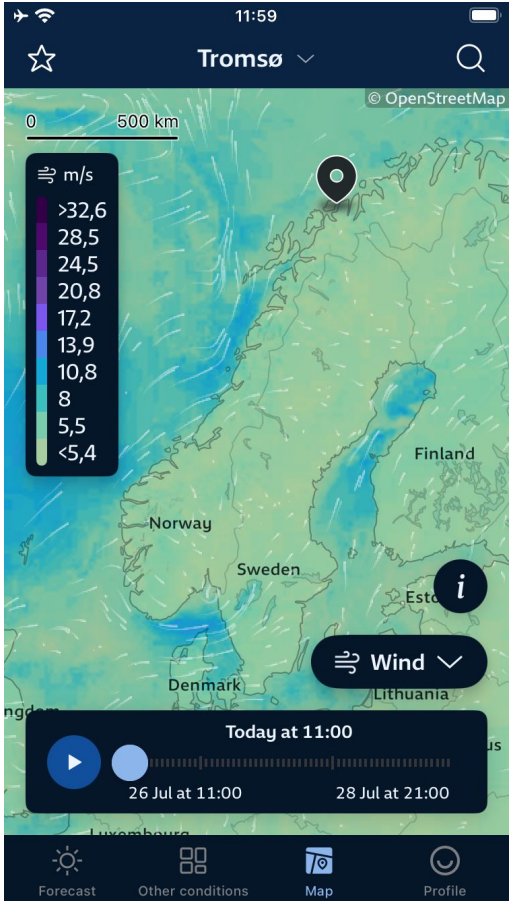
Norwegian Meteorological Institute



Getty images; https://nypost.com/2019/11/25/bees-can-use-their-wings-to-surf-themselves-to-safety/

MEPS

MetCoOp
Ensemble
Prediction
System
Operational
Weather
Forecast



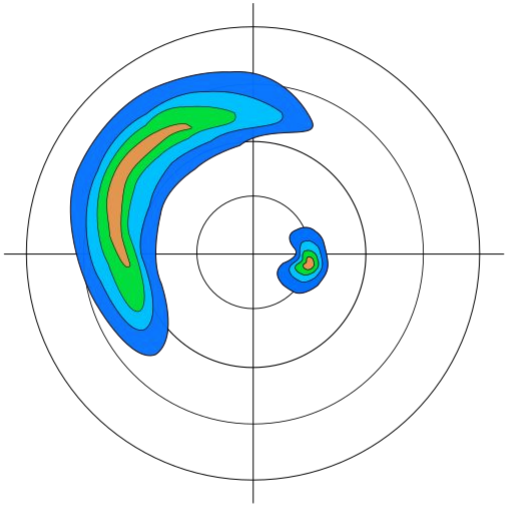
15-members
66-h range
2.5-km horizontal resolution
IFS on lateral boundaries

High Resolution Limited Area Model

MEPS + WAVEWATCH III

MetCoOp
Ensemble
Prediction
System
Operational
Weather
Forecast

Spectral ocean surface wave model (v6.07)



MEPS + WAVEWATCH III = WEPS

MetCoOp
Ensemble
Prediction
System
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Weather
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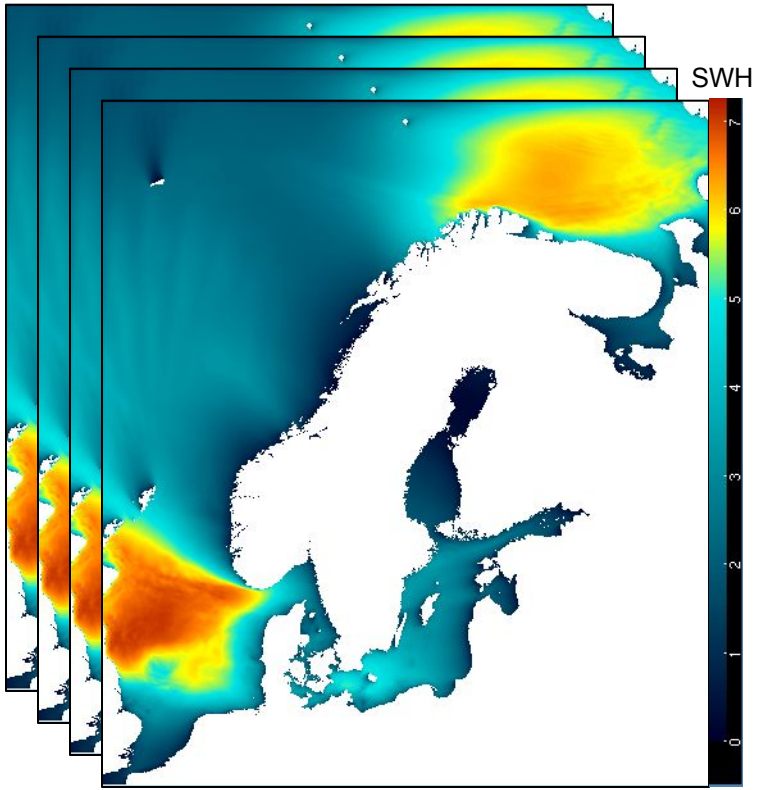
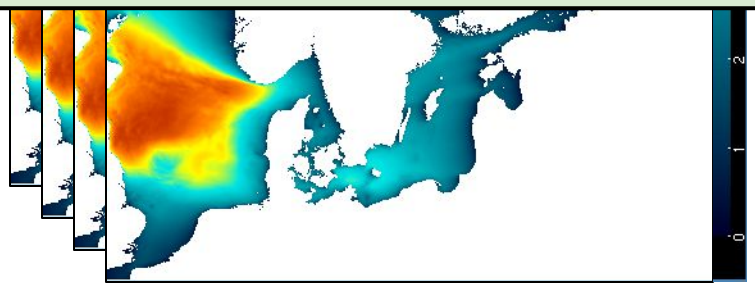


Regional
Wave
Ensemble
Prediction
System

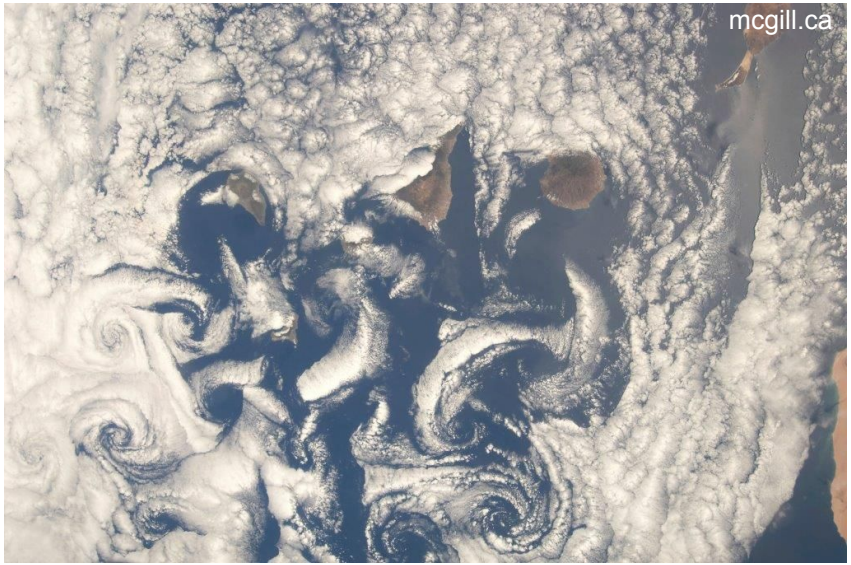
MEPS + WAVEWATCH III = WEPS

MetC…nal
Ense…
Pred…nble
Syste…tion
Oper…m
Weather
Forecast

Not operational (yet)

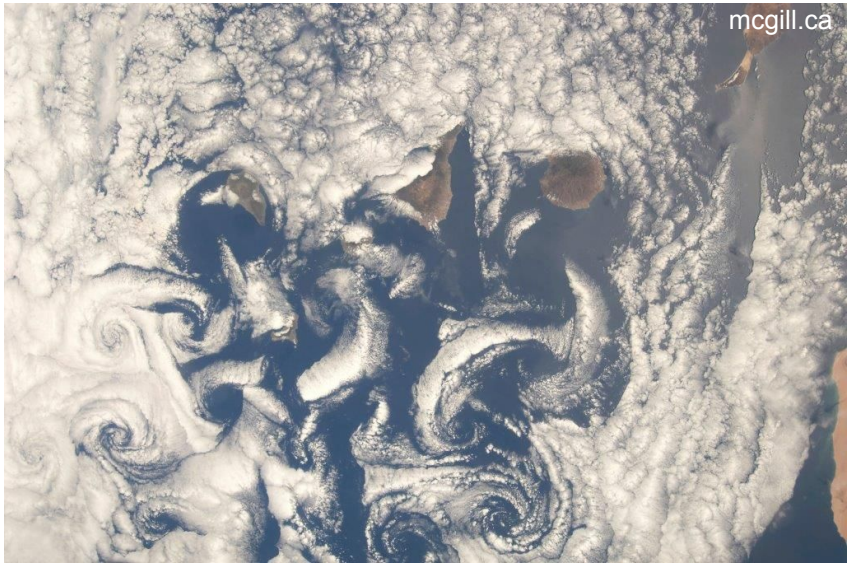


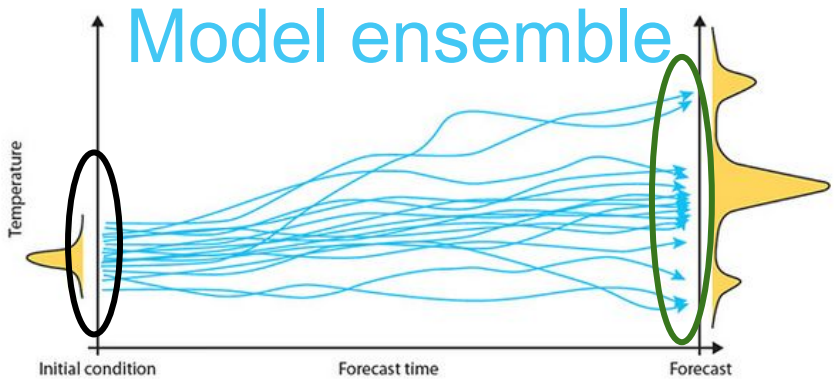
Ensemble forecasts



Turbulent (chaotic) and under-observed Earth system

Ensemble forecasts





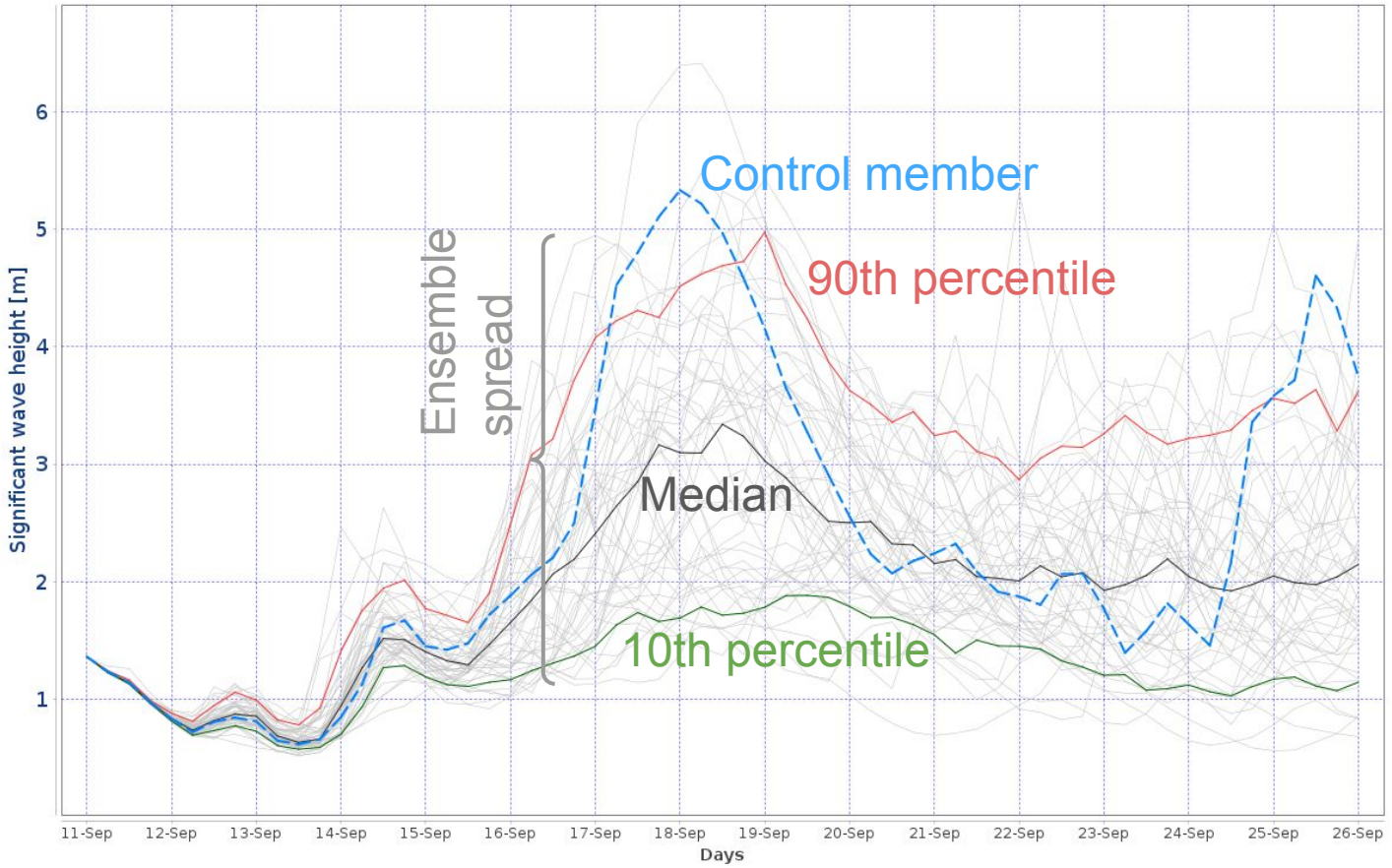
Perturbed initial conditions

Forecast spread

ECMWF

ECMWF wave ensemble forecast (Waef)

- IFS wind forcing
- 51-member 15-day forecast
- 9-km global model



ECMWF wave ensemble forecast (Waef)

- IFS wind forcing
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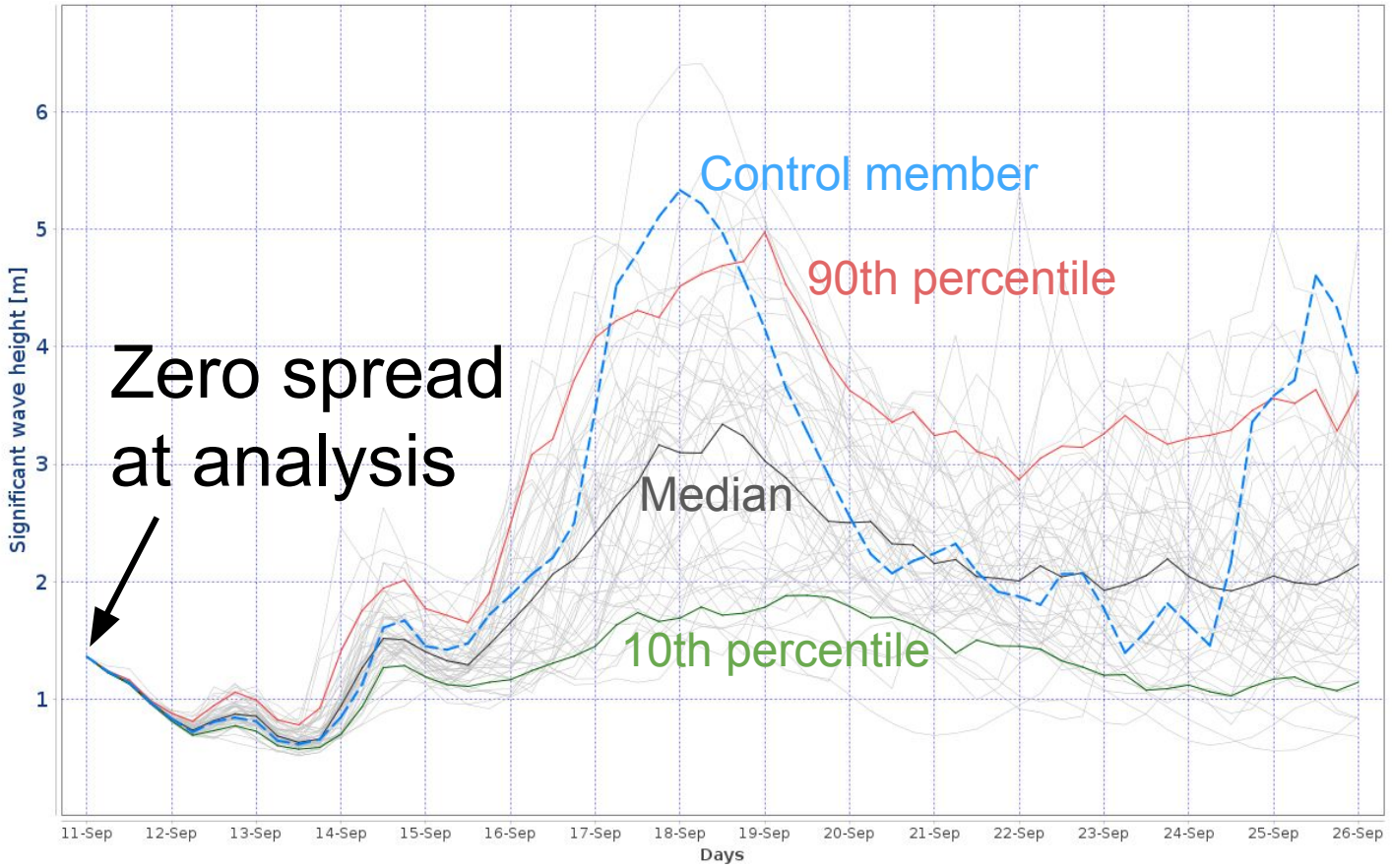
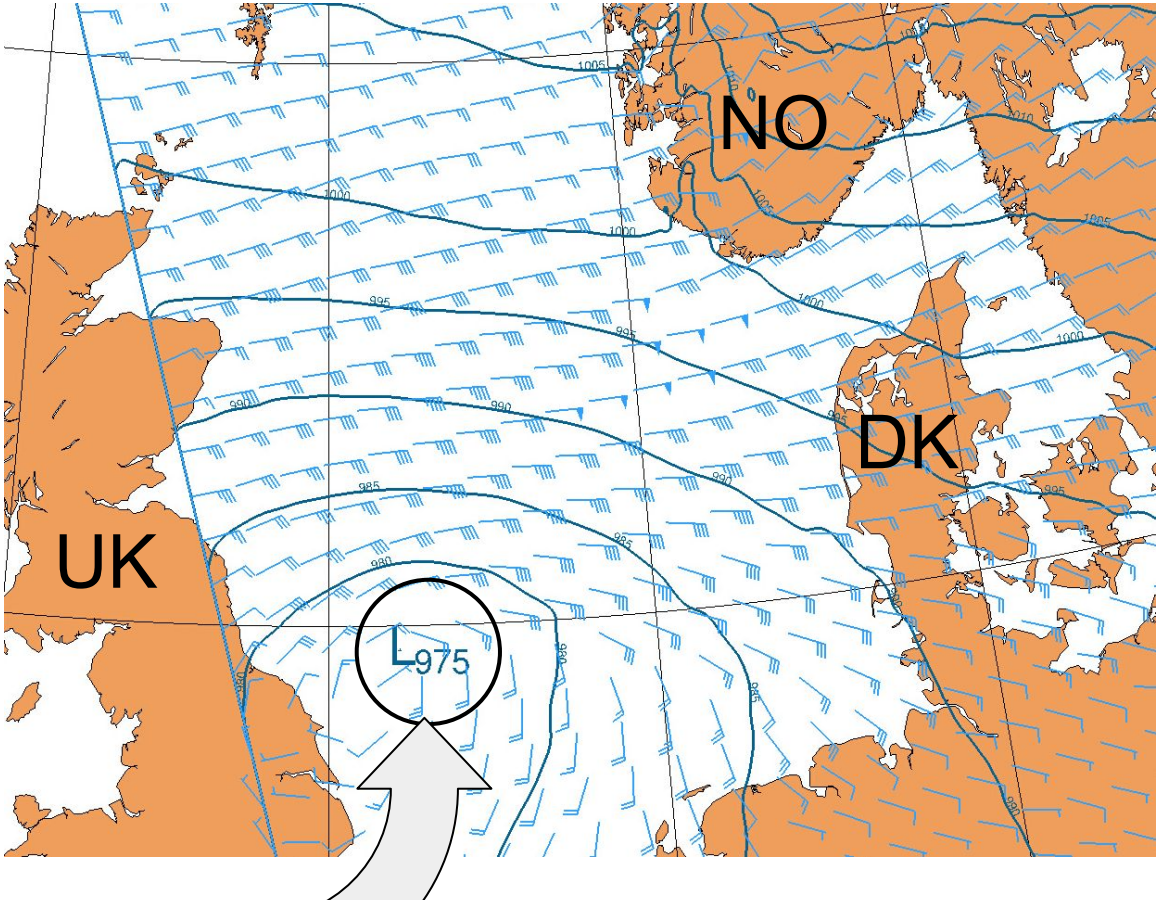


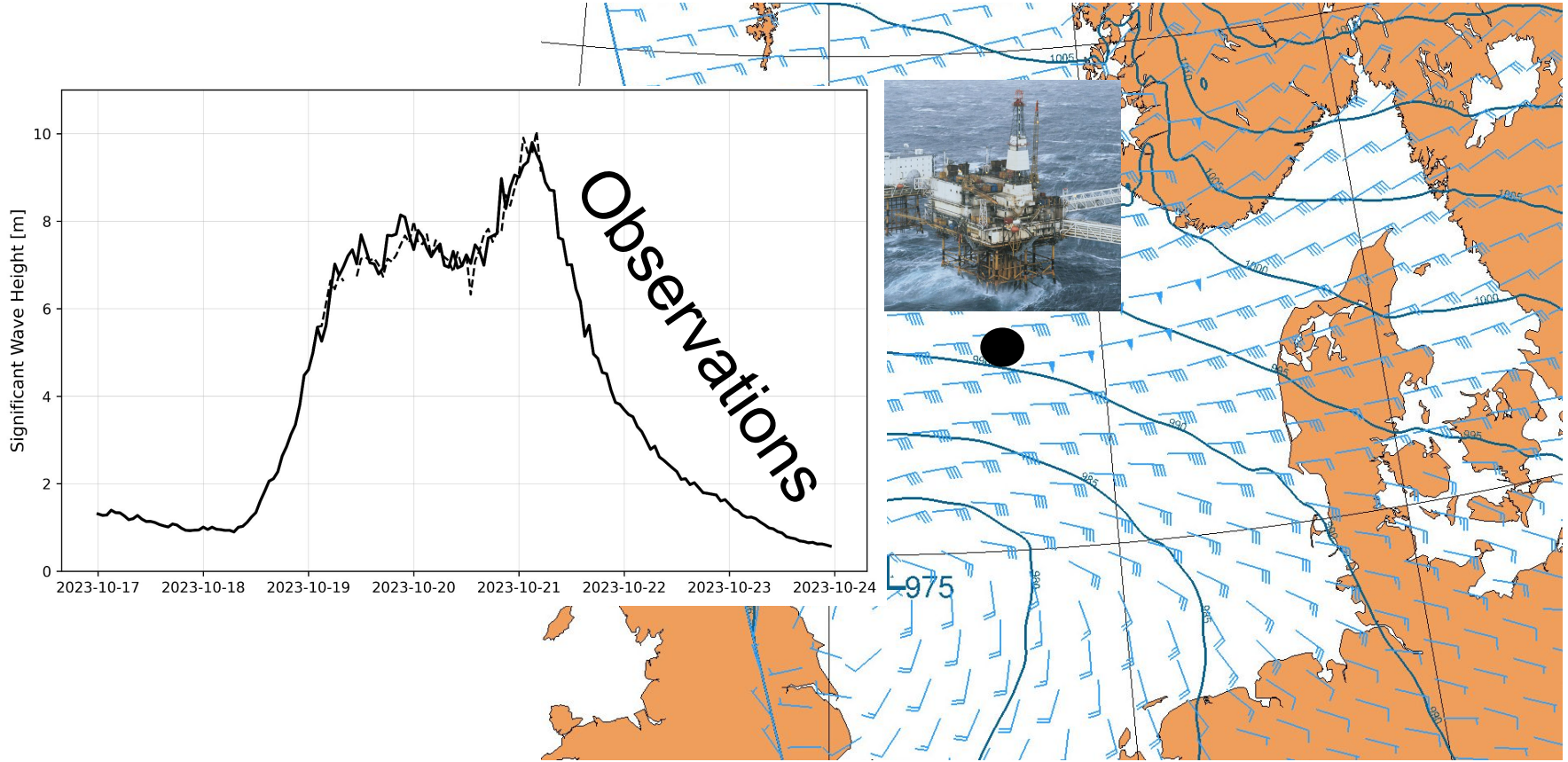
Why develop a new regional EPS?

October 2023 North Sea storm

Strong easterly wind field (U10 > 50kn)



October 2023 North Sea storm



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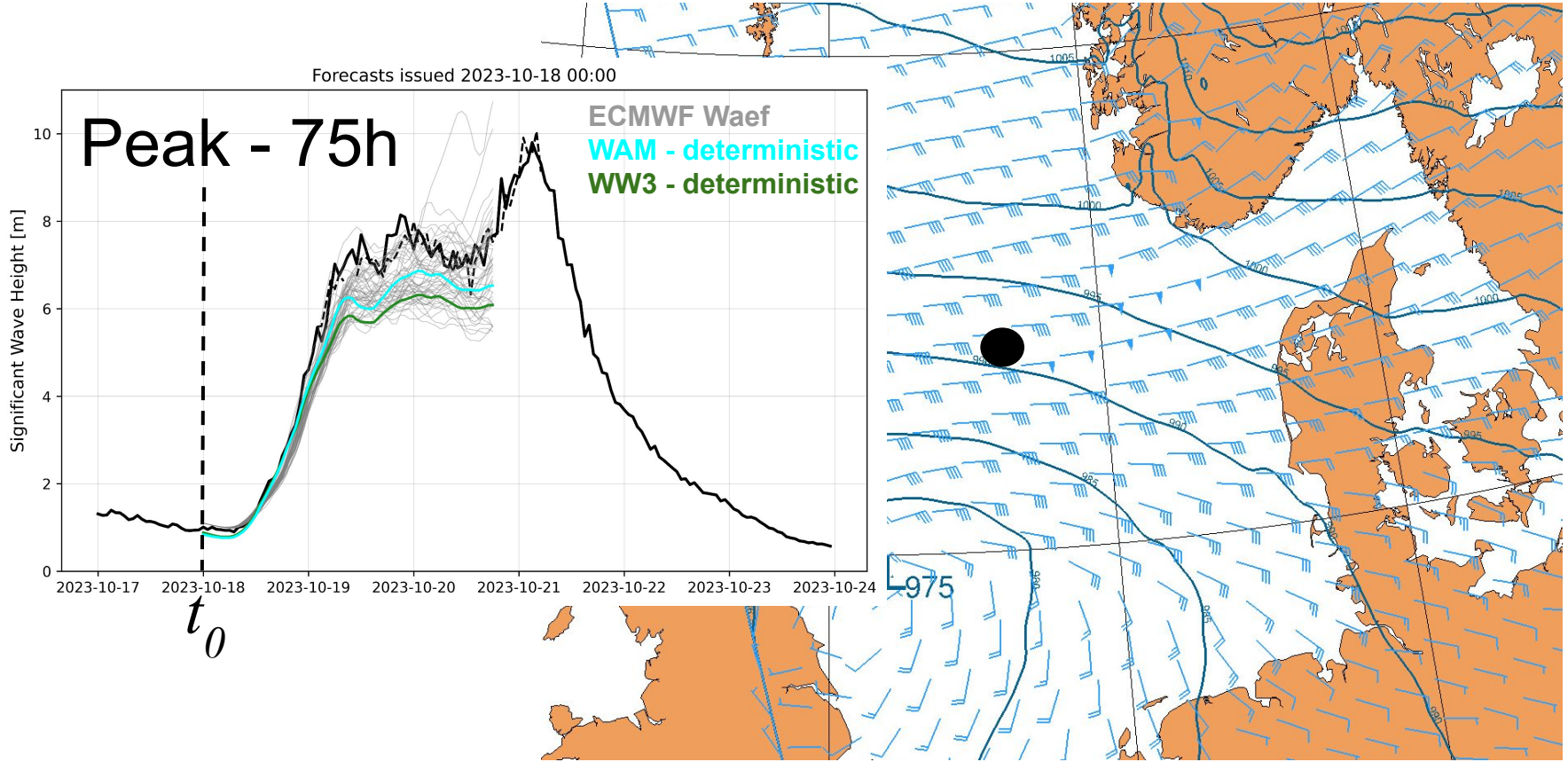

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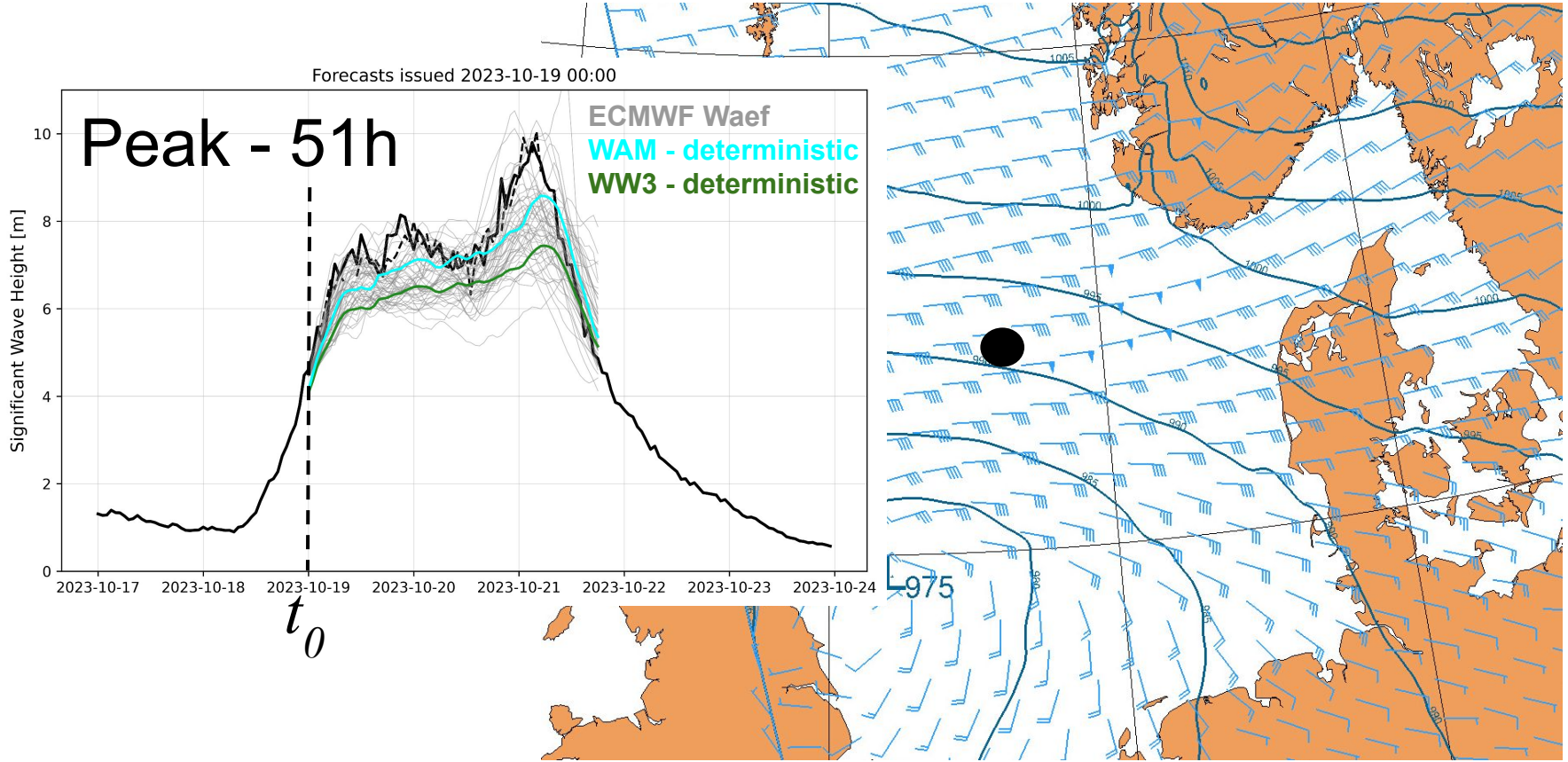

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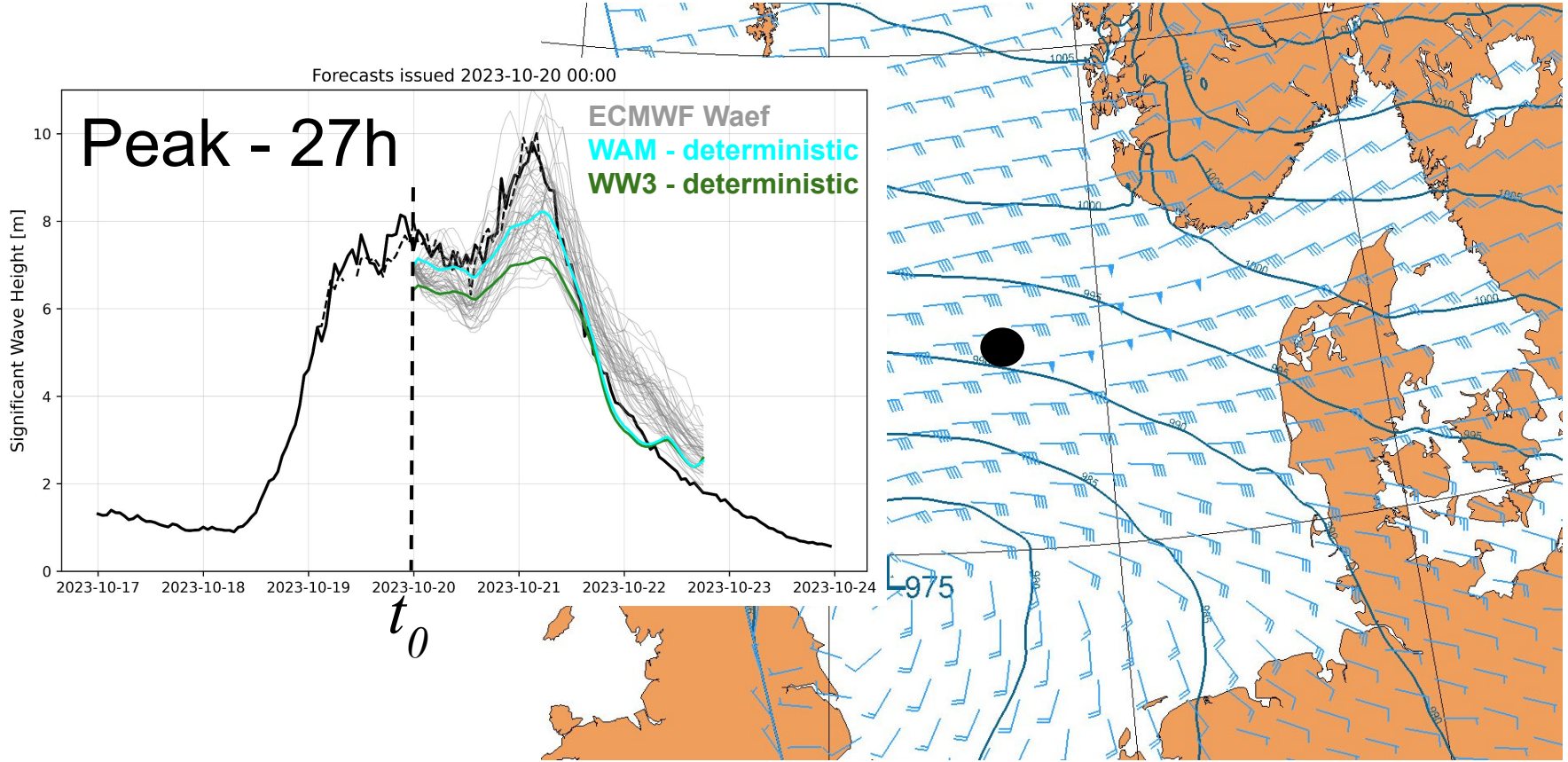

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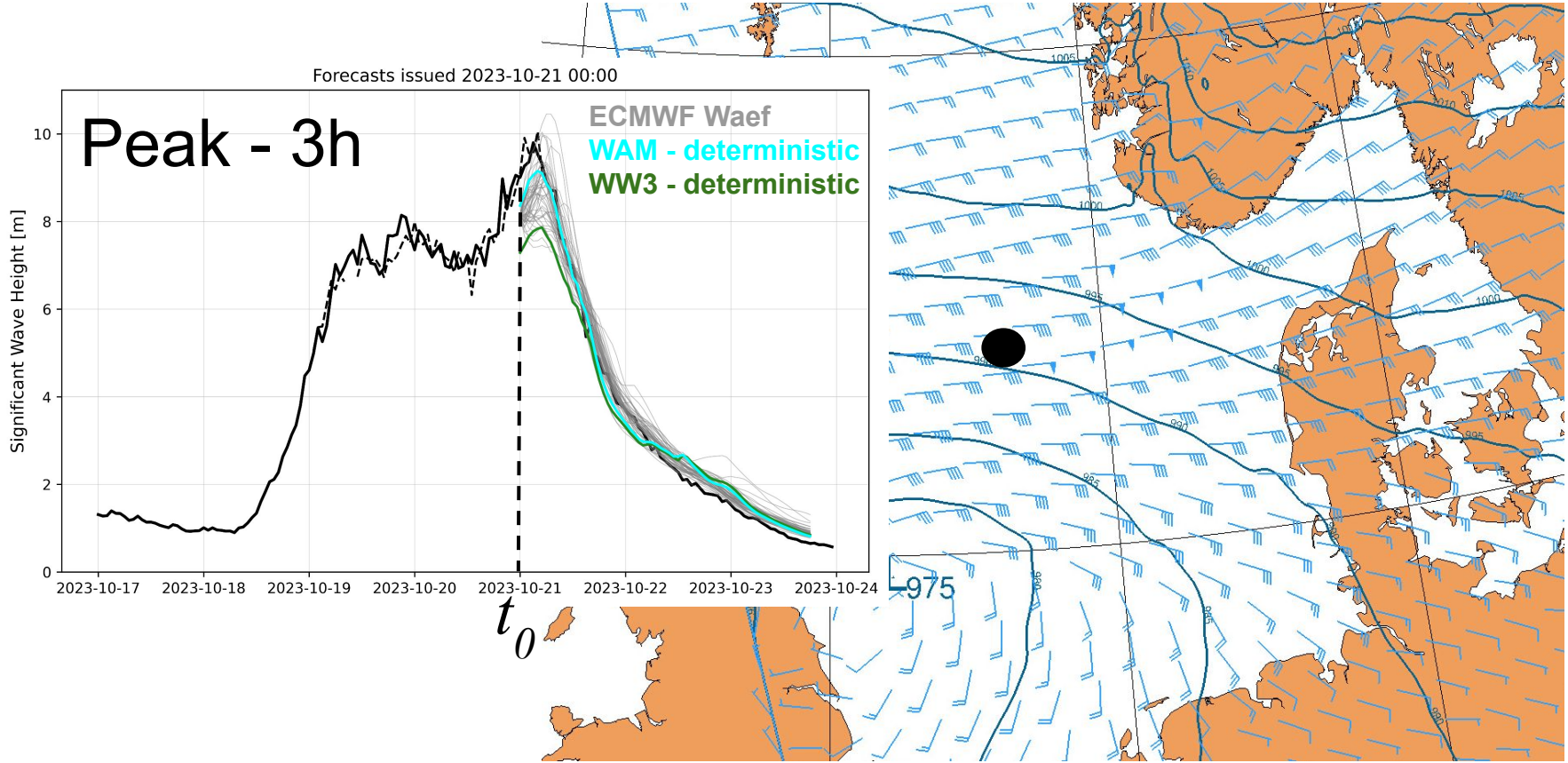

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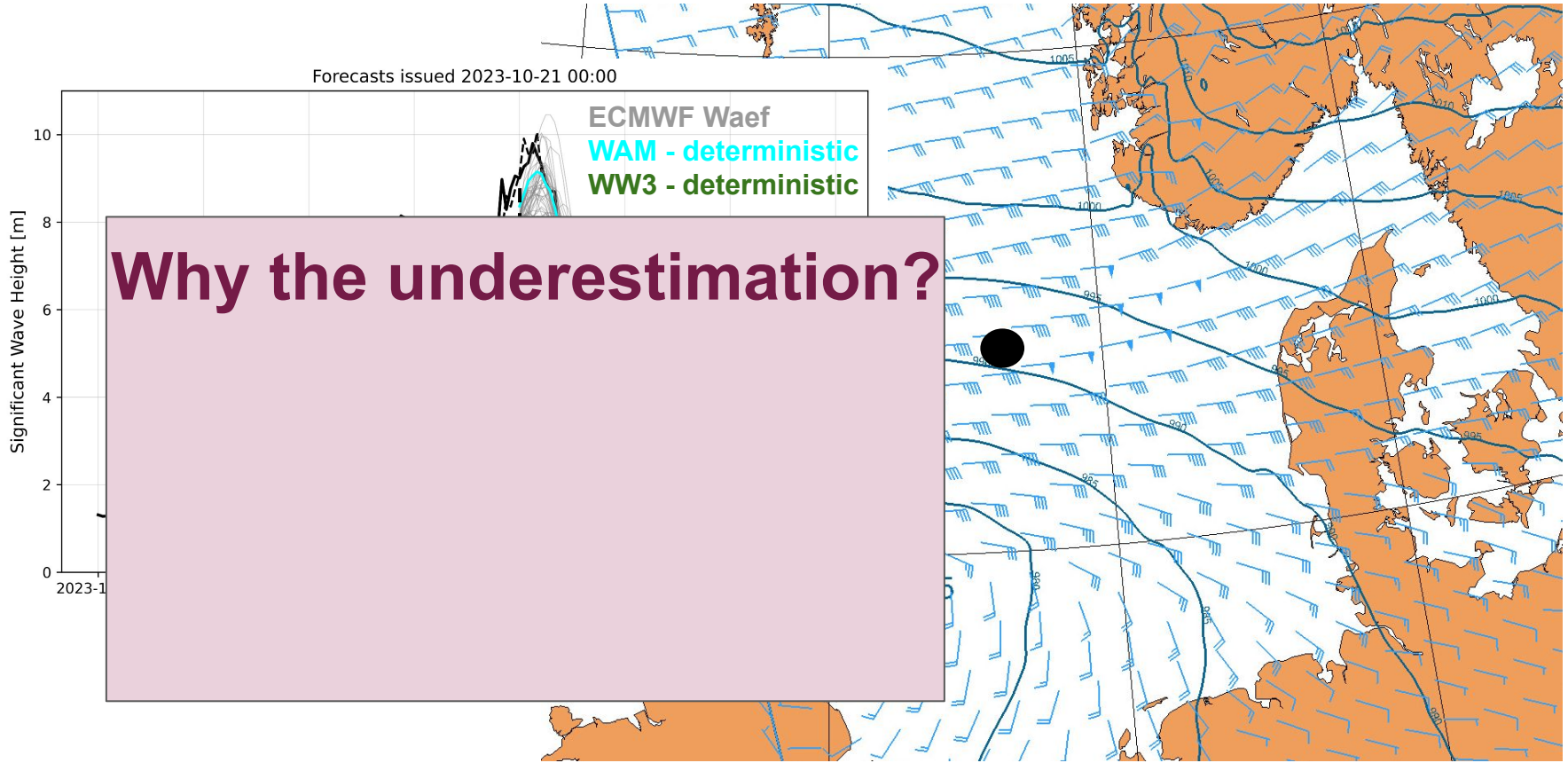
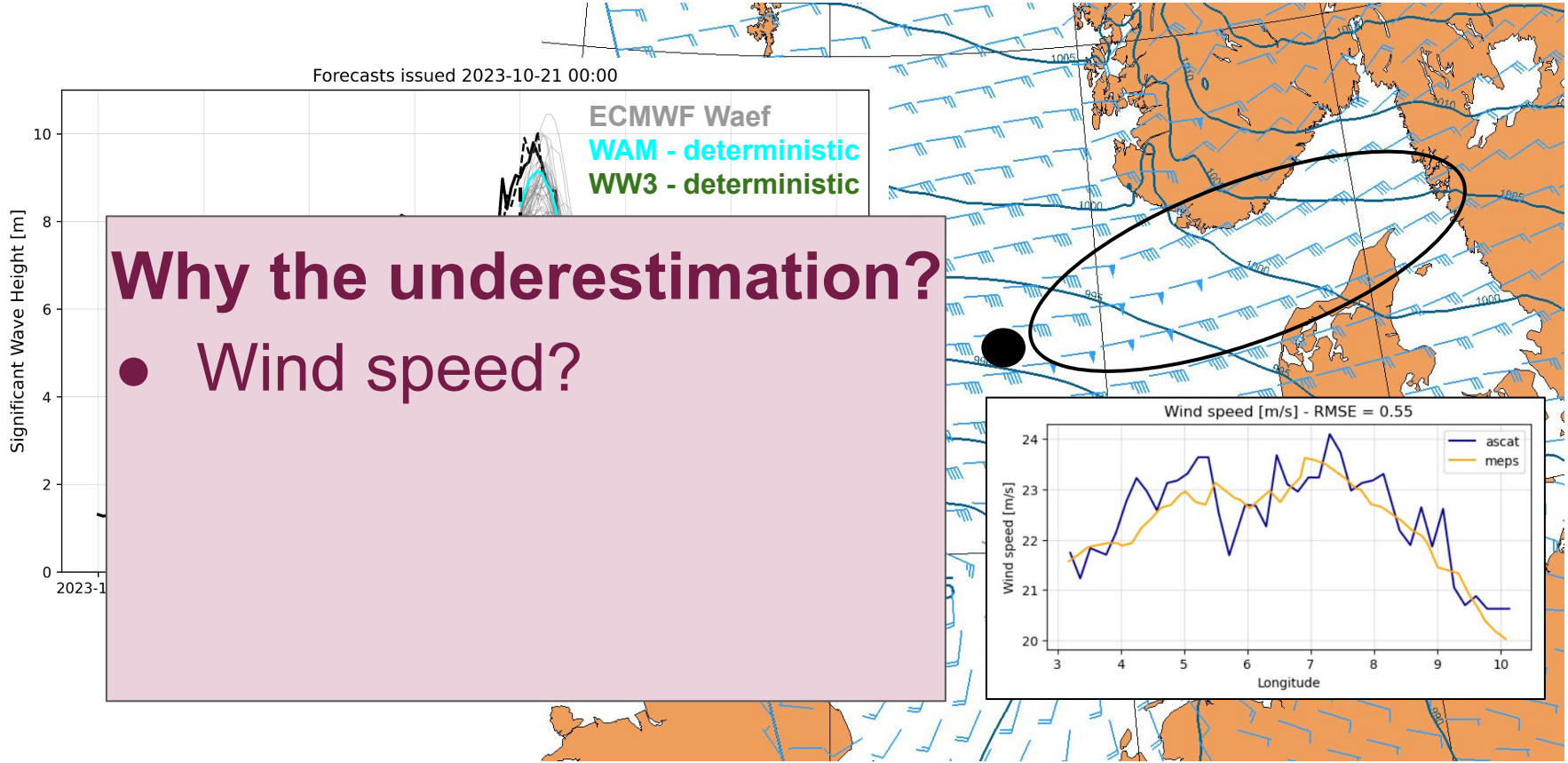


Why the underestimation?

October 2023 North Sea storm

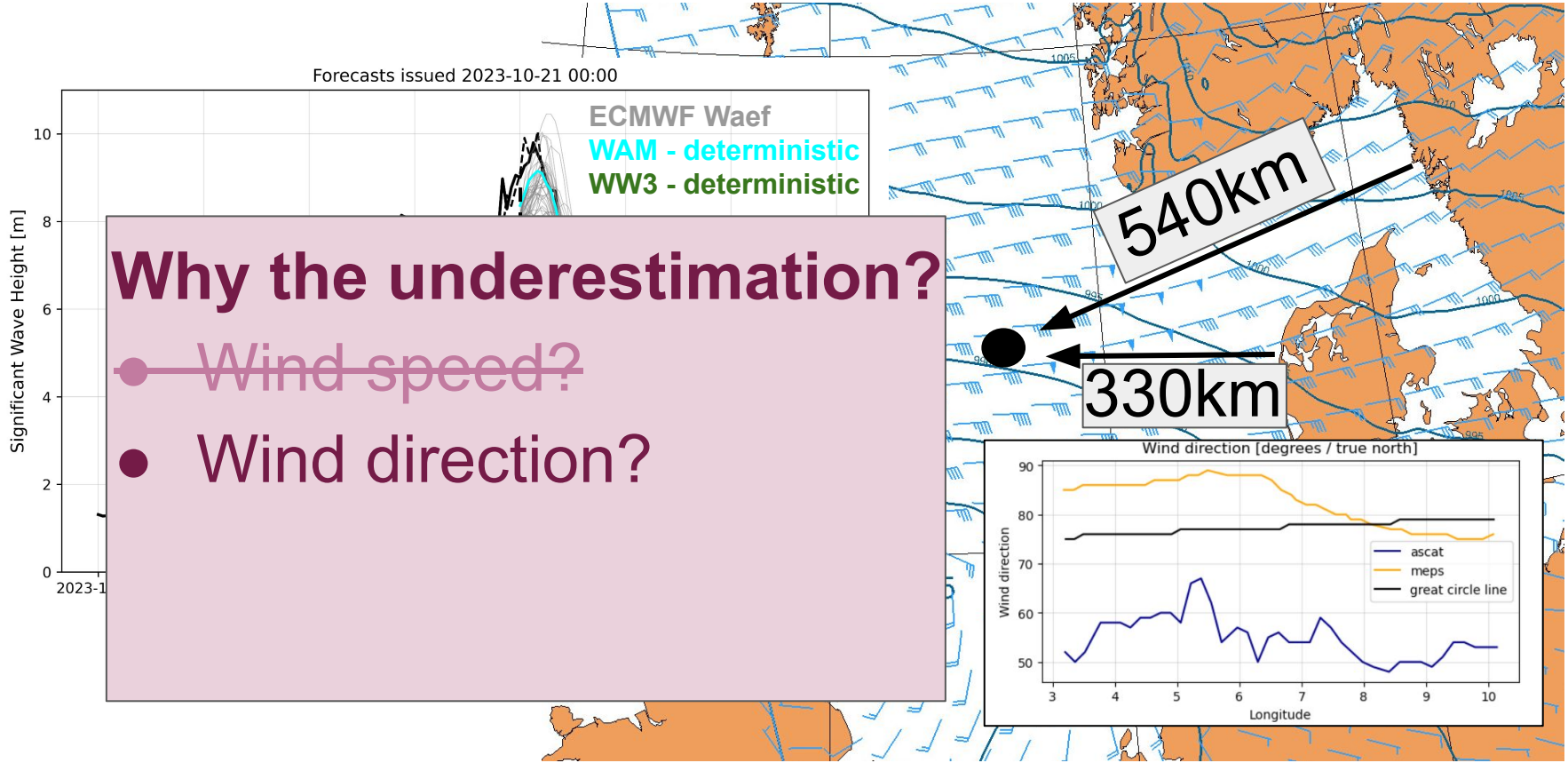


Why the underestimation?

- Wind speed?

Validation plot by Fabien Collas

October 2023 North Sea storm

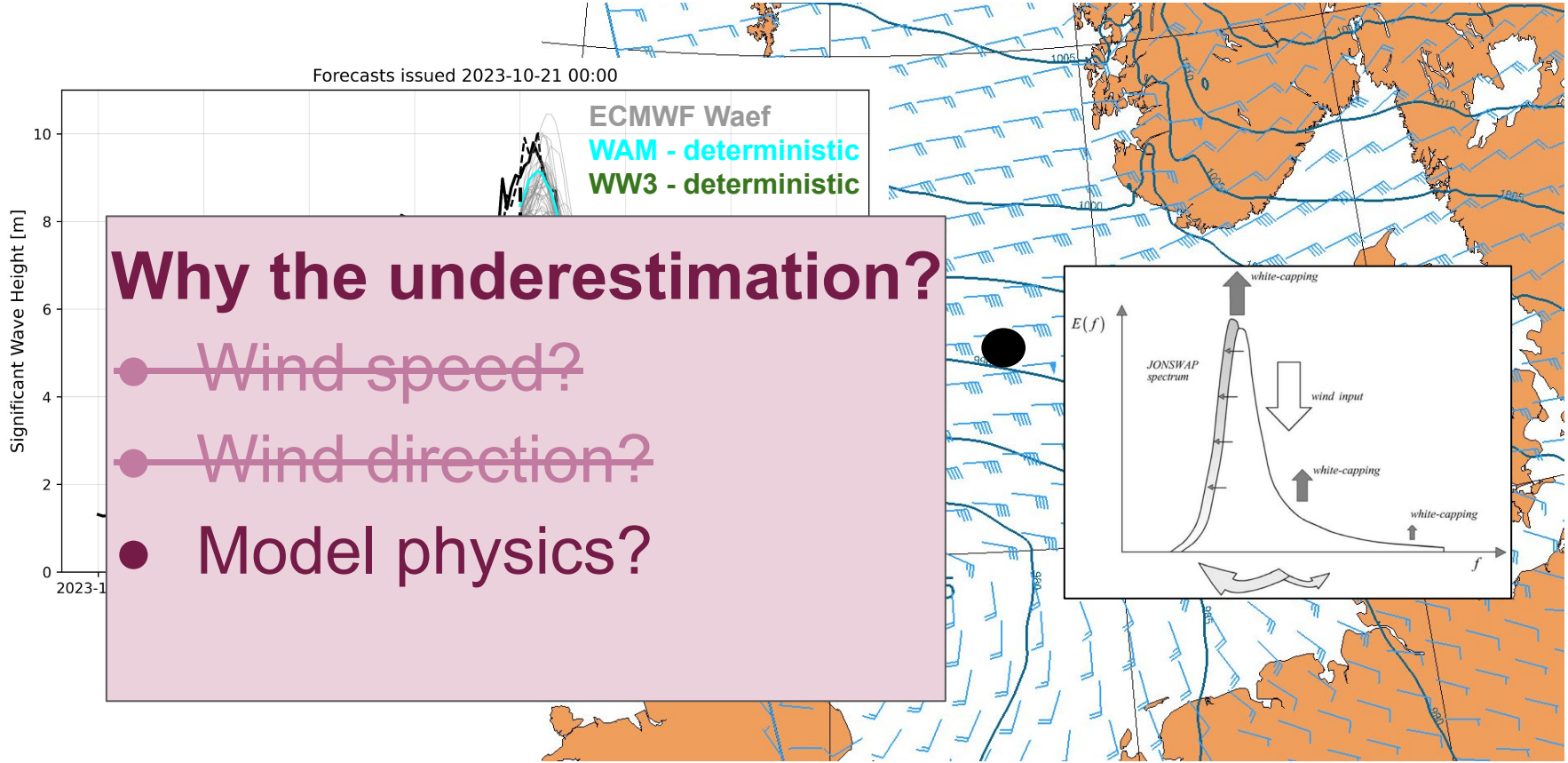


Why the underestimation?

- ~~Wind speed?~~
- Wind direction?

Validation plot by Fabien Collas

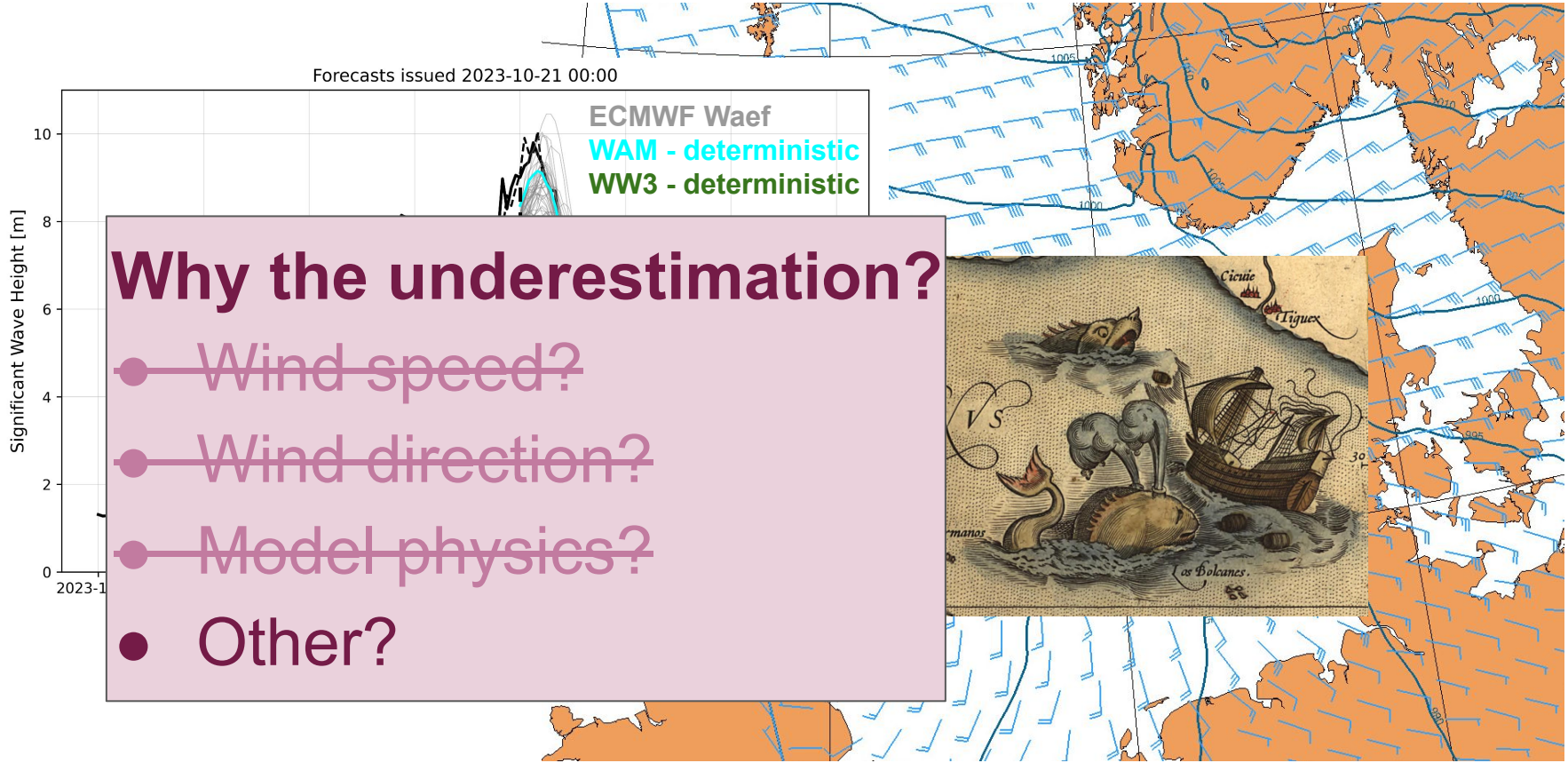
October 2023 North Sea storm



Why the underestimation?

- ~~Wind speed?~~
- ~~Wind direction?~~
- Model physics?

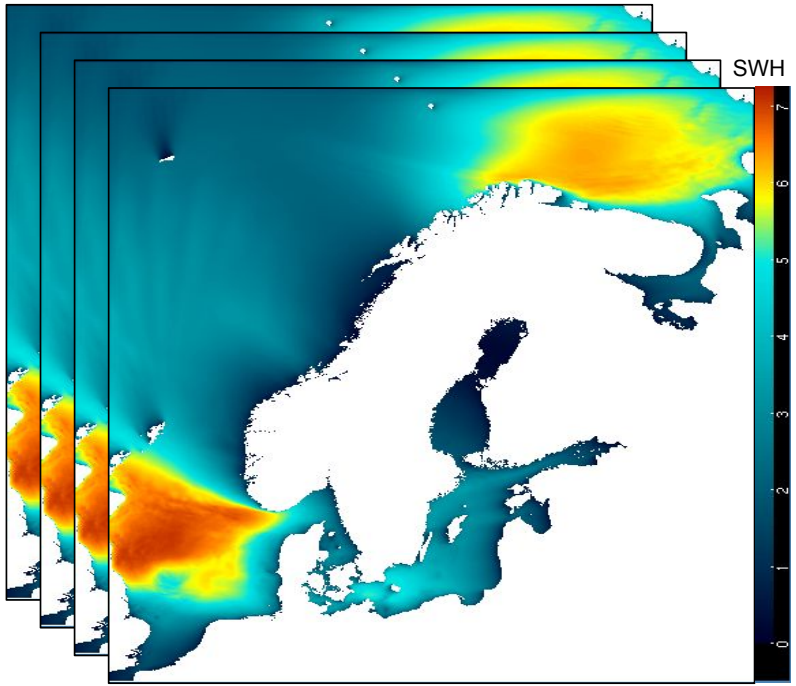
October 2023 North Sea storm



Why the underestimation?

- ~~Wind speed?~~
- ~~Wind direction?~~
- ~~Model physics?~~
- Other?

Remedy:
Regional high-resolution wave forecast ensemble (**WEPS**)



WEPS - WAVEWATCH III model setup

Model version: **v6.07**

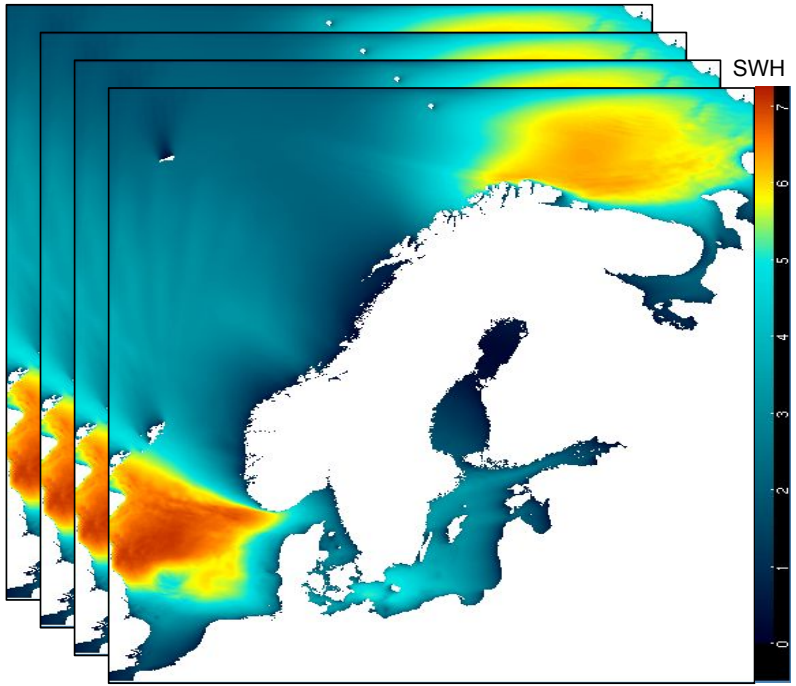
Horiz. resolution: **2.5km**

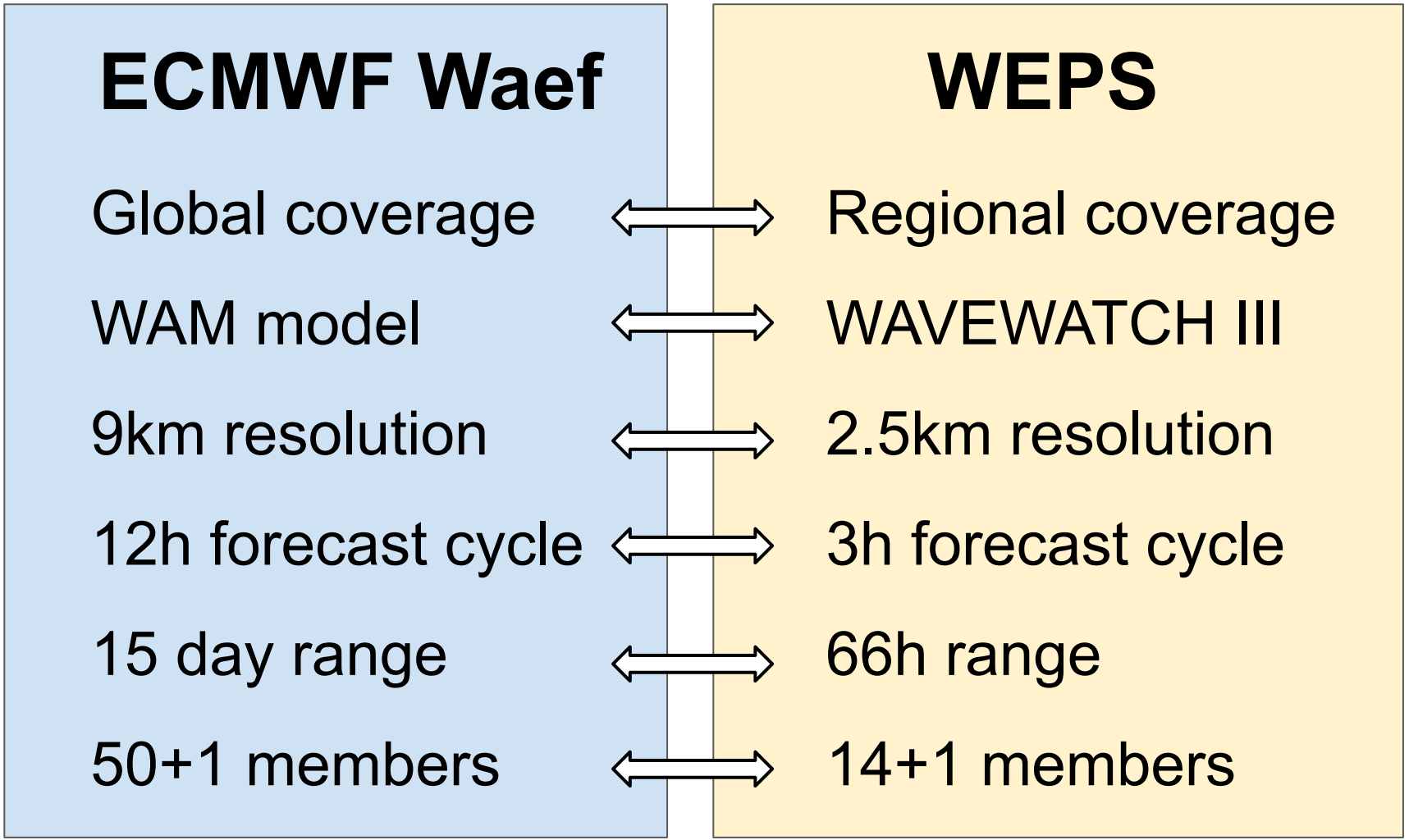
Physics: **ST4**

Wind forcing: **MEPS**

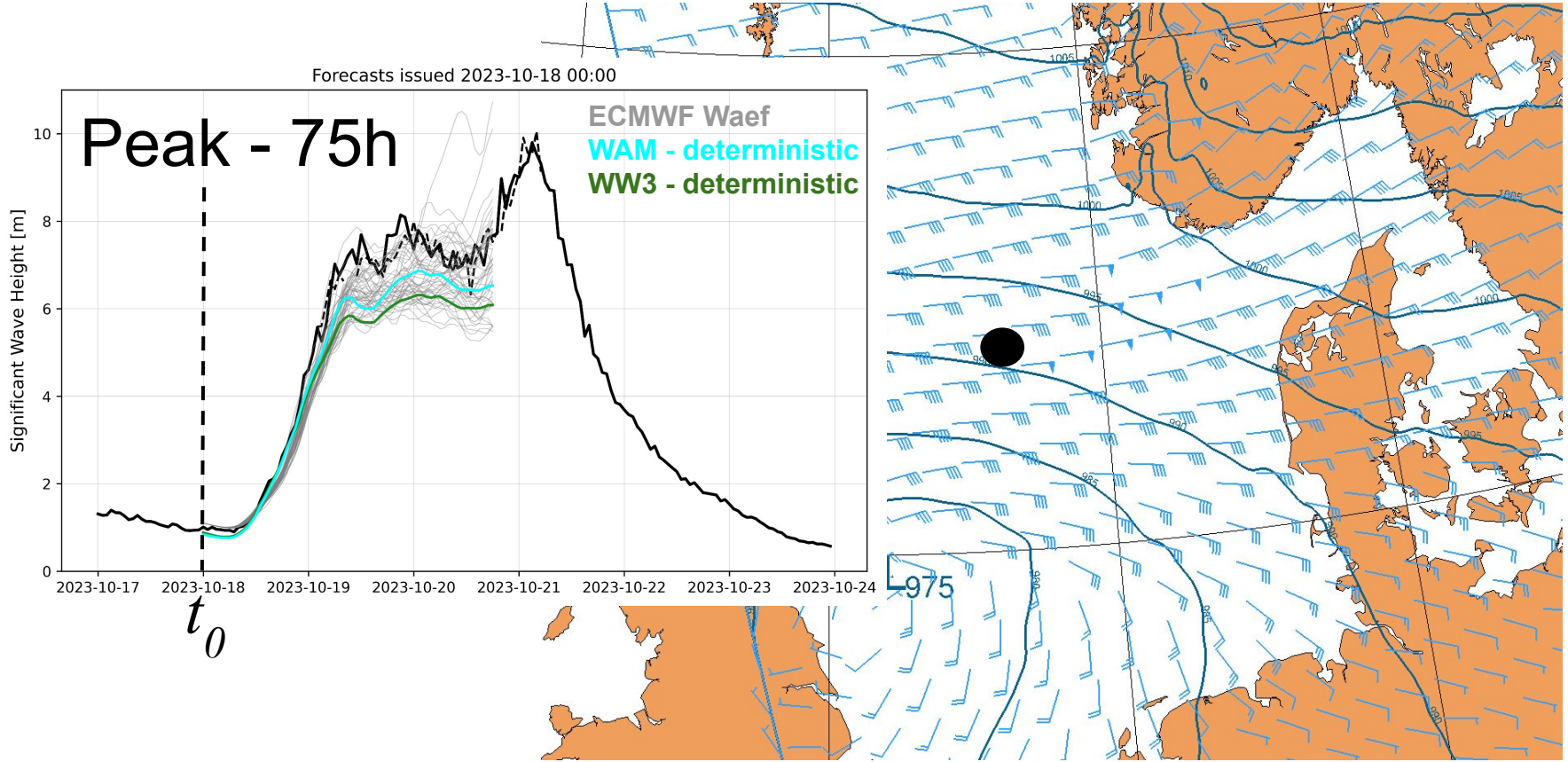
Boundaries: **ECMWF Waef**

BETAMAX: **1.75**




ECMWF Waef
WEPS
Global coverage
Regional coverage
WAM model
WAVEWATCH III
9km resolution
2.5km resolution
12h forecast cycle
3h forecast cycle
15 day range
66h range
50+1 members
14+1 members

October 2023 North Sea storm



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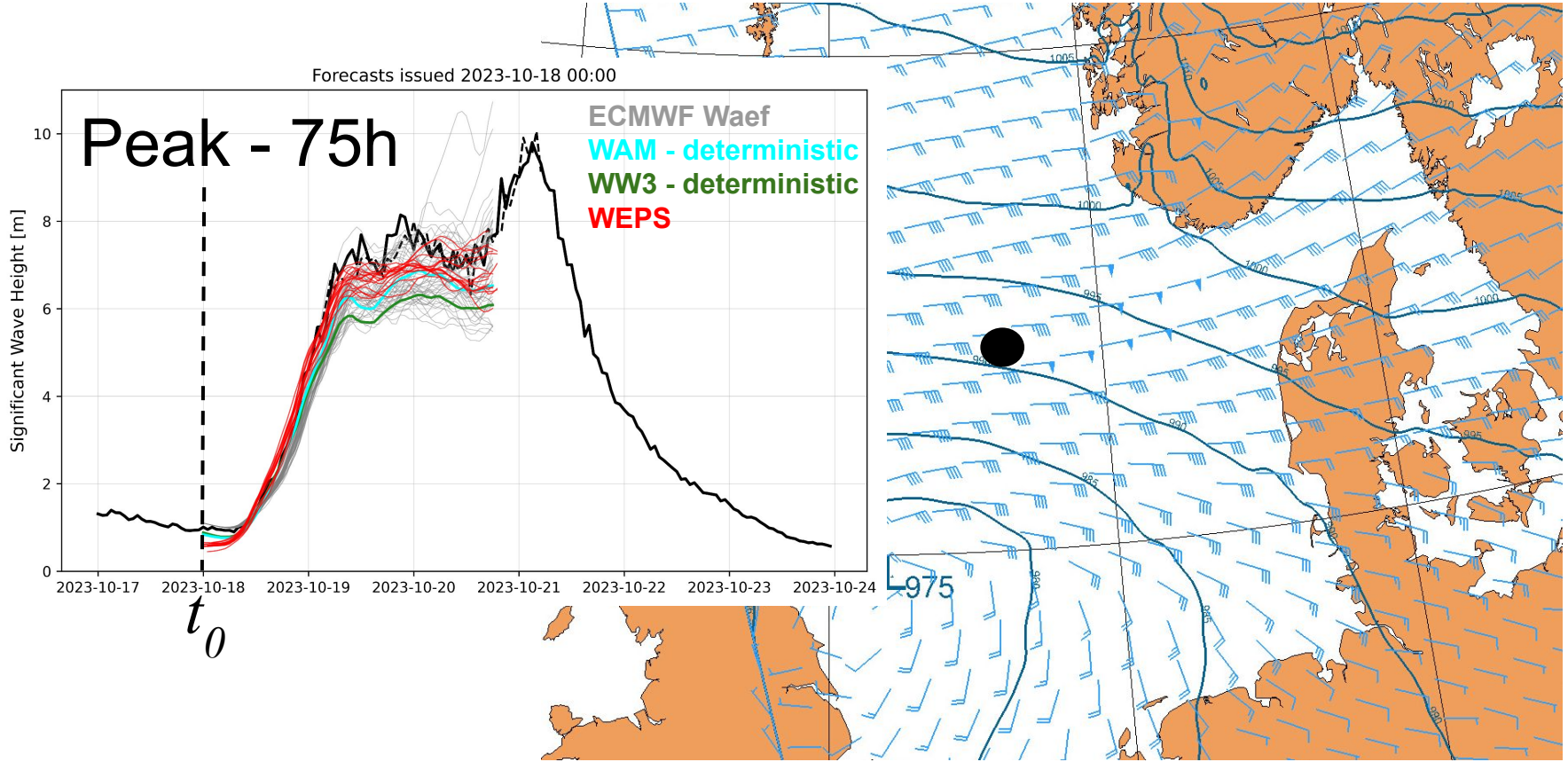

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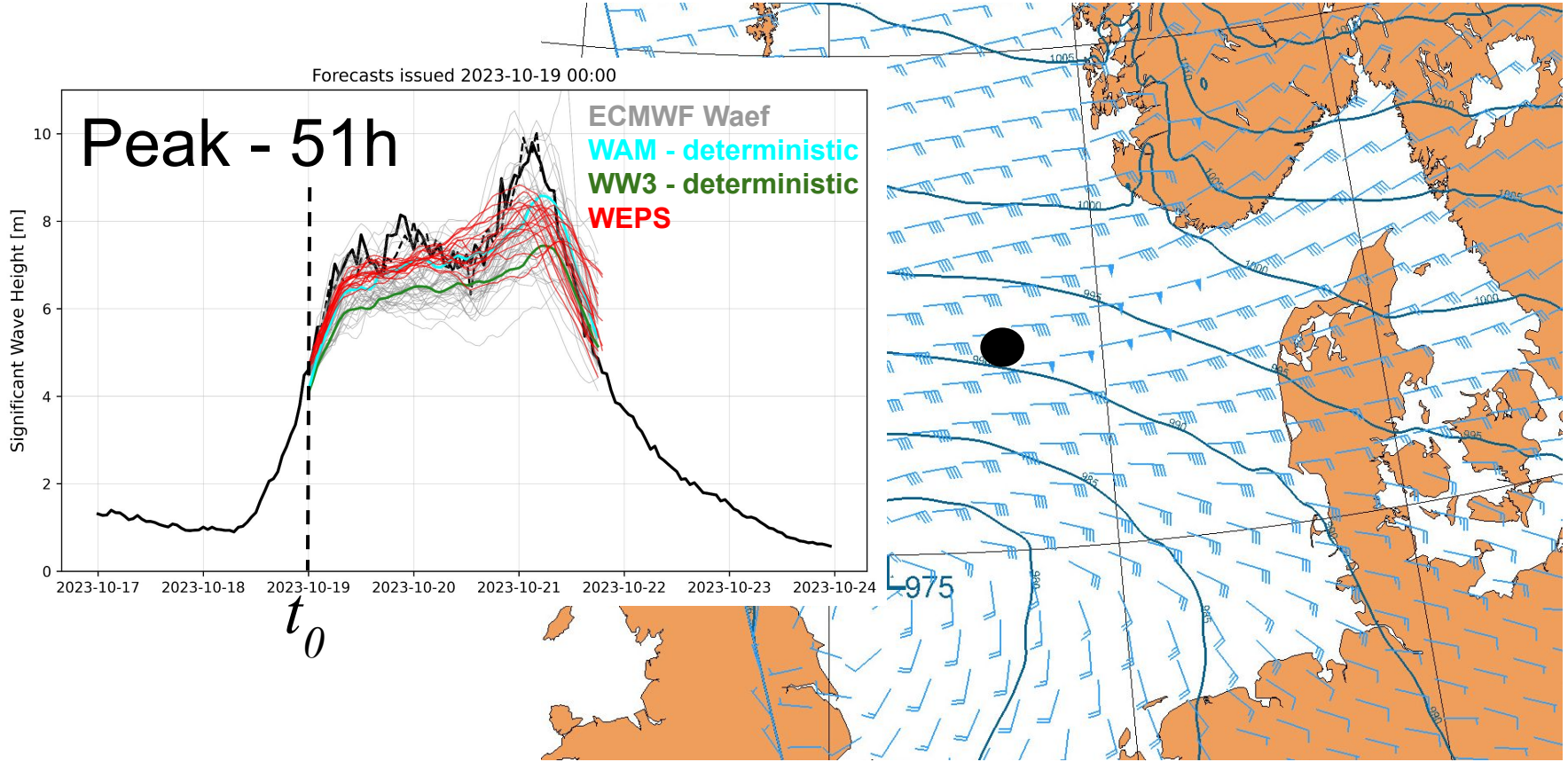

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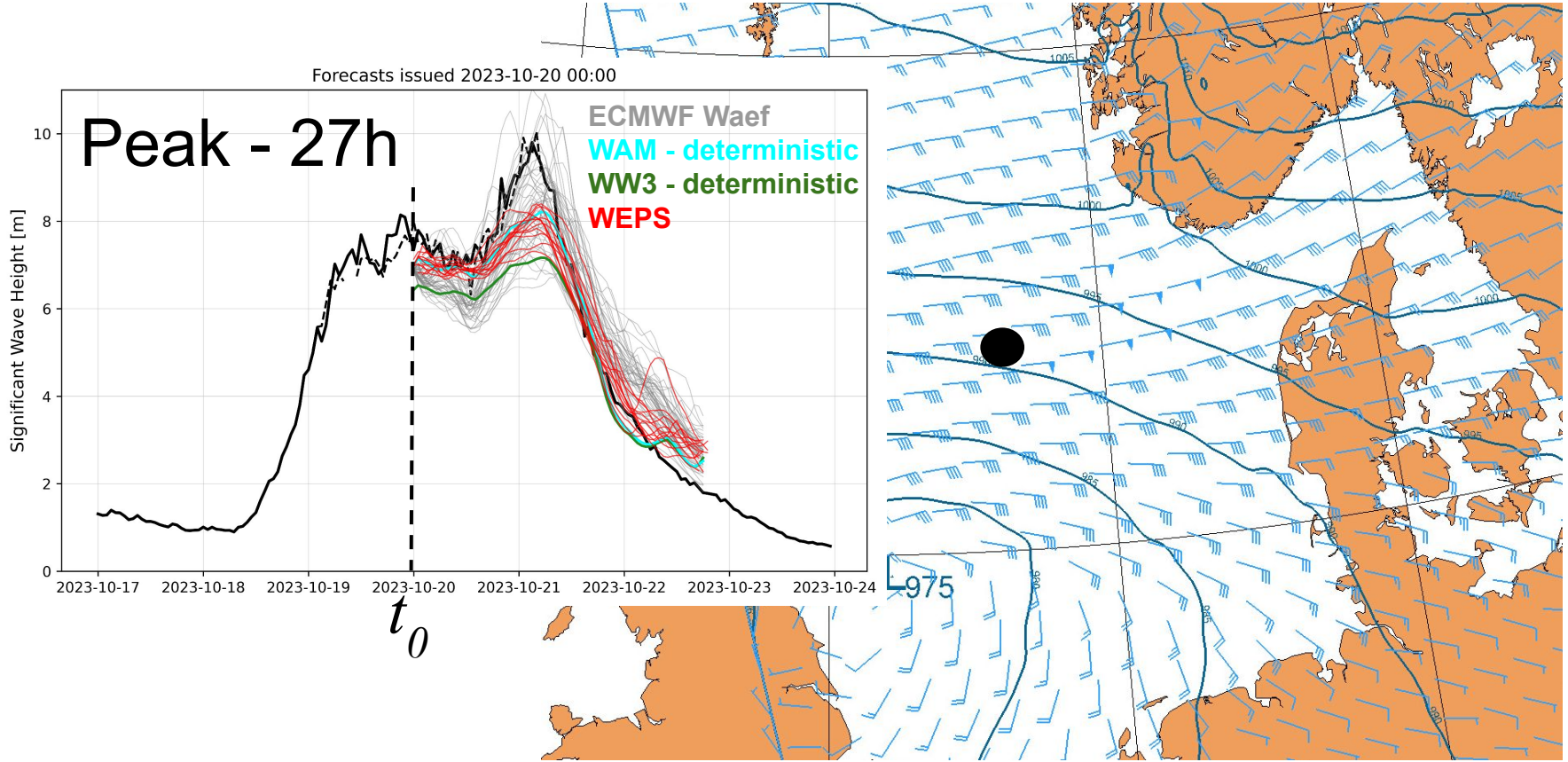

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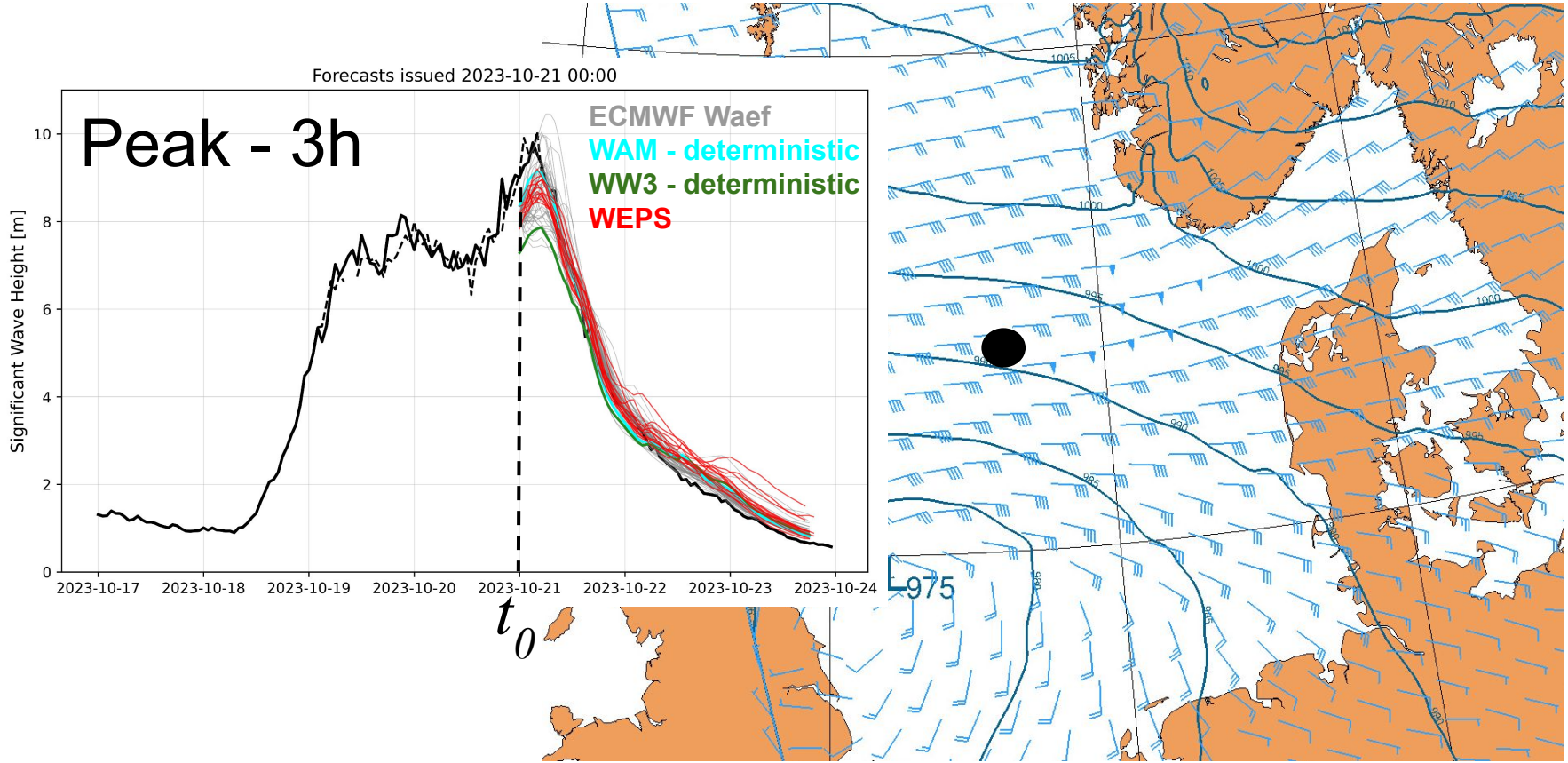

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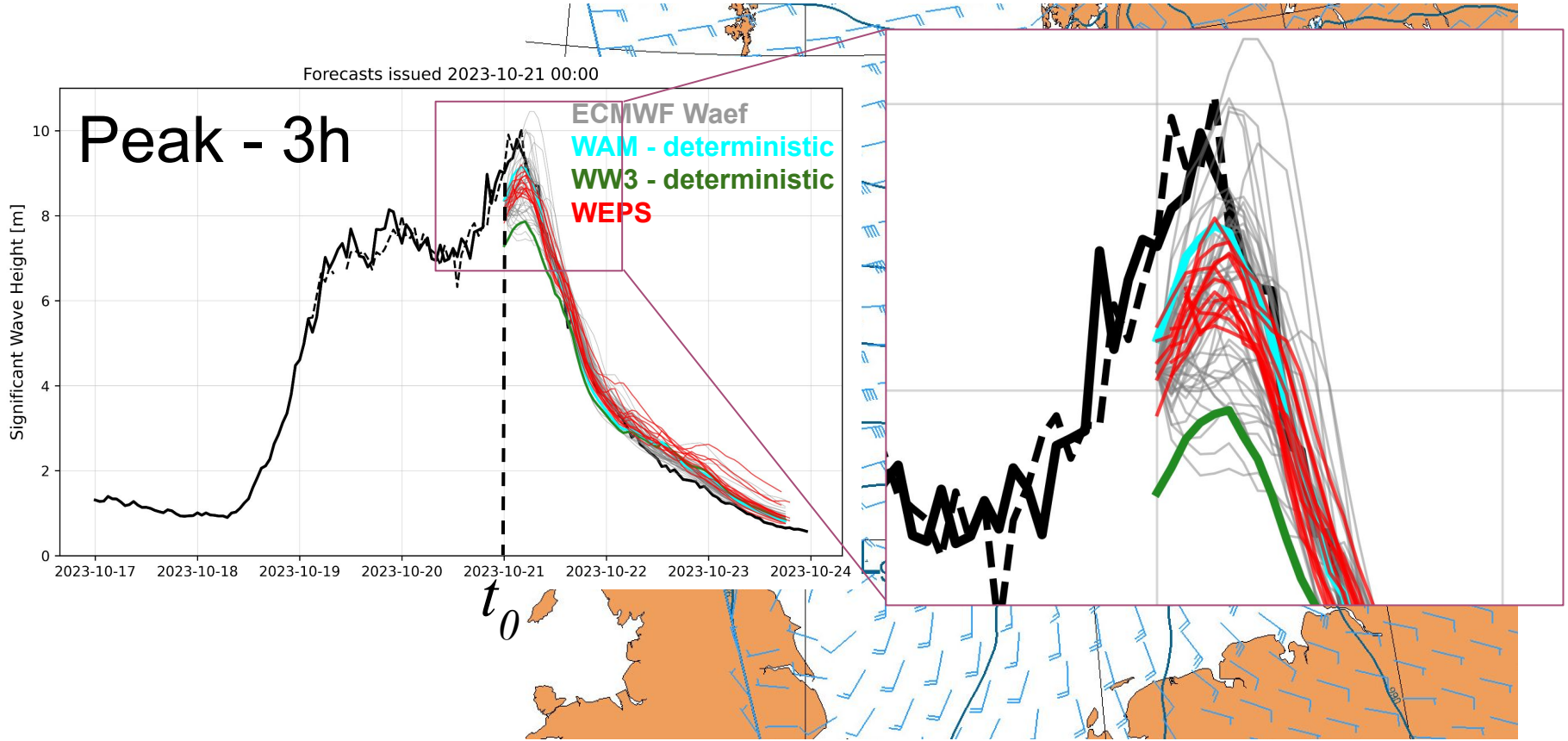
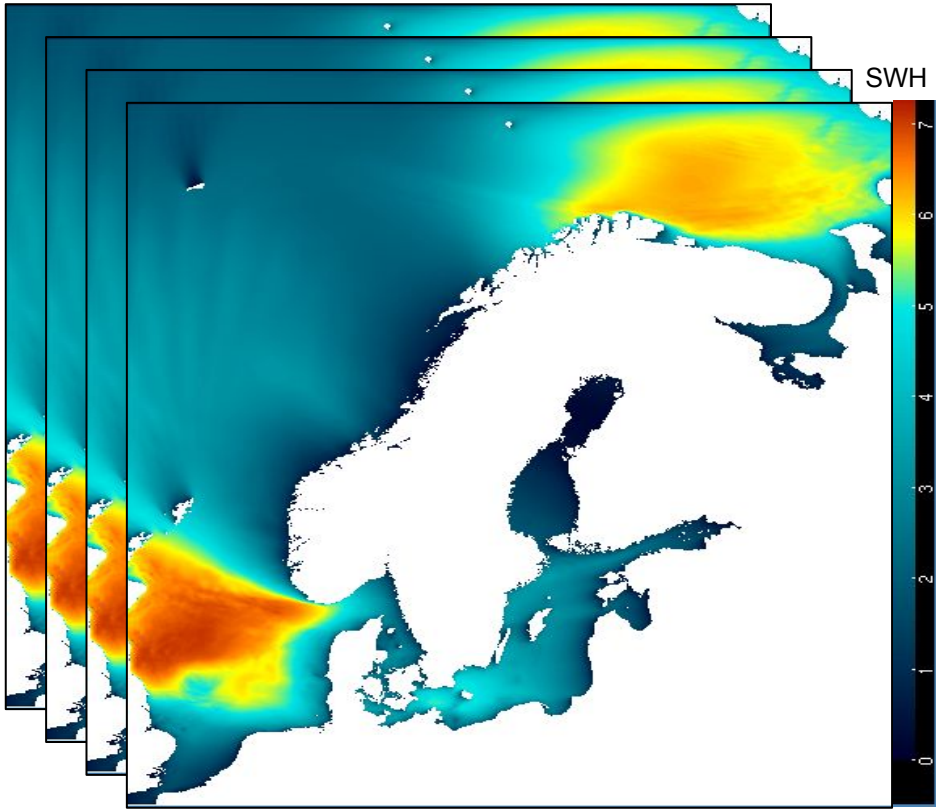


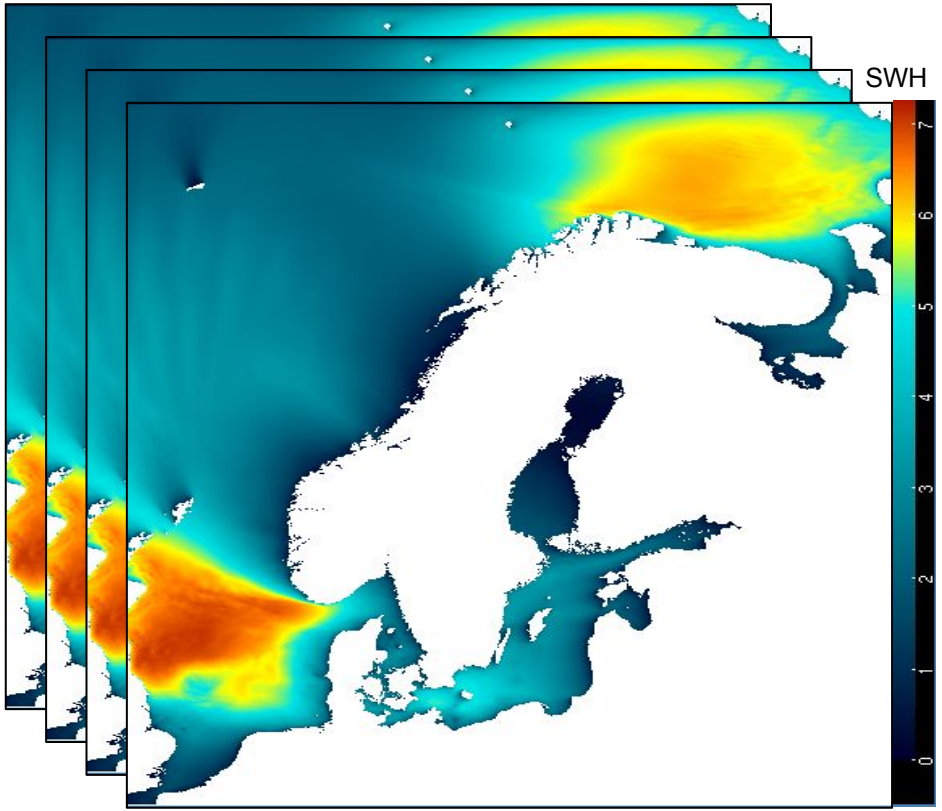
Benefits of new regional wave ensemble

- High resolution wind forcing



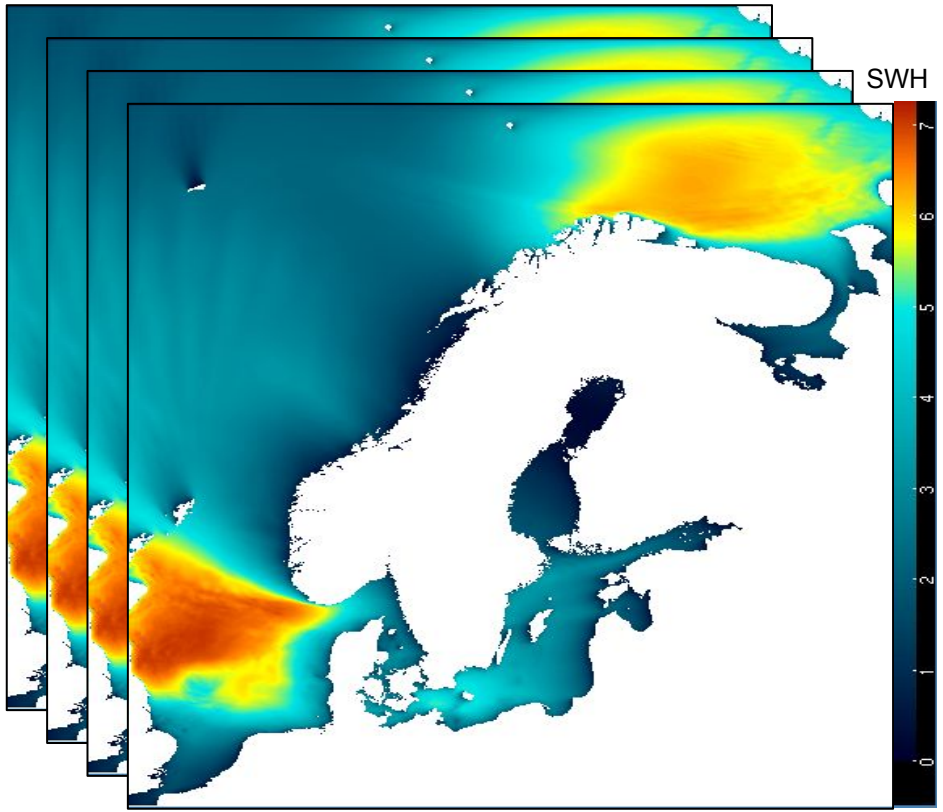
Benefits of new regional wave ensemble

- High resolution wind forcing
- Frequent forecast updates (every 3 hrs)



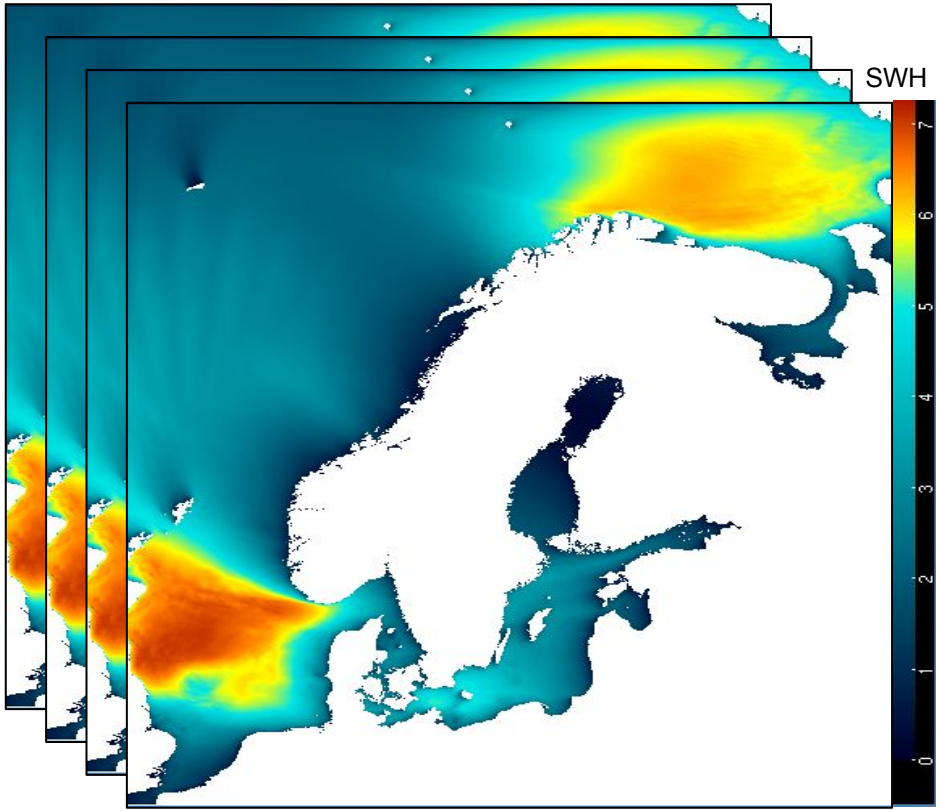
Benefits of new regional wave ensemble

- High resolution wind forcing
- Frequent forecast updates (every 3 hrs)
- Ensemble spread also at analysis



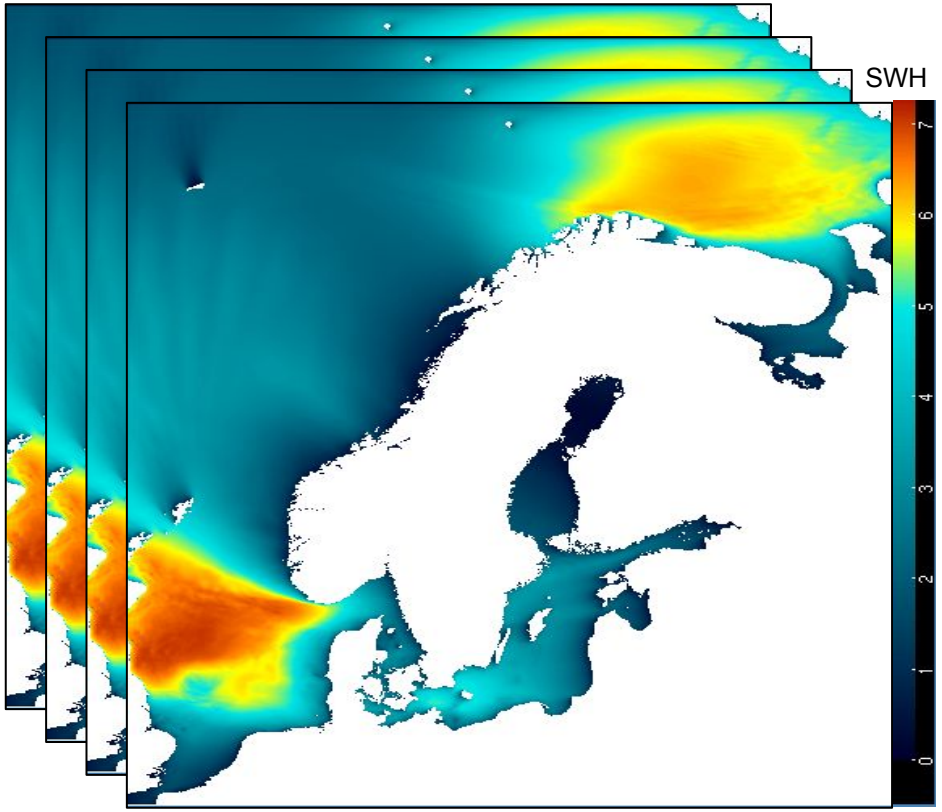
Benefits of new regional wave ensemble

- High resolution wind forcing
- Frequent forecast updates (every 3 hrs)
- Ensemble spread also at analysis
- Model parameters tuned to regional needs



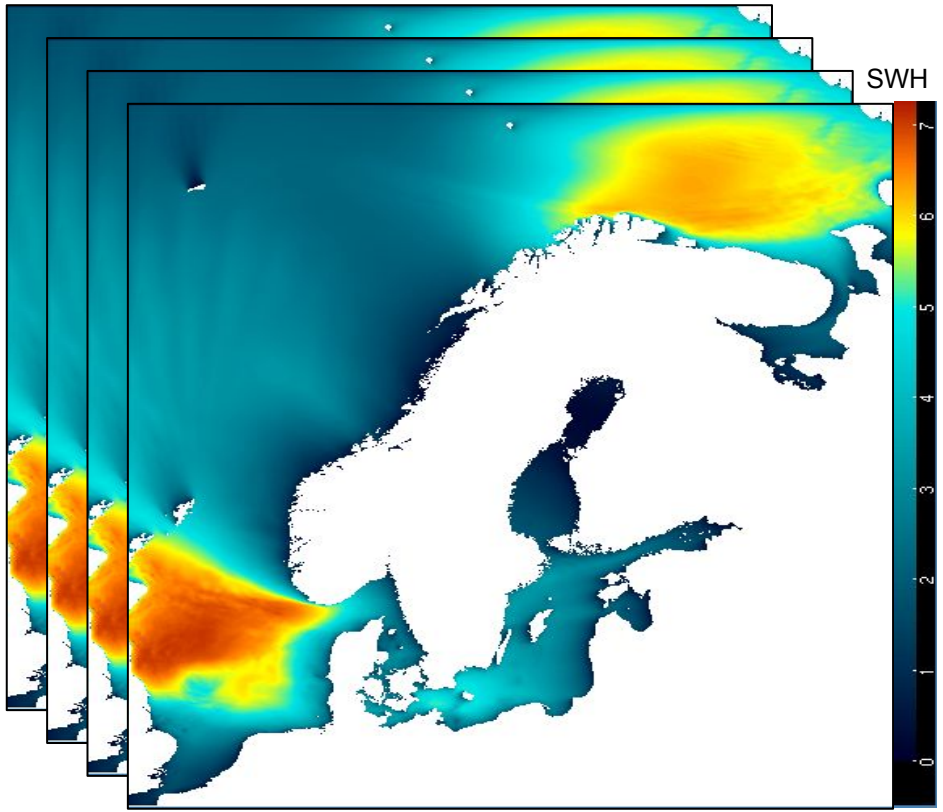
Ongoing work

- Validation and model parameter tuning



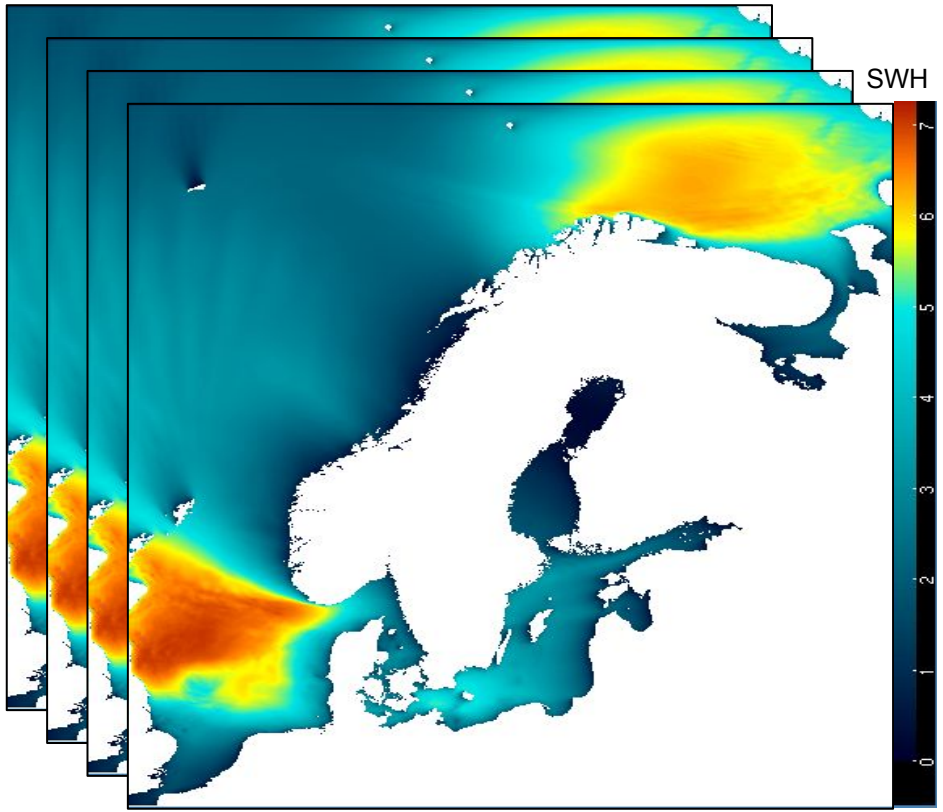
Ongoing work

- Validation and model parameter tuning
- Optimization (data-driven ensemble members?)



Ongoing work

- Validation and model parameter tuning
- Optimization (data-driven ensemble members?)
- Pre-operational forecasts in 2025-26 winter season



Questions?