



# Bris Powered by Forecast-in-a-Box

## A WMO pilot project for Malawi

AIM4Scale Workshop, Abu Dhabi

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Vojtech Tuma, Jenny Wong, Tiago Quintino  
**ECMWF**

Vegard Bønes, Thomas Nipen, Lene Østvand, Nico Budewitz et al.  
**MET Norway**

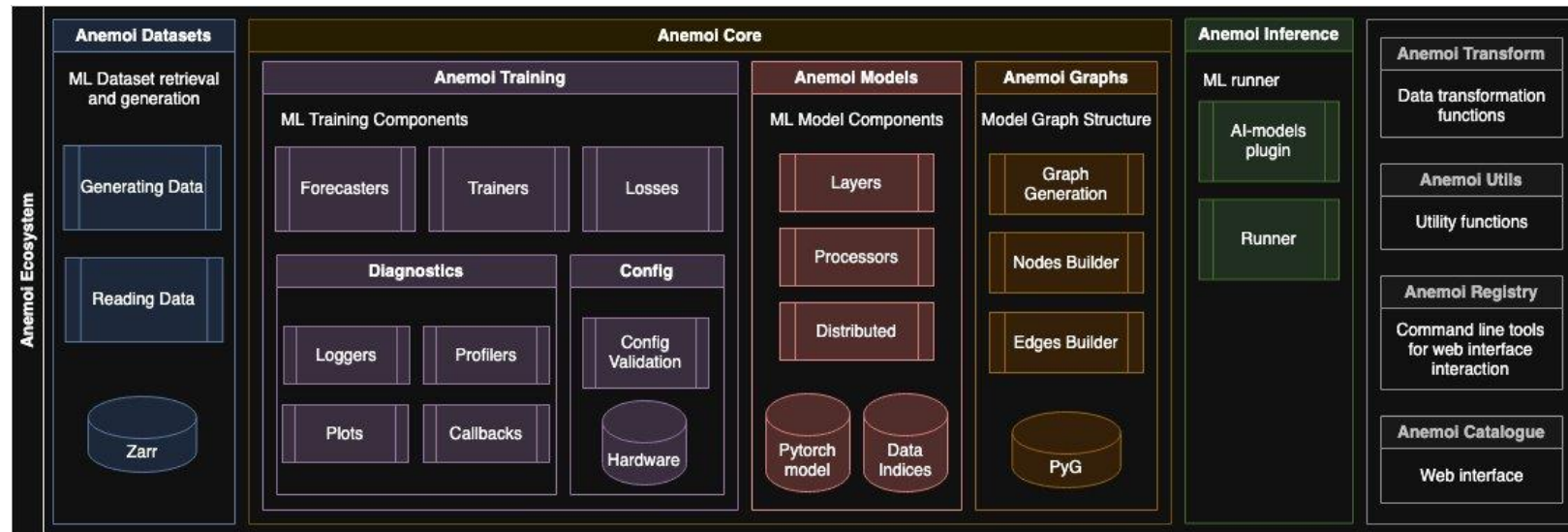


# AIFS: Artificial Intelligence Forecasting System



# What is Anemoi?

- *Open-source framework* that provides a complete toolkit to develop data-driven weather models – from data preparation through to inference
- A *highly modular framework* organised into different Python packages



# Who is Anemoi?

Winner of this 2025 EMS  
Technology Award

**anemoi** 

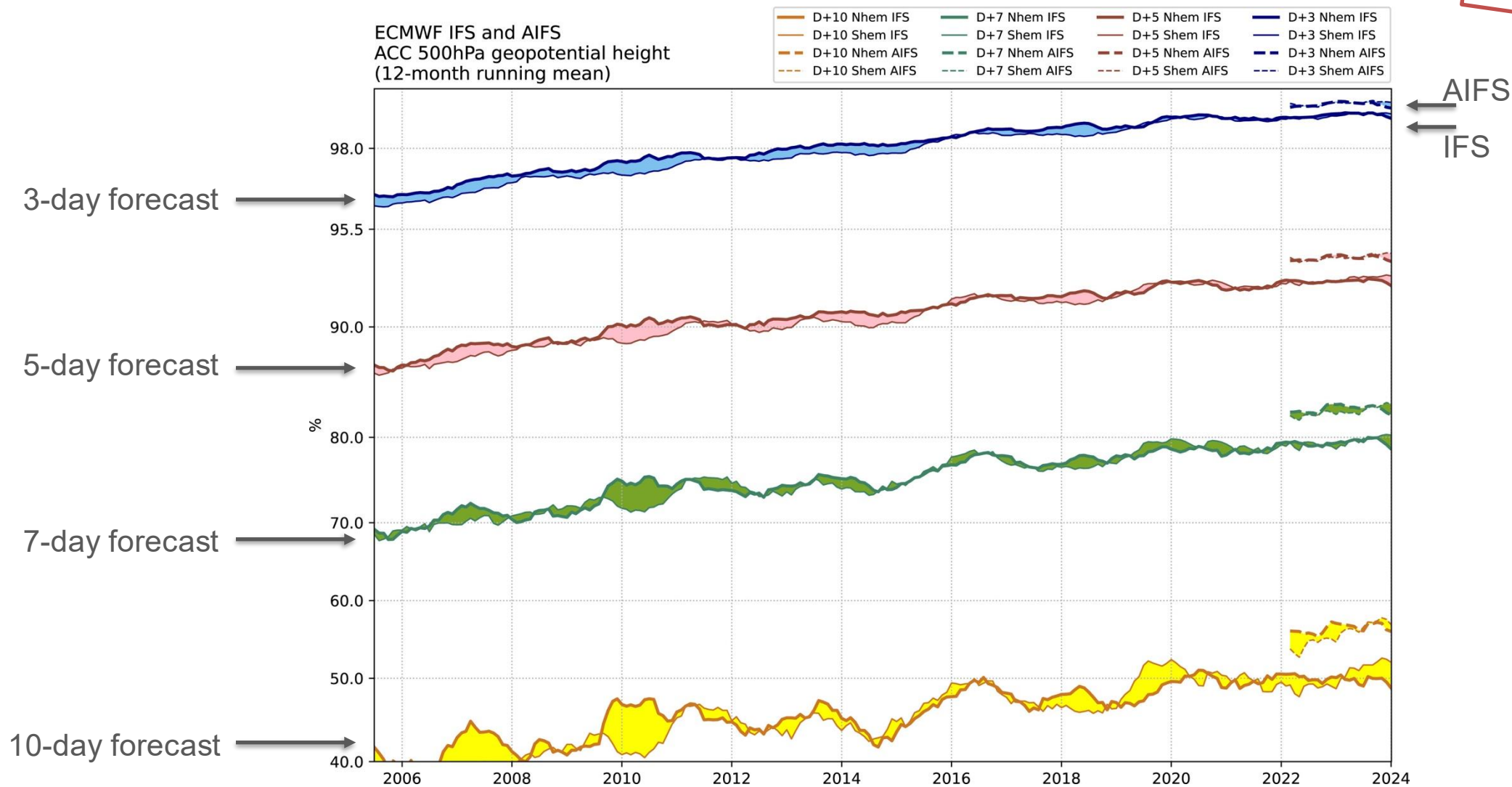


Pooling of resources without  
resulting in a single forecasting  
model

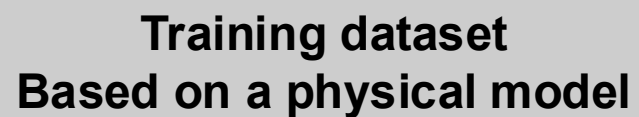
Open-source development driven by European Meteorological Centers and ECMWF

# Verification of AIFS against IFS: Accuracy of Z500 forecasts

OPERATIONAL  
AIFS SINGLE



following Bauer et al. 2015

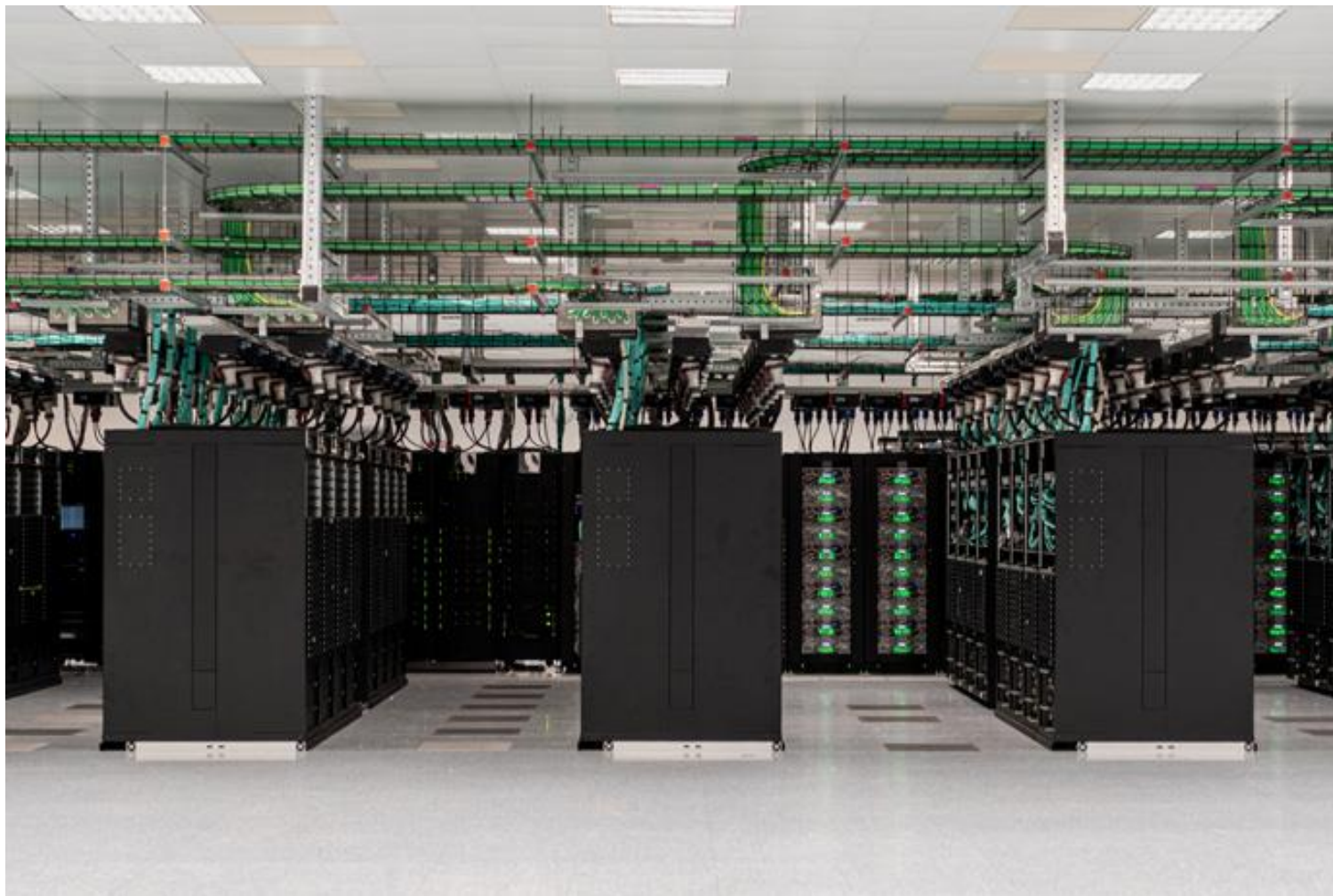


0.3  
per forecast

## Unit: System Billing Units (SBU)

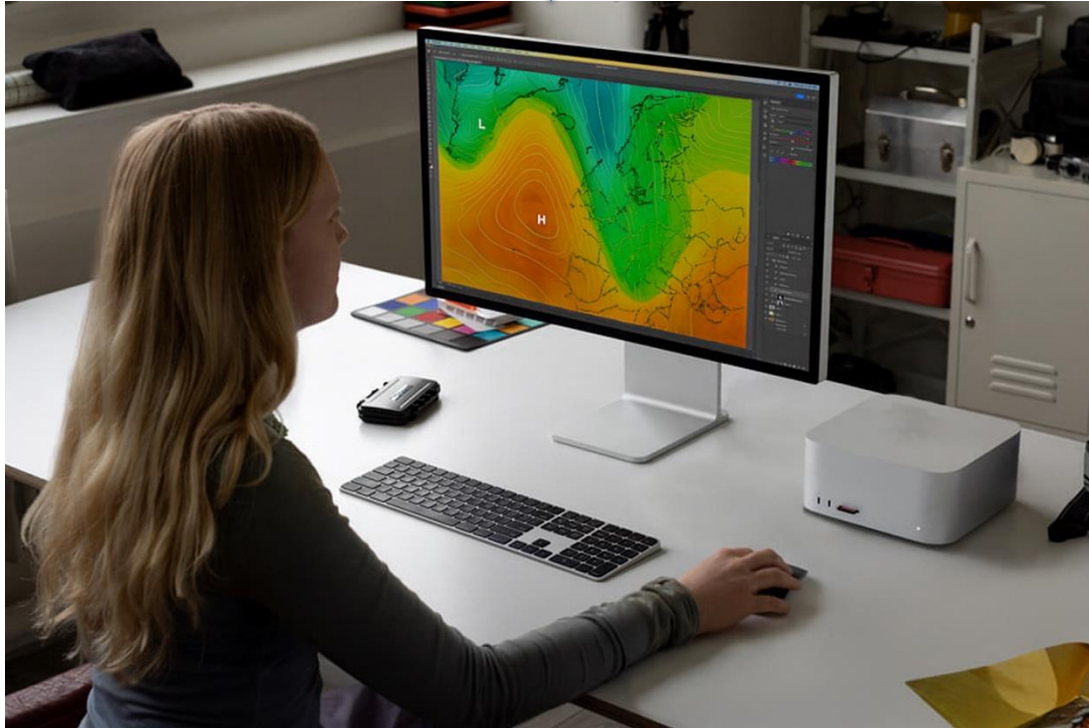
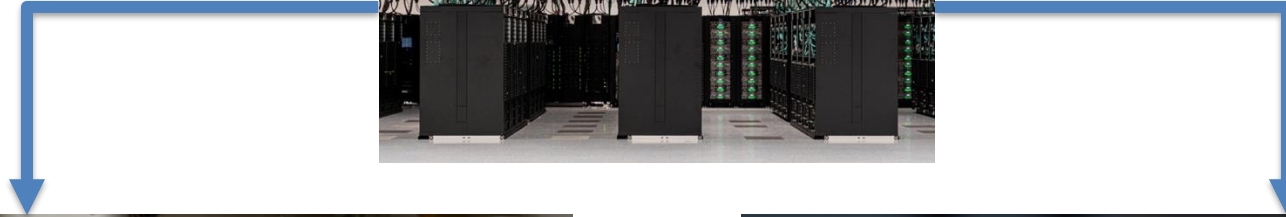
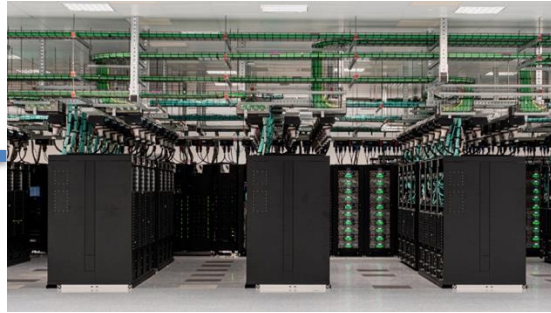


# High Performance Computing at ECMWF

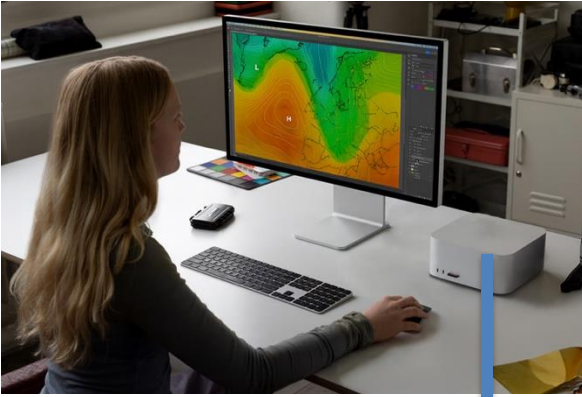


**ECMWF 50-year anniversary!**

# ***From Supercomputer to Super Convenient!***



# Forecast-in-a-Box: a Forecasting System on your Desk



New Paradigm:

Instead of shipping huge forecast data, we can send the model instead

Give them the “**box**” that produces the data



earthkit

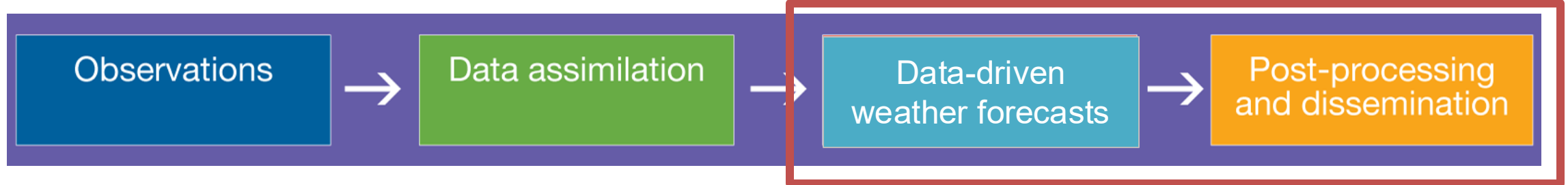
anemoi

Note: it is a virtual box, NOT hardware!

# The Earthkit Ecosystem



# Forecast-in-a-Box – What is it?



- **Forecast products, not only model outputs**
  - Includes all the the product generation and processing capabilities
  - Includes catalogue of products
  - Visualization of graphical products
- **Packaged in a 'Box'**
  - Easy to Install, Run and Use
  - Hardware agnostic - “Whatever works for you ...”
  - Workflow designed to work on resource constrained environments
  - Model, products and execution environment are fully configurable

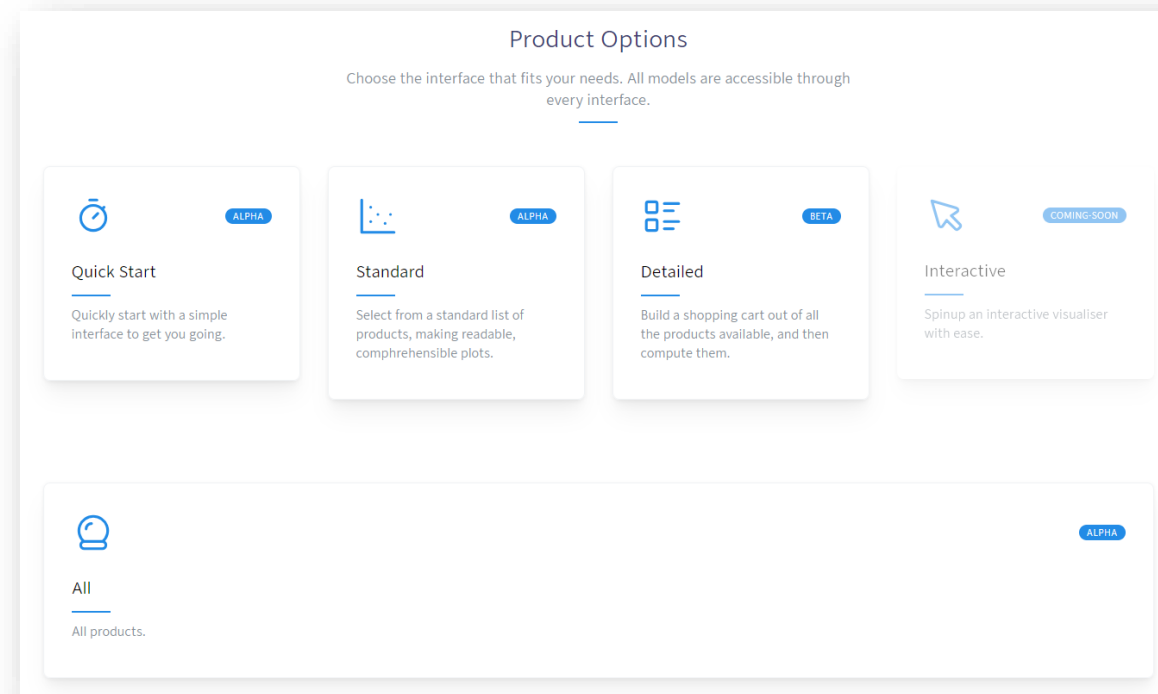
# Forecast-in-a-Box – “What’s in the box?”





# Forecast-in-a-Box – “What’s in the box?”

- **Application containing UI + Catalogue**
  - Provides control to the user, whilst keeping it accessible



# Forecast-in-a-Box – “What’s in the box?”



- **Task Definitions**

- Constructed from Anemoi and Earthkit functions



*Fetch Initial Conditions*

Regrid and Interpolate

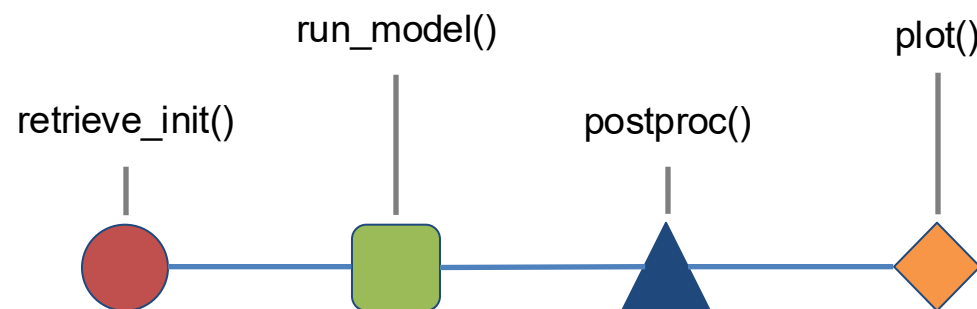
*Execute ML model*



*Visualise*

Transform outputs

*Compute statistics*

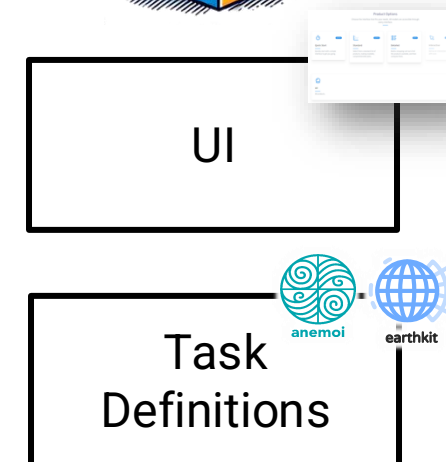
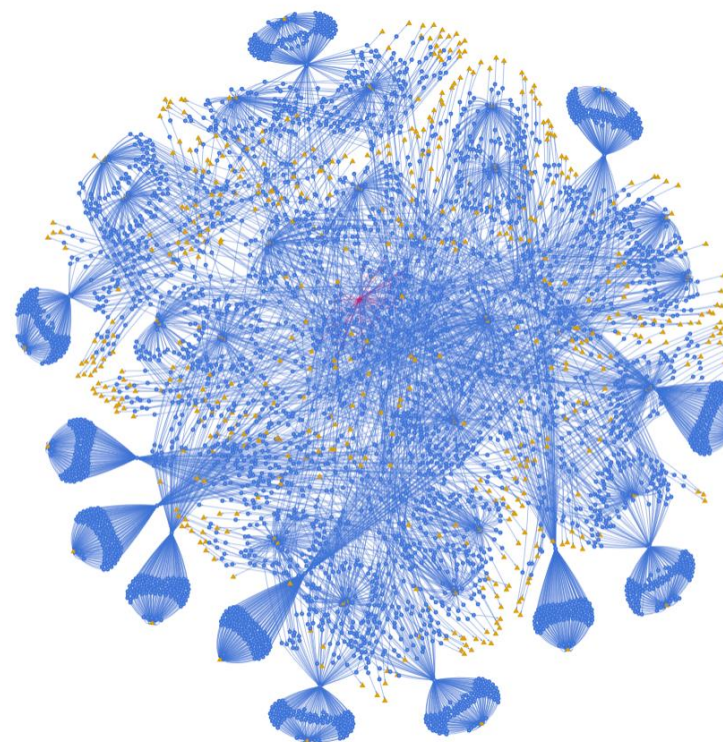
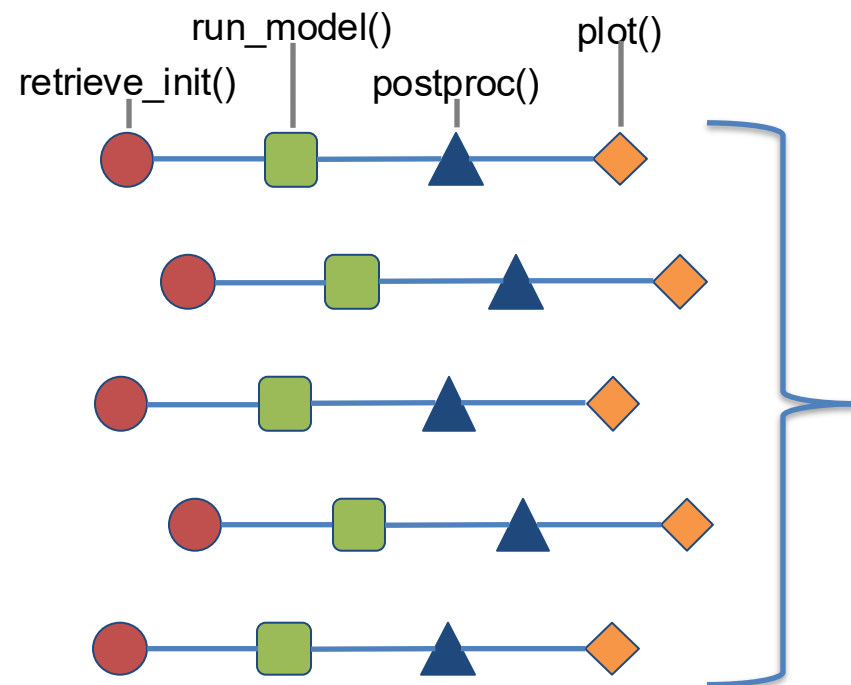


# Forecast-in-a-Box – “What’s in the box?”



- **Orchestration**

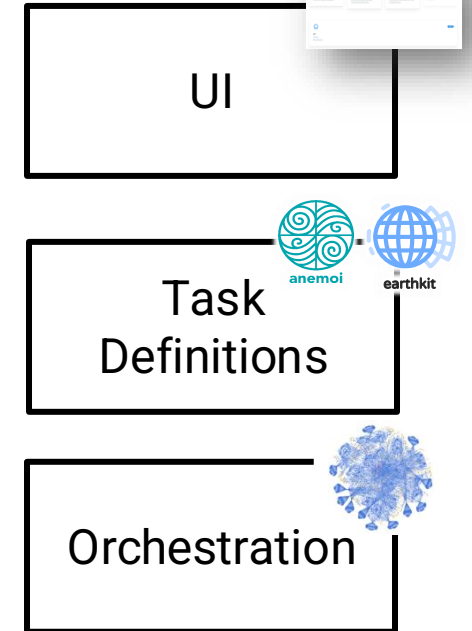
- Creation of a series of graphs from products specifications
- Construction of meta graph and scheduling



# Forecast-in-a-Box – “What’s in the box?”

- **Execution Layer**

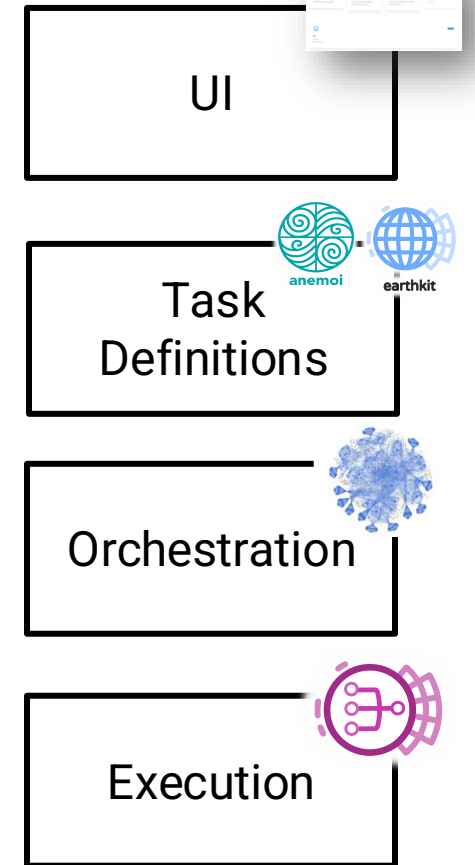
- Executes the tasks graph on the computing infrastructure
- Data caching and persistence layer
- Optimizing for data colocation and transfer
- All of that in memory



# Forecast-in-a-Box – “What’s in the box?”

- **Putting it all together**

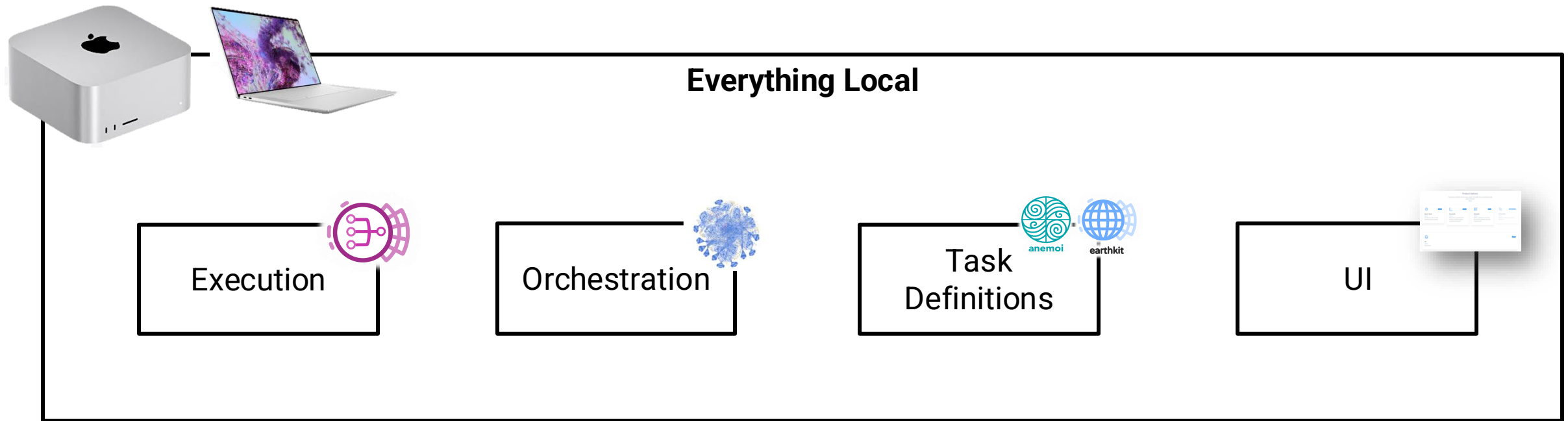
- A complete forecasting system
- Capable of running any Anemoi-compatible model inference
- Runs ECMWF’s full operational post-processing software
- Provides ECMWF production quality graphs and products





# Forecast-in-a-Box – “How to run the box?”

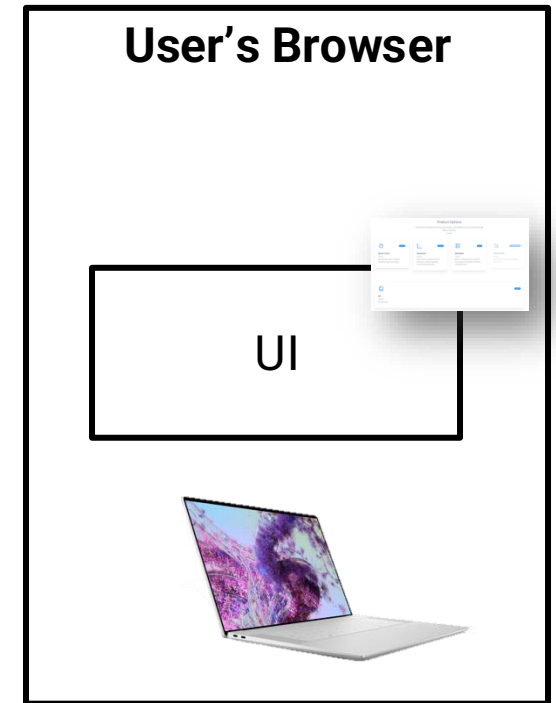
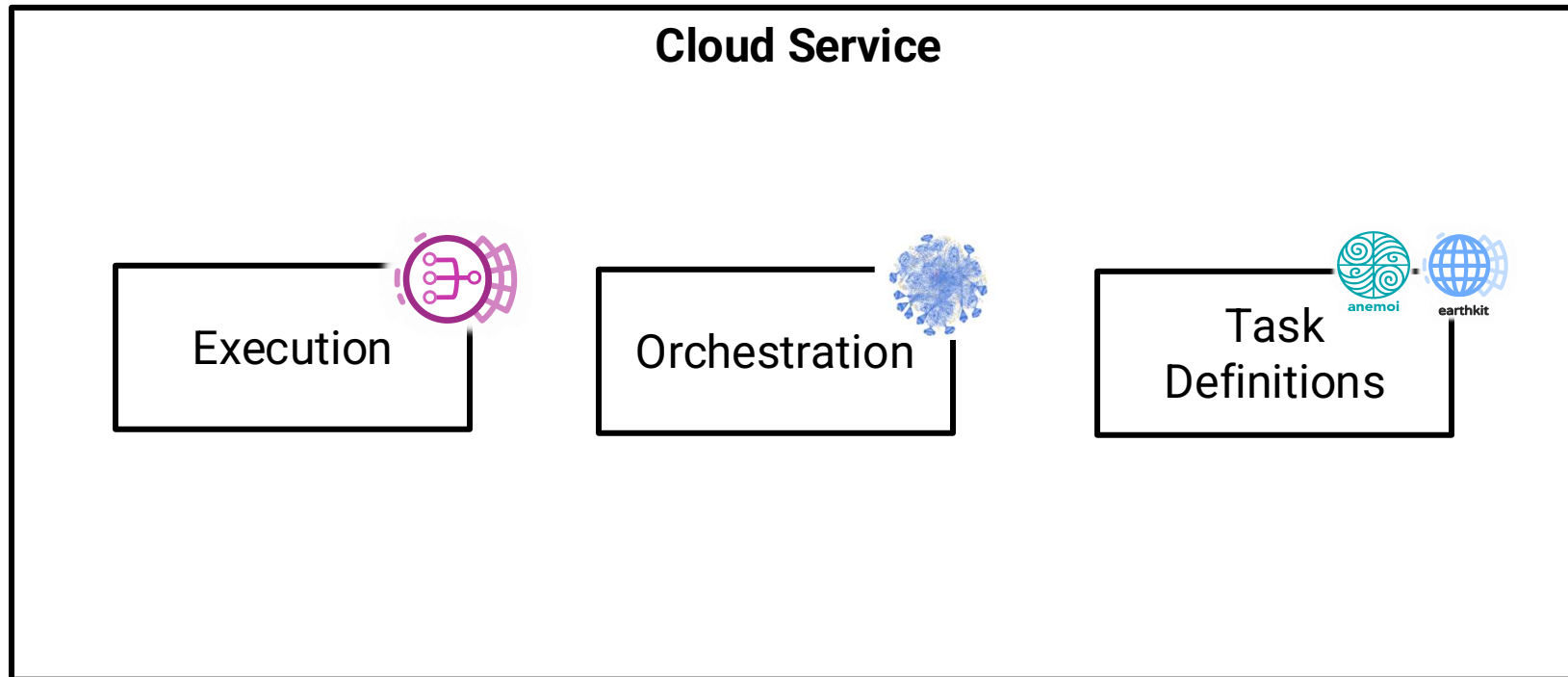
- Can be deployed in many ways...



# Forecast-in-a-Box – “How to run the box?”



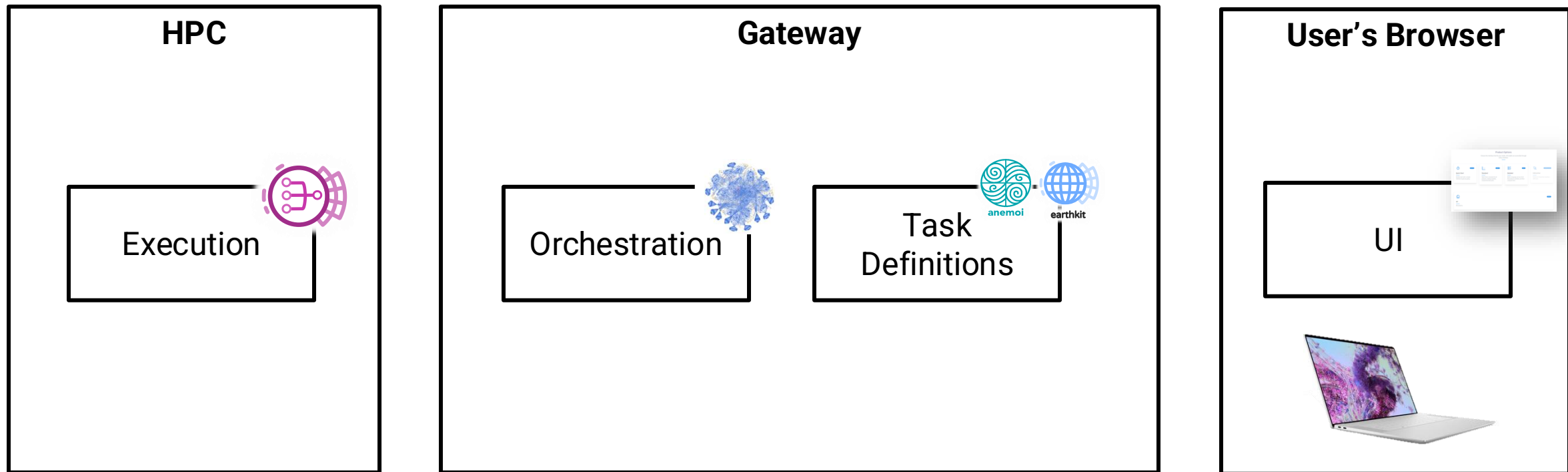
- Can be deployed in many ways...



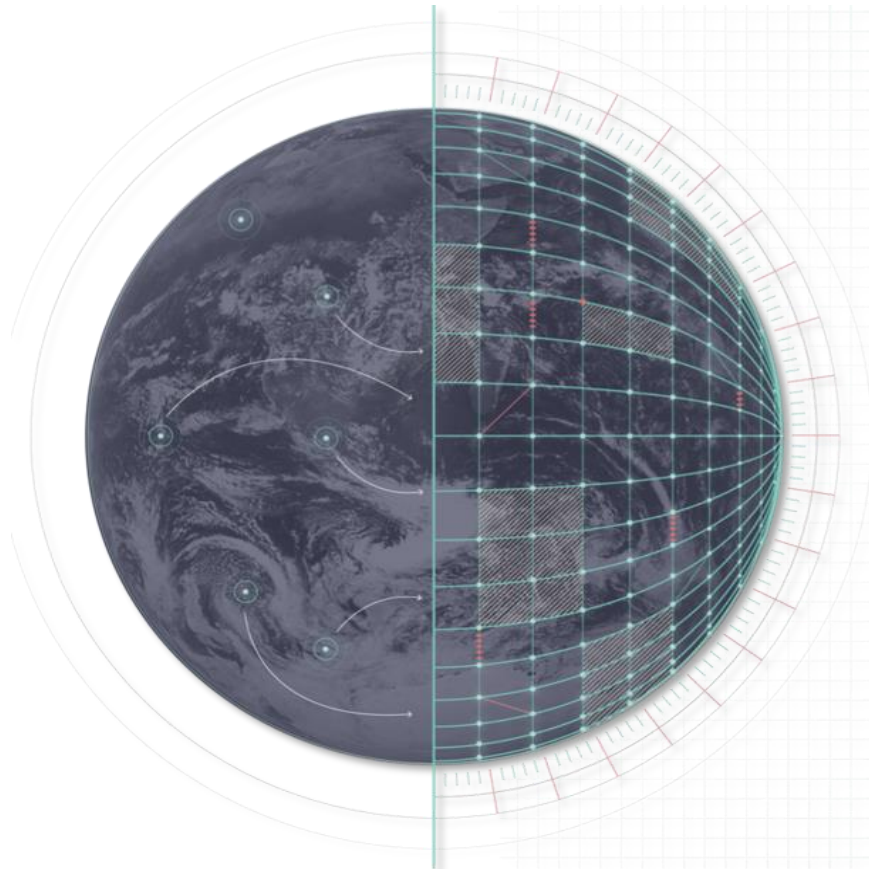


# Forecast-in-a-Box – “How to run the box?”

- Can be deployed in many ways...



# Ongoing Projects



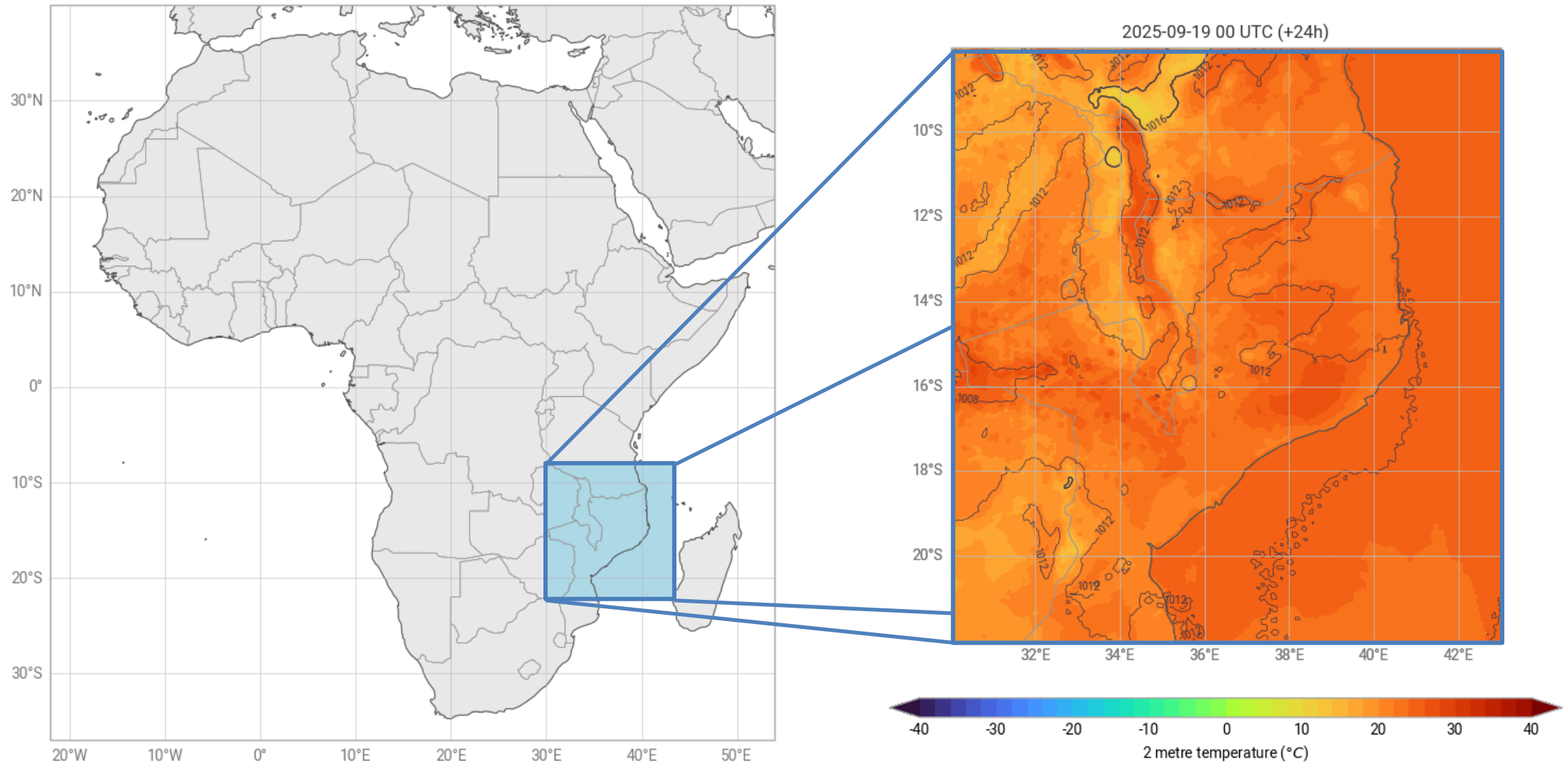


**Africa – EU Space Programme –  
Strengthening Early Warning in  
Africa (AESPP – SEWA):**  
Co-designed impact-based forecast tools  
and trainings to advise on early warning

Implemented in partnership with AUC and EUMETSAT



# WMO/Malawi Pilot Project Lead by MetNorway





Norwegian  
Meteorological  
Institute

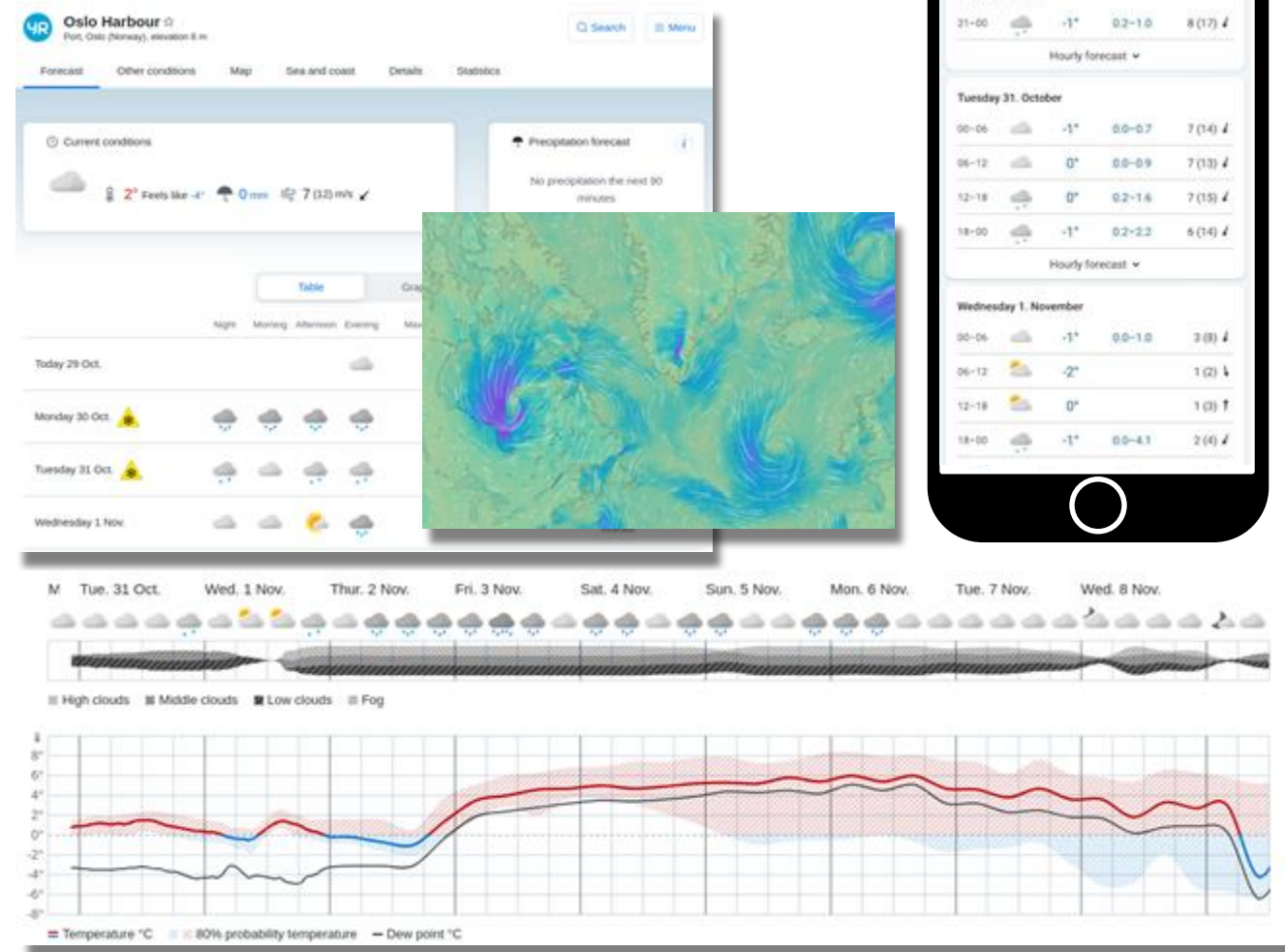
# Bris in Malawi

Running a localized model in Forecast-in-a-Box

24.09.2025

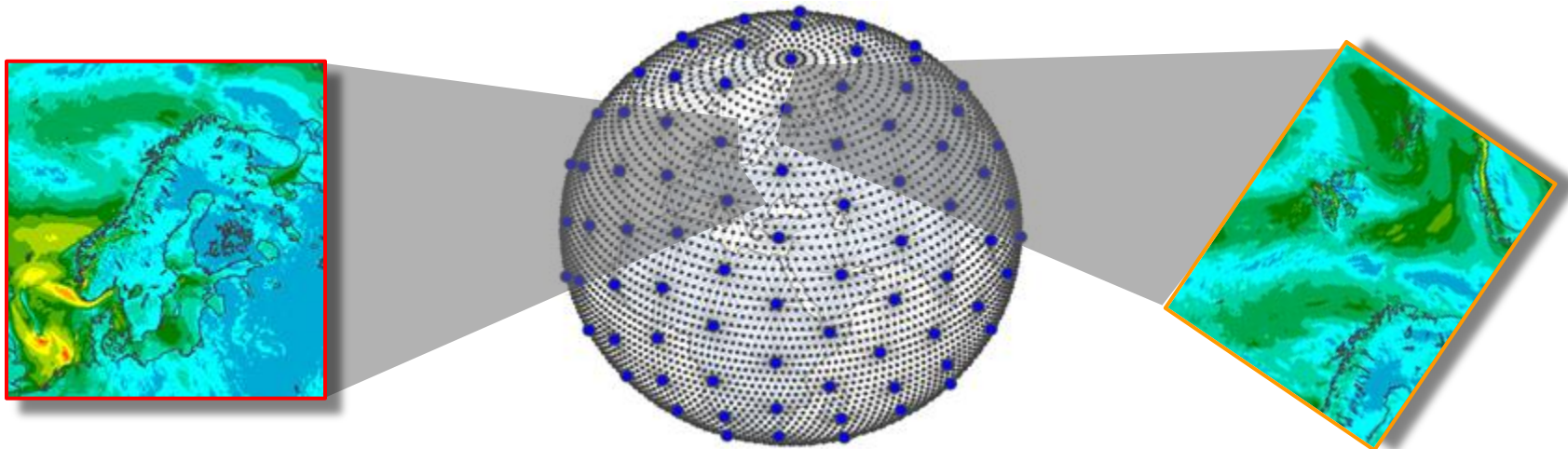
# What is Bris?

- Data-driven model for weather forecasting
  - Developed by Met Norway, in cooperation with several other institutions
- To be used with Met Norway's weather service yr.no



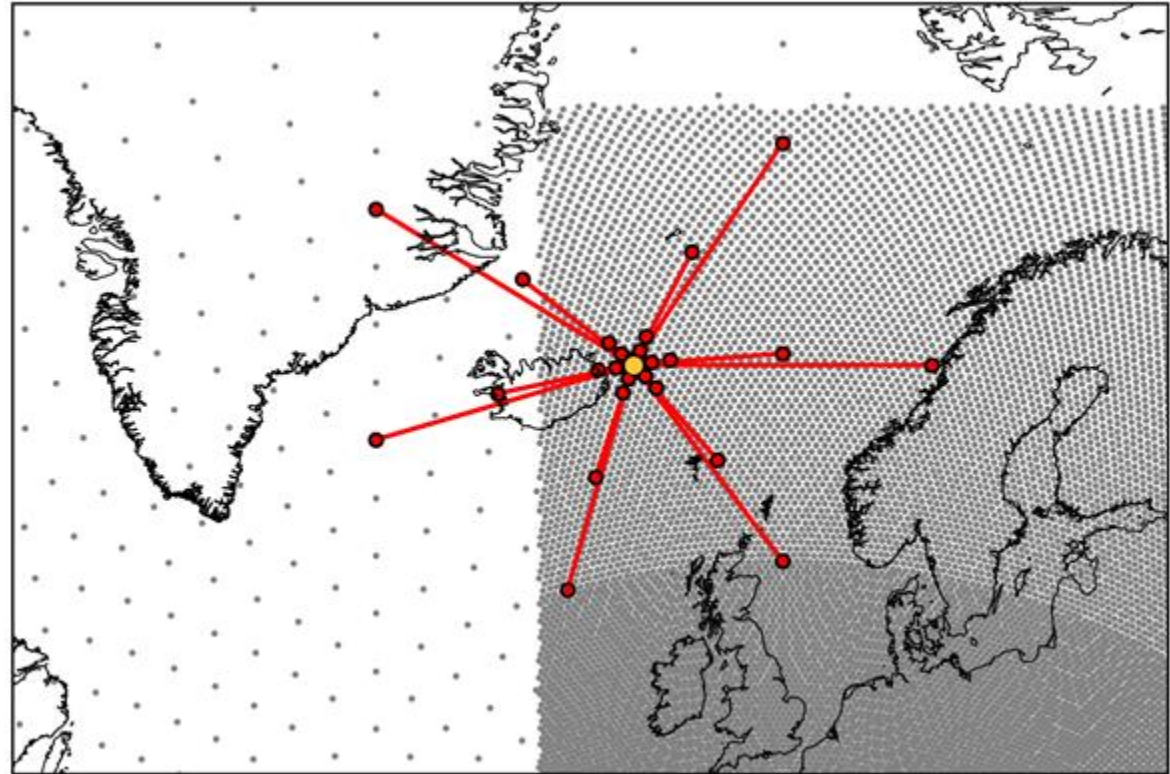
# What is Bris?

- Based on the Anemoi framework
- A global AI-based model with high resolution over a **focus area**
- Any focus area is possible (eg. Malawi)



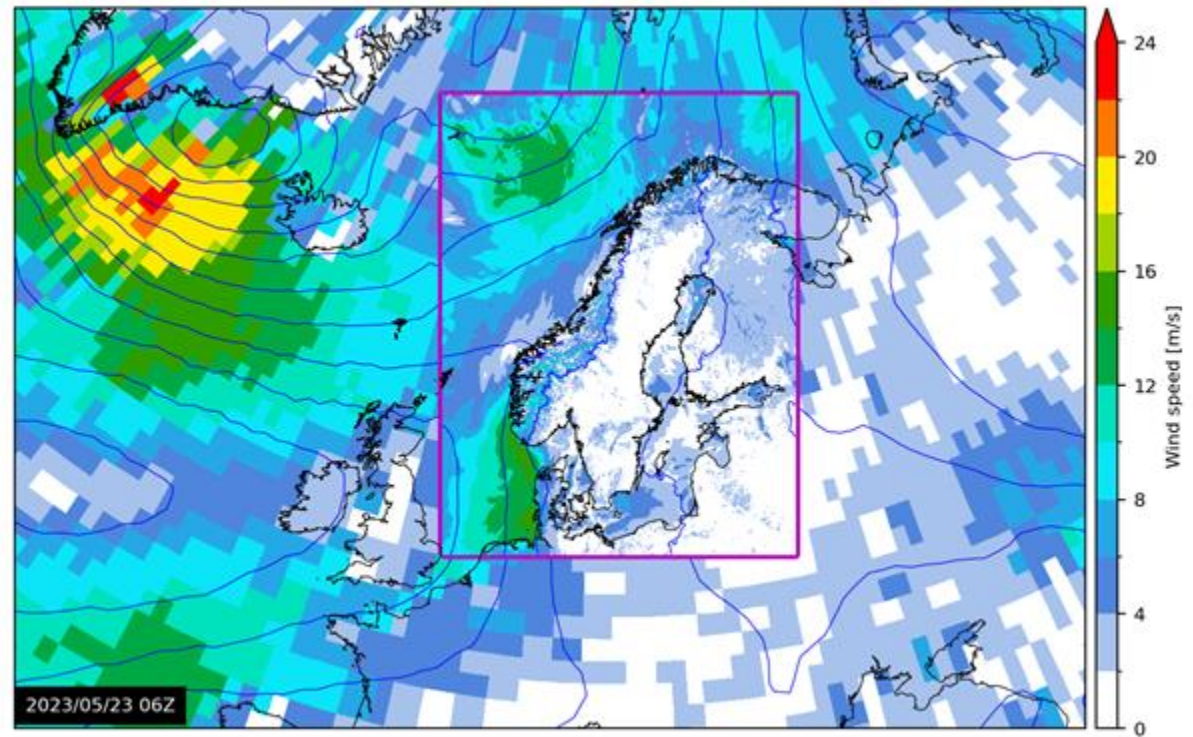
# What is Bris?

- A stretched-grid approach



# What is Bris?

- A stretched-grid approach



# What is Bris?

- 6-hour time resolution
  - WIP: interpolating to 1-hour resolution
- Training
  - 43 years of ERA5 data (31 km)
  - 3 years of MEPS data (2.5 km)
- Can run with any resolution

# What is Bris?

A photograph of a winter forest scene. The foreground and midground are filled with evergreen trees heavily laden with snow. The branches are intricate and dark against the white snow. The ground is a smooth, white expanse of snow. In the background, more snow-covered trees are visible under a clear, bright blue sky. The lighting suggests a sunny day, with some areas of the trees catching the light and appearing slightly warmer in tone than the rest of the scene.

Bringing it from Norway...



...to Malawi

# The vision

Deploy and evaluate AI weather prediction in Malawi, and explore how AI can strengthen early warning capabilities.

Work with WMO to scale up to additional NMHSs in LDCs and SIDS.

# Bringing Bris to Malawi

- Move the domain of the Bris model to Malawi
- Run Bris in Forecast-in-a-Box
- Provide a physical box that can run all of this

This is a **pilot project**

- We want to have a proof of concept before scaling up

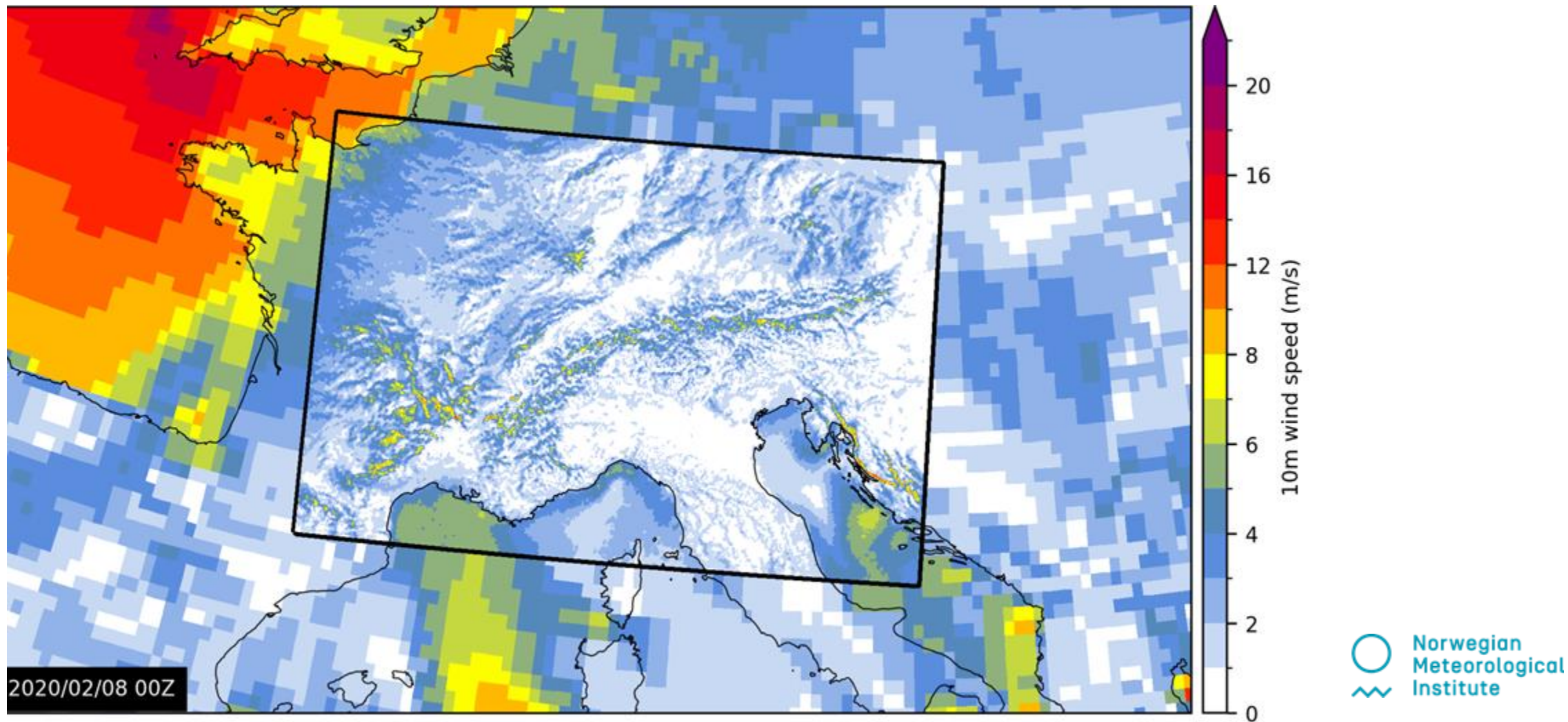
# Why should it work?



# Why should it work?

- Bris has not been trained specifically for Africa, but
  - Training included global ERA5 data
  - Training for the nordics should be transferable to other parts of the world
- Moving the model has already been tested, with success

# Why should it work?



# Why should it work?

- What if it does not work?
  - Training with higher resolution for more areas of the world
  - Adding other parameters in training
    - Surface type (forest, city, etc)

# Running it

# Running it

- Physical box
  - Mac Studio M4 Max
    - 128 GB memory
    - 16 core CPU
    - 40 core GPU
    - Costs around \$5000



# Running it

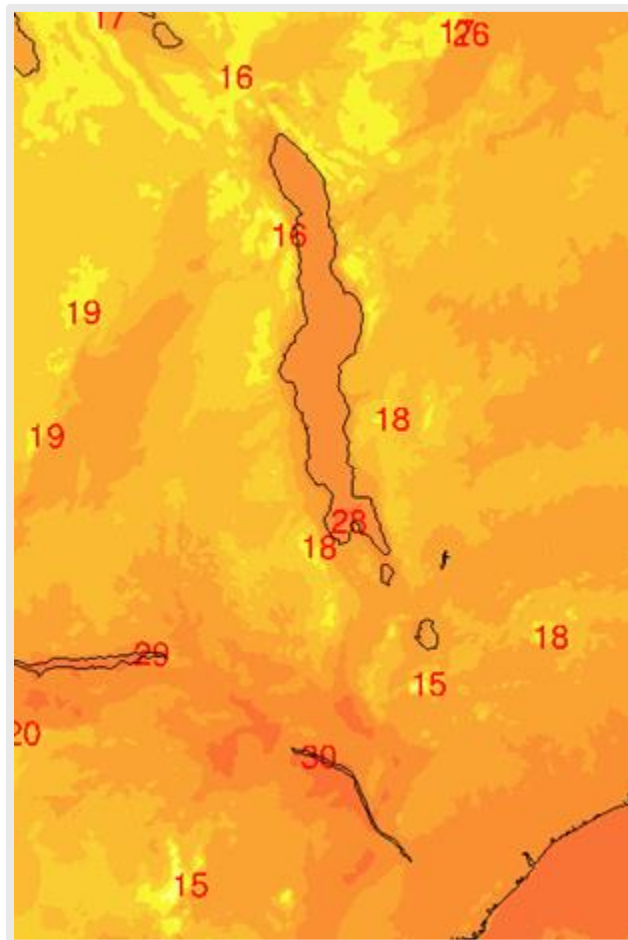
- Input data
  - ECMWF polytope service provides analysis data
  - Post-processed in the box
    - Downscaling
    - **Adiabatic correction** of surface parameters
  - In the future:
    - Locally provided analysis

# Status right now

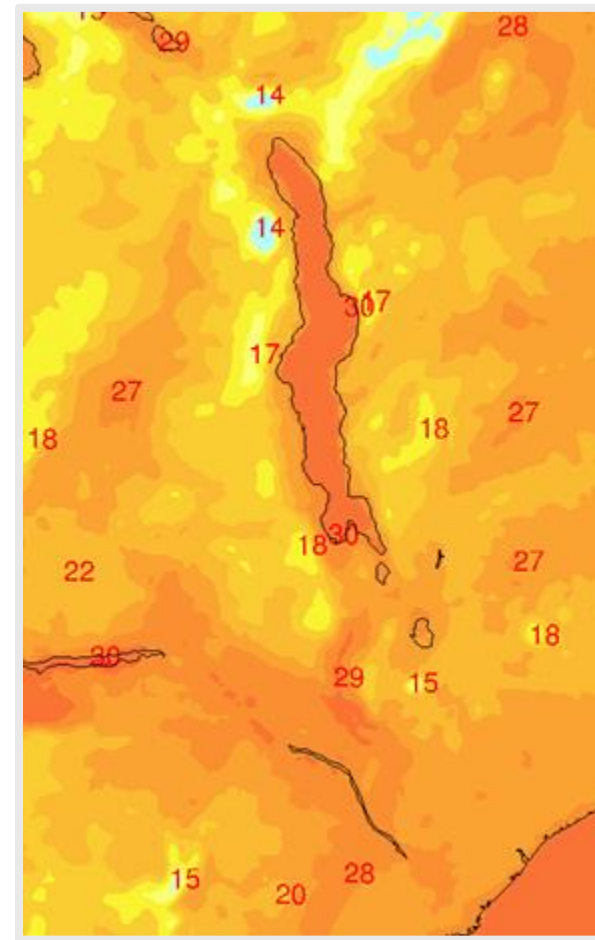
- Working version
- Some issues remain
  - Physical box problems
  - No systematic verification of the forecast
  - Incomplete outputs

# Results

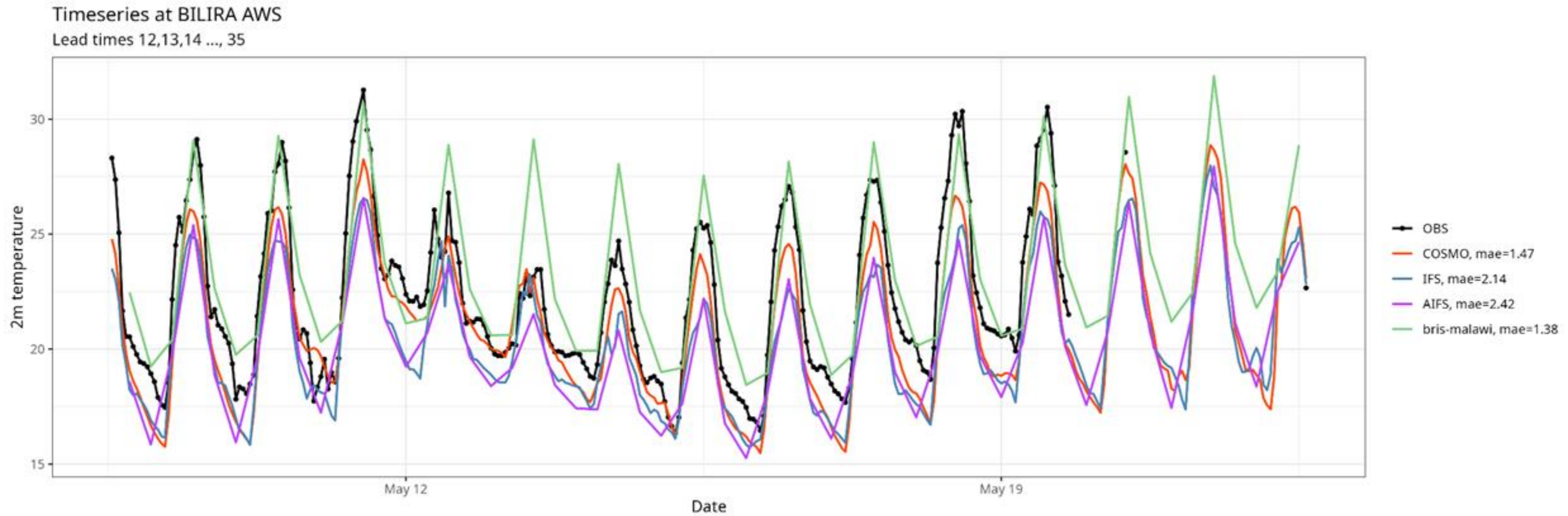
COSMO



Bris



# Results



# Results - timings

Running a 10-day forecast for Malawi

- Mac studio
  - ~23 minutes
- NVIDIA A100, 40GB memory
  - ~20 minutes
- NVIDIA H200, 141GB memory
  - 80 seconds

# Other options - cost overview

Costs presented are without VAT, in USD and do not include running costs, such as electricity, cooling, network, software etc.

Factors to consider:

- Different architectures e.g. ARM(GH200), x86\_64 require different levels of adaptation.
- High density systems (>4ways systems) require water cooling
- time constraints, ensemble runs

Example air cooled systems:

Grace Hopper GH200, 5y warranty, total memory ~540GB, 100Gb network: ~USD 50k

4way system: 4xH200 nvlink, 5y warranty, 4 x144GB GPUmemory, 100Gb network: ~USD 160k

2way system: 2xH200 nvlink, 5y warranty, 2 x144GB GPUmemory, 100Gb network: ~USD 96k

2way system means: 2x H200s in one chassis, connected via nvlink.

# Remaining work

- Verification
- Fixing Mac problems
- Working with DCCMS on further improvements
- Explore possibilities and benefits of using local data

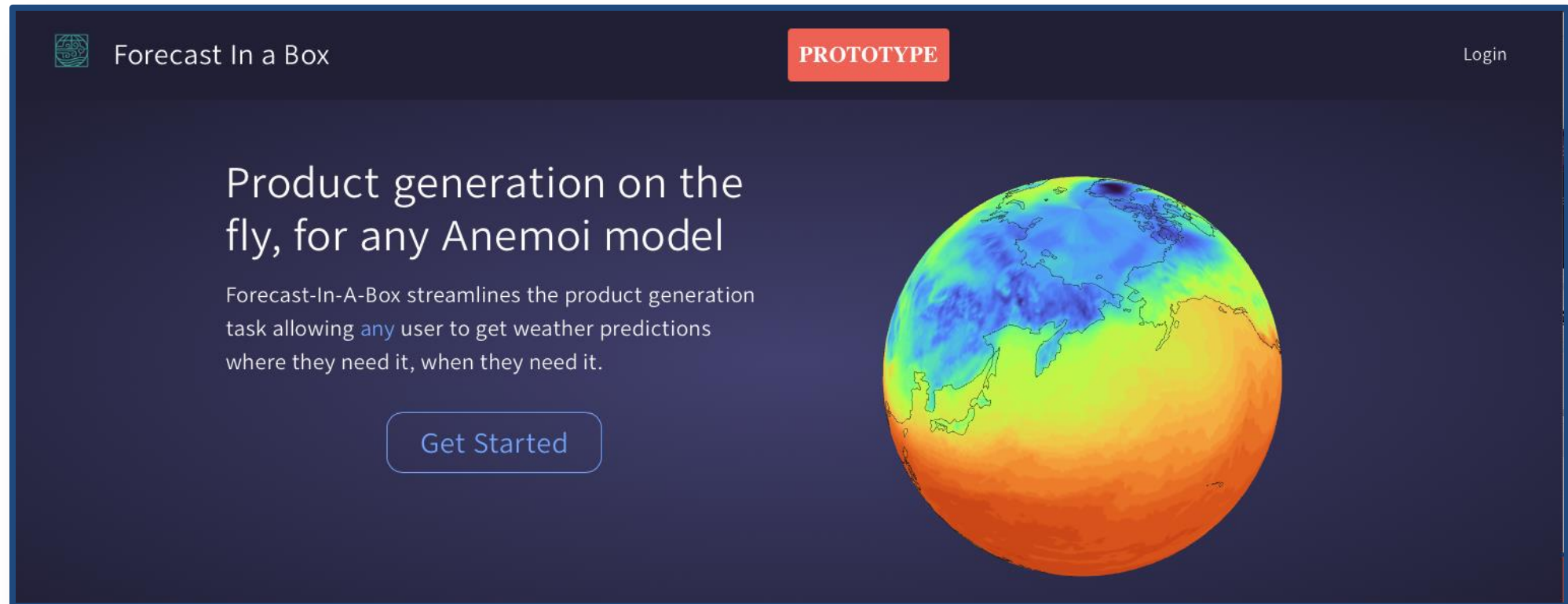
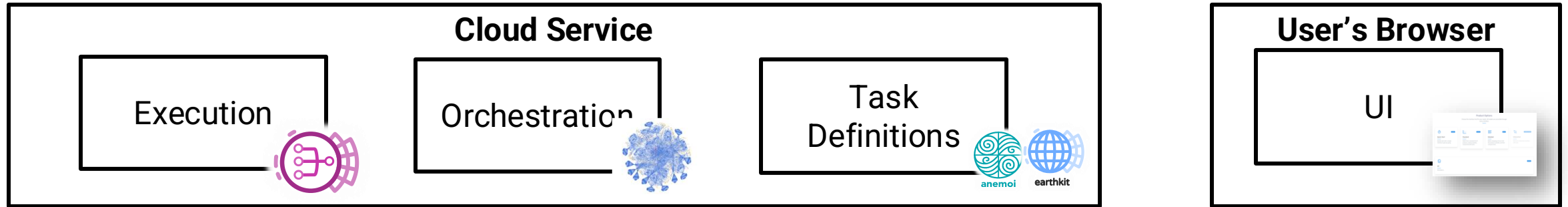
# The road ahead - after the pilot

Working with WMO on making this available elsewhere



Norwegian  
Meteorological  
Institute

# Demo



# Future Work

- Forecast-in-a-Box
  - Contractor working on a redesigned UI
  - Scale-up the system using ensemble forecasts (Multi-GPUs, scaling, etc.)
- Improve user experience
  - Still a prototype
  - Allow users to define their own products
  - Improve Bris integration by allowing users to select directly their local domain
  - Build plugins for forecasters/verification
    - Workflow triggers
    - Push products to operational database (Zarr, Grib, NetCDF)

# Thank you for your attention!

