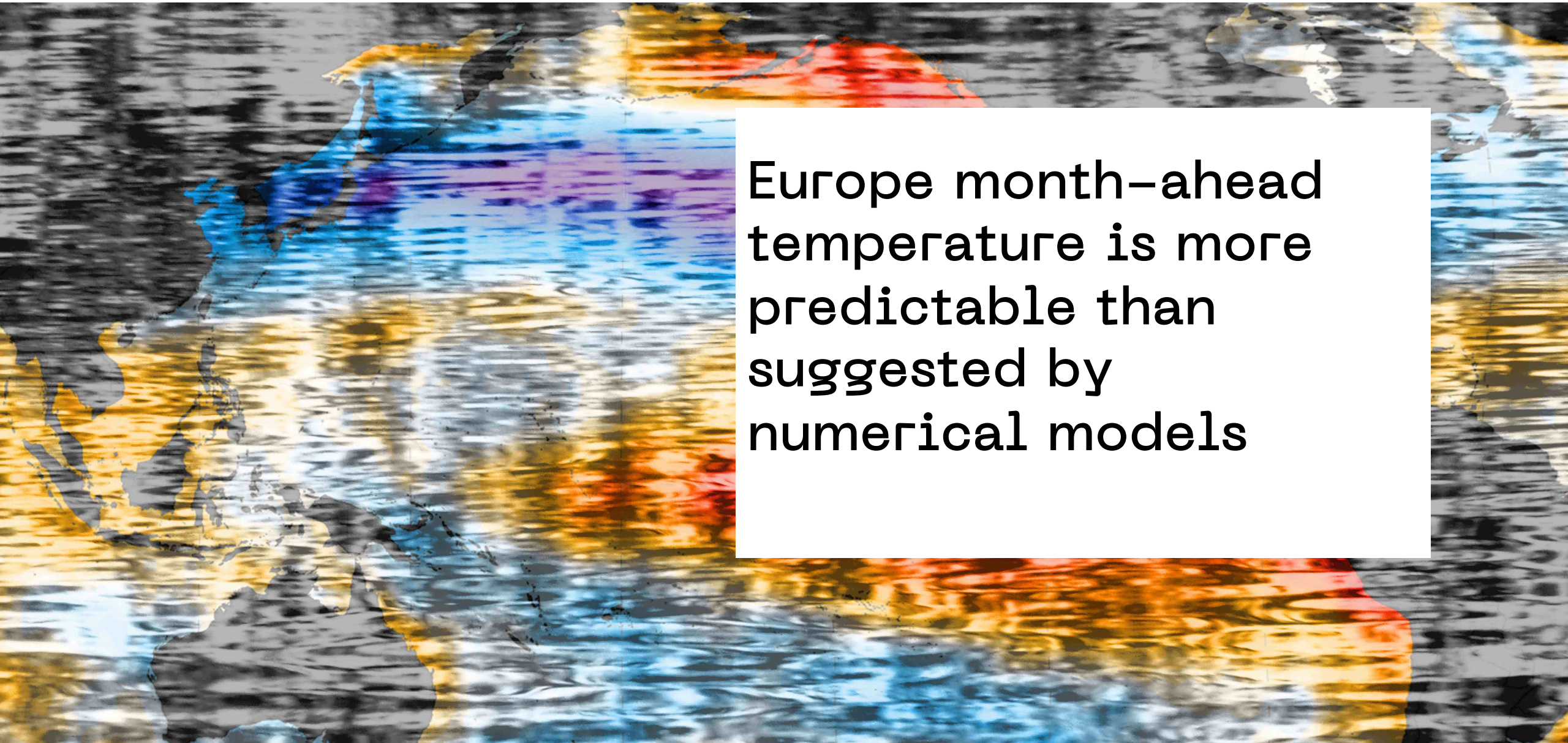
VU VRIJE UNIVERSITEIT AMSTERDAM



Europe month-ahead temperature is more predictable than suggested by numerical models

Energy sector needs reliable subseasonal-to-seasonal weather forecasts

Renewables are increasing the weather dependence

Climate extremes threatens energy security

Optimize resource management

Weather forecasting 2+ weeks ahead is notoriously difficult

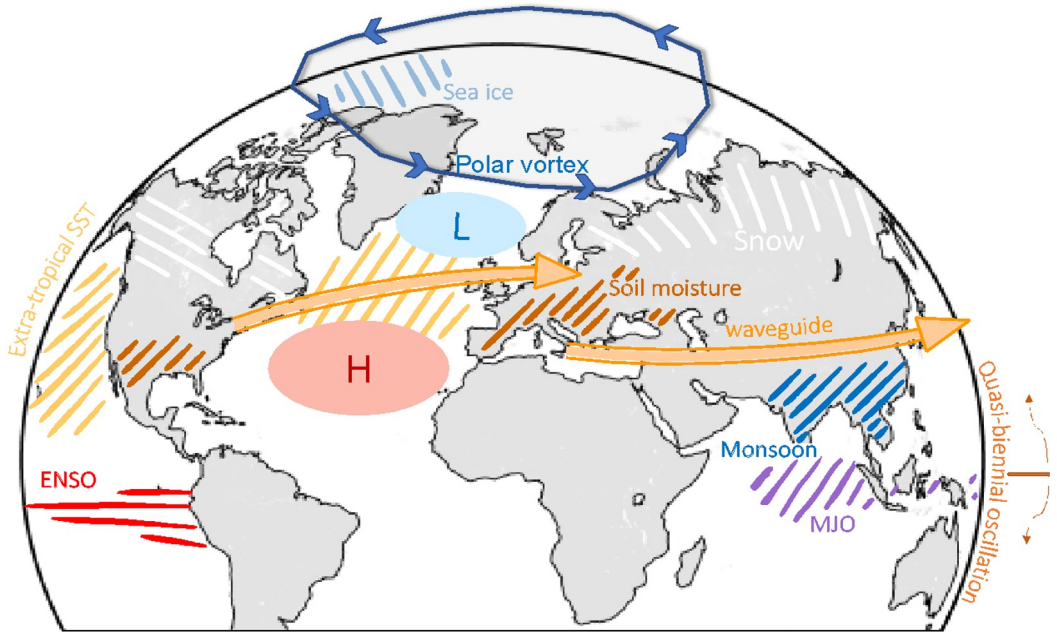
Days > 2 weeks *The prediction desert* Seasons

time

Weather forecasts

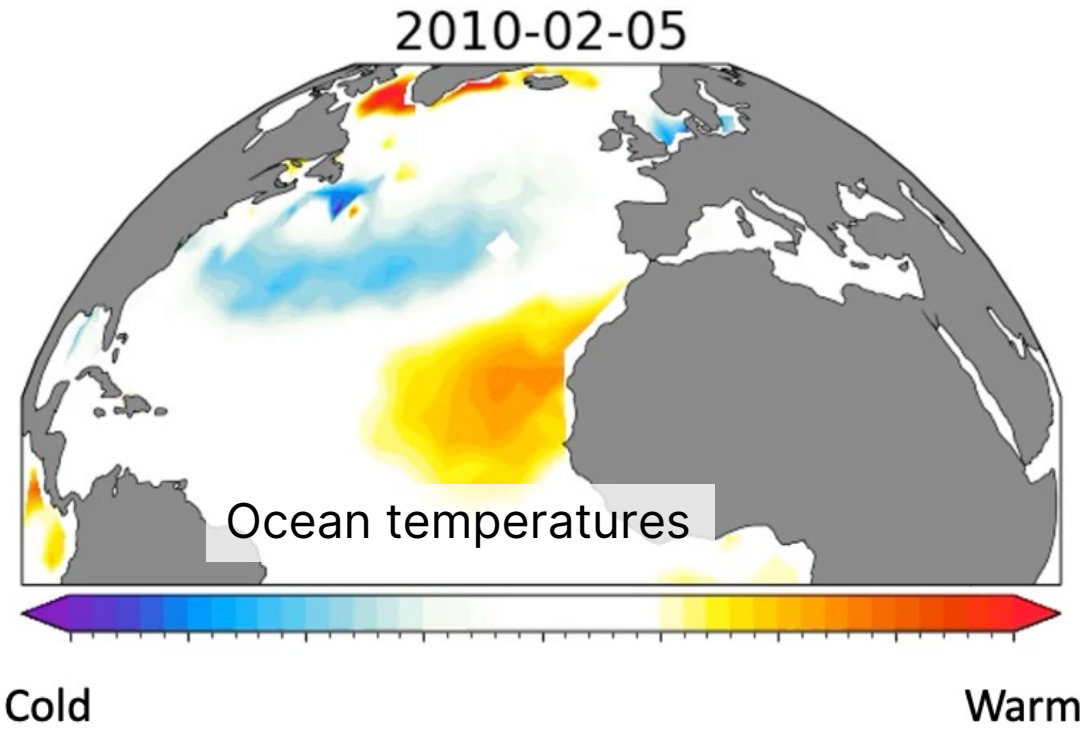
Forecasts rely on *atmospheric memory*

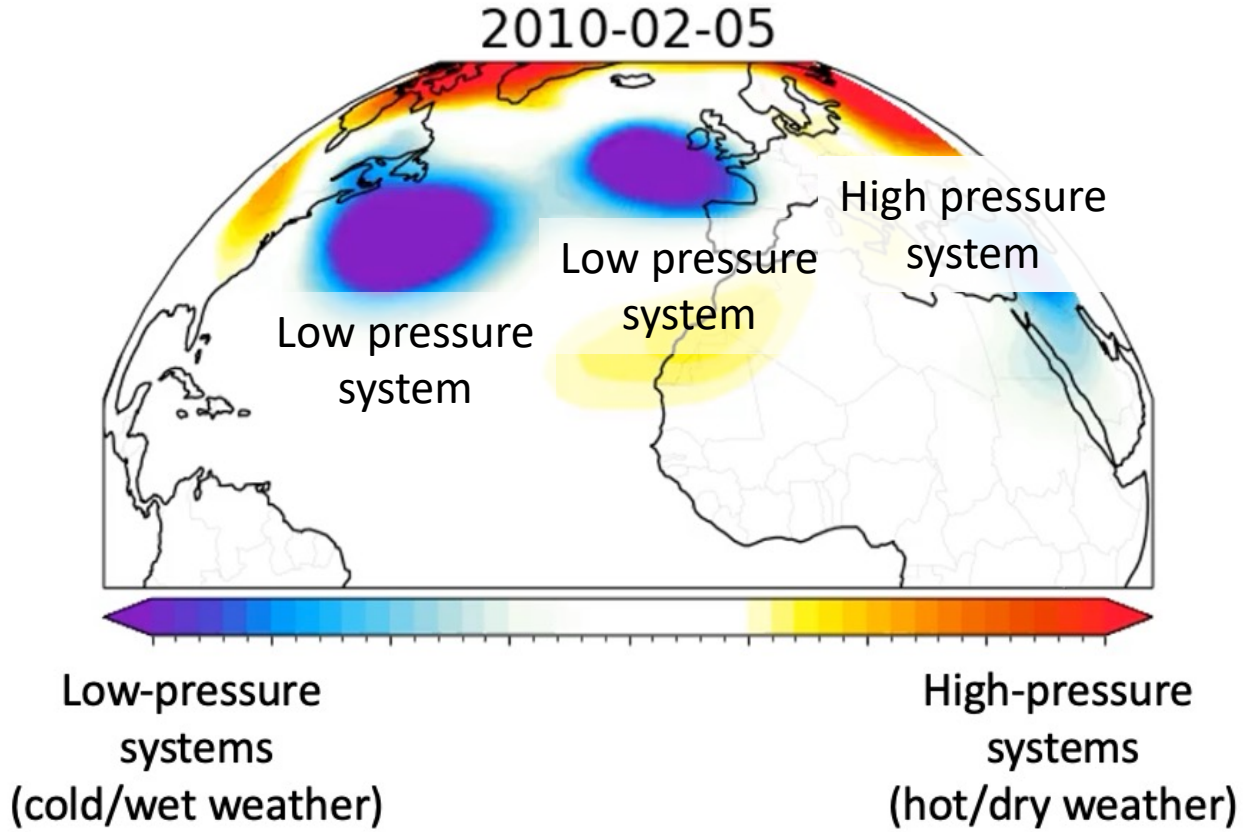
Subseasonal to seasonal (S2S) forecasts



Climate dynamics

on subseasonal-to-seasonal timescales

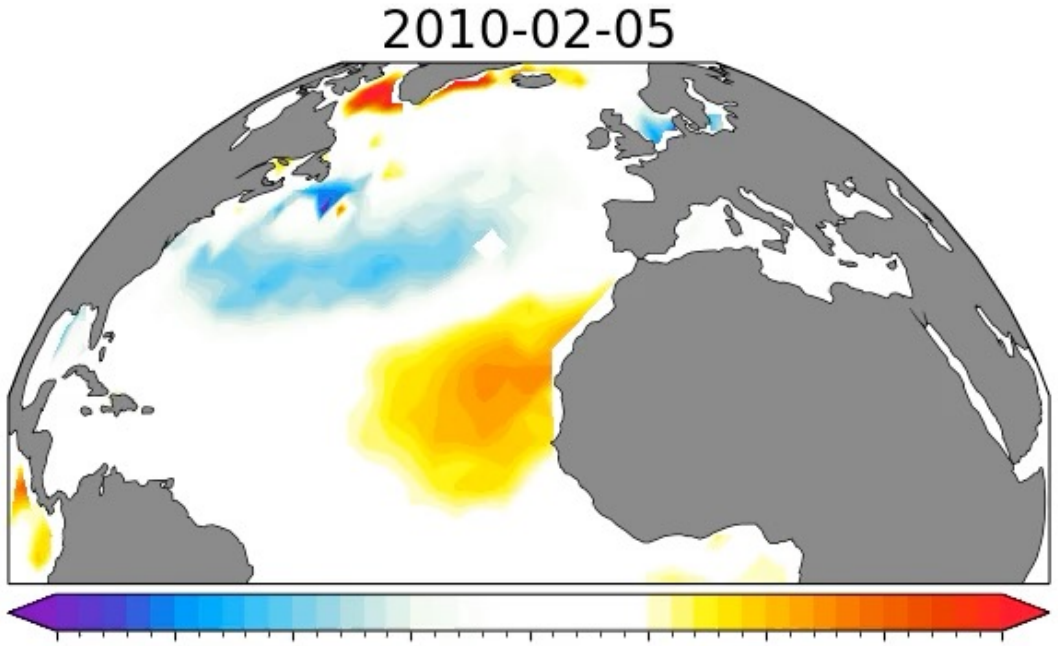




Based on ERA-5 reanalysis data

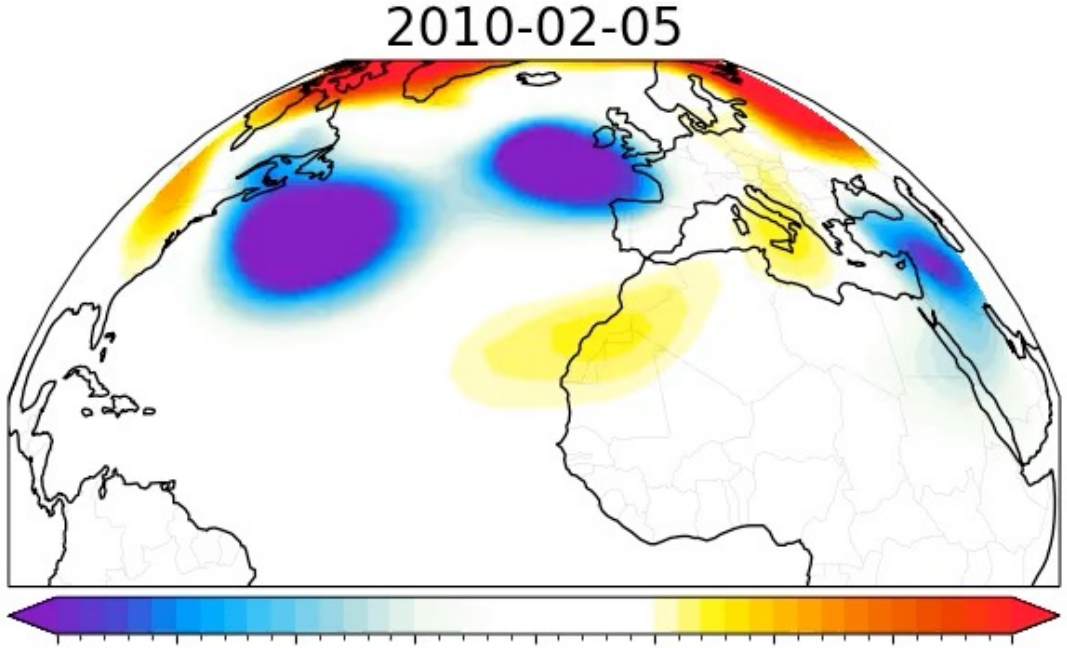
Climate dynamics

on subseasonal-to-seasonal timescales



Cold

Warm

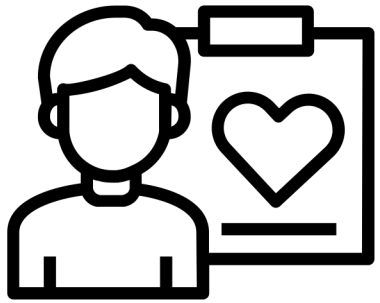


Low-pressure systems (cold/wet weather)

High-pressure systems (hot/dry weather)

Based on ERA-5 reanalysis data

Predicting extremes far in advance?



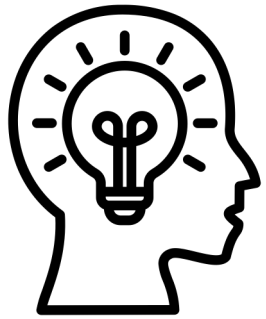
User

Ideal world:
highly accurate predictions:

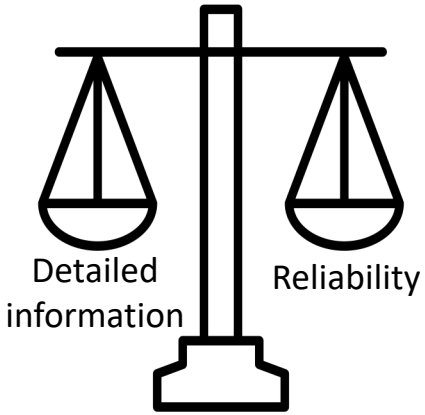
- Very extreme events
- High spatial detail

Reality:
simplify prediction task:

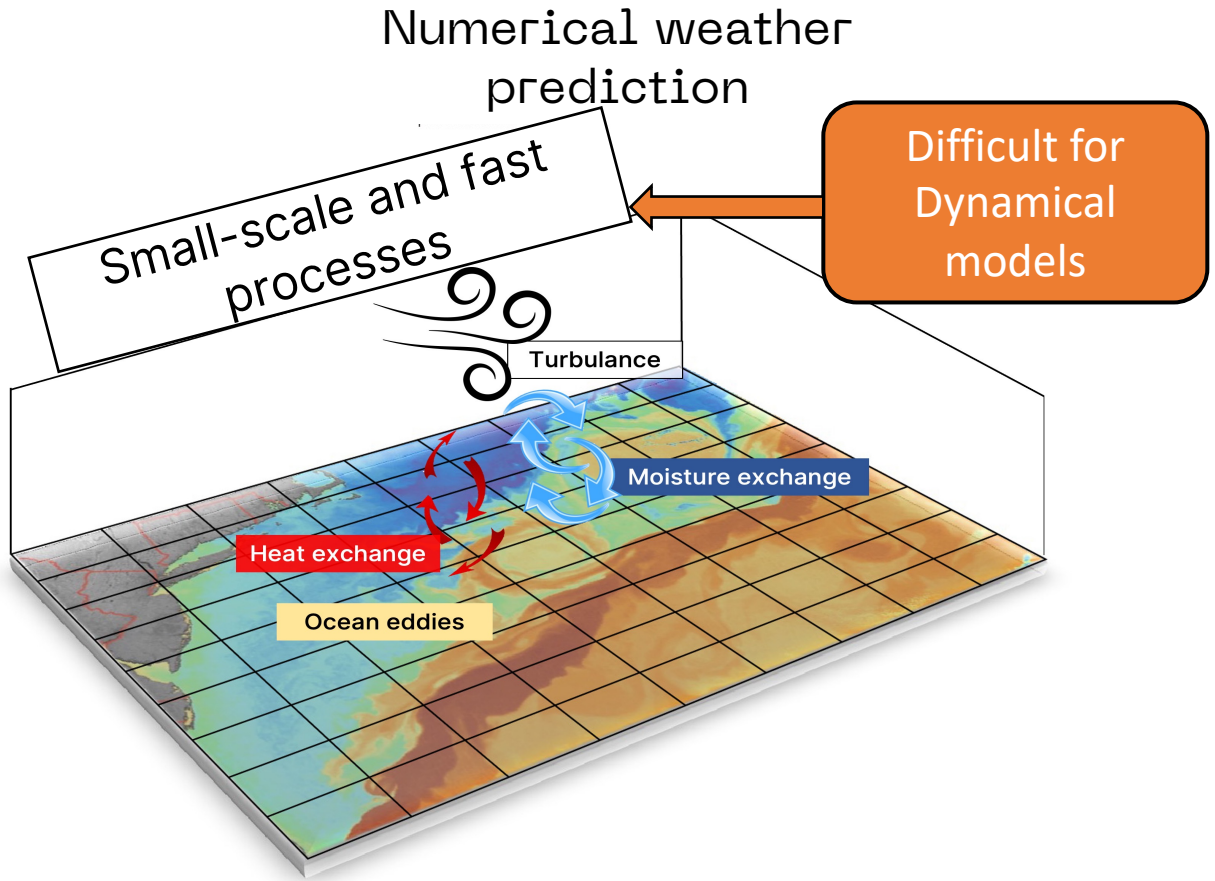
- Moderate events
- Low spatial detail



Expert



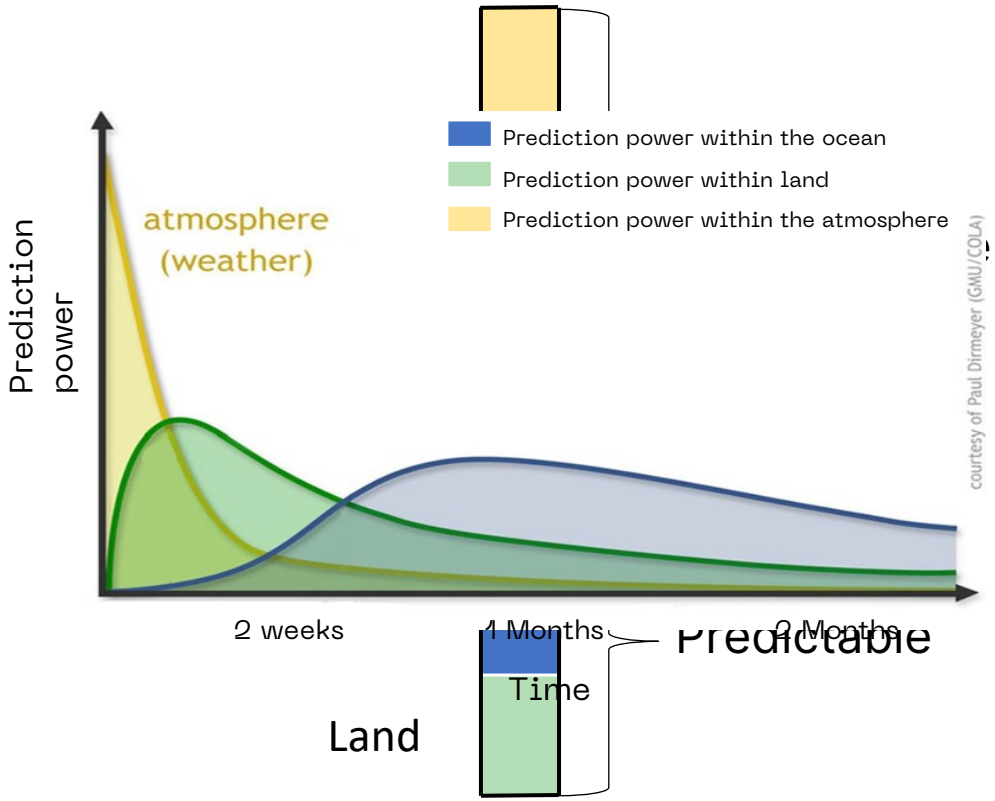
A comparison of approaches



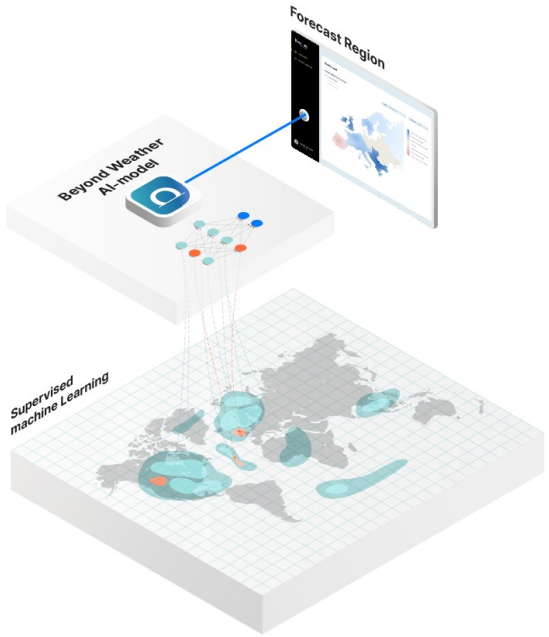
Simulation of the Earth's physical processes

A comparison of approaches

Numerical weather prediction



Artificial Intelligence model

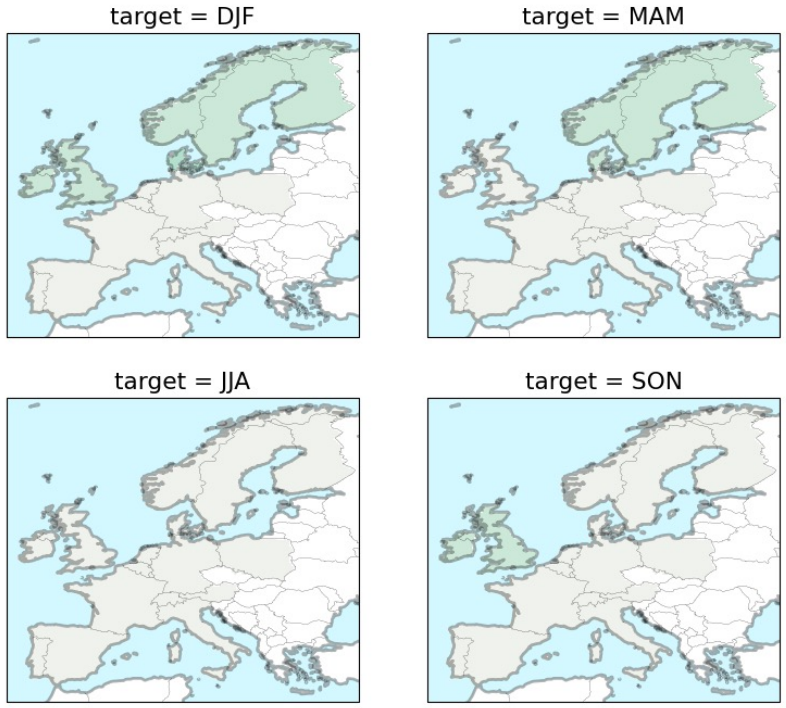


Smart learning of *slow moving climate components*

Skill comparison

1-month ahead temperature forecast, 1981-2021

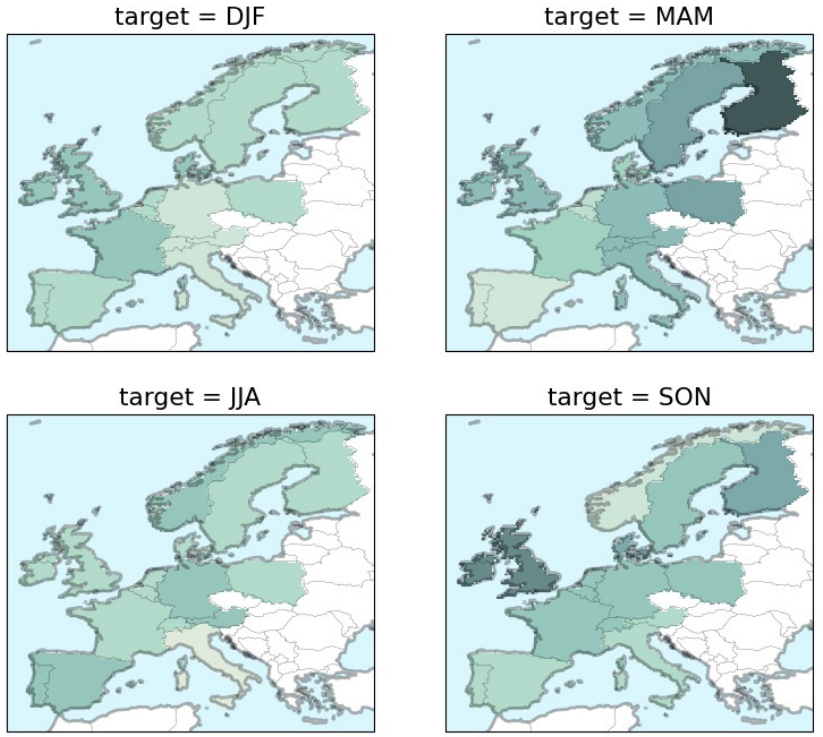
ECMWF SEAS5



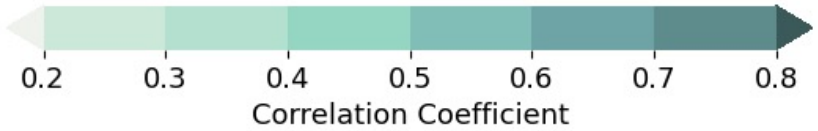
Average correlation coefficient:

0.10 → 0.51

Data-driven forecasts

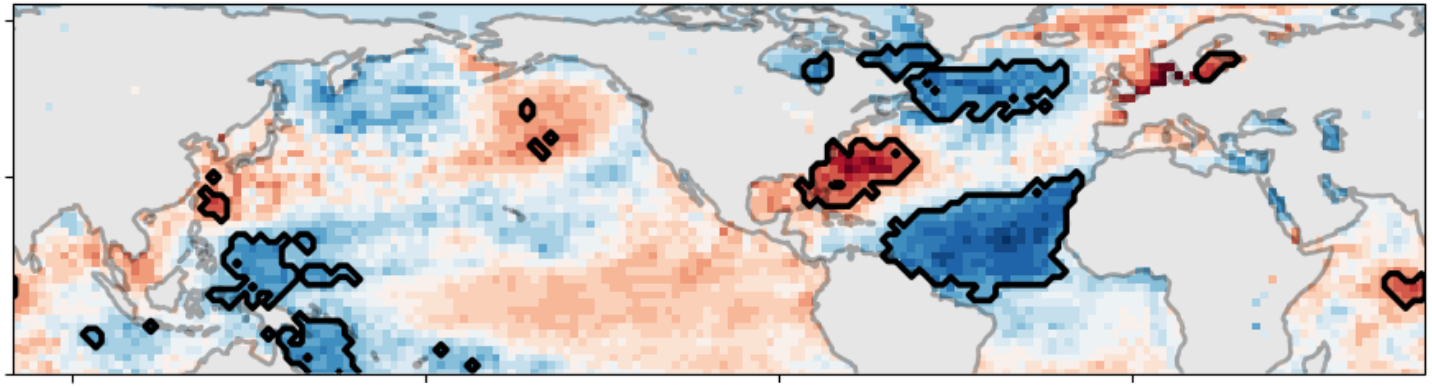


*preliminary results



Ocean driving December temperature in Germany?

December Sea Surface Temperature (SST) versus December area-averaged German temperature



−0.5 −0.4 −0.3 −0.2 −0.1 0.0 0.1 0.2 0.3 0.4 0.5

Correlation

August

October

North Atlantic

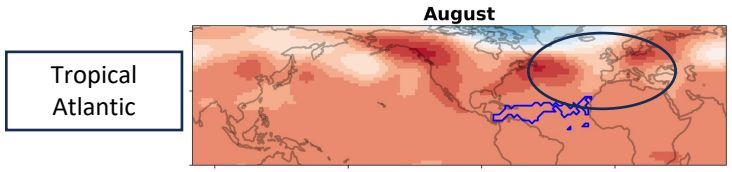
Tropical Atlantic

Western Pacific

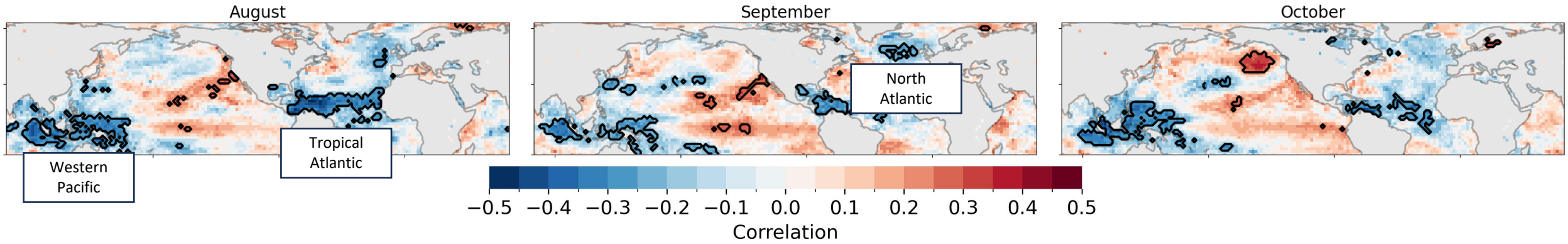
−0.5 −0.4 −0.3 −0.2 −0.1 0.0 0.1 0.2 0.3 0.4 0.5

Correlation

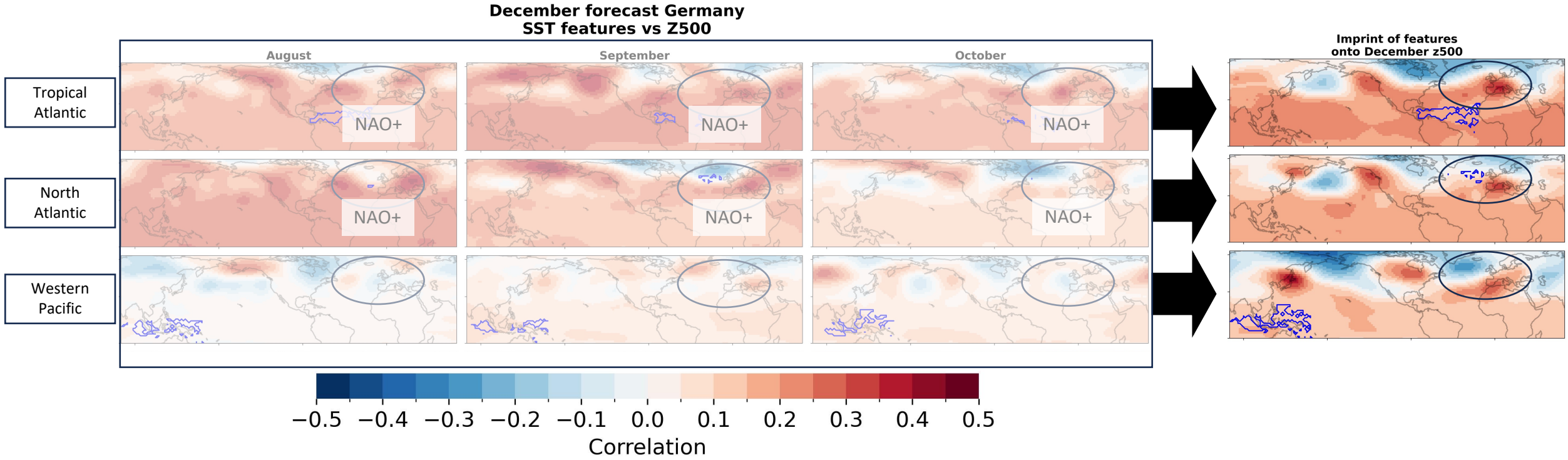
Visualize influence of ocean on circulation (geopotential height)



Lagged features

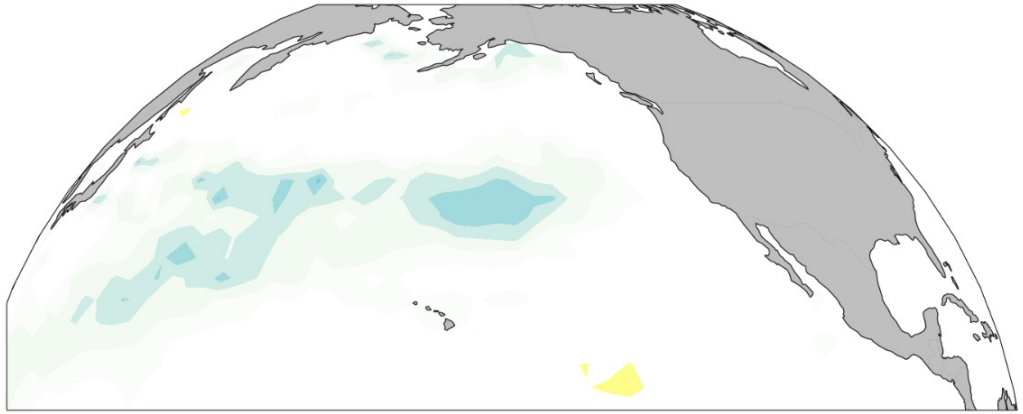


Visualize influence of ocean on circulation (geopotential height)



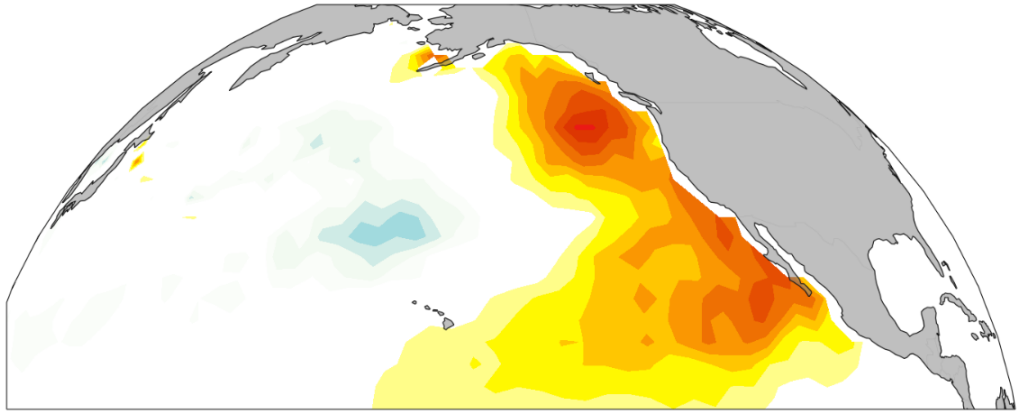
Windows of opportunity

Normal state



Weak boundary forcing
Less predictive power

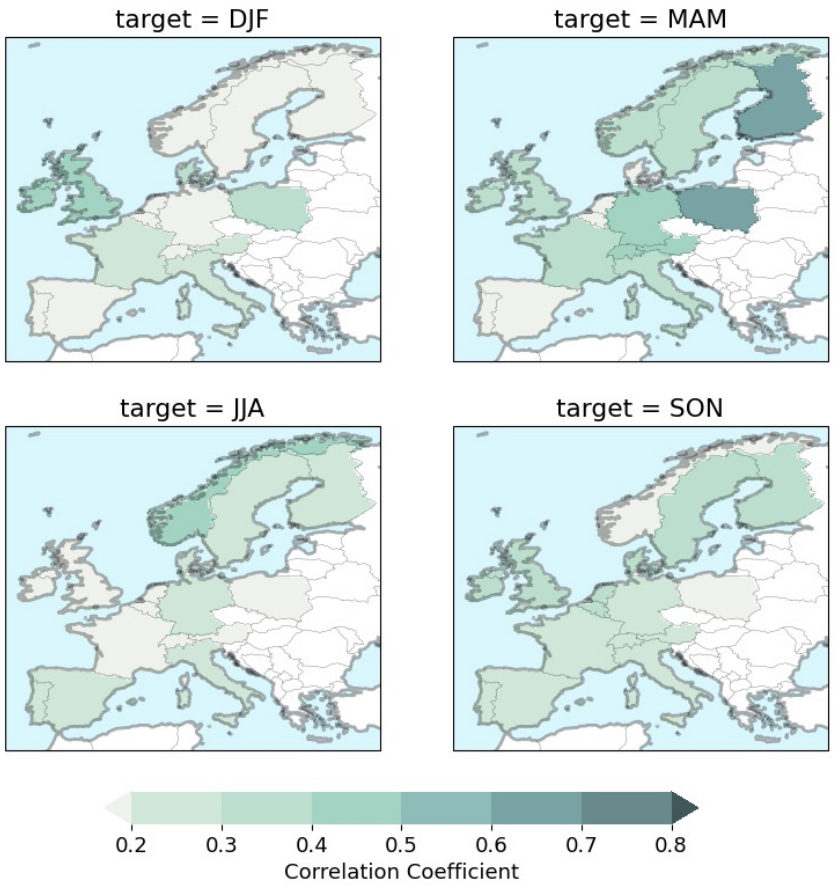
Extreme state



Strong boundary forcing
Higher predictive power

Windows of opportunity

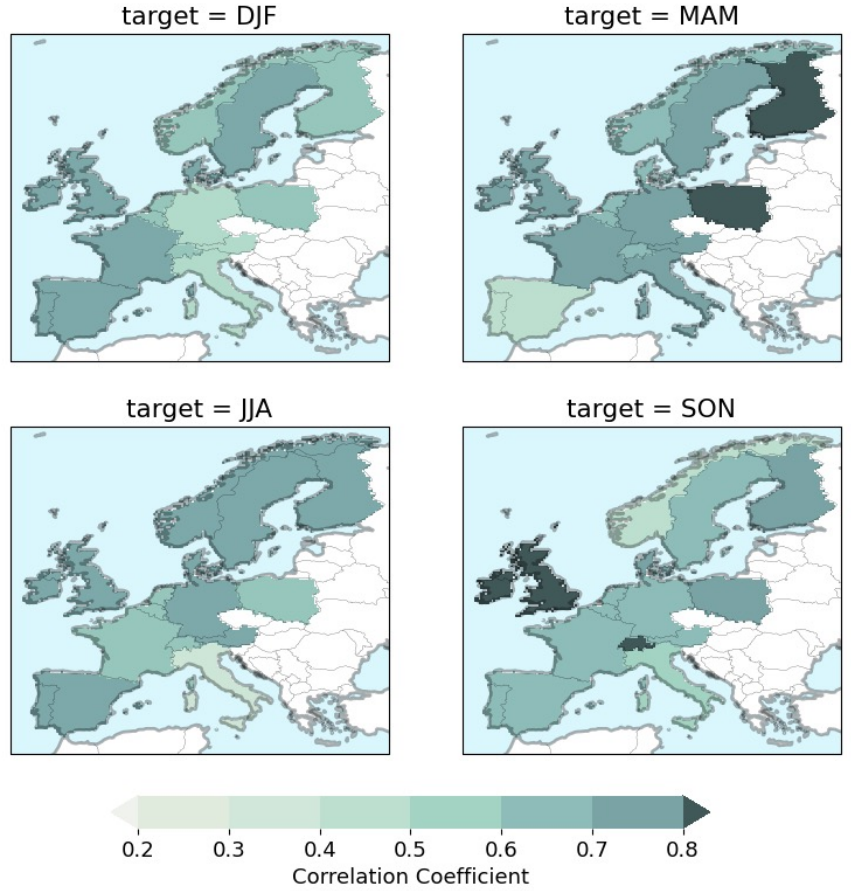
Performance
non-confident forecasts



correlation coefficient:

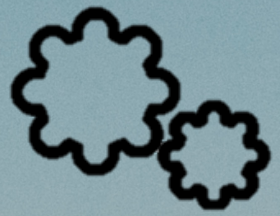
0.24 → 0.63

Performance
confident forecasts



Beyond Weather

Machine learning



Physics

User needs

Accurate & transparent subseasonal-to-seasonal

Beyond Weather

Machine learning

Physics

User needs

Feel free to reach out, 4 of us are present at ICEM23!

Dr. Sem Vijverberg (CTO)

Jannes van Ingen (CEO)

Prof. Dim Coumou (CSO)

Steven van den Tol (CCO)

Marc van der Peet (CPO)