MAELSTROM

Empowering weather & climate forecast:

ML Apps & Datasets

ML Workflow Tools

Hardware Systems

Welcome & Introduction

Peter Dueben (ECMWF)

"The MAELSTROM project has received funding from the European High-Performance Computing Joint Undertaking (JU) under grant agreement No 955513. The JU receives support from the European Union's Horizon 2020 research and innovation programme and United Kingdom, Germany, Italy, Luxembourg, Switzerland, Norway".

Co-ordinated by ECMWF

Timetable

MAELSTROM

8:30 GMT

Introduction
Peter Dueben (ECMWF)

ML Apps & Datasets
Bing Gong (JSC)

ML Workflow Tools
Fabian Emmerich (4cast)

Hardware Systems
Andreas Herten (JSC)
Daniele Gregori (E4)

Interactive part

10:30

Coffee break

Our sister projects

EuroHPC Joint Undertaking

11:00

TimeX
Giovanni Samaey (KU Leuven)
Martin Schreiber (TUM)

Deep-Sea
Estela Suarez (JSC)

Red-Sea
Nikos Xrysos (FORTH)

Interactive part

12:30

Lunch break

External science talks

13:30

Time-consistent downscaling of atmospheric fields with generative adversarial networks
Jussi Leinonen (MeteoSwiss)

Pangeo: an OS ecosystem for data-intensive science
Ryan Abernathey (Columbia)

Deep learning for earth sciences in the HPC context
Thorsten Kurth (NVIDIA)

Interactive part

15:30

Coffee break and more time for discussion

17:30

Housekeeping

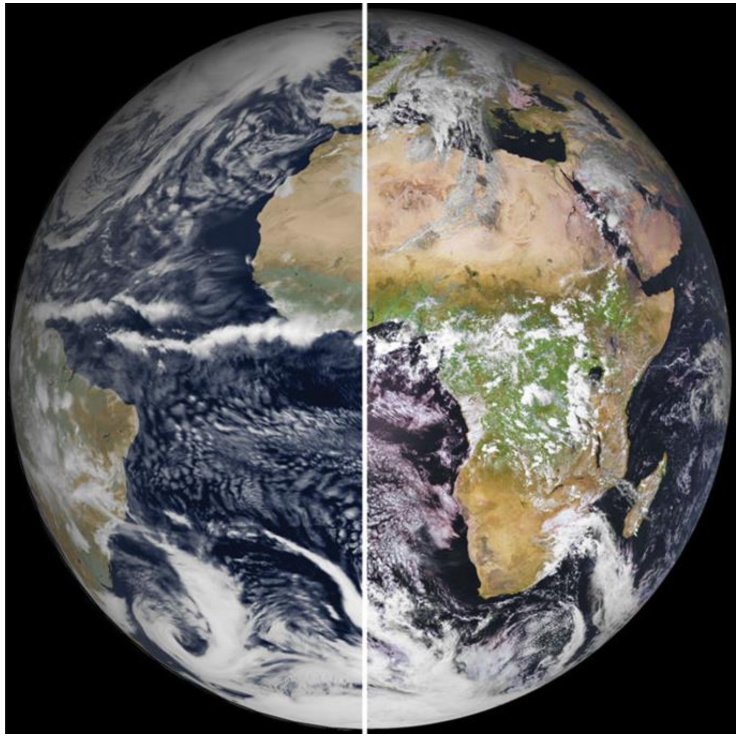
We will use Slido for Polls and Surveys (anonymously)
Please scan the QR code or access via slido.com using #MSC2022

As an attendee you can view the webinar but will not have video or audio functionality

Please ask questions via the Q&A option

Please raise your hands if you want to ask a question verbally and wait for a prompt to appear on your screen to allow you to unmute yourself.

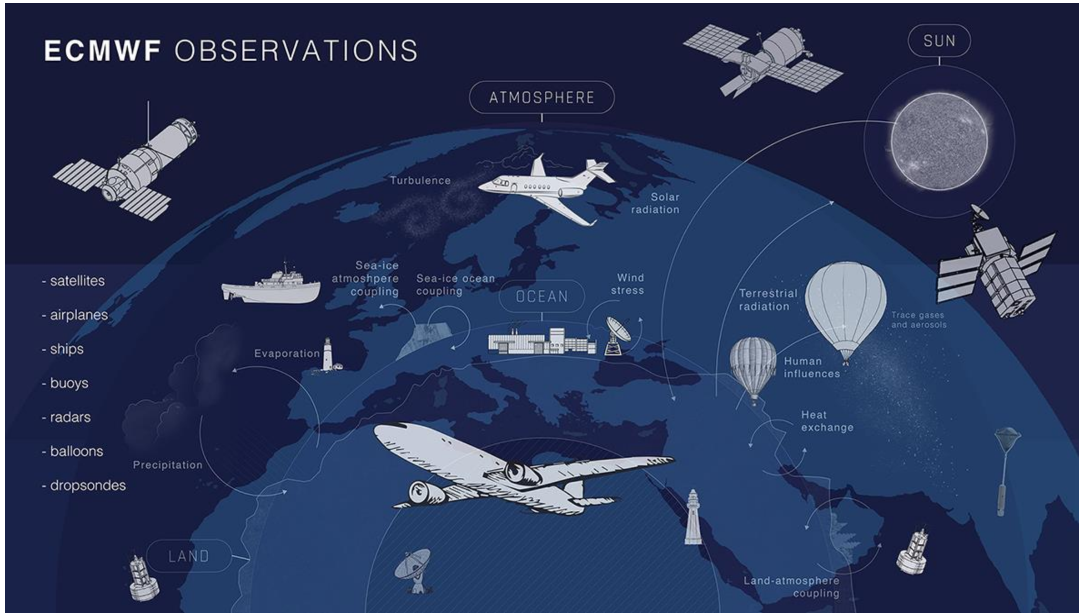
Weather and Climate, High-Performance Computing and Machine Learning



Predictions of weather and climate are difficult as the Earth system is huge, complex and chaotic, and as the resolution of our models is limited

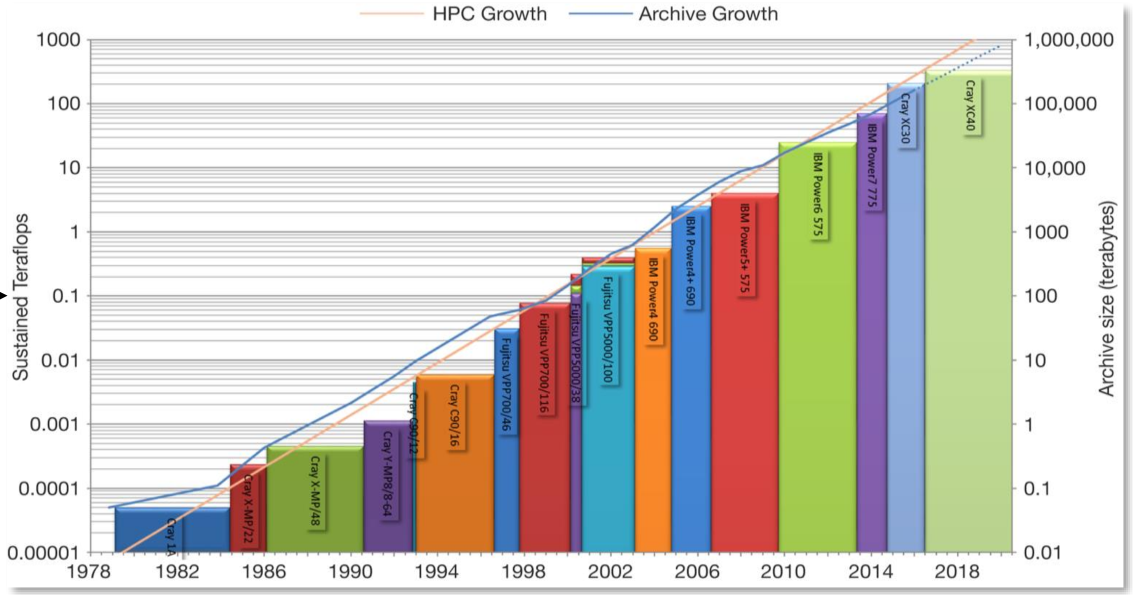
However, we have a several hundred peta-byte of Earth system data from observations and model output

- ➢ **There are many application areas for machine learning in numerical weather predictions**

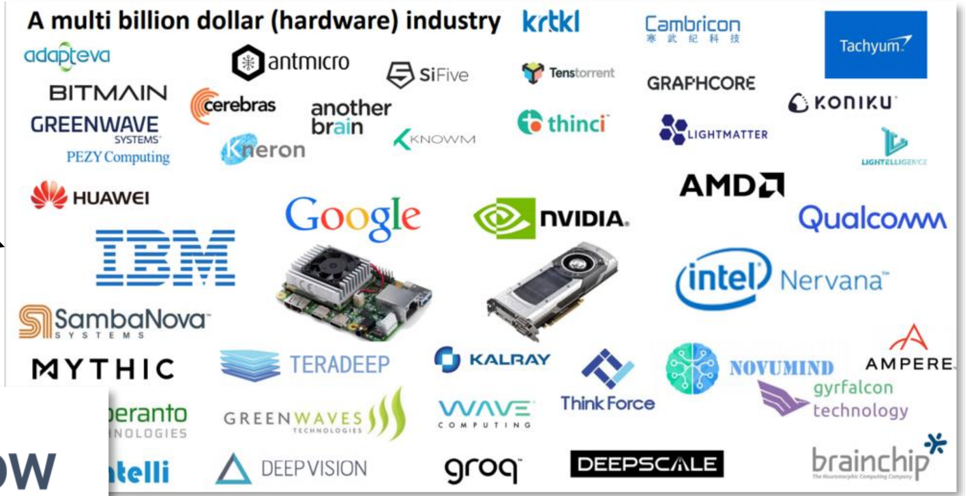


MAELSTROM – Why now?

Increase in data volume



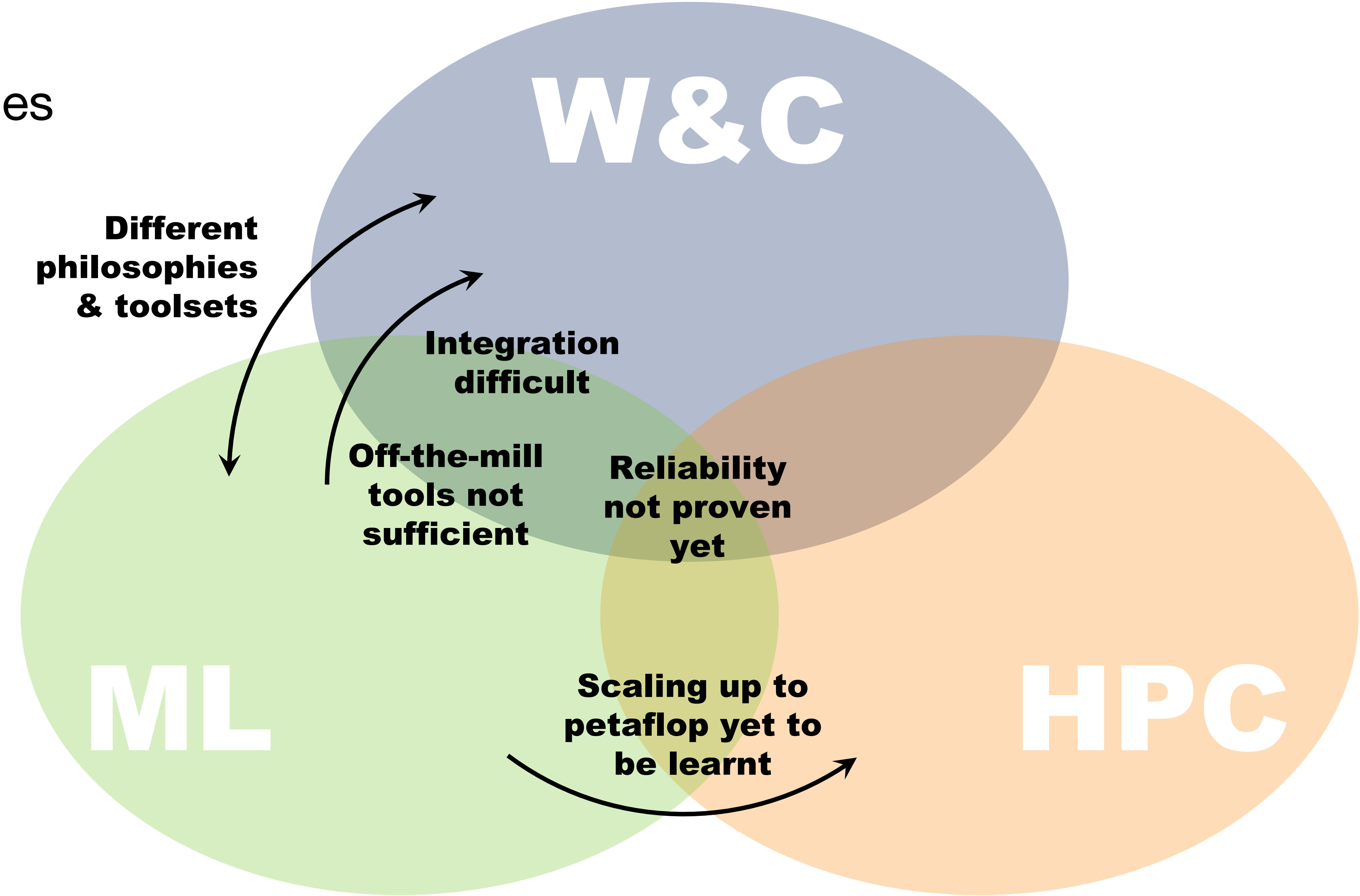
New computing hardware



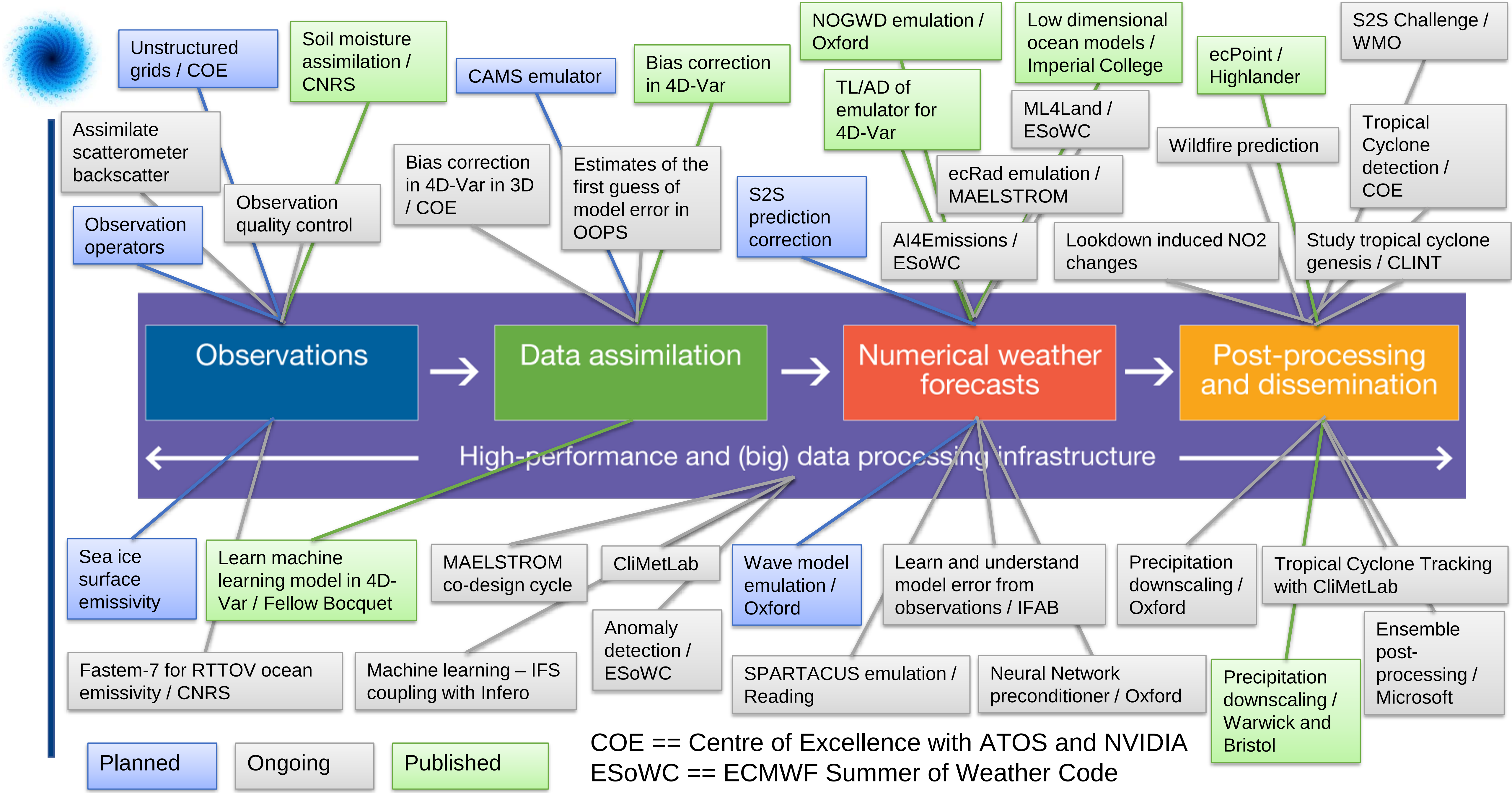
New machine learning software

Increase in knowledge

Challenges

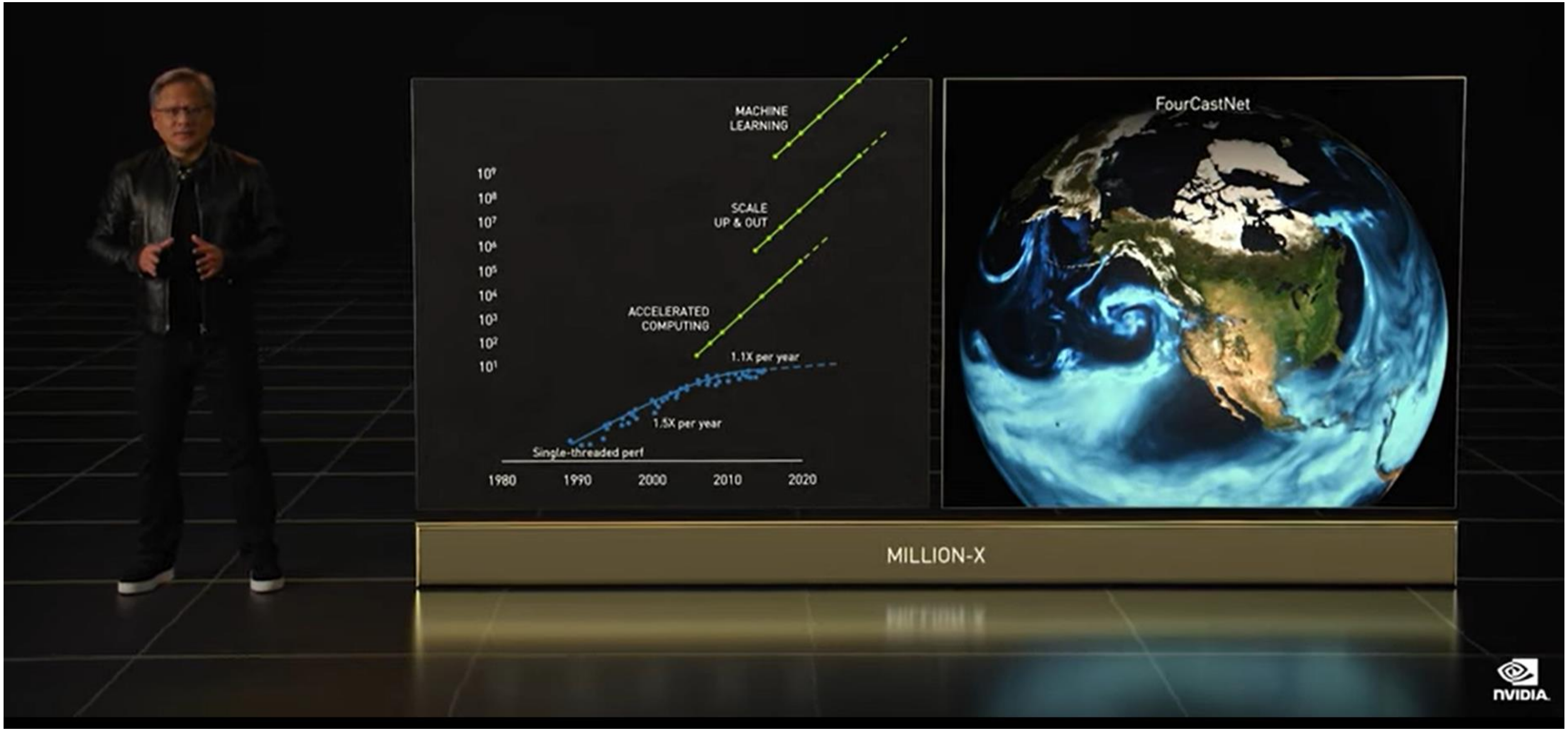

W&C
ML
HPC
Different philosophies & toolsets
Integration difficult
Off-the-mill tools not sufficient
Reliability not proven yet
Scaling up to petaflop yet to be learnt

The state-of-the-art – Machine learning at ECMWF



COE == Centre of Excellence with ATOS and NVIDIA
ESoWC == ECMWF Summer of Weather Code

The perspective – Full ML models for weather and climate?



NIVIDA's Earth-2 is coming with FourCastNet – see Thorsten's talk

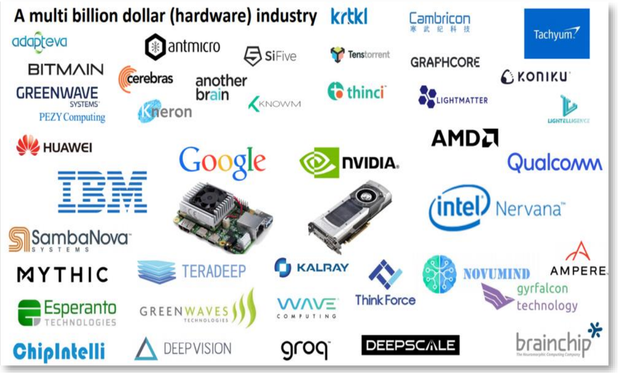
Climate?

A myriad of options…

A myriad of options for machine learning approaches

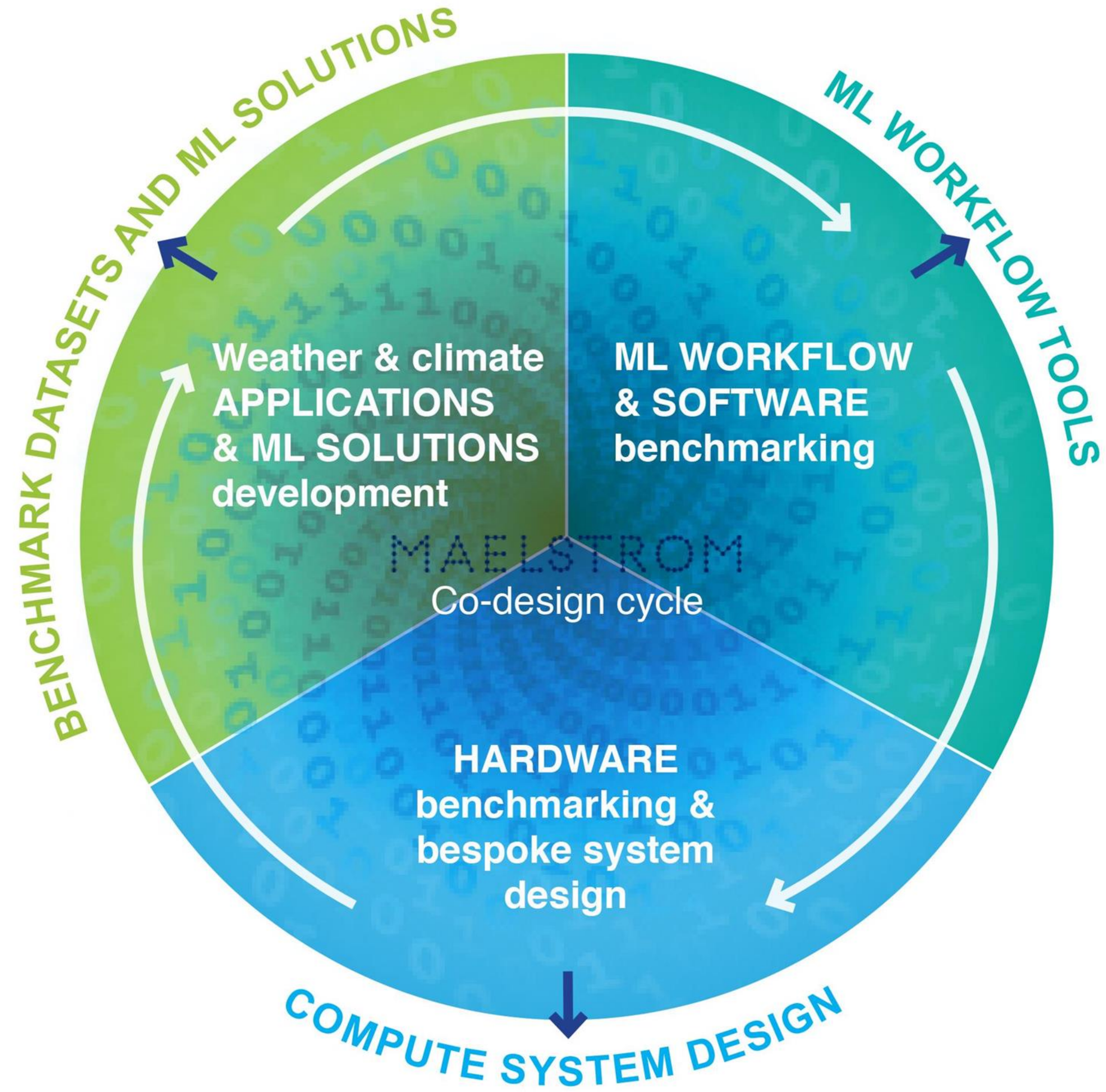
Dense Neural Networks, LSTMs, ConvGru, Attention Layers, Transformer networks, # of hidden layers, different normalisation of inputs, batch normalisation, tanh, relu, gelu, softplus, elu, selu, leaky relu, softmax, sigmoid function, generative adversarial networks, recurrent neural networks, encoding/decoding networks, random forests, boosting methods, clustering techniques, singular vector decomposition, causal discovery, ablation studies, root mean square error, variational auto encoder, gradient descent, stochastic gradient decent, adagrad, adadelta, RMSprop, Adam, # of epochs, # of batches, learning rate, overfitting, dropout, Bayesian networks, Gaussian processes, half precision, sparse networks…. Argh…

+ a myriad of options for machine learning hardware

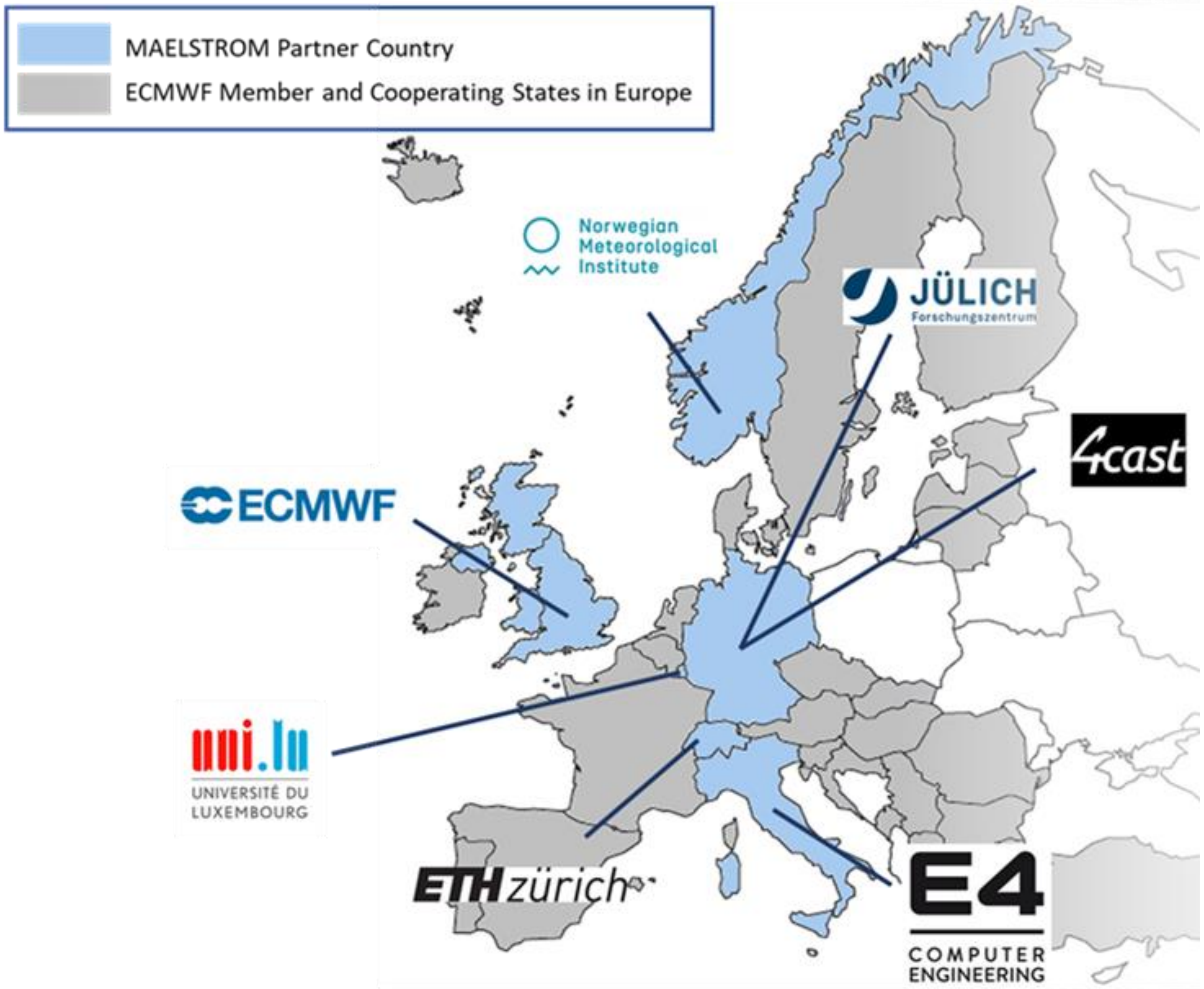


= confused scientists

The MAELSTROM approach



We are MAELSTROM



MAELSTROM – How to get involved?

- Visit our ***project webpage***: www.maelstrom-eurohpc.eu
- Use our ***benchmark datasets***
- Use our ***machine learning blueprints*** for other applications
- Use of ***machine learning workflow tools***
- Use of ***compute system designs***
- ***Talks, deliverables and publications***
- Two ***dissemination workshops*** are planned for April 2022 and Spring 2024 at ECMWF
- Two ***hackathons*** foreseen (2022 in Juelich and 2023 at ECMWF)

Questions?

Please also join us for the ECMWF Machine Learning Workshop Tu-Fr
https://events.ecmwf.int/event/294/

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