ESiWACE: Performance Predictions for Storm-Resolving Simulations of the Climate System

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esiwace
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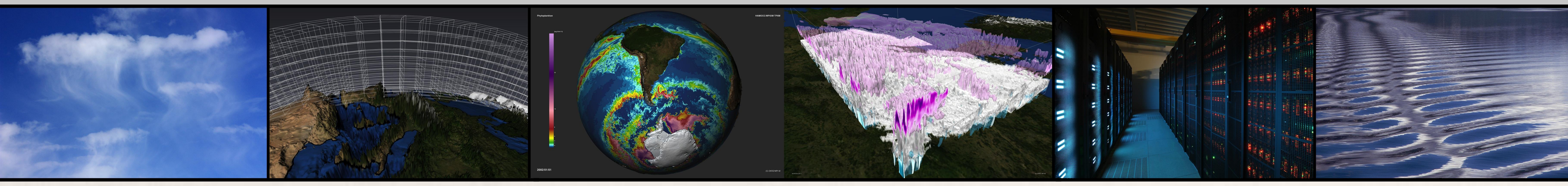


THE PROJECT

ESiWACE (Sep 2015-Aug 2019) forms a joint scientific community around **Earth system Modelling** (ESM) from the two communities of **weather** and **climate** research by leveraging two established European networks:

- The European Network for Earth System Modelling
- The European Centre for Medium-Range Weather Forecasts

ESiWACE addresses three core themes on the applications' way towards exascale computing:

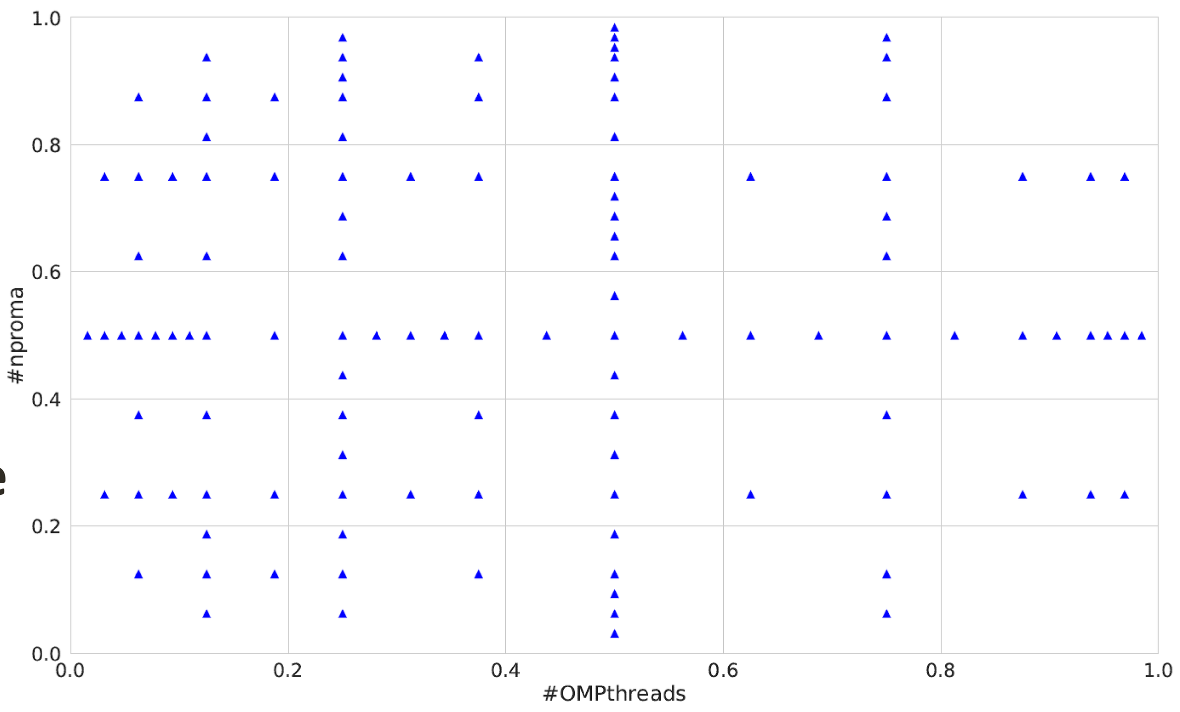
- **Scalability** of models and tools at extreme scale
  - Establishing extreme-scale **high-resolution demonstrators**
  - Code optimisation (vectorisation, communication, etc.)
- **Usability** of **HPC** systems for the ESM workflow
  - Handbooks for application and system software stacks
  - Spack-based solutions for software stack and model deployment
  - Improving robustness and performance of meta-scheduler Cylc
- **Exploitability** of climate data fostering new I/O paradigms
  - Business model development to address cost/benefit balance in data centres
  - Middleware development to alleviate the use of expensive and non-scalable disk resources

TOWARDS PERFORMANCE PREDICTION WITH SPARSE GRIDS

Accurate predictions for the run time of compute-intensive, multi-parameter weather and climate models may

- enable more efficient scheduling of simulations on a compute cluster,
- yield insights into the actual simulation bottlenecks .

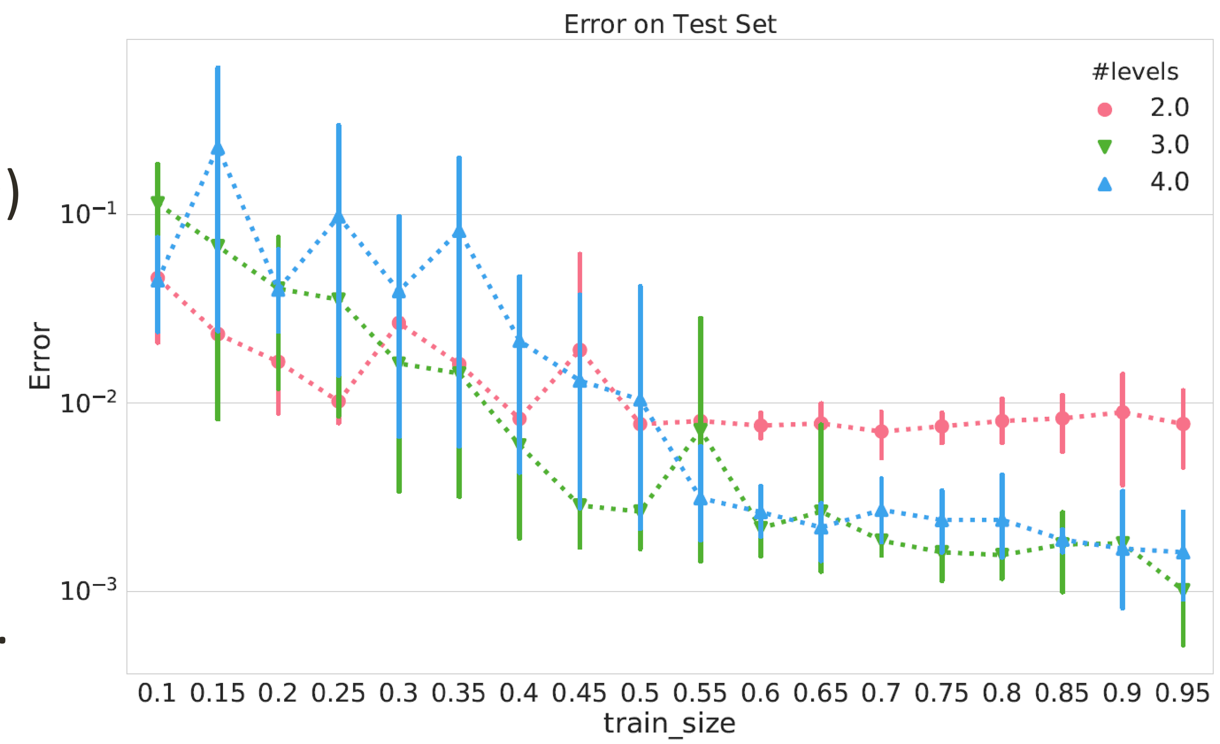
To cope with the high dimensionality of the parameter space that impacts performance, **regression on the performance data is carried out via adaptive sparse grids**.

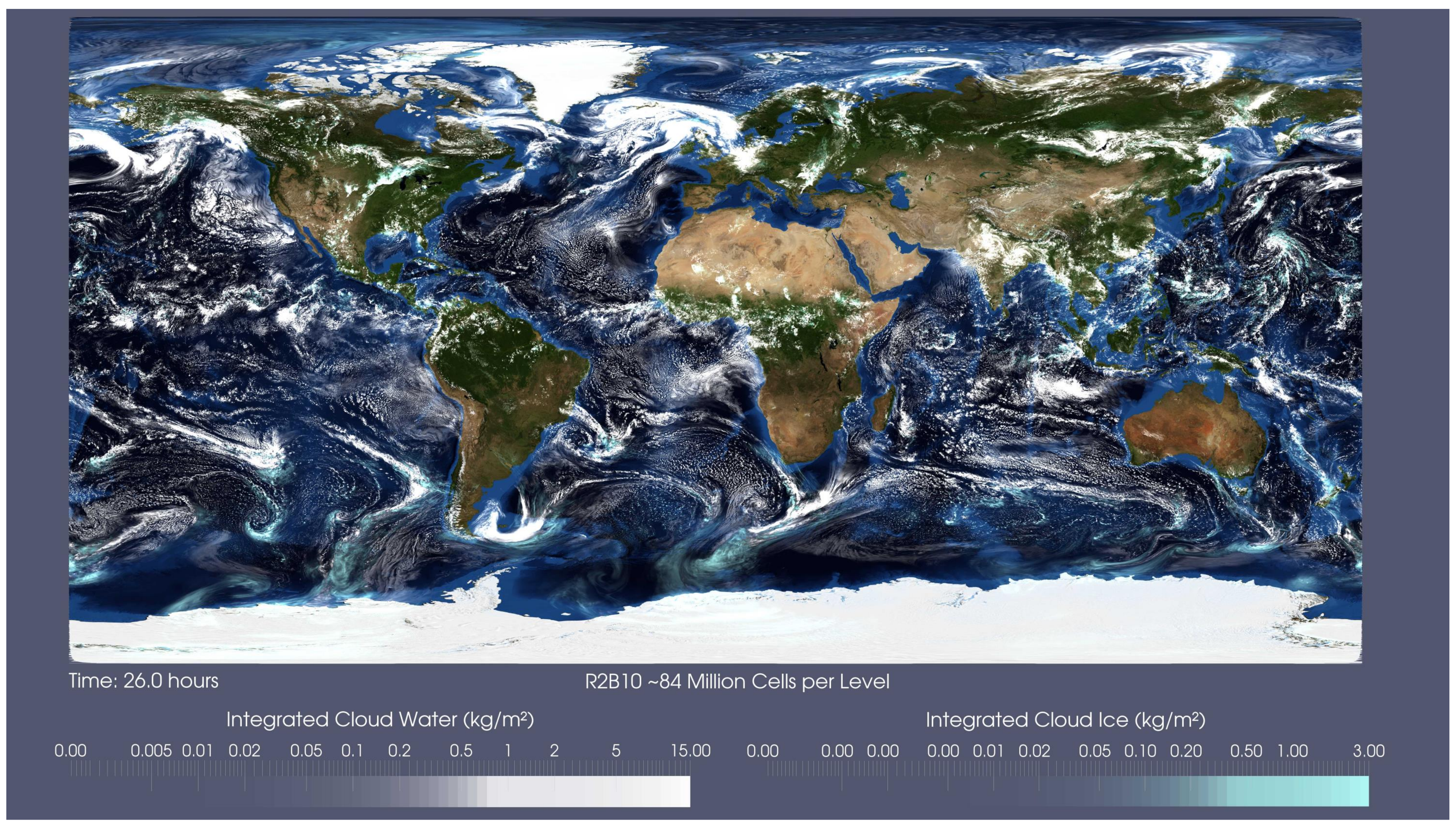


In a first study, the following parameters are considered in a coarse-grained version of the DYAMOND scenario (R2B4, corresponding to 160km global resolution; platform: Mistral/DKRZ, partition compute2, dual-socket Broadwell):

- Number of OpenMP threads/MPI tasks
- Loop-blocking parameter (nproma)

Preliminary results suggest that **runtime/ performance can be predicted very well using the adaptive sparse grids approach**.



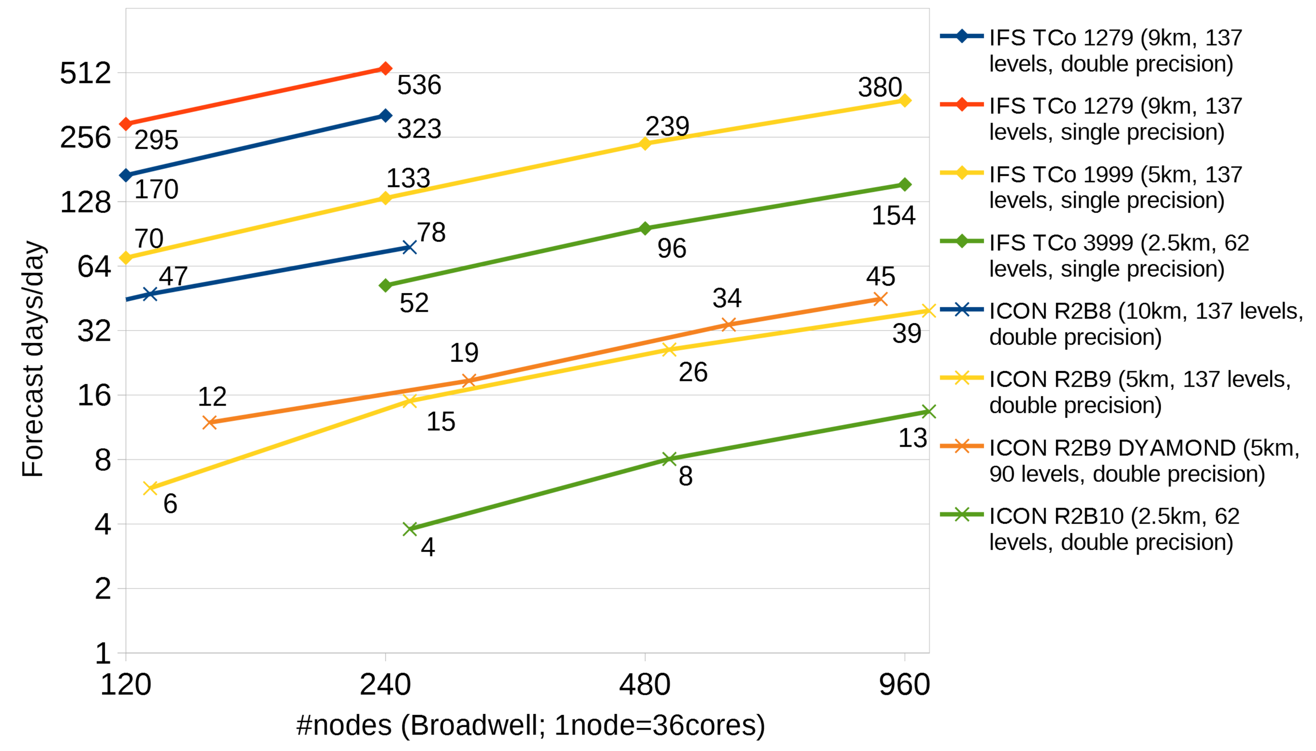


Global ICON-based weather forecast, run at a resolution of 2.5km

GLOBAL HIGH-RESOLUTION DEMONSTRATORS AND DYAMOND

In ESiWACE, global high-resolution demonstrator simulations are developed; a key target is to reach spatial resolutions (ca. 1 km) that allow simulating convective clouds and small-scale ocean eddies. This will provide much more fidelity in the representation of high-impact regional events. The demonstrators will deliver computability estimates of these configurations at exascale. They are based on widely used European models (IFS, ICON, NEMO, EC-EARTH).

Global high-resolution models are subject to international research. The project **DYAMOND** (**DY**namics of the **A**tmospheric general circulation **M**odeled **O**n **N**on-hydrostatic **D**omains) targets the intercomparison of this emerging class of atmospheric circulation models, with groups from Europe, USA and Japan participating so far. ESiWACE supports DYAMOND and contributes to the execution of corresponding HPC experiments with the ICON model.



Scalability of the models IFS and ICON for global high-resolution atmosphere-only predictions

THE ESiWACE CONSORTIUM

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