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Performance Modeling and Scalability for Global High-Resolution Weather and Climate Predictions

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Global kilometre-scale resolving weather and climate models come with extreme compute requirements. Therefore, profiling, understanding and finally predicting the performance and scalability of these models is of utmost importance to efficiently leverage the compute power of today's supercomputers on the one hand and to achieve optimal time-to-solution for the actual weather and climate predictions on the other hand. The Centre of Excellence in Simulation of Weather and Climate in Europe (ESiWACE) focuses on the development of prototypical global high-resolution models, which have recently fed into the international intercomparison project on the DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains (DYAMOND). A key challenge in these developments lies - besides the scientific case of DYAMOND - in the prediction of the actual performance of models used in the communities on upcoming exascale systems.

In my talk, I will present recent considerations on measuring and predicting performance of weather and climate models at the example of the ICOsahedral Non-hydrostatic (ICON) model. After introducing the context of ESiWACE and DYAMOND, I will focus on (1) scalability results of 2.5km- and 5km-resolving ICON runs and (2) on a semi-analytical performance modeling approach to predict scalability of the model on current and upcoming supercomputing architectures. Finally, I will point at the (3) capabilities of the sparse grid regression technique to predict performance from measured scalability data.