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Towards a multi-node OpenACC Implementation of the ICON Model

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We have ported the Icosahedral Non-hydrostatic (ICON) model's dynamics solver to Graphical Processing Units (GPUs), which is a task within the Partnership for Advanced Computing in Europe (PRACE) Second Implementation Phase (2IP) Work Package 8 (WP8). Initial single-node OpenCL and CUDA-Fortran implementations of ICON's non-hydrostatic dynamical core (NHDC) resulted in a maximum factor of two speedup over the latest CPU nodes, e.g., a dual-socket Intel Sandybridge. While this performance was promising, ICON developers viewed neither OpenCL nor CUDA-Fortran as viable programming paradigms for the actual production code, and suggested instead the OpenACC standard as the proper paradigm for the multi-node GPU implementation, which was then undertaken in WP8.

We will present the results of the multi-node OpenACC implementation of the ICON NHDC for hybrid multicore platforms. The code baseline is the ICON "DSL" (Domain Specific Language) testbed code, which is essentially a stripped-down version of the ICON model for dynamics simulations only. We will discuss on the OpenACC directives used for the port of the computational as well as the communication code to GPUs, and report the resulting GPU performance on NVIDIA K20x as compared to contemporary CPU architectures.

In addition, the future roadmap for an accelerated ICON version will be presented. As a first step, we are now incorporating the OpenACC directives into the ICON development trunk, based on the feedback given to us from the ICON developers at the Max Planck Institute for Meteorology (MPI-M) and the German Weather Service (DWD). Moreover, we plan to port the ICON Climate physical parameterizations stemming from the ECHAM model to OpenACC. This step should enable the full ICON on many core platforms which support OpenACC. The resulting model should benefit climate researchers world-wide who plan to transition from ECHAM to ICON in the coming years.