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Next-Generation Time Integration targeting Weather and Climate Simulations

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Running simulations on high-performance computers faces new challenges due to e.g. the stagnating or even decreasing per-core speed. This poses new restrictions and therefore challenges on solving PDEs within a particular time frame in the strong scaling case. Here, disruptive mathematical reformulations, which e.g. exploit additional degrees of parallelism also along the time dimension, gained increasing interest over the last two decades.

This talk will cover various examples of our current research on (parallel-in-)time integration methods in the context of weather and climate simulations such as rational approximation of exponential integrators, multi-level time integration of spectral deferred correction (PFASST) as well as other methods.

These methods are realized and studied with numerics similar to the ones used by the European Centre for Medium-Range Weather Forecasts (ECMWF). Our results motivate further investigation for operational weather/climate systems in order to cope with the hardware imposed restrictions of future super computer architectures.

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