A comparison of time-parallel "across the method" deferred correction schemes for atmospheric modelling

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In Numerical Weather Prediction (NWP) and climate modelling, computational efficiency and numerical accuracy are critical. This work investigates the viability of time-parallel Deferred Correction (DC) methods as alternatives to the traditionally serial-in-time approaches currently used at the Met Office. LFRic-Atmosphere—the Met Office's next-generation atmospheric model—is designed for modern supercomputing architectures, leveraging a quasi-uniform cubed-sphere mesh and a lowest-order compatible finite element discretisation to ensure scalability and accuracy. The model features an iterative semi-implicit time-stepping scheme combined with a Flux Form Semi-Lagrangian (FFSL) finite-volume transport method.

Time-parallel DC methods have the potential to enhance temporal accuracy while reducing computational cost. In this talk, I will first present results from dynamical core test cases solving the compressible Euler equations using serial Fast Wave Slow Wave Spectral Deferred Correction (FWSW-SDC). I will then examine two distinct strategies for introducing time parallelism in DC methods: (1) Revisionist Integral Deferred Correction (RIDC), which parallelises across correction sweeps, and (2) SDC with time-parallel preconditioners, which parallelises across collocation nodes.

These developments explore potentially more efficient time integration for atmospheric models and open new avenues for exploiting parallelism in next-generation weather and climate simulations.