P8 Exascale computing in numerical weather prediction: massively parallel I/O in atmospheric models on conformal meshes.

Heinzeller, Dom, *National Oceanic and Atmospheric Administration/Earth System Research Laboratory/Global Systems Division (NOAA/ESRL/GSD), University of Colorado/Cooperative Institute for Research in Environmental Sciences (CU/CIRES), and Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research, Germany (KIT/IMK-IFU),* Michael Duda, *National Center for Atmospheric Research/Mesoscale and Microscale Meteorology Laboratory,* Thomas Schwitalla, *University of Hohenheim, Institute of Physics and Meteorology, Germany,* and Harald Kunstmann, *KIT/IMK-IFU and University of Augsburg, Department of Geography, Germany*

Next-generation exascale computing systems require atmospheric models to scale out to orders of magnitude more cores than today. The dynamical solvers of traditional models on regular latitude-longitude grids as well as spectral models are challenged by this development. Conversely, dynamical solvers on conformal meshes as in MPAS have demonstrated excellent scaling on modern architectures.

A further challenge for applications at extreme scale is the efficiency of the model's I/O layer. Traditional file formats such as NetCDF or GRIB are subject to severe scalability issues for large numbers of I/O tasks and very large data sets.

Here, we present the implementation of an additional I/O layer based on the SIONlib library, developed at Research Centre Jülich and designed for massively parallel applications, in the MPAS model. Our implementation reduces not only the read and write times by factors of 5 to 60 compared to parallel NetCDF formats, but also the time required to initialize the model by up to 90%.

We demonstrate that embracing the power of a conformal Voronoi mesh and a massively-parallel I/O layer enables us to conduct modelling experiments at extreme scale. In particular, we show results for the first application of MPAS-A on a global 1km mesh with more than 589 million horizontal grid columns.