

iCONtainer: climate and weather simulations with ICON in a singularity container

The Icosahedral Nonhydrostatic Weather and Climate Model (ICON) is a community model for the simulation of weather and climate across scales of space and time. ICON is used for operational weather forecasting by the German Weather Service, for climate projections of the Coupled Model Intercomparison Project, and for high-resolution simulations that form the physical basis of digital twins of the Earth. ICON is also used for education and training of students. However, porting ICON to high-performance computing systems and using it efficiently on these systems can be quite challenging. This challenge is exacerbated by the fact that climate model simulations require a software stack that remains stable over several years, which is often not the case at multi-purpose HPC systems. In addition, many small university research teams lack the resources and expertise that are required for model porting.

With iCONtainer, we want to address these challenges by running ICON in a singularity container. Because of the long legacy of using ICON with Intel, iCONtainer uses the Intel compiler suite and Intel-MPI. We consider two drastically different flavors of ICON: a coarse-resolution version with 100 km grid spacing (ICON-ESM), and a high-resolution version with km-scale grid spacing (ICON-Sapphire). Because the two flavors differ drastically in their grid spacing, they sample different complexities and challenges. The project will compare the model performance for the container version and the native installation on these HPC systems, and will study to what extent model problems encountered with native installations of ICON can be avoided by use of the container. The project will also address issues related to finding the best match between the MPI libraries of the host HPC systems and the container.

We plan to make iCONtainer available to the public. By making it easier for domain scientists to use the state-of-the-art climate and weather model ICON, we hope that iCONtainer will help to democratize climate and weather modeling.