A new climate modeling framework for convection-resolving simulation at continental scale

Christophe Charpilloz (1), Salvatore di Girolamo (2), Andrea Arteaga (1), Oliver Fuhrer (1), Torsten Hoefler (2), Thomas Schulthess (3), and Christoph Schär (4)

(1) Federal Office of Meteorology and Climatology, MeteoSwiss, (2) Scalable Parallel Computing Laboratory, ETH Zürich, (3) Swiss National Supercomputing Centre, (4) Atmospheric and Climate Science, ETH Zürich

Major uncertainties remain in our understanding of the processes that govern the water cycle in a changing climate and their representation in weather and climate models. Of particular concern are heavy precipitation events of convective origin (thunderstorms and rain showers). The aim of the crCLIM project [1] is to propose a new climate modeling framework that alleviate the I/O-bottleneck in large-scale, convection-resolving climate simulations and thus to enable new analysis techniques for climate scientists. Due to the large computational costs, convection-resolving simulations are currently restricted to small computational domains or very short time scales, unless the largest available supercomputers system such as hybrid CPU-GPU architectures are used [3]. Hence, the COSMO model has been adapted to run on these architectures for research and production purposes [2]. However, the amount of generated data also increases and storing this data becomes infeasible making the analysis of simulations results impractical. To circumvent this problem and enable high-resolution models in climate we propose a data-virtualization layer (DVL) that re-runs simulations on demand and transparently manages the data for the analysis, that means we trade off computational effort (time) for storage (space). This approach also requires a bit-reproducible version of the COSMO model that produces identical results on different architectures (CPUs and GPUs) [4] that will be coupled with a performance model in order enable optimal re-runs depending on requirements of the re-run and available resources. In this contribution, we discuss the strategy to develop the DVL, a first performance model, the challenge of bit-reproducibility and the first results of the crCLIM project.


