WCRP CORDEX 17TH-20TH MAY 2016 STOCKHOLM, SWEDEN ICRC-CORDEX 2016

PARALLEL SESSION B : FRONTIER DOWNSCALING TOOL
B1: VERY HIGH RESOLUTION MODELLING

European-Scale Convection-Resolving Climate Modeling

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Moist convection is a fundamental process in our climate system, but is usually parameterized in climate models. The underlying approximations introduce significant uncertainties and biases, and there is thus a general thrust towards the explicit representation of convection. For climate applications, convection-resolving simulations are still very expensive, but are increasingly becoming feasible. Here we present recent results pertaining to the development and exploitation of convection-resolving regional climate models. We highlight validation using decade-long simulations, explore convection-resolving climate change scenarios, and provide an outlook on the use of next-generation supercomputing architectures.

Detailed results will be presented using the COSMO model over two computational domains at a horizontal resolution of 2.2 km. The first covers an extended Alpine region from Northern Italy to Northern Germany (500x500x60 grid points). For this domain decade-long simulations have been conducted, driven by both reanalysis as well as CMIP5 model data. Results show that explicit convection leads to significant improvements in the representation of summer precipitation, and to substantial differences in climate projections of precipitation. The simulations are particularly relevant for assessing projections of hourly precipitation events, and in order to assess the scaling of short-term heavy events with temperature (Ban et al. 2015, GRL).

The second domain covers most of Europe (1536x1536x60 grid points) and the respective simulations exploit heterogeneous many-core hardware architectures with GPUs. To efficiently use such computers, the model code underwent significant development, including a rewrite of the dynamical core in C++. Results demonstrate realistic mesoscale processes embedded into the synoptic scale, such as line convection along cold frontal systems, or the triggering of moist convection by propagating cold-air pools (Leutwyler et al., GMD, in preparation). Validation of a 10-year simulation driven by reanalysis data will also be presented. The European-scale simulation capability is currently further explored in a interdisciplinary project (crCLIM, see http://www.c2sm.ethz.ch/research/crCLIM.html).

It is argued that today's largest supercomputers would in principle be able to support – already now – global convection-resolving climate simulations, provided the respectively refactored codes would be available.

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