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Representation of Precipitation in a Decade-long Continental-Scale Convection-Resolving Climate Simulation

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The representation of moist convection and the associated precipitation in climate models represents a major challenge, due to the small scales involved. Convection-resolving models have proven to be very useful tools in numerical weather prediction and in climate research. Using horizontal grid spacings of O(1km), they allow to explicitly resolve deep convection leading to an improved representation of the water cycle. A new version of the Consortium for Small-Scale Modeling weather and climate model (COSMO), capable of exploiting new supercomputer architectures, allows convection-resolving climate simulations on computational domains spanning continents and time period up to one decade.

We present results from a decade-long, convection-resolving climate simulation on a European-scale computational domain. The simulation has a grid spacing of 2.2 km, 1536x1536x60 grid points, covers the period 1999-2008, and is driven by the ERA-Interim reanalysis. Specifically we present an evaluation of hourly rainfall using a wide range of data sets, including several rain-gauge networks and a remotely-sensed lightning data set. Substantial improvements are found in terms of the diurnal cycles of precipitation amount, wet-hour frequency and all-hour 99th percentile or in terms of the frequency-intensity distributions. However the results also reveal substantial differences between regions with and without strong orographic forcing. Furthermore we present an index for deep-convective activity based on the statistics of vertical motion. Comparison of the index with lightning data shows that the convection-resolving climate simulations are able to reproduce important features of the annual cycle of deep convection in Europe.

Leutwyler, D., Lüthi, D., Ban, N., Fuhrer, O., and Schär, C.: Evaluation of the Convection-Resolving Climate Modeling Approach on Continental Scales, J. Geophys. Res. Atmos., in revision.

Leutwyler, D., Fuhrer, O., Lapillonne, X., Lüthi, D., and Schär, C., 2016: Towards European-scale convection-resolving climate simulations with GPUs: a study with COSMO 4.19, Geosci. Model Dev., 9, 3393-3412, doi:10.5194/gmd-9-3393-2016.

Ban, N., Schmidli J. and Schär, C., 2015: Heavy precipitation in a changing climate: Does short-term summer precipitation increase faster?. Geophys. Res. Lett., 42, 1165-1172.