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Regional climate models add value to global model data

Frauke Feser[†]; Hans von Storch; Burkhardt Rockel; Jˆrg Winterfeldt; Matthias Zahn
[†] Helmholtz-Zentrum Geesthacht, Germany
Leading author: frauke.feser@hzg.de

An important challenge in current climate modeling is to realistically describe small-scale weather statistics such as topographic precipitation, coastal wind patterns or regional phenomena like polar lows. Global climate models simulate atmospheric processes with increasingly higher resolutions, but still regional climate models have a lot of advantages. They consume less computation time due to their limited simulation area and thereby allow for higher resolution both in time and space as well as for longer integration times. Regional climate models can be used for dynamical downscaling purposes, as their output data can be processed to produce higher resolved atmospheric fields, allowing the representation of small-scale processes and a more detailed description of physiographic details (such as mountain ranges, coastal zones, and details of soil properties). But does higher resolution add value when compared to global model results? Most studies implicitly assume that dynamical downscaling leads to output fields superior to the driving global data, but little work has been carried out to substantiate these expectations. Here, we review a series of articles that evaluate the benefit of dynamical downscaling by explicitly comparing results of global and regional climate model data to observations. These studies show that the regional climate model generally performs better for the medium spatial scales, but not always for the larger spatial scales. We conclude that regional models can add value, but only for certain variables and locations; particularly those influenced by regional specifics such as coasts or meso-scale dynamics such as polar lows. Therefore, the decision of whether a regional climate model simulation is required depends crucially on the scientific question being addressed.