Regionalization and downscaling

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For impact studies, information is needed on regional and local scales. However, both re-analyses and climate change simulations have skill chiefly on large-scales. For constructing states and statistics on smaller scales, the concept of downscaling has been developed.

The basic idea with downscaling is to understand the state of smaller scales as a conditional random variable, conditioned by the large-scales. A best guess for the state is commonly taken the expectation of this conditional random variables, or a random pick.

The derivation of the conditioning can be done by constructing a statistical model or a by using a dynamical model. The empirical link is based on ideas of synoptic climatology and spatial interpolation; the latter by constraining the large scales in a dynamical model (spectral nudging). The latter was originally applied to regional model, but following an idea by Yoshimura and Kanamitsu (2008) this concept is also applied to global models – so that with one high-resolution model simulation, forced by the reliably available larges scales in re-analyses or climate change simulations, consistent states regional climate states can be constructed.

The often-employed usage of limited area models, forced only at the lateral and lower boundaries is another method for regionalization of climate states, comprises not a real “downscaling”, because it does not, or only indirectly, process the state of the large-sales as a driver for constructing the smaller scales. Compared to the constrained simulation, the intermittent divergence in phase space - the tendency to form quite different trajectories when the lateral constraint breaks down - is considerably larger when only boundary conditions are applied than if a true downscaling is implemented.

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