Estimates of local temperature change by statistical downscaling: Sensitivity to the method and selection of predictors

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Various statistical downscaling models are applied to GCM outputs to provide climate change estimates for local daily surface temperature at a network of 39 stations in central and western Europe. Several linear downscaling methods are used; a number of sets of predictors are defined on a regular grid over the Euro-Atlantic domain. The site-specific temperature change estimates are shown to vary widely among the methods as well as among the predictors. The most counter-intuitive result is the dependence of the estimated warming on the number of principal components (PCs) of predictors: the larger the number of PCs, the higher the warming. The mechanisms of this effect are identified and discussed. The necessity to include among predictors the variables able to describe the radiation-induced changes, not only the circulation-induced ones, is underlined. In particular, it is shown that the use of sea level pressure or 1000 hPa heights as the only predictor in statistical downscaling leads to unrealistically low temperature change estimates. We further argue that the selection of the optimum downscaling method should be based not only on its performance in present climate conditions, but also on its ability to capture long-term climate variations. However, no criterion of the latter that has so far been used seems to work well. The main problem appears to stem from the fact that downscaling models are fitted predominantly to a short-term (daily, intraseasonal) variability, but the studies of future climate change are focused on variations on long-term (decadal) time scales.