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Evaluating the sensitivity of local temperature distributions to global climate change

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Climate change adaptation activities takes place at regional and local scales. The sensitivity of climate to increasing greenhouse gases is, however, most often studied at the global scale [Knutti and Hegerl 2008, and references therein]. At adaptation relevant spatial scales information is most often based on simulations of complex climate models [Murphy et al. 2009, Tebaldi et al. 2005]. These face significant questions of robustness and reliability as a basis for forecasts on such scales [Stainforth et al., 2007]. Here we propose a different approach, using observational timeseries to evaluate the sensitivity of different parts of the local climatic distribution. There are many advantages to such an approach: it avoids issues relating to model imperfections, it can be focused on decision relevant thresholds [e.g. Porter and Semenov, 2005], and it inherently integrates information relating to local climatic influences.

Our approach takes timeseries of local daily temperature from specific locations and extracts the changing cumulative distribution function (cdf) over time. We use the e-obs dataset to construct such cdf-timeseries for locations across Europe. We analyse these changing cdfs using a simple mathematical deconstruction of how the difference between two observations from two different time periods can be assigned to the combination of natural variability and/or the consequences of climate change. This deconstruction facilitates an assessment of the sensitivity of different quantiles of the distributions. These sensitivities are shown to be geographically varying across Europe; as one would expect given the different influences on local climate between, say, Western Scotland and central Italy. We nevertheless find many regionally consistent patterns of response of potential value in adaptation planning.

Both the methodology and a sensitivity analysis will be presented. The technique has the potential to be applied to many other variables in addition to temperature, and to many other parts of the globe, in support of adaptation activities and the assessment of potential impacts of climate change.

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