Title: A Virtual Climate Library of Surface Temperature over North America for 1979–2015

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Abstract: The most comprehensive continuous-coverage modern climatic data sets, known as reanalyses, come from combining state-of-the-art numerical weather prediction (NWP) models with diverse available observations. These reanalysis products describe the path of climate evolution that actually happened, and their use in a probabilistic context – for example, to document trends in extreme events in response to climate change – is, therefore, limited. Free runs of NWP models without data assimilation can in principle be used for the latter purpose, but such simulations are computationally expensive and are prone to systematic biases. Here we produce a high-resolution, 100-member ensemble simulation of surface atmospheric temperature over North America for the 1979–2015 period using a comprehensive spatially extended non-stationary statistical model derived from the data based on the North American Regional Reanalysis. The surrogate climate realizations generated by this model are independent from, yet nearly statistically congruent with reality. This data set provides unique opportunities for the analysis of weather-related risk, with applications in agriculture, energy development, and protection of human life.