1B.5

LAND USE CHANGE AND TEMPERATURE TRENDS

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1. INTRODUCTION

Urbanization in the vicinity of meteorological observations has long been recognized as having the potential to impact temperature measurements by altering the sensible and latent heat fluxes around the measurement site (Mitchell 1953). To quantify the impact of urbanization, comparisons often have been made between the means and trends from stations classified as urban and rural. Such classifications are typically based on population metadata data or satellite derived night lights with the recognition that such measures may not necessarily be good proxies for the nature of the land use/land cover in the immediate vicinity of a particular site (Karl et al. 1988; Gallo et al. 1999; Peterson 2003; Peterson and Owen 2005). For example, stations may be situated in a park-like setting within a larger urban area and therefore be unrepresentative of the city's industrial centers or central business district. In other cases, stations in small towns may be situated in build-up areas that impact the microclimate surrounding the instrumentation. Moreover, urbanization represents only one form of land use conversion. Other changes to land use affect the energy balance at the surface and thus may also impact surface temperatures. Unfortunately, as in the case of urbanization, information on land use change at a scale relevant to local measurements at long-term climate stations can be difficult to obtain.

Nevertheless, it is possible to derive high resolution Land Cover/Land Use (LUCL) information from multispectral satellite imagery. Hale et al. (2006; 2008), in particular, have used information from the National Land Cover Database (NLCD; Loveland et al. 2002; Homer et al. 2004) to evaluate the potential impact of changes in LULC on temperature trends at a number of U.S. Cooperative Observer stations. Specifically, Hale et al. 2006 examined temperature values at stations with LUCL within 10m of the station during the middle of the 1971 to 2000 period (a period determined by their use of the current U.S. Normals data). Temperature trends in the period following the land cover changes were found to be overwhelmingly positive while those from the period before the land cover changes were a near equal mix of positive and negative.

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Based on this analysis, Hale et al. 2006 concluded that there was a "strong correlation between increases in temperature trends at Normals stations and nearby LULC," but acknowledged that this association did not necessarily imply a causal link and that future analysis was required.

2. ANALYSIS

In this presentation, we demonstrate that a null hypothesis is required to determine whether the approach used by Hale et al. 2006 provides evidence of correlation between changes in LUCL and temperature trends. A hypothesis test is required because the nature of multi-decadal variations in the "background" climate signal across the United States predisposes temperature trends from the set of all Normals stations to be a mix of positive and negative during the 1970s and to be overwhelmingly positive in the 1990s, as shown in Fig. 1. While Hale et al. 2008 used reanalysis data to further explore the association between LULC changes and temperature trends at U.S. stations (Kalnay and Cai 2003), these results also require interpretation within the framework of hypothesis testing as outlined in this presentation.

3. REFERENCES

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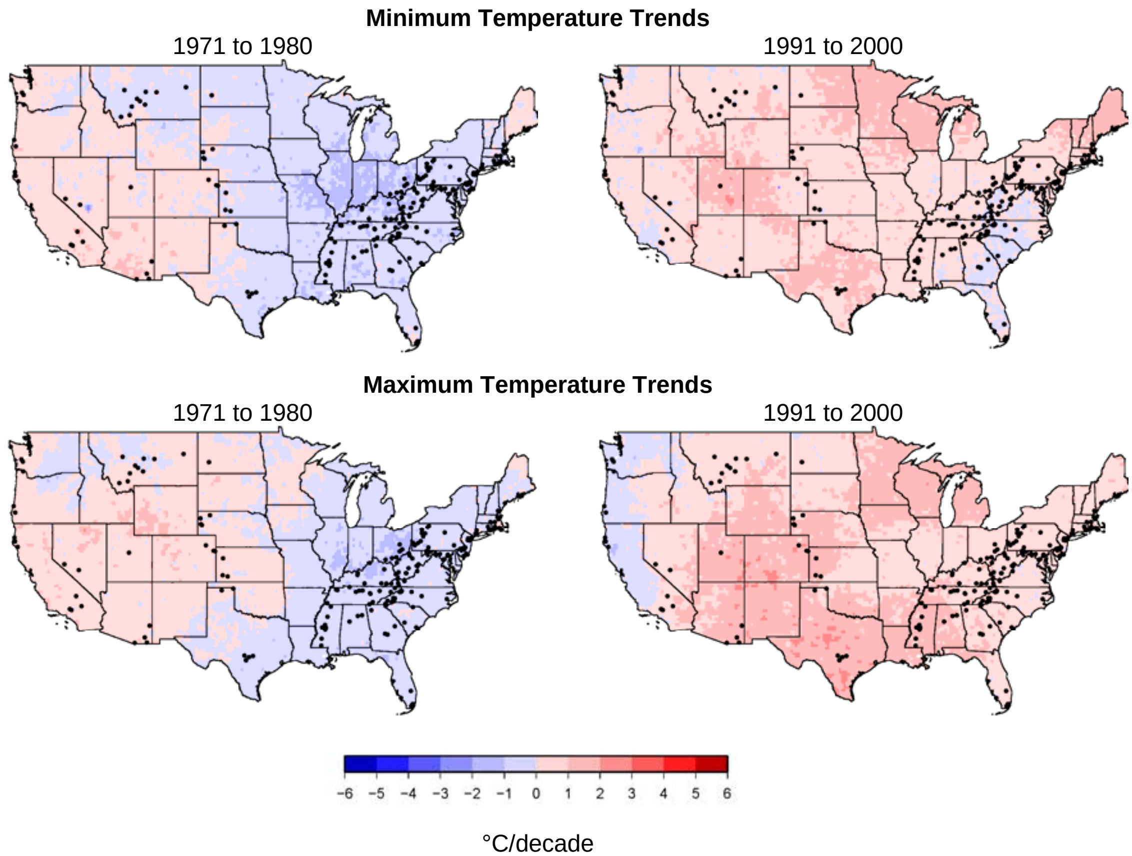

Figure 1. Gridded temperature trends from the U.S. Cooperative Observer Network adjusted using the procedures described in Menne et al. (2008). Black dots indicate the locations of stations with land use/land cover during the 1971 to 2000 period identified by Hale et al. (2006, 2008). Based on the depicted background climate change, trends at the stations analyzed by Hale et al. should be smaller, on average, in the early period relative to the later period regardless of changes in LULC.