12.2 WEEKEND/WEEKDAY DIURNAL TEMPERATURE RANGE IN CENTRAL ARIZONA

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1. INTRODUCTION

Many researchers have calculated the diurnal temperature range (DTR) and analyzed the spatial-temporal changes of the DTR globally and regionally (e.g., Karl, et al, 1993; Easterling, et al, 1997 and Durre and Wallace, 2001). An ongoing analysis by Brooks et al (in prep), using 24 stations for the period 1970-2000 in central Arizona, USA is showing that rural sites outside the Phoenix metropolitan area have much larger DTRs than urban-dominated sites (on the order of 2^0K difference), and that much of this variability is due to the rapid climb since WWII of the minimum temperature in the urban core area and environs, which has been previously reported (e.g., Balling and Brazel, 1987 and Brazel et al 2000).

Other DTR research has focused on the systematic nature of DTR alterations at regional to local scales, such as the weekend (Saturday through Monday)-weekday (Wednesday through Friday) DTR (DTR_{WE-WD}) changes possibly due to anthropogenic effects and impacts by aerosol-cloud interactions as well as other mechanisms (e.g., de F. Forster and Solomon, 2003). For many locations in the USA, DTR_{WE-WD} is positive, indicating larger DTR on weekends than during the weekdays. This statistic can be as large as $+0.5^0$K. The purpose of this present study was to initiate an analysis of the DTR_{WE-WD} differences evident from a high quality meteorological network in central Arizona - the AZMET system (Agricultural Meteorological Network). Anthropogenic traffic emissions and general pollution activity in the Phoenix area do show cyclic patterns on this time scale and have been previously linked to visibility alterations on a weekly cycle (Idso and Cooley, 1981). As part of past research on solar attenuation within the region linked to aerosol variability (Tomalty and Brazel, 2000), it is hypothesized that there may be a DTR weekend-weekday pattern difference for urban/rural sites.

2. METHODS

Temperature records of the AZMET network were extracted for the period 1988-2003 and DTR calculated for days in October-December (high pollution season plus height of the winter visitor season to Phoenix). In addition, an analysis is possible of solar radiation as recorded at these sites. Currently, these data have not been merged with Phoenix cloud cover records, but initially precipitation days have been eliminated from the analysis, as gleaned from AZMET records. The elimination of the low number of days of precipitation from the analysis likely reduced cloud effects on the results, but clouds remain as possible sources of impacts. For this paper, results of a representative rural site versus a site within the urban core region of the metropolitan area are discussed. The two sites used from the AZMET network are Paloma (in a farm community over 50 km to SW of the metro area) and Encanto Park, near the downtown area of Phoenix, but in a mesic vegetated golf course-neighborhood complex. Encanto Park is well within the high pollution and traffic emission regions of the city (Fernando, et al 2001 and Ellis et al, 1999). Thus, values were calculated for DTR_{WE-WD}pal and DTR_{WE-WD}enc where pal is the rural Paloma results and enc refer to Encanto urban results.

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3. RESULTS

The urban site DTR_{WE-WD}enc values for the October-December, 1988-2003 period understandably exhibit large year-to-year variability, ranging from $+2.03^0$K to -1.43^0K, but averaging 0.13^0K for the entire period, thus conforming closely to de F. Forster and Solomon (2003) Fig. 2a in their study (which show values close to $+0.15^0$K for central Arizona in the SW USA). At the rural Paloma site, DTR_{WE-WD}pal values ranged only from $+0.91^0$K to, however, a large -2.25^0K, with a grand mean of -0.21^0K, suggesting that the DTR is actually less at this rural site on weekends, in opposition to the Encanto Park urban area finding. However, the significance of the WE versus WD values is somewhat weak with the sample size of years used (significant at the 0.10 level).

The year-to-year variability at each site is forced primarily by variations in solar radiation, as observed on-site at the respective stations (r^2 values ~0.5 between year-to-year DTR_{WE-WD} values and incoming daily solar radiation). Also, the solar radiation patterns averaged in a format of sol_{WE-WD} for the two sites show that the Encanto urban site has positive values and the Paloma rural site negative values for this parameter. The urban results conform to a weekly aerosol pollution-solar attenuation impact as a possible cause (Tomalty and Brazel, 2000), whereas the rural Paloma reverse cycle from Encanto may be related to more weekend activity yet to be unraveled as a cause on both the solar reception and the DTR patterns. de F. Forster and Solomon (2003) found similar reversals of DTR_{WE-WD} for the American Midwest region.

4. CONCLUSIONS

DTR is a critically analyzed statistic in the climate community in the recent decade or two, signally possible natural and anthropogenic signals in the climate system. Understanding the spatial-temporal behavior of this

statistic has received significant attention in the climate community in general, and among those specifically interested in urban effects on climate. This study is ongoing at present, and initial results have suggested possible urban impacts on DTR on a weekend versus weekday cycle, but also surprisingly reverse effects for a nearby rural site. Since the climate in the central Arizona area is sunny and calm a great deal of the time, and the region is rapidly urbanizing with both myriad of urban and rural changes, it appears to be an excellent laboratory to further study the local systematic links of surface activities to the climate system and alterations of the DTR statistic.

5. REFERENCES

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