Evaluating Heat Index and Winter Weather Criteria in Deep South Texas and the Lower Rio Grande Valley

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1. Introduction

Establishment of local criteria for excessive heat and winter weather watches, warnings and advisories in a semi-tropical environment poses challenges in defining thresholds, identifying societal impacts, clarifying expectations in warning messages, and coordination with adjacent county warning areas. In 2008, the National Weather Service (NWS) Weather Forecast Office (WFO) in Brownsville, Texas established local criteria for the NWS Excessive Heat Program and revised local criteria for Winter Weather watches, warnings, and advisories (W/W/A).

Both efforts required examination of societal impacts as well as local climatologies. Considerations were given to local building construction, agricultural employment practices, human shelter needs, the large winter transitional and summer resort populations, and coordination with neighboring NWS offices. Extensive outreach was conducted with emergency management, health officials, and advocacy groups.

For both excessive heat and winter weather WFO Brownsville was able to identify weather conditions in the historical record that represented a significantly higher risk and were truly life threatening and/or damaging in Deep South Texas.

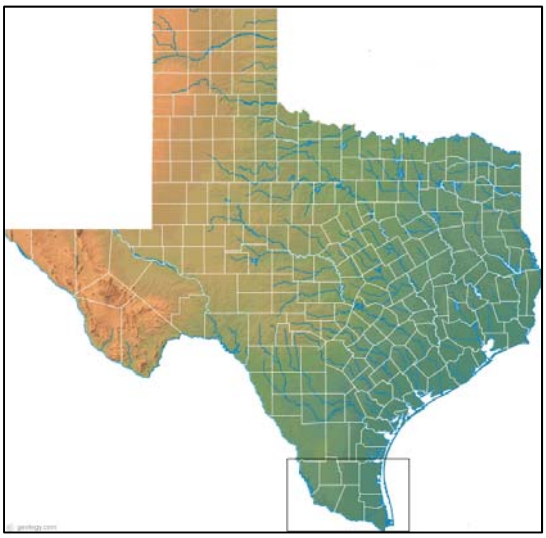

Figure 1. Map of Texas. Area of Deep South Texas and the Lower Rio Grande Valley outlined.

2. Background

There is a growing body of state regulatory law related to forecasts and/or issuances of W/W/A by the NWS. These include tow-in surfing, disconnection of services by energy providers, and mandatory evacuation during tropical cyclone events. Those related to energy provision are the most common, affecting twenty states and the District of Columbia (Table 1).[1]

In Texas, an entity that provides retail electric service "may not disconnect service to a residential customer when 1) the previous day's high temperature did not exceed 32 F and the temperature is predicted to remain at or below that level for the next 24 hours according to the

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nearest National Weather Service reports; or 2) the National Weather Service issues a heat advisory for any county in the relevant service territory, or when such an advisory has been issued on any one of the previous two calendar days."[2]

State Disconnection Policies *

Criteria	Heat	Cold
NWS Action – Heat Advisory	GA, MN, RI, TX, WI	
NWS Action – Temperature Forecast	NJ	AR, GA, IL, MS, MT, SC, TX
NWS Action HI Forecast	OK	
Observed Temperature	AR, DE, NV	AL, AZ, DE, DC, IL, IA, KS, MD, NV, OK, VT

* Administration for Children and Families
http://ftheap.ncat.org/Disconnect/disconnect.htm

Table 1. Data from the Low Income Home Energy Assistance Program.

WFO Brownsville, TX did not issue excessive heat watches, warnings, or advisories prior to 2008 and no local criteria had been determined. The national program has no default criteria, referring only to locally defined criteria.[3]

Prior to 2008, local criteria for wind chill advisories were 10F, a value not likely to be seen in Deep South Texas. Other winter weather related criteria were mismatched at county warning area borders and were reviewed in the process.

Determining heat and winter W/W/A criteria in Deep South Texas posed similar challenges. First, how to identify appropriate criteria for heat in a place where excessive heat is normal; and second, how to determine appropriate winter weather criteria in a place where many years do not see a freeze.

3. Discussion

Heat stress begins at temperatures that are common in Deep South Texas. To arrive at appropriate criteria in a region where excessive heat is normal, air-, dewpoint-, and apparent temperatures for the period 1997-2006 were analyzed to identify when substantial departures from the climatological normals occurred. These values were examined for correlation with mortality data where available. The Heat Stress Index (Kalkstein et. al.), a relative index designed to evaluate daily meteorological stress based on geographic location and time of year, was examined for utility and applicability. The small variance in summertime air- and dewpoint temperature limited the applicability of the Heat Stress Index.

WFO Brownsville requested input on heat and cold impacts from a number of decision makers including emergency managers and responders, employers with outdoor workers, prison, jail, and school officials, shelter providers, advocacy groups, and energy providers. Approximately 15% of households in the Lower Rio Grande Valley have no heat or air conditioning.[5] The area hosts large transient seasonal and resort populations. The winter population swells by about 125,000 each season and over one million people visit South Padre Island each year all with widely varying expectations and acclimation with respect to heat and cold conditions.

Climatological data for the summer period for two locations were examined. The City of Brownsville is located some 20 miles from the Gulf of Mexico. The City of McAllen is situated sixty miles inland. Observed maximum temperatures at both locations showed little variance during the

summer months. Between June 1 and August 31, the absolute value of the standard deviation is 5 degrees or less and on many days the record high temperature is less than 10 degrees from the normal maximum temperature value (Figure 2).

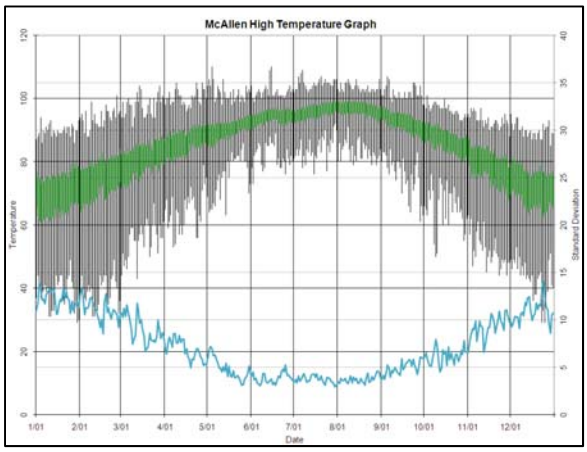

Figure 2. Observed maximum temperatures over the period of record (gray); First standard deviation centered on the average maximum temperature (green); Standard deviation of maximum temperatures (blue) for McAllen, TX. Period of record 1941-2008.

An analysis of heat index values for the summer period showed heat index values of 108 occur on average on 2/3 of summer days; 110 on 1/3 of summer days; and 111 on six days per summer season (Figure 3).

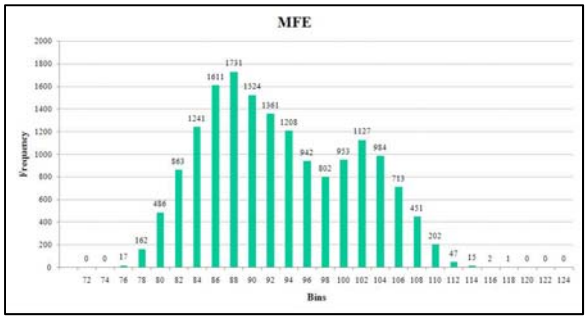

Figure 3. Frequency of Heat Index values in observations for McAllen, Texas, June through August 1997-2004.

Mortality data for the eight counties of Deep South Texas were also examined. Heat is rarely listed as the primary cause of death and the under-reporting of heat-related fatalities is well documented. There were 17 heat-related fatalities recorded between 1997 and 2006. Heat-related fatalities did not show a direct correlation to higher than normal dew point temperatures (Heat Index).

We found no local regulations based on the existence of heat advisories. We did learn of local day care and school guidance based on observed temperatures. Employers and outdoor activity planners reported taking extra precautions for hydration, sun exposure, and availability of shelter when near record temperatures were forecast or observed.

Societal impacts related to winter weather in Deep South Texas begin at much higher values than in non-tropical areas. Emergency managers and responders reported issues when wind chill values drop into the lower 40s. Shelter providers open shelters when either air temperatures or wind chill values drop into the middle 40s.

There are only a handful of significant winter weather events on record for the Lower Rio Grande Valley of Texas. These include the freezes of 1899, 1951, 1962, 1983 and 1989, and the snows of 1895 and 2004.

A 28 year record of average daily minimum temperatures was examined. Spline curves developed for average minimum temperature, 3% frequency temperature value below average, and 1% frequency temperature value below average, confirmed the unlikely occurrence of traditionally defined wind chill criteria (Figure 4).

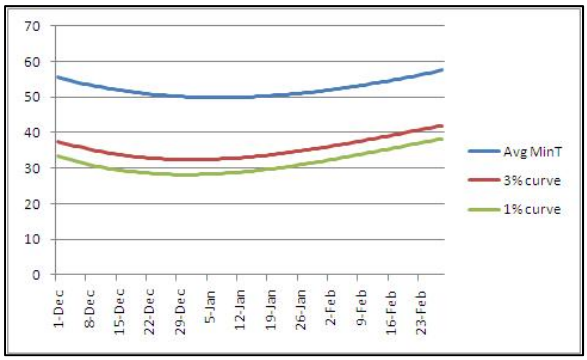

Figure 4. Average minimum temperature, 3% and 1% exceedance curves for McAllen, TX.

Emergency managers and social services agencies universally conveyed the desire for wind chill advisories at much higher values than previous practice. Most emphatically urged adoption of higher values than were eventually selected (Table 2).

	Watch	Warning	Advisory
Wind Chill Wind ≥ 10mph Previously	≤ 15 F North ≤ 20 F South	≤ 15 F North ≤ 20 F South < 0F	≤ 25 F North ≤ 30 F South < 10F
Winter Weather			Any accumulation
Winter Storm	1" Snow ½" Sleet 1/8" Ice	1" Snow ½" Sleet 1/8" Ice	

Table 2. Winter Weather W/W/A criteria for Deep South Texas.

Summary and Conclusions

WFO Brownsville was able to identify meteorologically significant criteria defining an excessive heat/high humidity event and adopted a heat index value of 111 for two hours or more on two consecutive days as criteria for issuing a Head Advisory.

The question of balance between wind chill criteria based on exposure and the development of frost bite and impacts to local populations with little acclimation to sharply colder weather while remaining meteorologically reasonable is not completely resolved. Future work will examine impacts more closely during cold outbreaks and the value of W/W/A in mitigation and local decision support.

Acknowledgements

We wish to acknowledge the help of Brian Meija, senior student at The University of Oklahoma who volunteered at WFO Brownsville, TX during Summer 2009 and assisted with acquisition and analysis of mortality data.

Notes

[1] Administration for Children and Families Low Income Home Energy Assistance Program

[2] Public Utility Regulatory Act of 2005, Public Utility Commission of Teas C.39.101(h)

[3] National Weather Service Instruction 10-515 WFO Non-Precipitation Weather Products Specification

[4] Kenneth Jones, Lower Rio Grande Valley Development Council, personal communication

References

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Public Utility Regulatory Act, Subchapter C, Sec.39.101, Public Utility Commission of Texas, September 2005.

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