Corpus Christi and Coastal Bend
Economic Pulse
College of Business and EDA University Center
Texas A&M University-Corpus Christi
2013 | No. 5

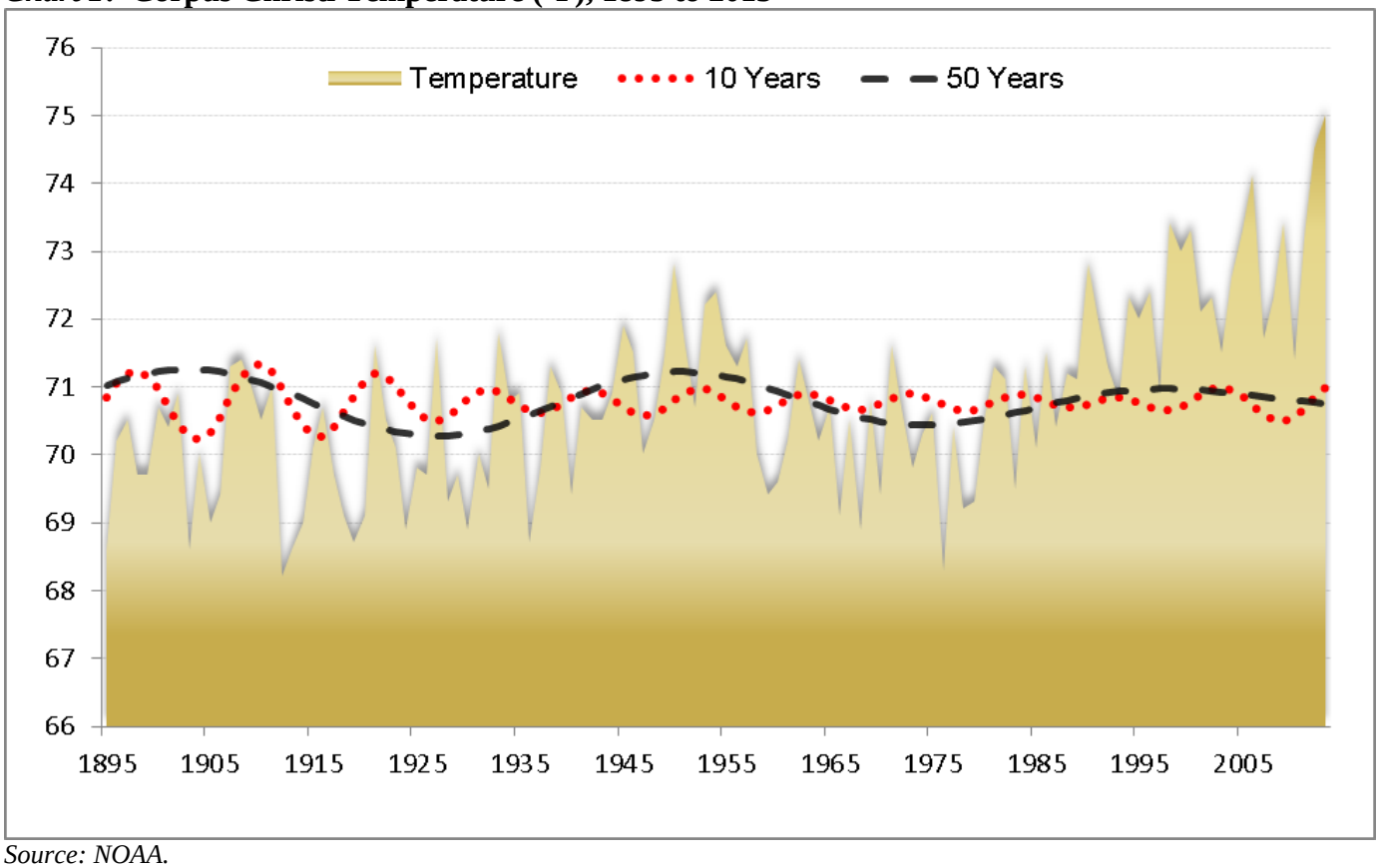
Local Climate Change

By Jim Lee

Historical data reveal signs of climate change for Corpus Christi. An unprecedented warming trend emerged beginning in the mid-1970s, resulting in rising energy consumption for local residents. In contrast to the observed deviations from historical norms in local temperature, the current rainfall patterns seem to align with some periodical or recurring effects. This reduces the uncertainty regarding whether the current drought conditions will persist indefinitely.

Climate change has been a major concern at the global level. How much has the widely publicized issue of global warming affected the local climate of South Texas? Beginning in December 2012, persistent drought conditions triggered the City of Corpus Christi's enforcement of Stage 2 mandatory water use restrictions, which were relaxed to Stage 1 in November 2013 after some heavy rains. Is the recent drought condition part of the global climate change that will likely continue? Before turning to meteorologists for insights, the following present data observations that provide some intuition to this question. Data for 2013 are estimates.

***Chart 1*: Corpus Christi Temperature (°F), 1895 to 2013**



Source: NOAA.

To understand whether the current climate conditions belong to historical norms, it is helpful to first disentangle new trends in weather from periodic, or cyclical, patterns. It is well known that the weather conditions of South Texas are subject to the alternating El Niño and La Niña effects over time (see the chronology of historical patterns on page 4). For instance, National Oceanic and Atmospheric Administration (NOAA) reported La Niña effects of varying strengths in 1973-75, 1988, 1999, and 2010. The following summarizes findings on annual temperature and precipitation data since 1895.

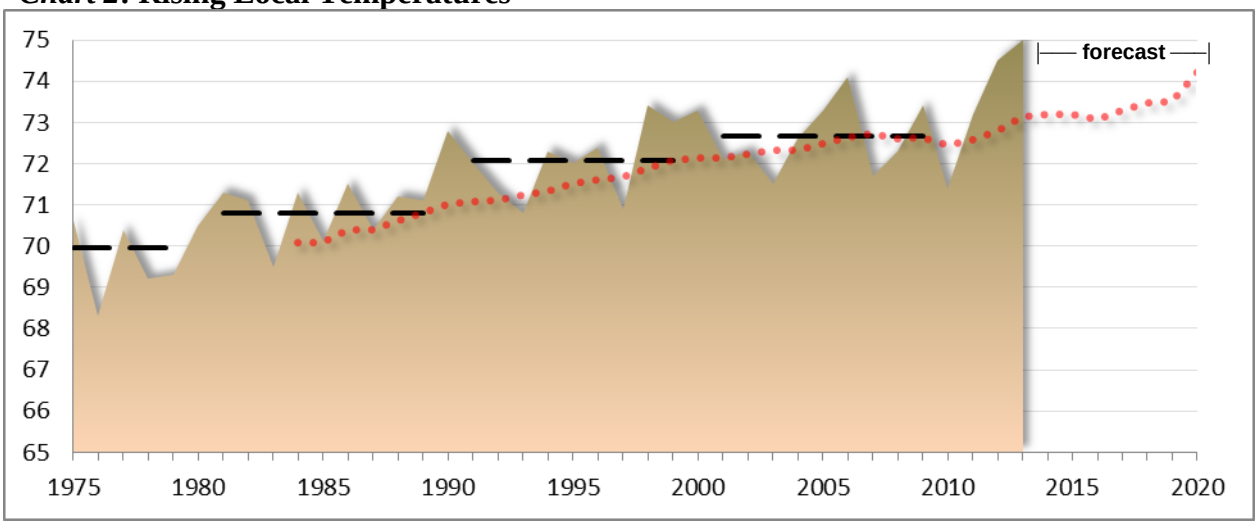
Temperature

The chart in the preceding page displays the patterns of Corpus Christi's annual average temperature in Fahrenheit since 1895. The historical average over the past century or so was about 71°F. It is also obvious from the chart that the local temperature tended to follow an upward trend beginning 1975. Between 2000 and 2013, the average temperature was 73°F. Was this gradual rise in temperature part of the regular patterns experienced in the past? Or was it an anomaly that might be attributable to the global warming phenomenon?

In the same historical temperature chart (***Chart 1***), there are two oscillating lines: one (dotted red line) captures fluctuations in the temperature data with a 10-year cycle, and another (dashed black line) captures variations in data with a 50-year cycle. Those lines are estimated using a statistical tool called frequency analysis, which treats data observations as sine and cosine wave like patterns over time. Those projections fit the underlying temperature data better than similar projections with longer or shorter cycle lengths, or frequencies.

Put simply, the two oscillating lines in ***Chart 1*** reveal that the local temperature has followed some regular up and down swings beyond the commonly known seasonal patterns within one year. The gradual rise in the past 40 years is in line with the upswing of the hidden 50-year cycle. However, the actual temperature during that period remained two to three degrees above the projections, and the discrepancy widened over time. In other words, the local temperature has increasingly deviated from its historical trend.

***Chart 2*: Rising Local Temperatures**



Source: NOAA; author's calculations.

The chart above focuses on the local temperatures over the last 40 years. The black dash lines represent decade-long average temperatures. Clearly, the temperature rose by nearly 3 degrees between the 1970s and 2000s. The red dotted line shows a 10-year moving average of the actual temperature with an extrapolation of the historical data forward through 2020. As the chart indicates, if history is any guide,

then the average annual temperature could reach as high as 74°F by 2020, a full degree higher than that in the past decade.

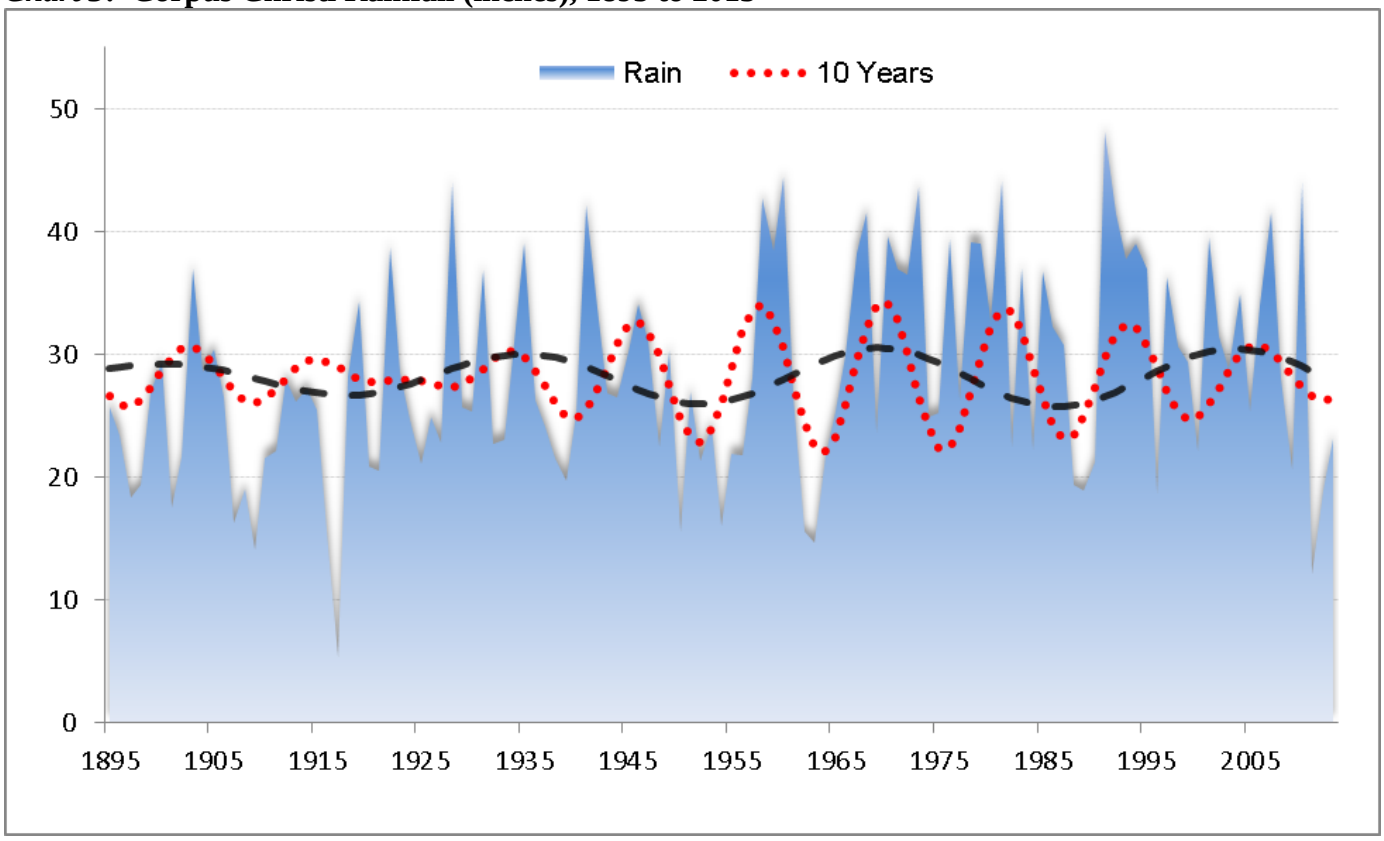
A rising annual average temperature has significant adverse economic consequences for local residents. As the overall temperature is higher year round, we would use more electricity and other energy sources for air conditioning and less for heating. According to the U.S. Environmental Protection Agency (EPA), if an area's climate warms up by 1.8°F, the demand for energy used for cooling would increase by about 5-20%, while the demand for energy used for heating would decrease by about 3-15%. For South Texas, the warming trend will increase summer peak electricity demand, and thus invariably raise the overall electricity bills for households over the year.

Precipitation

The rainfall data, however, tell a different story. The chart below shows the amounts of annual rainfall since 1895. The historical average was about 28 inches per year. The data appear quite "noisy" in the sense that the amount of rainfall in one year varied appreciably from the amount in the previous year. In contrast to the temperature charts above, however, there is no obvious long-term upward or downward trend in recent decades.

Yet how do the current drought conditions stack up historically? As for the temperature charts, ***Chart 3*** also shows two lines that delineate regular, cyclical patterns beyond the seasonal patterns within one year. In addition to the 10-year cycle as for the local temperature, the 30-year cycle instead of the 50-year cycle seems to fit the historical data well. The 10-year cycle is, of course, related the El Niño and La Niña effects. According to NOAA, the most recent Na Niña pattern began in 2010. The El Niño or La Niña effects were not active in 2013.

***Chart 3*: Corpus Christi Rainfall (inches), 1895 to 2013**



Source: NOAA.

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(Cont'd)

Chronology of *Strong* El Niño/La Niña Effects

El Nino	La Nina
1972	
	1973
	1975
1982	
	1988
1997	
	1999
	2010

Source: NOAA.

In sharp contrast to the findings for local temperatures, the two lines representing the respective effects of the 10- and 30-year cycles both point to declines in the amount of rainfall within the past 5 years, the end of the observation period. In other words, unlike deviations from historical trends that were observed for the local temperature, the drought conditions in the past three years could probably be part of a hidden recurring pattern that might be reversed in the future. We certainly hope so!