

September 12, 2007

Temperature Trends in Major U.S. Cities

By WeatherBill, Inc.

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INTRODUCTION

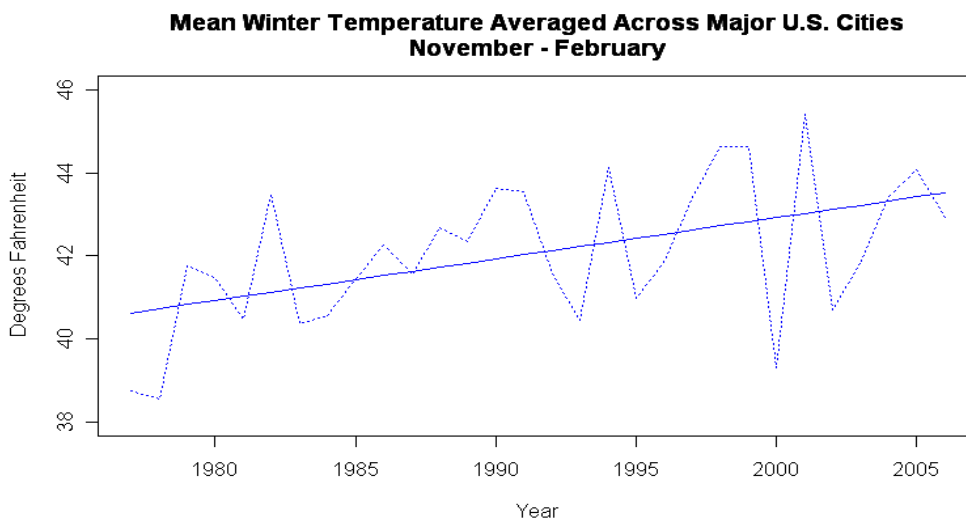
WeatherBill analyzed 30 years of daily temperature data from the nation's most populous cities to determine long-term trends in daily average temperatures in major US cities. The study is restricted to weather data from 130 cities which, as of the 2006 Census, had more than one hundred thousand residents and maintained a National Weather Service weather station with a clean historical record of at least 30 years of daily data, either within the city proper or at a nearby location.¹

To isolate seasonal temperature trends for each city in question, daily average temperature data is studied for both winter (November through February) and summer (June through September) seasons. Daily average temperature is defined as the midpoint of the high and low temperatures of the day. For each city, the mean (or average) and standard deviation (or volatility) of daily average temperature are calculated for winters and summers from 1977 through 2006. A Mann-Kendall test is used to determine the statistical significance of seasonal trends in the means and standard deviations of temperature over time.

SUMMARY OF TEMPERATURE TRENDS

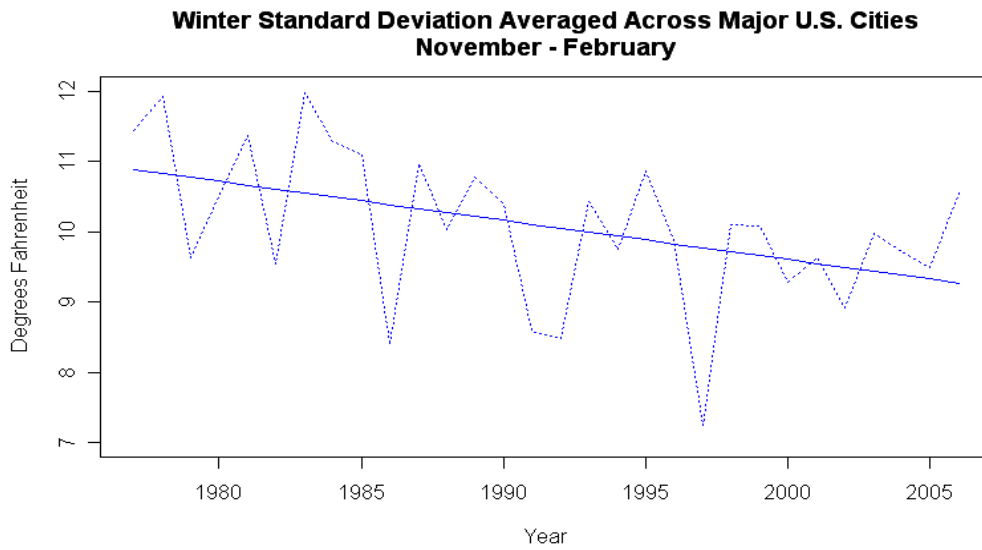
Of the 130 cities studied, 74 cities, 57% of those studied, show significant warming trends during the winter, while 17 show significant warming trends for the summer season. Temperature volatility (measured by standard deviation) is on the decline. None of the cities show trends toward increasing volatility for either season. Thirty-eight percent of cities are seeing trends toward decreasing volatility in the winter. Seven percent of cities show trends toward decreasing volatility during the summer months. (See Appendix 3 for trends by city)

Figure 1: Average Winter Temperature Trend of Major U.S. Cities



¹ Of the 258 U.S. cities with sufficiently large populations, 130 are specifically covered in this study. Twenty-five cities had to be omitted completely (including those in Alaska and Hawaii) due to insufficient historical data or because there simply isn't a weather station close enough to the city limits and suitable for use as a proxy for local weather. The vast majority of the omitted cities, however, are part of larger metropolitan areas that likely experience weather patterns similar to those of the major cities included in this study. In fact, the metropolitan areas covered by the 130 major cities account for 62 percent of the U.S. population. (See Appendix 2 for a map of studied cities and Appendix 3 for the complete list of cities)

Figure 2: Winter Volatility Trend of Major U.S. Cities



WINTER TEMPERATURE TRENDS

During the winter, 74 of the 130 cities show a warming trend while 54 show no significant temperature trend. Only two of the 130 cities have a significant cooling trend, Los Angeles and San Diego. Forty-nine cities show a decreasing volatility trend while the remaining eighty-one lack any significant trend in their standard deviations of historical average temperatures.

Table 1: Ten Major U.S. Cities with Greatest Winter Warming Trends

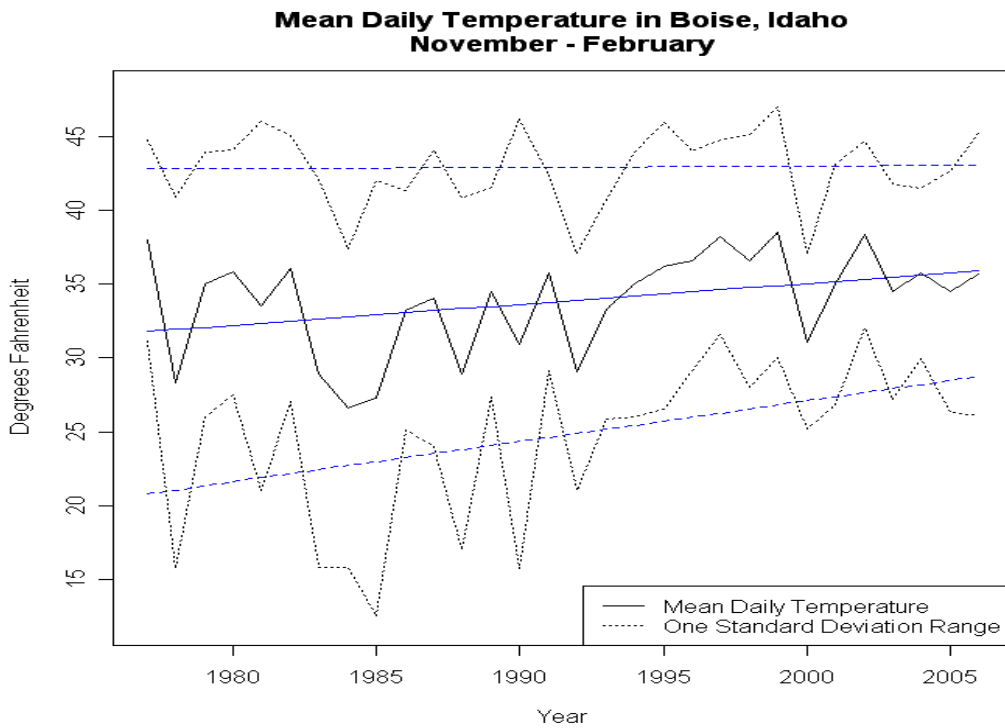
	Annual Trend in Temperature (degrees F)	Over 30 Years
Minneapolis, Minnesota	0.21	6.42
Madison, Wisconsin	0.21	6.34
Peoria, Illinois	0.21	6.24
Omaha, Nebraska	0.20	6.10
Rockford, Illinois	0.20	6.06
Topeka, Kansas	0.20	5.95
Milwaukee, Wisconsin	0.20	5.94
Chicago, Illinois	0.20	5.92
Green Bay, Wisconsin	0.19	5.79
Toledo, Ohio	0.19	5.78
Average across 130 cities	0.08	2.40

Table 2: Ten Major U.S. Cities with Greatest Trends in Winter Volatility

	Annual Trend in Standard Deviation (degrees F)	Over 30 Years
Boise City, Idaho	-0.13	-3.98
Spokane, Washington	-0.11	-3.31
St. Louis, Missouri	-0.10	-3.02
Springfield, Illinois	-0.10	-2.95
Lubbock, Texas	-0.09	-2.81
Peoria, Illinois	-0.09	-2.76
Evansville, Indiana	-0.09	-2.72
Oklahoma City, Oklahoma	-0.09	-2.70
Amarillo, Texas	-0.08	-2.52
Springfield, Missouri	-0.08	-2.45
Average across 130 cities	-0.03	-0.90

Of the 54 cities that do not display significant trends in average winter temperature, 17 demonstrate decreasing trends in standard deviation of winter temperature. The rest do not show any trend in volatility. The two cities with winter cooling trends both lack significant trends in their standard deviations of average winter temperature. Thirty-two of the 74 cities exhibiting winter warming trends display a significantly negative trend in volatility—again, an indication that as average winter temperatures rise in these cities, temperatures are becoming increasingly predictable.

Figure 3: Rising Average Winter Temperatures and Falling Volatility in Boise, Idaho



One prime example of the phenomenon of rising winter temperatures being accompanied by falling temperature volatility is Boise, Idaho. Figure 3 depicts how Boise's annual warming trend of 0.14°F has amounted to a significant increase in average winter temperature over the last thirty years. The center line shows the mean temperature for each year, with a trend imposed. The dotted lines above and below are placed at one standard deviation away from the average for each year, with trends imposed. The decreasing distance between the highest and lowest lines illustrates how temperatures in Boise, the city with the greatest trend in decreasing volatility, are becoming more predictable.

SUMMER TEMPERATURE TRENDS

Eighty-five percent of the 130 cities studied display no significant temperature trend during the summer. Thirteen percent of the cities exhibit warming trends. Two cities show decreasing summer temperature trends, San Diego and Hampton, Virginia. Cities that do not have significant temperature or cooling trends have insignificant trends in volatility for the most part. However, nearly 25 percent of the cities with warming temperature trends demonstrate decreasing volatility trends. This indicates that as average temperature increases in these cities temperature is also becoming more predictable.

Table 3: Ten Major U.S. Cities with Greatest Summer Warming Trends

	Annual Trend in Temperature (degrees F)	Over 30 Years
Reno, Nevada	0.23	6.86
Boise City, Idaho	0.16	4.86
Hartford, Connecticut	0.10	2.99
Las Vegas, Nevada	0.09	2.72
Detroit, Michigan	0.09	2.57
Toledo, Ohio	0.08	2.36
Syracuse, New York	0.08	2.27
Manchester, New Hampshire	0.07	2.15
Erie, Pennsylvania	0.07	2.11
Philadelphia, Pennsylvania	0.07	2.06
Average across 130 cities	0.01	0.30

Table 4: Ten Major U.S. Cities with Greatest Trends in Summer Volatility

	Annual Trend in Standard Deviation (degrees F)	Over 30 Years
Rochester, New York	-0.04	-1.26
Los Angeles, California	-0.04	-1.25
Manchester, New Hampshire	-0.04	-1.13
Hartford, Connecticut	-0.04	-1.09
Jackson, Mississippi	-0.04	-1.06
Buffalo, New York	-0.03	-1.03
Oxnard, California	-0.03	-0.94
Worcester, Massachusetts	-0.03	-0.85
Toledo, Ohio	-0.03	-0.84
Greensboro, North Carolina	-0.03	-0.82
Average across 130 cities	0.00	0.00

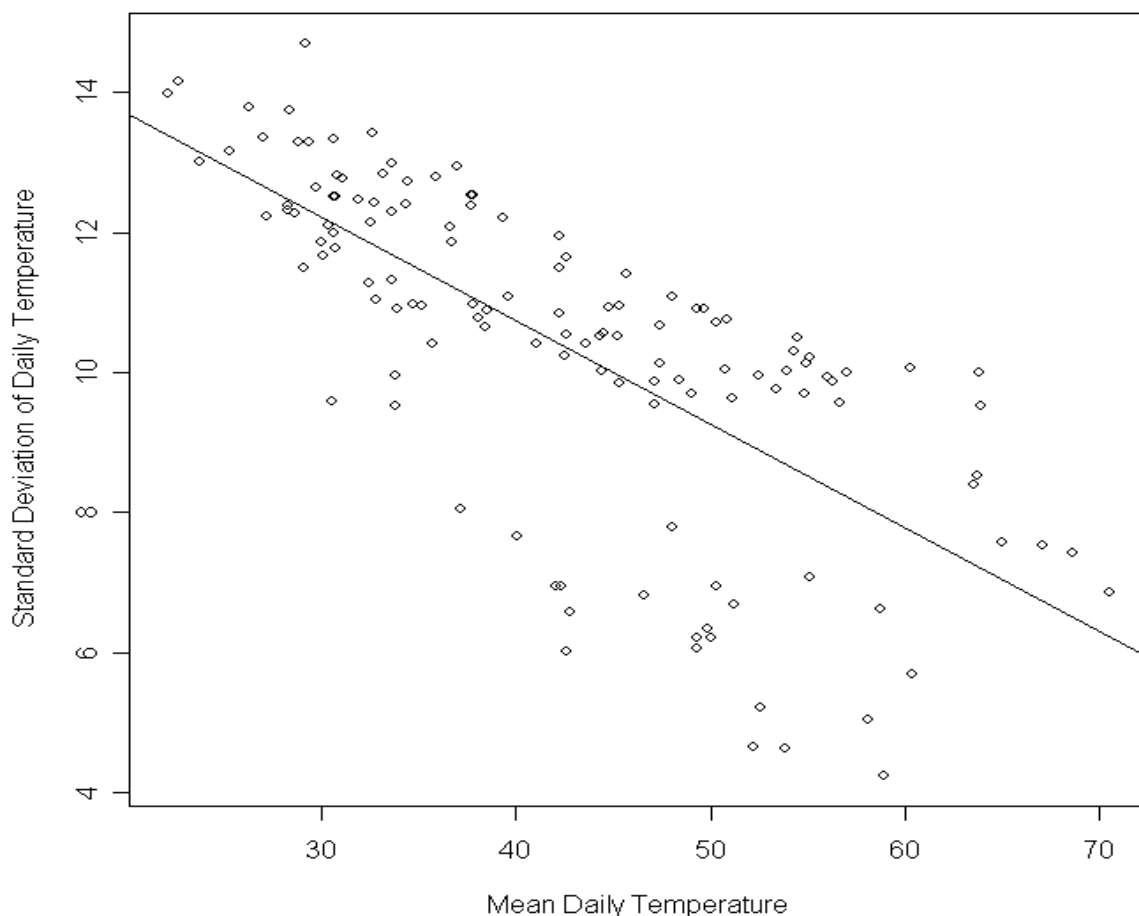
WINTER VS. SUMMER STANDARD DEVIATION

In all but three cities, average winter volatility across time is higher than average summer volatility (and often markedly so), which is consistent with the observation of widespread upward trends in average winter temperatures and the general stability of average summer temperatures. It is interesting to note that all of the cities with an average summer standard deviation of less than half of the winter's standard deviation fall within just three geographical regions: East South Central (5), West South Central (11), and the South Atlantic (11). These cities have some of the lowest average summer standard deviations among those studied as well as some of the highest average summer temperatures among major cities across the nation.

The relationship between means and standard deviations is not unique to the southern regions. Across the United States, average seasonal temperature and standard deviation in major cities are inversely related. During the summer, mean temperature and standard deviation exhibit a notable correlation of -0.59 , meaning that if a city's average daily temperature is above the country's average, its standard deviation is very likely to be below the country's average. During the winter, the relationship is particularly strong with a correlation of -0.71 . Thus, a pattern emerges of higher temperatures being associated with lower standard deviations. As warming trends are seen in this data, predominantly during the winter months, this pattern fits with our observation of downward trends in winter standard deviations as winter average temperatures move closer to those of warmer months.

Figure 4: Average Winter Temperature and Standard Deviation in Major U.S. Cities

Mean Daily Temperature vs. Standard Deviation of Daily Temperature November - February



CITIES WITH WINTER AND SUMMER TRENDS

Ten cities show increasing temperature trends in both winter and summer (table 5). San Diego is the only city with decreasing temperatures in both winter and summer.

Table 5: Ten Major U.S. Cities with Winter and Summer Warming Trends

	Annual Winter Trend in Temp (degrees F)	Over 30 Years	Annual Summer Trend in Temp (degrees F)	Over 30 Years
Boise, Idaho	0.14	4.24	0.16	4.86
Toledo, Ohio	0.19	5.79	0.08	2.36
Detroit, Michigan	0.16	4.89	0.09	2.58
Erie, Pennsylvania	0.14	4.26	0.07	2.11
Philadelphia, Pennsylvania	0.14	4.19	0.07	2.06
Hartford, Connecticut	0.11	3.22	0.10	2.99
Manchester, New Hampshire	0.11	3.24	0.07	2.15
Syracuse, New York	0.10	2.98	0.08	2.27
Providence, Rhode Island	0.10	3.04	0.06	1.68
McAllen, Texas	0.09	2.63	0.04	1.14

CLIMATE CHANGE, CAUSATION, AND IMPLICATIONS

The data presented in this study clearly identifies trends of increasing average daily temperatures and decreasing volatility in average daily temperatures across major U.S. cities. Thus, the study is consistent with a broad scientific consensus (*see the Intergovernmental Panel on Climate Change reports at <http://www.ipcc.ch>*) that such identifiable warming trends (especially during winter) are an exemplification of a global climate change phenomenon. This study does not state, nor does it imply, a theory for causation and it does not seek to differentiate the impacts of natural, man-made, or observation bias as causes for the identified trends. There are a number of theories that seek to identify causes for observed warming trends in measured daily average temperatures in urban regions. These include the Urban Heat Island Effect, natural global climate temperature cycles, and atmospheric carbon-cycle effects.

Further, this study does not analyze the social, political, or economic implications of the trends identified. WeatherBill primarily serves small, medium, and large businesses that may be financially sensitive to the weather. Such business include Agriculture, Construction, Manufacturing, Retail, Transportation, Travel, Ski, and Leisure companies that may experience daily, monthly, or seasonal volatility in profits due to the unpredictability of local temperatures, precipitation levels, and/or snowfall levels. The financial effects experienced on a regular basis by these businesses are vast and diverse, and this paper is not meant to identify specific effects that may be experienced by these businesses. The primary purpose of identifying urban temperature trends is to help weather-sensitive businesses, and consumers, better plan, forecast, and manage weather risk. WeatherBill sells weather contracts to businesses that pay them when unusual weather conditions occur. WeatherBill's weather contracts help businesses protect their bottom line from weather events that may fall outside of expected "trended" weather averages. This study serves to identify those potential trends and put into context rapidly evolving climate conditions in urban regions that may have a financial impact on businesses of all sizes.

APPENDIX 1: DATA INFORMATION & STATISTICAL METHODS

Data analyzed

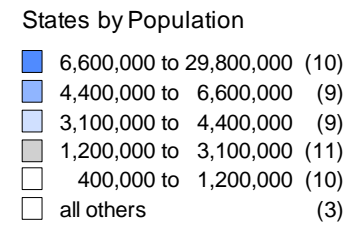
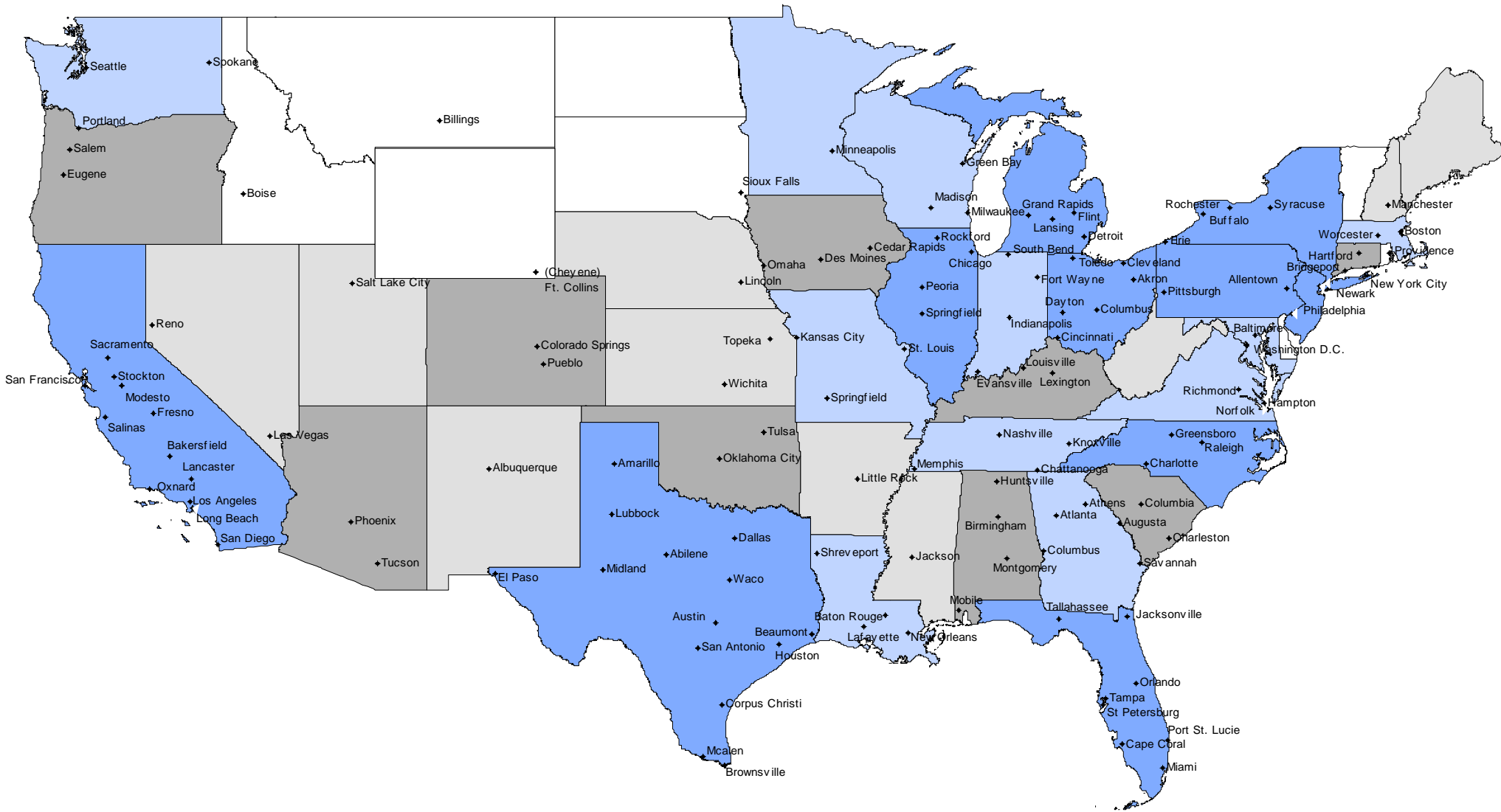
Thirty years (1977-2006) of historical daily temperature data from 130 National Weather Service stations.

Data source

United States National Weather Service data cleaned of missing and erroneous values by Earth Satellite Corporation.

Calculation of Trends in Temperature and Volatility

Trends were calculated by looking at the mean and standard deviation of daily average temperature (taken to be the midpoint of the daily maximum and minimum recorded values for a given weather station) for each season and for each of the last thirty years. A linear trend line was fit to each series and a Mann-Kendall test was used to determine if these trends were significant.




Winter & Summer Temperature Trends in 130 U.S. Cities with 100,000+ Population

Cities with over 100,000 Population	Weather Station Location	Average Winter Temp	Winter Temp Trend	Winter Trend in Std Dev of Temp	Average Summer Temp	Summer Temp Trend	Summer Trend in Std Dev of Temp
New England							
Boston, Massachusetts	Boston, MA	35.2	0.00	0.00	69.8	0.00	0.00
Bridgeport, Connecticut	Bridgeport, CT	35.7	0.00	0.00	70.4	0.06	0.00
Hartford, Connecticut	Hartford, CT	32.9	0.11	0.00	69.5	0.10	-0.04
Manchester, New Hampshire	Concord, NH	27.2	0.11	-0.06	65.8	0.07	-0.04
Providence, Rhode Island	Providence, RI	34.8	0.10	-0.06	69.5	0.06	0.00
Worcester, Massachusetts	Worcester, MA	30.1	0.00	0.00	66.2	0.06	-0.03
Mid Atlantic							
Allentown, Pennsylvania	Allentown, PA	33.9	0.00	0.00	70.3	0.00	0.00
Buffalo, New York	Buffalo, NY	30.6	0.00	0.00	67.4	0.00	-0.03
Erie, Pennsylvania	Erie, PA	32.5	0.14	0.00	68.1	0.07	0.00
New York, New York	New York City, NY	38.5	0.00	0.00	73.3	0.00	0.00
Newark, New Jersey	Newark, NJ	37.8	0.00	0.00	73.9	0.00	0.00
Philadelphia, Pennsylvania	Philadelphia, PA	38.0	0.14	0.00	74.0	0.07	0.00
Pittsburgh, Pennsylvania	Pittsburgh, PA	33.6	0.13	0.00	69.3	0.00	0.00
Rochester, New York	Rochester, NY	30.4	0.00	0.00	67.3	0.00	-0.04
Syracuse, New York	Syracuse, NY	29.7	0.10	0.00	67.4	0.08	0.00
East North Central							
Akron, Ohio	Akron, OH	31.9	0.00	0.00	68.6	0.00	0.00
Chicago, Illinois	Chicago, IL	31.1	0.20	0.00	71.8	0.00	0.00
Cincinnati, Ohio	Cincinnati, OH	36.8	0.00	0.00	72.9	0.00	0.00
Cleveland, Ohio	Cleveland, OH	32.7	0.13	0.00	69.1	0.00	0.00
Columbus, Ohio	Columbus, OH	34.3	0.15	0.00	71.3	0.00	0.00
Dayton, Ohio	Dayton, OH	33.2	0.11	0.00	71.0	0.00	0.00
Detroit, Michigan	Detroit, MI	30.7	0.16	0.00	69.4	0.09	0.00
Evansville, Indiana	Evansville, IN	37.7	0.14	-0.09	74.9	0.00	0.00
Flint, Michigan	Flint, MI	28.7	0.11	0.00	67.2	0.00	0.00
Fort Wayne, Indiana	Fort Wayne, IN	30.8	0.14	0.00	70.0	0.00	0.00
Grand Rapids, Michigan	Grand Rapids, MI	29.1	0.11	0.00	67.8	0.00	0.00
Green Bay, Wisconsin	Green Bay, WI	23.8	0.19	0.00	65.8	0.00	0.00
Indianapolis, Indiana	Indianapolis, IN	33.7	0.16	-0.08	72.1	0.00	0.00
Lansing, Michigan	Lansing, MI	28.3	0.13	0.00	67.0	0.00	0.00
Madison, Wisconsin	Madison, WI	25.3	0.21	0.00	67.2	0.00	0.00
Milwaukee, Wisconsin	Milwaukee, WI	28.3	0.20	0.00	68.0	0.00	0.00
Peoria, Illinois	Peoria, IL	30.6	0.21	-0.09	71.8	0.00	0.00
Rockford, Illinois	Rockford, IL	27.0	0.20	0.00	69.3	0.00	0.00
South Bend, Indiana	South Bend, IN	30.7	0.00	0.00	69.7	0.00	0.00
Springfield, Illinois	Springfield, IL	32.6	0.18	-0.10	72.6	0.00	0.00
Toledo, Ohio	Toledo, OH	30.7	0.19	-0.07	69.3	0.08	-0.03
West North Central							
Cedar Rapids, Iowa	Cedar Rapids, IA	26.3	0.00	0.00	69.8	0.00	0.00
Des Moines, Iowa	Des Moines, IA	28.3	0.18	0.00	72.0	0.00	0.00
Kansas City, Missouri	Kansas City, MO	35.9	0.16	0.00	76.7	0.00	0.00
Lincoln, Nebraska	Lincoln, NE	29.4	0.19	0.00	73.0	0.00	0.00
Minneapolis, Minnesota	Minneapolis, MN	22.1	0.21	0.00	68.7	0.00	0.00
Omaha, Nebraska	Omaha, NE	28.8	0.20	0.00	72.3	0.00	0.00
Sioux Falls, South Dakota	Sioux Falls, SD	22.6	0.19	0.00	68.8	0.00	0.00
Springfield, Missouri	Springfield, MO	37.9	0.14	-0.08	74.8	0.00	0.00
St. Louis, Missouri	St. Louis, MO	36.9	0.19	-0.10	76.2	0.00	0.00
Topeka, Kansas	Topeka, KS	34.4	0.20	0.00	74.8	0.00	0.00
Wichita, Kansas	Wichita, KS	36.6	0.18	0.00	77.3	0.00	0.00
South Atlantic							
Athens-Clarke County, Georgia	Athens, GA	47.2	0.00	-0.06	77.5	0.00	0.00
Atlanta, Georgia	Atlanta, GA	47.4	0.10	-0.07	77.6	0.00	0.00
Augusta-Richmond County, Georgia	Augusta, GA	49.0	0.00	-0.05	78.8	0.00	0.00
Baltimore, Maryland	Baltimore, MD	38.5	0.00	-0.05	73.7	0.00	0.00
Cape Coral, Florida	Fort Myers, FL	67.1	0.00	-0.04	82.8	0.00	0.00
Charleston, South Carolina	Charleston, SC	52.5	0.00	-0.05	79.8	0.00	0.00
Charlotte, North Carolina	Charlotte, NC	45.3	0.07	0.00	76.5	0.00	0.00
Columbia, South Carolina	Columbia, SC	48.4	0.09	0.00	78.8	0.00	0.00
Columbus, Georgia	Columbus, GA	51.1	0.08	-0.06	80.2	0.00	0.00
Greensboro, North Carolina	Greensboro, NC	42.5	0.13	0.00	74.6	0.00	-0.03
Hampton, VA	Langley, VA	44.3	0.00	0.00	76.1	-0.06	0.00
Jacksonville, Florida	Jacksonville, FL	56.7	0.00	-0.04	80.6	0.00	0.00


Winter & Summer Temperature Trends in 130 U.S. Cities with 100,000+ Population

Cities with over 100,000 Population	Weather Station Location	Average Winter Temp	Winter Temp Trend	Winter Trend in Std Dev of Temp	Average Summer Temp	Summer Temp Trend	Summer Trend in Std Dev of Temp
Miami, Florida	Miami, FL	70.6	0.00	-0.05	83.0	0.00	0.00
Norfolk, Virginia	Norfolk, VA	45.2	0.10	-0.06	76.6	0.00	0.00
Orlando, Florida	Orlando, FL	63.5	0.00	-0.05	82.0	0.00	0.00
Port St. Lucie, Florida	West Palm Beach, FL	68.7	0.00	-0.04	82.2	0.00	0.00
Raleigh, North Carolina	Raleigh, NC	44.5	0.11	-0.05	75.9	0.00	0.00
Richmond, Virginia	Richmond, VA	42.2	0.10	-0.05	75.5	0.00	0.00
Savannah, Georgia	Savannah, GA	53.4	0.00	-0.05	80.3	0.00	0.00
St. Petersburg, Florida	St Petersburg, FL	65.0	0.00	-0.04	83.0	0.00	0.00
Tallahassee, Florida	Tallahassee, FL	54.8	0.00	0.00	80.5	0.00	0.00
Tampa, Florida	Tampa, FL	63.7	0.00	-0.05	82.3	0.00	0.00
Washington, District of Columbia	Washington, VA	41.1	0.00	0.00	76.1	0.00	0.00
East South Central							
Birmingham, Alabama	Birmingham, AL	47.4	0.10	0.00	78.1	0.00	0.00
Chattanooga, Tennessee	Chattanooga, TN	44.4	0.13	-0.07	76.9	0.00	0.00
Huntsville, Alabama	Huntsville, AL	44.7	0.11	-0.07	76.9	0.00	0.00
Jackson, Mississippi	Jackson, MS	49.7	0.08	-0.07	79.7	0.00	0.00
Knoxville, Tennessee	Knoxville, TN	42.6	0.08	-0.06	75.4	0.00	0.00
Lexington-Fayette, Kentucky	Lexington, KY	37.7	0.12	-0.08	73.1	0.00	0.00
Louisville/Jefferson County, Kentucky	Louisville, KY	39.3	0.16	-0.07	75.5	0.00	0.00
Memphis, Tennessee	Memphis, TN	45.7	0.11	0.00	79.9	0.00	0.00
Mobile, Alabama	Mobile, AL	54.0	0.00	-0.05	80.4	0.00	0.00
Montgomery, Alabama	Montgomery, AL	50.8	0.00	0.00	79.8	0.00	0.00
Nashville-Davidson, Tennessee	Nashville, TN	42.6	0.12	-0.07	76.7	0.00	0.00
West South Central							
Abilene, Texas	Abilene, TX	48.0	0.11	-0.07	80.6	0.00	0.00
Amarillo, Texas	Amarillo, TX	39.6	0.13	-0.08	74.8	0.00	0.00
Austin, Texas	Austin, TX	54.5	0.14	0.00	83.1	0.00	0.00
Baton Rouge, Louisiana	Baton Rouge, LA	54.3	0.09	0.00	80.8	0.00	0.00
Beaumont, Texas	Port Arthur, TX	56.0	0.07	0.00	81.8	0.00	0.00
Brownsville, Texas	Brownsville, TX	63.9	0.10	0.00	84.1	0.00	0.00
Corpus Christi, Texas	Corpus Christi, TX	60.3	0.10	0.00	83.1	0.00	0.00
Dallas, Texas	Dallas, TX	49.3	0.16	-0.07	82.7	0.00	0.00
El Paso, Texas	El Paso, TX	48.1	0.00	0.00	80.2	0.00	0.00
Houston, Texas	Houston, TX	57.0	0.14	-0.06	82.4	0.00	0.00
Lafayette, Louisiana	Lafayette, LA	55.1	0.09	0.00	81.2	0.00	0.00
Little Rock, Arkansas	Little Rock, AR	45.3	0.13	-0.07	79.6	0.00	0.00
Lubbock, Texas	Lubbock, TX	43.6	0.10	-0.09	77.5	0.00	0.00
McAllen, Texas	McAllen, TX	63.8	0.09	0.00	85.8	0.04	0.00
Midland, Texas	Midland, TX	47.1	0.07	-0.06	79.6	0.00	0.00
New Orleans, Louisiana	New Orleans, LA	56.3	0.10	-0.06	81.4	0.00	0.00
Oklahoma City, Oklahoma	Oklahoma City, OK	42.2	0.16	-0.09	78.7	0.00	0.00
San Antonio, Texas	San Antonio, TX	55.0	0.11	0.00	83.1	0.00	0.00
Shreveport, Louisiana	Shreveport, LA	50.3	0.14	-0.07	80.9	0.00	0.00
Tulsa, Oklahoma	Tulsa, OK	42.2	0.15	0.00	79.6	0.00	0.00
Waco, Texas	Waco, TX	50.9	0.12	0.00	83.0	0.00	0.00
Mountain							
Albuquerque, New Mexico	Albuquerque, NM	40.0	0.00	0.00	75.1	0.00	0.00
Billings, Montana	Billings, MT	29.2	0.00	0.00	67	0.00	0.00
Boise City, Idaho	Boise, ID	33.8	0.14	-0.13	70	0.16	0.00
Colorado Springs, Colorado	Colorado Springs, CO	32.5	0.00	0.00	67	0.00	0.00
Fort Collins, Colorado	Cheyenne, WY	30.0	0.10	0.00	64.3	0.00	0.00
Las Vegas, Nevada	Las Vegas, NV	50.3	0.00	0.00	87.0	0.09	0.00
Phoenix, Arizona	Phoenix, AZ	58.7	0.00	0.00	91.7	0.00	0.00
Pueblo, Colorado	Pueblo, CO	33.6	0.00	0.00	71.5	0.00	0.00
Reno, Nevada	Reno, NV	37.1	0.00	0.00	68.5	0.23	0.00
Salt Lake City, Utah	Salt Lake City, UT	33.8	0.00	0.00	72.9	0.00	0.00
Tucson, Arizona	Tucson, AZ	55.1	0.00	0.00	84.9	0.05	0.00
Pacific							
Bakersfield, California	Bakersfield, CA	51.2	0.00	0.00	80.2	0.00	0.00
Eugene, Oregon	Eugene, OR	42.1	0.00	-0.05	64.2	0.00	0.00
Fresno, California	Fresno, CA	49.8	0.00	0.00	79.4	0.00	0.00
Lancaster, California	Lancaster, CA	46.6	0.00	0.00	77.4	0.00	0.00
Long Beach, California	Long Beach, CA	58.1	0.00	0.00	72.5	0.00	0.00
Los Angeles, California	Los Angeles, CA	60.4	-0.06	0.00	73.6	0.00	-0.04


Winter & Summer Temperature Trends in 130 U.S. Cities with 100,000+ Population

Cities with over 100,000 Population	Weather Station Location	Average Winter Temp	Winter Temp Trend	Winter Trend in Std Dev of Temp	Average Summer Temp	Summer Temp Trend	Summer Trend in Std Dev of Temp
Modesto, California	Modesto, CA	50.0	0.00	0.00	75.6	0.00	0.00
Oxnard, California	Santa Barbara, CA	53.9	0.00	0.00	65.5	0.00	-0.03
Portland, Oregon	Portland, OR	42.8	0.00	-0.06	66.7	0.05	0.00
Sacramento, California	Sacramento, CA	49.3	0.00	0.00	73.3	0.00	0.00
Salem, Oregon	Salem, OR	42.3	0.00	-0.06	64.7	0.07	0.00
Salinas, California	Salinas, CA	52.5	0.00	0.00	63.3	0.00	0.00
San Diego, California	San Diego, CA	59.0	-0.08	0.00	70.5	-0.11	0.00
San Francisco, California	San Francisco, CA	52.2	0.00	0.00	63.6	0.00	0.00
Seattle, Washington	Seattle, WA	42.6	0.00	0.00	63.3	0.00	0.00
Spokane, Washington	Spokane, WA	30.6	0.00	-0.11	64.8	0.00	0.00
Stockton, California	Stockton, CA	49.3	0.00	0.00	75.1	0.00	0.00

128 U.S. Cities with 100,000+ Population without reported Temperature Trends

Appendix 3

Cities with over 100,000 Population		Nearest Weather Station	Cities with over 100,000 Population		Nearest Weather Station
New England			Mountain		
Cambridge, Massachusetts	Boston, MA	Glendale, Arizona	Phoenix, AZ		
Lowell, Massachusetts	Worcester, MA	Henderson, Nevada	Las Vegas, NV		
New Haven, Connecticut	Bridgeport, CT	Mesa, Arizona	Phoenix, AZ		
Springfield, Massachusetts	Worcester, MA	North Las Vegas, Nevada	Las Vegas, NV		
Stamford, Connecticut	Bridgeport, CT	Peoria, Arizona	Phoenix, AZ		
Waterbury, Connecticut	Hartford, CT	Provo, Utah	Salt Lake City, UT		
Mid Atlantic		Scottsdale, Arizona	Phoenix, AZ		
Elizabeth, New Jersey	Newark, NJ	Tempe, Arizona	Phoenix, AZ		
Jersey City, New Jersey	Newark, NJ	Thornton, Colorado	NA		
Paterson, New Jersey	Newark, NJ	West Valley City, Utah	Salt Lake City, UT		
Yonkers, New York	Newark, NJ	Westminster, Colorado	NA		
East North Central		Pacific			
Ann Arbor, Michigan	Jackson, MI	Anaheim, California	Los Angeles, CA		
Aurora, Illinois	Chicago, IL	Anchorage, Alaska	NA		
Elgin, Illinois	Chicago, IL	Antioch, California	Stockton, CA		
Joliet, Illinois	Chicago, IL	Bellevue, Washington	Seattle, WA		
Naperville, Illinois	Chicago, IL	Berkeley, California	NA		
Sterling Heights, Michigan	Detroit, MI	Burbank, California	Los Angeles, CA		
Warren, Michigan	Detroit, MI	Chula Vista, California	San Diego, CA		
West North Central		Concord, California	NA		
Independence, Missouri	Kansas City, MO	Corona, California	NA		
Kansas City, Kansas	Kansas City, MO	Costa Mesa, California	Long Beach, CA		
Olathe, Kansas	Topeka, KS	Daly City, California	San Francisco, CA		
Overland Park, Kansas	Topeka, KS	Downey, California	Los Angeles, CA		
St. Paul, Minnesota	Minneapolis, MN	El Monte, California	Los Angeles, CA		
South Atlantic		Elk Grove, California	Sacramento, CA		
Alexandria, Virginia	Washington, VA	Escondido, California	San Diego, CA		
Arlington CDP, Virginia	Washington, VA	Fairfield, California	Sacramento, CA		
Cary, North Carolina	Raleigh, NC	Fontana, California	NA		
Chesapeake, Virginia	Norfolk, VA	Fremont, California	NA		
Clearwater, Florida	Tampa, FL	Fullerton, California	Los Angeles, CA		
Coral Springs, Florida	Miami, FL	Garden Grove, California	Los Angeles, CA		
Durham, North Carolina	Raleigh, NC	Glendale, California	Los Angeles, CA		
Fayetteville, North Carolina	Raleigh, NC	Hayward, California	NA		
Fort Lauderdale, Florida	Miami, FL	Honolulu CDP, Hawaii	NA		
Gainesville, Florida	NA	Huntington Beach, California	Long Beach, CA		
Hialeah, Florida	Miami, FL	Inglewood, California	Los Angeles, CA		
Hollywood, Florida	Miami, FL	Irvine, California	Long Beach, CA		
Miramar, Florida	Miami, FL	Lakewood, Colorado	Los Angeles, CA		
Newport News, Virginia	Langley, VA	Moreno Valley, California	NA		
Pembroke Pines, Florida	Miami, FL	Norwalk, California	Los Angeles, CA		
Pompano Beach, Florida	Miami, FL	Oakland, California	NA		
Portsmouth, Virginia	Norfolk, VA	Oceanside, California	San Diego, CA		
Virginia Beach, Virginia	Norfolk, VA	Ontario, California	NA		
Winston-Salem, North Carolina	Greensboro, NC	Orange, California	Los Angeles, CA		
East South Central		Palmdale, California	Lancaster, CA		
Clarksville, Tennessee	Nashville, TN	Pasadena, California	Los Angeles, CA		
West South Central		Pomona, California	Los Angeles, CA		
Arlington, Texas	Dallas, TX	Rancho Cucamonga, California	NA		
Carrollton, Texas	Dallas, TX	Richmond, California	NA		
Denton, Texas	Dallas, TX	Riverside, California	Los Angeles, CA		
Fort Worth, Texas	Dallas, TX	Roseville, California	Sacramento, CA		
Garland, Texas	Dallas, TX	San Bernardino, California	NA		
Grand Prairie, Texas	Dallas, TX	San Buenaventura (Ventura), California	Santa Barbara, CA		
Irving, Texas	Dallas, TX	San Jose, California	NA		
Killeen, Texas	Waco, TX	Santa Ana, California	Los Angeles, CA		
Laredo, Texas	San Antonio, TX	Santa Clara, California	NA		
McKinney, Texas	Dallas, TX	Santa Clarita, California	Lancaster, CA		
Mesquite, Texas	Dallas, TX	Santa Rosa, California	NA		
Norman, Oklahoma	Oklahoma City, OK	Simi Valley, California	Los Angeles, CA		
Pasadena, Texas	Houston, TX	Sunnyvale, California	NA		
Plano, Texas	Dallas, TX	Tacoma, Washington	Olympia, WA		
Mountain		Thousand Oaks, California	Los Angeles, CA		
Arvada, Colorado	NA	Torrance, California	Long Beach, CA		
Aurora, Colorado	NA	Vallejo, California	NA		
Chandler, Arizona	Phoenix, AZ	Vancouver, Washington	Portland, OR		
Denver, Colorado	NA	Visalia, California	Fresno, CA		
Gilbert, Arizona	Phoenix, AZ	West Covina, California	Los Angeles, CA		