

## 5.B3

### Impacts of the 1954 Summer Heat Wave

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#### Introduction

The highest recorded temperature in Illinois, 117°F (47.2°C) occurred on 14 July 1954 in East St. Louis, IL. This occurred in the midst of a widespread, long-lasting heat wave covering significant parts of 11 states: from eastern Colorado through Kansas, Oklahoma, part of Texas, Missouri and Arkansas, southern Illinois, and extending to the southeast to western Tennessee, Alabama, Georgia and parts of the Carolinas. According to Climate Division data, this ranked at one of the top five extended periods of heat in these states since 1895. At the St. Louis Lambert International Airport, temperatures of at least 100°F (37.8°C) were observed on 22 days from the last week in June through the first week of September 1954. The average number of 100°F (37.8°C) days is three at this site, based on the period of record, 1930 – 2009. Temperatures  $\geq$  95°F (35°C) occurred on 51 days (normal 14 days) and  $\geq$  90°F (32.2°C) on 79 days (normal 40 days). Similarly, at Olathe, KS (near Kansas City, MO), there were 31 days of at least 100°F (37.8°C, normal 5 days), 52 days with temperatures of 95°F (35°C) or more (normal, 17 days), and 80 days with temperatures of 90°F (32.2°C) or more (normal 41 days). The Olathe normals are based on the 1891-2008 period. Only 1913, 1918, 1934, and 1936 had more 100°F (37.8°C) days at Olathe. In the central Midwest, such widespread extended periods of extreme temperatures have not been observed since the 1950s, although  $\geq$  10 100°F (37.8°C) days,  $\geq$  30 95°F (35°C) and  $\geq$  60 90°F (32.2°C) days were observed in 1980, 1983 and 1988 at St. Louis.

1954 was the third consecutive year with high summer temperatures in this region. Record temperatures set in the mid-1930s were broken.

Further, the summer heat of 1954 followed a severe drought. 1953 was an extremely dry year, with only 23 inches (58 cm) of precipitation, compared to an average of about 39 inches (99 cm). The period of 1 June 1953 to 31 May 1954, had only 16.4 inches (41 cm) of precipitation, about 42% of normal. During the summer of 1954 (June-August) below average precipitation was reported at St Louis Lambert Airport and at Olathe, in June and July, but above average precipitation in August 1954.

This research examines the impacts of the heat felt in the Illinois, Missouri and Kansas region, as well as the responses to the extreme temperatures, as determined from newspaper articles in St. Louis Post Dispatch (SLPD) and the Kansas City Star (KCS) and Kansas City Times (KCT). Impacts on human health and well-being, water resources, utilities, agriculture and commerce are detailed, as well as responses by individuals, communities and governmental bodies.

#### Heat Wave

In Kansas City, temperatures of at least 100°F (37.8°C) were observed in the last week of June and the first week of July 1954, in two successive 5-day periods, with a brief respite from 30 June to 1 July 1954. Another five-day streak of 100°F (37.8°C) temperatures began 2 July 1954, followed by a 4-day heat streak in mid-July. Temperatures reached 111°F (43.9°C) on 13 July 1954, and 112°F (44.4°C) on 14 July 1954 in Kansas City. There were 15 days in July with temperatures of 100°F (37.8°C) or more, and 7 days in August (3-4, 15-17, and 28-29). Previous to this year, August record highs had been below

100°F (37.8°C) for Kansas City. While temperatures remained above average in September, the final three days of 100°F (37.8°C) temperatures occurred on 2-4 Sept 1954. Similar weather was observed in St Louis, MO., with 100°F (37.8°C) temperatures in the last week of June and in various runs of multiple days in July and August, followed by 100°F (37.8°C) temperatures during the first week of September 1954. The record temperature in the St Louis area was 117°F (47.2°C) at 5 PM on 14 July 1954 in East St. Louis. The warmest night of the year occurred on 18 July 1954, with an average night-time temperature of 85°F (29.4°F), also at the East St. Louis site.

### **General Welfare**

Through 18 July 1954, 137 deaths were attributed to the heat in Missouri and 47 deaths in Kansas, including 19 patients in mental hospitals (KCT, July 19, 1954). In Wyandotte County (Kansas City, KS) during the first 18 days of July there had been more deaths than births, an unusual occurrence blamed on the heat (KCS, July 19, 1954). The Jackson County (Kansas City, MO) coroner reported investigating 159 deaths for the month of July, the largest number reported in a single month in many years. While only 13 of the deaths were from heat prostration, it was thought that most were indirectly related to the extreme temperatures (KCS, Aug 27, 1954). For the extended period, 12-24 July 1954, 108 deaths in the St. Louis area alone were attributed to the extreme heat. Nationwide, over 300 deaths were attributed to the heat during that time period. Most of deaths were in the 50-90 year age group (Bridges et al., 1976). The number of deaths due to heat has been traditionally underreported. One reason for this in 1954 is that only those deaths under the jurisdiction of the county coroner and not under the care of an individual's doctor were reported. Other possible causes of mortality underestimation were outlined in Bridges et al., 1976 and Changnon et al., 1996.

While residential air conditioning is now in widespread use, home window air conditioners were first introduced after World War II ([http://www.facstaff.bucknell.edu/mvigeant/therm\\_1/ac\\_final/bg.htm](http://www.facstaff.bucknell.edu/mvigeant/therm_1/ac_final/bg.htm)). In Kansas City, during the summer of 1954, 15,000 air conditioners were sold by 18 July 1954 resulting in a total of about 30,000 homes having access to air conditioning (KCS, July 19, 1954). In St Louis, there were 30,000 room air conditioners at the beginning of the summer and it was expected that by the end of the summer there would be 50,000 room a/c units (SLPD, July 18, 1954). Many public buildings however, did not have air conditioning, resulting in postponement of meetings (KCT, July 7, 1954) and trials (SLPD, July 20, 1954). Many hospitals were only partially air conditioned. For those in hospital rooms without air conditioners, nurses had a difficult time reading the temperatures of patients as thermometers would not go below 100°F (37.8°C, SLPD, July 13, 1954).

Air conditioned rooms were not always available even for former presidents. Former President Harry S. Truman, age 70, underwent surgery on 20 June 1954, to remove his gall bladder and appendix. He spent several weeks recuperating in the hospital. It was reported on 25 June that the high temperatures were bothering Mr. Truman during his recuperation. At first he refused to be moved to a room with air conditioning but relented on the afternoon of 26 June at the insistence of Mrs. Truman. He returned to his home in Independence, MO in mid-July after an air conditioning unit had been installed in his bedroom. (KCT, June 25-26, 1954; July 9, 12, 1954; KCS, June 25-28, 1954). To help speed his recovery, a Cleveland, OH, cold-storage plant sent President Truman a box of snow balls as temperatures in Kansas City exceeded 109°F (SLPD, July 12, 1954).

Aside from air conditioning issues, other infrastructure problems were noted. The extreme heat was responsible for such things as contorted railroad tracks caused by expanding rails in Kansas, as well as over 50 instances of streets buckling from the heat (SLPD, July 15, 1954).

Young trees, evergreens, hedges and groundcover plants with shallow root systems were particularly vulnerable to the burning sun (SLPD, July 25, 1954). Lastly, it was reported that the extreme heat caused a Kansas City weather beacon to malfunction and forecast snow (SLPD, July 12, 1954).

In Kansas City, animals and people adapted to heat in various ways. Spectators huddled in the shade at the Swope Park Zoo on July 4 hoping to see the animals wander around their habitats. They actually saw the animals led by an ostrich run for the lake in the middle of the habitat upon being released. Many humans did the same thing, as the nearby pool had over one thousand swimmers that day (KCT, July 7, 1954). An elephant show at the St Louis zoo was cancelled as the elephants could not tolerate walking on the hot concrete (SLPD, July 12, 1954). In Abilene KA, a Faith and Freedom day rally was postponed until later in the evening when temperatures cooled (KCT, July 5, 1954).

People had difficulty sleeping due to warm nighttime temperatures so that some sought refuge outside in their backyards or in local parks, or in their basements. Many purchased fans and air conditioners during the summers of 1953 and 1954. The installation of awnings was also popular, particularly for non-shaded, non-air conditioned homes. One of the larger orders for the St Louis Home Improvement Company was for vertical venetian-type awnings that took over two months to install at the Wagner Electric office and plant (SLPD, July 18, 1954).

### **Water Resource Issues and Utilities**

Three lakes in the St. Louis area (Creve Coeur Lake, Horseshoe Lake, and a lake system in Grand Marais Park in Illinois) dried up during the summer as a result of silting, extreme heat and drought (SLPD, July 17, 1954). Due to drought conditions, Missouri Governor Donnelly requested that Dr. Edward Clark, state geologist, begin a geological survey of Missouri's water supply. He reported that 56 of the 114 counties in Missouri

had critically low water conditions, with most of these counties found in southwestern MO. Dr. Clark further urged that loans be made available to farmers to drill wells and develop community water supplies in these areas to help relieve dry conditions (SLPD, July 31, 1954). 76 counties in Missouri were declared drought disaster areas in early August by President Eisenhower and 5 more were added in mid-September (SLPD, Sept 16, 1954). A total of 414 counties in 8 states were declared drought disaster areas (SLPD, Sept 15, 1954).

Water shortage problems were common throughout Kansas and Missouri (KCT, July 4, 1954). Water rationing was common throughout the region. In Jefferson County, the Raytown Water Company claimed that the watering of sod for new homes resulted in water shortages. The water company went to the Missouri Public Water Commission to see if it could enforce water restrictions by cutting off the water from houses not complying with restrictions (KCS, June 29, 1954). In response, residents served by the Raytown Water Company signed petitions which they sent to the Missouri Public Service Commission, stating that the water company was not doing enough to ameliorate the crisis (KCS, June 30, 1954; July 1, 1954). The cause of the water shortage was reported to be in the rapid growth of the suburban population and a deficiency in the Kansas City water distribution system (KCT, July 9, 1954).

The strain on the St Louis water supply was first noticed in late June, when temperatures began to exceed 100°F (37.8°C). The water company asked residents of St. Louis County to refrain from lawn watering between noon and 10 PM every day, as daily water consumption exceeded the company's water supply capacity (SLPD, June 26, 1954). Certain areas had weak water pressure or, as in the case of Webster Groves, almost no water at all. There, a water emergency was declared and under penalty of a fine, watering lawns or washing cars was prohibited from 6 AM to 10 PM daily until the crisis was resolved (SLPD, June 27, 1954). From 12-14 July 1954, and on 20 July 1954, daily water

consumption by city residents reached all-time record levels (SLPD, July 21, 1954). Watering restrictions were relaxed after rains in early August (SLPD, Aug 2, 1954).

The 1954 heat wave also strained the utility supplies in Kansas City and St Louis. Focusing on St. Louis, air conditioner usage resulted in record-breaking water and power use during the summer heat wave. It was reported that about 10-12% of the city's water usage on weekdays was from air conditioners using water as a coolant (SLPD, June 28, 1954). As a result of heavy air conditioning and thus water use, the president of the water company wanted to add a surcharge of \$40 per ton of cooling capacity for households using air conditioners which did not in some way conserve water (SLPD, Aug 6, 1954).

The increase in air conditioning units also was believed responsible for the frequent occurrence of circuit overloads tripping safety devices on transformers (SLPD, July 18, 1954). It was reported that about 12-15% of power usage during the summer of 1954 went to cooling city residents (SLPD, Aug 10, 1954). The president of Union Electric reported that based on the summer of 1953, peak power usage had shifted from December when electricity is used for heating and lighting to the summer when it is used for air conditioning (SLPD, June 19, 1954). Both the St. Louis County Water Co. and Union Electric Co. reported record uses of their respective utilities sometime during that summer.

## **Crops**

The hot, dry weather experienced over much of the Midwest during the summer of 1954 had both positive and negative economic impacts on agriculture. In Kansas, it was reported that the rain and sunshine experienced during the first half of June made conditions excellent for plant growth (KCS, June 18, 1954). The hot and dry conditions that followed were ideal harvest weather for the Kansas and Missouri winter wheat crop. In eastern Kansas and in Missouri, in June some were predicting record wheat yields (KCS, 23 June

1954). The harvest did occur early and quickly. By June 25 harvesting was underway throughout most of Kansas, peaking in early July (KCS, July 6, 1954). The dry conditions helped to decrease the moisture content of the crop, making it easier to store while waiting for a more optimal time to sell. The winter wheat crop did quite well (SLPD, Aug 12, 1954).

In contrast, for some areas of western Kansas (near Garden City in Finney County), the heat and hot, dry winds left the wheat crop "light and shriveled." Grasshoppers became problematic during this summer (KCS, July 18, 1954). The hot weather also had an adverse effect on home-grown fruits and vegetables. Fewer tomatoes were available as they stop growing when temperatures get above 90°F (32.2°C). The peach crop was also reported to be smaller than usual (SLPD, July 1, 1954).

The continued extreme heat and dryness in July had a negative impact on corn, soybeans, and spring wheat crops. The damage to the corn was particularly devastating as hot, dry conditions continued through the crucial tasseling stage for the corn. By the end of July, some farmers were pulling up damaged corn to use as silage. Some areas reported 100% loss of their crop. (SLPD, July 31, 1954).

In St. Louis County, some relief from the drought came in August, with 3.2 inches (8.1 cm) of rain falling in St Louis from 1-11 Aug 1954. Although some shrubbery and grass in the area turned green during August, it was too late for much of the corn and soybean crops. For the county, 75% of the corn crop, 60-80% of the soybean crop, and about 80% of the small fruit and truck crops had been lost by mid-August. The adverse weather also allowed wheat farmers to enter into price support programs (SLPD, Aug 15, 1954).

## **Livestock**

Livestock were particularly hard hit by the heat of the summer of 1954. The hot weather caused the deaths of thousands of poultry (KCT, July 14, 1954). Egg prices were up (SLPD, July 19, 1954); the reasons cited were that "hens lay less in hotter weather," and that it is harder to maintain the eggs' quality before they reach the market in such extreme temperatures. Heat and drought conditions also affected livestock prices at the markets. With the extremely high temperatures, cattle, sheep and hogs were sold earlier than normal and price dropped as the demand for meat was down due to the heat (SLPD, July 17, 1954). It was reported that a bison herd lost 8 of 124 bison in a 10 day period in July (KCS, July 18, 1954).

The plight of the farmers was apparent to state and federal policy makers. In mid-July, the US Senate passed a bill allowing the Farm Credit Administration to make long-term loans to drought-stricken farmers and livestock growers to help pay mortgages. Further, Missouri Governor Donnelly called together farm groups from throughout the state to discuss what needed to be done to help the ailing agriculture industry. The conference urged that: 1) the Federal Government begin to purchase beef cattle from drought-stricken farmers in an emergency program, 2) that the entire state be declared a drought disaster area so that federal aid could be obtained, and 3) the Federal Commodity Credit Corporation supply livestock growers with available surplus grain (SLPD, July 17, 1954).

The Federal Government was indeed ready to go through with some of these actions to help both Missouri and Kansas. In particular, it agreed to begin purchasing beef if necessary to prevent a price drop (SLPD, July 28, 1954). Assistant Secretary of Agriculture Ross Rizley toured drought-stricken areas of the state and was expected to recommend that all of Missouri be declared a disaster area (SLPD, July 31, 1954). However, President Eisenhower declared only 76 of the 114 Missouri counties to be disaster areas. These included most of the counties in the

southwestern part of the state (SLPD, Aug 4, 1954). Governor Donnelly again requested that the remaining counties be declared disaster areas as well (SLPD, Aug 21, 1954). In mid-September, 93 additional counties in the United States were declared disaster areas, bringing the total number to 414, with five of the new counties in Missouri (SLPD, Sept 15, 1954). Grants were made by state and federal governments to transport surplus hay to drought-stricken farmers in Kansas and Missouri from 32 states and Canada. The largest shipments were made from the Dakotas and Minnesota (SLPD, Sept 22, 1954).

## **Retail**

The hot and dry weather had impacts in economic areas other than agriculture, with some of the impacts positive. While farmers suffered from the heat, many retail stores enjoyed increased sales of warm weather apparel, summer vacation supplies, as well as fans and air conditioning units (KCT, July 2, 1954). Many vacationers, however, headed to Michigan to escape the heat. Air-conditioned movie theaters saw an increase in patrons as did places selling ice cream and cold beverages. (KCT, July 5, 12, 1954; KCS, July 18, 1954). The monthly report on the Eighth Federal Reserve District, which includes St. Louis, described the area's weather as having the "dominant influence" on the district's trade (SLDP, Aug 1, 1954). It also was reported that despite problems in the agriculture industry, especially in the southern part of the district, "overall business activity continued steady." Worker productivity had decreased due to the heat, but construction was up. On some of the hottest days, workers handling metal had to wear gloves to avoid burning their hands (KCS, July 12, 1954). Department store sales also were up 4%, from the same week the previous year (SLPD, July 23, 1954).

## Discussion

A number of factors could exacerbate the effects of an extended heat wave if it were to occur again, such as population growth and per capita energy usage increases. Suburban populations have increased dramatically in Midwestern cities. The Kansas City Metropolitan area has grown by about 108% to about 1.7 million and the St. Louis Metropolitan area has grown by about 48% to about 2.6 million since the 1950 census, (<http://www.demographia.com/dm-usmet-fr50.htm>, <http://www.demographia.com/db-usmet2000.htm>).

If such a heat wave were to occur without significant planning, water shortages and an increased burden on the power industry seems likely. The use of air conditioners is now quite common as well as use of other electric appliances such as refrigerators with ice makers, computers and televisions. For air conditioners, data from the US Census Bureau indicates that by 2005, only 10% of households lacked air conditioning

(<http://www.ahrinet.org/ARI/util/showdoc.aspx?doc=703>). In addition, there has been a general trend towards the use of central rather than window air conditioning and home sizes have more than doubled so that the amount of space cooled has greatly increased.

([http://www.eia.doe.gov/emeu/consumptionbriefs/recs/actrends/recs\\_ac\\_trends.html](http://www.eia.doe.gov/emeu/consumptionbriefs/recs/actrends/recs_ac_trends.html)) While appliances are more energy efficient than in the past, per capita energy usage in the United States increased by about 75% between 1950 and 2000 ([http://epb.lbl.gov/homepages/Rick\\_Diamond/LBN\\_L55011-trends.pdf](http://epb.lbl.gov/homepages/Rick_Diamond/LBN_L55011-trends.pdf)). While energy demand has already increased, summertime peak power would further increase in during an extensive heat wave.

For governmental bodies, infrastructure costs from buckled streets and warped railroad ties were accrued in 1954. However, the most costly governmental interventions were those related to the agricultural community. The extreme heat resulted in many deaths and much discomfort. People did adapt. Individuals sought out swimming pools, air-conditioned theatres and

stores. Sales of fans, air conditioners, and awnings, as well as, cold drinks, ice cream and warm weather attire were brisk.

No such prolonged heat wave has occurred in the Midwest since 1954. In fact, throughout the Midwest, the annual number of 90°F (32.2°C) days has diminished (Changnon et al., 2010). This summer cooling trend or “warming hole” is discussed in Robinson et al., 2002 and Pan et al., 2009, and has been simulated by a regional climate model (Kunkel et al., 2006). While its exact cause is unknown, it would stand to reason that since such a prolonged widespread heat wave has occurred in the last 100 years, there is a distinct possibility that it could occur again. Such prolonged high temperatures have not been experienced by most living today. Past heat waves, such as the one in 1954 could serve as a template in planning for a heat wave in the future, as shorter duration heat waves, such as the Chicago heat waves of 1995 and 1999 already have (Kunkel et al, 1996; Changnon et al, 1996, Palecki et al, 2001). The EPA and a large number of cities including St Louis and Kansas have developed guidelines for individuals and communities addressing health aspects of excessive heat conditions (USEPA, 2006). Community planning to address energy and water issues would be beneficial as well.

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## References

- Bridges, C.A., F.P. Ellis and H.L. Taylor, 1976: Mortality in St. Louis, Missouri, during Heat Waves in 1936, 1953, 1954, 1955, and 1966. ENVIRONMENTAL RESEARCH, **12**, 38-48.
- Changnon, D., V. Gensini, and J. Prell, 2010: A common Midwestern question: Where have all our 90°F days gone? Recorded presentation, *First Conference on Weather, Climate, and the New Energy Economy*, Amer. Meteor. Soc.
- Changnon, S.A., K.E., Kunkel, and B.C. Reinke, 1996: Impacts and responses to the 1995 heat wave: a call to action. *B. Amer. Meteor. Soc.*, **77**(7): 1497-1506.
- Kansas City Star, 1954:
- Kansas City Times, 1954:
- Karl, T.R., and R.G. Quayle, 1981: The 1980 summer heat wave and drought in historical perspective. *Mon. Wea. Rev.* **109**(10): 2066-2073.
- Kunkel, K.E., X-Z Liang, J. Zhu, and Yiruo Lin, 2006: Can CGCMs simulate the twentieth-century "warming hole" in the central United States? *J. Climate*, **19**, 4137-4153.
- Kunkel, K.E., S.A., Changnon, B.C. Reinke, and R.W. Arritt, 1996: The July 1995 heat wave in the Midwest: A climatic perspective and critical weather factors. *Bull. Amer. Meteor. Soc.*, **78**, 1107-1119.
- Mahmood, R., S.A. Foster, T. Keeling, K.G. Hubbard, C. Carlson, R. Leeper, 2006: Impacts of irrigation on 20th century temperature in the northern Great Plains, *Global and Planetary Change*, Science Direct, Elsevier, **54**, 1–18.
- Pan Z., M. Segal, X. Li, and B. Zib, 2009: Chapter 3. Global Climate Change Impact on the Midwest USA – Summer Cooling Trend in Understanding Climate Change: Climate Variability, Predictability, and Change in the Midwestern United States, S. C. Pryor, ed., Indiana University Press, 29-41.
- Palecki, M.A., S.A. Changnon, K.E. Kunkel, 2001: The nature and impacts of the July 1999 heat wave in the Midwestern United States: Learning from the lessons of 1995. *Bull. Amer. Meteor. Soc.*, **82**(7): 1353-1367.
- Robinson, W.A., R. Reudy, and J.E. Hensen, 2002: General circulation model simulations of recent cooling in the east-central United States. *J. Geophys. Res.* **107**(D24), 4748, doi:10.1029/2001JD001577.
- St. Louis Post Dispatch, 1954:
- United States Environmental Protection Agency, 2006: Excessive Heat Events Guidebook, EPA 430-B-06-005, June 2006, 60 pp.