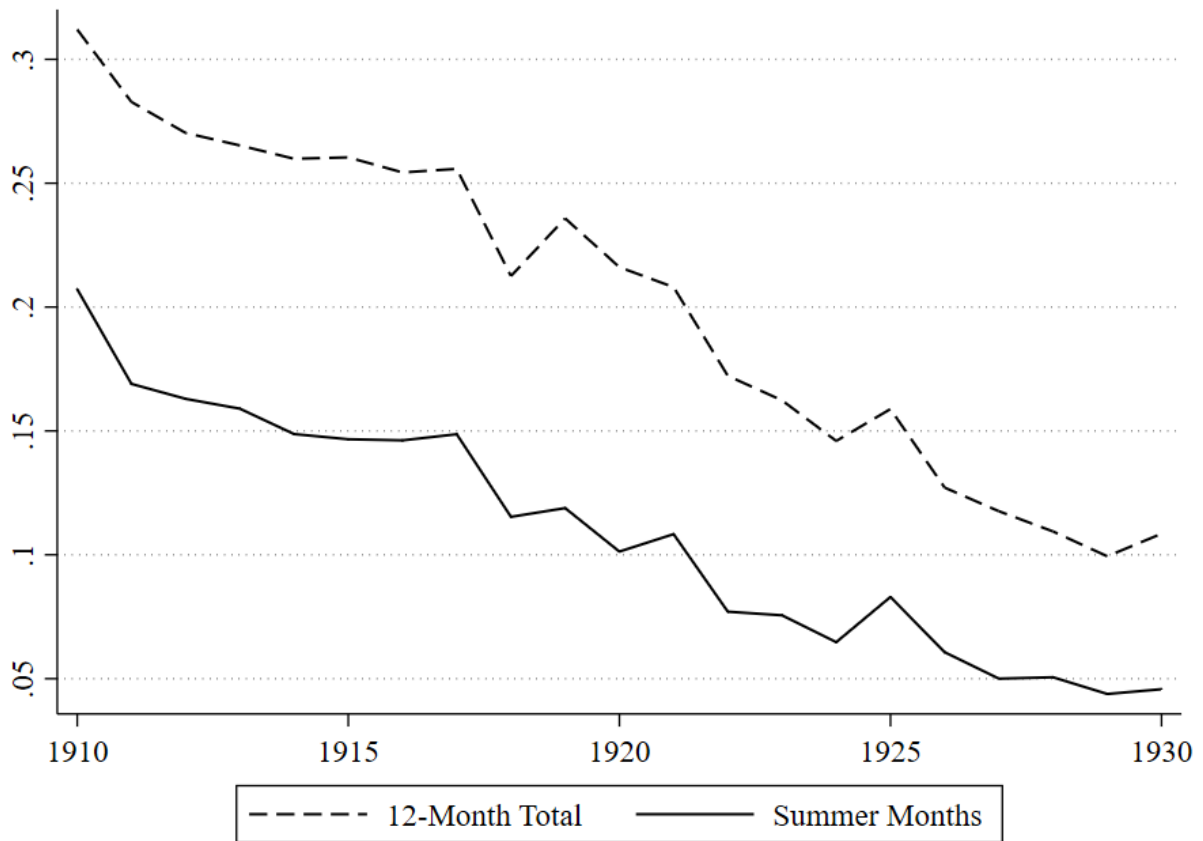


## **Appendix**

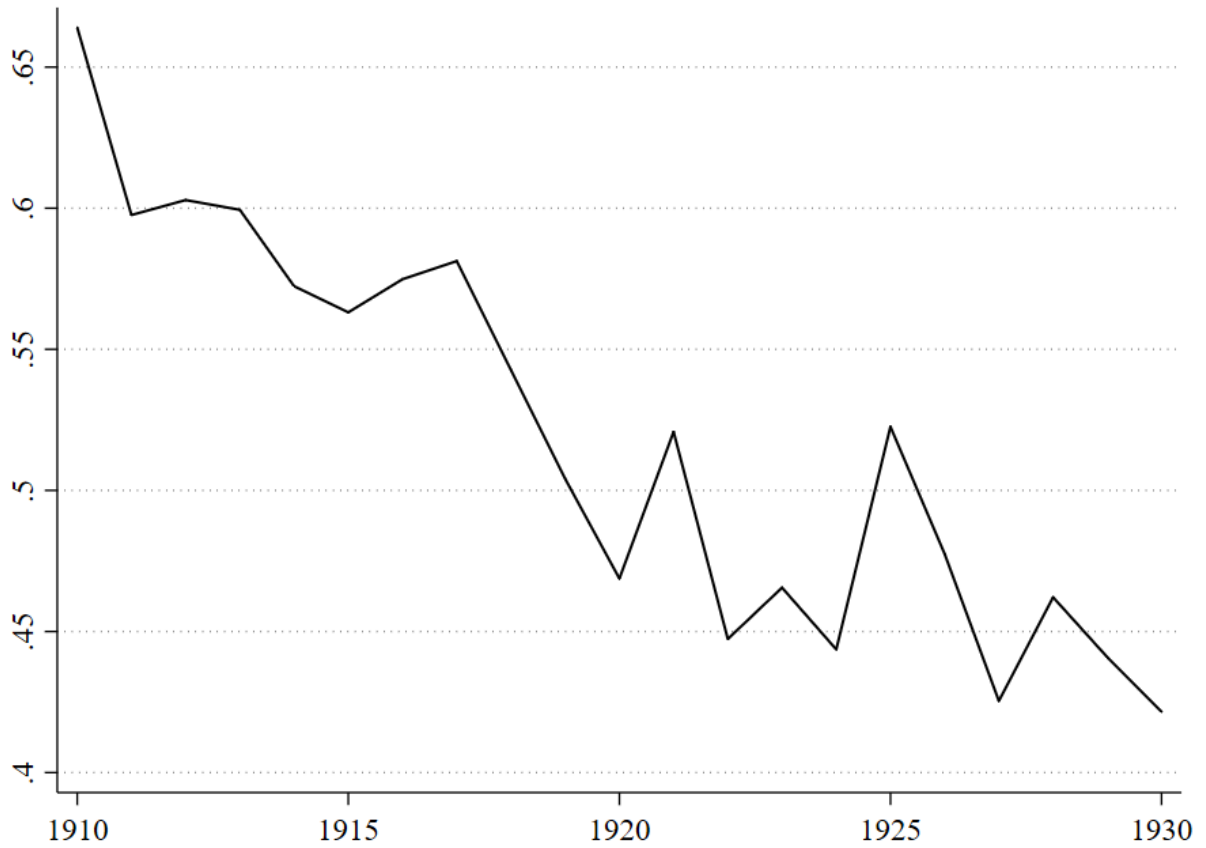
For Online Publication

**Appendix Figure 1. Ratio of Diarrheal Mortality to Total Mortality among Children Under the Age of Two**



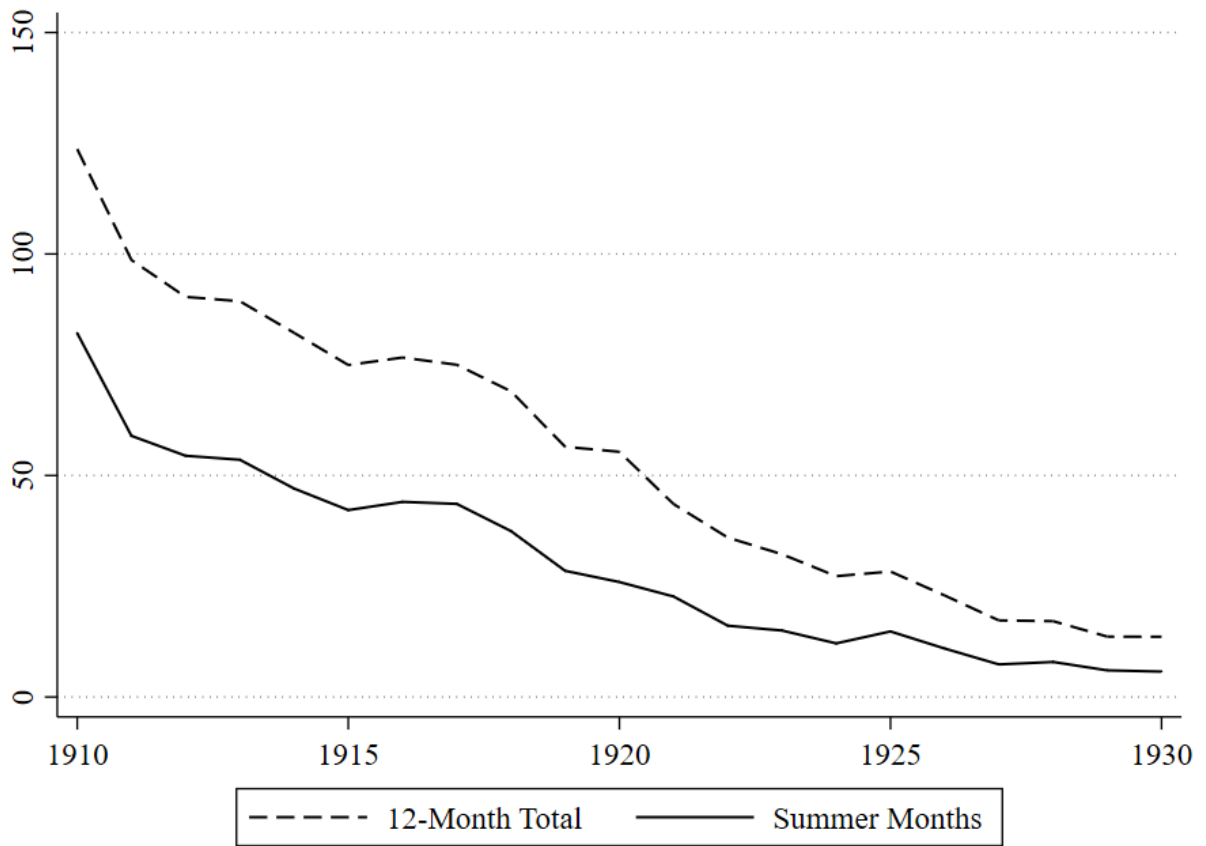
Notes: Based on data from *Mortality Statistics* for the 26 cities under study, published by the U.S. Census Bureau. The summer months are defined as June-September.

**Appendix Figure 2. Ratio of Summer Diarrheal Mortality to Total Diarrheal Mortality among Children Under the Age of Two**



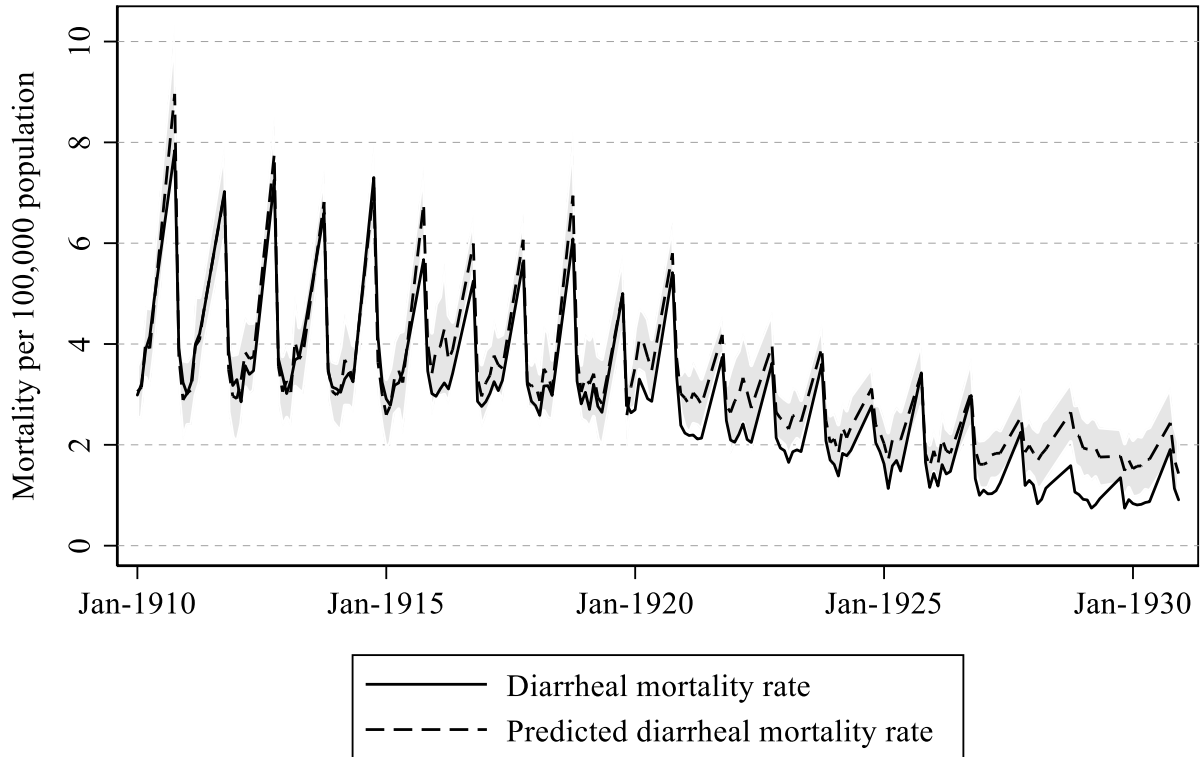
Notes: Based on data from *Mortality Statistics* for the 26 cities under study, published by the U.S. Census Bureau. The summer months are defined as June-September.

**Appendix Figure 3. Diarrheal Mortality among Children Under the Age of Two per 100,000 Population**



Notes: Based on data from *Mortality Statistics* for the 26 cities under study, published by the U.S. Census Bureau. The summer months are defined as June through September.

**Appendix Figure 4. Actual vs. Predicted Non-Summer Diarrheal Mortality Rates among Children Under the Age of Two**  
The Effect of Municipal Water Filtration



Notes: Based on annual data from *Mortality Statistics* for the period 1910-1930, published by the U.S. Census Bureau. Predicted diarrheal mortality rates are calculated under the assumption that municipalities did not filter their water supply. Shaded area represents 90% confidence region around diarrheal mortality rates.

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**Appendix Table 1. Descriptive Statistics**

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	Mean (SD)	Description
<i>Diarrhea</i>	4.08 (5.16)	Monthly diarrheal mortality per 100,000 population among children under the age of two
<i>ln(Population)</i>	13.2 (.762)	Natural log of the city population
<i>Percent Female</i>	.500 (.018)	Percent of the city population that was female
<i>Percent Nonwhite</i>	.072 (.072)	Percent of the city population that was nonwhite
<i>Percent Foreign</i>	.212 (.096)	Percent of the city population that was foreign born
<i>Percent Age &lt; 15</i>	.253 (.031)	Percent of the city population that was less than 15 years of age
<i>Percent Age 15-44</i>	.529 (.025)	Percent of the city population that was 15-44 years of age
<i>Percent Age 45+</i>	.218 (.030)	Percent of the city population that was 45 years of age or older

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N = 6,552

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Notes: Unweighted means with standard deviations in parentheses.

**Appendix Table 2. Municipal Water Purification, 1900-1930**

City and State	Water Filtration Plant <sup>a</sup>	Water Treated with Chlorine <sup>b</sup>
Baltimore, Maryland	1915	1911
Boston, Massachusetts	...	1928
Buffalo, New York	1926	1914
Chicago, Illinois	...	1912
Cincinnati, Ohio	1907	1918
Cleveland, Ohio	1918	1911
Detroit, Michigan	1923	1913
Indianapolis, Indiana	1904	1909
Jersey City, New Jersey	...	1908
Kansas City, Missouri	1928	1911
Los Angeles, California	...	1925
Louisville, Kentucky	1909	1913
Milwaukee, Wisconsin	...	1910
Minneapolis, Minnesota	1913	1910
Newark, New Jersey	...	1921
New Orleans, Louisiana	1909	1915
New York, New York	...	1911
Philadelphia, Pennsylvania	1906	1910
Pittsburgh, Pennsylvania	1908	1910
Providence, Rhode Island	1904	1917
Rochester, New York	...	1925
San Francisco, California	...	1922
Seattle, Washington	...	1911
St. Louis, Missouri	1915	1913
St. Paul, Minnesota	1923	1920
Washington, D.C.	1905	1923

<sup>a</sup> **Philadelphia, PA:** Filtration began before 1906, but not all parts of the city received filtered water until February, 1909. **Pittsburgh, PA:** By October 1908, the water supply of peninsular Pittsburgh was being filtered. In 1909 and 1914, the Southside and the Northside, respectively, began receiving filtered water.

<sup>b</sup> **Chicago, IL:** Chlorination began in 1912, but full chlorination was not achieved until 1917. **Milwaukee, WI:** Water was chlorinated from June, 1910-December, 1910; February, 1912-March 1912; April, 1912 onwards. **Newark, NJ:** Chlorine was used in rare, emergency-only cases beginning in 1913; continuous use started in 1921. **Philadelphia, PA:** Water was chlorinated from December, 1910-April, 1911; December, 1911-February, 1913; November, 1913 onwards. **Pittsburgh, PA:** Water was chlorinated from January, 1910-March, 1910; November, 1910-April, 1911; August, 1911 onwards.

Notes: Identification of the filtration estimates comes from cities that began filtering their water supply during the period 1910-1930. Identification of the chlorination estimates comes from cities that began chlorinating their water supply during the period 1910-1930.

**Appendix Table 3. Clean Water Projects, 1900-1930**

City and State	Clean Water Project	Description
Boston, Massachusetts	1904	Water was conveyed by the Wachusett/Weston Aqueduct to the Weston Reservoir. Water was first delivered to metropolitan Boston on December 29, 1904.
Buffalo, New York	1913	Water intake, located on Lake Erie's Emerald Channel, was completed on May 12, 1913.
Cleveland, Ohio	1904	Cleveland built the first tunnel (the "Five Mile Crib") to draw water from Lake Erie. It went into operation on April 6, 1904.
Jersey City, New Jersey	1904	The Boonton Reservoir began delivering water to Jersey City on May 23, 1904.
Los Angeles, California	1913	Los Angeles began receiving water from Owens Valley on November 5, 1913.
Newark, New Jersey	1930	The Wanaque Reservoir began delivering water to Newark on March 20, 1930.
New York, New York	1907	The New Croton Dam was completed on January 1, 1907 and began delivering water to New York City on November 6, 1907.
		The Catskills Aqueduct began delivering water to the Bronx on December 27, 1915. By January 22, 1917, all other boroughs were receiving water.
Providence, Rhode Island	1926	The Scituate Reservoir began delivering water to Providence on September 30, 1926.

Notes: Identification of the clean water estimates comes from the cities that undertook clean water projects during the period 1910-1930.



**Appendix Table 4. Sewage Treatment/Diversion, 1900-1930**

City and State	Sewage Treatment Plant/Sewage Diversion	Description
Baltimore, Maryland	1911	Operation of the sewage treatment plant was begun “in the latter part of 1911” (Wagenhals et al. 1925).
Chicago, Illinois	1907	In 1907, the last sewer outfalls emptying into Lake Michigan were shut off.
Cleveland, Ohio	1922	The first sewage treatment plant was opened in 1922. By 1928, two additional plants were in operation.
Detroit, Michigan	1912	The Detroit River Interceptor was built in 1912. It intercepted sewage and discharged it below the intake for drinking water. Detroit began treating its sewage in February, 1940.
Indianapolis, Indiana	1925	The sewage treatment plant began operations in May, 1925.
Jersey City, New Jersey	1924	The sewage treatment plant was built in 1924 and upgraded in 1937.
Milwaukee, Wisconsin	1925	The sewage treatment plant began operations in June, 1925.
Newark, New Jersey	1924	The sewage treatment plant began operations in 1924.
Providence, Rhode Island	1901	The Providence sewage treatment plant, built in 1901, used chemical precipitation. It converted to using an activated sludge process in the mid-1930s.
Rochester, New York	1917	The sewage treatment plant began operations in March, 1917

Notes: Identification of the sewage treatment estimates comes from the cities that began treating their sewage during the period 1910-1930.

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## Appendix Table 5. Bacteriological Standards for Milk, 1900-1930

City and State	Bacteriological Standard <sup>a</sup>
Baltimore, Maryland	1913
Boston, Massachusetts	1905
Buffalo, New York	1918
Chicago, Illinois	1909
Cincinnati, Ohio	1914
Cleveland, Ohio	1906
Detroit, Michigan	1915
Indianapolis, Indiana	1916
Jersey City, New Jersey	1915
Kansas City, Missouri	1910
Los Angeles, California	1905
Milwaukee, Wisconsin	1908
Minneapolis, Minnesota	1907
Newark, New Jersey	1913
New Orleans, Louisiana	1923
New York, New York	1912
Philadelphia, Pennsylvania	1915
Pittsburgh, Pennsylvania	1910
Providence, Rhode Island	1915
Rochester, New York	1907
San Francisco, California	1909
Seattle, Washington	1910
St. Louis, Missouri	1923
St. Paul, Minnesota	1907

<sup>a</sup> **Baltimore, MD:** On October 15, 1912, Baltimore passed an ordinance setting a bacteriological standard, but the first milk inspectors did not start working until January 1, 1913. **Boston, MA:** On March 1, 1905, the Boston Board of Health (in conjunction with the State Board of Health) set a bacteriological standard for health inspectors to follow. On January 8, 1913, Boston passed an ordinance that required licensing of milk producers and set a bacteriological standard. **Buffalo, NY:** The Buffalo Health Commissioner conducted bacteriological tests of milk as early as 1907, but standards were not set by law until October 9, 1918. **Chicago, IL:** The Chicago milk ordinance that came into effect on January 1, 1909 was nullified by the Illinois legislature on June 12, 1911. A new ordinance, passed on August 14, 1912, required that non-pasteurized milk come from tuberculin-tested cows and meet a bacteriological standard. On July 22, 1916, the Chicago Commissioner of Health required that all milk be pasteurized. **Detroit, MI:** An ordinance required that all milk sold in Detroit be pasteurized as of May 1, 1915. **Philadelphia, PA:** As of October 15, 1909, dairy farmers were required to have a license. Although inspections were conducted under rules set by the Board of Health, a bacteriological standard was not enforced until July 1, 1915.

Notes: Identification of the *Bacteriological Standard* indicator comes from the cities that began requiring that milk sold within their limits meet a bacteriological standard during the period 1910-1930.

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**Appendix Table 6. Public Health Interventions and Summer Diarrhea by Average City Temperature**

	$\ln(\text{Diarrhea})$
<i>Filtration</i> × <i>Below 30°F</i>	-.146** (.059)
<i>Filtration</i> × <i>30°- 40°F</i>	-.175*** (.059)
<i>Filtration</i> × <i>40°- 50°F</i>	-.183*** (.047)
<i>Filtration</i> × <i>50°- 60°F</i>	-.090 (.055)
<i>Filtration</i> × <i>60°- 70°F</i>	-.047 (.085)
<i>Filtration</i> × <i>70°F and Above</i>	.128 (.146)
<i>Chlorination</i> × <i>Below 30°F</i>	.056 (.057)
<i>Chlorination</i> × <i>30°- 40°F</i>	.024 (.063)
<i>Chlorination</i> × <i>40°- 50°F</i>	-.042 (.057)
<i>Chlorination</i> × <i>50°- 60°F</i>	-.098* (.056)
<i>Chlorination</i> × <i>60°- 70°F</i>	-.001 (.056)
<i>Chlorination</i> × <i>70°F and Above</i>	.048 (.073)
N	6,552
R <sup>2</sup>	.862

\*Statistically significant at 10% level; \*\* at 5% level; \*\*\* at 1% level.

Notes: Based on annual data from *Mortality Statistics* for the period 1910-1930, published by the U.S. Census Bureau. Each column represents the results from a separate OLS regression. The dependent variable is equal to the natural log of the number of diarrheal deaths among children under the age of two per 100,000 population in city  $c$  and month  $t$ . Controls include the city characteristics listed in Appendix Table 1, temperature indicators, interactions between the temperature indicators and the remaining public health interventions (*Clean Water Project*, *Sewage Treated*, and *Bacteriological Standard*), city fixed effects, month-by-year fixed effects, and city-specific linear trends. Regressions are weighted by city population. Standard errors, corrected for clustering at the city level, are in parentheses. Data on temperature come from the nClimDiv data set at the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA), which is available at: <ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/>. Temperature is measured at the climate division-by-month level.