

Activity: Sacramento and Climate Change: Evidence for Warming

Part 1. Calculating Annual Mean Temperatures

Look at the monthly average temperature data for Sacramento, CA.

Discussion:

- How are monthly mean temperatures determined?
- Within a single year, how do monthly mean temperatures change?
- Do you see any trends?

You will be assigned a year in the range 1900-1909.

1. Calculate the annual mean temperature for your year and plot your data point on the graph in class.
2. Report your annual mean temperature in class and record the values in the table to the right.

Determine the average temperature for the decade from 1900 to 1909. We will use this data point as a baseline for comparing temperature data for other decades.

Year	Mean Temp (°F)
1900	59.90
1901	60.15
1902	59.19
1903	59.41
1904	60.14
1905	59.69
1906	60.44
1907	59.56
1908	59.74
1909	59.62

Average Temperature 1900-1909 = **59.78** °F

Table 1: Monthly Mean Temperatures (°F) for Sacramento, CA

	Jan	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1900	47.26	51.68	57.32	56.72	64.39	69.43	73.56	70.26	67.05	60.79	55.22	45.18
1901	45.02	50.12	56.00	56.43	61.42	69.67	72.61	72.58	67.53	66.48	56.75	47.15
1902	43.32	52.09	52.24	56.43	60.03	70.63	73.21	71.31	70.75	61.84	51.47	46.92
1903	43.37	45.48	52.27	56.08	65.18	70.98	69.40	71.74	70.40	66.19	54.87	46.89
1904	45.68	49.31	51.90	58.18	67.60	71.45	71.19	71.95	71.67	62.48	54.53	45.71
1905	47.61	52.12	56.44	59.17	60.08	66.80	72.90	72.03	68.88	62.65	53.20	44.39
1906	48.69	53.80	52.85	58.42	60.35	66.53	76.61	72.92	69.82	65.47	53.20	46.66
1907	45.32	54.04	50.89	60.28	63.05	66.37	70.69	70.77	66.03	64.29	55.52	47.50
1908	47.53	49.24	55.44	60.97	61.03	67.15	75.84	71.45	71.22	60.70	54.22	42.13
1909	50.52	49.45	51.31	61.12	62.52	68.17	71.73	71.81	69.88	61.56	53.39	43.98

Decade	Mean Temp (°F)
1900-09	59.78
1910-19	59.65
1920-29	60.44
1930-39	61.42
1940-49	60.90
1950-59	61.39
1960-69	61.66
1970-79	62.78
1980-89	63.06
1990-99	63.86
2000-09	63.64

Part 2. Plotting Annual Mean Temperatures

You will be assigned a decade in the range from 1910-2009.

1. Using a pencil, plot the annual mean temperature for each year of your assigned decade on the plot template. The range of years will begin with a year ending with a 0 and end with a year ending with a 9 (e.g., 1910-1919). When you have completed your plot, connect the dots in pencil and check your work.

2. Label the years on the x-axis of your plot.

3. Draw a horizontal line on your plot that represents the average temperature for the decade 1900-09 in pencil.

4. After you have checked that your work is correct, darken your temperature data with a red marker.

5. Darken the 1900-09 line with a blue marker.

6. When the whole class is finished, tape all of the graphs together to create a plot that shows temperature in Sacramento for the last 110 years.

7. Determine the average temperature for your decade. Report your decadal mean and record all of the data in the table.

Discussion:

Are data from a single decade sufficient to observe a long-term trend in temperature (from Part 1)? **No.**

What overall trend do you observe for the range 1900-2009? **Climate is warming**

What is the difference between annual mean temperatures and the decadal mean temperature in your plots? **The decadal mean temperature is the average of the annual mean temperatures and averages out the noise in the annual temperatures.**

What was the hottest year since 1900? **1997**

What was the hottest decade since 1900? **1990-99**

Year	Annual Mean Temp (°F)
1900	59.90
1901	60.15
1902	59.19
1903	59.41
1904	60.14
1905	59.69
1906	60.44
1907	59.56
1908	59.74
1909	59.62
1910	59.89
1911	58.38
1912	59.29
1913	60.41
1914	59.86
1915	60.42
1916	59.44
1917	60.03
1918	59.53
1919	59.29
1920	59.21
1921	60.70
1922	59.59
1923	60.30
1924	60.84
1925	60.17
1926	62.09
1927	61.72
1928	60.68
1929	59.09
1930	60.07
1931	61.72
1932	60.70
1933	60.16
1934	63.08
1935	60.51
1936	62.62
1937	61.12
1938	60.67
1939	62.20

Year	Annual Mean Temp (°F)
1940	63.29
1941	61.65
1942	60.44
1943	61.36
1944	60.62
1945	61.10
1946	59.99
1947	61.04
1948	59.31
1949	60.16
1950	61.88
1951	60.53
1952	61.00
1953	61.34
1954	60.43
1955	60.51
1956	60.84
1957	61.41
1958	62.99
1959	62.93
1960	61.88
1961	61.23
1962	60.75
1963	60.12
1964	60.95
1965	61.57
1966	63.74
1967	62.06
1968	61.77
1969	62.55
1970	63.43
1971	61.39
1972	61.86
1973	62.49
1974	63.47
1975	62.19
1976	65.05
1977	62.20
1978	62.46
1979	63.28

Year	Annual Mean Temp (°F)
1980	62.81
1981	64.67
1982	61.73
1983	63.61
1984	63.77
1985	61.66
1986	63.66
1987	62.98
1988	63.60
1989	62.10
1990	63.63
1991	63.48
1992	64.73
1993	63.44
1994	62.98
1995	64.52
1996	65.32
1997	65.58
1998	62.81
1999	62.11
2000	63.01
2001	64.03
2002	63.48
2003	63.88
2004	63.83
2005	63.73
2006	63.02
2007	63.06
2008	62.94
2009	62.73