The Sun and Climate
Solar Irradiance

The Solar Constant $f = 1.4 \times 10^6$ erg/cm$^2$/s. Over the surface of the Earth, this is $2 \times 10^{24}$ erg/s, or $2 \times 10^{17}$ watts (100 million gigawatts).

This energy input keeps the Earth warm. If the solar constant were to change, so would the Earth’s temperature.

Solar irradiance varies by about 0.1% over a solar cycle.
Changes in the Solar Irradiance

• Solar irradiance is higher when the Sun is more magnetically active.

• The Sun was magnetically active, and the climate was warm, 800-1200 CE.

• Shortly after Galileo observed them, the sunspots vanished during the Maunder Minimum, from 1645-1715. This was a fairly cold period.

• A cooler period (including 1816, the “year without a summer”) corresponds to minimum in sunspots 1800-1830 - the Dalton Minimum.

• 1400-1900 CE is called the "Little Ice Age".

• Sunspot numbers are the highest they have been since before 1750.
Does the Sun Drive Climate?
The Temperature’s Rising

Global Temperature Land-Ocean Index

- Annual Mean
- 5-year Mean

Temperature Anomaly (°C)

1880 1900 1920 1940 1960 1980 2000
Sunspots and CO$_2$

What is Cause and What is Effect?

Carbon dioxide concentration as measured at Mauna Loa, Hawaii. These measurements represent the globally mixed concentration.
What is Cause and What is Effect?
Web Sites:
For further information on the influence of the Sun on climate, with special attention to global warming, check the following web sites:

Informational sites:
• The NOAA Global Warming web page:  
  http://www.ncdc.noaa.gov/oa/climate/globalwarming.html
• The American Institute of Physics:  
  http://www.aip.org/history/climate/

Discussions of the Sun's role in global warming:
• http://www.aip.org/history/climate/solar.htm
• http://solar-center.stanford.edu/sun-on-earth/glob-warm.html
• http://www.jeffreybennett.com/newsletters/superbowl.html