

The Greenhouse Effect

Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

Solar radiation powers the climate system.



Some solar radiation is reflected by the Earth and the atmosphere.

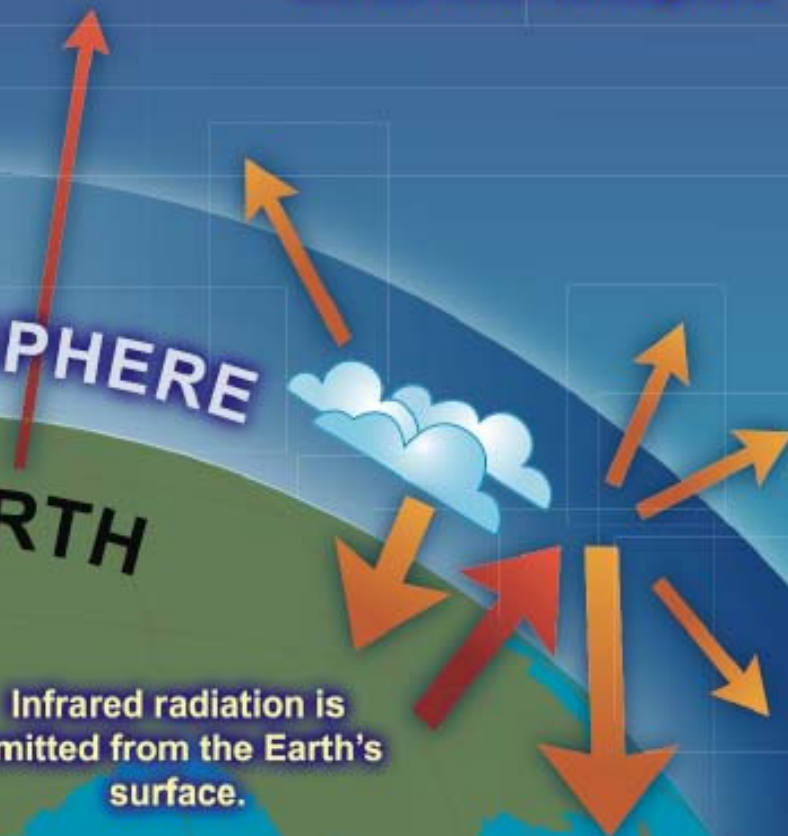


ATMOSPHERE

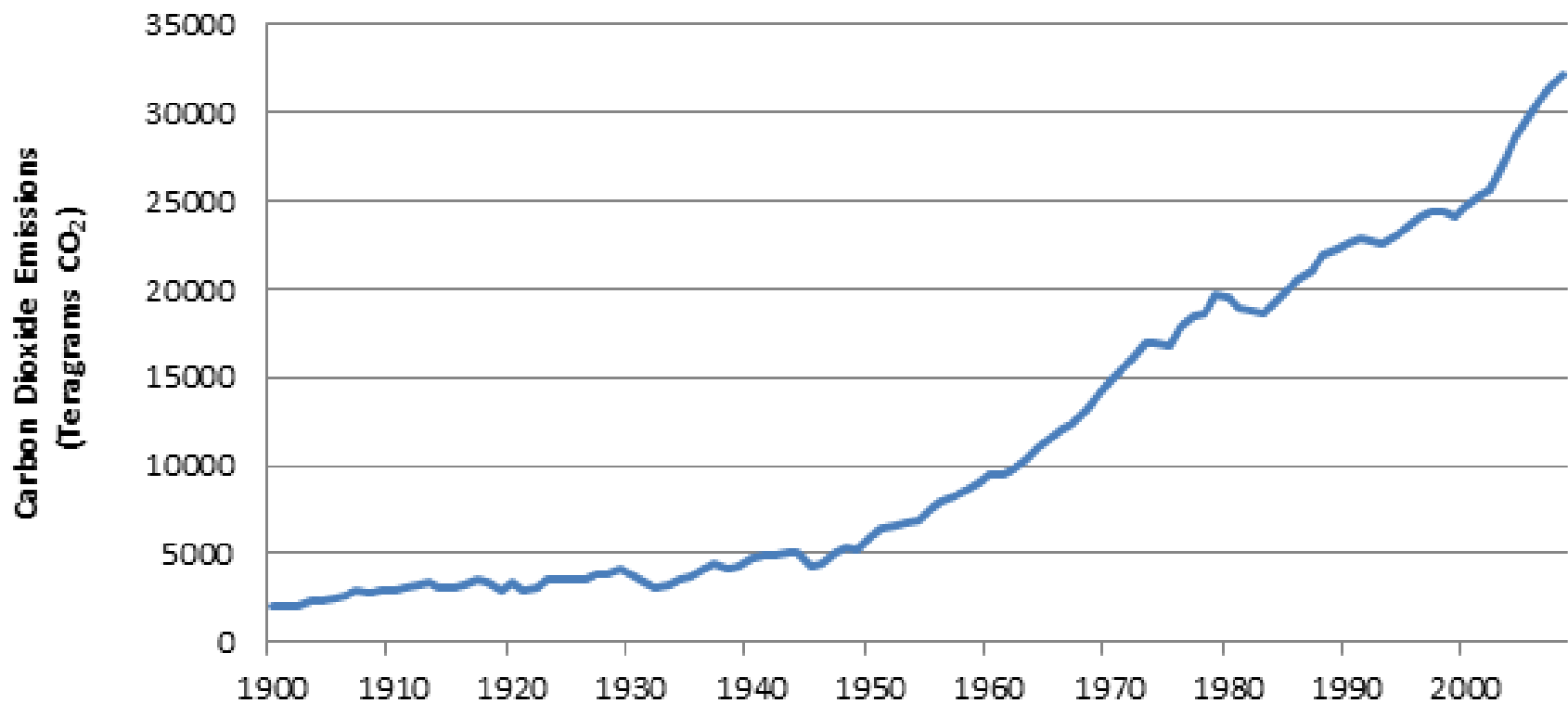
EARTH

About half the solar radiation is absorbed by the Earth's surface and warms it.

Infrared radiation is emitted from the Earth's surface.



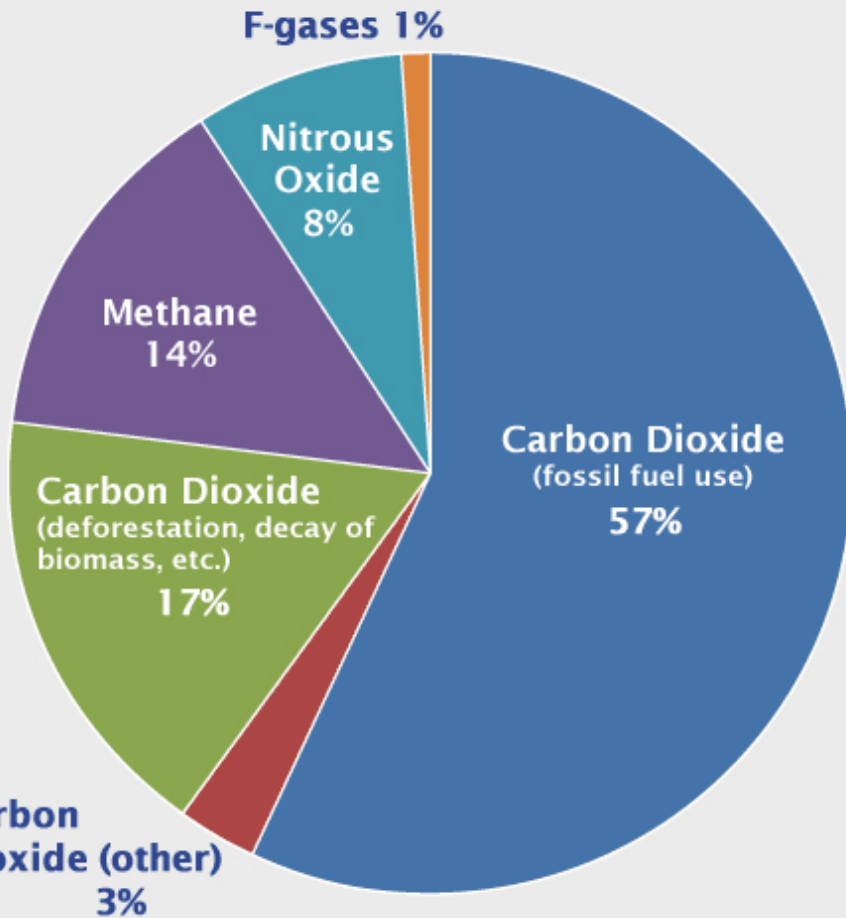
Global Carbon Dioxide (CO₂) emissions from fossil-fuels 1990–2008



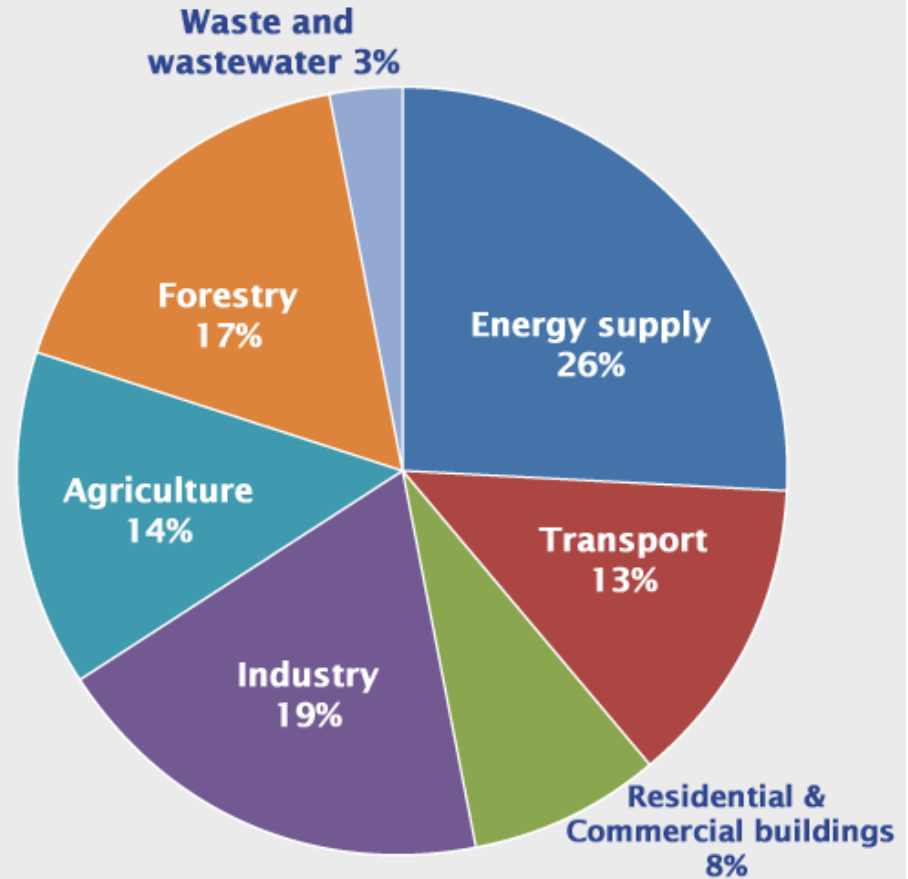
Source of data: Boden, T.A., G. Marland, and R.J. Andres (2010). Global, Regional, and National Fossil-Fuel CO₂ Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001_V2010.

Global Greenhouse Gas Emissions (IPCC, 2007)

By Gas

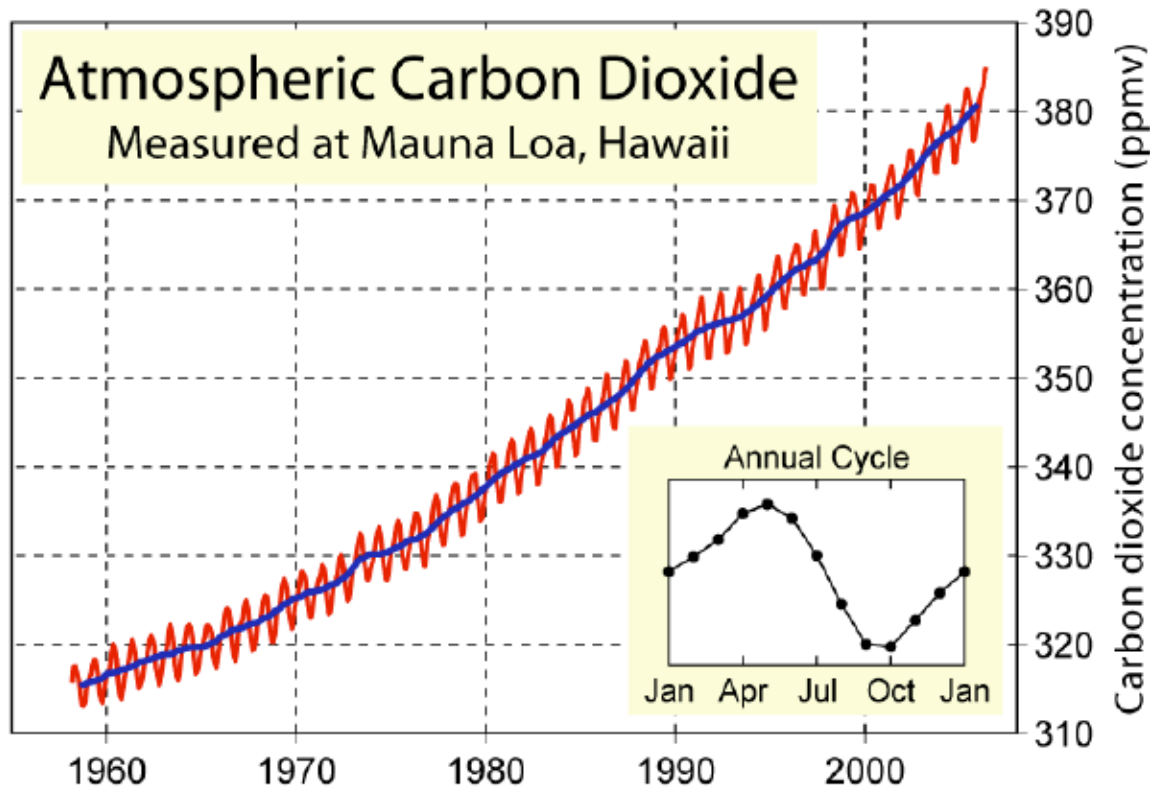


By Source



Why, briefly, are climate scientists so sure about the human origins of these changes?

50 years of the Keeling Curve



- Atmospheric CO₂ levels have been going up since at least the early 19th century

- Natural “carbon sinks” do not absorb CO₂ as fast as we emit it

Once CO₂ enters the atmosphere, it stays for ~ 100 years.

The Fourth Assessment Report of the IPCC (2007)

-11 of the previous 12 years [1995-2006] were among the 12 warmest on record since 1850.

•[NOAA finds all 13 years since 2000 among the 14 hottest]

-The 100 year temperature trend [1906-2005] was $+0.75^{\circ}\text{C}$ [0.56°C to 0.92°C], or 1.35°F .

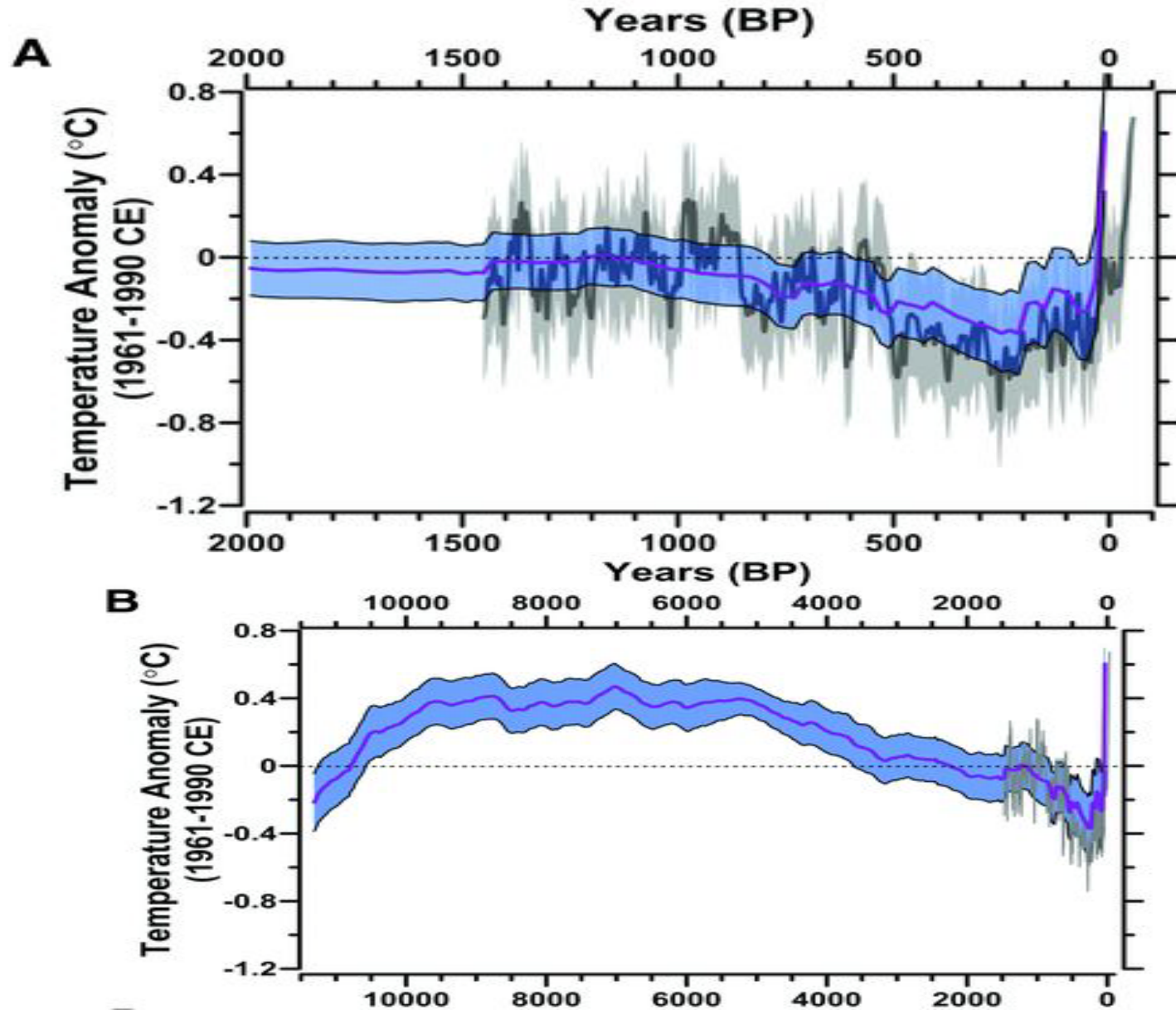
•[NOAA finds $+0.8^{\circ}\text{C}$, or 1.4° from 1880-2012]

-Oceans have heated up to depths of up to 3000 m, and hotter water expands (higher sea levels)

-Loss of ice mass in Greenland of between 50 and 100 billion tons per year between 1993 and 2003

•[OSU Researcher finds 2012 to be record melt year]

What is the mainstream scientific argument about climate change?



Graphs from
Marcott,
Shakun, Clark
& Mix (2013)

Weather vs. Climate

	Weather	Climate
Definition	Describes the atmospheric conditions at a specific place at a specific point in time.	Describes the average conditions expected at a specific place at a given time.
Time frame	Short term: Minutes, hours, days, or weeks	Long term: Months, years, decades, or longer
Determined by:	Real-time measurements of atmospheric pressure, temperature, wind speed and direction, humidity, precipitation, cloud cover, and other variables	Aggregating weather statistics over periods of 30 years ("climate normals").
Study	Meteorology	Climatology

Contiguous U.S., Temperature, March

