



Evidence for human causes of climate change

- Dr. Richard Alley discusses how we know humans are causing the rise in CO₂ – because O₂ levels have decreased (2:41)
<https://www.youtube.com/watch?v=-PrrTk6DqzE>

How do we know that humans are causing the rise in CO₂ levels by burning coal, gasoline, and other fossil fuels? There are several different lines of evidence; here are three.

1. When we burn fossil fuels, the carbon in them combines with oxygen to form CO₂ molecules. That oxygen comes from the atmosphere. This means that levels of oxygen in the atmosphere should be decreasing as we burn fossil fuels. Sure enough, oxygen levels over the past two decades have dropping at a rate proportional to the increase in CO₂ levels. It's not nearly enough of a drop to cause breathing problems, but it is measurable.

2. There is an easy way to tell whether higher temperatures come from the increase in insulation from greenhouse gases, or from an external source of heat like the sun. Scientists have measured the temperature at different levels of the atmosphere, including the very outer layers. Temperatures are higher in the lowest layers, and lower in the upper layers. This is what we would expect from the extra insulation from greenhouse gases, rather than from extra incoming heat from the sun.

To understand, imagine you're wearing a jacket but are still feeling cold. If someone lights a bonfire near you, the outside of the jacket would warm up before your body feels the heat from the fire. Now imagine that instead of lighting a bonfire, you added a layer of long underwear underneath the jacket. It would trap more heat inside the jacket with you. What would happen to the outside layer of the jacket? Less of your body heat would reach the outer layers of the jacket. This means that the outer layers would be cooler.

3. There are three types of carbon molecules (called isotopes) with different atomic weights: carbon-12, carbon-13 and carbon-14. Carbon-14 is radioactive and dies away to undetectable levels in 50,000 years or so. Fossil fuels, being millions of years old, have no carbon-14 left. If burning fossil fuels is the cause of rising CO₂ levels in the atmosphere, the proportion of carbon-14 in the atmosphere should have decreased. Sure enough, it has. For the last 50 years, as the amount of CO₂ in the atmosphere has increased, its carbon-14 ratio has fallen steadily.

More information

For more information on how we know what's causing the climate to change, check out these links:

- This video from the Union of Concerned Scientists discusses the ways we know that humans are causing the climate to warm (3:14)
<https://www.youtube.com/watch?v=pbBb-SvRFjM>
- This video from Earth the Operator's manual provides evidence from analysis of carbon isotopes that rising CO₂ levels are caused by burning fossil fuels (2:41)
<http://earththeoperatorsmanual.com/segment/6>