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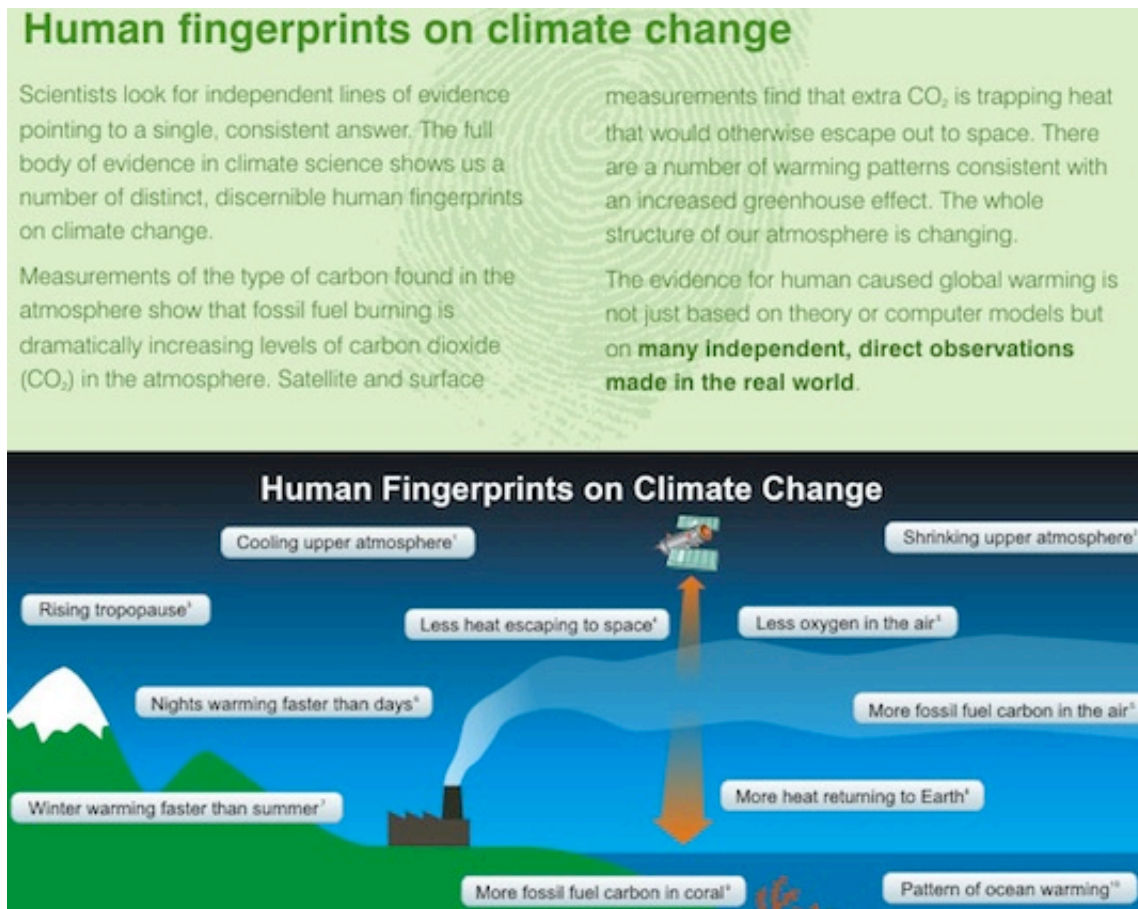
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Eight Must-Have Charts Summarize the Evidence for a “Human Fingerprint” on Recent Climate Change

By **Joe Romm** on Oct 6, 2011 at 4:05 pm



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The Yale Project on Climate Change Communications asked Americans “If you had the opportunity to talk to an expert on global warming, which of the following questions would you like to ask?”

The top question, as reported in their “[Global Warming’s Six Americas in May 2011](#)” report, is “How do you know that global warming is caused mostly by human activities, not natural changes in the environment?”

So this is a question that all climate hawks should be able to answer, and the figures/charts in this post are ones that you can refer to. I just used this post myself today during a radio interview.

Given the popularity of my recent “[Illustrated Guide to the Science of Global Warming Impacts](#),” which collected and summarized dozens of posts covering some 50 scientific articles, I thought I would occasionally repost updated versions of other important pieces and reviews.

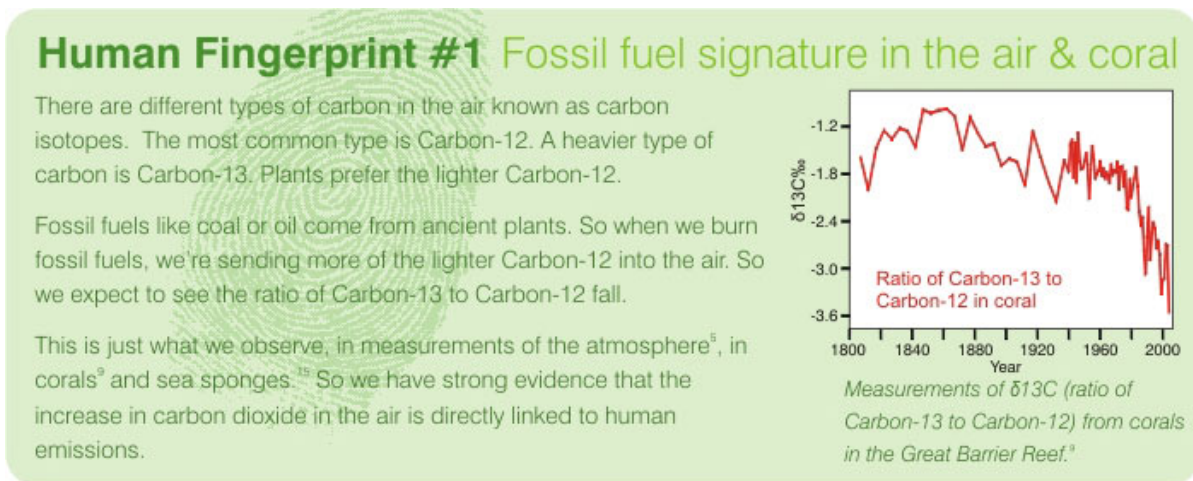
Last year, physicist John Cook, who runs the must-read website [Skeptical Science](#), published “[The Scientific Guide to Global Warming Skepticism](#).” It’s a good introduction to global warming science and skepticism.

He sent me the 8 figures of the “human fingerprints on climate change,” which I repost below.

The clever deniers these days don’t deny the painfully obvious reality that the planet is warming or that climate is changing — they simply deny that humans are a major cause.

But in fact there is an overabundance of evidence that humans are warming the planet and changing the climate, so much so that the U.S. National Academy of Sciences labels as “[settled facts](#)” that “the Earth system is warming and that much of this warming is very likely due to human activities.”

Here are key fingerprint figures:

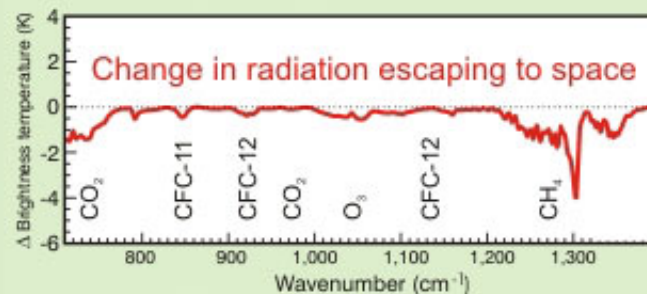


Human Fingerprint #2

Less heat is escaping out to space

Satellites measure infrared radiation as it escapes out to space, clearly observing the greenhouse effect. A comparison between satellite data from 1970 to 1996 found that even less energy is escaping to space at the wavelengths that greenhouse gases absorb energy. Researchers described this result as *"direct experimental evidence for a significant increase in the Earth's greenhouse effect"*.⁴

This has since been confirmed by subsequent measurements from several different satellites.^{19,20}

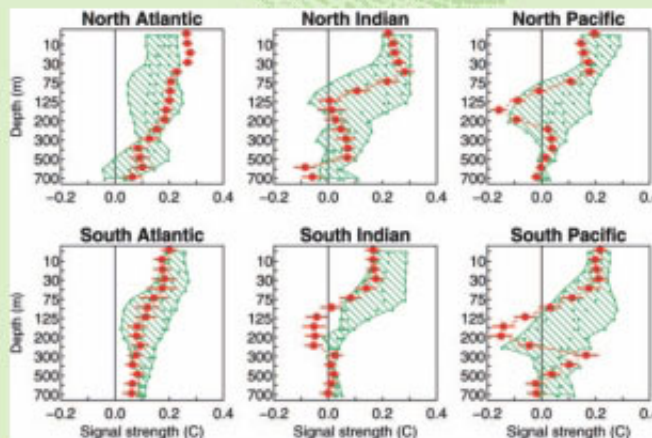


Change in outgoing radiation spectrum from 1970 to 1996 due to increasing greenhouse gases. Negative values mean less outgoing heat.⁴

Human Fingerprint #3

The ocean warming pattern

The world's oceans have steadily been building up heat over the past 40 years. The specific pattern of ocean warming, with heat penetrating from the surface, can only be explained by greenhouse warming.¹⁰

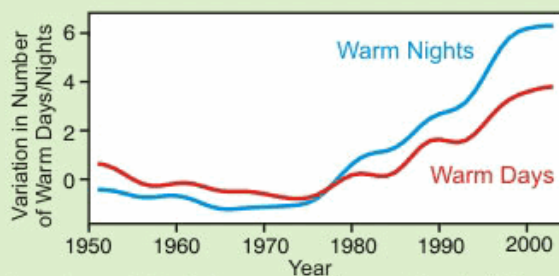


Observed ocean temperature (red) compared to model results that include greenhouse warming (green).¹⁰

Human Fingerprint #4

Nights warming faster than days

An increased greenhouse effect means nights should warm faster than days. During the day, the sun warms the Earth's surface. At nighttime, the surface cools by radiating its heat out to space. Greenhouse gases slow down this cooling process. If global warming was caused by the sun, we would expect the warming trend to be greatest in daytime. Instead, what we see is the number of warm nights increasing faster than the number of warm days.⁶



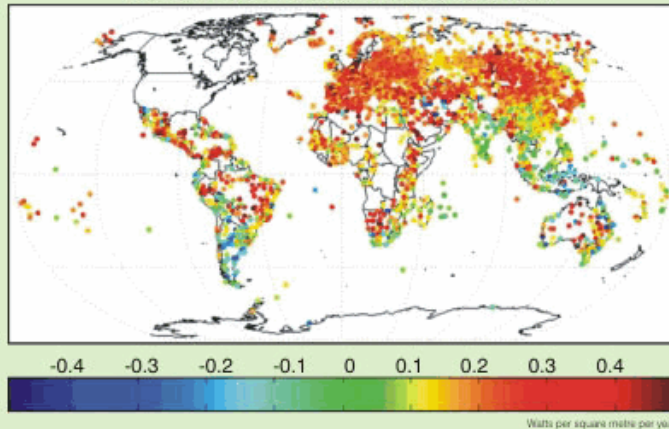
Long-term variation in the number of warm days (red) & warm nights (blue) per year. Warm is defined as the top 10%.⁶

Human Fingerprint #5 More heat is returning to Earth

An increased greenhouse effect means we should see more infrared radiation returning down to Earth from the atmosphere. This has been directly observed. When we take a close look at the spectrum of the downward radiation, we can work out how much each greenhouse gas is contributing to the warming effect. From these results, it was concluded:

"This experimental data should effectively end the argument by skeptics that no experimental evidence exists for the connection between greenhouse gas increases in the atmosphere and global warming."⁸

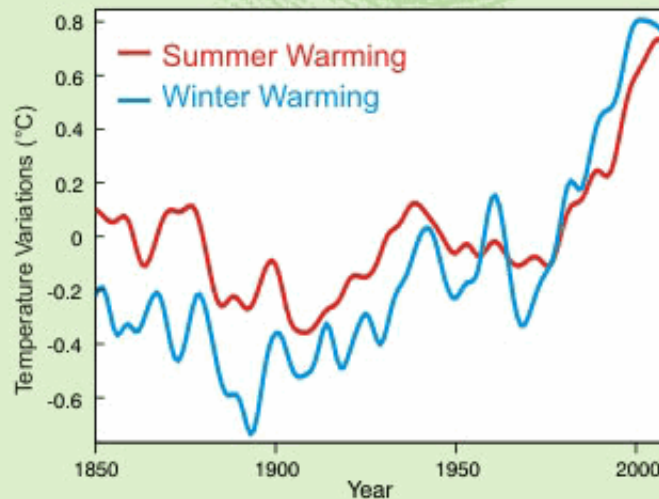
Trend in downward infrared radiation



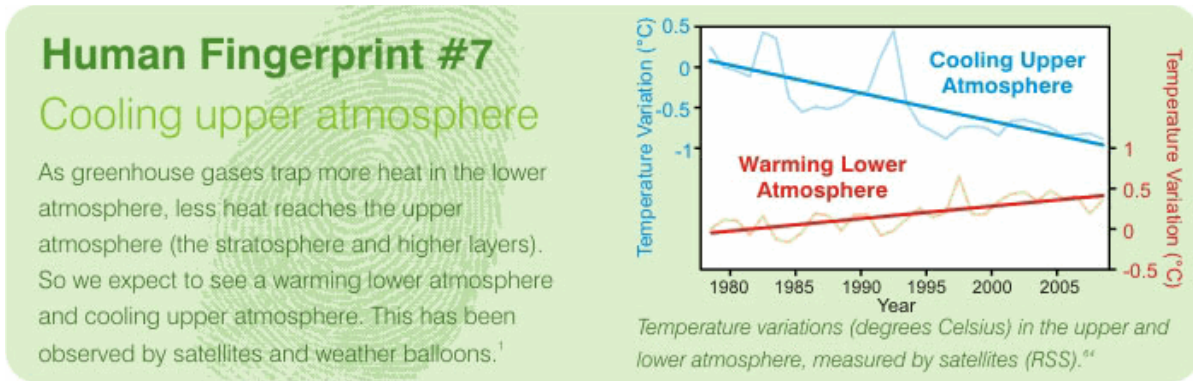
Trend in downward infrared radiation over 1973 to 2008. North America is blank because data in those regions don't cover the entire 1973 to 2008 period.¹³

Human Fingerprint #6 Winter warming faster

As greenhouse warming increases, winters are expected to warm faster than summers. This is because the greenhouse effect has a greater influence over winter. This is what is observed in the instrumental record.¹⁶



Smoothed temperature variations for winter and summer, averaged over land only, from 1850 to 2009.²¹



Q.E.D.

I wouldn't recommend referring to all 7 when asked the question. Just pick 2 or 3 to familiarize yourself with, and then give people this link.

For those who want to dive in deeper, here is a post that contains links to one scientific study for each of the 7 fingerprints, plus 3 more: [10 indicators of a human fingerprint on climate change](#)

Related Posts:

- [How carbon dioxide controls earth's temperature](#)
- [In must-see AGU video, Richard Alley explains "The Biggest Control Knob: Carbon Dioxide in Earth's Climate History."](#)