POST

Understanding Blogs

This study explores your memory for the material you are about to read. The study also queries your beliefs about the topic discussed and your attitudes towards the material presented. The survey consists of reading a blog article, followed by several comments from bloggers and around 10 questions relating to the blog and the comments. There may be a debriefing and some additional questions afterwards. The survey should take no more than 20-25 minutes to complete.

Participation in this study is entirely voluntary. Completion of this Internet survey is taken to constitute your consent to participate. If you do not wish to participate, exit this webpage now.

The data will be analyzed without regard to your identity. If the results from this study are published, only aggregate results will be reported and individual responses will not be identifiable.

If you have any questions please do not hesitate to contact the experimenter, Dr Nicolas Fay, at nicolas.fay@uwa.edu.au.

The Human Research Ethics Committee at the University of Western Australia requires that all participants are informed that, if they have any complaint regarding the manner in which a research project is conducted, it may be given to the researcher or, alternatively to the Secretary, Human Research Ethics Committee, Registrar's Office, University of Western Australia, 35 Stirling Highway, Crawley, WA 6009 (telephone number +61 8 6488-3703).

Please read the following blog post carefully, you will be asked some questions about it at the end. You need to answer those questions correctly in order to qualify and receive the incentive.

How we know we're causing global warming in a single graphic

Posted on 27 July 2014 by ClimateBlogger

In 1859, physicist John Tyndall ran an experiment demonstrating the greenhouse effect. Visible sunlight easily passes through our atmosphere to warm the Earth. However, invisible heat rays rising from the Earth's surface, otherwise known as infrared radiation, don't easily escape back to space. What Tyndall showed by shining heat rays through tubes filled with different gases is that certain gases like water vapour and carbon dioxide block the heat rays. These became known as greenhouse gases.

Tyndall also predicted what we expect to see if greenhouse gases were causing warming (Tyndall 1861). There are a number of distinctive patterns in greenhouse warming. Observing these patterns strengthens the evidence that humans are causing global warming. They also eliminate other possible natural causes.

Humans are raising CO2 levels

The first point to establish is that humans are causing the rise in atmospheric CO2 levels. This fact is common sense. The amount of CO2 in the atmosphere is going up by around 15 billion tonnes per year. Humans are emitting around twice that much! Atmospheric CO2 levels are currently around 390 parts per million, having increased 40% from pre-industrial levels.

On top of this, many lines of evidence confirm that we're the cause of rising CO2 levels. When we measure the type of carbon building up in the atmosphere, we observe more of the type of carbon that comes from fossil fuels (Manning 2006). As you burn fossil fuels, you take oxygen out of the atmosphere. Oxygen levels are falling in line with the amount of carbon dioxide rising (Manning 2006). "Fossil fuel carbon" has sharply risen in corals (Pelejero 2005) and sea sponges (Swart 2010). Our CO2 emissions are penetrating even to the ocean depths (Murata 2010). Tree-ring measurements confirm human activity is the cause of rising CO2 (Levin 2000).

The extra CO2 is trapping heat

If carbon dioxide is trapping more heat, we should see less heat escaping to space. Satellites measuring infrared radiation coming from Earth find less heat escaping to space over the last few decades. This is happening at those exact wavelengths that carbon dioxide absorbs energy (Harries 2001).

If less heat is escaping to space, there's only one place it can go - back to the Earth's surface. Scientists check this by measuring infrared heat coming down from the atmosphere. These measurements confirmed the satellite data - more heat is returning to the Earth's surface (Philipona 2004).

Global warming has a distinct greenhouse signature

In 1859, Tyndall predicted that greenhouse warming should cause nights to warm faster than days. This is because at night, the Earth's surface cools by radiating heat out to space. Greenhouse gases trap some of this heat, slowing the night-time cooling. Over 140 years later, Tyndall's prediction has been confirmed. Over the last few decades, scientists have observed nights warming faster than days (Braganza 2004).

Tyndall also predicted that greenhouse gases should also slow down winter cooling. So he anticipated winters warming faster than summers. Again, recent research over the last few decades bear this out (Braganza et al 2003). Both thermometers and satellites find winters warming faster than summers.

Another distinctive greenhouse pattern can be found in the atmosphere. As heat is being trapped, we expect to see the lower atmosphere to warm. But with less heat escaping to space and more carbon dioxide in the stratosphere, we also expect to see the upper atmosphere cool. Satellites and weather balloons both observe this contrast between upper cooling and lower warming (Jones 2003).

With the lower atmosphere warming and the upper atmosphere cooling, the boundary between the troposphere and stratosphere, otherwise known as the tropopause, should rise as a consequence of greenhouse warming. This has been observed (Santer 2003). We are changing the very structure of our atmosphere.

What's fascinating about all these greenhouse signatures is they also rule out a number of other potential causes of global warming. If the sun was causing global warming, it would cause summers to warm faster than winter, days to warm faster than nights and the upper atmosphere to warm. Observations rule out the sun.

Similarly, the pattern of ocean warming rules out ocean cycles as the driver of global warming. The world's oceans have been building up heat over the past half century. This isn't a case of heat shifting around due to ocean cycles but the entire global ocean system building up heat. The specific pattern of ocean warming, with heat penetrating from the surface, can only be explained by greenhouse warming (Barnett 2005).

If it walks like a duck and quacks like a duck...

Current global warming shows all the distinctive signatures of greenhouse warming. To be skeptical that humans are causing global warming, you must believe two things. Something unknown is causing warming that happens to mirror the greenhouse effect. And something unknown is somehow suppressing the well understood (and well observed) greenhouse effect. So we can accept what we know to be true (greenhouse warming) or we accept two unknowns.

The saying goes if it walks like a duck and quacks like a duck, then it must be a duck. But climate skeptics are trying to convince us it's some other, undefined animal impersonating a duck that's also mysteriously hiding the real duck.

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The blog post you just read suggested that the climate has been changing due to changes in the ocean.

- Yes
- No

The blog post you just read suggested that Bono (U2 singer) should have no business in politics.

- Yes
- No

The blog post you just read stated that atmospheric CO2 levels have risen 40% since pre-industrial times.

- Yes
- No

Once you have answered the questions, click below to read comments on the blogpost

Default Question Block

Comments

LM

Yes - climate change is happening and we are causing it. It isn't rocket science. How do we know that climate change is happening? Apart from the satellite data, these observations can all be - and have been - replicated by amateur scientists. Even the relatively 'hard' science of CO2 absorption has been tackled by amateurs. All you need is a telescope and a spectrometer. You too can see the absorption spectrum of CO2.

Gunpowder

I do know that we have used up many sources of coal, oil and gas. I also know that we keep adding area to our roads and cities. This reduces the area capable of absorbing CO2. It adds CO2 from the manufacture of cement. We have used up most of the high grade metal ores and are now using carbonates. Reducing carbonates to metals puts vast amounts of CO2 into the atmosphere. We are making vast reductions of green spaces. We are dumping great amounts of CO2 and other gases into the atmosphere. Some suggest that this is not causing the climate change that I have observed in my lifetime. This view is far beyond the realms of rational thinking, to put it as kindly as I can.

steveo

Skeptics often think the theory of Global Warming is like a house of cards - pull one card out and it all falls down. Actually it is more like a jigsaw puzzle. Lots of pieces that all fit together. Most of the pieces are in place. Occasionally we aren't sure about where one piece should go. And we can see most of the detail of our puzzle - looks like a farming scene. If one piece doesn't look quite right, does that mean we have it all wrong and the jigsaw is actually of a skyscraper? No. It just means we aren't quite sure about this piece yet. Climate Science is made of so many parts that all support each other. The pieces all fit together pretty well. And I think most of us can tell the difference between a jigsaw puzzle and a house of cards. So why can't they?

Tambourine

A picture says more than a thousand words, doesn't it? Thanks for the neat graphic. It highlights some of the important fingerprints showing that, yes; humans are causing global warming. We may not yet know all the nitty gritty details of how and why things work as they do. But we most certainly know more than enough to get our act together and reduce our carbon emissions ASAP.

Grand Poobah

That is a great graphic, showing all the 'fingerprints' of man-made global warming. A key 'fingerprint' is the

cooling upper atmosphere, as the Earth's lower atmosphere and surface warm. There aren't a lot of ways to explain why the upper atmosphere would be cooling, other than an increased greenhouse effect trapping heat in the lower atmosphere. Increased solar activity would make all layers of the atmosphere warm, for example. Great graphic, and great summary of the evidence for man-made global warming.

barberella
There's one other indicator of humans increasing CO2 as opposed to the oceans being a source. Oceans are getting more acid at the surface, and at lesser rates as you go down. If the oceans were net giving up CO2 instead of taking it in, we would expect pH to go up since CO2 is an acid. As CO2 increases, it leads to a decrease in pH, which we are observing. So, it's not just that the ratios of 13C/12C and 14C/12C are decreasing. The idea of oceans supplying CO2 doesn't match with the fact that the ocean is building up CO2! Excellent summary. Especially the list of references.

cyborg
The ocean getting more acidic is a strong sign that humans are raising CO2 levels. But it's also a grave concern as it's causing damage to coral reefs. These are some of the most diverse ecosystems on the planet. To add insult to injury, more CO2 causes warming. This is causing even more damage to the coral reefs through bleaching. Corals provide both evidence for man-made global warming and concern over its impacts.

g-whizz
Good points about the oceans getting more acidic. The impacts aren't just restricted to coral reefs. There is a range of small creatures throughout the open ocean. They will also be badly affected by the impact of acidification on their ability to maintain shells. Corals are a great source of biodiversity. They are often spawning grounds for many fish. But the open ocean is where most of the life in the oceans is located. And the small creatures out there are the basis of the entire marine food chain. Acidification combined with overfishing could devastate that food chain.

Tambourine
The past tells us much about what our future holds in store for us. In the past, when the Earth was warmer than it is now, sea levels were metres higher than current levels. Just on the sea level front alone, we can expect severe impacts on most of the human population living on coastlines. The past also describes these concerning feedback events, where warmer temperatures lead to further release of greenhouse gases. We're already seeing this start to happen in the Arctic, with methane bubbling from the permafrost and methane clathrates. The past paints a vivid picture of our future and it's a picture of great concern.

deeb
1. Increasing the level of a greenhouse gas in a planet's atmosphere, all else being equal, will raise that planet's surface temperature.
2. CO2 is a greenhouse gas.
3. CO2 is rising.
4. Therefore (given 1-3 above) the Earth should be warming.
5. From multiple converging lines of evidence, we know the Earth is warming.
6. The warming is moving in close correlation with the carbon dioxide.
7. The new CO2 (as shown by its isotopic signature) is mainly from burning fossil fuels.
8. Therefore the global warming currently occurring is anthropogenic (caused by mankind).
Not exactly rocket science.

Click below to answer questions

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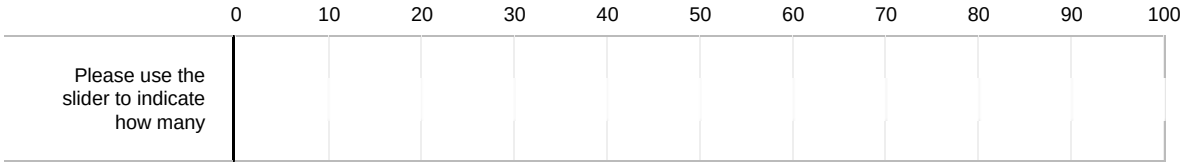
My opinion about a blogpost is completely unaffected by the comments made on the article by others.

How much do you agree with the above statement?

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Out of every 100 readers of this post, how many do you think support the basic argument made in this blog post?



Overall, I support the basic argument made in this blog post.

How much do you agree with the above statement?

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I believe that the climate is always changing and what we are currently observing is just natural fluctuation.

How much do you agree with the above statement?

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I believe that most of the warming over the last 50 years is due to the increase in greenhouse gas concentrations.

How much do you agree with the above statement?

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I believe that the burning of fossil fuels over the last 50 years has caused serious damage to the planet's climate.

How much do you agree with the above statement?

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Human CO2 emissions cause climate change.

How much do you agree with the above statement?

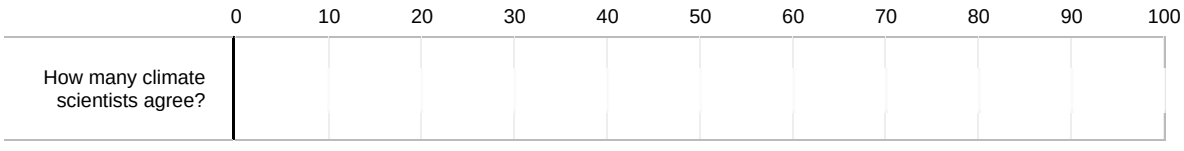
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Humans are too insignificant to have an appreciable impact on global temperature.

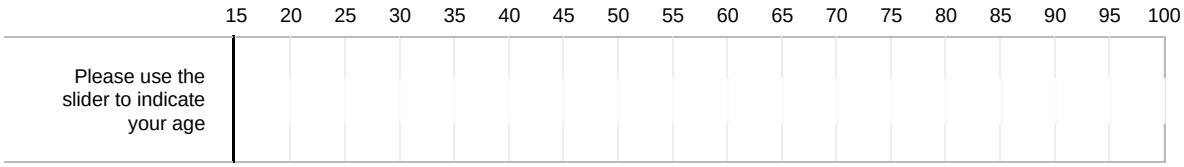
How much do you agree with the above statement?

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

On a scale from 0% to 100%, in your opinion, how many climate scientists agree that human activity is causing global warming?



What is your age?



What is your gender?

- Male
- Female

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