Why More Carbon Dioxide Makes Little Difference

A mistake in the climate model architecture changes everything; trapped energy just reroutes to space on another path

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Full version of the dam analogy

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There are serious architectural errors in the basic climate model. When fixed, it shows future warming due to carbon dioxide will be a fifth to a tenth of official estimates. Less than 20% of the global warming since 1973 was due to increasing carbon dioxide.

Increasing carbon dioxide "thickens the blanket", reducing the heat radiated to space by carbon dioxide. In reality, the blocked heat mainly just reroutes out to space by being radiated from water vapor instead, all in the upper atmosphere. In the current climate models, however, that blocked heat travels down to the Earth's surface where it is treated like extra sunlight, and less heat is radiated to space from water vapor.

This discovery debuted recently on blogs, withstanding detailed public scrutiny, and is in a paper currently undergoing peer review.

Like most scientists, I am convinced carbon dioxide is a greenhouse gas and causes some global warming. I agree that carbon dioxide levels have been rising. My dissent is about *how much* warming it causes.

Basic Climate Model

The basic climate model, used to calculate the Earth's sensitivity to carbon dioxide, dates back to 1896. It is the cornerstone of the carbon dioxide theory of global warming. Predating computer simulations, it applies "basic physics" to climate.

The idea that "it's the physics" makes the carbon dioxide theory impregnable in the minds of the establishment.

Despite the numerous mismatches between theory and climate observations to date, many climate scientists remain convinced that increasing carbon dioxide causes dangerous warming essentially because of the basic model, rather than because of the huge opaque computer models. The basic model ignited concern about carbon dioxide; without it we probably wouldn't be too worried.

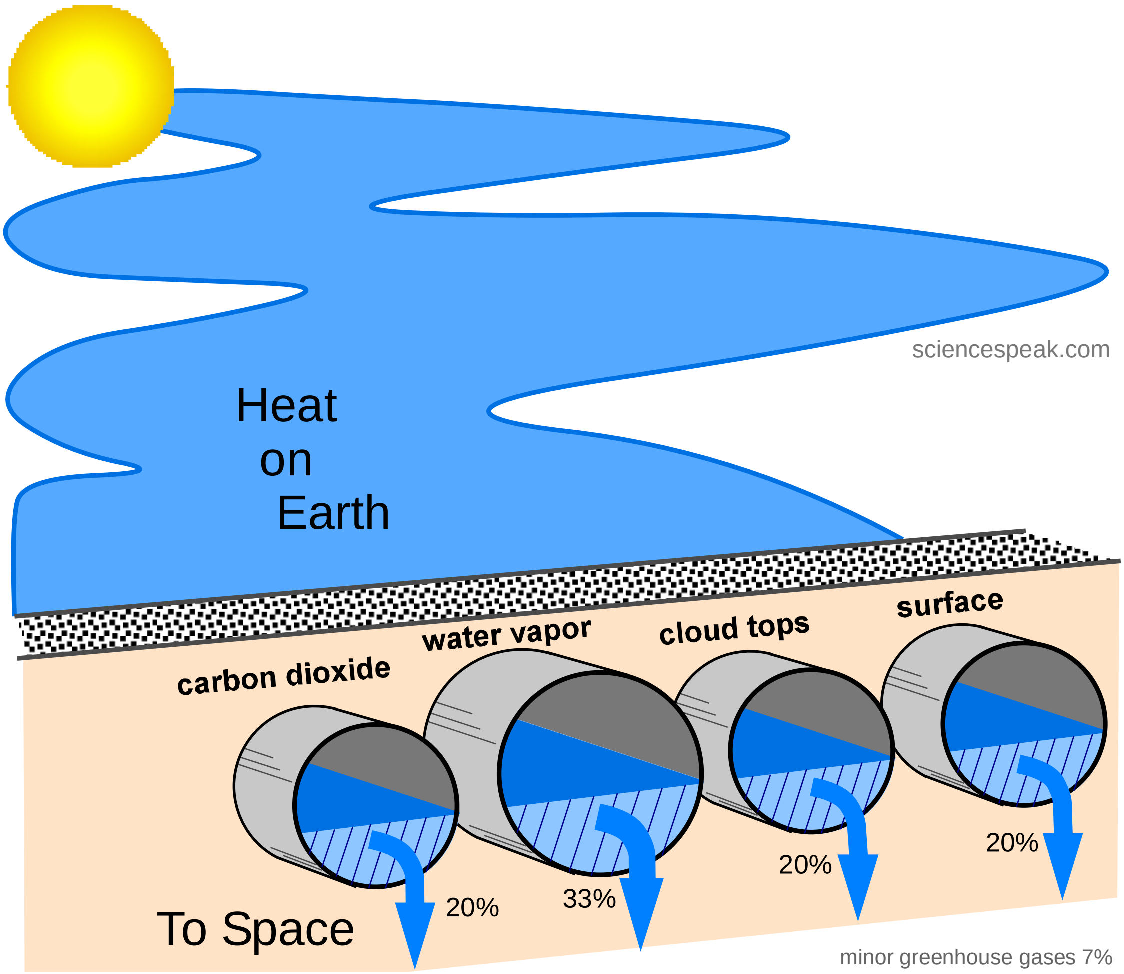
There is no empirical evidence that rising levels of carbon dioxide will raise the temperature of the Earth's surface as fast as the UN's Intergovernmental Panel on Climate Change (IPCC) predicts. The predictions are entirely based on calculations with models.

It's Like a Dam with Four Pipes

The architectural flaws in the basic climate model can be illustrated by a simple analogy.

The amount of heat on Earth is like the amount of water in a dam. There is only one inflow to the dam—a river of absorbed sunlight from the Sun (sunlight reflected by clouds and ice does not heat the Earth). Water flows out of the dam through four pipes, one for each of the main sources of emission of heat to space.

Importantly, the pipes are only partly full; they could carry more if the water level in the dam rose. When the dam is in its normal "steady state", neither filling nor emptying, the inflow from the Sun is equal to the outflow through all four pipes.



The carbon dioxide pipe carries heat emitted by carbon dioxide molecules, the water vapor pipe is for emissions from water vapor (water in gaseous form, or humidity), cloud tops also emit heat to space, and the surface pipe is for emissions to space directly from the surface (ocean and land) that are on wavelengths not absorbed by any gases in the atmosphere.

More Sunlight

If absorbed sunlight steps up to a new level, more water would flow into the dam, so the water level would rise. Soon the total outflow would match the new inflow (the new steady state) but there would be more water in the dam—so more heat on Earth.

Hotter objects emit more heat, and it's the same at the sources of emission for the pipes. More energy flowing to space through the surface pipe means more emissions to space from the surface. So the surface must be warmer, which means a higher "global temperature"—the average temperature of the air at the surface, where we live.

Water vapor is a greenhouse gas, meaning it absorbs and emits radiation at certain wavelengths. It envelops the Earth, but it is only the *top* of the water vapor that can emit to space—because upwards emissions by water vapor molecules beneath the top layer are absorbed by water vapor molecules higher up. Effectively, radiation to space by water vapor molecules only comes from the top layer of water vapor, called the water vapor emissions layer (WVEL, rhymes with "bevel"). The warmer the WVEL, the more radiation to space from water vapor molecules—the more energy flows out the water vapor pipe. Similarly for carbon dioxide, the next most important greenhouse gas.

Our analogy correctly tells us that when absorbed sunlight increases, the total radiation of heat to space increases by the same amount—but through which pipes exactly? This is pivotal—if all the extra heat went out the surface pipe then the surface would warm a lot, whereas if it all went out the water vapor pipe then the surface would not warm at all.

There is a crucial complication, known as water vapor amplification. A warming surface causes more evaporation from the oceans, which increases water vapor in the atmosphere, so the WVEL ascends. The atmosphere near the WVEL gets colder with altitude, so the ascending WVEL cools, so it emits less heat to space—so the water vapor pipe carries *less* heat, as if a partial blockage were impeding the flow. Therefore the other pipes must carry more heat than otherwise. Surface warming has little effect on the carbon dioxide emission layer (it is mostly in the stratosphere); the surface and cloud pipes are left to carry more heat. Therefore the surface must warm even more.

There are also other "feedbacks", changes caused by surface warming that cause the surface to further warm or cool, but water vapor amplification is the main one. Climate scientists currently reckon that all these feedbacks combined cause the surface to warm about 2.1 times more than if they didn't exist.

So, increased absorbed sunlight causes less heat to flow through the water vapor pipe, and a lot more through the surface pipe. The surface warms substantially, and the WVEL ascends.

More Carbon Dioxide

If the concentration of atmospheric carbon dioxide increases, things are quite different. This is like impeding the flow of heat to space through the carbon dioxide pipe with a partial blockage (or, to mix analogies, the carbon dioxide blanket thickens). The flow in the carbon dioxide pipe has declined by about 4% since 1750.

The input to the dam is unchanged, so the total outflow remains the same. So the effect of increasing carbon dioxide is to *redistribute* the heat radiating to space—less from carbon dioxide, more from the other pipes combined.

The basic climate model dates back to 1896, when climate data was sparse. People could estimate the response to increased sunlight almost entirely from lab-based data. But those lab-based principles could not be used to directly estimate what would happen if the radiation to space was merely redistributed.

So a fateful piece of reasoning was applied: *blocking an outflow from the dam was assumed equivalent to increasing the inflow by the same amount.* The amount of water in the dam would be the same in either case, so it appears logical.

So the basic climate model calculates the surface warming due to increased carbon dioxide as equal to *the surface warming due to increased absorbed sunlight*, where the increase in absorbed sunlight is the same as the reduction in emissions of heat to space by carbon dioxide.

It's effectively the same in the large computerized climate models—the GCMs. While the GCMs treat an increase in absorbed sunlight differently to an increase in carbon dioxide by taking more factors into account, the end results are similar. The GCMs apply mainly the same responses ("feedbacks") to extra carbon dioxide as to extra absorbed sunlight, and calculate a similar surface warming.

GCMs are a bottom-up model, trying to take everything into account, but they are tuned to reproduce the warming of the 1970s to 1990s—which is assumed to be entirely due to increasing carbon dioxide because the rate of warming calculated by the basic climate model roughly matches the observed rate in those decades, so ultimately the GCMs are tweaked to match the basic model.

So, as per the response to more sunlight, in the view of the basic model and the GCMs the surface warms substantially due to water vapor amplification, and the WVEL ascends.

But hang on! How can redistributing the outflow between the pipes be equivalent to adding more water into the dam? The amount of outflow is different!

More absorbed sunlight increases the heat radiated by Earth, but increased carbon dioxide does not (ignoring minor surface albedo feedbacks). Moreover extra sunlight mainly heats the surface, while extra carbon dioxide blocks some heat from being radiated to space from the upper atmosphere. They seem pretty different.

Generations of climate scientists have convinced themselves this logic is correct. What if they got it wrong?

The dam analogy instead suggests that if the carbon dioxide pipe is blocked a little then the water would just back up a fraction then flow out the other pipes. Let us suppose something like this happens.

Slightly more heat would flow through the water vapor pipe, so the WVEL would be warmer, which implies that the WVEL must descend to a warmer height. Slightly more heat would also flow through the surface pipe, so the surface would warm a little—and there would only be a little water vapor amplification, much less than in the response to increase sunlight. So the surface warming would be much less than predicted by the current climate models.

This way of looking at the climate problem is apparently novel. The rerouting feedback, in which the atmosphere responds to increasing carbon dioxide mainly by increasing the radiation to space from water vapor instead, is currently in a paper undergoing peer review.

The rerouting feedback cannot even exist in the conventional basic climate model because in that model a “feedback” can only be in response to surface warming—the rerouting feedback is in the blindspot of the conventional models.

Climate Data

So which is it? If the carbon dioxide concentration increases: does the surface warm a lot and the WVEL ascend, or does the surface warms a little and the WVEL descend? Let’s turn to the data.

We have more climate data than in 1896. Weather balloons are released from 900 locations around the world, twice a day. The balloons, over thirty million since the 1950s, ascend and measure temperature and humidity at each height. The weather balloon data, especially the more reliable data since 1973, shows that the atmosphere around the WVEL has not been warming and might have cooled a little, and has dried slightly as carbon dioxide has increased.

The WVEL’s average height is around 8 km, though at a given location it can move up and down a couple of kilometers over time. Beneath the WVEL the air is warmed by condensing water vapor, but above the WVEL is cooler and drier. The data is therefore only consistent with a descending WVEL.

The GCMs all predict a sharply ascending WVEL, which in their simulations creates the so-called “hotspot” as the WVEL moves up and warm humid air replaces cool dry air, especially over the tropics.

Establishment climate scientists are clearly concerned that the hotspot has not been found, and sometimes claim it can be seen in satellite data. However, the vertical resolution of satellites is poor—satellites aggregate information from several vertical kilometers into each data point.

Dr Roy Spencer, who pioneered microwave sounding for measuring atmospheric temperatures from satellites, and leads one of the two teams analyzing satellite temperatures for NASA, used a different mix of microwave channels to specifically look for the hotspot in May 2015. He concluded: “But I am increasingly convinced that the hotspot really has gone missing.”

Conclusions

In the last few decades there was surface warming yet the WVEL did not ascend, so the GCMs are wrong. The water vapor amplification, which accounts for more than half of the warming the GCMs predict from rising carbon dioxide, is not occurring. So the GCMs seriously overestimate warming due to carbon dioxide.

The last few decades has seen rising carbon dioxide and a descending WVEL. Therefore the response to carbon dioxide is for the surface to warm a little and the WVEL to descend, as suggested by the dam analogy, quite different to the response to more absorbed sunlight.

The conventional models seemed to work for temperature (though not the hotspot) when the world was warming in the 1970s to 1990s, but have failed since 1998 now that the world has almost stopped warming. A model that has the wrong architecture would act like this—correct sometimes by accident (especially if tuned to fit the data), but failing a lot of the time too. No amount of hammering on the current climate models can make them work all the time.

An alternative basic model has been developed that fixes the architectural errors in the conventional basic model. It allows for rerouting, and instead of applying the increased-sunlight response to the influence of carbon dioxide it applies a response specifically for carbon dioxide.

There is far more climate data available now than in 1896. When the alternative model is fitted with the data, it finds a much lower sensitivity to carbon dioxide—the UN's IPCC overestimated future warming by a factor of five to ten.

Conclusion

It appears that the alarm over carbon dioxide is rooted in a modeling error made long ago when climate data was scarce.

The error is to assume that blocking outgoing heat with increased carbon dioxide is equivalent to more incoming heat from sunlight. You don’t need a PhD in physics to know this doesn’t make much sense.

This modeling error went unnoticed for a hundred years presumably because people focused on the values of the parameter values in the model—such as how much heat is trapped by increasing carbon dioxide—rather than on how the model combines them to estimate future warming.