

CO₂ Trend for Mauna Loa - note the dip in 2008 when global temperatures plummeted, and the step again from 2009 into 2010 when an El Niño occurred

Breath of the Earth: Cycling carbon through terrestrial ecosystems

New data on photosynthesis and respiration will improve models, researchers say

Two recent international studies are poised to change the way scientists view the crucial relationship between Earth's climate and the carbon cycle. These reports explore the global photosynthesis and respiration rates – the planet's deep “breaths” of carbon dioxide, in and out – and researchers say that the new findings will be used to update and improve upon traditional models that couple together climate and carbon.

Christian Beer from the Max Planck Institute for Biogeochemistry in Jena, Germany, along with colleagues from 10 other countries around the world, first take a look at Earth's Gross Primary Production, or “GPP”, which represents the total amount of carbon dioxide that terrestrial plants breathe in through photosynthesis each year. With a novel combination of observations and

modeling, they estimate the total amount of carbon that the world's plant life inhales annual is 123 billion metric tons.

Then Miguel Mahecha, also from the Max Planck Institute for Biogeochemistry, and another international team of researchers settle a long-standing debate over the effects of short-term variations in air temperature on ecosystem respiration, or the Earth's exhalation of carbon dioxide back into the atmosphere. They show that the sensitivity of ecosystem respiration to short-term variations in temperature is similar around the world. The researchers also suggest that factors other than temperature, such as the slow, ongoing transformations of carbon in the soil and water availability, appear to play crucial roles in long-term ecosystem carbon balances.

Together, these findings shed more light on the global cycle of carbon into and out of the atmosphere and how those processes are coupled with Earth's ever-changing climate. The researchers analyzed vast amounts of climate and carbon data from around the world, and they say their results should help to improve the validity of predictive models and help resolve how climate change might affect the carbon cycle – and our world – in the future.

“An understanding of the factors that control the GPP of various terrestrial ecosystems is important because we humans make use of many ecosystem services, such as wood, fiber, and food,” said Beer. “Additionally, such an understanding is important in the context of climate change as a consequence of carbon dioxide emissions from burning fossil fuels because vegetation greatly modulates the land-atmosphere exchanges of greenhouse gases, water, and carbon dioxide...”

In their report, Beer and his colleagues pooled large amounts of data from FLUXNET, an international initiative established more than 10 years ago to monitor exchanges of carbon dioxide between Earth's ecosystems and the atmosphere, with remote sensing and climate data from around the world to calculate the spatial distribution of mean annual GPP between 1998 and 2006.

The researchers highlight the fact that uptake of carbon dioxide is most pronounced in the planet's tropical forests, which are responsible for a full 34 percent of the inhalation of carbon dioxide from the atmosphere. Savannas then account for 26 percent of the global uptake, although the researchers note that Savannas also occupy about twice as much service area as tropical forests.

Precipitation also plays a significant role in determining the gross global carbon dioxide uptake, the researchers found. They suggest that rainfall has a significant influence on the amount of carbon that plants utilize for photosynthesis on more than 40 percent of vegetated lands, a discovery that stresses the importance of water availability for food security. According to the study, climate models often show great variation, and some of them overestimate the influence of rainfall on global carbon dioxide uptake.

“We reached a milestone with this paper by using plenty of data from FLUXNET in addition to remote sensing and climate reanalysis,” Beer said. “With our estimation of global GPP, we can do two things – compare our results with (Earth System) process models and further analyze the correlation between GPP and climate.”

In the second study, Mahecha and his team of researchers also relied on the global collaboration within the FLUXNET network during their investigation of ecosystems' sensitivity to air temperature. Compiling and analyzing data from 60 different FLUXNET sites, these researchers

found that the respiratory sensitivity to temperature of the world's ecosystems, commonly revered to as Q10, is actually quite set in stone – and that the Q10 value is independent of the average local temperature and of the specific ecosystem conditions.

For years, experts have debated the effect that air temperature has on global respiration, or the collective metabolic processes of organisms that return carbon dioxide to the atmosphere from Earth's surface. Most empirical studies suggest that such ecosystem respiration around the world is highly sensitive to increasing temperatures, while the majority of predictive models suggest otherwise. Scientists say that global air temperatures may rise due to the presence of heat-trapping carbon dioxide from the burning of fossil fuels. But, this new result suggests that the temperature sensitivity of the natural exhalation of carbon dioxide from ecosystems has been overestimated and should be reevaluated.

This latest study, in settling the controversy, suggests that previous field studies failed to disentangle processes acting on different time-scales. Mahecha and his team considered the processes of the 60 different ecosystems on the exact same time-scale in order to nail the global mean Q10 down to a value of 1.4. Their new, standard value for various ecosystems' sensitivity to air temperature suggests a less pronounced short-term climate-carbon feedback compared to previous estimates.

“Our key finding is that the short-term temperature sensitivity of ecosystem respiration to air temperature is converging to a single, global value,” Mahecha said. “Contrary to previous studies, we show that the sensitivity of ecosystem respiration to temperature variations seems to be independent from external factors and constant across ecosystems. In other words, we found a general relationship between variation in temperature and ecosystem respiration... Our findings reconcile the apparent contradictions of modeling and field studies.”

In the future, these two separate studies should allow for more precise predictions of how Earth's warming climate will affect the exchange of carbon between our ecosystems and the atmosphere – and vice versa. They provide scientists with important tools for better understanding the world's ecosystems and how the human race continues to influence and alter them.

The two reports were published online by the journal SCIENCE at the SCIENCE Express Web site. – <http://www.sciencemag.org>.

Please see the Back up Materials and Methods at:

<http://www.sciencemag.org/cgi/data/science.1184984/DC1/1>

P Gosselin – NoTricksZone

Climate News from Germany in English

« [Max Planck Institute: Especially Alarmist Scenarios Are Unrealistic – Oops! German Newspaper Takes It Off Its Website!](#) »

[Max Planck Institute: It's Back To The Drawing Board For Climate Modellers. Alarmist Scenarios Unrealistic](#)



The Max Planck Institute in Jena, Germany has just put out a press release in English on a new study on the role of terrestrial ecosystems in the global carbon cycle: [A new balance for the global carbon balance](#). If anything, the report shows there remains lots of uncertainty in the science that many like to call “settled”.

In climate science the only certainty is uncertainty.

Well worth reading. Some of the main points, according to the authors:

1. In most ecosystems, the photosynthesis rate at which plants fix carbon dioxide from the atmosphere changes relatively little as the temperature varies.
2. The respiration of the ecosystems, when flora and fauna release carbon dioxide again, also increases to a lesser extent than has recently often been assumed when the temperature rises.
3. Moreover, this temperature dependence is the same all over the world – even in ecosystems as different as the tropical savannah and the Finnish needleleaf forest.
4. The climate is quite temperamental: countless factors are involved and many feedback mechanisms enhance effects such as the anthropogenic greenhouse effect. **This makes it difficult to make predictions, especially as many processes in the Earth system are still not completely understood.**
5. Results suggest that the availability of water, in particular, plays a decisive role for the carbon cycle in ecosystems. It is often more important than temperature.
6. **Particularly alarmist scenarios for the feedback between global warming and ecosystem respiration thus prove to be unrealistic.”**

7. The factor which determines the acceleration of the respiration thus obviously does not depend on the local temperature conditions and the specific characteristics of an ecosystem. “We were very surprised that different ecosystems react relatively uniformly to temperature variations.”

8. “It is still not possible to predict whether this attenuates the positive feedback between carbon dioxide concentration and temperature,” says Markus Reichstein. “The study shows very clearly that **we do not yet have a good understanding of the global material cycles and their importance for long-term developments.**”

9. “We were surprised to find that the primary production in the tropics is not so strongly dependent on the amount of rain,” says Markus Reichstein. “**Here, too, we therefore need to critically scrutinize the forecasts of some climate models which predict the Amazon will die as the world gets drier.**”

UPDATE: There's also some highly interesting background information here on Fluxnet.
<http://www.fluxdata.org/default.aspx>

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6 Comments on “Max Planck Institute: It's Back To The Drawing Board For Climate Modellers. Alarmist Scenarios Unrealistic”

1.  *GregO* Says:

[July 6, 2010 at 3:11 pm](#)

Excellent post and I can't help but wonder if after Climategate and the debacle at Copenhagen there was an organized counterattack from CAWG and now we are seeing the beginning of what could be called a strategic retreat.

Reply: Unlike the Potsdam Institute for Climate Impact Research (alarmists Schellnhuber & Rahmstorf), the Max Planck Institute is quite professional and put out world class scientific reports. Of course they'll throw in their endorsements of the AGW theory here and there to keep interest groups off their backs, but I can't say they're doing anything differently than before. – P Gosselin

[Reply](#)

2. [World Wide News Flash](#) Says:

[July 6, 2010 at 3:19 pm](#)

Max Planck Institute: It's Back To The Drawing Board For Climate

I found your entry interesting do I've added a Trackback to it on my weblog :)...

[Reply](#)

3.  *Brian H* Says:

[July 6, 2010 at 8:25 pm](#)

Here's my latest personal brilliant insight:

All IR intercepted by CO2 in the atmosphere is IR which otherwise would have reached the surface. The CO2 molecules heat up, and re-radiate. Most of that goes back outwards, into space.

Hence, the CO2 acts as a shield, shadowing the surface and hence has a net COOLING effect.

Q.E.D.


[Reply](#)

o  *Brian H* Says:

[July 6, 2010 at 8:28 pm](#)

Just to clarify one point, the re-radiation cools the CO2 molecule back down to where it was before, so there is no net warming of the atmosphere by the IR, except for that brief interval between absorption and re-radiation. Meanwhile, the surface has been deprived of that energy completely, and most of it never gets there.

[Reply](#)

4.  *Ed Caryl* Says:

[July 6, 2010 at 9:38 pm](#)

The reradiation is in all directions, up, down, and sideways, and is at a different wavelength. What does that do?

[Reply](#)

o  *Brian H* Says:

[July 6, 2010 at 11:40 pm](#)

Irrelevant. If the CO2 were absent, more IR would reach the surface, increasing heat and temperature. So the net effect of any GHG must ALWAYS be cooling.

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