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Drink that water!

"The international accounting firm Farther Slanderson today announced the discovery of 500 million tons of carbon. The element -- in the form of carbon dioxide -- was found emerging from rivers in South America's Amazon Basin. "We found the stuff bottled up in the waters of the Amazon River," said I. Shade Greene, head bean-counter at the venerable firm. "We had no way of knowing that climatologists around the world had been searching for this stuff. It just looked like a whiff of gas coming from swamps and rivers. Who knew it would unbalance their ledgerbooks?"

Coming on the heels of the Enron-Arthur Anderson debacle, the "discovery" raised new questions about the once-trusted accounting profession. And while no investors stand to lose gigabucks, and nobody is being accused of erasing hard drives, the news will not make life easier for the quarrelsome crew who keep the balance-books on Earth's climate."

(Okay, we admit it: Greene and the whole Farther Slanderson shtick is a concoction of febrile-brained Why Filers. Still, the search for missing carbon is a key to resolving the debate over global warming caused by carbon dioxide and other greenhouse gases.)

Mighty strange fish! These guys are angling for data on the global carbon cycle. That circular gizmo isn't designed to keep beer cold, but rather to capture carbon dioxide leaving river water. But we do wonder what's in that cooler... Courtesy University of Washington.

Exactly how much of the greenhouse gas carbon dioxide is siphoned from the atmosphere each year by various biological and geological processes? Unlike the value of Enron stock, this carbon does not vaporize. Instead, it sloshes around the planet in the so-called carbon cycle.

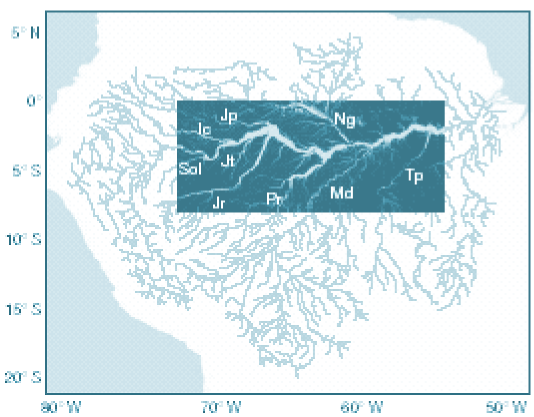
Eventually, carbon is returned to the atmosphere, which contains roughly 750 gigatons (billion tons) of the stuff, in the form of carbon dioxide. But the delay time can be weeks (about as long as it took Enron to crash and burn) -- or millions of years.

About 5 gigatons of carbon enters the atmosphere each year from burning fossil fuels, deforestation and other human causes. Some of that is incorporated into vegetation, dissolved in the ocean, or solidified into sedimentary rock. A key question is how long the carbon stays bound up before returning to the atmosphere.

Budgetary imbalance

In recent years, some scientists have argued that large amounts of carbon dioxide get trapped in vegetation, especially wood. They looked at forests -- both temperate and tropical -- as one of the biggest so-called "sinks."

But the world is a big place, and there are plenty of questions about how much carbon should actually be listed on the account books of Earth's various habitats. To document the movement of carbon dioxide, Jeffrey Richey, a professor of oceanography at the University of Washington, and colleagues took 1,800 samples in the Central Amazon basin, a huge potential sink for atmospheric carbon.



Richey and colleagues worked in this oft-flooded section of the central Amazon basin. Courtesy Jeffrey Richey.

To assess carbon-dioxide outgassing from the many rivers and wetlands in the Amazon heartland, the researchers trapped gas in floating shelters. They also measured the partial pressure of carbon dioxide in air and water. The so-called "gas laws" (written when accountants were still counting on their fingers, for all we know) tell us that partial pressures determines the movement of gases between adjacent fluids. Gases flow from fluids with higher partial pressures to fluids with lower partial pressures.

Because the partial pressure of carbon dioxide in Amazonian surface waters often exceeds its pressure in the air, the gas is forced from the water.

But none of these measurements would have been worth much without data from the Japanese Earth Resources Satellite. The high-performance radar on JERS allowed estimates of the area of various types of habitat in the oft-flooded region.

Different habitats, after all, can be expected to emit different levels of carbon dioxide.

When the researchers crunched the numbers, they discovered that about half a billion tons of carbon, in the form of carbon dioxide, was emerging from the rivers and wetlands. Globally, the humid tropics would be contributing 900 million tons, the authors wrote.

The most likely source of the carbon, says Richey, is upland vegetation that was washed into the rivers and is decomposing on its way downstream.

Budgetary blues

The new finding conflicts with studies that, based on carbon dioxide measurements in air above tropical forests, indicated that trees were storing a great deal of carbon. But, as Richey notes, that conclusion meant the trees would have to grow awfully fast. "The argument that the humid tropics were going to be a big sink meant that the trees were doubling in biomass every few decades," he says. "That's not possible."

Carbon Assets

RESERVOIR	SIZE (billion tons of carbon)
Atmosphere	750
Forests	610
Soils	1580
Surface ocean	1020
Deep ocean	38,100
FOSSIL FUELS:	
Coal	4,000
Oil	500
Natural gas	500
TOTAL FOSSIL FUEL	5,000

Data from James Kasting

The finding also alters the global "carbon budget," an assessment of how the element is moving around the Earth. The atmospheric section of this abacus-level accounting says simply:

Carbon in - carbon out = change in carbon content

If Richey's measurements hold water, the Amazon, far from being a huge carbon sink, actually has a neutral carbon budget.

That change helps balance the global carbon budget, which had previously been looking almost as screwy as Enron's accounting books.

One last item on the positive side of the ledger: Climatology and carbon budgeting may be confusing, but at least nobody has shredded the files...

-- David Tenenbaum

BIBLIOGRAPHY

Outgassing from Amazonian Rivers and Wetlands... Jeffrey Richey et al, Nature, 11 April 2002, pp. 617-20; see also commentary, pp. 594-5.

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