Carbon Dioxide: Where Does It All Go?

Scientists studying carbon dioxide have run into an arithmetic problem. A research team reports that the world's oceans do not absorb nearly as much of this greenhouse gas each year as previous work has suggested. Though they can't agree on whether to call it good or bad news, experts say it points out an unnerving ignorance about carbon dioxide.

"We've been overconfident for a long time about our knowledge of the carbon cycle. We've held on to the idea that the oceans were absorbing roughly 40 percent of the [carbon dioxide from] fossil-fuel combustion. Now we really think that's wrong," says Pieter P. Tans, an atmospheric scientist with the National Oceanic and Atmospheric Administration in Boulder, Colo.

The burning of coal, oil and natural gas each year spews about 5.3 billion tons of carbon into the atmosphere in the form of carbon dioxide. Because oceans and land can absorb only a fraction of the gas, 3.3 billion tons a year go into the air, causing the carbon dioxide buildup that has concerned the world. Of all the "sinks" that pull carbon dioxide from the atmosphere, scientists assume that oceans — particularly in the Southern Hemisphere — do most of the work.

But computer simulations and actual measurements dispute this assumption, says Tans, who worked with Inez Y. Fung from NASA's Goddard Institute for Space Studies in New York City and with oceanographer Taro Takahashi of the Lamont-Doherty Geological Observatory in Palisades, N.Y. Fung described their work earlier this month in Toronto at a meeting of the American Institute of Biological Sciences.

About 96 percent of the carbon dioxide from fossil-fuel combustion enters the atmosphere in the Northern Hemisphere. Although winds blow the gas around the world, measurements show that North Pole air contains 3 parts per million (ppm) more carbon dioxide than South Pole air, Fung says. This number plays a key role in the new study.

Using an atmospheric general circulation model, Fung and her colleagues examined carbon dioxide's movement around the globe after its release during fossil-fuel combustion. By adding and subtracting various processes, they tested parts of the carbon cycle.

When they "turned off" the oceans and all other sinks for carbon dioxide, the computer atmosphere generated a north-south gradient of 4.4 ppm. With an ocean sink, working mostly in the south, the gradient increased — a result farther from the real value of 3 ppm. Fung says the simulations indicate the southern ocean cannot possibly account for most of the carbon dioxide absorbed worldwide. Only when the largest sink resides in the Northern Hemisphere does her model match real-world measurements.

Measurements show the northern oceans don't pull in much carbon dioxide, leading the researchers to suggest that land areas in the northern midlatitudes must absorb a staggering amount, between 1 billion and 2.5 billion tons of carbon a year.

If this is true, scientists face a grand mystery. Nobody knows what on land could store all that carbon, says ecologist Richard A. Houghton of the Woods Hole (Mass.) Research Center. Trees or soil might be doing the job, but Houghton and others say researchers should have noticed such conspicuous storage by now.

Lamont-Doherty's Wallace S. Broecker speculates that the finding may be good news. If soils currently absorb much of the carbon dioxide from fossil-fuel combustion, he says, policymakers might consider using this natural process to reduce the greenhouse threat.

Takahashi sees it differently. "If what we're saying is true," he says, "it's more bleak than we used to think." He and others believe land areas cannot store as much carbon dioxide as the oceans, and may reach capacity in the foreseeable future. At that point, carbon dioxide would accumulate much more rapidly in the atmosphere, accelerating a greenhouse warming. — *R. Monastersky*

Demonstrating the disability of depression

Depression — or even a few symptoms of depression that do not rate a psychiatric diagnosis — physically disables some people just as badly as high blood pressure, diabetes, arthritis and many other ailments treated by primary care physicians, according to preliminary results of a long-term study.

"Depression may be more like major medical conditions in its disabling effects than has previously been appreciated," says psychiatrist Kenneth B. Wells of the University of California, Los Angeles, who directed the study.

Many psychiatrists and psychologists have long recognized that depression can physically disable their patients, "but this is the first study to clearly demonstrate this scientifically," comments psychiatrist Martin B. Keller of Harvard Medical School in Boston.

Primary care physicians provide most mental health care, and studies indicate they often misdiagnose depression and its symptoms.

The new study, described in the Aug. 18 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, is based on data from 11,242 medical outpatients being treated in Boston, Chicago and Los Angeles. During office visits in 1986, patients filled out a questionnaire developed by the researchers, which asks about physical, social and work-related functioning as well as perceptions of current health and well-being.

About half the people in the sample had depressive symptoms, full-fledged depression or one of eight chronic medical conditions: high blood pressure, diabetes, advanced coronary artery disease, chest pain due to angina, arthritis, back ailments, lung problems or a gastrointestinal disorder. Researchers telephone-interviewed more than half the 2,467 patients with depression or some of its symptoms.

Depressive symptoms include feeling down in the dumps, having crying spells or expressing intense guilt. Depressive disorder involves a number of symptoms associated with recurring sadness and loss of interest or pleasure in all activities for at least two weeks.

Compared with patients suffering depression or depressive symptoms, only patients with angina or coronary artery disease were more limited in routine daily activities, such as climbing stairs, walking, dressing and going to work. In addition, only arthritis patients reported more bodily pain than the depressed group, and only coronary artery disease patients reported more days in bed.

Day-to-day functioning proved most disturbed among patients with both depressive symptoms and a chronic medical condition, the researchers say.

Somewhat surprising, Keller notes, is the researchers' conclusion that people with depressive symptoms function nearly as poorly as those with depressive disorder. The significance of depressive symptoms will not emerge without a long-term study, he says. Wells and his coworkers are completing a two-year follow-up of all subjects.

In a five-year study in Boston and Chicago, Keller is using the same questionnaire to measure general functioning and well-being among patients with anxiety disorders. Since symptoms of anxiety often accompany depression, Keller says, future research must examine the functioning of depressed patients with and without anxiety. — *B. Bower*