

SCIENCE NEWS of the week

Biomass Burning Ignites Concern

Burning practices around the world pollute the atmosphere far more than scientists had assumed, leaving once-pristine tropical regions bathed in high levels of harmful ozone and acid precipitation, researchers reported last week in Williamsburg, Va., at the first international conference to address the issue of biomass burning.

Scientists once viewed air pollution as a problem primarily of smokestacks and tailpipes, but a growing body of evidence shows that intentionally lit fires over the globe also contribute significantly to pollution levels and could play a major role in changing Earth's climate. "[Fires related to] agricultural practices and land-

use conversion have a very large impact on the overall chemistry of the atmosphere. That is something that has come as a surprise," says Paul J. Crutzen, an atmospheric chemist from the Max Planck Institute for Chemistry in Mainz, West Germany.

Fires cover about 2 to 5 percent of the Earth's land areas each year, and scientists at the conference estimate that humans light more than 95 percent of them, says Joel Levine of the NASA Langley Research Center in Hampton, Va., who organized the meeting. The fires burn primarily in tall-grass savannas, in tropical rain forests and on farms around the world.

Concern over the effects of biomass burning has grown since the late 1970s, when Crutzen first alerted scientists to the widespread emission of gaseous pollutants from fires. In the last few years, researchers have carried out studies in Africa, South America, the United States and elsewhere to measure how biomass burning affects the local and global environment.

Among the results reported at the meeting:

- Levels of ozone in the troposphere (lower atmosphere) over certain regions of tropical Africa are approaching values shown to be toxic to plants, says Meinrat Andreae of the Max Planck Institute. Tropospheric ozone, which irritates the eyes and lungs as well as harms vegetation, forms when sunlight energizes chemical reactions between nitric oxide, hydrocarbons and carbon monoxide — three kinds of chemicals emitted during combustion. It also adds to the greenhouse effect.

In field experiments in the Congo, researchers from Germany, France and the Congo measured monthly average ozone levels as high as 40 parts per billion at ground level and 100 parts per billion in air during the dry season, when fires are worst.

The ground measurements verify satellite data collected over the past few years, which suggest that levels of tropospheric ozone over a wide region of the tropics are much higher than researchers believed. Without confirmation from ground-based studies, many scientists questioned the high values measured by satellite.

The satellite data indicate that ozone over broad regions of unindustrialized West Africa reaches levels comparable to those over the heavily industrialized eastern United States, says Jack Fishman of NASA Langley. Satellite measurements also show high ozone levels over Indonesia and South America, particularly Brazil. Moreover, Fishman reports, aircraft and satellite data collected last year suggest that ozone from fires in Africa travels clear across the Atlantic and can be measured in easternmost Brazil.

- Measurements taken over the last several years in the Ivory Coast and Congo reveal unexpectedly high acidity in the rainwater. "Our data show that acidity fluxes in regions of the tropics are of the same order of magnitude certainly as those we get in the eastern United States," says Andreae. Other researchers have found high acidity levels in rain falling over the Amazon.

Much of the acidity comes from gases emitted by fires, says Levine. Combustion

Vibration imaging: Sounding out tumors

Two researchers are tooting their own horn to detect cancerous tumors. The new technique, called doppler vibration imaging, is the first to use a horn's low-frequency sound waves to create vibrations that distinguish between hard and soft tissues, they say. Malignant tumors are more rigid and vibrate less rapidly than surrounding healthy tissues, offering a potentially useful diagnostic clue.

Tumors embedded in soft tissues such as the prostate, breast, liver and spleen often escape early detection because they can't be seen or felt, says Kevin J. Parker, who developed the imaging technique with Robert M. Lerner. The two University of Rochester scientists describe their work in the April *ULTRASOUND IN MEDICINE AND BIOLOGY*.

Like conventional ultrasound, doppler vibration uses sound waves to image targeted tissues in the body. Ultrasound, however, bombards tissues with inaudible sound waves at more than 20,000 hertz, and the echoes returning from tumors and healthy tissues can be identical, leaving the tumor undetected, Lerner says. Doppler vibration instead uses a speaker-like horn to generate whisper-soft sound waves at 200 hertz. A doppler device detects the resulting tissue motion, and



Left: Conventional ultrasound image of a human malignant prostate tumor shows a faint impression of a possible tumor that would warrant a biopsy to determine whether it is malignant. Right: The same tumor imaged with doppler vibration reveals distinct differences between the stiff malignancy and the surrounding healthy tissues. The tumor appears dark, while the softer, healthy tissues show up in red.

a video screen displays a color "map" of the contrasting vibrational patterns.

Using the new method in rabbit livers and in human prostate and breast samples, the Rochester researchers say they have detected cancerous tumors that conventional ultrasound missed. They plan to conduct clinical trials and compare the method's sensitivity to that of other imaging systems in about a year. Lerner says the technique, if successful, would be much more affordable and more widely available than the magnetic resonance imaging sometimes used to detect prostate tumors or the CT scans often used to detect tumors in the liver and spleen.

"I'm convinced the principle [of the technique] works," says Daniel Rachlin of Stanford University, who has used doppler vibration imaging with synthetic tumor models. But the real test, he says, will come when researchers compare it with other imaging methods.

— C. Decker

Parker, Lerner

of vegetation produces nitric oxide and other gases that get converted in the atmosphere into nitric acid and organic acids. Crutzen adds that researchers don't really know how the acidic precipitation and high ozone levels affect tropical ecosystems. Future research must address this question, he says.

Levine says scientists expect pollution from fires in tropical regions to worsen as the rapidly growing population places greater stress on the surrounding environment.

- New studies highlight the importance of carbon monoxide emissions from fires. Carbon monoxide tends to lower the concentration of hydroxyl radicals, so-called "detergent" molecules that clean the atmosphere by reacting with pollutants. The reduction in hydroxyl concentrations also contributes indirectly to the greenhouse effect by lengthening the tropospheric life spans of ozone and methane, another greenhouse gas.

From test fires, Crutzen estimates that biomass burning contributes about half the carbon monoxide present in the atmosphere; other recent studies suggest it contributes about one-fourth the carbon monoxide. Scientists have estimated that the carbon monoxide level itself has been growing at about 1 percent per year.

- Until the past few years, researchers studying biomass burning focused on fires associated with the clearing of tropical rain forests. But recent findings have revealed the importance of two other practices that appear to burn as much material as land-clearing fires: the worldwide burning of agricultural waste left over after harvest, and the annual burning of grasslands in Africa, South America, Australia and elsewhere to improve grazing.

Scientists at the meeting also discussed the importance of cooking/heating fires in heavily populated regions of Asia, and a huge boreal forest fire in 1987 in China and the Soviet Union. Satellite measurements indicate the 1987 blaze may have been the single largest fire in the last 500 to 1,000 years, says Levine.

As a result of the recent findings, researchers have boosted their estimates of the amount of biomass burned by fires each year. Only a few years ago, Crutzen says, experts thought biomass fires burned about 2.5 billion tons of carbon annually; now they are speaking in a range of 3 billion to 4 billion tons each year.

Using current estimates of biomass burning, two research groups calculate that fires and the process of deforestation contribute about 15 percent of the warming expected from the buildup in greenhouse gases. This means policies attempting to slow global warming will have to limit biomass burning, insists Daniel Lashof of the Natural Resources Defense Council in Washington, D.C.

— R. Monastersky

Satellites find no global warming in 1980s

Satellite measurements indicate Earth's lower atmosphere has not warmed over the last decade. But because these data span such a short period, they cannot settle the question of whether increasing levels of greenhouse gases have started to raise global temperatures.

"I certainly wouldn't say we've proven there isn't a global warming [underway]," says Roy W. Spencer of NASA's Marshall Space Flight Center in Huntsville, Ala., who analyzed the atmospheric measurements with John R. Christy of the University of Alabama in Huntsville.

The satellite instruments measure the temperature of the atmosphere's lower 10 kilometers by absorbing microwave radiation emitted by oxygen molecules. Between 1979 and 1988, the instruments recorded strong upswings and downswings in average global temperature, each lasting several months, but showed no general warming trend, the researchers report in the March 30 *SCIENCE*.

Concern over global warming stems in part from measurements taken at land stations and on ships, which indicate Earth's average surface temperature has risen by 0.5° since the late 1800s. The surface record differs slightly from the satellite data, showing a subtle rise since 1979. However, most of the surface warm-

ing occurred before 1979.

The surface record has come under fire in recent years from critics who contend that it fails to represent true global temperatures for two important reasons: The network does not sufficiently cover vast regions of the remote oceans, and urban heat from developing cities may artificially boost temperatures at land stations.

In contrast, the satellite sensors survey the entire lower atmosphere, and city warmth does not skew their readings. The sensors thus provide a powerful tool for monitoring future global temperatures, and could detect a global warming sooner than surface measurements, Spencer and Christy say. They plan to use satellite measurements to test the reliability of computer climate models that predict a 1.5°C to 4.5°C warming by the middle of the next century.

Spencer says the disagreement between satellite and surface data for the 1980s does not necessarily mean one source is wrong. Satellite measurements encompass a thick region of the lower atmosphere, he explains, and over a time span as brief as a decade, Earth's surface and its lower atmosphere might follow different temperature trends.

— R. Monastersky

'Vaccine' spurs immune attack on melanoma

Researchers this week reported some "dramatic" improvements among patients with widespread melanoma who received vaccination-like injections to spur the immune system to attack this particularly lethal form of skin cancer.

Malcolm S. Mitchell and his colleagues at the University of Southern California at Los Angeles formulated the experimental treatment using cultured, fragmented human melanoma cells. While it cannot prevent cancer, they say the vaccine seems to prod the immune system's killer T-cells to destroy existing tumors. Preliminary tests in 12 people had suggested the vaccine slowed melanoma progression (SN: 10/24/87, p.267).

Now Mitchell reports some striking results among a group of 79 people whose melanoma had spread beyond the initial skin site to distant body parts, although the primary skin tumors had been surgically removed. Each participant received weekly injections for four weeks, followed by another injection in the sixth week and monthly booster shots for those showing a treatment response.

The researchers found that 18 of the 79 patients (23 percent) had tumors that shrank to half their original size or completely vanished for at least a month. Five of the 18 survived two years or more, with one patient still living nearly four years

after treatment.

Mitchell, who described the new results at an American Cancer Society science writers' seminar in Daytona Beach, Fla., says this is a significant survival advantage; most people with widely disseminated melanoma who receive conventional treatment die within a year after doctors detect tumor spread. Only 30 to 40 percent of melanoma patients benefit from standard chemotherapy, and among these the reprieve is often brief, adds John Laszlo of the American Cancer Society. In all, melanoma kills about 6,300 people in the United States each year.

Mitchell says the experimental vaccine caused swelling at the injection site but no other adverse reactions. In contrast, he notes, standard chemotherapy often causes severe side effects.

One unexpected result of Mitchell's trial: An 83-year-old man with melanoma in the skin lining the back of the eye showed "remarkable" tumor shrinkage and vision improvement. Such tumors usually grow inexorably and resist chemotherapy, leaving surgical removal of the eye as the only remedy, Mitchell says. He and his colleagues now plan to give the vaccine to 30 people with melanoma of the eye to see whether it can halt tumor growth and preserve eyesight.

— K.A. Fackelmann