Environment

Janet Raloff reports from Toronto at the annual meeting of the American Institute of Biological Sciences

Peatlands: A global warming threat?

For millennia, peatlands have captured and stored carbon, preventing its atmospheric dissipation as carbon dioxide, a potent greenhouse gas. But a new study indicates some of these soggy carbon-storage depots may be changing from carbon "sinks" to significant carbon dioxide emitters — an unexpected and potentially alarming transformation.

Methane-producing bacteria, or methanogens, are among the plant-decay microbes that ordinarily thrive at peaty sites. But where sulfate levels are high, aggressive sulfate-reducing bacteria (SRBs) tend to move in, starving methanogens out. At least that's the conventional wisdom. But the situation can play itself out quite differently, according to a year-long study by Joseph B. Yavitt of Cornell University in Ithaca, N.Y., and R. Kelman Wieder of Villanova (Pa.) University.

SRBs and methanogens coexist at West Virginia's Big Run Bog, they found. Previously, "microbiologists would have laughed at this assertion and called it impossible," says Yavitt. Moreover, while the bog's sulfate levels are only about one-thousandth those in marine sediments, its SRBs produce unexpectedly copious amounts of carbon dioxide — comparable to rates for oceanic SRBs, he says. Finally, Yavitt says his preliminary study of the bog's carbon budget — what goes in and comes out — quite unexpectedly showed that "more carbon is being lost as greenhouse gases than is stored by plants."

Methanogens produce two greenhouse gases — methane and carbon dioxide. Yavitt and Wieder found Big Run Bog's SRBs 50 percent more efficient than methanogens at producing carbon-based greenhouse gases. And by coexisting in this ecosystem, Yavitt says, these two microbe types more than double the bog's greenhouse-gas output over expected levels.

These data suggest sulfate deposition by acid rain at presently pristine peatlands will lure SRBs to more wetlands, converting them from carbon sequesterers to potent carbon dioxide sources, Yavitt says. And with peatlands estimated to hold some 15 to 20 percent of land-stored carbon, their emissions might significantly exacerbate climate change, he notes. Finally, Yavitt points out that carbon dioxide production at peatlands can be expected to climb even more if climate warming contributes to their drying and colonization by oxygen-using microbes, which decompose carbon-based plant debris more efficiently than do anaerobes such as methanogens and SRBs.

Carbon dioxide may spur plant predation

Plants grow faster in air containing double today's carbon-dioxide levels — an atmospheric increase expected within the next century. However, this "carbon dioxide fertilization" results in more carbohydrate-based tissue and less protein in the plant — a condition expected to limit insect growth and perhaps vitality. Three studies now confirm adverse effects in insects eating plants grown at doubled levels of carbon dioxide.

Buckeye-butterfly larvae dining on such plants ate about 15 percent more than their counterparts eating plants grown at today's carbon dioxide levels, took 10 percent longer to reach pupation and were visibly weaker, report ecologist Eric Fajer and his co-workers at Harvard University.

David E. Lincoln at the University of South Carolina at Columbia found that cabbage-butterfly larvae dining on plants grown at double the ambient carbon dioxide level needed 43 percent more food to maintain the same growth as larvae eating plants raised at current levels. And he found that sagebrush-eating grasshoppers needed 36 to 58 percent more food if dining on plants raised at high carbon dioxide levels.

It remains unclear, Lincoln says, whether a plant's increased growth under carbon-dioxide-rich conditions would compensate for this greater predation.

Space Sciences

The shocking surface of Io

Jupiter's moon Io, the only known volcanically active body in the solar system besides the Earth, may also give off sparks, two space scientists suggest.

Ions and electrons trapped on the lines of Earth's magnetic field have often affected the operations of artificial satellites orbiting the planet. These electric charges have caused communications problems and other difficulties with the satellites by triggering discharges from such components as circuit boards and solar panels. Even greater effects occur in the strong magnetic fields of the solar system's giant outer planets. While Pioneers 10 and 11 and Voyagers 1 and 2 were in the powerful field of Jupiter, for example, their electronic circuits produced some incorrect photo details and their computer memories suffered altered settings.

The unusual appearance of Io's surface, rich in sulfur and sulfurous compounds, has fascinated researchers for a decade. Humberto Campins, now at the University of Florida in Gainesville, and E. Philip Krider of the University of Arizona in Tucson have simulated the effects of Jupiter's magnetic field on Io by bombarding a cylindrical sample of sulfur 6 centimeters in diameter and 4 cm high with an electron beam in a vacuum chamber at SRI International in Menlo Park, Calif. They varied the beam's intensity, whose weakest level they describe in the Aug. 11 SCIENCE as "comparable to that expected on the surface of Io," about 10 billion particles per second.

The scientists used an electric-field antenna to monitor bursts of electromagnetic radiation from the sample, such as might accompany sparks or lightning. They conducted the tests in the dark so they could see any such discharges. The observed discharges varied from event to event: Sometimes they lit up the sulfur's entire surface (at times even after the beam was turned off); on other occasions they formed branching "dendritic" patterns resembling terrestrial lightning.

The project continues, but Campins and Krider report they already have "evidence that discharge phenomena do occur on natural sulfur under conditions similar to those expected on the surface of Io." On Io itself, the scientists say, the sparks would probably be most numerous and intense at night, because the lower temperatures would lower the sulfur's electrical conductivity and enable stronger charges to build up. Their likeliest location would presumably be near Io's equator, where the concentration of electrons coming in along Jupiter's magnetic field lines would be greatest.

The discharges would be far too weak to detect from Earth, either in photos or by their static-like radio noise, though they may be visible to the Galileo spacecraft, due for launch toward Jupiter this October and scheduled to go into orbit around the planet in 1995 to study it and its moons.

Campins and Krider suggest similarly produced sparks may occur on the surface of Earth's moon when the moon is going through the tail of Earth's magnetic field. Other candidates include some asteroids and inactive comet nuclei (in both cases during strong solar flares), and perhaps even the dust shells around young stars when the dust is exposed to outpourings of highly ionized gas from the star at the center.

The biggest list of stars

At the Baltimore-based Space Telescope Science Institute, which will serve as the operations center for the Hubble Space Telescope, officials have announced completion of "the largest sky survey in the history of astronomy." Nearly 60 times larger than any previous such inventory, the catalog contains data about the positions and magnitudes of 18,819,291 celestial objects. The list will aid astronomers using ground-based telescopes and the Space Telescope, now scheduled to enter orbit around Earth next March.