Radical News About SSTs and Ozone

Since the late 1960s, atmospheric scientists have expressed concern about the threat that large fleets of supersonic transport (SST) planes might pose to life on this planet. Ozone in the upper atmosphere keeps much of the sun's biologically harmful ultraviolet radiation from reaching Earth's surface. But the nitrogen oxides (NO_x) and water vapor in the engine exhaust of an SST were expected to foster the destruction of significant amounts of ozone — leading to crop damage, increased numbers of human skin cancers, and more.

New data collected by a high-flying NASA aircraft during the Stratospheric Photochemistry, Aerosols, and Dynamics Expedition (SPADE) in May 1993 now suggest something quite different — at least in the lower stratosphere. SPADE's findings, published in the Oct. 21 SCIENCE, indicate that small increases in NO_x will actually slow ozone destruction in the lower stratosphere — around 20 kilometers, where SSTs fly.

Aircraft makers should not interpret the new data as justification for retooling their assembly lines to manufacture SSTs, says Paul O. Wennberg of Harvard University, the study's lead author. SSTs' emissions can move to higher altitudes, where NO_x are more efficient catalysts of ozone destruction.

Rather, Wennberg argues, the new data reinforce concern over the ozone-destroying power that halogenated pollutants — such as chlorofluorocarbons — wield throughout the stratosphere, and why public policies should continue to focus on limiting their release.

Three families of radicals — highly reactive chemical gases — foster a breakdown of ozone in the stratosphere. Which family dominates — hydrogen (HO_x), nitrogen (NO_x), or the halogens chlorine and bromine — can vary with such factors as altitude, latitude, and season.

Because there were few measurements of NO_x in the lower stratosphere until fairly recently, studies of their role and how it might change with heavy SST traffic had to rely on computer modeling. Most models in the 1970s and 1980s, Wennberg notes, indicated that NO_x would prove responsible for over 50 percent of any ozone losses there.

Then came the June 1991 eruption of Mt. Pinatubo in the Philippines. The huge quantities of sulfates injected into the stratosphere by the volcano were converted into long-lived microscopic droplets, or aerosols, of sulfuric acid. Atmospheric scientists observed a large reduction in NO_x, along with a more than tenfold increase in aerosols. This demonstrated that chemical reactions occurring on the surfaces of aerosols affect NO_x concentrations.

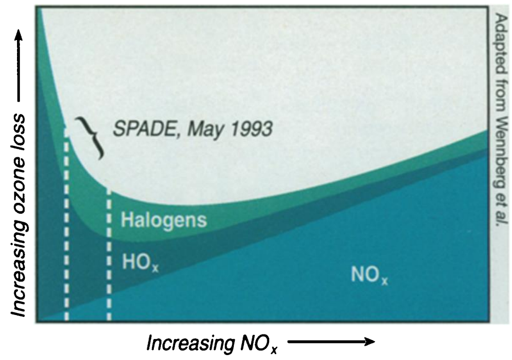
When ozone modelers incorporated these reactions, they immediately saw that "this aerosol loading will diminish the impact of the nitrogen [radicals]" in the destruction of lower stratosphere ozone, notes Debra Weisenstein of Atmospheric and Environmental Research in Cambridge, Mass. Wennberg's new measurements confirm that prediction, she notes.

SPADE's data show that Pinatubo aerosols lowered normal amounts of NO_x. As these fell, concentrations of the other two classes of radicals — and ozone loss — increased. Indeed, notes F. Sherwood Rowland of the University of California, Irvine, a similar depletion of NO_x in the stratosphere over Antarctica during the austral spring contributes to the efficiency with which chlorine radicals form and foster an ozone hole there.

Other aircraft-sampling data had hinted at "this inverse dependence of ozone loss on NO_x," says Randy Kawa of NASA's Goddard Space Flight Center in Greenbelt, Md. "But," he adds, "I don't think anybody has ever pointed it out as neatly and concisely as Wennberg."

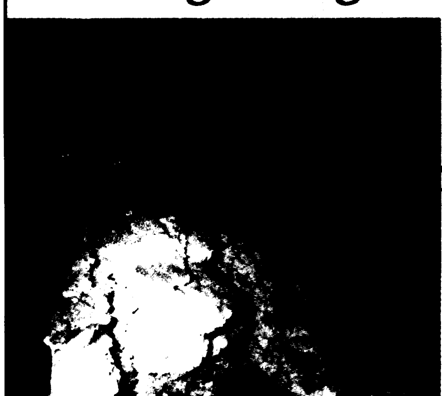
Still unknown, Rowland and the others note, is how an increase of NO_x, from SST traffic, for example, will affect ozone globally. Knowing that will take far more modeling and sampling — at higher altitudes and in skies freer of aerosols.

— J. Raloff

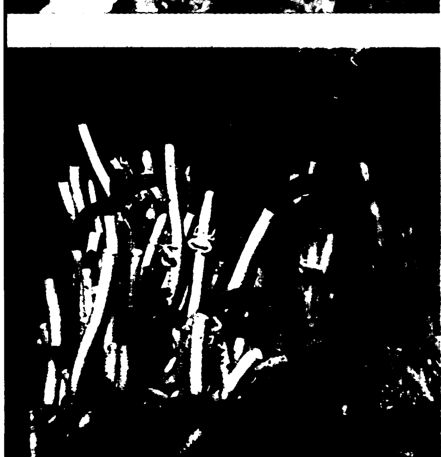


SPADE data (between white dashes) suggest that as NO_x concentrations fall in the lower stratosphere, rates of ozone loss increase — driven by increases in the concentrations of halogen radicals and HO_x. Projections appear to left and right of SPADE data.

Fastest (growing) worms in the world



Woods Hole Oceanographic Institution



Al Giddings

In 1991, researchers in the undersea vessel* Alvin *came upon a barren patch of seafloor 2,500 meters down (top). Recent lava flows had destroyed almost all life along this 2.5 mile stretch of the East Pacific Rise, off southern Mexico. Yet a "snowstorm" of white bacteria had already blanketed the gray lava, recalls Richard A. Lutz, a biological oceanographer at Rutgers University in New Brunswick, N.J.

By 1993, the drifting larvae of giant tube worms had settled there — along with fish and other organisms — and grown 4 feet tall (bottom), Lutz and his colleagues report in the Oct. 20* NATURE *and the November* NATIONAL GEOGRAPHIC. *"That's the fastest growth of any marine invertebrate that we have ever seen," Lutz says.

These organisms thrive near hydrothermal vents, where seawater seeps into crevices in Earth's crust, heats up, and resurfaces full of minerals and the sulfide compounds that fuel life there. As the water cools, it releases the minerals as a black "smoke" that forms a chimney around the emerging jet of water. The* Alvin *crew observed one chimney increase 20 feet in 3 months, an incredible pace.

"The rates both geologically and biologically are far faster than anyone had recognized," Lutz says. — **E. Pennisi**

Science Service, Inc. is collaborating with JSTOR to digitize, preserve, and extend access to *Science News.* JSTOR www.jstor.org