Nuclear Satellites Disrupt Research

Airborne and spacecraft sensors designed to observe solar flares and cosmic rays commonly detect closer radiation sources: nuclear-powered Soviet satellites. Emissions from the Soviet spacecraft daily disrupt the operation of scientific instruments flown by groups from nations including the United States, the Soviet Union, Japan and West Germany. Now astronomers are developing techniques to prevent radiation from the Soviet satellites—which are used to track U.S. warships — from hampering a U.S. scientific spacecraft not yet launched.

Some scientists have known about the emissions for 10 years, but uncertainty concerning U.S. government classification of the subject kept them from publicizing it. Last week, however, a private group opposing nuclear power in Earth orbit made public an August NASA memorandum discussing the issue.

"The memo was intended to provide clarification that we *can* talk about the situation," says its author, Arthur J. Reetz, program manager for NASA's Gamma Ray Observatory (GRO), a $500-million scientific satellite scheduled for launch in 1990. He says radiation from the Soviet spacecraft presents a potential problem for a major sensor aboard GRO, but astronomers probably can program the instrument to ignore the emissions.

Powered by uranium fuel, the Soviet reactors produce gamma rays that pass through their spacecraft, explains Joel R. Primack of the University of California, Santa Cruz. The rays knock electrons and positrons loose from the Soviet vessels' hulls, and some of these charged particles get trapped in specific areas of the Earth's magnetic field.

When radiation sensors detect the particles, they fill their computer memories with data that temporarily prevent them from recording natural emissions. "False alarms caused by satellites occur as much as 30 percent of the time," says Edward E. Fenimore of Los Alamos (N.M.) National Laboratory, who analyzes X-ray data collected by a Japanese satellite.

NASA's Reetz says GRO scientists plan two redundant safeguards against the unwanted emissions. First, they can command GRO not to collect information while in the particle-trapping areas. Second, they might be able to program GRO to disregard any radiation detected simultaneously with high counts of electrons—particles associated with satellite emissions but not with the natural phenomena the sensor seeks.

Reetz says the work will cost less than $200,000 and won't set back the launch of GRO, which astronomers hope will clarify the sources of distant gamma rays. "Cosmic gamma ray bursts appear to originate in the proximity of neutron stars, but the sources have never been pinned down," says Gerald H. Share of the Naval Research Laboratory in Washington, D.C.

For instruments already in orbit, astronomers can only continue to identify the unwanted data, a time-consuming but manageable task. "There's really nothing else we can do about it," Share says.

Detectable increases in gamma rays from the sun or in radiation from more distant sources occur less than once per day on average. "These events are golden. We don't want to lose them," Share says. For this reason, once sensors detect radiation increases, including those from satellites, they record all the data their memories will hold. This prevents them from recording any more events, including natural ones, until they transfer data to ground-based computers at the end of each orbit. Orbit periods for the disrupted satellites vary from about 90 minutes to almost 5 hours.

Some U.S. satellites derive energy from the natural decay of radioactive plutonium, but the radiation they emit does not hamper scientific satellites, says Steven A. Aftergood of the Committee to Bridge the Gap, the Los Angeles-based group that distributed the NASA memorandum.

– C. Knox

Bottled error distorts N_2O estimates

In the dentist's office it goes by the name of "laughing gas," yet nitrous oxide (N_2O) is no laughing matter in the atmosphere, where it serves as a "greenhouse" gas and leads to the destruction of stratospheric ozone. As levels of this gas rise by some 0.2 to 0.3 percent annually, scientists are trying to determine how much each major source of it contributes to the atmospheric burden. Recent work has suggested that power plants — particularly those that burn coal — contribute as much as a third of the nitrous oxide in air. However, two chemists now report finding evidence that these studies vastly overestimate the nitrous oxide coming from combustion of fossil fuels.

According to Lawrence Muzio of the Fossil Energy Research Corp. in Laguna Hills, Calif., and John Kramlich of the Energy and Environmental Research Corp. in Irvine, Calif., a measuring artifact may be creeping into most analyses of furnace exhaust. Because of this, a researcher analyzing exhaust could measure high levels of nitrous oxide even if the gas leaving the furnace contained little or none of it, they report in the November GEOPHYSICAL RESEARCH LETTERS.

"This looks like a major embarrassment in the sense that the research community thought the N_2O budget was balanced," says Ralph Cicerone, an atmospheric chemist at the National Center for Atmospheric Research in Boulder, Colo.

To analyze the nitrous oxide content of furnace exhaust, researchers have traditionally collected gas inside the furnace, stored the exhaust in a flask, then carried the flask back to the lab for testing. Muzio and Kramlich discovered, though, that while a gas sample sits in the flask, chemical reactions can create nitrous oxide from other components in the exhaust.

While sampling gas from a model furnace, the researchers found that in less than 2 hours, nitrous oxide levels in a stored sample could shoot from less than 5 parts per million to 300 parts per million, if the original exhaust contained nitric oxide (NO), water and sulfur dioxide, all common products of fossil-fuel combustion.

"This fundamentally revises our thinking," says atmospheric chemist Joel Levine from NASA Langley Research Center in Hampton, Va. "If the emission factor in the chimney is reduced by a factor of 100, then coal burning, on a global scheme, does not become a major source of N_2O."

If fossil-fuel combustion does not account for much of the nitrous oxide in the atmosphere, then some other source must be much more prodigious than previously supposed. Scientists say one possible process making up the difference might be biomass burning — which includes tropical rain forests, grasslands and agricultural stubble. When vegetation burns, the combustion process creates nitrous oxide and other gases.

According to Levine, new work suggests that past studies have underestimated the amount of land burned each year. Moreover, his group and others around the world have recently discovered that burning creates nitrous oxide not only through straight combustion but also by stimulating soil microbes, which produce this gas for months after a fire (SN: 4/9/88, p.231).

– R. Monastersky