Solar-sensitive technology

"The bad news," says H. H. Sargent, "is that on top of all our other problems now we have to worry about solar flares."

The reason, he said at the American Geophysical Union meeting in San Francisco, is that, through technology we have unwittingly increased our vulnerability to high solar activity. Sargent, of the National Oceanic and Atmospheric Administration's Space Environment Services Center in Boulder, Colo., outlined the progress and expectations of the current sunspot cycle. Based on the number of sunspots, a cycle is measured from minimum to minimum. The present cycle — cycle 21 — which began in June 1976, should reach its maximum in 1980. According to Sargent, it promises to be a big one; he estimates the maximum number of sunspots at 150. The second largest cycle peaked at 151 and the largest, cycle 19, reached 202.

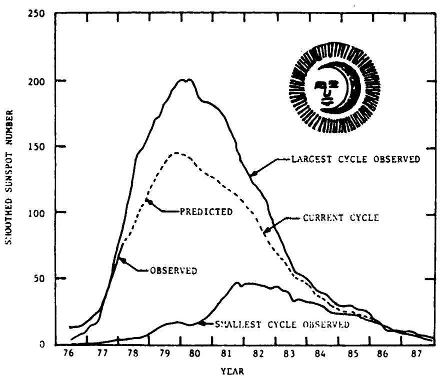
But it's not the increasing number of sunspots that worries Sargent. It is the concomitantly greater intensity and frequency of solar flares. And technologically we have laid ourselves open to the effects of flares, he says.

The effects of flares on radio propagation are well known. Flares such as the one recorded last April (SN: 5/13/78, p. 309) temporarily destroy satellite, ship-to-shore and air-controller communications and navigation.

Even worse, he said, is the danger of high doses of radiation to airline passengers and astronauts. The increasing number of flights over the poles ups the chance of a plane being caught where the earth's atmospheric shield is weakest. An astronaut, without any atmospheric protection, would receive a full blast of the X-ray burst from a flare. Had an Apollo mission been in space during the "benchmark" August 1972 flare, Sargent says, the astronauts could have received a lethal dose.

More down to earth, he says, is the possibility of a flare knocking out the huge power grids that are interconnected across the United States. "I'm not making a prediction," he stresses, "but imagine power use peaking like a wave across the country and a flare strikes. . . ."

The solutions? Regulate the way power systems interconnect, use radiation warning devices already installed in some airplanes and check with the Space Environment Services Center for flare warnings. "The good news," he says, "is that in Boulder there is a service to use as a foundation for action." □



Heckman/NOAA

GAMETAG studies the troposphere

If the length of an acronym is directly proportional to the quality of a project, then GAMETAG ought to be a winner. And judging by the results from its second year of operation, presented at the American Geophysical Union meeting in San Francisco last week, it will be.

GAMETAG, which stands for Global Atmospheric Measurements Experiment on Tropospheric Aerosols and Gases, is the first coordinated study of background conditions in the troposphere, the atmospheric layer that lies between eight and 15 kilometers above the earth and is responsible for our weather. Previous sampling studies have concentrated on the stratosphere or on the movements of isolated species, such as pollutants, usually from ground-based stations.

Searching for "clear air," as project director Doug Davis of Georgia Institute of Technology says, the Electra, a plane owned by the National Center for Atmospheric Research in Boulder, Colo., sampled the troposphere over the Pacific Ocean from Alaska to the Antarctic Circle. Two series of flights, one in August and September 1977 and one in April and May 1978, guaranteed picking up summer and winter conditions in both hemispheres. Simultaneously with sampling ozone, OH, CO, SO_2, NO, N_2O, CO_2, hydrocarbons, chlorofluorocarbons, carbon tetrachloride, carbonyl sulfide, methyl chloroform, nitric acid and methyl chloride, the instruments on board measured ultraviolet solar flux, relative humidity, temperature, pressure and wind velocity. Among the aerosols measured are nitrate ion, sulfate ion, chloride ion and ammonium ion. For many species, such as OH, SO_2 and carbonyl sulfide, these are the first measurements in tropical and subtropical latitudes in both northern and southern hemispheres, according to Davis.

GAMETAG has already added a "quantum leap" in knowledge, says Robert J. McNeal of the atmospheric sciences division of the National Science Foundation, particularly about the relative importance of exchange between atmospheric layers and chemical reactions. For example, GAMETAG found a "box" of atmospheric calm near the equatorial Pacific Canton Islands, Berry Huebert of Colorado College told SCIENCE NEWS. The extremely low wind velocity of the area resulted in very little exchange between the lower "boundary" layer (from the ground up to 1.5 km) and the troposphere. Studying such an area will allow researchers to isolate the effects of transport processes on the distribution of chemicals, he said.

A sampling of the results of this joint effort by seven universities, government and private industry includes:

- **OH** OH is believed to be the rate-controlling chemical in atmospheric reactions. The results showed unexpectedly high levels of OH — nearly 50 to 60 percent of the total — in the boundary layer at tropical and subtropical latitudes. A finding of less OH in the northern than in the southern hemisphere correlates well with that suggested by previous GAMETAG measurements of CO, the chemical sink for OH.
- **Ozone** Ozone was believed to be fairly evenly distributed in the tropical and subtropical troposphere, but GAMETAG found intense layering of ozone in the troposphere over the Pacific. Ed Danielsen of Oregon State University speculated that these bands may result from the transport of stratospheric ozone from the high latitudes to the tropical latitudes.
- **Carbonyl sulfide** Before the summer of 1977, virtually nothing was known about the distribution of this chemical, which is believed to be fairly inert and which characterizes the dense atmosphere of Venus. Based on these first-round experiments, investigators cannot distinguish whether its source is human or natural. But future measurements, such as its impact on stratospheric aerosols, should establish its importance.
- **Nitric acid** GAMETAG found a nearly even hemispheric distribution, meaning that, as opposed to earlier predictions, natural sources of nitric acid are far stronger than human sources in the troposphere. Lower nitric acid levels were found in the boundary layer than in the troposphere; Huebert speculates that the chemical may move up to the upper layers at night or that reactions catalyzed by lightning may be a significant nitric acid source in the upper atmosphere.
- **SO_2** GAMETAG results give strong indications that industrial sources of SO_2 from both the United States and Europe are affecting many remote regions of the northern hemisphere, but that the effects are not being felt in the southern hemisphere.
- **Aerosols** Contrary to some speculations about the impact of volcanoes, GAMETAG found very similar distributions of aerosols and particles — in both size and number — above the boundary layer over both continents and oceans.

Davis anticipates at least another quantum leap in atmospheric chemistry from future phases of GAMETAG. Plans through 1982 include sampling over tropical continental areas, measurements of 10 to 15 more species and studies of diurnal variations in reactions and concentrations. □