Analyzing the atmosphere

Globe-wide sampling seeks to reveal man's influence on the atmosphere's composition and, ultimately, on climate

NOAA

Keystone in the monitoring network will be NOAA's Mauna Loa Observatory.

by Louise A. Purrett

In the world's major cities the skies are full of pollutants and manmade aerosols, and gases may be blown many miles from their sources. There is no doubt that such pollution is far-reaching. Measurements in rural areas of the continental United States show an increase of 20 to 30 percent in the weight of airborne particles over the last decade. Carbon dioxide has been increasing annually, on an apparently worldwide basis, by an average of 0.7 parts per million. The present concentration is 323 parts per million, so that the increase is about 0.25 percent annually.

This rate appears to be gradually increasing. Increases in atmospheric carbon dioxide, which tends to trap infrared radiation, could lead to warmer climates. On the other hand, some aerosols shield the earth from solar radiation, causing cooling. Any predictions of the earth's future climate will have to consider trends in the concentrations and types of aerosols as well as increases in carbon dioxide—all on a global basis. The only way to determine if man's activities have actually permanently altered the composition of the atmosphere is to make continuous measurements of atmospheric constituents at locations far from the sources of pollution.

Carbon dioxide has been systematically measured at the National Oceanic and Atmospheric Administration's Mauna Loa Observatory in Hawaii for some 15 years. Charles Keeling of the Scripps Institution of Oceanography introduced both the need and techniques for precision measurements of this atmospheric constituent. But up to now, as Donald H. Pack of NOAA's Air Resources Laboratory puts it, measurements of most trace constituents have been made "hither, thither and yon."

Now NOAA meteorologists are setting up a global system of stations to monitor carbon dioxide, carbon monoxide, ozone, dust from agricultural activity and volcanism and other trace constituents of the atmosphere. The project, called Geophysical Monitoring for Climatic Change (GMCC), will be the first orderly, long-range effort to monitor these constituents from a number of different locations. Pack is the project's director. The Mauna Loa Observatory will be the main station in the network. Its data will be the standard against which measurements at the other stations will be compared and interpreted. Located at an altitude of 11,200 feet, the station has two major advantages for such study. An inversion layer below it inhibits pollution from the island of Hawaii, particularly the city of Hilo, from affecting measurements. And winds are from the west, so that in effect the observatory is 3,000 to 4,000 miles from any pollution source.

Other stations are planned for Barrow, Alaska, and the South Pole. The meteorologists are also looking for a suitable site in the southwest Pacific. They asked the National Geographic Society for help in selecting it, and its study found that many of the southwest Pacific islands studied had the drawbacks of inaccessibility and primitive conditions. Pack says the Island of Tutuila in American Samoa appears to be the best bet so far, though the Manua Islands may do as well. The GMCC scientists are also considering monitoring sites somewhere on the Pacific coast of South America and off the eastern coast of the United States.

A number of other nations are planning similar observation networks. The Soviet Union has mentioned three possible sites—in the Caucasus, in central Asia and in Northern Siberia. Canadians are likewise talking about three sites, Swedish scientists are considering setting up instruments in the northern part of their country and the British are looking at the possibility of a station in northern Scotland. Many nations are interested in atmospheric monitoring; the United States just happens to be first. These would all be separate projects but Pack expects that the countries carrying out such studies will exchange and compare their results.

Though the Mauna Loa Observatory has contributed much good data, the whole point of the GMCC program is that one station is insufficient. As Pack says, "It will take a fair number in both hemispheres to be able to see any trends." Likewise, the program will have to run for several decades. Some of the changes will be in terms of only one part per million per year. "It takes a while to establish a small trend like this." A long-range study will also be necessary to separate natural from manmade variables. Pack cites as an example the global warming trend from the beginning of this century to the 1940's, followed by a period of cooling climate (SN: 11/15/69, p. 458). Such natural trends will have to be distinguished from man's influences. The researchers also hope to determine the chemical composition of particles, an important clue to their sources.

The atmosphere does have the ability to cleanse itself. Particulates may be washed out by precipitation or may be deposited on earth by slackening winds. In 1963, the explosion of Mt. Agung on the island of Bali spewed so much debris into the stratosphere that a 5.3 percent decrease in solar radiation was measured, eight months later, at the South Pole. Last month, Rudolf F. Pueschel, director of the Mauna Loa Observatory, reported that the atmosphere over Mauna Loa had finally cleansed itself of volcanic debris and the amount of solar radiation reaching the observatory had returned to pre-1963 levels. "Thus, we can now safely say that we know what the natural population of particulates is for the Central Pacific area and any future changes, in the absence of a catastrophic natural event, will clearly herald an increase in mankind's impact on his environment." One of the things the GMCC scientists want to find out is if the earth's atmosphere can maintain this capacity to cleanse itself in the face of all man's pollution. □