

NCAR

Information Release

1978-26

September 12, 1978
For Immediate Release

Civilization A Major Ozone Source, Scientists Say

Miami, Florida---"A major source of ozone in the lower atmosphere--the troposphere--seems to be industrialization and human activities," according to Jack Fishman. "We have polluted the entire Northern Hemisphere," he said in a talk before the American Chemical Society.

Fishman, a visitor to the National Center for Atmospheric Research (NCAR) from Colorado State University, reported on studies which he, Susan Solomon, an NCAR visitor from the University of California at Berkeley and Paul Crutzen of NCAR have carried out on the world-wide distribution of ozone. The conventional theory which accounts for ozone in the troposphere holds that ozone is produced higher up, in the stratosphere, is mixed into the lower atmosphere by storm activity and atmospheric circulation patterns and is then destroyed when it reaches land surfaces.

"If this were true, then we should find something like three times less ozone in the Northern Hemisphere than in the Southern, since there is three times more land surface in the Northern Hemisphere," Fishman explains. "Instead, measurements show that there is 30 - 40% more ozone in the Northern Hemisphere."

The difference between the theory and observations led Fishman, Crutzen and Solomon to examine the meteorological variables between the two hemispheres. They could find no significant difference in the occurrence of storms and cyclones between one hemisphere and the other nor any important variation in the air circulation patterns to account for the high concentrations of tropospheric ozone in the Northern Hemisphere.

The conclusion they reached was that there must be a man-made source for producing ozone in the Northern Hemisphere, which they found in the complex chemistry of air pollution. The primary culprit is carbon monoxide, (CO), which

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is produced by fossil fuel burning. The reaction of the hydroxyl radical (OH) with CO produces ozone; the rate at which ozone is produced is stepped up when nitrogen oxide, another pollutant, is present in the air.

The difference in the CO measurements between the two hemispheres lends further support to their theory. Concentrations of around 60 parts per billion of CO are found in the relatively unpolluted Southern Hemisphere. In the Northern Hemisphere these measurements soar to 220 parts per billion of CO per volume of air. However, this indicates that pollution is on the rise in the Southern Hemisphere as well; natural sources of CO would account for approximately 30 parts per billion of CO.

While the oxidation of CO may contribute as much as 50% of the ozone found in the troposphere, other chemical reactions with methane, hydrocarbons and OH may also lead to increased ozone production. Although there are some uncertainties as to the rate at which these various pollutants may react to produce ozone, all the evidence points to human activities as a major, and previously ignored, source of ozone in the troposphere.

Since ozone is an absorber of infrared radiation from the sun, increasing the ozone in both the troposphere and the stratosphere has the potential for creating significant changes in the global climate. Determining just what these changes might be will take further study, and require much more detailed measurements, especially from the Southern Hemisphere where few have been taken. The preliminary evidence indicates that increasing ozone would bring about a global warming trend.

Fishman and other scientists at NCAR, which is sponsored by the National Science Foundation, plan to continue analyzing both current and historical measurements of ozone in the troposphere. By examining the Southern Hemisphere, where the atmosphere is much closer to pre-industrial conditions, and comparing it with the Northern Hemisphere, it will be possible to assess the full impact of industrialization on the atmosphere and its potential for altering the world's climate.

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