IV. GEOPHYSICAL RESEARCH

A. High Magnetic Fields*

Academic and Research Staff

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1. PERTURBATION OF ELECTRON ENERGY DISTRIBUTION BY A PROBE

[This report is an abstract of a paper that has been submitted for publication to the *Journal of Applied Physics*.]

In order to determine electron-energy distribution in a plasma, the electron current to a probe is measured as a function of potential on the probe. If the rate of removal of high-energy electrons by measurement is comparable with the rate of replenishment by the various plasma processes, serious perturbation of the electron-energy distribution will result as a consequence of the act of measurement. A criterion for deciding when this effect may be ignored is presented. It is based on the hypothesis that when the depletion time constant τ_d of electrons of a particular energy by a given probe in a given plasma is large compared with the "self-collision time" of electrons for coulomb collisions as given by Spitzer, perturbation of the electron-energy distribution is negligible. The depletion time constant is $\tau_d = 4V/A_p \cdot v$, where V is plasma volume, A_p is probe area, and v is electron velocity. The criterion for no perturbation of the electron-energy distribution then becomes $N \gg 2600\ T^2 A_p$, in which N is the total number of electrons in the plasma, T is the temperature in degrees Kelvin, and A_p is the probe area in square centimeters. It is shown that even if the criterion is not satisfied, probe measurements of the electron-energy distribution may still be made by using a pulsed or transient system with pulses of length τ_p, provided $\frac{1}{\omega_p} \ll \tau_p \ll \tau_d$.

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*This work is supported by the Joint Services Electronics Programs (U.S. Army, U.S. Navy, and U.S. Air Force) under Contract DA 36-039-AMC-03200(E).

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B. Upper Atmosphere Physics*

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1. STUDIES OF STRATOSPHERIC AEROSOLS AND THEIR CORRELATION WITH OZONE

Observations of stratospheric aerosols were conducted for one hundred days in a two-year study with an optical radar at Lexington, Massachusetts. During the summer of 1964, some observations were also conducted at College, Alaska simultaneously with studies of mesospheric clouds. The optical radar system and the techniques used to record and analyze the data have been described previously.[1,2] Observations conducted after the summer of 1964 were made with the improved apparatus used in Sweden

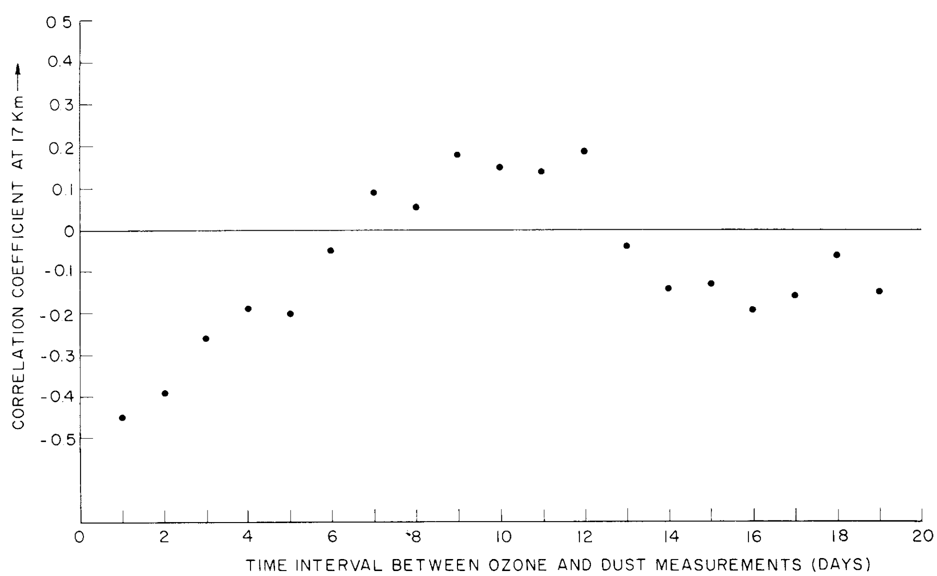

Fig. IV-1. Correlation coefficient for ozone and dust displayed as a function of time.

*This work is supported principally by the National Aeronautics and Space Administration (Grants NGR-22-009-131 and NGR-22-009-(114)), and in part by the Joint Services Electronics Programs (U.S. Army, U.S. Navy, and U.S. Air Force) under Contract DA 36-039-AMC-03200(E).

for the mesospheric cloud study.[3]

The data show that the aerosol layer at ~20 km exhibits little temporal variation. Profiles obtained on different nights may differ as much as 10-20%; smaller fluctuations are observed during a single night of observation.

The observed aerosol profiles have been correlated with ozone profiles obtained at Bedford, Massachusetts by the Air Force Cambridge Research Laboratories. Figure IV-1 shows the correlation between the amounts of dust and ozone at the altitude where a maximum in the aerosol mixing ratio is observed (17 km); correlation coefficients for 17-km altitude are displayed as a function of the time between the dust and ozone observations. The relatively large negative correlation observed for shorter time intervals seems to be a significant result.

Pittock[4] presents evidence suggesting that, at times, the presence of dust in the stratosphere may destroy ozone; Kroening[5] has also suggested that stratospheric aerosols may be an important sink for ozone. The observed negative correlation between dust and ozone in the lower stratosphere substantiates these views.

Other explanations for the negative correlation are also being investigated, since in the lower stratosphere chemical destruction of ozone is usually assumed to be negligible.

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