ON STRATOSPHERIC AEROSOL SIZE DISTRIBUTIONS FROM RECENT OPTICAL RADAR OBSERVATIONS

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ABSTRACT

Stratospheric aerosol size distributions have been studied directly by impactor or indirectly by scattered radiation. Typical contemplated aerosol size distributions so far proposed are

1) Junge's size distribution.

$$d\,N(r)/\,d(\log r) \propto r^{-\nu}$$

$0.1\ \mu < r < 1.0\ \mu$, $\nu = 2$ (Junge et al.1961)

$0.1\ \mu < r < 1\sim2\ \mu$, $\nu = 3.5$ (Friend et al.1961, Newkirk et al.1963)

2) Log-normal size distribution.

$$d\,N(r)/\,d(\log r) \propto \exp\{-(\log r/r_0)^2/\,2s^2\}$$

$r_0 = 0.35\ \mu$, $s = 0.30$ (average of Mossop (1965) and Friend(1966))

3) Bimodal size distribution.

In addition to 2), Friend, de Bary and Roosler (1966) required a large number of small (Aitken) particles.

We consider whether or not observations of both laser radar backscattering and small ion density are explained by these size distributions. The laser radar observations have been carried out at Fukuoka, southwest Japan(Hirono et al.1972), since October,1972. Small ion density has been observed by radiosonde at Kagoshima, located at a distance about 200 km of Fukuoka.

If we assume that the refractive index of aerosol is 1.5, conditions for aerosol size distributions to explain both observations are

1) It is necessary that the minimum radius of aerosol is smaller than 0.02 μ for $\nu \leq 4$ when Junge's size distribution is assumed.

2) Log-normal size distribution is inadequate.

3) Bimodal size distribution can be determined by taking small and large particle number densities appropriately.

From these we cannot determine aerosol size distribution uniquely. We examine here bimodal size distribution in some detail by considering the elementary physical processes.