Reply

PETER V. HOBBS AND ARTHUR L. RANGNO

Atmospheric Sciences Department, University of Washington, Seattle, WA 98195

7 July 1986

The ice enhancement ratio (ER) is used to provide a rough ("order of magnitude") measure of the extent to which the maximum measured ice particle concentrations in a cloud exceed standard ice nucleus measurements. The accuracy of the values for ER given in Tables 1, 2 and 3 of our paper (Hobbs and Rangno, 1985) were based on the *definition* of ER given in section 1 of our paper. However, from a practical point of view, these values should be corrected to the first significant figure.

It is well known that ice nucleus measurements are very variable in both time and space. However, the available measurements cannot explain the very high concentrations of ice particles that we and others have measured in many clouds with top temperatures $\geq -15°C$. These ice particle concentrations are often $\sim 100\ L^{-1}$, even for clouds with tops as warm as $-7°C$. By contrast, the maximum concentrations of ice nuclei in the atmosphere that have been measured at this temperature are only $\sim 0.1\ L^{-1}$. This is the ice enhancement paradox.

In section 6 of our paper we suggested that ice nuclei acting by contact nucleation might be responsible for ice enhancement. Also, Gagin and Nozyce (1984) have suggested that ice nucleation in the region of relatively high, transient supersaturations that surround a freezing drop (Dye and Hobbs, 1968) might be responsible for ice enhancement. However, such hypotheses must remain speculative until such time as measurements indicate that sufficient concentrations of suitable ice nuclei are present in the atmosphere.

REFERENCES

Dye, J. E., and P. V. Hobbs, 1968: The influence of environmental parameters on the freezing and fragmentation of suspended water drops. *J. Atmos. Sci.*, **25**, 82–96.

Gagin, A., and H. Nozyce, 1984: The nucleation of ice crystals during the freezing of large supercooled drops. *J. Rech. Atmos.*, **18**, 119–129.

Hobbs, P. V., and A. L. Rangno, 1985: Ice particle concentrations in clouds. *J. Atmos. Sci.*, **42**, 2523–2549.