6.8 REMOTE TEMPERATURE PROFILING IN THE TROPOSPHERE AND STRATOSPHERE BY THE RADIO-ACOUSTIC SOUNDING TECHNIQUE

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The application of radar to study of the atmospheric phenomena is carried out by receiving echoes from precipitation and atmospheric inhomogeneities or structure caused by turbulence and atmospheric gravity waves. A somewhat different kind of radar application is the radio-acoustic sounding technique as presented here, in which Doppler frequency shift of radar echoes returned from the atmospheric spherical wave structure, in association with travelling acoustic pulse transmitted from the ground, is detected to give the speed of sound, and hence the atmospheric temperature, as function of altitude.

The experiment presented here aims at temperature measurement in the troposphere and stratosphere by the radio-acoustic sounding technique with the Radio-Acoustic Sounding System (RASS) consisting of the MU Radar, completed in November 1984, at Shigaraki, Shiga, Japan, by the Radio Atmospheric Science Center of Kyoto University (peak power 1 MW, radio frequency 46.5 MHz) and a movable high-power acoustic transmitter provided by Radio Research Laboratory (acoustic power 100 W, acoustic frequency around 100 Hz variable).

Two basic conditions to be satisfied for receiving echoes by RASS in an efficient power are the following: one is the Bragg condition with respect to the radio wavelength λ_r (= 6.45 m) and the acoustic wavelength λ_a, i.e., $\lambda_r = 2\lambda_a$, and the other is the perpendicularity between the radar beam and the acoustic wave front. The Bragg condition can be kept from failure owing to height variation of the acoustic wavelength arising from temperature variation, by sweeping the acoustic frequency from pulse to pulse. The latter condition, which is influenced by the atmospheric wind, can be kept partly by changing the direction of the radar beam and partly by changing location of the acoustic transmitter.

Successful experiments were carried out in March 1985, and August 1985, of remote temperature profiling in the troposphere and stratosphere, attaining with the maximum measurement altitude of about 20 km beyond the tropopause in the August experiment.