Continuous monitoring of temperature profiles in the tropical troposphere with EAR-RASS

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This study aims to continuously measure temperature profiles in the tropical troposphere (from 1.5 km to about 15-17 km) with high accuracy and high time-resolution by adopting Radio Acoustic Sounding System (RASS) to the Equatorial Atmosphere Radar (EAR) at KotoTabang, west Sumatra, Indonesia. We installed high-power speakers in the antenna field of EAR.
Because propagation of sound waves in the atmosphere is largely affected by the background winds, we employed the 3D ray-tracing of acoustic waves in order to predict the shape of acoustic wave fronts. Then, we selected appropriate antenna beam directions of EAR that satisfy the Bragg condition, i.e., the wave number vectors for radar waves and the target acoustic waves must be parallel.
We successfully observed the temperature profiles from 1.5 km to 5-12 km continuously with the time and height resolutions of about 3 minutes and 150 m, respectively. Temperature profiles were sometimes obtained up to about the lapse rate tropopause at 16 km. Standard deviation of the temeprature difference between EAR-RASS and radiosondes was about 0.3 K. We tested the effect of sound pressure level on RASS observation. We also examined two correction methods of the background wind velocity on the sound speed.
EAR-RASS results are useful for the studies of peculiar atmospheric phenomena in the equatorial regions, such as the intense cloud convection, structure of the boundary layer, and atmospheric waves.

Keywords: RASS, EAR, tropical tropopause, temperature profile

