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赤道 MU レーダー・RASS による温度プロファイル測定に関する基礎研究
Measurement of Temperature Profiles Using Equatorial Middle and Upper Atmosphere (EMU) Radar with Radio Acoust

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Because of intense solar radiation, the equatorial atmosphere involves various atmospheric disturbances with a wide range of temporal and spatial scales. The tropopause located at 15-17 km altitude separates the troposphere (0-15 km) and the stratosphere (15-60 km). There are a number of interesting phenomena in the upper troposphere ? lower stratosphere (UTLS) region, including transport and exchange of energy and atmospheric minor constituents. Thus it is important to observe structure and variations of wind velocity and temperature in the UTLS region.

We have been promoting to construct the Equatorial Middle and Upper Atmosphere (EMU) Radar in Koto Tabang (-0.204 deg, 100.320 deg), Indonesia. The EMU radar is a high power Doppler radar similar to the MU radar in Shigaraki, Japan, and it can measure three components of wind velocity up to about 25 km altitude. In addition, we plan to apply the radio acoustic sounding system (RASS) to the EMU radar. RASS is an advanced radar observation method, by combining an acoustic transmitter and a radar, to measure a temperature profile. Adding RASS in the EMU radar makes it possible to observe the height profiles of temperature in the entire troposphere and lower stratosphere with good accuracy and high time resolution.

In order to estimate a possible height range of RASS measurements in the equatorial region, we analyzed the sound propagation characteristics using ray-tracing method, assuming realistic profiles for horizontal winds and temperature. Equatorial region is known that wind velocity is relatively weak. However, the zonal winds sometimes become strong at around 5 km and 15 km altitude, and a sharp bent in the temperature gradient near the tropopause affect the RASS observation. The quasi-biennial oscillation (QBO) of the zonal winds in the stratosphere also affects the observation height range of RASS.

We summarized the effects of zonal wind and temperature on RASS measurements. We further investigated that steering of radar antenna beam and relative position between an acoustic speaker and the radar enable us to observe temperature from the ground up to height 25 km throughout a year, where the speakers should be moved along the wind direction by 200 to 500 m.

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