Cirrus cloud observation in the tropical troposphere by the Equatiorial Atmosphere Radar and the 95-GHz cloud profiling radar

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Cirrus clouds existing in the upper part of the troposphere consist almost entirely of ice particles, and play a significant role in regulating the radiation balance of the earth-atmosphere system. In this study, features of vertical air motion (V_{air}) in tropical cirrus clouds and its relationship to particle falling velocity ($V_{particle}$) are investigated. V_{air} and reflectivity-weighted $V_{particle}$ (V_Z) relative to the ground were respectively observed by 47-MHz and 95-GHz Doppler radars. They were operated at Equatorial Atmosphere Observatory, Kototabang, West Sumatra, Indonesia (0.2°S, 100.32°E, and 865 m MSL).

A case on 14 November 2005 is intensively studied. On that day, cirrus clouds existing in the outflow region of convective system were observed from 2030 LT to 3130 LT. Figure 1a shows a scatter plot between V_{air} observed by the 47-MHz Equatorial Atmosphere Radar [*Fukao et al.*, 2003] and V_Z observed by the 95-GHz cloud profiling radar developed by National Institute of Information and Communications Technology (NICT) [*Horie et al.*, 2000]. It is clear that V_Z, a velocity relative to the ground, contains fluctuations due to upwelling and downwelling of V_{air}. Figure 1b shows a scatter plot between V_Z and radar reflectivity factor observed by 95-Ghz radar (Z_e). A negative correlation between V_Z and Z_e is observed. Though V_Z tends to show consistent changes with Z_e, it contains large fluctuations. Figure 1c shows a scatter plot between (V_Z - V_{air}) and Z_e. By eliminating fluctuations by V_{air}, a negative correlation between (V_Z - V_{air}) and Z_e becomes clearer, which indicates that the fluctuations in Figure 1b occurred due to upwelling and downwelling of V_{air}. These results indicate that V_{air} observation by VHF Doppler radar is indispensable for observing particle falling velocity ice particle in cirrus clouds.

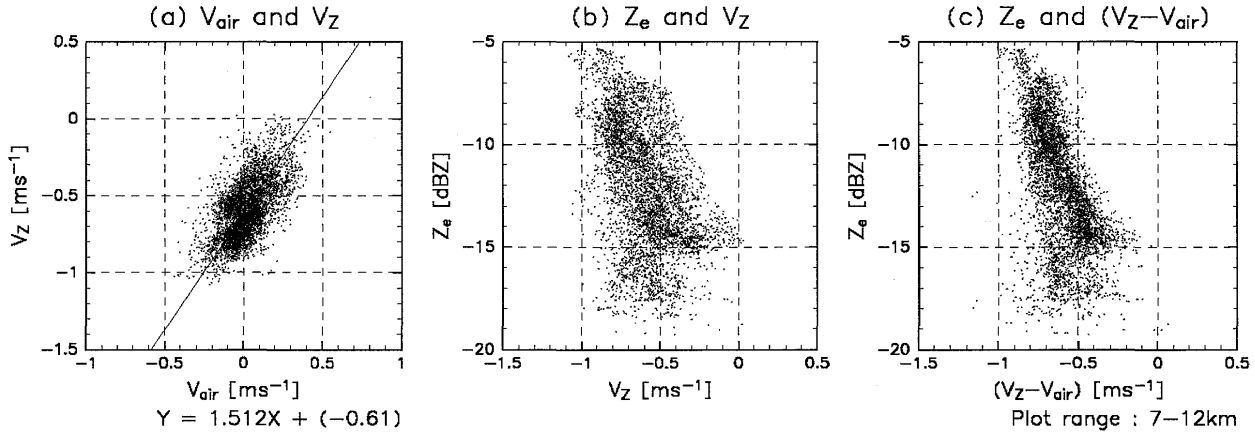

Figure1: Scatter plots between (a) V_{air} and V_Z, (b) V_Z, and Z_e, (c) (V_Z - V_{air}) and Z_e, in an altitude range of 7–12 km.

REFERENCES

[1] Fukao, S., H. Hashiguchi, M. Yamamoto, T. Tsuda, T. Nakamura, M. K. Yamamoto, T. Sato, M. Hagio and Y. Yabugaki: The Equatorial Atmosphere Radar (EAR): System description and first results, *Radio Sci.*, 38(3), 1053, doi:10.1029/2002RS002726, 2003.

[2] Horie, H., T. Iguchi, H. Hanado, H. Kuroiwa, H. Okamoto and H. Kumagai: Development of a 95-GHz airborne cloud profiling radar (SPIDER) -- Technical aspects --, *IEICE Trans. Communications*, Vol. 83, No.9, pp.2010--2020, 2000.