Precipitation processes revealed from hydrometeor measurements by videosondes

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Videosonde is one of strong tools to measure hydrometeors in clouds directly. It is a balloon-borne radiosonde that acquires images of precipitation particles via a CCD camera. The system has a stroboscopic illumination that provides information on particle size and shape. Interruption of the infrared beam by particles triggers a flash lamp and particle images are then captured by the CCD camera. Precipitation particles are classified as raindrops, frozen (or partly melted) drops, graupel, ice crystals, or snowflakes on the basis of transparency and shape. One of the advantages for the videosonde is to capture images of precipitation particles as they are in the air because the videosonde can obtain particle images without contact.
Videosonde observations of Baiu monsoon clouds have been conducted from 2007 to 2016, as part of the in-situ campaign observation by a C-band polarimetric radar synchronized with videosonde, which were carried out at Okinawa Electromagnetic Technology Center of National Institute of Information and Communications Technology (26ºº29′N, 127ºº50′E). In the case of May 20, 2012, a Baiu stationary front was located over the Okinawa Island, and we experienced heavy rain of 71.1 mm from 09 JST to 13 JST. Six videosondes were launched into the different developing stages of the rainband. In the cases of the developing stage, frozen drops were observed from 0ºC to -15ºC. Graupel were also detected in the same altitude. On the other hand, in the mature stage, we observed them between 5ºC and 0ºC layer, and graupel were dominant in between 0ºC and -5ºC. It was supposed that freezing processes and graupel formation processes near the 0ºC was different in the different developing stages.
We also carried out the videosonde observation at Bengkulu (3.86ºS, 102.3ºE), Indonesia from November 24 to December 15, 2015 for the better understanding of microphysical precipitation processes of tropical convection, which were conducted as a part of Pre-YMC field campaign. In the case of November 30, 2015, we experienced a strong rain associated with diurnal variation with convection along the coastline of Sumatera Island. A videosonde was launched into this convective cloud with cloud top 9 km. It transmitted images of large raindrops up to 6 mm in diameter in the lower level, and nearly round frozen drops and graupel above the freezing level. This was a typical tropical convective cloud characterized by the warm rain and freezing process.

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