Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

MIS29-01 Room:203 Time:May 24 09:00-09:15

Equaorial Fountain

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We discuss in this paper the behavior of various processes of the equatorial fountain, on the basis of intensive observations in the tropical regions in Asia-Oceania by means of the Equatorial Atmosphere Radar (EAR) and complementary measurements.

Keywords: equatorial atmosphere, atmospheric waves, atmospheric composition, cumulous convection, plasma fountain

Japan Geoscience Union Meeting 2012
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MIS29-02 Room:203 Time:May 24 09:15-09:30

Current Status of Program of the Antarctic Syowa MST/IS Radar (PANSY)

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Since 2000, we have developed an MST/IS radar to be operational in the Antarctic and have made feasibility studies. After solving various significant problems such as treatment against strong winds, energy saving, weight reduction, and efficient construction method, we reached the final system design which is a VHF Doppler pulse radar with an active phased array consisting of 1045 Yagis. This project was authorized as a main observation plan for JARE (Japanese Antarctic Research Expedition) 52-57 in 2008, and finally funded by Japanese government in 2009. The radar construction started in late December, 2010. Here we will present hot results from this radar and discuss the uniqueness of the MST radar observation on the middle atmosphere research. The observation will continue for 13 years covering one solar cycle.

Keywords: Antarctic atmosphere, MST/IS radar, katabatic wind, ozone hole, gravity wave, polar mesospheric cloud

Japan Geoscience Union Meeting 2012
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MIS29-03 Room:203 Time:May 24 09:30-09:45

Ten years on ionospheric observation with the Equatorial Atmosphere Radar

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Equatorial ionospheric observation with the Equatorial Atmosphere Radar (EAR) has been conducted since 2001, and its unique observational data has been obtained for almost one solar cycle. The EAR is sensitive to 3-m scale ionospheric irregularities, which can be regarded as a tracer of equatorial spread F (ESF) or plasma bubbles. ESF is one of the long-standing subjects in the low-latitude ionosphere particularly because plasma irregularities associated with ESF cause severe scintillation on satellite signals which results in communication/navigation outages. The rapid beam steering capability of the EAR, along with simultaneous ground-based and satellite observations, has revealed important aspects such as spatial/temporal structures of ESF and other intriguing phenomena. During solar maximum period, ESF plumes are observed just after sunset and traverse eastward until around midnight. During solar minimum period, on the other hand, the radar backscatter echoes are commonly observed around or after midnight and traverse westward, which are quite similar to the midlatitude-type irregularities observed with the MU radar in Japan. We will summarize observational results with the EAR during solar maximum and minimum periods, and discuss future potential of the ionospheric observation with the EAR.

Keywords: Equatorial Atmosphere Radar, plasma bubble, equatorial spread F, ionosphere, EAR

Japan Geoscience Union Meeting 2012
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MIS29-04 Room:203 Time:May 24 09:45-10:00

Current status and future plan of NICT's ionospheric observations in the Southeast Asia by SEALION and GNSS-TEC

TSUGAWA, Takuya[1*], NISHIOKA, Michi[1], ISHIBASHI, Hiromitsu[1], MARUYAMA, Takashi[1], Pornchai Supnithi[2], Buldan Muslim[3], SAITO, Akinori[4], OTSUKA, Yuichi[5], YAMAMOTO, Mamoru[6], NAGATSUMA, Tsutomu[1], MURATA, Ken T.[1]

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National Institute of Information and Communications Technology (NICT), Japan has developed the Southeast Asia low-latitude ionospheric network (SEALION) and ionospheric observation system using GNSS receiver networks in the Southeast Asia for the purpose of monitoring and researching severe ionospheric disturbances, such as plasma bubble. These ionospheric disturbances can affect satellite-to-ground radio propagation, degrade GNSS navigations, and cause loss-of-lock on GNSS signals. SEALION consists of six ionosondes, four GPS receivers, two GPS scintillation monitors, and two magnetometers, and one all-sky imager in Indonesia, Thailand, Vietnam, Philippines, and China. SEALION is a unique ionospheric observation network in having the conjugate observational points in the northern and southern hemispheres and around the magnetic equator. Developing dense GNSS receiver networks in the Southeast Asia would make it possible to reveal spatial structures and temporal evolutions of the several 100 km scale ionospheric disturbances in the wide area of 2,000-3,000 km in latitude and longitude in this Southeast Asia. We will introduce the current status of the SEALION and the GNSS-TEC observations and present some recent researches related with plasma bubbles, mid-night ionospheric irregularities, and late-afternoon periodic TEC fluctuations. A future plan of NICT's ionospheric observations and a proposal of GNSS-TEC data sharing in this region will be also presented.

Keywords: ionosphere, equator, plasma bubble, irregularity, GPS, ionosonde

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MIS29-05 Room:203 Time:May 24 10:00-10:15

Radio and optical observations of equatorial ionosphere and thermosphere in Indonesia

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In order to understand the coupling processes between the tropospheric activity and ionospheric disturbances and irregularities over the equatorial region, we have been operating optical instruments, VHF radar and GPS receivers at Kototabang Indonesia since 2002. Based on the observations using these instruments, following results were obtained. (1) A comparison between GPS scintillation and Earth's brightness temperature suggests that plasma bubble occurrence over Kototabang can be related to tropospheric disturbances over the Indian Ocean to the west of Kototabang. (2) Quasi-periodic poleward-propagating waves were observed in the 630-nm airglow images. These waves could be caused by atmospheric gravity waves propagating from mesosphere or lower atmosphere. (3) Following the large earthquake that occurred near Sumatra Island in Indonesia on December 26, 2004, we observed TEC variations propagating from the epicenter. These TEC variations could be caused by acoustic waves launched from the epicenter. (4) Continuous observation of the Field-Aligned irregularities (FAIs) with a VHF radar reveals that the F-region FAIs frequently occur at post-midnight between May and August during a solar minimum period.

Fabry-Perot interferometers were installed at Kototabang and its geomagnetic conjugate point, Chiang Mai in Thailand on February and June 2010, respectively in order to measure the thermospheric neutral winds at the geomagnetic conjugate points in northern and southern hemispheres. In 2009, five additional receivers for the VHF radar were installed to make radar imaging observations of the E- and F-region FAIs. We also installed three GPS receivers at Pontianak, Indonesia to measure the GPS scintillation drift velocities and compare them with the results obtained at Kototabang. We present the recent results obtained by using these instruments.

Keywords: ionosphere, thermospshere, equatorial region, plasma bubble, airglow, ionospheric disturbance

Japan Geoscience Union Meeting 2012
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MIS29-06 Room:203 Time:May 24 10:15-10:30

Upper thermosphere coupling with the lower atmosphere: features revealed by the 10-year CHAMP mission

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Recently rapidly growing observations have revealed clear evidences for a close coupling between the upper thermosphere and the lower atmosphere. Some of these evidences are seen in the spatial structures (e.g. the terminator wave, the wave-4 structure), while others are more prominent in the temporal variations (e.g.16-day wave, and the Stratospheric Sudden Warming effect). In this presentation, I try to review several aspects of the coupling by focusing on results obtained from the 10-year CHAMP mission.

Keywords: thermosphere, vertical coupling, CHAMP mission

Japan Geoscience Union Meeting 2012
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MIS29-07 Room:203 Time:May 24 10:45-11:00

Research Enhancement and System Establishment for Space Weather in Indonesia

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Space weather is a program to observe, assess, and forecast the space environment. Global and regional observations are both important for the space weather. The Equatorial Atmosphere Radar (EAR) is a VHF atmospheric radar located in Kototabang, West Sumatra, Indonesia. It is operated by collaboration between the Research Institute for Sustainable Humanosphere (RISH), Kyoto University of Japan and National Institute of Aeronautics and Space of Indonesia (LAPAN) since 2001. The EAR is not only used for the atmospheric studies, it has also been utilized for the studies of the ionosphere. The Grant-in-Aid for Scientific Research on Priority Areas "Coupling Processes in the Equatorial Atmosphere (CPEA)" leaded by Prof. S. Fukao (2001-2007) contributed a lot to fulfill the EAR site by installing number of supporting instruments, i.e., a meteor wind radar, an all-sky airglow imager, several lidars, 30MHz FAR radar, etc. From 2004, NICT started SEALION (SouthEast Asia Low-latitude IOnospheric Network) over Thailand, Vietnam, and Indonesia. One of the SEALION ionosondes is located at the EAR site. STE Laboratory, Nagoya University also supports us by providing several instruments of OMTI (Optical Mesosphere Thermosphere Imagers) to the SEALION and the EAR sites. Recently LAPAN runs their own project to start the space weather service in Indonesia. In relation to this movement, we have started a new project "Research Enhancement and System Establishment for Space Weather in Indonesia" since 2010 under the framework of Strategic Funds for the Promotion of Science and Technology. In the presentation we overview the project and current status, and discuss future expansion of the project.

Keywords: Equatorial Atmosphere Radar, Ionospheric study, Space weather, Strategic Funds for the Promotion of Science and Technology, Indonesia

Japan Geoscience Union Meeting 2012
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MIS29-08 Room:203 Time:May 24 11:00-11:15

Monitoring plasma bubbles by a VHF radar for advanced use of GNSS

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Spatial gradient of the ionospheric total electron content (TEC) is one of the most important error source of differential GPS (DGPS) systems. It is especially important for augmentation systems where very high safety is required, such as a ground-based augmentation system (GBAS) or a space-based augmentation systems (SBAS).

The plasma bubble which frequently occurs in the low latitude ionosphere is one of the most important phenomena that accompany sharp ionospheric gradients. Its frequent occurrence makes it difficult to implement such augmentation systems with high availability in low latitude regions.

Among a number of techniques, the incoherent scatter radar which can directly measure electron density distribution is the most powerful but the most expensive one. Instead, we have propose a VHF coherent backscatter radar for the external ionosphere anomaly monitor.

In this study, the effects of the VHF radar monitoring for GBAS is studied by a simulation study with a 3-D ionosphere model including plasma bubbles.

The concept will be verified by using the EAR and GNSS measurements in the region.

Keywords: Equatorial Atmosphere Radar, plasma bubble, GNSS augmentation system, TEC gradient, ionosphere anomaly monitoring, field-aligned irregularities

Japan Geoscience Union Meeting 2012
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MIS29-09 Room:203 Time:May 24 11:15-11:30

Lidar for equatorial atmosphere measurements

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We have constructed the lidar facility for survey of atmospheric structure over troposphere, stratosphere, mesosphere and low thermosphere over Kototabang (100.3E, 0.2S), Indonesia in the equatorial region. The lidar system consists of the Mie and Raman lidars for tropospheric aerosol, water vapor and cirrus cloud measurements, the Rayleigh lidar for stratospheric and mesospheric temperature measurements and the Resonance lidar for metallic species such as Na, Fe, Ca ion measurements and temperature measurements in the mesopause region. The most parts of this lidar system have been remotely controlled via the internet from Japan.

Recently, we are preparing DIAL (differential absorption lidar) system for ozone measurements in the tropopause region over Kototabang.

Keywords: lidar, equatorial region, cloud, aerosol, metallic layer

Japan Geoscience Union Meeting 2012
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MIS29-10 Room:203 Time:May 24 11:30-11:45

Meteor echo observations by a large atmospheric radar

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[1]National Institute of Polar Research

Meteor scatter echo of VHF radio wave from 80 - 120 km altitude has been used over 60 - 70 years for wind velocity measurement for atmospheric dynamics studies and meteor flux/orbit studies for interplanetary dust studies. More recently, high power large aperture (HPLA) radars for atmospheric studies, i.e., large atmospheric radars have extensively been used to detect more faint meteor echoes, and precision of measurement, for both atmospheric and meteor science studies, has been improved significantly. In this paper, we introduce the progress of the radar meteor echo observation, and discusses possible application to the future equatorial radar system.

Keywords: radar, meteor, equator, mesosphere, atmospheric wave, atmospheric radar

Japan Geoscience Union Meeting 2012
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MIS29-11 Room:203 Time:May 24 11:45-12:00

Conceptual Study of L-band new Equatorial Atmosphere Radar System

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[1]Research Institute for Sustainable Humanosphere

In this paper, the conceptual study of the extremely new style radar system will be discussed for considering the next generation Equatorial Atmosphere Radar. To monitor the wide spatial distribution of ionosphere and lower atmosphere, the pair of high-elevation antenna array facing the opposite azimuth direction is very useful. The high power antenna beam with the elevation of 10-15 degrees is required to observe the ionosphere over the geomagnetic equator. To elucidate the detailed behavior of the columns convection in the Equatorial region, Comprehensive horizontal distribution of radial wind velocity and turbulence intensity is also very important to elucidate the detailed behavior of columns convections and their impact on the atmospheric activity in TTL region. This radar enables us to monitor the radial wind velocity by detecting clear-air echo in the no precipitation conditions.

The required total power of this radar with L-band radiowave is roughly estimated to 1 MW in peak power to monitor the lower atmosphere from the atmospheric boundary layer to the tropopause region and ionosphere.

The detailed concept of this new radar system will be explained. We are very welcome to discuss the advantage/disadvantage and feasibility of this new concept radar system.

Keywords: Equatorial Atmosphere Radar, Radar System

Japan Geoscience Union Meeting 2012
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MIS29-12 Room:203 Time:May 24 13:45-14:00

Innovations on radar convection dynamics and Japan-Indonesia collaboration

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Planetary fluid dynamics has two categories: (i) vortex or Rossby waves, and (ii) convection or gravity waves. Radars including UHF/VHF bands have been used as standard tools for (ii). Because (i) and (ii) are dominat respectively in mid-/high- and low-latitudes on Earth, radars are essentially important in the equatorial region. In particular the Indonesian maritime continent (IMC) is the convection center due to systematic diurnal-cycle along the warld's longest coastlines, which affects equatorial atmosphere over oceans (intraseasonal and interannual variations), mid-/high-latitudes (monsoons and teleconnections) and middle/upper atmospheres (upward propagating waves). Such significance of IMC had been already noticed far before construction of EAR, and now many radars including our HARIMAU radars have been used to clarify each category of convection dynamics. Asian countries developing far rapidly than expected before EAR construction need much accurate weather/climate predictions to sustain their development against their own vulnerability as well as global crisis. The two G20-member archipelagic nations must consider new collaborations including atmospheric science and technology.

Keywords: convection, gravity waves, cumulonimbus, climate, disaster prevention, international relationship

Japan Geoscience Union Meeting 2012
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MIS29-13 Room:203 Time:May 24 14:00-14:15

Estimation of raindrop size distribution profile using EAR and BLR

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Raindrop size distribution (DSD) is important and useful to analyze precipitation microphysics and to improve the accuracy of estimating rainfall rate from the radar observation. Estimation of DSD in Koto Tabang has been done using single-frequency algorithms by Kozu et al., 2003, Renggono et al., 2006, and Marzuki et al., 2009. Now this study presents estimation of DSD using a dual-frequency algorithm with two radars, i.e., the Equatorial Atmosphere Radar (EAR) that oparates at 47 MHz to measure the back-ground clear-air motions and a Boundary Layer Radar (BLR) that operates at 1357.5 MHz to provide precipitation return. We present a comparison of DSD estimates between dual-frequency versus single frequency algorithm and some results of vertical DSD profiles using the dual-frequency algorithm.

Keywords: DSD, Radar, Equatorial atmosphere

Japan Geoscience Union Meeting 2012
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MIS29-14 Room:203 Time:May 24 14:15-14:30

Raindrop size distribution observations with Parsivel and Micro Rain Radar (MRR) over Sumatra

MARZUKI, Marzuki[1*], HASHIGUCHI, Hiroyuki[1], YAMAMOTO, Masayuki[1], KOZU, Toshiaki[2], SHIMOMAI, Toyoshi[2], YAMANAKA, Manabu D.[3], MORI, Shuichi[3]

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The variability in the observed drop size distribution (DSD) or its integrated parameters is attributable to two main sources: instrumental effects and natural (diurnal, intraseasonal and seasonal) variability [1]-[2]. The aim of the present study is to compare the performances of various instruments, based on different measuring principles, in the rainfall-rate (R) and DSD estimates. It is also to investigate the variability of the DSD over Sumatra, Indonesia.

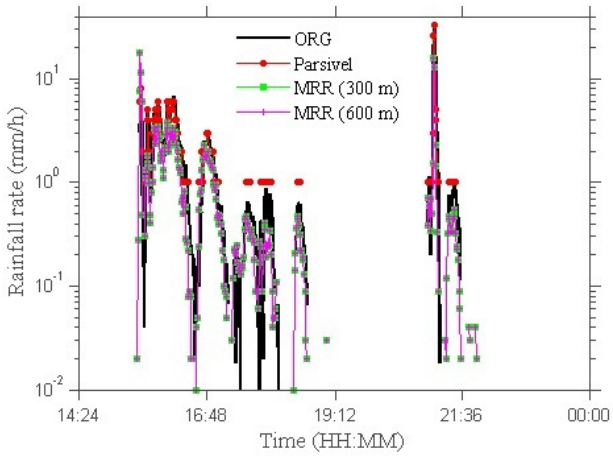
We collect the precipitation data by using Parsivel, Micro Rain Radar (MRR) and Optical Rain Gauge (ORG). The Parsivel disdrometer is a laser optical device which - in theory - can measure the size and fall speed of hydrometeors. The size category goes up to 25 mm, with 32 size classes of varying diameter intervals, and the velocity category
goes up to 20m/s, again with 32 classes, and again with varying velocity intervals. Parsivel provides several parameters such as rainfall rate and DSD. The instrument at Koto Tabang (Sumatra) has been installed since January 2012. In the present study, MRR data is used to classify the precipitating systems and to retrieve the microphysical parameters. The DSDs are parameterized by normalized gamma distribution [2]

Figure 1 shows an example of rainfall rate (R) time series for rain event on 11 January 2012. In general, R of ORG and Parsivel is in good agreement ($r\hat{}2 > 0.9$). On the other hand, MRR provides lower R than ORG and Parsivel. The difference in R between MRR and ORG/Parsivel is significant during heavy rain which is probably due to strong rain attenuation in the frequency of MRR (24 GHz) in this condition. Detailed analysis regarding the comparison between the instrument performance and the variability of the DSD over Sumatra will be presented in the meeting.

[1] Marzuki, Randeu, W.L., Schoenhuber, M., Bringi, V.N., Kozu, T., Shimomai, T., 2010. Raindrop Size Distribution Parameters of Distrometer Data With Different Bin Sizes, IEEE Trans. Geosci. Remote Sens. 48, 3075–3080.

[2] Marzuki, Randeu, W.L., Kozu, T., Shimomai, T., Schoenhuber, M., 2011. Raindrop axis ratios, fall velocities and size distribution over Sumatra from 2D-Video Disdrometer measurement, Atmospheric Research., doi: 10.1016/j.atmosres.2011.08.006.

Keywords: Raindrop size, Parsivel, MRR



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MIS29-15 Room:203 Time:May 24 14:30-14:45

Characteristics of precipitation systems associated with intra-seasonal variability observed with the EAR and rain radar

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In the tropics, the dominant intra-seasonal variability with a period of 30-60 days is characterized by a large-scale convective system propagating from the eastern Indian Ocean to the western Pacific. When the ISV arrived at the mountainous region of western Sumatera, its structure and movement are suddenly changed owing to the organization of meso-scale convective system and topographic effects of Sumatera, while the evolution of meso-scale convective systems occurring over the mountainous region is strongly influenced by a low-level environmental wind associated with the ISV. In the present study, we investigated evolution features of meso-scale convective system and the associated wind behavior in relation to ISV phase, using the long-term (2002-2010) observational data of the equatorial atmosphere radar (EAR) and X-band rain radar at Kototabang over the mountainous region. In the analysis period, 110 convective events with diurnal cycle were observed within 30 km from the X-band rain radar. According to the duration and size of typical convection in each event, we classified organized convections into four convective types (long-lasting and short-lasting convective systems in meso-beta and gamma scale). In the presentation, we will describe the development and organization mechanism of each convective type in relation to the low-level environmental wind of ISV and local circulation over the mountainous region of west Sumatera.

Keywords: Equatorial Atmosphere Radar, Convective system, Intra-seasonal variability

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MIS29-16 Room:203 Time:May 24 14:45-15:00

Vertical wind and hydrometeor characteristics measurement in and around melting layer by the EAR and polarization lidar

YAMAMOTO, Masayuki[1*], ABO, Makoto[2], SHIBATA, Yasukuni[2], HASHIGUCHI, Hiroyuki[1], YAMAMOTO, Mamoru[1], FUKAO, Shoichiro[3]

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Simultaneous measurement of vertical air velocity (W), particle fall velocity, and hydrometeor phase was carried out using a 47-MHz wind profiling radar and a polarization lidar installed at Sumatra, Indonesia (0.2S, 100.32E, 865 m MSL) in December 2008. The 47-MHz wind profiling radar, referred to as the Equatorial Atmosphere Radar (EAR), measured W and reflectivity-weighted particle fall velocity relative to the air (Vz) simultaneously. The lidar measured linear depolization ratio (LDR), which is an indicator of hydrometeor sphericity. A stratiform precipitation case on 8 December 2008 and that on 16 December 2008 were compared to describe differences of W, Vz, and LDR.

Surface rainfall intensity was greater than 2 mm/h in the 16 December case, while raindrops evaporated until they reached to the ground in the 8 December case. Upward W above the melting level was greater than 0.2 m/s in the 16 December case, while it was weak (less than 0.1 m/s) or absent in the 8 December case. Vz of 1.6 m/s at 300 m above the 0 degC altitude (5.2 km MSL) in the 16 December case was greater than the 8 December case (1.3 m/s). The thickness of melting layer in the 16 December case (900 m) was greater than the 8 December case (300 m). Because Vz is an indicator of particle size, the results suggests that the size growth of hydrometeors under the presence of upward W contributed to the formation of thick melting layer in the 16 December case. Owing to complex interfaces of water-coated ice crystal branches, LDR at the melting level increased 0.17-0.20 in the two cases. Lidar dark band was also observed in the two cases.

Vz of raindrops in the 16 December case (7.0-7.5 m/s) was greater than that in the 8 December case (3.7-3.9 m/s) due to larger sized raindrops in the 16 December case. LDR of raindrops in the 8 December case was less than 0.01, while it was up to 0.10 in the 16 December case. A possible reason for the LDR difference is discussed.

Keywords: Equatorial Atmosphere Radar, lidar, precipitation, melting layer