2007FY　Next Generation Research Initiative　Research report

1.　Title、Visiting Site、Name

Title: Monitoring of lightning activity in the Southeast Asia
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2.　Purpose

Recent satellite-based optical measurements have clarified significantly high levels of activity of lightning discharges in the Southeast Asian region. However, since lightning observation network systems do not exist in this region, the relationship between lightning activity and meteorological condition is not yet fully understood and their effects on social activity is still an open question.

In the present study, a lightning observation network system, which consists of three VLF electromagnetic receivers and an optical sensor, has been developed. While the installations of VLF sensors are conducted as the project of Tohoku University, the installation of an optical imaging sensor is carried out based on the Grant for Next Generation Research Initiative under the Global COE Program. The purpose of this study is to investigate lightning activity in various spatiotemporal scales and to clarify severe weather phenomena which eventually cause significant damage to human activity.

3.　Installation and results

On the basis of the G-COE research grant, a lightning CCD camera was installed at JAMSTEC/MIA radar site in Padang, West Sumatra, Indonesia. During the period from 27 January to 2 February in 2008, an optical observation system was setup at the MIA site (100.3 E, 0.79 S), which is located near Padang international airport and is part of the observation network HARIMAU (Hydrometeorological Array for ISV-Monsoon Automonitoring). About 75 km north of the site, the equatorial atmosphere radar (EAR) of Kyoto University is also located. Thus, the MIA site is one of the most suitable regions to carry out lightning observation in cooperation with meteorological radar measurements. At the MIA site, an X-band Doppler radar, an automatic weather station, and a sky-view camera are continuously operated and the obtained data are collected and analyzed by the recording system installed in a container. The lightning camera used in this study was fixed on the roof of the container and is directed to the sky above the EAR site (azimuth: 5 degrees west from the geographical north, elevation: 30 degrees up from the local horizon). Since the residential area is located in the viewing direction, a masking structure was deployed in front of the camera to improve the lightning detection efficiency especially in the night time observation. By using a non-spherical lens which has an automatic aperture-adjuster that is synchronized to the CCD output level, the imaging system can be continuously operated both day and night time. Furthermore, the data recorder was connected to the internet so that we could check the status of the system and change the observation mode from anywhere in the world.

On the night of 29 January, 2008, test observations were carried out to check the full functionality of the system. As a result, no problem was found in the observation mode, image quality, and network connection. On the next day, by analyzing the observation data with a motion-capture software named “UFO capture”, 322 lightning events were found during a 3.5-hour observation. Temporal variations of occurrence frequency indicated that the lightning activity started at 19:30 LT (Local time), reached the maximum intensity at 20:20 LT, and dissipated at 21:30 LT. From this one-night observation, it was found that the time scale of lightning activity corresponds to the typical life time of a cloud cell, suggesting an isolated thunderstorm was the producer of lightning.

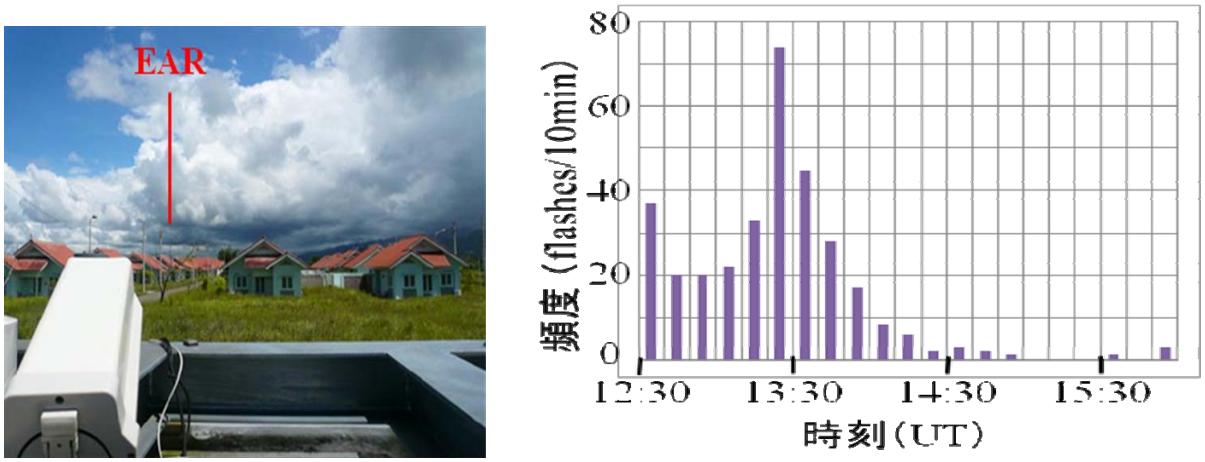
After the installation in January, regular continuous observations have been carried out. Since the data recorder has a large sized hard disc (500 GB) and the input data are compressed into a MPEG-4 format, the

imaging system can store data for 4 or 5 months. Furthermore, by using the trigger recording mode, which records data only when the output signal level exceeds certain criteria, 1-year automatic observations are possible with maintenance-free. As preliminary observations, the system is currently set to record continuous data during the period from 18 LT to 04 LT every night. In this case, the amount of recorded data is about 3.4 GB per one night and, therefore, 5-month data can be stored to the 500 GB hard disk.

4. Future Plan

In order to clarify severe weather phenomena which have had a significant influence on social activity, the observed data will be brought back to Japan in September 2008 and then analyzed with MIA radar and EAR data. The obtained results will be submitted to Kyoto Working Papers on Area Studies.

5. Related pictures



(Left) The lightning camera installed at MIA site and the direction of EAR site. (Right) Temporal variation of lightning occurrence frequency observed on 29 January, 2008.