C07

Preliminary Investigation of Generation of Guerilla-Heavy Rainfall Using Himawari-8 and XRAIN Information in Kinki Region

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In this study, we investigate the capability of combining Himawari-8 and XRAIN data to detect the generation of Guerilla-heavy rainfall by using real observation data in Kinki region. To fix parallax errors in Himawari-8 observation, a parallax equation is calibrated by 16 pairs of cloud brightness temperature (Tbb) and radar echoes, which are manually extracted from real observation data. As the difference of Tbb value is related to the distance between cloud and rain echoes, it is used as an input of parallax equation for determining the cloud height. The vectors of locations of Tbb value before and after parallax correction were applied to adjust cloud location in visible data. Finally, the matched of cloud and rain echo locations are used to study cloud development process to find a very important signal before the occurrences of Guerilla-heavy rainfall.

1. Introduction

Flash floods and landslides that occurred in or around urban area mostly caused by localized heavy rainfalls. In Japan, localized torrential rainfall generated by an isolated cumulonimbus cloud that grows rapidly is called "Guerilla-heavy rainfall" (GHR for abbreviation). In 2008, an isolated cumulonimbus cloud developed around Osaka-Bay Area within 30 minutes and brought localized heavy rainfall to trigger a flash flood in Toga River in Kobe. This sudden flood disaster caused five people dead. Therefore, for preventing the public from this threat, it is very important to investigate the initiation mechanism of GHR and to develop a method to predict its occurrence. Nakakita et al (2011) have proposed a technique to detect the early stage of rain cell, and investigated the model to predict short term rainfall (Nakakita et al 1996, 2012).

To improve our knowledge about GHR, we would like to utilize Himawari-8 observation data with XRAIN data for analysis. As the Himawari-8 data has fine temporal and spatial resolutions, it can provide very valuable information for finding the important feature of a developing cumulonimbus cloud. Hence, we propose a methodology to utilize Himawari-8 and XRAIN data to pinpoint the cloud location before the first echo of heavy rainfall detected by weather radar.

2. Data and Methodology

The data from Himawari-8 satellite observation and XRAIN is used for this study. Himawari-8 a is Geostationary Meteorological Satellite which was launched by the Japan Meteorological Agency, and located at about 36,000 km above the equator and 140^{o} east in the space. It has 16 observation bands, including three visible bands, three near-infrared bands and ten infrared bands. It has fine spatial and temporal resolutions (0.5-2 km, 2.5 minutes) (Bessho et al, 2015). To investigate cloud albedo and cloud-top temperature, we use the visible (albedo) data and brightness temperature (Tbb), observed by channel #B03 and #B13, respectively. We also use radar echo from XRAIN, which is a system of multi-parameter weather radar operated by Ministry of Land, Infrastructure, Transport and Tourism. The spatial resolution of XRAIN is 150 m in a maximum observation range of 80 km. Using observation data in Kinki region, we overlay the albedo and Tbb from

Himawari-8 with radar echo from XRAIN to analyze the correlation among parameters and development of cloud and rainfall.

In order to fix parallax errors in Himawari-8 data, we manually extract 16 pairs of Tbb and radar echoes, and use them to calibrate a parallax equation. Fig. 1 shows the distance between the locations of clouds and radar echoes. The difference of Tbb caused the difference of distance between the echoes. The lower of Tbb value reflect the farther distance between the echoes. The cloud height depends on the difference of the distance, and is used as the input to the Parallax equation.

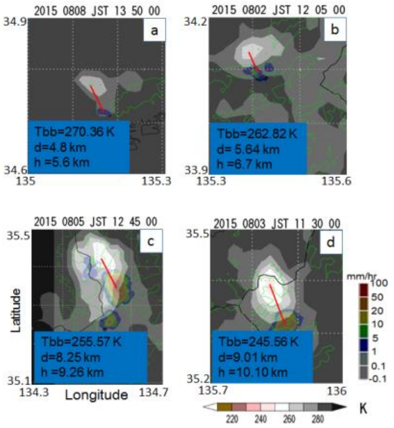

Figure 1. The cloud height information retrieved from the distance between Tbb and cloud echo.

3. Result and Discussion

The overlay of Tbb with radar echoes before and after parallax corrections are shown in Figure 2. In Fig.2a, before correction the Tbb location is northern of radar echo. The parallax is removed by our parallax equation, as is in Fig. 2b. Besides, by using the movement vector of Tbb value, the albedo data can also be shifted to the original location. The overlays of albedo and radar echoes before and after parallax correction are shown in Fig. 3a and b, respectively. As in Fig. 3a the distribution of lower cloud albedo (0.1-0.4) is eliminated to show the pair of albedo and radar echoes clearly. Also, fig. 3b shows the overlay of albedo (0.5-1) and radar echoes.

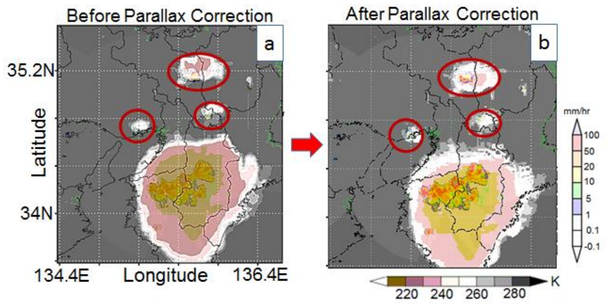

Figure 2. Overlay of Tbb and radar echo on 8 August 2015 1440 JST, a) before parallax correction, b) after parallax correction.

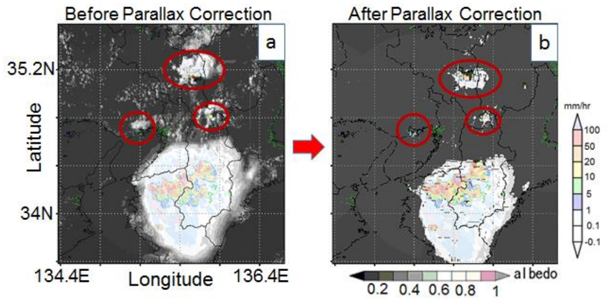

Figure 3. Overlay of albedo and radar echo on 8 August 2015 1440 JST, a) before parallax correction, b) after parallax correction.

4. Conclusions

In this preliminary study, we have investigated the capability of Himawari-8 observation data to detect the signal in the initial stage of cloud development earlier than the GHR echo by weather radar. To fix parallax error in Himawari-8 data we calibrated a parallax equation using Tbb and cloud height by observed data. The result of case study of observation in Kinki region shows that combining Himawari-8 and radar echoes are capable to detect the important signal of a cloud in the initial stage before the occurrence of the first echo of GHR.

References

1. Nakakita et al, "Short-term rainfall prediction method using a volume scanning radar and grid point value data from numerical weather prediction," *J. Geophys. Res.*, vol. 101, no. D21, p. 26181, 1996.
2. Nakakita et al, "Application of Error-Ensemble prediction method to a short-term rainfall prediction model considering orographic rainfall," no. April 2011, p. 2012, 2012.
3. Bessho et al, "An Introduction to Himawari-8/9— Japan’s New-Generation Geostationary Meteorological Satellites," *J. Meteorol. Soc. Japan. Ser. II*, vol. 94, no. 2, pp. 151–183, 2016.