THE STRUCTURE OF CONVECTIVE SYSTEMS OBSERVED BY PHASED ARRAY RADAR IN THE KINKI REGION, JAPAN

Sho Yoshida[1], Tomoo Ushio[2], Satoru Yoshida[2], Shigeharu Shimamura[2], Kouichi Maruo[2], Nozomu Takada[1]

[1]Meteorological Engineering Center, Inc.   [2]Graduate School of Engineering, Osaka University

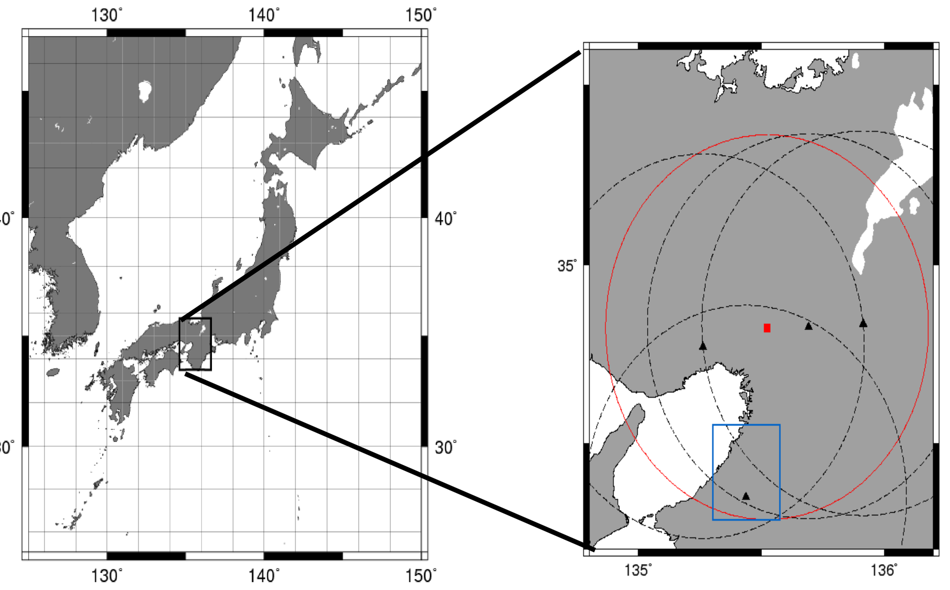
INTRODUCTION

Localized and short-term heavy rainfall generated by convective systems often cause disasters in Japan. In particular, urban flash floods, which have short response time of less than an hour, threaten the safety of urban residents. To solve these problems, Osaka University developed the phased array radar (PAR) at X band in Japan. PAR can scan very rapidly (30 seconds for full volume scan) with the high resolutions of azimuthal 1.2 degrees and range 0.1 km. We used the phased array radar data to investigate convective systems which cause local and short term heavy rainfall, mainly from the viewpoints of their vertical structure and process of development.

DATA

We used three dimensional reflectivity data observed by PAR and X-band multiparameter (XMP) radars. Both data resolution are indicated as follows:

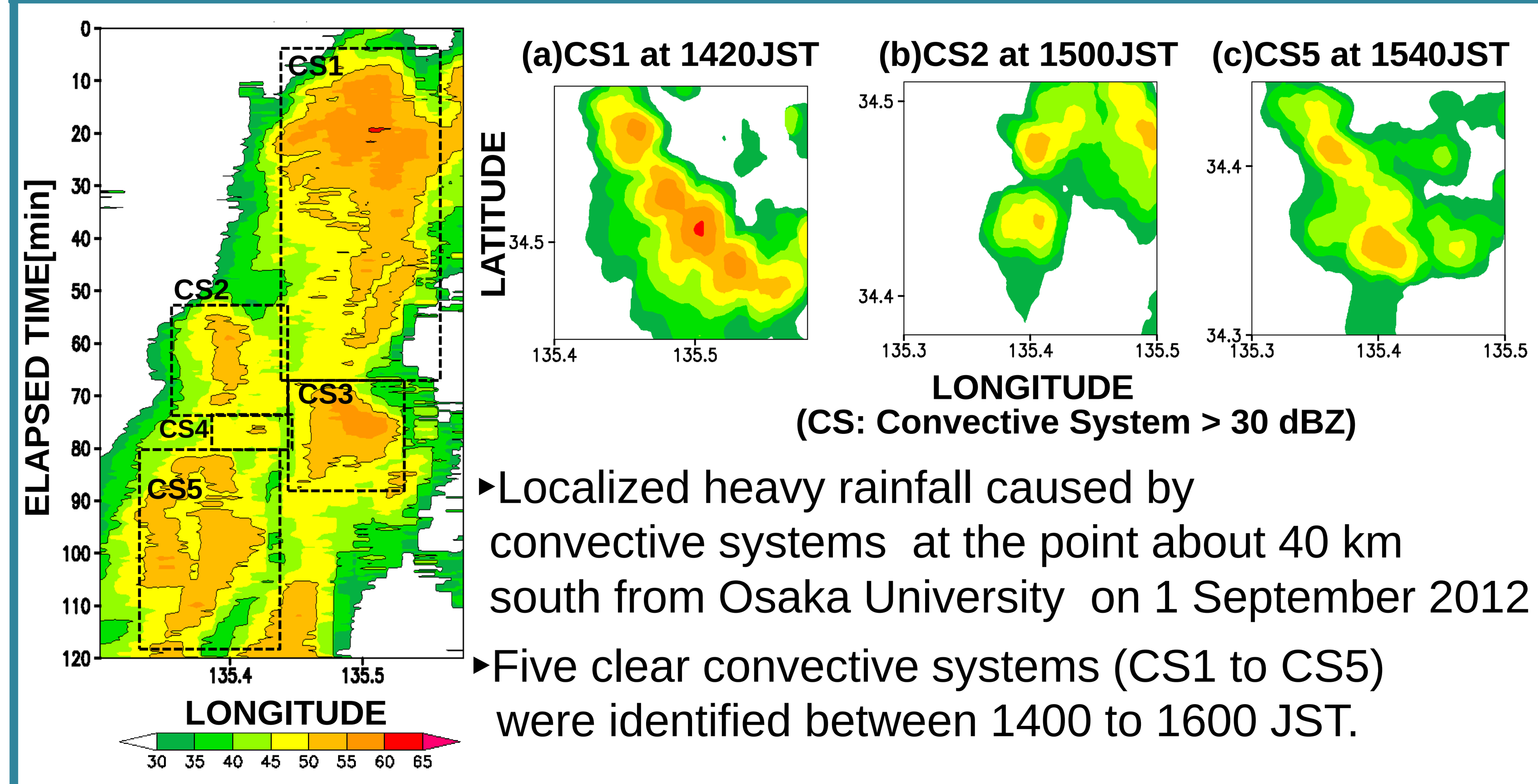
	XMP	PAR
Temporal resolution :	5 min	30 sec
Spatial resolution :	250 m	100 m



■PAR site
▲XMP radar sites
□Target domain

Fig. 1. Location and observation area of radars.

CASE OVERVIEW



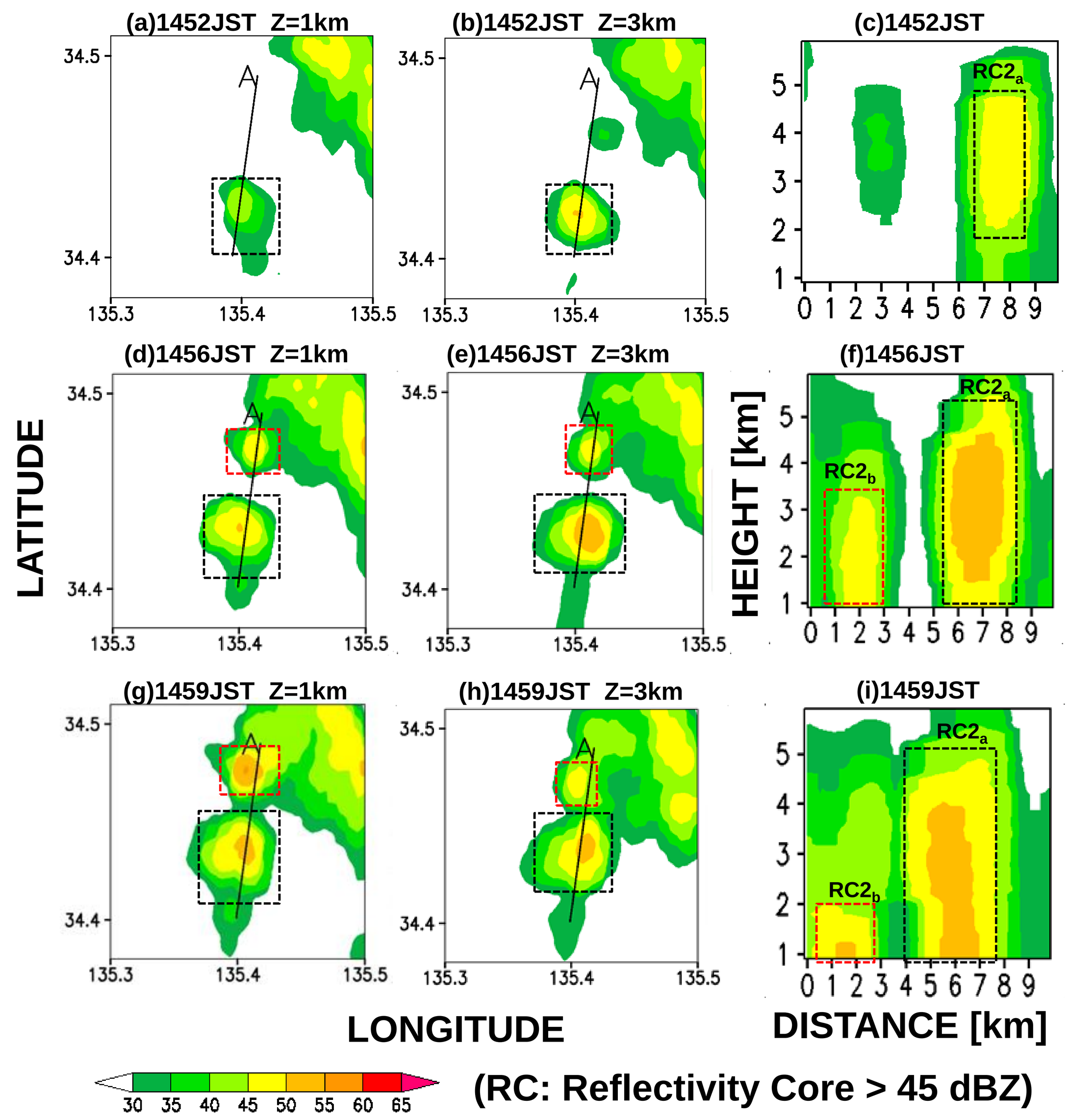
- Localized heavy rainfall caused by convective systems at the point about 40 km south from Osaka University on 1 September 2012
- Five clear convective systems (CS1 to CS5) were identified between 1400 to 1600 JST.

Fig. 2 Hovmoller diagram of maximum reflectivity at 1 km height (left) and snapshots of CS1, CS2 and CS4 at 1420(a), 1500(b), 1540(c) JST, respectively. Vertical axis of hovmoller diagram indicates elapsed time from 1400 JST.

CONCLUSIONS

- We used PAR data to investigate life cycle and vertical structure of convective systems which caused localized heavy rainfall
- The convective cells which organized convective systems generated and dissipated repeatedly.
- These temporal evolutions can be identified with reflectivity at upper level in advance. Reflectivity cores were formed around 5 km height and descended to the ground in about 10 minutes.
- XMP failed to detect these temporal changes, because the temporal resolution of full volume data was not sufficient.
- Detection of the reflectivity core in real time is prospective to be new indexes for more accurate short time forecasting

RESULTS



- At 1452JST, radar echo (> 45 dBZ) was found at 3 km height (black dotted rectangle in (b)).
- However, radar echo at 1 km height was not so strong (black dotted rectangle in (a)).
- At 1456JST, radar echoes at 1 and 3 km height gained reflectivity, respectively (black dotted rectangles in (d),(e)).
- On the other hand, new radar echo was observed (red dotted rectangle in (d)). This echo was found at 3 km height at 1452JST in advance((b)).
- At 1459JST, both radar echoes at 1 km height gained reflectivity (red and black dotted rectangles in (g)).
- These temporal changes at 1 km height were identified with those at 3 km height in advance.

Fig. 3 Horizontal distribution of reflectivity at 1 km height (a, d and g) and at 3 km height (b, e and h), and vertical cross section of reflectivity along line A at 1452(c), 1456(f) and 1459(i) JST.

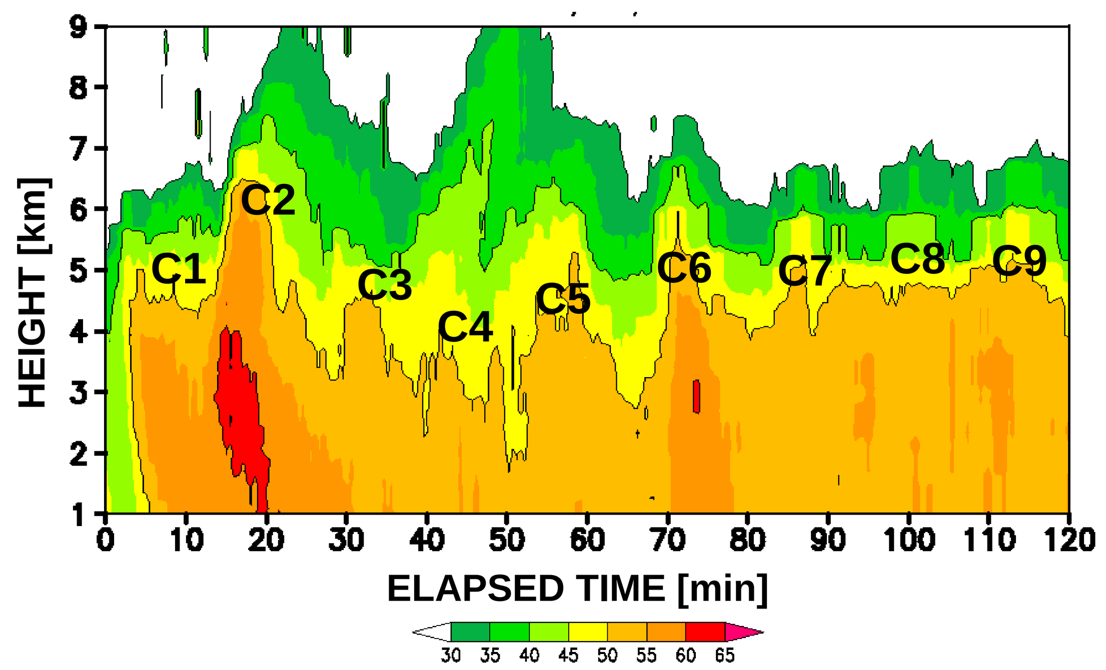


Fig. 4 Time-height cross section of maximum reflectivity. Horizontal axis indicates elapsed time from 1400 JST.

- At least nine reflectivity cores can be identified between 1400 to 1600 JST (C1-C9)
- These cores recurred every 10 minutes and formed at 3 to 5 km height.
- Temporal resolution of XMP radar was not sufficient to detect these temporal changes and detailed structure of reflectivity cores.