P6A.2 FOG DETECTION BY KA-BAND METEOROLOGICAL DOPPLER RADAR

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1. INTRODUCTION

A Ka-band meteorological Doppler radar was co-developed by Mitsubishi Electric Corporation and Kyoto University for experimental observations of fog (Ohmori et al. 1999; Hamazu et al. 2001; Hamazu et al. 2003). The appearance of radar mounted on a truck is shown in Fig. 1. Field tests were conducted in Beppu-Bay and on the coast of Kushiro for the purpose of developing fog detection and prediction techniques. In this paper, we analyze field observation data of fogs, and deriving a fog detection algorithm based on criteria which indicates the status of low visibility.

Fig. 1: Ka-band meteorological Doppler radar.

2. FOG DETECTION ALGORITHM

We investigated the relation between the time periods when visibility is low and time variations of radar echoes. Figures 2 and 3 show sample images of observed radar echoes in Beppu-bay. Fig. 2 shows the echoes when visibility was good, while Fig. 3 shows the echoes when low visibility was observed. We acquired the following conditions from the analysis of radar echo data.

- Correlation is seen between state of low visibility and a specific echo intensity value; －25 － 10dBZ.
- Echo top altitude becomes constant when fog exists; 0.5 － 1.0km.
- Echo area (rate) increases as the elevation is lower.

From the above, we developed the low visibility status detection algorithm which uses three radar parameters such as echo intensity, echo top altitude and echo area rate, and calculates the logical product of these parameters. Figure 4 shows a block diagram of the low visibility detection algorithm.

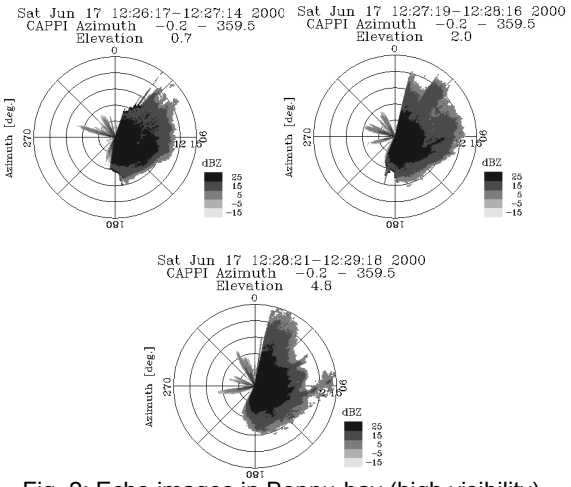

Fig. 2: Echo images in Beppu-bay (high visibility).

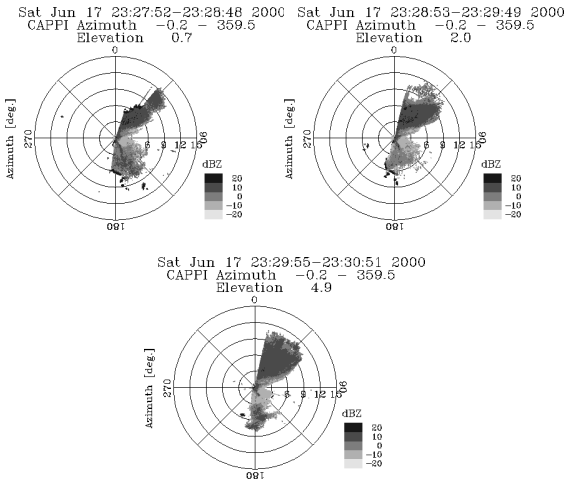

Fig. 3: Echo images in Beppu-bay (low visibility).

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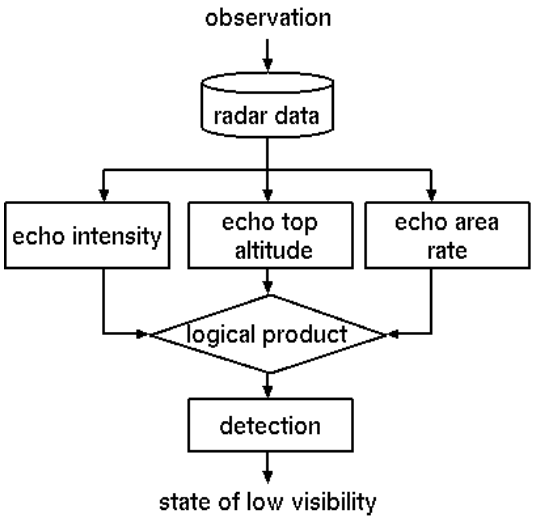

Fig. 4: Block diagram of the low visibility status detection algorithm.

3. FOG DETECTION RESULTS

In this section, we apply the proposed algorithm to field data, and show results of fog detection.

(a) Data observed in Beppu-Bay
Figure 5 shows fog detection results using Beppu-Bay data. Solid curves show visibility range reference measured by visibility meter, and X marks indicate the time periods when the proposed algorithm detected fogs. These results show that the reference visibility and the fog detection results based on radar observations are well in agreement.

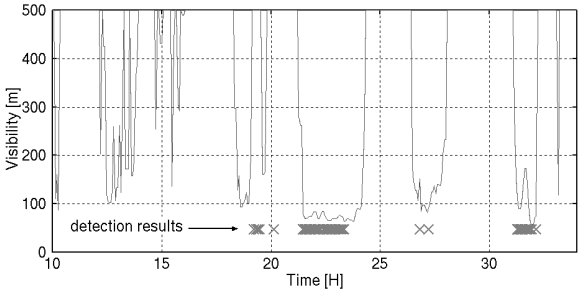

Fig. 5: Fog detection results in Beppu-Bay (2000).

(b) Data observed at Kushiro coast
Figure 6 shows fog detection results using Kushiro coast data. Also in this case, the time periods of the state of low visibility has detected appropriately. Furthermore, these results indicate that the proposed algorithm can be properly applied to different type of fog observed in other place.

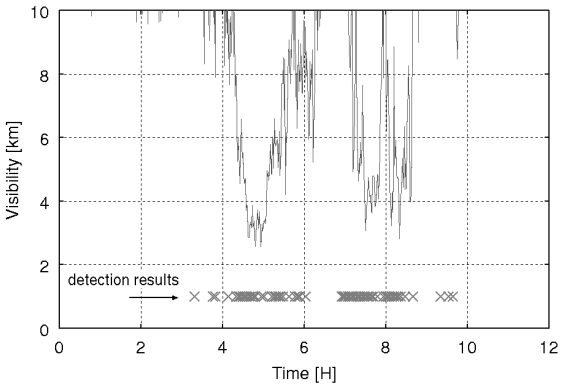

Fig. 6: Fog detection results at Kushiro coast (2001).

4. CONCLUSIONS

We proposed fog detection algorithm using three radar parameters such as echo intensity, echo top altitude and echo area rate. The results of data analysis show that the proposed algorithm can properly detect different types of fog.

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