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Estimation of Rain Rate from Phased Array Weather Radar Using X-Band Polarimetric Radar Measurements

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Estimation of Rain Rate from Phased Array Weather Radar Using X-Band Polariometric Radar Measurements

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1.Introduction
- In a dam basin, for hydraulic power generation that Kansai Electric Power manages, sudden floods with local heavy rain occur frequently.
- Therefore, difficulty of the dam operation increases, and the need for accurate short term rainfall prediction technique becomes higher.
- To improve the accuracy of short term rainfall prediction, it is necessary to observe precipitation distribution in and around of the dam basin with high resolution and high accuracy.
- X-band phased array weather radar (PAWR) can observe with high temporal and spatial resolution. However, PAWR can observe only reflectivity (Z).
- In general, rain rate (R) can be estimated from Z using fixed Z-R relations (Z = B'R²). However, Z-R relations vary widely due to variations in drop size distribution (SD).
- It is difficult to retrieve the SD from non-polarimetric radar (PAWR). While the SD can be retrieved by using not only Z but also polarimetric radar parameters.
- We have developed rain rate estimation method from PAWR using DSD information retrieved by X-band polarimetric radar information network (X-RAIN)*.

* X-RAIN is a polarimetric radar network operated by Ministry of Land, Infrastructure and Transport and Tourism (MLIT) in Japan.

2.Method of retrieving DSD
- In this study, DSD is retrieved by
  1. GM method (Zhang et al., 2001)
     - DSD is retrieved from Z and R using empirical formulas obtained from disdrometer observation.
     - The retrieval accuracy tends to decrease in heavy rainfall case due to the rainfall attenuation.
  2. The method proposed by Yamasaki et al., 2012 (YM method)
     - DSD is retrieved from Z and R using empirical formulas obtained from disdrometer observation.
     - The retrieval accuracy tends to decrease in light rainfall case due to the variations of R.

3.Data
The ground observation points (Miyama, Honjo, Syuchi) are slightly greater than the method without XRAIN.

4.Target events
We selected following events that local heavy rainfall had occurred in the Wachi dam basin.

5.Results
(1) Time change of Z-R relation
The right figure shows examples of time series of estimated Z-R from XRAIN and XPRD.

(2) Comparison of rainfall estimation accuracy
We compared estimation accuracy of 10 minutes rainfall between the method with XRAIN and without XRAIN.

6.Conclusion and future works
- We have developed a rain rate estimation method from PAWR using DSD information retrieved by XRAIN. As a result of application to Wachi dam basin in Japan, the new method showed improving underestimation against fixed Z-R relation (B = 200, R = 1.6).
- We will develop short time prediction method using 3D high resolution radar data observed by PAWR.
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Methods of analysis

Implementation of the method

Results

Discussion

Acknowledgments

References