Poster3-45

USE OF SPACE-BORNE RADAR OBSERVATIONS IN EVALUATING GROUND RADAR NON-PRECIPITATION ECHO IDENTIFICATION ALGORITHM

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1. INTRODUCTION

The performance of non-precipitation echo identification algorithm directly affects the results of downstream applications (such as quantitative precipitation estimation). Therefore, it is important to evaluate the algorithm performance objectively and quantitatively. It has been shown that PR observations can be used to systematically monitor the calibration coefficient of ground-based radar (GR) systems (Han et al. 2018). Given that the space-borne radar(TRMM PR) and ground-based weather radar system measure the same variable (i.e., reflectivity), and that the PR is fairly consistent with respect to calibration accuracy, the evaluation could be carried out by comparing the PR reflectivity factor values with those of GR before and after the identifying. The evaluation results can provide basis for the improvement of the identification algorithm.

2. Temporal and spatial matchup

Because the duration of a GR volume scan is 6 min, PR scan data and GR volume scan data collected within 6 min were selected. Six minutes is the maximum theoretical time difference between a TRMM scan and a GR volume scan to permit valid matching, and there may be more than one GR volume scan that meets the criterion. When performing temporal matching using the PR and GR data, volume scan data were chosen according to the overpass time of TRMM in the GR observational area and the start time of the GR volume scan, to minimize the discrepancy.

The PR and GR matchup method described by Schwaller and Morris (2011) was used to merge the PR data and GR observations in the same coordinates. The method matches the PR and GR data by calculating the average PR reflectivity and GR reflectivity at the geometric intersection of the PR rays with the individual GR elevation sweeps (Fig. 1). The horizontal resolution of the matchup point was in accordance with that of PR, and the vertical resolution was in accordance with that of the GR reflectivity data.

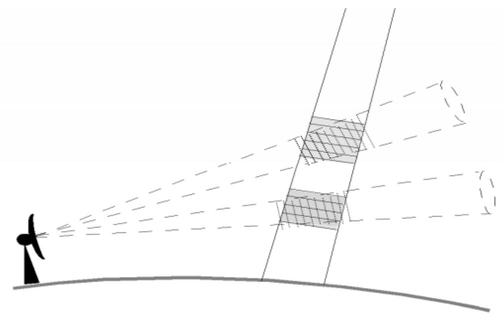
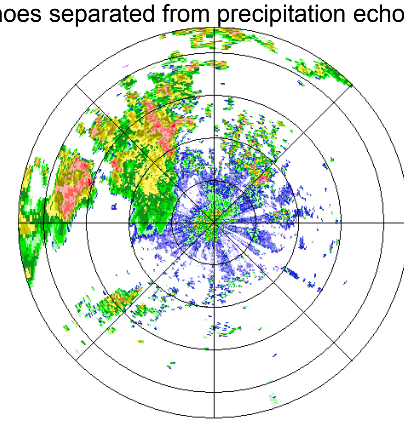


Fig.1 Schematic of Geometry-matching method (The solid lines represent PR scanning beam, the dotted lines represent GR sweeps, and the shaded area represents overlap area) (Goddard Space Flight Center, 2014)

3. Evaluation of identification algorithm

3.1 Visual evaluation

Fig. 2a shows the PPI observed by Wuhan Radar at 0.5 degree elevation at 18:50 on July 21, 2010. The matched TRMM satellite orbital number is 72239.. From Fig. 2a and Fig. 2c, AP echoes were observed in the northeast and southwest directions. Figure 2b shows the data processed by the Severe Weather Now-casting System (Wu et al. 2013). The identification algorithm well removed the AP echoes, From Fig. 2b and Fig. 2c, it can be seen that the recognition algorithm performed well in the case that AP echoes separated from precipitation echoes.



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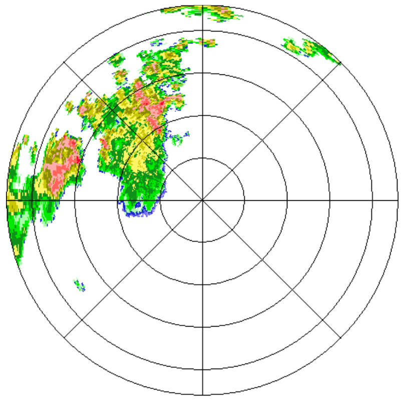

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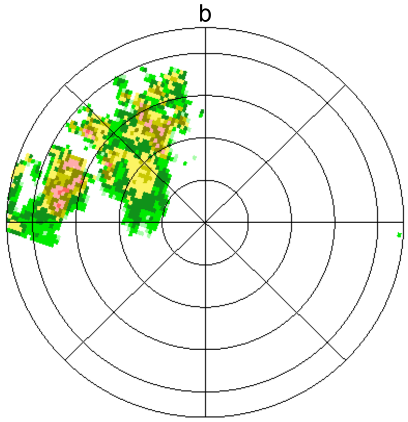

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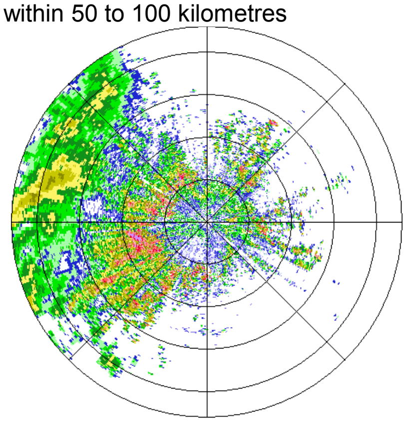
Fig.2 Geometrically matched GR before (a) and after(b) processing by the non-precipitation identifying algorithm, and PR(c) for the 0.5 elevation sweep of Wuhan radar at 18:50 21 July 2010, rendered as PPIs.

Fig. 3a shows the PPI observed by Wuhan Radar at 0.5 degree elevation at at 20:49 12 June 2004. The matched TRMM satellite orbital number is 37483. It can be seen from fig.3a and 3c that the 0.5 degree elevation data are seriously contaminated by the AP echoes. The precipitation echoes and AP ehoes mixed together in the third and fourth quadrants. It can be seen from figure 3b and 3c that the AP echoes were removed at the cost of losing some precipitation echoes within 50 to 100 kilometres



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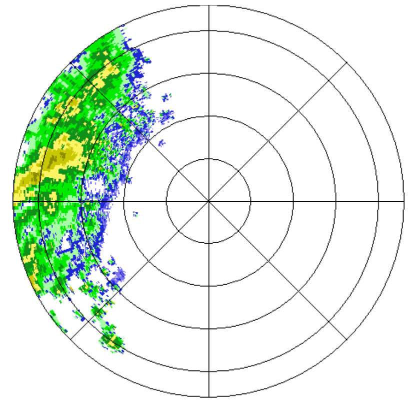

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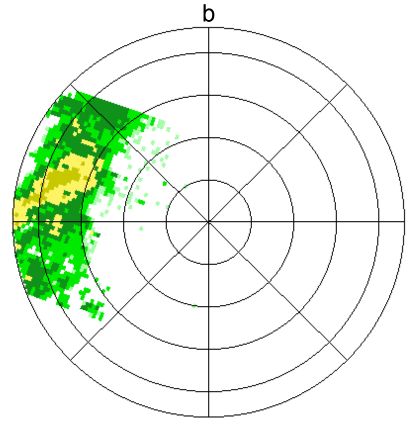

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Fig.3 Geometrically matched GR before (a) and after processing (b) by the non-precipitation identifying algorithm, and PR(c) for the 0.5 elevation sweep of Wuhan radar at 20:49 12 June 2004, rendered as PPIs.

3.2 Statistical analysis

If PR has no valid value of at the matching point while GR has one, the ground-based radar echo at the matching point is considered as non-precipitation echo. The detection rate POD (probability of detection), false alarm ratio (FAR) and critical success index (CSI) are used to evaluted identification results in the areas that non-precipitation echoes separated from the precipitation echoes.

From the statistical results, it can be seen that the algorithm performed well in areas that non-precipitation echoes separated from the precipitation echoes. Some precipitation ehcoes were mistakely removed when precipitation echoes and AP echoes mixing together (orbital number 37483).

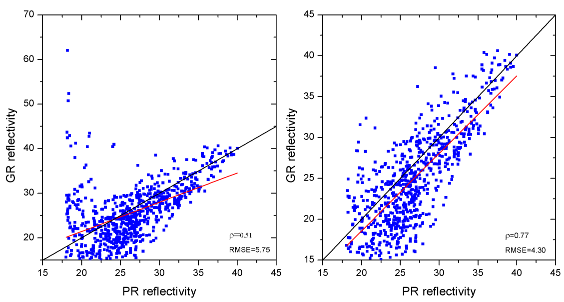
Table 1 Identification results of non-precipitation (N-P) echoes that have no overlapping with precipitation(P) echoes

Obit	N-P	N-P identified	Misidentified	POD	FAR	CSI
72239	1115	1108	35	99.4%	3.1%	96.4%
37483	1887	1884	104	99.8%	5.5%	94.6%

AP echoes can not be distinguished from precipitation echoes in the precipitation area based on the observation of spaceborne radar. Because both Spaceborne Radar and ground-based radar have valid values. But the difference of the observations between ground-based radar and spaceborne radar before and after processing can be used to evaluate the results of identification algorithm.

It can also be seen from Fig. 4a that there are some points that the reflectivity intensity of ground-based radar is much greater than that of space-borne radar(around 20dBZ). After processing, as shown in Fig. 4b, the number of these points is significantly reduced, which indicates that the AP echoes mixed with precipitation echoes were effectively suppressed.

The correlation coefficients of GR and PR reflectivity factors before and after the processing by the identification algorithm are 0.51 and 0.77, and RMSE are 5.75 and 4.30, respectively. The results show that the ground-based radar observations after processing by the algorithm are closer to those of Spaceborne Radar.



(a) (b)

Fig.5 Reflectivity scatter plot and density distribution for PR and GR for the 0.5 elevation angle before (a) and after (b) the identifying

4. Discussion

An objective evaluation method for non-precipitation algorithm using space-borne radar data is provided in this paper, two match-up precipitation events were used to briefly introduce the method.

Because of the limited matched-up precipitation events between PR and GR, the identificaiton agrithm can not be evauated in real time. It will need a long period of time to get enough match-up data to give an evaluation result for a indentification algorithm.

There are some differences (such as wave-length, sensitivity, viewing angle) between space-borne radar and ground-based radar. These difference should be considered before comparing the observations between the two radars.

5. *References*

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