P1.48 TROPICAL CYCLONE INTENSITY ESTIMATION BY TRMM/TMI MICROWAVE RADIOMETER DATA

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1. INTRODUCTION

One of the most popular methods to estimate intensity of tropical cyclone is the Dvorak technique (Dvorak, 1975, 1984). It is based on the cloud pattern in satellite imagery, but not based on a physical parameter. To complement this weak point, additional methods to estimate intensity of tropical cyclones will be needed.

Nowadays, we can get the data of physical parameters from microwave instruments on satellites, such as SSM/I, TRMM PR/TMI, AMSR-E, AMSU and QuikSCAT.

Edson(2001) found that lower-base rain appears warm in the TMI 85GHz-H brightness temperature and cool in the 37GHz-H, and rain with deeper convection appears cool in the 85GHz-H and warm in the 37GHz-V.

Several studies trying to estimate intensity of tropical cyclones with the SSM/I data have already been done. For example, Cecil and Zipser(1999) obtained the relationship between the Polarization Corrected temperature(PCT) and the maximum wind speed of tropical cyclones, and revealed that the PCT parameter is correlated with the future intensity, rather than the current intensity. They also revealed that the mean PCT and the area where the PCT is below 250K shows higher correlation than the minimum PCT.

In this study we extract the information of tropical cyclone intensity from TRMM/TMI data.

2. DATA

The data we use in this study is the TRMM TMI 1B11 brightness temperature of 19GHz-V(TB19v), 37GHz-V(TB37v) and 85hGHz-H(TB85h) channels. The PCT, defined by PCT = 1.818TB85v - 0.818TB85h is used to eliminate the radiation from ocean.

We also use the maximum wind speed data in the best-track database by National Hurricane Center(NHC) and Japan Meteorological Agency(JMA), and the ocean surface wind data by the QuikSCAT (version 3) data (from Remote Sensing Systems, www.ssmi.com) for the references of intensity of tropical cyclone. We also used the location of the center of tropical cyclones in the best-track database.

3. METHOD

We calculated the mean value of the PCT, TB85h, TB37v and TB19v within every 0.5 degree radius circles (C) and annulus(A) from the center of tropical cyclone, in the same way by Cecil and Zipser(1999). The location of the center was determined by interpolation from the best-track data. We calculated the minimum value of the PCT and TB85h, the maximum value of the TB37v and the percentage of the area where the PCT and TB85h is above 250K and TB37v is below 255K.

And to see the organization around the core region, we have used three more parameters as proposed by Bankert and Tag(2002), 1)the warmest/coldest pixel value (WPC/CPC) for the PCT,TB85h,TB37v and TB19v within 0.5 deg radius of the center, 2)the surrounding temperature(ST), determined as the coldest value in the set of warmest(coldest) values on each 0.5 deg-wide annulus (0.25 - 1.5 deg lat) (See Fig.2) and 3)the WPC(CPC)-ST as the third parameter. If the tropical cyclone has eye, the WPC(CPC)-ST tends to become large positive(negative).

We analyzed the correlation of these parameters with the maximum wind speed of tropical cyclone from the best-track or QuikSCAT. The time collocation is within 3 hours for the best-track data and 6 hours for the QuikSCAT data. We analyzed 38 tropical cyclones in the year of 1999-2001 season.

4. RESULTS

Table 1 is the parameter list with higher correlation with greater than 0.6 with the intensity. For example the annulus between 1.0 deg and 1.5 deg is shown A1015, or the circle within 1.0 deg as C10. That is, the first parameter in Table 1, 19GHz-Mean-C05, means the mean TBB within 0.5 deg of 19 GHz. The parameters of higher correlations with

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Temp	parameter	region
19GHz	Mean	C05 C10 C15 A0510
	Area	C10
	Surround	
37GHz	Mean	C10 A0510
	Area	C10 C15 A0510
	Surround	
PCT	Difference	

Table 1 List of all parameters with higher correlation greater than 0.6 with best-track intensity.

intensity are useful to estimate the intensity of tropical cyclone. The mean value and percentage of the area have higher correlation. It is consistent with the result by Cecil and Zipser(1999).

The correlations between TB19v and TB37v with the wind speed are higher than the one between the PCT with the wind speed. As the PCT may represent the activity of the convection and TB19v and TB37v are associated with the rainfall rate, we expected that the PCT or TB85h shows similar performance with the lower frequencies.

For the mean value and the percentage of area, the correlation of the wind speed with the parameters near the center within 0.5 deg is smaller than the one with the parameters away from the center. It suggests that the information of the physical parameter surrounding the core region is important.

Fig. 1 shows the scatter diagram of TB19v mean within 1.0 deg circle (C10) vs maximum wind speed by the best-track(left) and the QuikSCAT data(right). There is a linear relationship, however, we know that the rmse of both diagram is 9 m/s for the best-track and 7 m/s for the QuikSCAT data. The scattering is a bit large to estimate the intensity from this method, thus we have to improve the method by incorporating other methods, such as to combine multi parameters or to use rainfall rate or total precipitable water etc from TRMM/PR and TMI.

5. SUMMARY

We examined the usefulness of the TRMM TMI data for estimating tropical cyclone intensity. Comparing with several parameters, we found that the mean and percentage of TBB 19 GHz and 37 GHz within 1.0 deg circle or between 0.5 and 1. deg annulus gives better correlations. However the scatttering is a bit large, the rmse is about 7-9 m/s, thus requiring more improvement

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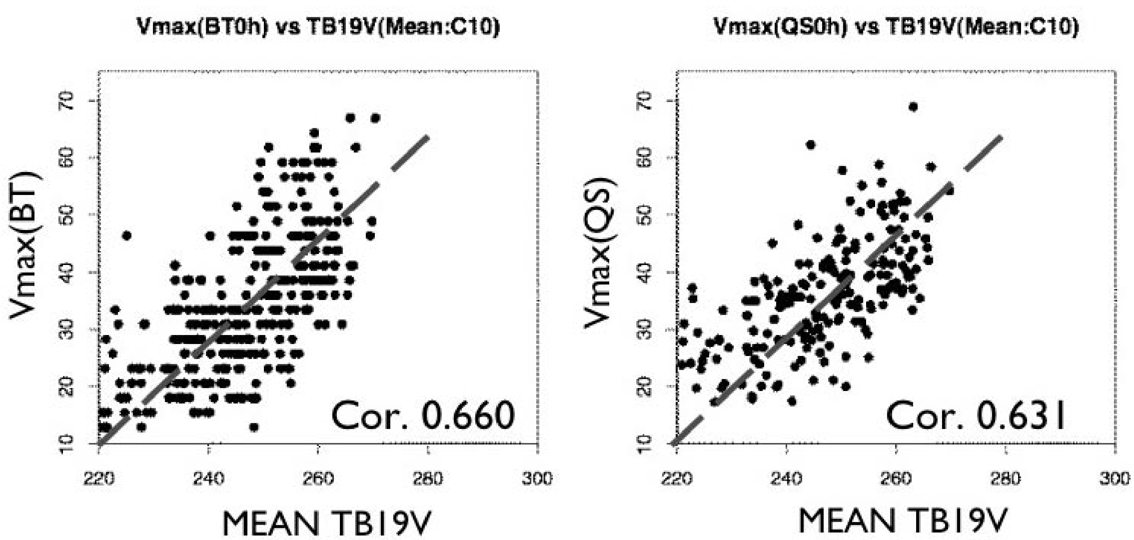

Fig. 1 Scatter diagram of mean TB19v within 1.0 deg circle (C10) with the best-track maximum wind (left) and the QuikSCAT (right) data.