THE DETERMINATION METHOD OF EXTREME EARTHQUAKE DISASTER AREA BASED ON THE DUST DETECTION RESULT FROM GF-4 DATA

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ABSTRACT:

The remote sensing has played an important role in many earthquake emergencies by rapidly providing the building damage, road damage, landslide and other disaster information. The earthquake in the mountains often caused to the loosening of the mountains and the blowing of the dust in the epicentre area. The dust particles are more serious in the epicentre area than the other disaster area. Basis on the analysis of abnormal spectrum characteristics, the dust detection methods from medium and high resolutions satellite imagery are studied in order to determinate the extreme earthquake disaster area. The results indicate the distribution of extreme disaster can be acquired using the dust detection information from imagery, which can provide great help for disaster intensity assessment. 。

STUDY AREA

The earthquake with Ms 6.9 occurred in Milin, Tibet province at 6:34, November 18th , 2017. The epicentre is located at 29.75° N and 95.02° E, with focal depth 10 kilometres. This earthquake is located close to the north-eastern part of the underthrust of Indian plate to Eurasian plate. Here the crustal shortening and the tectonically rotated deformation are the strongest with respect to other areas along the whole Himalayan orogenic belt. The extreme disaster area was located in the mountain area with the high elevation of about 4000 meters above sea level. So it is difficult for investigators to get the disaster information in the field. The Fig.1 shows the location and the topography of study area.

Figure 1. The location of study area

DATASET

The remote sensing images acquired by GF-4 satellite from November 18th to 21th, are used to detect the dust.

Table 1. The parameters of GF-4

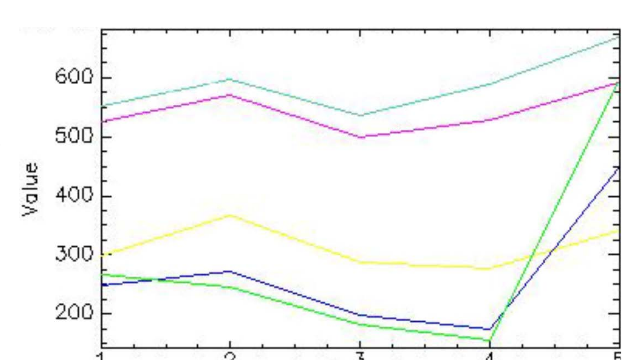
	Spectrum Band NO.	Spectral Range(μm)	Spectral Resolution (m)	Swath (km)	Revisit Period
VNIR	1	0.45-0.90	50	400	20s
	2	0.45-0.52			
	3	0.52-0.60			
	4	0.63-0.69			
	5	0.76-0.90			
MWIR	6	3.50-4.10	400	400	20s

BRIGHTNESS NORMALIZATION

The spectral discrepancy of the same objects is taken into account and a brightness normalization method was applied to highlight spectral shape information and weaken the absolute reflectance. The normalized brightness value can be calculated by the equation

$$B_i^{kl} = \frac{n \times b_i^{kl}}{\sum_{j=1}^{n} b_j^{kl}}$$

Where b_i^{kl} is the pixel value of the i band at the k line, l column, n is the total number of bands.



The mean of brightness before normalization

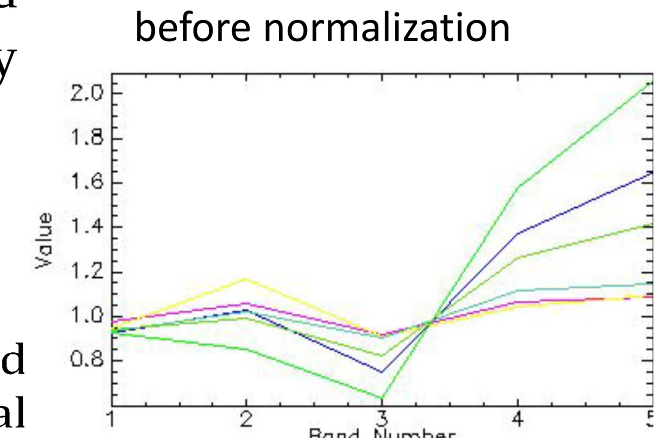


Fig. 2 The mean of brightness after normalization

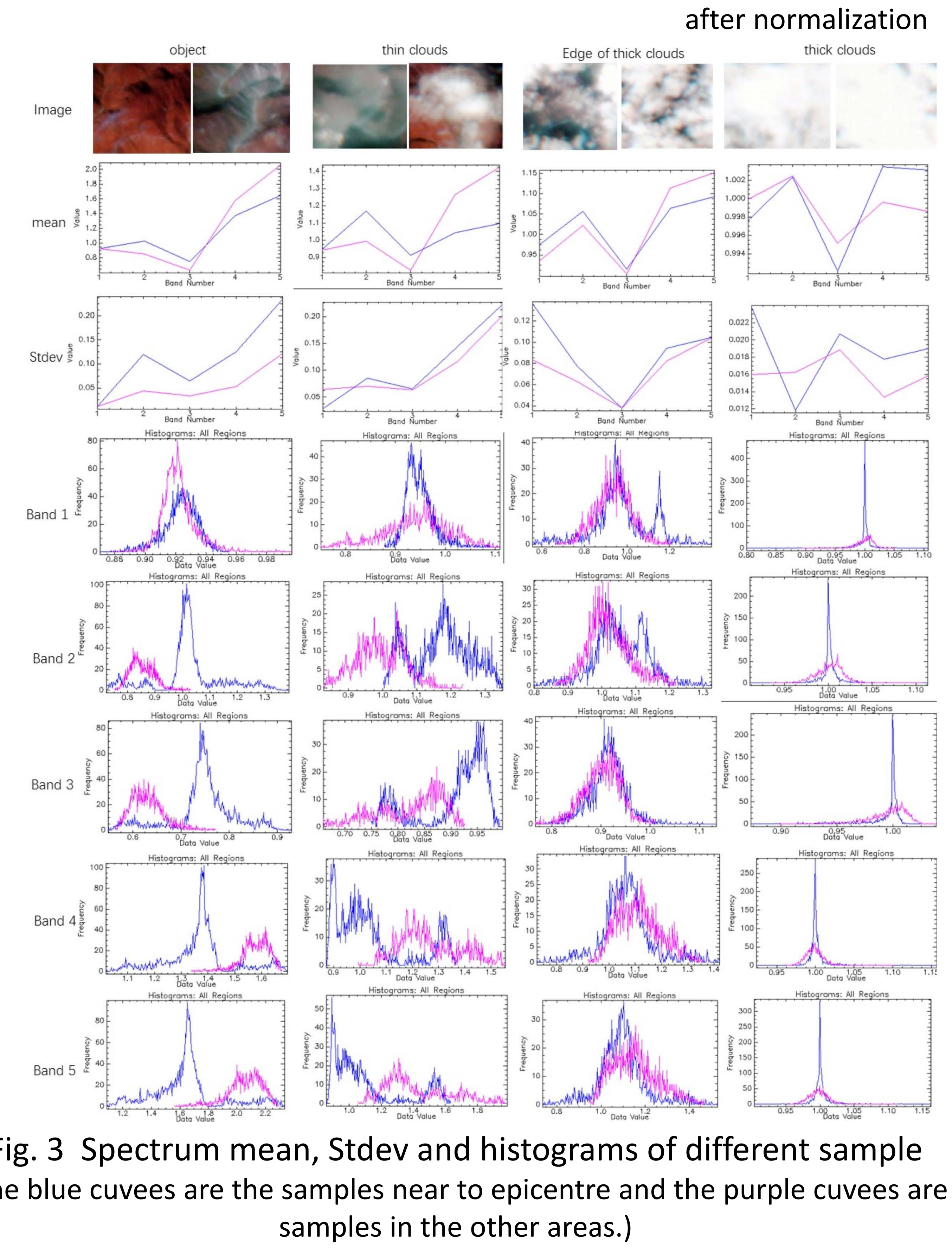


Fig. 3 Spectrum mean, Stdev and histograms of different sample
(The blue cuvees are the samples near to epicentre and the purple cuvees are samples in the other areas.)

ANALYSIS OF THE SPECTRUM ABNORMAL FEATURES

The samples are the thick clouds, edge of thick clouds, thin clouds, and ground object near to the epicentre and in the other disaster area. These sample histograms of different bands and their mean, standard deviation are calculated, shown in the Fig.3. From the Fig.3, we can see that the spectrum of ground object is obviously difference from band 2 to band 5. The brightness of band 2 and band 3 is higher in the area near to the epicentre than the others. However, the brightness of band 4 and band 5 is smaller in the area near to the epicentre than the others. The spectral characteristics of thin clouds are similar to the ground object. Because the thick clouds have strong reflections, the histograms of normalized brightness in both two areas have little difference. However, at the edge of thick clouds, the histogram presents two peaks in band1 and band2 in the area near to epicentre, but there is a peak far away from the epicentre. These characteristics mean that the dust changed the reflectivity of object in the area near to epicentre. So we can identify the extreme earthquake disaster area.

DETECTION RESULTS AND VALIDATION

According to the dust distribution identified from images and the information observed in the field, the extreme earthquake disaster area is estimated and shown in Fig.4. The area is about 850 square kilometres. In order to assess the accuracy of this method, the spatial distribution of aftershocks and earthquake intensity of field investigation are used to verify the results. Figure 5 shows the earthquake scene pictures before and after Milin earthquake. Comparing the two pictures, we can see that before the earthquake, the sky is bright blue and the mountains are clear, but after the earthquake both the sky and the mountains are grey.

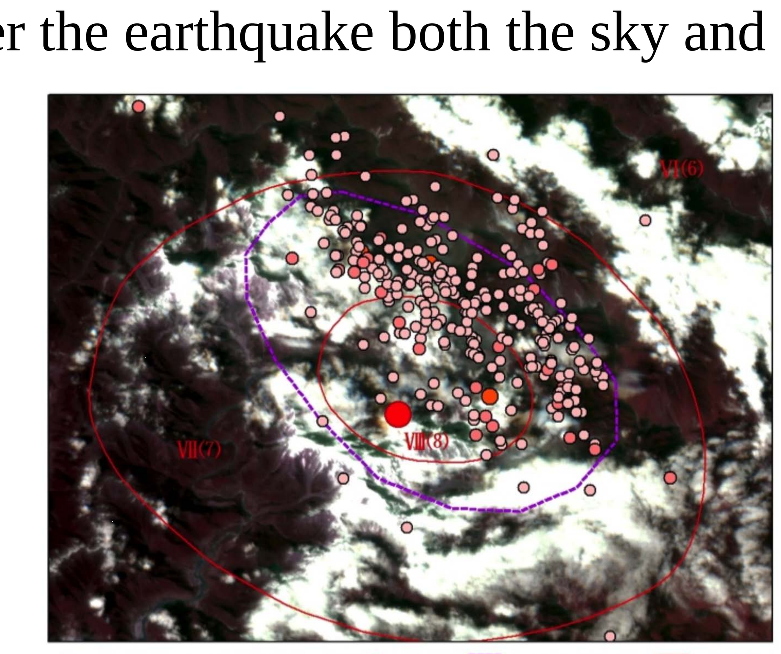


Figure 4. The dust distribution detected from GF-4

Raising dust after the earthquake

Fig. 5 No dust before the earthquake

CONCLUSION

The validation result indicates that the spatial distribution of extreme disaster can be acquired comprehensively using medium and high resolutions satellite data. The GF-4 is an important data source of quickly identified the extreme disaster area, which can provide great help for disaster intensity assessment.