REMOTE SENSING OF CLOUD COVER IN THE HIGH ALTITUDE REGION FROM MTSAT-1R DATA DURING THE HEI'HE EXPERIMENT

Gaoli Su[1,2,3], Xiaozhou Xin[1], Qinhuo Liu[1], Binrong Zhou[4]

1. State Key Laboratory of Remote Sensing Science, Institute of Remote Sensing Applications, Chinese Academy of Sciences, Beijing , China; 2. Graduate University of the Chinese Academy of Sciences, Beijing, China; 3.Zhejiang Climate Center, Hangzhou, China; 4.Meteorological scientific research institute of Qinhai Province, Xining, China.

1. INTRODUCTION

To make uses of remote sensing data to estimate the surface variables (such as albedo, land surface temperature, vegetation index, and snow cover, *etc*.), the cloud-free pixels have to be identified at first. Cloud detection is also necessary to be carried out to gain accurate surface solar global radiation [1].

In this study, multispectral threshold method was applied to detection cloud cover in the high altitude region from MTSAT-1R data during the Hei'he experiment (range from 97.05°E,40.66°N to 102.61°E, 36.1°N).

2. DATA AND METHODS

2.1 DATA

MTSAT-1R images during May 1-31st, 2008 were from download from website: http://quicklooks.cr.chiba-u.ac.jp/.

MODIS cloud products down load form website: http://ladsweb.nascom.nasa.gov/

Meteorological data at Qilian (100º 15´E, 38 º11´N) was obtained from Qinghai Climate Center.

2.2 CLOUD DETECTION METHODS

The detection algorithm is based on a multispectral threshold method applied to each pixel of the MTSAT image during the daytime (i.e. when the solar elevation is greater than 10 degrees), which identifies pixels as cloudy or cloud-free (ice/snow over land and clear). The scheme uses all available channels of the MTSAT which are in the following wavelength ranges: VIS(0.55-0.90μm), IR1(10.3-11.3μm),IR2(11.5-12.5μm),IR3(6.5- 7.0μm), and IR4(3.5-4.0μm). The MODIS cloud products (MOD35 and MYD35)[2] within ±10 minutes to time of MTSAT observed was applied to determine the thresholds. And the cloud detection scheme is shown in Fig.1 and Fig.2.

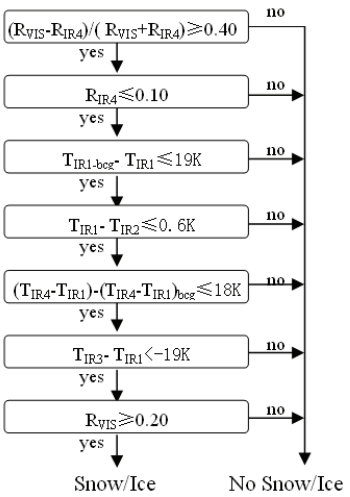

Figure 1. Description of the snow/ice detection schemes

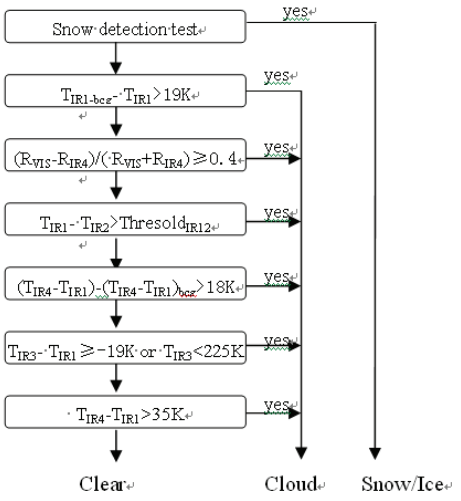

Figure 2. Description of the cloud cover detection schemes

3. RESULTS

Fig.3a -Fig.3d present the Classification results of MTSAT images at 11:30, 12:30, 13:30 and 14:30 of March 12th, 2008. Those figures have clearly portrayed the movement and development of cloud. Since there was a snow in the study area on March 11th, 2008; large area of snow cover can be found from the classification maps (Fig3).

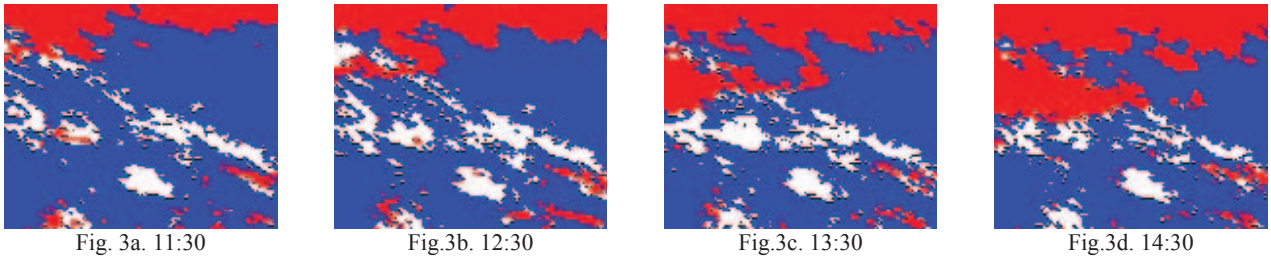

Fig. 3a. 11:30 Fig.3b. 12:30 Fig.3c. 13:30 Fig.3d. 14:30

Fig.3 Classification results of MTSAT images at 11:30 (Fig.3a), 12:30 (Fig.3b), 13:30 (Fig.3c), and 14:30 (Fig.3d) of March 12th, 2008 (clear pixel in blue, cloud in red, snow in white).

Cloud cover fraction measured at Qilian meteorological station was compared with those from MTSAT estimates. A cell of f N×N (N=3, 5, 7, 9,11) pixels cloud cover was obtained by the ratio of the number of pixels classified as CLOUD to the total number of pixels in the cell [3]. For the comparison we have used the images which passed in a range of ±30min around the station observation time. The differences between satellite cloud amounts and observation were showed in the histograms (Fig.4a and Fig.4b). The histograms indicated that most part of the differences fall in a range of ±0.2 and ±0.1 at 13:30 and 14:30, respectively. The cell of 11×11 pixels (around 44×44 km) achieved an accuracy rate of 64.52% and 87.10% at 13:30 and 14:30, respectively. This demonstrated the classification results were reasonable and satisfied. Classification errors mainly found when the cirrus densus was appeared in sky. Cloud detection of cirrus need to be improved.

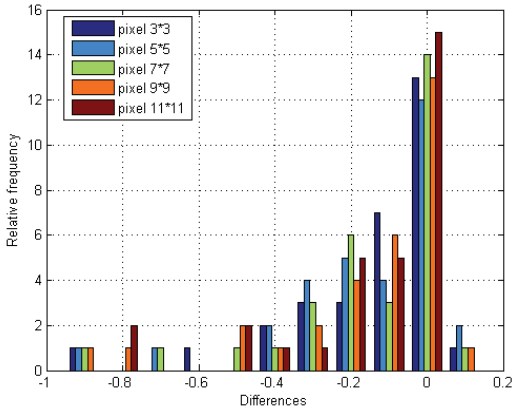

Fig4. cloudiness of MTSAT at 13:30 vs. observed at 14:00

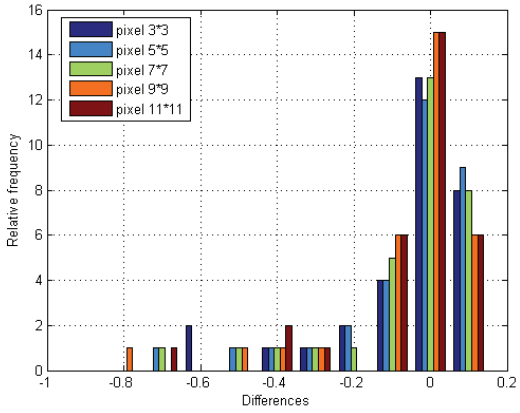

Fig4. cloudiness of MTSAT at 14:30 vs. observed at 14:00

Fig.4 Difference between the MTSAT cloudiness estimates in an N×N pixel cell and cloud amount meteorological observations at Qilian station

4. REFERENCES

[1] J. M. Yeom, K.S. Han, Y. S. Kim and J. D. Jang. “Neural network determination of cloud attenuation to estimate insolation using MTSAT-1R data”. International Journal of Remote Sensing, 29, pp. 6193-6208, 2008.

[2] R. A. Frey, S. A. Ackerman, Y. Liu, K. I. Strabala, H. Zhang, J. R. Key, and X. Wang. “Cloud Detection with MODIS. Part I: Improvements in the MODIS Cloud Mask for Collection 5”. Journal of Atmospheric and Oceanic Technology, Volume 25, Issue 7, pp. 1057–1072, 2008.

[3] C. Annasso,R. Santoleri,S.Marullo and F.Dortenzio. “Remote sensing of cloud cover in the Arctic region from AVHRR data during the ARTIST experiment”. International Journal of Remote Sensing, vol.24,No.3,pp.437-456,2003.