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CMA Report on Operational Use of Satellite Data for Nowcasting Convective Cloud System

Summary of the Working Paper.

This working paper reports the CMA practice of operational use of satellite data for the nowcasting. At CMA, satellite data in operational use for nowcasting is primarily indicating the identification, tracking and warning of convective clouds. At CMA, monitoring and tracking convective systems is mainly the task of geostationary meteorological satellites, and operationally uses a suite of methods to identify and track the convective cloud. Parameters such as the cloud temperatures, range can also derived and provided to forecasters for reference.

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1 Introduction

At CMA, satellite data in operational use for nowcasting is primarily indicating the identification, tracking and warning of convective clouds. The synoptic scale convective system is one of the reasons for catastrophes in China. Many local meteorological disasters are caused by rapidly developed convective clouds, which are difficult to use the conventional method to spot and monitor. However, the meteorological satellites can play an important role in monitoring the convective system.

At present, monitoring and tracking convective systems is mainly the task of geostationary meteorological satellites, FY-2 series. FY-2D and FY-2E jointly observe to provide observation every 15 minutes in summer, which allows for capturing the continuous change of a convective system. Recently, the regional scanning mode is made available with FY-2C, which observes the convection-prone areas every 10 minutes. The convective clouds can be monitored and tracked efficiently with these satellites.

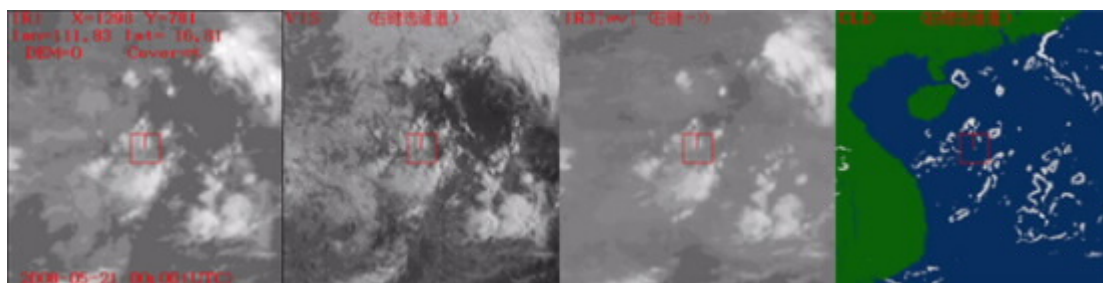
The National Satellite Meteorological Center has operationally used a suite of methods for the convective clouds monitoring, tracking, and feature extraction based on multi-channels data of geostationary meteorological satellites, and developed an operational system for monitoring and tracking. Nowadays, the results have been applied to operational nowcasting in CMA.

2 Method for Identification and Tracking Convective Clouds

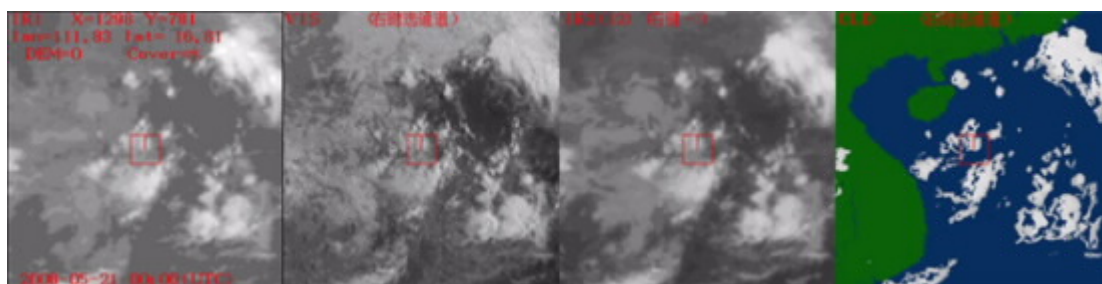
2.1 Method for Strong Convective Clouds Monitoring

Combining the characteristics of convective clouds and characteristics of observational channels of FY-2, and based on Weber's law, a comprehensive method that identifies the convective boundary is worked out, which utilizes multiple brightness temperatures as thresholds, such as the brightness temperature of infrared and water vapor channels, the cloud edge brightness temperature gradient of

the infrared and water vapor channels, the brightness temperature difference of the infrared and water vapor channels, and the brightness temperature difference of the infrared split-window channels. Making use of the method for detecting convective cloud edge all the way through a given region, then the convective clouds can be monitored. The impact of dense cirrus is filtered out with the homogeneity testing. Compared with the commonly used method of infrared brightness temperature threshold, this comprehensive method can distinguish cumulus, cirrus and altostratus much better. The fig-1 shows the results of example of identified convective cloud edge and convective cloud mass using this method.



(a) the results of identification for convective clouds edge



(b) The results of identification for convective clouds body

Fig-1 examples of the result of convective cloud identification

2.2 Tracking Convective Clouds

Tracking convective clouds uses the method of the Sequential Monte Carlo (SMC) based on the field of statistics, which not only simplifies the track process, but also solves the storm split and merge, simultaneously in the process of tracking. In recent years, SMC, which originates from statistics, has been proved to be a highly effective tracking method in the field of target tracking. It's simple, flexible and easy to be

handled, significant advantages for the nonlinear and non-Gaussian. In fact, the SMC is an iterative process. Every iterative node includes three steps: sampling, prediction and measurement (see fig-2); thus, dynamic information can be obtained in real-time.

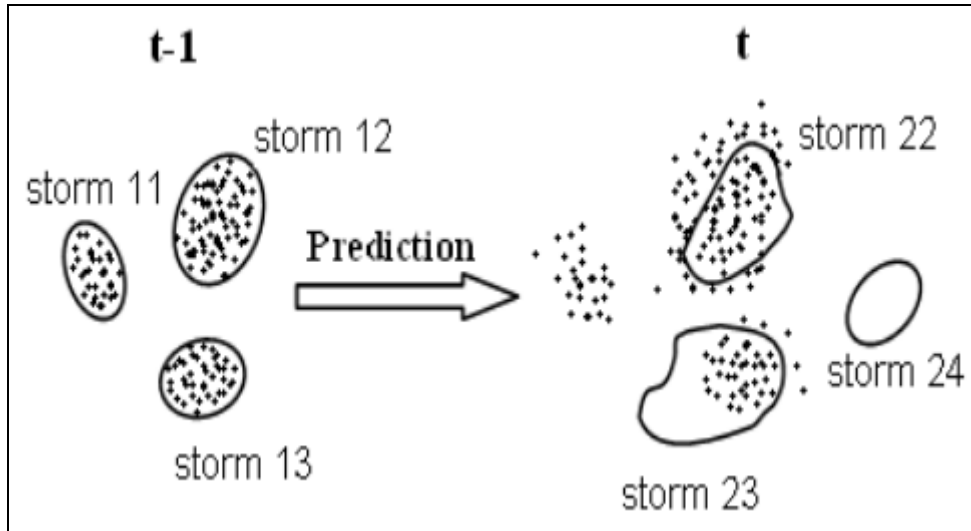
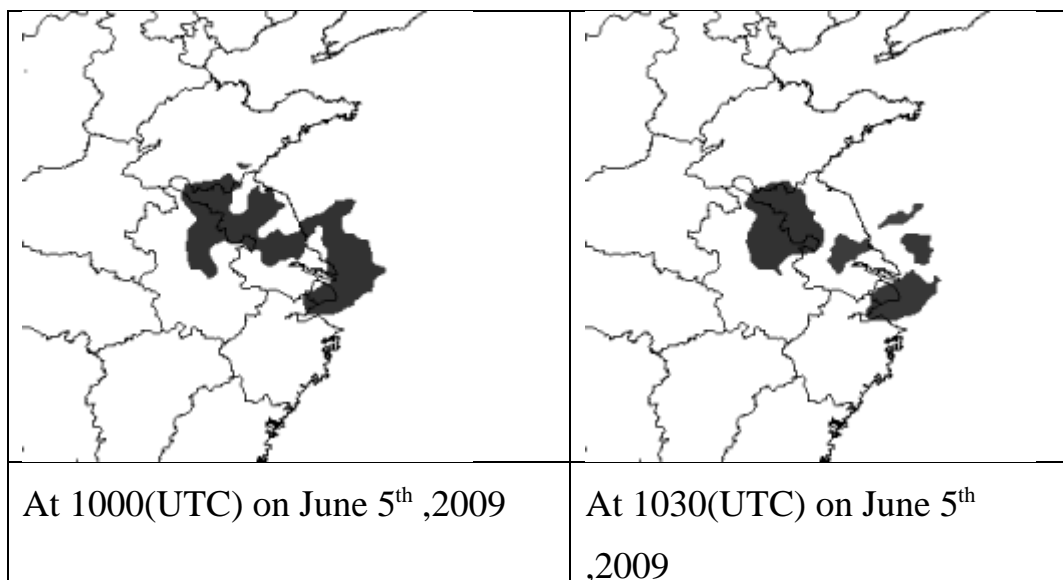


Fig-2 the schematic diagram of tracking method for adjacent time storm

Using SMC method we can track the split and merge process of the storm. The fig-3 shows an example of the split process. In the process of a convection, 10:00(UTC) June 9th, 2009, the identified convective cloud is an entirety, but in irregular shape. After half an hour, the convective cloud split into five sub-clouds. In the course of future development, two bigger sub-clouds last a long life time, while the rest of three dissipate rapidly.



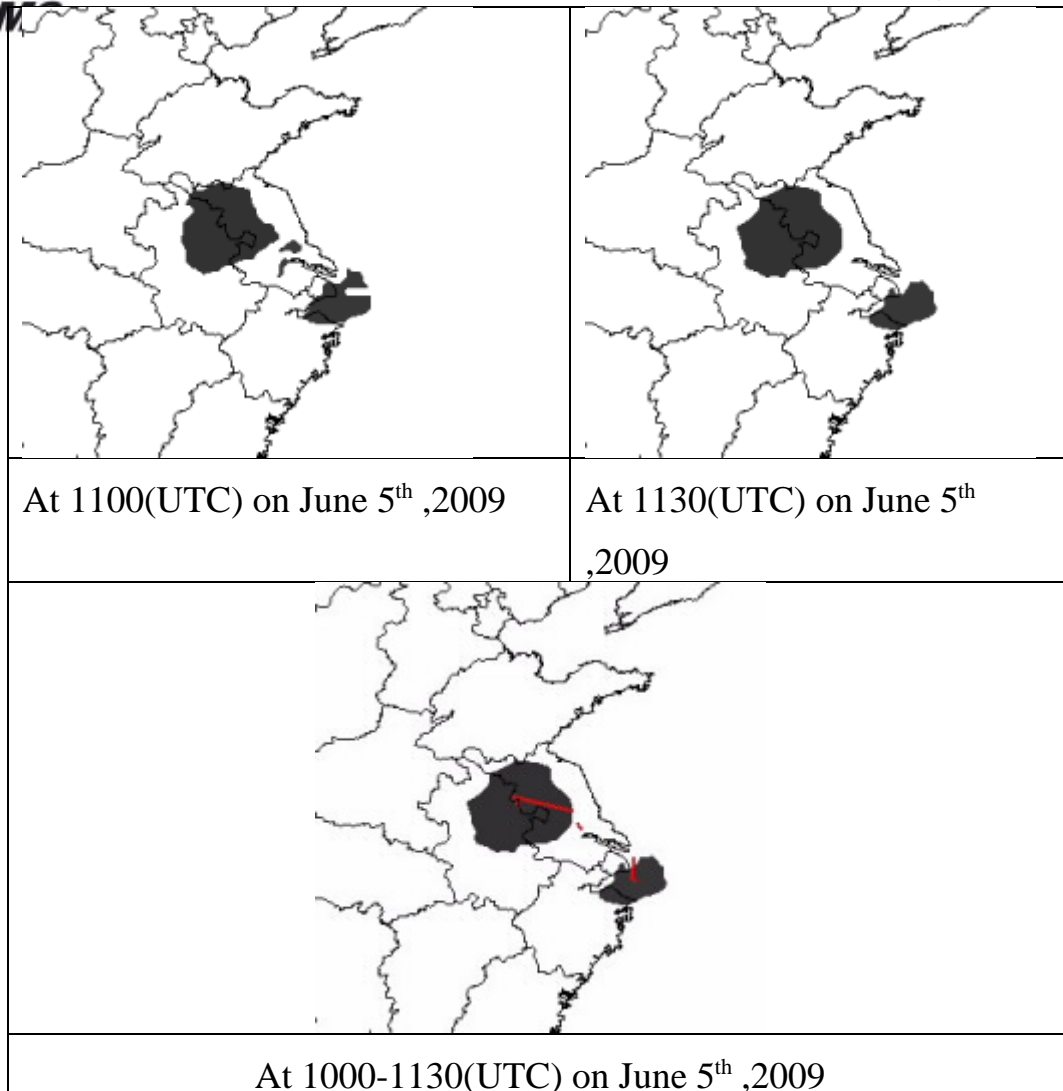


Fig-3 an example of the split process

2.3 Parameter Extraction

Based on the results of tracking, indicators for the physical characteristics of the convective cloud can be derived, such as the lowest and the highest temperature, the mean and the gradient brightness temperature of convective cloud. By the cloud shape, the centre of gravity, centroid, area and profile can be obtained. All these information are provided to forecasters for reference.