Nowcasting of Mesoscale Convective System Using Satellite Data

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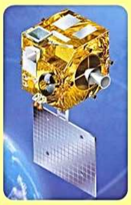
ABSTRACT

In southwest monsoon season, the Mesoscale Convective System (MCS) plays an important role in the weather of Southeast Asia. The severe weather events such as heavy rain, hail storm and strong wind are governed and driven by the mature stage of this system. Nowcasting, which refers to forecasting for a very short time range (up to 6 hours) is useful for predicting the development and dissipation of such systems. Satellite data, acquired from geostationary satellite provide valuable inputs for nowcasting due to their high spatio-temporal resolution. Scientists are continuously striving towards newer techniques to track and nowcast convective systems with higher accuracy and improved lead times. In this context, in the present study an image analysis technique i.e. the Source Apportionment (SA) algorithm has been applied for predicting convective system using Kalpana-1 satellite sequence of images. The algorithm uses neighborhood search criteria to extract contiguous convective pixels. The extracted pixels are then used to trace the evolution and predict the development of MCS, using some identified nowcasting parameters.

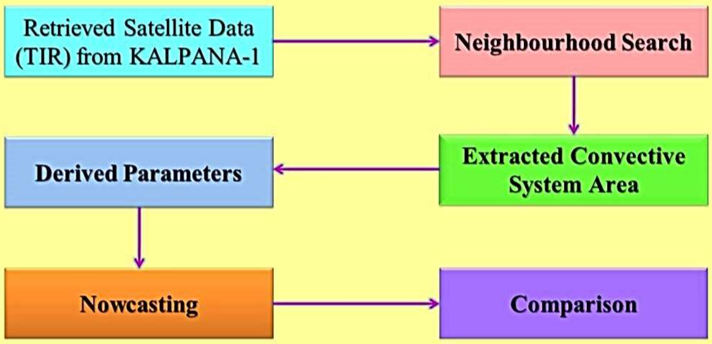
The present technique has been applied over a geographical region (5^0 S–25^0 N, 85^0 E–115^0 E) covering Thailand and adjoining oceanic regions for convective systems case studies during monsoon season of 2012. For tracking and forecasting, analysis of new nowcasting parameters has also been carried out. The results of study show that temporal variation of effective radius of convective system and effective radius for deep convective zones are suitable for identifying the mature stage while evolution of their slopes are good for identifying the dissipating stage. Additionally an analysis of different thresholds was also carried out to investigate their effects on forecasting methodology. It is seen from the study that model is able to predict the mature and dissipation of a MCS with a lead time up to 3 hours. An improvement in accuracy and lead time will be an area for future research.

OBJECTIVES

1. Understanding Source Apportionment technique for extraction of mesoscale convective cells.
2. Implementation of Source Apportionment technique for tracking and nowcasting over the interesting region.
3. Analysis of new nowcasting parameters.
4. Testing during monsoon period.



METHODOLOGY



CONCLUSIONS

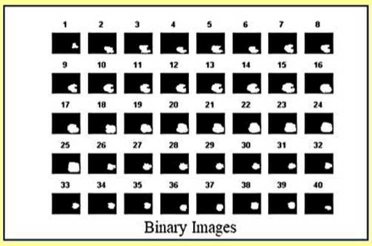
This present study investigates the application of SA technique, which is the conventional technique to determine the relative contributions of the different pollution sources to ambient air quality, for MCS tracking and nowcasting. For this convective system was chosen, out of which this case study covers the dissipating stage of a typhoon Kai-Tak. The earlier developed technique (Shukla et al, 2012) was implemented on the case studies for the domain of interest. It is found that the technique is able to extract convective regions and is capable of tracking the life cycle of convective systems. Also the ability of SA technique to work over large domains with good computational efficiency makes it a desirable choice for near real time application.

Moreover 2 new nowcasting parameters are investigated in this study. These parameters are mean brightness temperature and Rate of change of RSA (RRSA). The mean brightness temperature represents the average cloud top temperature values of the extracted convective region. Its curve can show life cycle of MCS and matches with the evolution of RSA and RSADC. RRSA can be used to identify the mature stage and dissipating stage of MCS. The values of RRSA will be continuously positive in time of mature stage while it will be continuously negative in period of dissipating stage. These parameters show good potential for forecasting the life cycle of MCS.

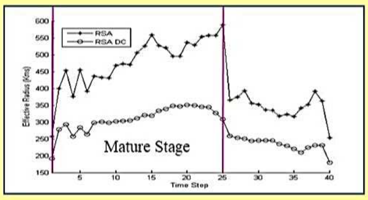
RESULTS

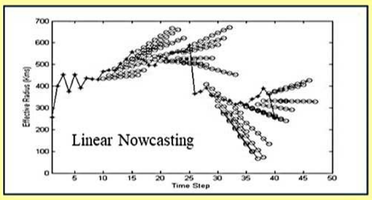
Case Study of Typhoon Kai-Tak

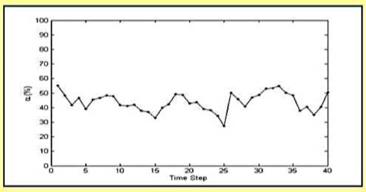
Date	Location		Category	Wind speed (km/hr)
	Latitude	Longitude		
12/8/2012	16.60^0 N	128.50^0 E	Depression	47
13/8/2012	16.60^0 N	126.60^0 E	Tropical Storm	64
15/8/2012	18.70^0 N	118.40^0 E	Typhoon	121
17/8/2012	20.70^0 N	111.30^0 E	Typhoon	130
17/8/2012	21.50^0 N	107.90^0 E	Tropical storm	111
18/8/2012	21.50^0 N	100.90^0 E	Depression	37

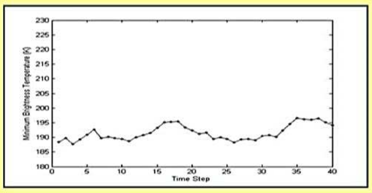


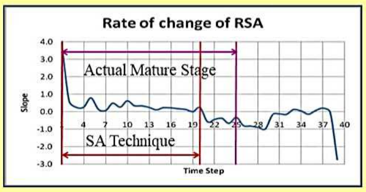
Binary Images

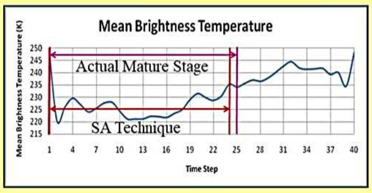












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