Relationship between Life Cycles of Mesoscale Convective Systems and Observed Rainfall Using Satellite Based Observation

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Convective systems are responsible for most of the rainfall in tropical regions and for extreme weather conditions in various parts of the world. The knowledge of convective system evolution is of fundamental importance for understanding weather and climate, and it is essential to improve forecasting of these systems to reduce vulnerability to extreme damage of life and property. Identification of predictor parameters for evolution of a convective system, based on its previous evolution, can make a significant contribution to a nowcasting scheme.

The ForTrACC technique is Forecasting and Tracking of Active Cloud Clusters. It is a method to study the characteristics of mesoscale convective systems (MCS) during its life cycle. The important features of this technique are: cloud clusters detection based on temperature threshold, evolution of morphological parameters of each MCS detected in the previous step, tracking technique based on the center of mass method and life cycle building. The ForTrACC methodology is applied in the development of algorithm for the nowcasting of MCS. This study was done for a number of MCS observed during the monsoon period of 2006 and 2007 using high temporal IR data of INSAT –3A and KALPANA. Two different types of convective systems were considered: (i) rainfall associated deep convective systems and (ii) stratiform convective systems.

Growth rate of convective systems using ForTrACC can be deduced from their area of expansion. Area time rate of expansion acts as an indicator for development of MCS. The larger positive values indicate growing stage and zero indicates mature stage, whereas the negative values indicate decaying stage. Thus, the area time rate of expansion acts as a predictor parameter for the evolution and dissipation of MCS's. It was observed that mean lifetime for rainfall associated deep convective MCS's was larger than for shallow convective MCS's or stratiform convective system. The cloud top temperature (CTT) for rainfall associated deep convective MCS's was 8-10deg K less than that for stratiform systems. The cooling rate during the initial stages of MCS is larger for rainfall associated deep convective MCS's than for shallow convective systems. In both, deep convective and stratiform convective systems, rain rate was maximum when the CTT attained its minimum value. The relationship between the change in area of expansion, which is a representative of life cycle of MCS, and the associated rainfall will be useful for the monitoring of heavy rainfall events.