Statistical Characteristics of Convective Clouds over the Western Ghats
Derived from X-band Radar Observations

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Background, Data, and Methodology

Orographic precipitation over Western Ghats (>6000 mm annual): Despite one of the largest rainfall areas of the SW monsoon, observations on convection lifecycle are lacking.

Few ground-based studies: [e.g. Kouraw et al (2014); Deshpande et al (2015); Das et al (2017); Kalapureddy et al (2017)]

But most studies confined to long-term satellite data: [e.g. Ramanath and Houze, 2011; S. Kumar et al., 2014; Silege et al 2016; Kumar and Bhat 2016]

Satellite lack time-continuous aspects of convection: formation, growth, duration, movement.

Number of questions remain unanswered.

Where does convection initiate in the Western Ghats?

What is the average size of convective clouds?

What are their propagation aspects, average lifetime, vertical structure and diurnal cycle?

Continuous X-band radar observations (pertaining to small-scale convective state) at Mandhurade provide the best test bed to study these questions.

TITAN cell-tracking algorithm is used to identify, track convective storm (Dixon & Wiener 1993). “Storm (or cell)” is a 3D contiguous region in space with reflectivity > 35 dBZ at 2 km altitude above the surface, and volume exceeds 15 km³. A storm must last for a minimum of two successive radar scans (>24 min).

Spatial Distribution of Convective Cell Properties

Convection has shallow depth, sub-MCS nature, short lifetime, slow movement, east-west alignment.

Considers convection system over land & ocean.

Convective system over land & ocean.

Storms exhibit small nocturnal and strong afternoon maxima. Afternoon peak due to convective system over land & ocean.

Convergent area peak delayed by several hours due to precipitation.

Classification of Convective Cell Types

Congestus dominates. Cumulus and Congestus clusters along windward mountains.

Deep convection on lee side. Lead-Lag relation of Congestus and deep convection from shallow to deep (heating and moistening by Congestus important).

Effective of Underlying surface on Convective Cell Onset

• In order to identify the occurrence of cumulonimbus convection and the processes that trigger or suppress it, the Convective cell onset is studied.

Convection onset is defined as the first time occurrence of convective cell with reflectivity of 35 dBZ. Therefore, it can also be called as single newly-formed storm.

• An eastward progression of convective activity from upramps the barrier through windward slopes of mountains over to the lee side is observed.

• Cell onset time depends on the combination of local time and the underlying surface.

Effect of Underlying surface on Convective Cell Onset

For wide range of 0dBZ Top, height attained by 35 dBZ is maximum 7km. June corresponds to the period with deep storms having intense internal structures.