



How do trends in convective cloud fraction affect lightning frequency? Satellite and radar perspectives over the west coast of India

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It is theorized that a warming planet perturbed by anthropogenic interventions could witness severe consequences in terms of increased frequency of droughts, flash floods, heat/cold waves, wild fires, intense lightning strikes etc. Recent studies indicate that the west coast of India (WCI), one of the most densely populated areas, receives more convective rainfall during the monsoon season [1, 2] as a result of the steady increase in near-surface and sea surface temperatures (SST). Convective rainfall is showing a significant increase in many parts of the WCI [2], characterized by higher rain rates over smaller areas resulting from stronger updrafts. Climatologically, less lightning activity during the monsoon season of June through September is noticed compared. Nevertheless, this study examines if there is any noticeable change in the frequency of lightning activity in the monsoon season along the west-coast as a result of the changing convective pattern.

By analyzing a long record of 26 years (1998-2023) of lightning data from the OTD/LIS (optical transient detector/lightning imaging sensor) onboard the tropical rainfall measuring mission (TRMM) satellite and ground-based observations, we find statistically significant increase in lightning activity associated with deep convective clouds over the southern part of the WCI (74-77 E, 8-15 N) while a decreasing trend is observed in the northern part of the WCI (72-75 E, 15-22 N). It is already reported that LIS observations indicate synoptic weather systems as major contributors of lightning in Indian hotspots [3]. Ground-based radar observations support the conducive atmosphere favoring deep convective clouds. Proportionate with an increase in the convective rain fraction, lightning frequency shows increasing trends towards the southern WCI. Our results emphasize that the southern WCI requires greater caution as the lightning strikes increases with an increase in surface air temperature and SST, providing ample fuel for deep convection in an unstable environment as also evidenced by enhanced moist static energy. The results ring the bell of a changing climate which calls for early warning, preparedness and disaster prevention in view of exposure and vulnerability of individuals and communities.

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