Spatio-temporal Analysis of Lightning Activities over Pakistan During 2001-2014

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Abstract

Lightning is a naturally occurring spectacular and powerful phenomenon often accompanied by thunder. In Pakistan, this hazardous phenomenon mostly occurs in Monsoon and Pre-Monsoon seasons. To prevent or at least minimize the unforeseen property damages and human casualty, we need to identify the vulnerable locations of lightning in Pakistan, but there has been no detailed study carried out for Pakistan. In the present study (for the years 2001 – 2014) Lightning Image Sensor (LIS) datasets of locations and Time of Occurrence (TOA) are used to identify the lightning prone locations all over the Pakistan. Generated maps show frequency distribution trends of lightning in many regions of Pakistan that enable us to locate high, moderate and low lightning-susceptible areas. Results demonstrate that thunderstorm frequency is comparatively higher over the mountain and sub-mountain regions in the Punjab, Federally Administered Tribal Areas (FATA) and Khyber Pakhtoonkhwa (KPK) provinces. Interestingly, lightning data showed a strong correlation between the Flashes\Year and the El Niño and La Niña years. A severe lightning event with 4559 flashes in just 3.08 seconds is also recorded on 8-Oct-2005 in Pakistan-India border near Azad Jammu Kashmir (AJK) and Jammu Kashmir. However, it is to be noted that on the same date Pakistan was hit by a major Earthquake. This may highlight a link between both events which further needs to be investigated. An increase of 4.9% in lightning has been observed in Pakistan since 2001-2014. Therefor this study has been designed to deduce the possible metrological parameters responsible for high lightning. Dependency of lightning is correlated with Convective Available Potential Energy (CAPE), Aerosol Optical Depth, Total Cloud Cover, Convective Precipitation, Soil Temperature Level 1 and Total Column Ozone. In the analyses it is found that high surface temperatures in Pre Monsoon and Monsoon season follow up with high CAPE values which with 0-0.4 τ AOD seasoning results in devastating lightning in the region. Moreover lightning and meteorological parameters spatial relation is also studied by making climatologies of 14 years data.

Topic Areas

Lightning Detection from Space: Performance, Research and Applications, Lightning Climatology

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