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Relationship between flash density and rainfall over Bulgaria and Black sea

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The aim of the present work is to study the difference in lightning activity and its relation with precipitation over sea and over land.
The lightning activity and precipitation over Bulgaria and Black sea during the summer (June, July, August) of 2006 are analysed. The area of analysis is confined within 22° to 42°E and 41° to 47°N. Information on precipitation is taken from Tropical Rainfall Measurement Mission (TRMM) project. The precipitation estimates are based on the 3B42RT (V6) product, distributed by NASA. It consists of 3-hour precipitation rate estimates at 0.250x0.250 resolution within the global latitude belt 60°S to 60°N that are distributed in near real-time. The lightning data are provided from the ZEUS system operated by the National Observatory of Athens (NOA) and have been organized into 0.25x0.25 degree grid boxes that correspond to the 3B42RT grid boxes, and flash densities have been calculated. So the data base that has been constructed includes rain rate, accumulated precipitation, flash density and number of recorded flashes at 3-hour time intervals in the grid boxes of 0.25x0.25 degrees.
Investigation of diurnal and spatial distributions of lightning shows that during the night and early morning hours lightning activity is greater over the Black sea than over the territory of Bulgaria, while during the noon and afternoon hours there is dominant presence of lightning over the land. The flash density over the continental area has a maximum around 1200 UTC, while over the Black sea the maximum is around 0600 UTC. For this reason the detailed analysis concerning lightning activity and precipitation is carried out using data for both 3-hour time intervals: at 0600 UTC (corresponding time interval 0430–0730 UTC) and at 1200 UTC (within the time interval 1030-1330 UTC). Taking into account that the local time is UTC+3 over the area of analysis, the 1200 UTC time interval in our work is referred to as the afternoon interval.
The results show that over the Black sea and over the territory of Bulgaria the frequency distribution of the precipitation amount is shifted towards larger values for the cases with lightning as compared to the cases without lightning. For example the frequency of events with rainfall equal to 10 mm is approximately twice as large in the case of flash detection as that without flash detection. Using the data in the both time intervals, it is found that the number of cases with 3-hour accumulated rainfall greater than 10 mm is bigger when lightning occurred (53% over sea , 71% over continental area) than when it was absent (47% and 29% respectively).
Our study reveals that at the afternoon time interval and when flash density is averaged in logarithmic bins of rain-rate, the correlation coefficients R between rain rate and average flash density is high over the territory of Bulgaria (R=0.92), while there is no correlation between rain rates and average flash density over the Black sea (R=0.20). At morning time interval correlation coefficients are low: R= 0.52 over the Black sea and R=0.62 over the territory of Bulgaria.