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Near surface gamma-ray and electric field enhancements during disturbed weather: combined signatures from convective clouds, lightning and rain

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We present correlations found between ground-level gamma-ray enhancements with precipitation and strong electric fields typical of thunderstorms. The data was obtained at the Cosmic Ray Observatory located on the western slopes of Mt. Hermon in northern Israel (altitude 2020 m ASL). During several thunderstorms in October and November 2015, we recorded extended periods of gamma ray enhancements, which lasted tens of minutes and coincided with peaks both in precipitation and the vertical electric field (Ez). We distinguish between two types of events based on the behavior of these parameters: (a) slow increase (up to ∼300 minutes) of atmospheric gamma ray radiation due to radon progeny washout along with minutes of Ez enhancement, which were not associated with the occurrences of near-by CG lightning discharges, and (b) rapid 30 minutes-long bursts of gamma rays, coinciding with much shorter Ez enhancements that were associated with the occurrences of near-by CG lightning discharges, and were superimposed on the radiation from radon daughters at ground level washed out by precipitation. We conclude that the superposition of accelerated high energy electrons by thunderstorm electric fields with the radon progeny washout explains the relatively fast gamma-ray increase observed at ground level, where the minutes-scale vertical electric field enhancement are presumably caused due to near-by convective clouds. Our results show that the mean half-life depletion times of the residual nuclei that were produced during events without lightning occurrences were between ∼25-65 minutes, compared to ∼55-100 minutes when lightning were present, indicating that different types of nuclei were involved.