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Radon daughters rain-induced activity

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During and after a rainfall event an increasing of the gamma activity at ground level is observed. This rain-induced radioactivity is caused by the atmospheric ^{214}Pb and ^{214}Bi, daughters of ^{222}Rn, having approximately 27 and 20 minutes of half-life. These ionized radionuclides attach themselves to aerosol particles, which are then subjected to the scavenging of rain droplets. Every impulse of rain produces a sudden increase of gamma activity which can be measured at the ground using gamma-ray spectroscopy techniques. In the energy windows of ^{214}Pb and ^{214}Bi the observed enhancement of net count rate can be four times that measured in absence of rain.

A proximal remote sensing experiment has been carried out in a test field where a sodium iodide scintillator and a rain gauge have been positioned at a height of 2.25 m. Gamma-ray activity and rainfall rate have been measured continuously for a 7-month period. A physical model describing the ^{214}Pb and ^{214}Bi rain-induced gamma activity evolution in time has been developed and used to fit the experimental data.

The data fit analysis demonstrates that the transient increasing of ^{214}Pb and ^{214}Bi gamma activity during the rainfalls is due only to the atmospheric radon progenies falling to the ground with the precipitations themselves. On the basis of a dozen events of rain we obtain an inverse correlation between the concentration of ^{222}Rn daughters in the rain and the rainfall rate.

The developed algorithm is an extraordinary tool for calculating the enhancement of the absorbed dose rate during a rainfall event, for reconstructing the background before and after the rain and for discriminating rainfall from irrigation.