Scavenging of soluble radioactive gases by rain from inhomogeneous atmosphere

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Rains and drizzle represent an important element in self-cleansing process of the atmosphere. Scavenging of the atmospheric gaseous pollutants by rain droplets is the result of gas absorption mechanism [1]. In the present work we analyze an influence of concentration and temperature inhomogeneity in the atmosphere, rain droplets evaporation and radioactive decay of soluble gases on the rate of trace gas scavenging by rain. We employ a one-dimensional model of precipitation scavenging of radioactive soluble gaseous pollutants that is valid for small gradients and non-uniform initial vertical distributions of temperature and concentration in the atmosphere, assuming that conditions of equilibrium evaporation of rain droplets are fulfilled. It is showed that transient altitudinal distribution of concentration under the influence of rain is determined by linear wave equation that describe propagation of scavenging wave front. The obtained equation is solved by the method of characteristics. Scavenging coefficients and the rates of precipitation scavenging are calculated for wet removal of gaseous Iodine-131 and tritiated water vapor (HTO) for exponential initial distribution of trace gases concentration in the atmosphere and linear temperature distribution. Theoretical predictions of the dependence of the magnitude of the scavenging coefficient on rain intensity for tritiated water vapor are in good agreement with the available atmospheric measurements.

[1] Elperin *et al* (2015*) J Environ Radioact* **143**, 29-39.