

## Experimental and Modeling Studies of $^{220}\text{Rn}$ Decay Products in Outdoor Air Near the Ground Surface

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Measurements of the concentrations of  $^{220}\text{Rn}$  gas and its short lived decay products ( $^{216}\text{Po}$ ,  $^{212}\text{Pb}$ ,  $^{212}\text{Bi}$ ) in attached-to-aerosol and unattached states were carried out at a semi-arid field site in central New Mexico under varying atmospheric conditions. A high volume air sampler ( $100\text{ L min}^{-1}$ ), with a single 635-mesh stainless steel screen (50% penetration for 4 nm particles) and a glass fiber filter, were employed. Analysis of the 105 outdoor measurements yielded the following average values:  $9\text{ Bp m}^{-3}$  for the  $^{220}\text{Rn}$  activity concentration;  $22\text{ nJ m}^{-3}$  for the concentration of potential alpha energy, 0.03 for the equilibrium factor, 0.15 for the unattached fraction of potential alpha energy, and  $14\text{ nSv h}^{-1}$  for the effective dose rate. The measurements were interpreted using the computer code TPOUT which applies one-dimensional eddy transport to calculate the vertical concentrations of  $^{220}\text{Rn}$  and its decay products as a function of atmospheric stability, aerosol concentration, terrain roughness, and surface wind speed. This code successfully predicted the observed trends of unattached and attached decay products concentrations with height, and demonstrated the importance of the mixing height and the rate of vertical transport for controlling breathing level dose. Projection of the present results to conditions typical of temperate climates suggests an average annual outdoor effective dose from  $^{220}\text{Rn}$  decay products of about  $0.025\text{ mSv}$ , which is a significant component of the total outdoor dose.

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