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Short-term and short-range variations of ^{222}Rn concentrations and fluxes from soils in Krakow, Poland

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Measurements have been made of ^{222}Rn concentrations and release from two soils of different degrees of anthropogenic impact in the city of Krakow (Southern Poland). Radon fluxes were estimated by use of two methods. Direct method (static chamber) bases on observation of the growth rate of radon activity under the leakproof chamber covering soil. A closed-circuit analytical system consisting of a static accumulation chamber, pump, dryer and active radon monitor RAD7 was used to measure activity of radon via its short-lived daughter ^{218}Po. The second method, indirect one, uses the ^{222}Rn concentration measurements at several depths in soil profile to estimate radon flux. Stainless steel tubes with an internal diameter of 1 cm were used to pump soil air from the depths of 20, 30, 40, 60, 100, 150 and 200 cm into the active volume of the RAD7 monitor. The obtained depth profiles provided insights into the vertical variability of radon concentrations and allowed for the estimation of radon fluxes to the atmosphere.

Short-term (diurnal) variations in radon concentrations and fluxes were significant in some cases and negligible in others. The depth profiles of radon concentrations were very rarely monotonous. Occasionally radon was not detected in water-logged soil layers. The highest concentrations reached 9600 ($\pm$800) Bq·m^{-3} at the heavily anthropogenically disturbed site and 20 000 ($\pm$1000) Bq·m^{-3} at the alluvial soil of the Vistula river valley. Radon concentrations differed considerably, even by two orders of magnitude, among profiles separated by only around 1 m. These spatial and temporal variations seem to be driven by the variability of soil properties such as ^{226}Ra content, porosity, water content and by the hydrological and meteorological conditions.