Urban air pollution dynamics assessment by use of ^{222}Radon in the lower atmosphere

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The worsening of air quality in urban areas presents a high level of interest within the scientific community and society because of the known strong relationship between exposure to radioactive gas radon (^{222}Rn) used as a tracer of air masses transport and air pollutants in form of particle materials PM or gases and increased adverse short- and long-term effects on human health (Zoran M. et al, 2012). This paper focuses on the assessment of urban air pollution dynamics in relation with radon (^{222}Rn) for Bucharest metropolitan area in Romania. Specifically, daily mean concentrations of particle matter (PM2.5, PM10), ozone (O_3), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and global air quality indices (AQI) have been analyzed in relation with radon (^{222}Rn) concentrations measured in the air near the ground with an AlphaGUARD Radon Monitoring System and CR-39 SSNTDs during 2012 year. Such new information is required by atmospheric sciences to prove suitability of ^{222}Rn as a tracer for atmospheric dynamics analysis as well as by epidemiological and radiological protection studies.

Results

Despite efforts to mitigate air pollution in Romania and former East European countries, the number of exceedances of EU ground-level of different pollutants like as particle matter PM in both sizes 2.5µ (PM2.5) and 10µm (PM10), ozone (O_3), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2) remained at serious levels during summer 2012 (Zoran M.et al, 2016), when the threshold of 120 µg m^{-3} of ozone in air maximum daily eight-hour mean was exceeded on more than 25 days across large parts of Europe including Romania. Have been investigated also meteorological effects on the temporal patterns of atmospheric radon and air pollutants. Radon (^{222}Rn) concentrations measurements in the lower atmosphere can provide immediate information on air pollutants dynamics on different time scales (emission rates, chemical transformations, dry and wet deposition and removal processes. The seasonal pattern of radon concentration in air near the ground at the given test site reflects, to some extent, the regional meteorological conditions prevailing at Bucharest metropolitan test site with higher values in the winter time and lowest in summer. The analyses of observational time-series data evidenced a significant correlation between PM10 and ^{222}Rn daytime and seasonal concentrations due to the dominant role of atmospheric dispersion in determining the temporal variation of PM10 levels. During summertime the ground ozone concentrations increase with the increase of air temperature due to the intensity of solar radiation on the clear sky days and urban heat island phenomenon. This effect is reflected in relatively high positive correlation (R^2= 0.6283) that suggests that the change of ground level ozone concentration corresponds well to the change of the air temperature. Ground level 24 hours ozone concentrations displayed an anticorrelation with the PM10 concentrations during 2012 (Figure 1).

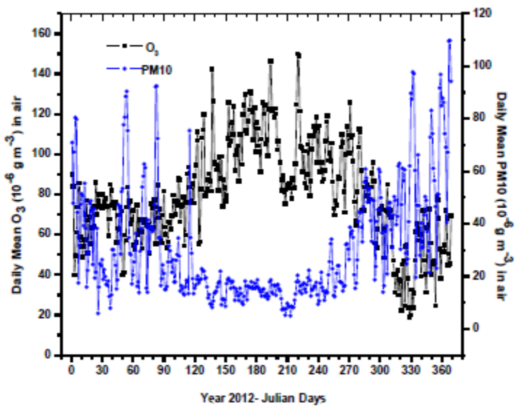

Figure 1. Daily mean PM10 and ozone concentrations (µg/m^3) during 2012 year in Bucharest test area

The difference of summer and winter values of radon in air concentration and main air pollutants (ozone - O_3, nitrogen dioxide -NO_2, sulphur dioxide -SO_2, and particulate matter in two size fraction PM10 and PM2.5) is attributed to meteorological variables influence (air temperature, relative humidity, pressure and wind intensity) and air masses stagnation.

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