Inter-comparison study of European atmospheric ^{222}Rn and ^{222}Rn progeny monitors

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The noble gas radon (^{222}Rn) is widely used as tracer to study different research topics related with atmospheric transport and mixing processes within the planetary boundary layer, experimental estimation of fluxes of greenhouse gases (GHGs), etc. High-quality ^{222}Rn activity concentrations observations are needed with high spatial resolution. Worldwide monitoring networks of GHGs are already performing atmospheric ^{222}Rn measurements at different heights from the ground and using different measurement principles. These data should be harmonized before being used for regional-to-global applications, as suggested by the International Atomic Energy Agency, because calibration issues could introduce significant biases and therefore limit the data utility.

An inter-comparison study, lasting 3 months, was carried out in Gif sur Yvette (France) in fall 2016 using $^{222}Rn/^{222}Rn$ progeny monitors based on different measurement techniques. Two single-filter ^{222}Rn progeny monitors (a **H**eidelberg **R**adon **M**onitor (**HRM**) and a **K**azan **M**onitor (**KM**)); two two-filters ^{222}Rn monitors by the **A**ustralian **N**uclear **S**cience and **T**echnology **O**rganisation, (**ANSTO)** and an electrodeposition **A**tmospheric **R**adon **MON**itor (**ARMON**) were simultaneously running and sampling air at 5 m and at 100 m above ground level (a.g.l.). The ARMON requires dry sampled air (< 2000 ppmv). The HRM and KM utilize the disequilibrium factor (F) between ^{222}Rn and its progeny. The aim of this study was to evaluate: i) possible biases and associated correction factors between monitors; ii) the dependence of the monitors response in relation to the sampling height, the meteorological and aerosol conditions; iii) the portability and maintenance of each monitor.

The linear regressions between monitors hourly data were calculated using the HRM as reference instrument following past studies. At 5 m a.g.l. results show slopes between 0.760 and 1.44 and biases ranging between -0.310 and 0.996 Bq m^{-3}. Results at 100 m a.g.l. show slopes between 1.06 and 1.16 with offsets being between 0.13 and 0.21 Bq m^{-3}. Correction factors, including calibration and disequilibrium contributions, ranged between 0.42 and 0.62. Changes of F were observed in relation to the sampling height, under rainy and/or clean atmospheric aerosol concentrations (< 500 particles cm^{-3}) events. These last influences should be further investigated for a complete harmonization of the data.