A European-wide intercomparison of atmospheric ^{222}Radon and ^{222}Radon progeny measurements

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^{222}Radon (^{222}Rn) is a short-lived radioactive noble gas (half-life time $T_{1/2}$ = 3.8 days) that is produced in all soils from the radioactive decay of ^{226}Radium (^{226}Ra), a member of the primordial ^{238}Uranium decay series. As the first gaseous constituent in this series, ^{222}Rn has a chance of escaping from the (unsaturated) soil zone into the atmosphere. The only sink of ^{222}Rn is its radioactive decay. The ^{222}Radon flux from ocean surfaces is almost zero. As the continental ^{222}Rn exhalation rate and its spatial and temporal variability are relatively well known, ^{222}Rn can serve as a quantitative tracer for atmospheric boundary layer mixing and transport model validation. Due to its increasing use in these applications, the number of atmospheric ^{222}Rn measurements has greatly increased in the last decade, with several fundamentally different analysis systems applied, either measuring ^{222}Rn directly or via its short-lived progeny in the atmosphere. Comparable calibration of the different measurement systems is, however, principally impossible. Therefore, within the EU-funded project InGOS, we conducted a European-wide ^{222}Radon/^{214}Polonium intercomparison of the various types of monitors in use at European atmospheric monitoring stations. Our aim was to determine correction factors that could be applied to existing (and future) observations to harmonise the data as input for regional atmospheric transport model validation in Europe. Two compact and easy-to-transport Heidelberg Radon Monitors (HRM) (one-filter systems) were sent around to run for at least one month at each of the eight European measurement stations included in the intercomparison. Linear regressions of the resulting parallel atmospheric ^{222}Rn data sets were calculated, yielding correction factors relative to the HRM ranging from 0.68 to 1.45. For the stations that use one-filter systems, preliminary ^{214}Po/^{222}Rn disequilibrium factors were also estimated, which decreased with height above local ground. Our study clearly demonstrates that significant corrections need to be applied to existing ^{222}Rn and ^{214}Po activity concentration data in order to obtain a consistent European ^{222}Radon data set for model validation.