Lessons learned on atmospheric radon modelling by statistical model-to-data comparison on gamma dose rate peaks

Arnaud Quérel, Denis Quélo, Thierry Doursout, and Claire Gréau
IRSN, Fontenay-aux-Roses cedex, France (arnaud.querel@irsn.fr)

Radon-222 is a progeny of Uranium-238, naturally present in the Earth's crust. After its migration through the soil, it reaches the atmosphere. The Radon progenies are then adsorbed to aerosol particles. The particles are scavenged by falling rain drops, leading a large amount of radon progenies to the ground. This sudden addition of radon progenies explains the gamma dose rate peaks occurring during rainfall events.

An atmospheric radon modelling chain was developed. It is based on the IRSN long-range atmospheric transport modelling, and can be used to forecast or to reanalyze these events. The peaks are observed hundreds times a year on radioactivity monitoring networks in France. Then, a comprehensive statistical comparison can be achieved to evaluate the modelling, in particular its atmospheric transport component.

Less than half of the gamma dose rate peaks simulated matches the observed ones. We considered false positive – peaks simulated but not observed – and false negative – peaks observed but not simulated. Radon exhalation spatial distribution and seasons seem to have a major impact on the model capability to reproduce these peaks. The choice of rain data is also essential for a better simulation.

Beyond other validation cases, IRSN now has a validation tool, the database of which is populating on a daily basis, to evaluate the long-range atmospheric transport model used for emergency purposes. The quality of this response is a critical issue and has to be constantly improved. The statistics on the gamma dose rate peaks will improve our understanding of the phenomena. It will also be used to validate the improvement made on the accuracy of the radon exhalation spatial distribution.