



Communicating results and uncertainties of radioecological modelling – a transdisciplinary workshop

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Abstract. Compared with geological structures, many processes and fluctuations in the biosphere take place on much shorter timescales and are difficult, often nearly impossible to predict over long periods of time. Consequently, modelling results are subject to tremendous uncertainties. While German regulations require biosphere modelling for dose estimations as part of the site selection procedure for a nuclear waste repository, they also recognize those uncertainties by stating that the calculated dose estimates are not an actual prognosis of the effective dose used in practical radiation protection but merely an indicator for the safety of the repository (BASE, 2022, p. 6). In addition to the complex technical aspects, this subtle but important distinction might pose an additional difficulty in understanding the meaning of dose modelling results and their uncertainties when presented to an interested public.

Within a transdisciplinary online workshop on safety indicators in nuclear waste management, relevant aspects for communicating dose estimates and uncertainties were evaluated. As the target group, the Citizens' Working Group (CWG) of the TRANSENS research project was chosen. TRANSENS is a transdisciplinary project addressing socio-technical questions concerning the disposal of nuclear waste (TRANSENS, 2023). As an “extended peer community”, the CWG is an important part of the transdisciplinary research approach (Seidl et al., 2021). Currently, the group consists of 14 citizens with a diverse distribution of age, profession and degree of (scientific) education. By design, citizens with no stakes and no particular expertise concerning nuclear waste or radioactivity were recruited. However, the members of the CWG acquired ever-increasing knowledge about the subject in over 2 years of regular meetings and workshops within the project. Thus, the CWG can be seen as a proxy for members of the public with high interest in nuclear waste disposal but potentially without distinct scientific education.

The workshop took place over two days as a virtual meeting and covered the full modelling chain from the confinement providing rock zone to the biosphere. Here, mainly results concerning the radioecological modelling will be presented.

As a central element we investigated the use of an interactive web tool to illustrate the effects of parameter uncertainties on dose estimates. The web tool, created specifically for this workshop, consists of some slide controls, allowing the user to select values from a given range for four parameters relevant for biosphere modelling. From the selected parameter combination, a dose estimate based on the biosphere model described in the German regulations (BASE, 2022) is calculated and displayed. Additionally, a probability is displayed for each combination, which results from (not necessarily scientifically accurate) underlying probability distributions assumed for each parameter. This rather abstract numerical value, which varies over many orders of magnitude, is in addition visualized by a density plot. The user is asked to rate the information regarding dose value and probability on a scale from “very concerning” to “very reassuring” in an input form at the lower end of the screen.

After an introductory presentation on the concepts of effective dose and radioecological modelling, the participants had time to try out the web tool in breakout rooms of three to four people followed by a free discussion on various aspects connected to the tool. Afterwards, the CWG members were asked to collect decisions that need to be made when designing such a tool together with available options (e.g. “Which colour should the slide controls have” → “red, green, blue ...”). For inspiration, two alternative designs were shown as examples.

A subsequent multiple-choice survey found that the employment of explanatory information boxes, the indication of (legal) reference values and the annotation of the dose axis were perceived as the most important aspects within the group. Each of these questions was then revisited in a silent discussion collecting advantages and disadvantages for multiple options on how to address these issues.

In the last part of the workshop, the effective dose was compared to two other safety-related indicators resulting from modelling calculations (porosity of the backfill material and radionuclide concentration in groundwater). For this purpose, the participants were asked to discuss to what extent each of the three indicators matched a number of desirable features identified in a previous part of the workshop.

The workshop was planned, conducted and evaluated by a team of engineers and natural scientists with support of CWG's coordination team offering psychological and social–scientific expertise as well as experience from a number of previous workshops with the CWG.

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