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Consequences of severe nuclear accidents in Europe

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A first part of the presentation is devoted to the consequences of the severe accident in the 1986 Chernobyl NPP. It lead to a substantial radioactive contaminated of large parts of Europe and thus raised the awareness for off-site nuclear accident consequences. Spatial patterns of the (transient) contamination of the air and (persistent) contamination of the ground were studied by both measurements and model simulations. For a variety of reasons, ground contamination measurements have variability at a range of spatial scales. Results will be reviewed and discussed. Model simulations, including inverse modelling, have shown that the standard source term as defined in the ATMES study (1990) needs to be updated. Sensitive measurements of airborne activities still reveal the presence of low levels of airborne radiocaesium over the northern hemisphere which stems from resuspension. Over time scales of months and years, the distribution of radionuclides in the Earth system is constantly changing, for example relocated within plants, between plants and soil, in the soil, and into water bodies.

Motivated by the permanent risk of transboundary impacts from potential major nuclear accidents, the multidisciplinary project flexRISK (see http://flexRISK.boku.ac.at) has been carried out from 2009 to 2012 in Austria to quantify such risks and hazards. An overview of methods and results of flexRISK is given as a second part of the presentation. For each of the 228 NPPs, severe accidents were identified together with relevant inventories, release fractions, and release frequencies. Then, Europe-wide dispersion and dose calculations were performed for 2788 cases, using the Lagrangian particle model FLEXPART. Maps of single-case results as well as various aggregated risk parameters were produced. It was found that substantial consequences (intervention measures) are possible for distances up to 500-1000 km, and occur more frequently for a distance range up to 100-300 km, which is in agreement with Chernobyl experiences. However, emergency planning presently is still often focussing on too small areas. In reality, almost all of Europe should be prepared for nuclear disaster. The project investigated also the effect of a simple phase-out scenario. A regional phase-out policy is effective for reducing or even eliminating high damage in the respective regions. It should also be mentioned that risk distribution depends strongly on accident frequency, but this parameter is highly uncertain.

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