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MODULAR TOOLBOX FOR ASSESSING THE IMPACTS OF CO_2 LEAKING FROM A GEOLOGICAL STORAGE RESERVOIR INTO A BUILDING

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ABSTRACT

CO_2 capture and storage is recognized as a promising solution to tackle greenhouse gas emissions. Containment effectiveness of the reservoir is required to ensure harmlessness to humans and to the environment. However, leakage may occur via existing faults, an abandoned well or a sealing deficiency of the cap rock, and impact surface elements. This paper focuses on the assessment of these impacts on surface targets, especially on humans.

Our objective is to provide an efficient tool for decision support based on simple modeling, which enables to assess the most critical and plausible scenarios concerning human exposure to leaking CO_2.

We choose a reference scenario corresponding to a leakage through a fault or a well just a few meters below an occupied building. This scenario can be divided in different steps that correspond to different spatial zones. Since each of these steps has its own physical properties and consequently its own models, we offer an adequate and relevant modular approach to constitute a global tool:

- Module 1: Leakage from the reservoir and migration in the saturated zone through a fault or a well. This module delivers the leakage rate at the bottom of the vadose zone with an analytical model.
- Module 2: Migration in the vadose zone and the basements of the building. Through a literature review and sensitivity analyses on numerical simulations, we demonstrate that the vadose zone plays a substantial role of attenuation on the intrusion rate in the building and we highlight the most influential parameters. This module delivers the leakage rate in the building.
- Module 3: Accumulation in the building. The leakage rate is translated into a CO_2 concentration exposure through an analytical model of mass balance in the building. The concentration exposure is directly comparable to maximum legal concentration.
- Module 4: Exposure to impurities, based on a basic model of dilution rate.

We propose a first version of a global, efficient, quick and easy-to-use tool for decision support, which enables to assess the impact of CO_2 leakage on human health. Additional improvements are planned for a comprehensive and robust evaluation of impacts when assessing risk.