ID: **P2.3-198** Type: **E-poster**

and versatile radionuclide source term estimation, including host rock seepage and atmospheric venting

Atmospheric transport modelling requires the rapid estimation of a radionuclide source term (including radioxenon) potentially released to the atmosphere from an underground nuclear cavity. A versatile model must include venting to the atmosphere and seepage into the host rock, allowing for barometric pumping. The nuclear cavity is connected to the ground surface by two interacting media, namely a fracture network embedded in a porous matrix. The first one is schematized as one-dimensional, and the second as spherical. The carrying gas is compressible, but still isothermal. Convection is governed by Darcy scale equations in both media. The transport of radionuclides from the cavity is governed by a convection-diffusion equation in the fracture network, and by a diffusion equation in the porous matrix. These equations are discretized by the finite volume method with a time implicit formulation which yields tridiagonal systems to solve. Moreover, the convection-diffusion equation uses a flux limiting scheme. Non linearities mostly due to compressibility are addressed by classical Picard schemes. Examples are given to illustrate the precision and the efficiency compared with full three dimensional codes. This model is to be implemented in STM_toolkit, the source-term modeling software in use at the French NDC.

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Session Classification: P2.3 Atmospheric and Subsurface Radionuclide Background and Dispersion

Track Classification: Theme 2. Monitoring events and Nuclear Test Sites: T2.3 Atmospheric and Subsurface Radionuclide Background and Dispersion