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What a Variety of Tracers can tell about the Occurrence of Underground Nuclear Explosions

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Underground nuclear explosions induce a strong flow of air through the surrounding fractured porous media, which carries radionuclides or chemical species. While radioxenon and 37Ar represent tracers scrutinized by the International Monitoring System and On-Site Inspection, respectively, a larger variety of tracers is emitted at the ground surface: radioxenon and heat generated by the explosion, radon and carbon dioxide naturally occurring underground and in the soil cover, respectively. The objective is to determine the conditions under which these additional tracers would help to better discriminate the origin of air masses and reduce uncertainty regarding the origin of radioxenon in cases of high background signals.
This objective can be achieved by a recent code, which solves flow, tracer transport and thermal effects through a fractured porous medium on the Darcy scale (Pazdniakou et al., Pure Appl. Geophys., https://doi.org/10.1007/s00024-022-03038-4, 2022).
The influence of fractures and of their volumetric density is shown to be crucial on the evolution and the distribution of the tracers at the surface. The natural atmospheric fluctuations play an important role on the instantaneous tracer releases. A soil cover smooths out the ground distribution. Finally, all the previous exhalations appear to be sufficiently large to be measurable.

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Promotional text

Transport to the atmosphere of tracers additional to radioxenon (Rn, CO2 and heat) following underground nuclear explosions are determined and shown to be measurable. The influence of the fractures, their density, of the atmospheric fluctuations and of the soil cover is analyzed.

Oral preference format

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