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# Impact of the Variability in Hydraulic Parameters of the Vadose Zone on Pollutant Plume Development

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## INTRODUCTION AND CONTEXT

Simulations of hydraulic parameter fields, spatially variable, and radionuclide plumes have been generated to assess:

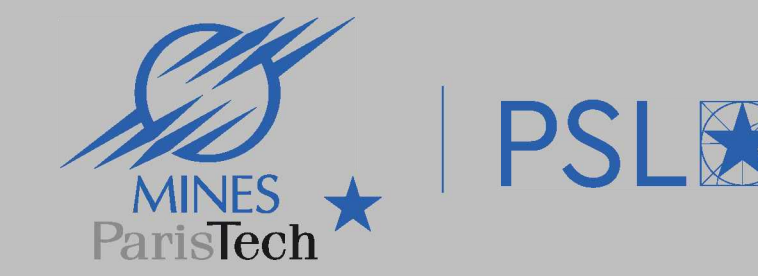
- the influence of small scale variability in hydraulic parameters on solute transport;
- the parameter that should be the most precisely characterized when studying a polluted site.

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### (I) PARAMETER FIELDS

3 parameters of the Mualem-van Genuchten formalism:  $K_s$ ,  $\alpha$  and  $n$ , represented by random fields (lognormal distribution) characterized by  $\sigma^2$  (variance),  $a_x$  and  $a_z$  (ranges).

### (II) PLUME SIMULATIONS

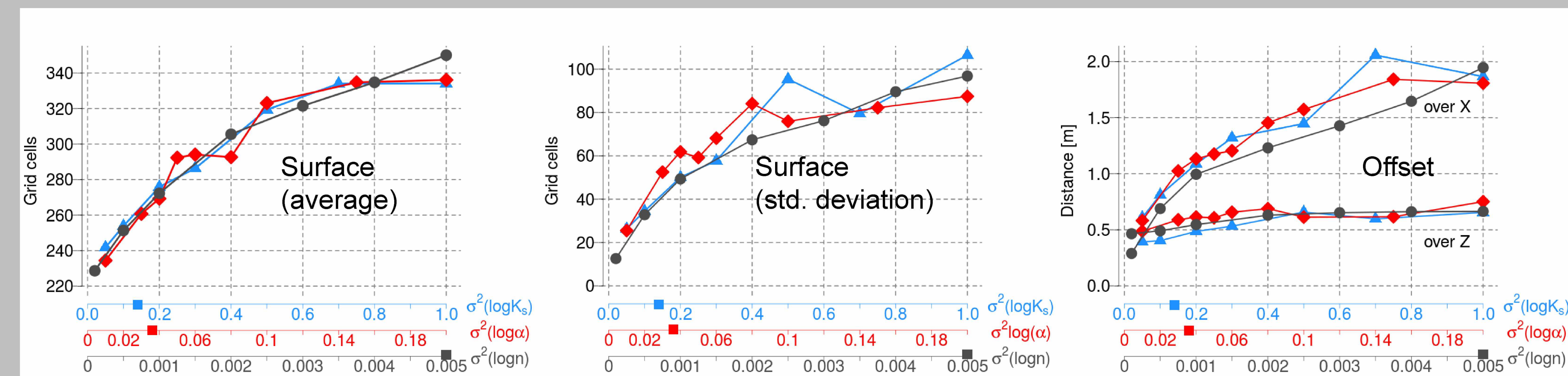
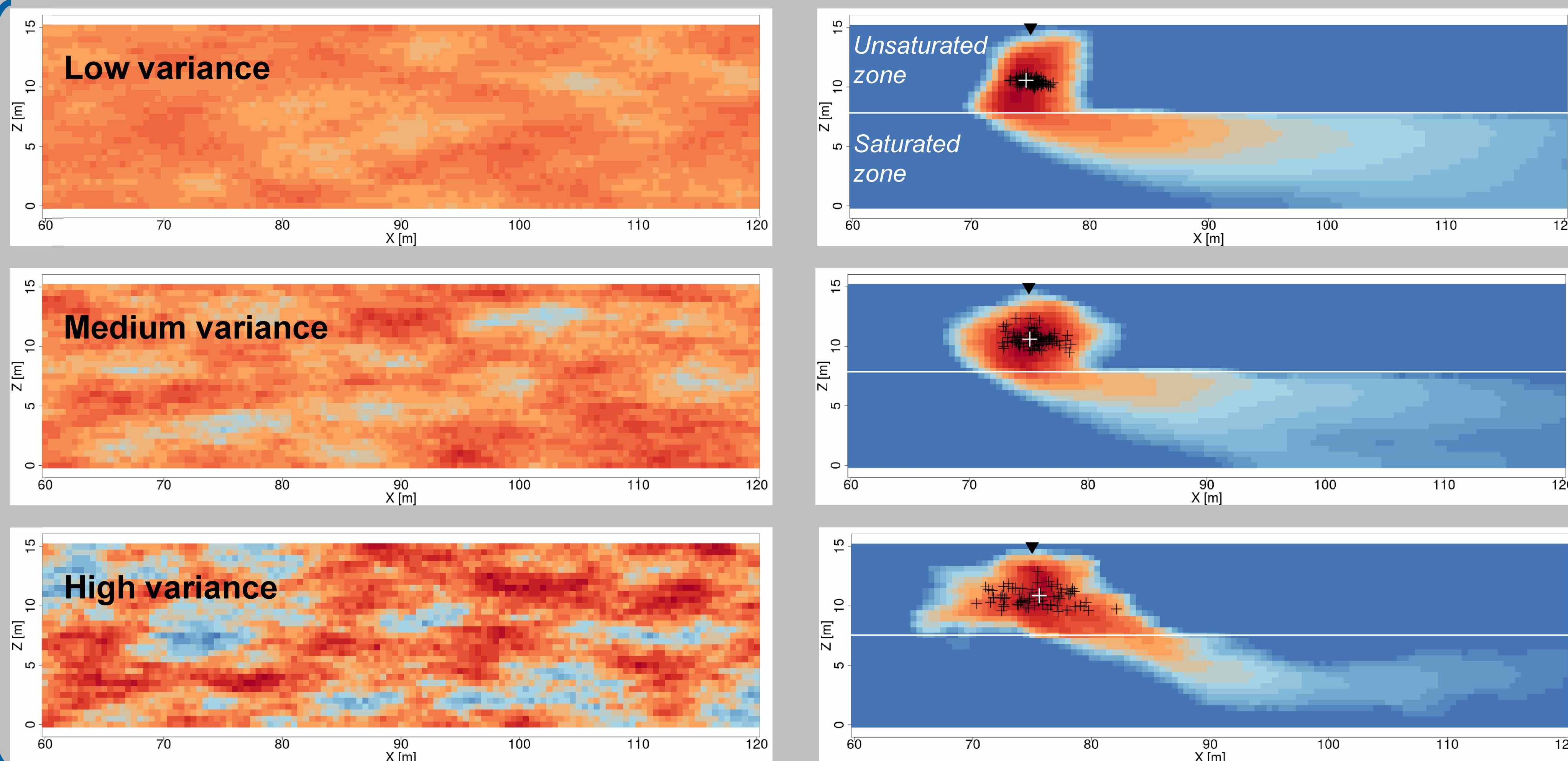
Simulation of flow and solute transport in variably saturated porous media from a localized source of tritiated water, using random fields as inputs for hydraulic parameters.

### (III) SENSITIVITY ANALYSES

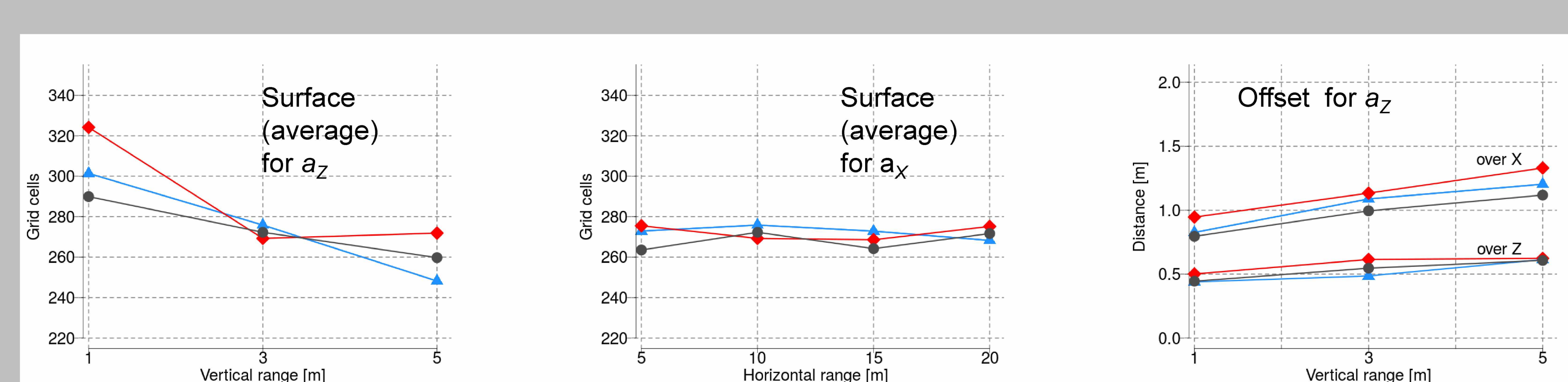
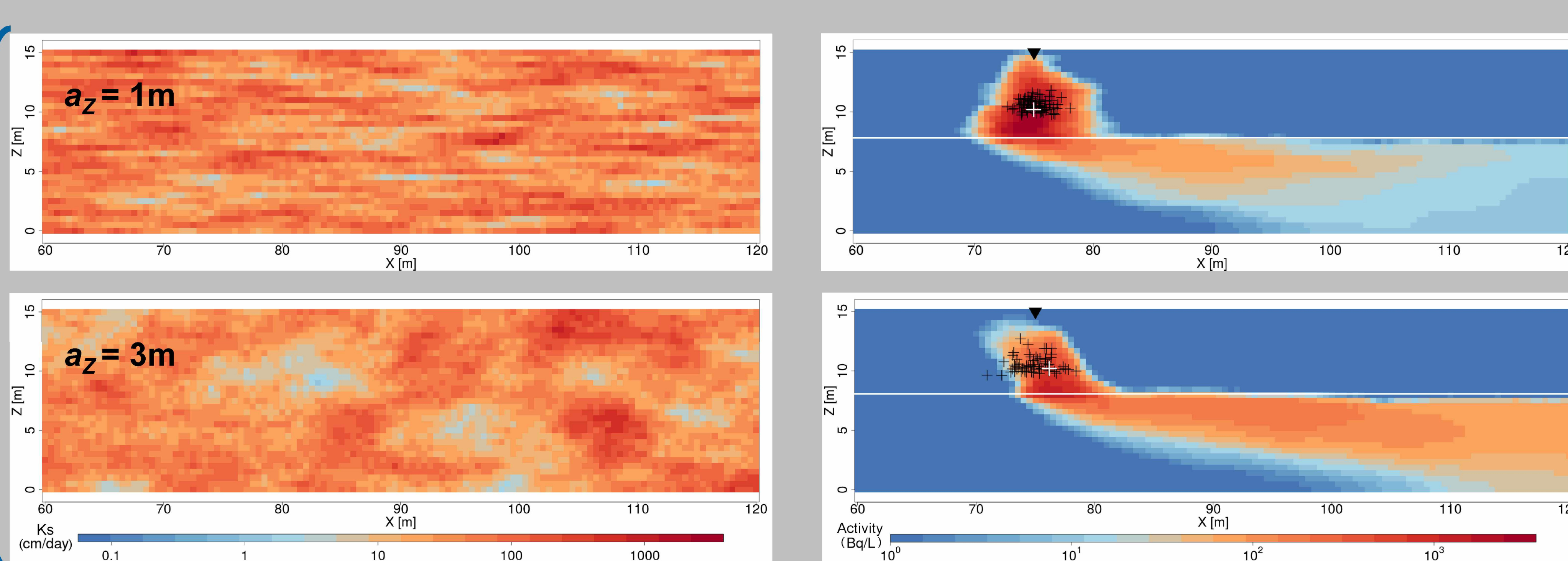
For each triplet  $\{\sigma^2, a_x$  and  $a_z\}$ , sets of 100 random fields are generated and the corresponding plumes are simulated and characterized (in the vadose zone) thanks to:

- their surface (average and standard deviation for each set);
- the position of their center of mass (average distance between the centers of mass of the set and the center of mass of the plume simulated in a homogeneous medium).

Examples of random fields and the corresponding simulated tritium plumes.



- Variances of hydraulic parameters strongly impact the simulated tritium plumes: when  $\sigma^2$  increases, plumes are more expanded and more spread in space;
- $n$  is the most critical parameter: mean variances found at field scale (marked by ■, ■ and ■ on the X-axis) result in an increase of 65% of plume size compared to the homogeneous medium for  $n$  and 20 to 25% for  $K_s$  and  $\alpha$ .



- Parameter ranges have a minor impact on simulated plumes (especially  $a_x$ ) at least for the values tested.

The + correspond to centers of mass of all plumes simulated from the same  $\{\sigma^2, a_x$  and  $a_z\}$  triplet.

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