COMBINING GEOSTATISTICS AND NUMERICAL SIMULATIONS TO IMPROVE ESTIMATIONS OF POLLUTION PLUMES

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INTRODUCTION AND CONTEXT

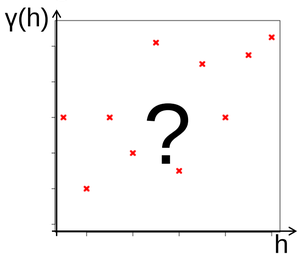
Characterization of **polluted soil or groundwater** around nuclear facilities is a major issue in **site remediation**. Two methods are classically used to estimate the level of pollution.

- **Kriging** (geostatistical method): honors the data but does not take physical knowledge about the phenomenon into account.
- **Simulations of flow and solute transport**: physically based but does not honor the data.

How to combine the two approaches to improve estimations of polluted zones?

KRIGING WITH A NUMERICAL VARIOGRAM

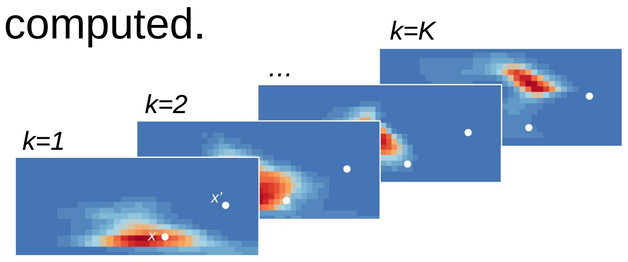
From few data, the fitting of a variogram model might not be accurate enough.



How to characterize the dispersion of the pollutant plume?

Using simulations to describe this spatial structure.

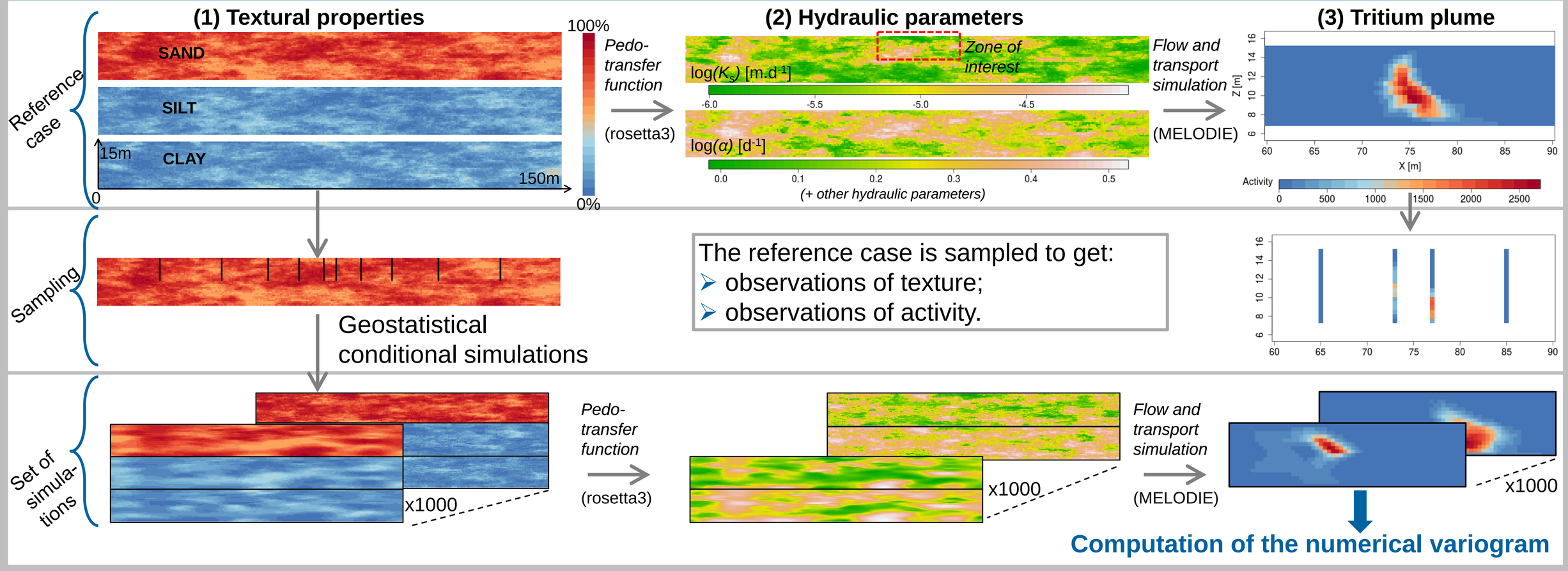
From *K* physically-based simulations of $\mathcal{Z}$, a numerical variogram is computed.



$$\gamma(x,x') = \frac{1}{K}\sum_{k=1}^{K}\frac{[\mathcal{Z}_k(x) - \mathcal{Z}_k(x')]^2}{2}$$

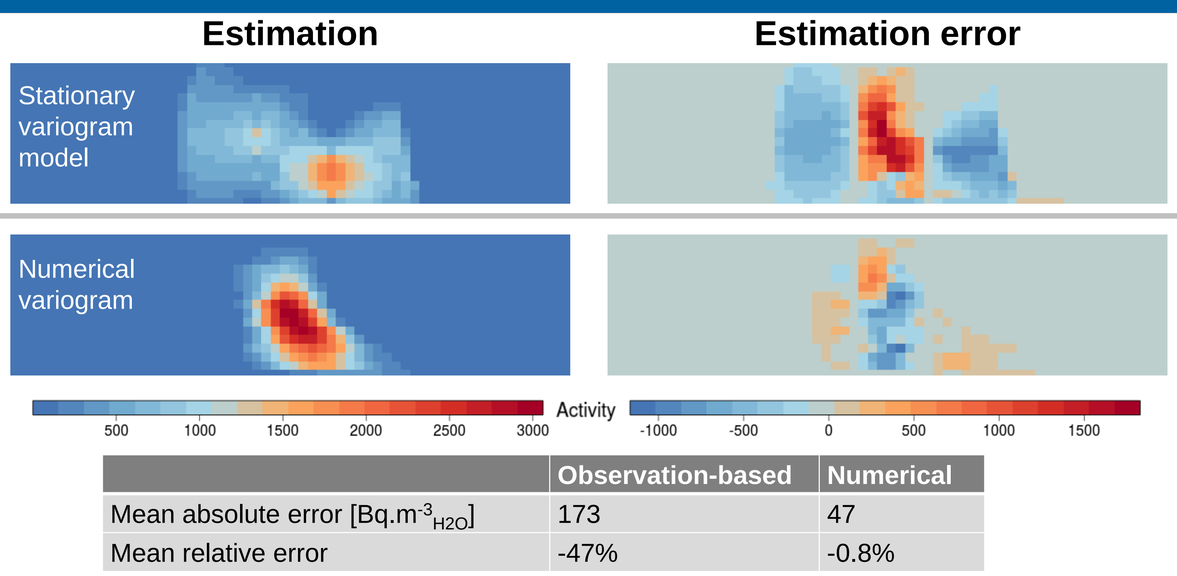
This variogram does not require any assumption about the stationarity and isotropy of the phenomenon under study. Besides, it is **computed from flow and solute transport simulations.**

SYNTHETIC TEST CASE

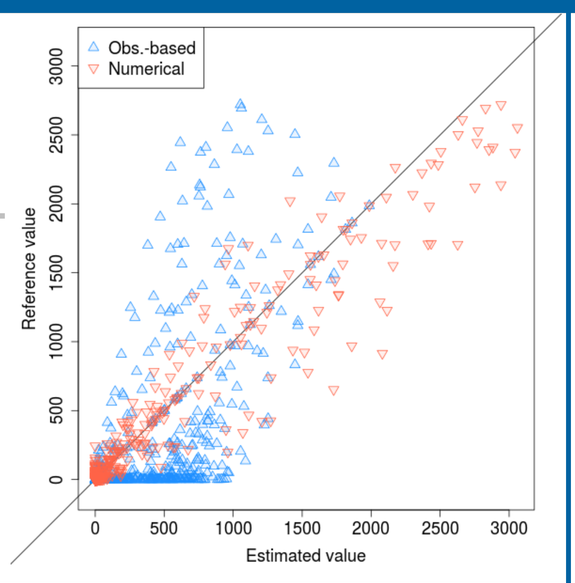


The reference case is sampled to get:
- observations of texture;
- observations of activity.

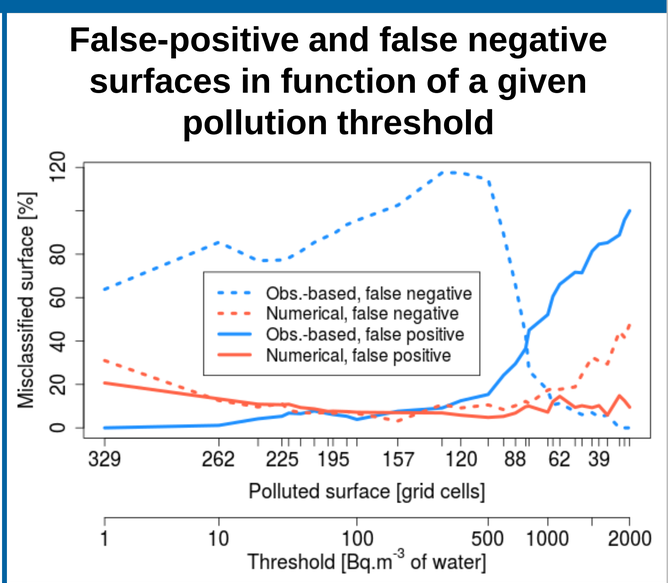
RESULTS: stationary variogram model vs. numerical variogram



	Observation-based	Numerical
Mean absolute error [Bq.m$^{-3}_{H2O}$]	173	47
Mean relative error	-47%	-0.8%



False-positive and false negative surfaces in function of a given pollution threshold



CONCLUSION AND OUTLOOKS

- Implementation of **kriging with a numerical variogram**: improvement of the estimations (smaller errors, consistent maps, less misclassifications).
- Focus on **other modeling uncertainties**: boundary conditions, source of pollution, etc.
- Test on a more complex case.

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