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Effects of the soil pore network architecture on the soil's physical functionnalities

Smet Sarah

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EGU

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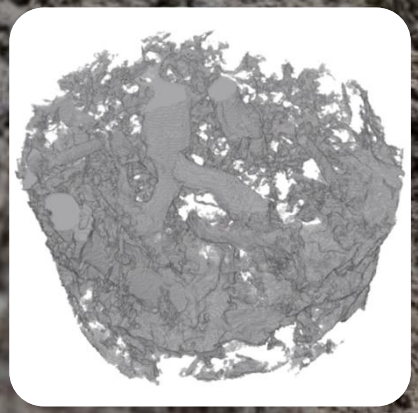
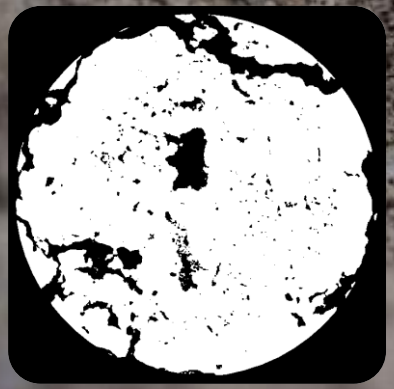
Objective





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Methods (1)

10 soil samples of 3 x 5 cm

Macroscopic behavior

Porosity

Density

Saturared hydraulic conductivity

Air permeability at various water content

Retention curve

Microscopic structure

Voxel size of 43 µm³

Average pore size
Connected porosity
Coordination number Z
Euler number
Length
Number of branches
Number of junctions
(and their ratio)
Tortuosity

…and some more…

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Methods (2)

Exploration of the µscopic parameters value's pore size dependency

1) Calculation for a growing minimal pore volume *(5, 10, 110, 210, 310, … voxels)* until the sample's macropore size is reached

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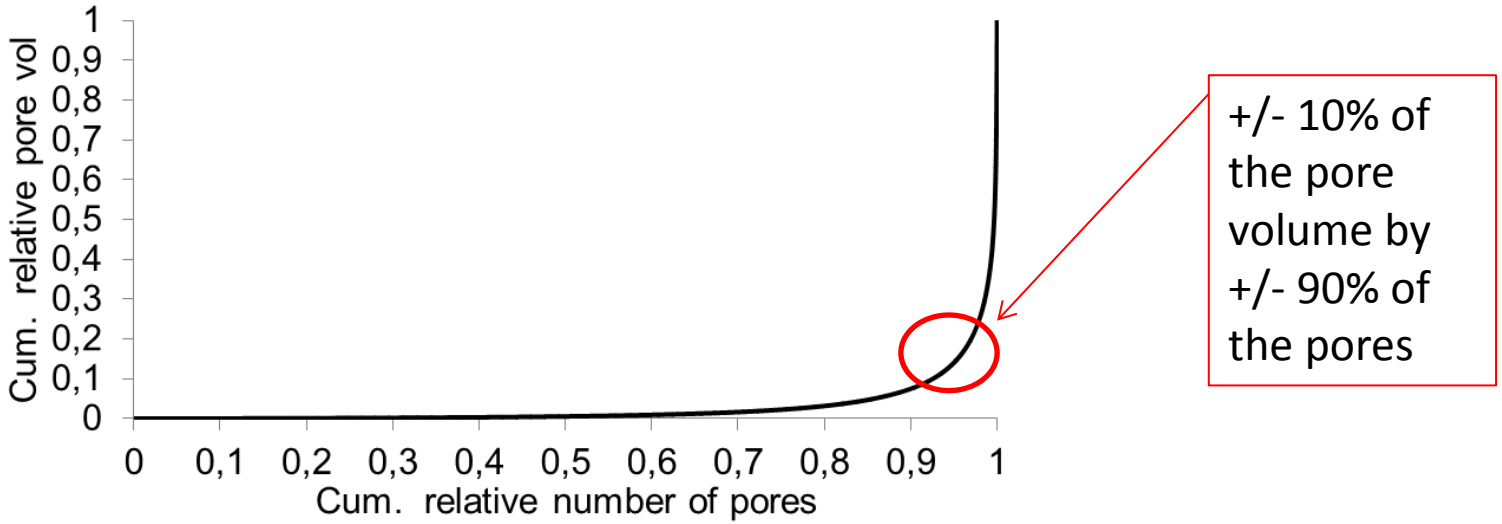

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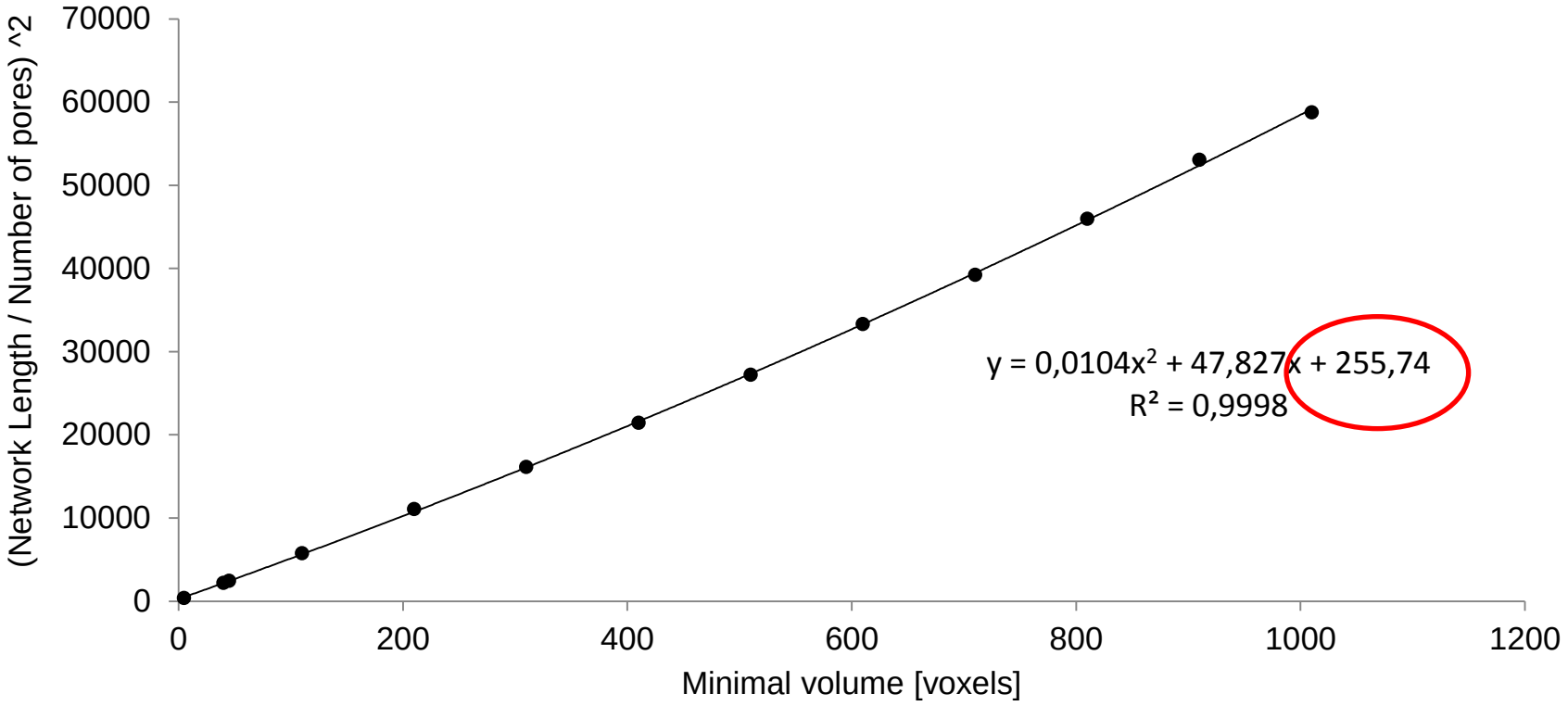
Methods (2)

Exploration of the « micro » parameters's pore size dependency

1) Calculation for a growing minimal volume *(5, 10, 110, 210, … voxels)* until the sample macropore size is reached
2) **Quadratic relationship between the min volume and the squared parameters value**

Methods (2)

Exploration of the « micro » parameters's pore size dependency



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Methods (3)

Correlation with Bayesian Statistics

P(H0) and P(H1) are updated -> P(H1|data)

Bayes Factor for interpretation

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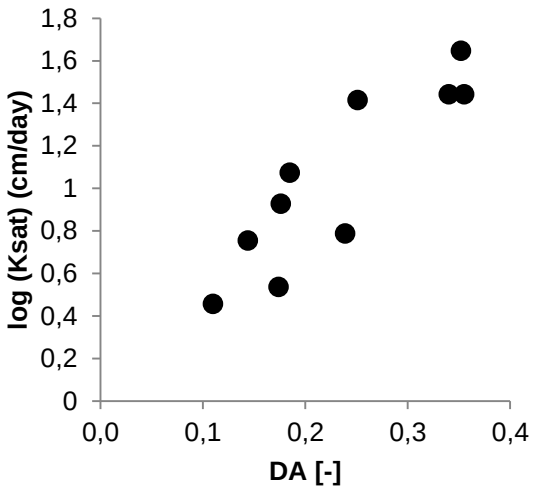
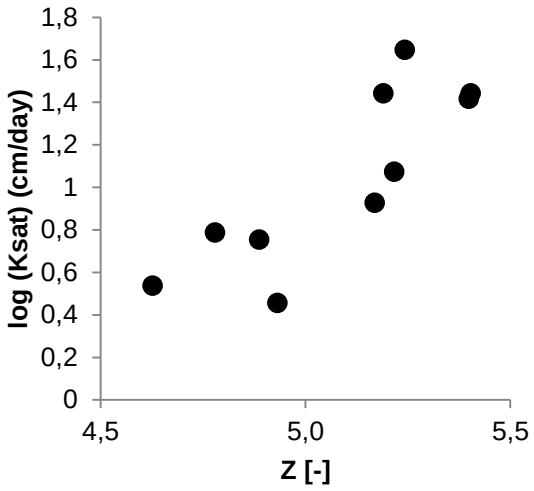
Results (1)
Correlation with $\log(K_{sat})$

Very strong evidence (BF>30)

Degree of Anisotropy **(0,83)**

Coordination number **(0,77)**





Degree of Anisotropy calculated by the Mean intercept length method

Coordination number Z Averaged number of connections of the connected pores

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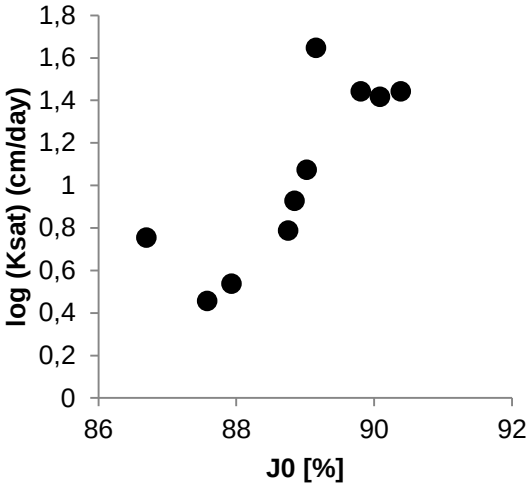
Results (1)
Correlation with $\log(K_{sat})$

Very strong evidence (BF>30)	Strong evidence (BF>10)
Degree of Anisotropy **(0,83)** Coordination number **(0,77)**	Proportion of network without junctions **(0,74)**



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Results (1)
Correlation with $\log(K_{sat})$

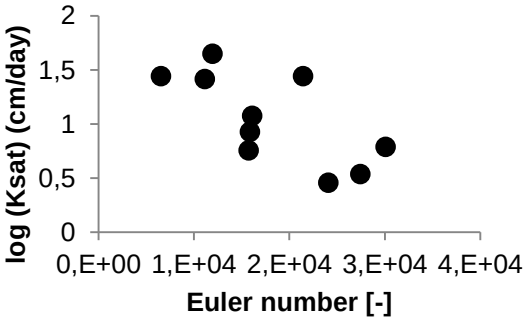
Very strong evidence (BF>30)	Strong evidence (BF>10)	Substantial evidence (BF>3)
Degree of Anisotropy **(0,83)** Coordination number **(0,77)**	Proportion of network without junctions **(0,74)**	Euler number **(-0,63)**

Euler number = N – L + O

N = isolated object

L = loops = redundant connections

O = cavities



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Results (2)
Correlation between conductance and WC after draining

Very strong evidence (BF>30)	Strong evidence (BF>10)	Substantial evidence (BF>3)
500 kPa **(-0,80)**	70 kPa **(-0,73)** 100 kPa **(-0,77)**	1500 kPa **(-0,62)**

Anedoctical evidence (1>BF>3) with water content after draining
30kPa **(-0,56)**

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Results (2)

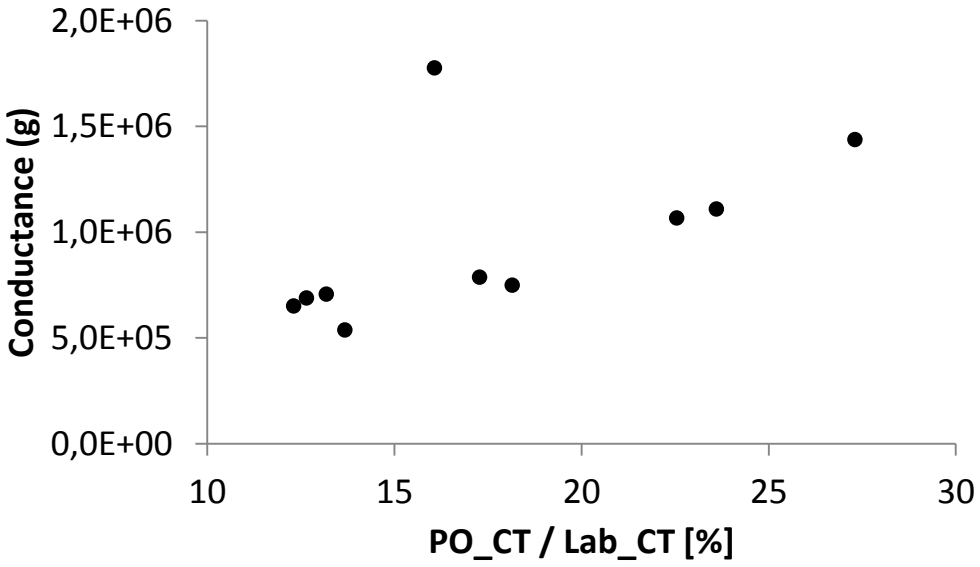
Correlation with conductance

CONDUCTANCE

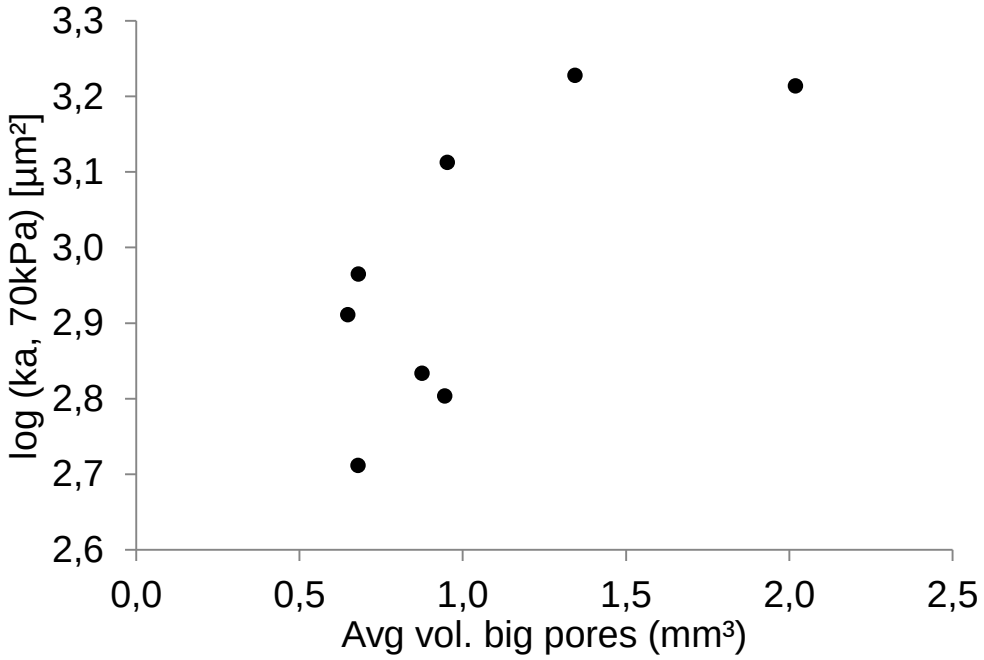
Min 5 voxels of 43 µm³

WATER CONTENT

Diameter from 4 to 0,2 µm



Results (3)
Correlation with $k_{a,70\ kPa}$



Substantial evidence (BF>3)

Avg pore vol **(0,69)**

Avg small pores vol **(0,70)**

Avg big pores vol **(0,65)**

No correlation between the **number of pores** and the **averaged pore volume** or the **air permeability**

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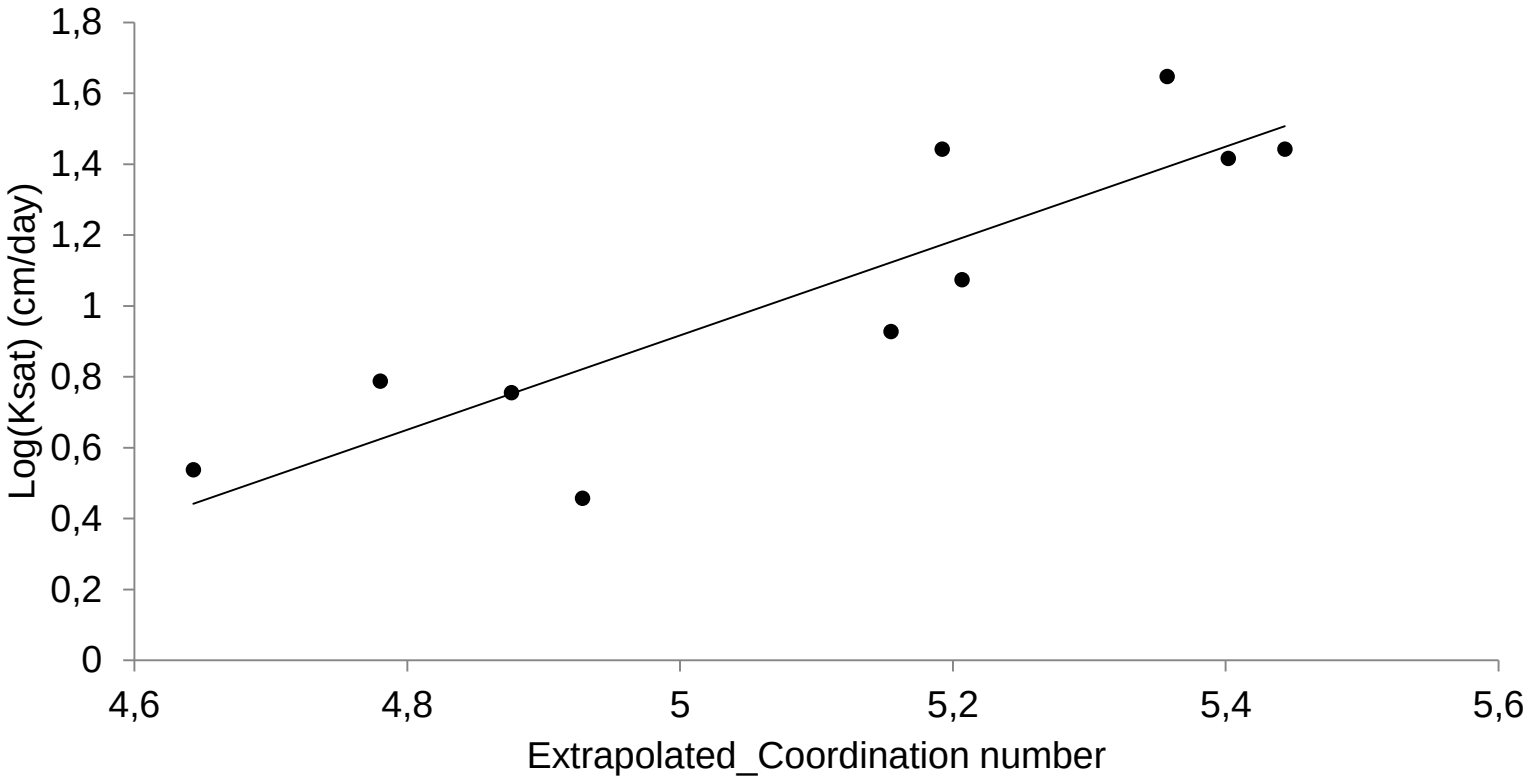
Results (4)

Correlation with extrapolated parameters



Conclusion

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Thank you for your attention !

Special Section: Noninvasive Imaging of Processes in Natural Porous Media

X-ray Micro-CT: How Soil Pore Space Description Can Be Altered by Image Processing

Sarah Smet,* Erwan Plougonven, Angélique Leonard, Aurore Degré, and Eléonore Beckers

A physically accurate conversion of the X-ray tomographic reconstructions of soil into pore networks requires a certain number of image processing steps. An important and much discussed issue in this field relates to segmentation, or distinguishing the pores from the solid, but pre- and post-segmentation

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