



FOOTPRINT

Functional Tools for Pesticide Risk Assessment and Management

FOOTPRINT / MACRO scheme for soil susceptibility to macropore flow: A model-independent validation

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FOOTPRINT / MACRO scheme for soil susceptibility to macropore flow: Model Independent Validation

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WP4, Activity 4.1:
Post-modelling, and model-independent validation of Soil macropore flow parameterisation with MACRO PTF

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Estimating pesticide leaching risks?

→ Back to basics



“estimating” pesticides leaching risks with MACRO model / software

implies

Setting parameters for soil, crop, pesticide...





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Parameters for MACRO model?

- Measure them?
- Site specific
- Expensive
- Resource intensive...
- Not suitable for large areas

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Parameters for MACRO model?

- Estimate them?
- Only suitable option at (supra)national scale and “unsampled” catchments.

But how?

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Parameters for MACRO model?

Underlying relations

Statistics → **PedoTransfer Functions (PTF)**

- other data already available: soil maps, land use, cropping systems, etc.

Model parameters (Soil biological, chemical or physical properties)

Lower cost	Higher cost
Easier to measure	Hard to measure

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FOOTPRINT / MACRO scheme for soil susceptibility to macropore flow

today / FOOTPRINT:

PedoTransfer Functions (PTF)

for

Water Flow in Macropores

ASCALE, ZN (and *K_{sat}* indirectly)

NB: FOOTPRINT / MACRO PTF for non-preferential flow in soil matrix, are based on Wästen et al. 1999 (Geoderma:90) → Already widely used (124 citation in ISI-WOS 31/10/08)

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FOOTPRINT / MACRO scheme for soil susceptibility to macropore flow

Soil susceptibility to macropore flow:

- 1) Is (sometimes / often) important for pesticide leaching
- 2) Few, if any, successful attempts to estimate it
- 3) We can model it, we can measure parameters, but it is difficult to understand and so predict their extent in unsampled location

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FOOTPRINT / MACRO scheme for soil susceptibility to macropore flow

Decision tree: Classify soil horizons

Parameters for MACRO

from: I Low susceptibility

II

III

to: IV High susceptibility

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FOOTPRINT / MACRO scheme for soil susceptibility to macropore flow

Decision tree: Classify soil horizons

Parameters for MACRO

I Low susceptibility

II

III

IV High susceptibility

Decision tree BLUEPRINT = model independent

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How does it work?

...: 3 pillars ...:

Earthworms channels

Tillage

Aggregation

Soil structure

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How does it work?

TOPSOIL

SUBSOIL

Jarvis 2007, EJS:58

Jarvis et al. 2007, FOOTPRINT DL19 & 21

not Footprint, not tested (info not available)

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How does it work?

Adapted from: Lindahl et al., 200X, Submitted, VZJ

EARTHWORMS

~ Do they have: **food, water, space, and loose material** to channel?

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How to validate the scheme independently from MACRO

→ Using solute / tracer leaching experiments conducted on soil core?

- Constant water flow + Pulse of solute
- Soil sample
- Measure solute concentration

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Analysing the shape of solute breakthrough curves

Valocchi, 1985, WRR:21
And many others...

Solute transport breakthrough curve

"Time Moments Analysis"

= Curve's shape

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Analysing the shape of solute breakthrough curves

To make a long story (too) short:

- The earlier peak,
- The more asymmetrical,
- The peakier,

= The more preferential flow

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Analysing the shape of solute breakthrough curves

'Robust' descriptors
Ren et al., 1996, SSc:161
Comegna et al., 1999, Geod.:92

Pore volume at peak Concentration (PV_{peak}) = Robust descriptors (among others tested)

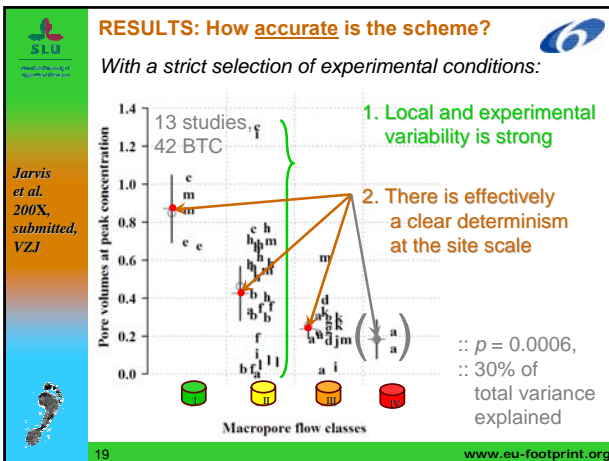
no preferential flow + no dispersion
→ The peak arrives at one pore volume

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Analysing the shape of solute breakthrough curves

Computing pore volume at peak concentration and FOOTPRINT / MACRO preferential flow classes on 42 selected* breakthrough curve experiments from the literature (* selected from a larger data set)

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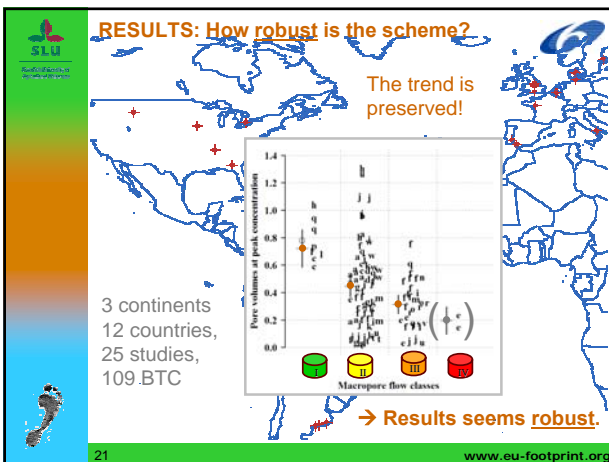


RESULTS: How robust is the scheme?

With a "relaxed" selection of experimental conditions?

- Not necessarily nearly saturated soil columns
- i.e.: Full potential for macropore flow NOT guaranteed
- i.e.: Error (and bias) introduced in statistical tests

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RESULTS:

Contrary to common belief, it is possible to **estimate** soil susceptibility to macropore flow at the **site scale!!!**

even though local variability remains important

In the future, progress are still possible to reduced even more this variability

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Perspective 1:

Danish Soil Survey dataset:

Parameters estimated

versus

Parameters measurements

~ External to FOOTPRINT project

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Perspective 2: Model specific tests


Testing the full set of FOOTPRINT / new MACRO 5.2 pedotransfer functions on in-situ lysimeter experiments/measurements

PTF: Jarvis et al. 2007, FOOTPRINT DL19 & 21

- Several soil layers;
- Long-term;
- Transient meteorological (rain) conditions;
- Full range of soil water contents;
- Water and solute uptake by crop;
- More heavy clay soils.

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In summary...

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Take home message:


- A decision tree has been developed to estimate MACRO macropore flow parameters with readily available site / soil data *as part of a set of other parameterisation tools*
- The scheme classes have been validated against a large leaching dataset, *and we currently work to validate the parameters associated to each class.*
- The decision tree is in FOOTPRINT tools and in the new future release of MACRO.

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Thank you for your attention

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