# How biologically formed macropores influence subsurface flow

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## Introduction

- Water flow in soil influences heavily erosion, pollution and/or agronomic issues. However, **subsurface flow** processes still need further research.
- Subsurface flow is described as **preferential** uniform or non-uniform **flow occurring in interconnected macropores** (diameter > 2mm).
- **Biological macropores formed by plant root systems** and **pedofauna** influence largely this preferential flow.

## Aims

- **How do different forest cover types influence preferential flow by root morphology and pedofauna activity ?**
- **Is there any evident relationship at this scale between preferential flow and biotic parameters ?**

## Methods

### Tropical climate

Field work Xishuangbanna, Yunnan province, China

### Treatments

- Rubber tree plantation (*Hevea brasiliensis*) vs endemic tree forest
- Understory fine root effect vs weak fine roots bare soil
- Sites have a similar soil texture




**Fig. 1: Sites presentation**. 1 site = 1 treatment. (i) 'Bare soil trees': Tree plantation and bare soil ; (ii) 'Clear-cut trees': clear-cut tree plantation with understory ; (iii) 'Forest': Secondary forest with understory.

### Experiment

1) Dyed infiltration simulation
   3 experimented plot per site
2) Soil excavation
   3-5 soil profiles per plot
3) Measurements for each soil profiles

### Measurements

Photo-description-sampling : spatialized with referenced grid (Fig.2)

- Patterns of water infiltration by blue dyeing } Image analysis (Fig. 2)
- Roots impact by diameter classes
- Pedofauna activity: presence / absence
- Soil resistance to penetration

} Manual field description

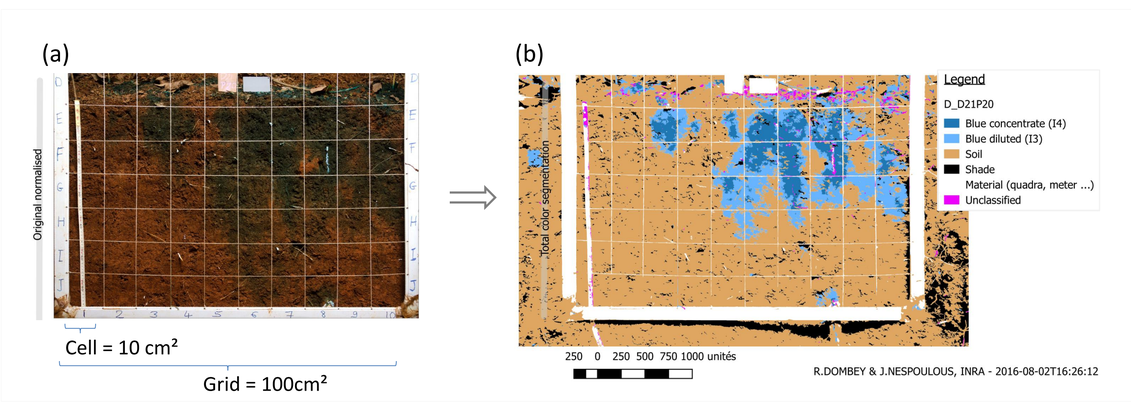



**Fig. 2:** Image analysing for preferential flow measurements (a) Soil profile photo normalized, (b) Soil profile photo after colour segmentation: color classes are selected by color thresholding. Software : Qgis and Ecognition.

## Results

### Site variability (Fig.3)

- Fauna was more present on clear-cut plantations.
- Fine roots were equally developed in clear-cut plantation and forest, and less developed in bare soil.
- Coarse root were significantly more developed in forest.
- Resistance to penetration is much less important in forest.

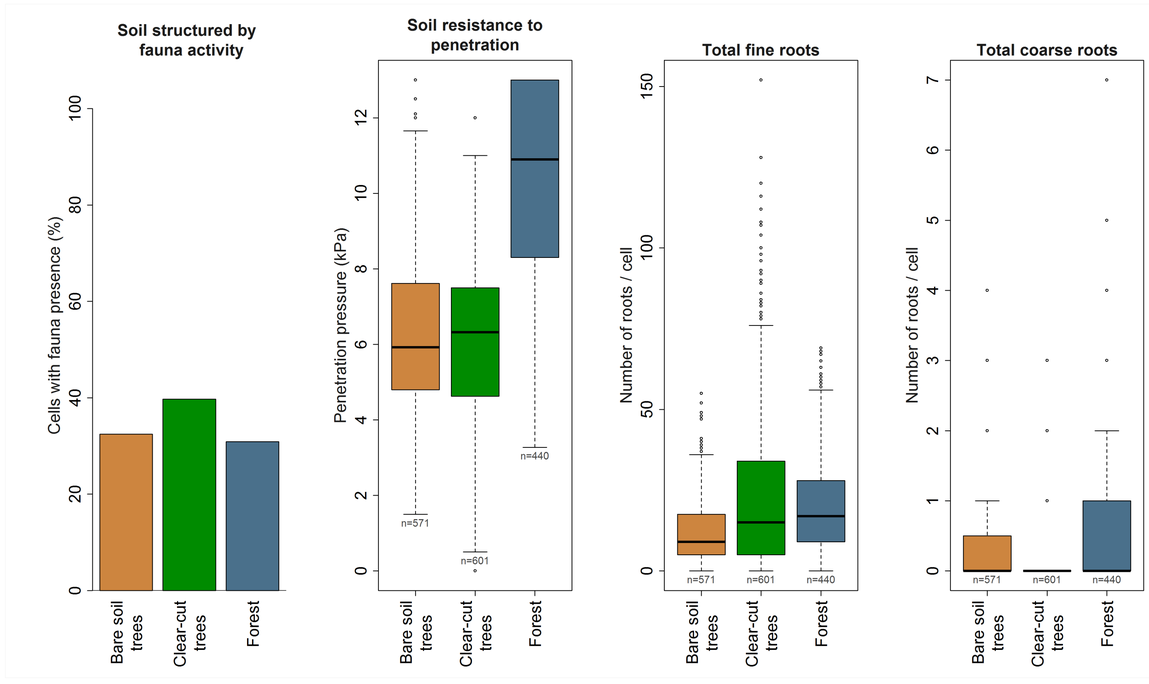
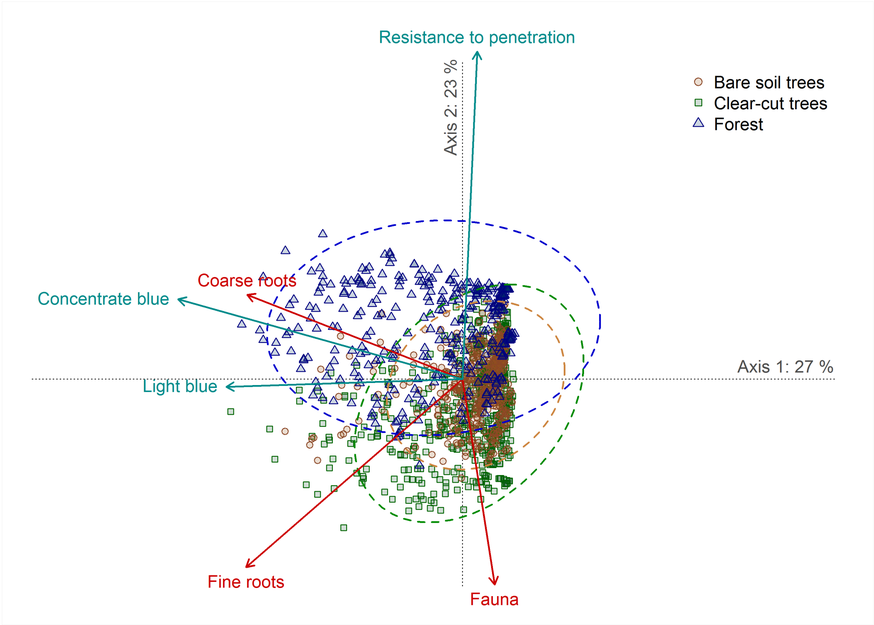



**Fig. 3: Variability between treatments**. Measured for each grid cell: (i) Fauna activity described by cumulated presence/absence. (ii) Resistance to penetration is the pressure resistance: 0kPa = void ; 12kPa = maximum resistance for the penetrometer. (iii) Coarse roots (≥2mm) and fine roots (<2mm) impact are counted in function of coloration.

### PCA (Fig.4)

- 'Blue dye' is related to roots and 'concentrate blue dye' is mostly explicated by coarse roots.
- Coarse root effects on subsurface flow was more observed in forest .
- Fine root effect on subsurface flow was more observed in clear-cutted trees with the most amount of grass (Fig. 3).
- Bare soil trees with less roots is affected by fauna activity.

**Fig. 4: PCA** (Principal component analysis) on the first projection (axis 1:2) representing 48.99% of projected inertia.




## Conclusions

- Preferential flow is driven by roots.
- The effect of fauna on preferential flow is not evident as fauna was present in the most of the cases.
- In the forest, preferential flow is mainly influenced by coarse tree roots.
- The influence of grass is lower in the forest than in clear-cut plantations.

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