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Soil and substrate morphology as witnesses of present and former agricultural landscape management

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BACKGROUND: Combination of water / tillage erosion and successive regroupings of the lands, have significantly modified the morphology of cultivated hillslopes. Nowadays, we can still observe over cultivated landscapes various anthropogenic structures (e.g. lynchets) that correspond to former and/or present field limits.

AIM: To characterise the geometry of these various structures, and assess their relation with topography, surficial resistivity, or any other easily available indicator.

→ existence of a strong mathematical relation between these indicators and soil thickness would allow us to extrapolate the quantification to larger areas.

STUDY SITE:

- near Tours in the Parisian Basin (France)
- 17 ha hillslope in a chalky watershed
- elevation: from 35 to 90 m (SE facing slope)
- regrouping of the lands in the 1960s



1 – STRUCTURES CHARACTERISATION

Two types (Figs. 1&2)

- **Lynchets:** at lower limits of **present** fields mostly **concave**
- **Secondary structures:** at some **former** field limits (1950) mostly **convex**



Lynchet



Secondary structure

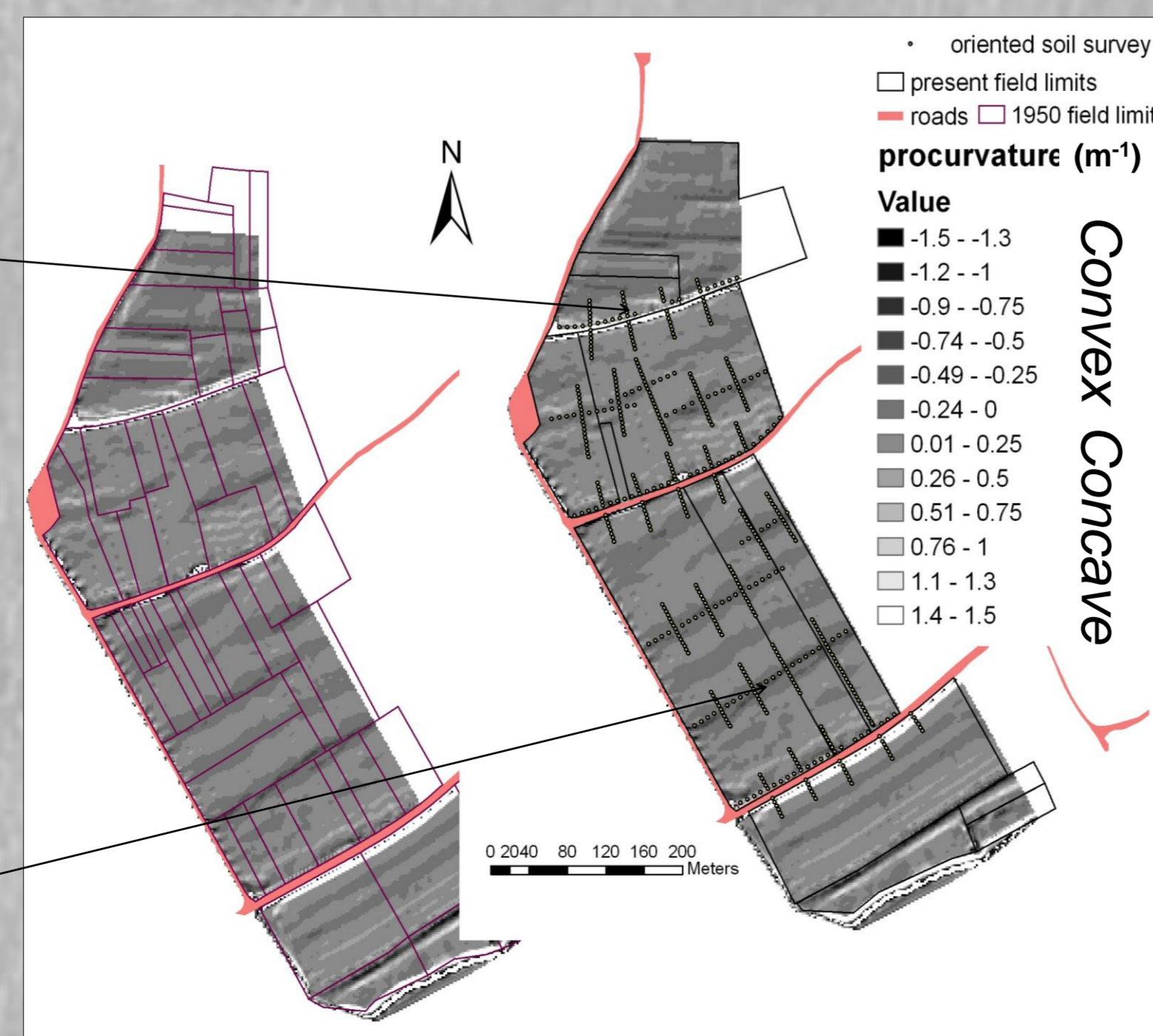


Figure 1: Profile curvature and present and former (1950) field limits

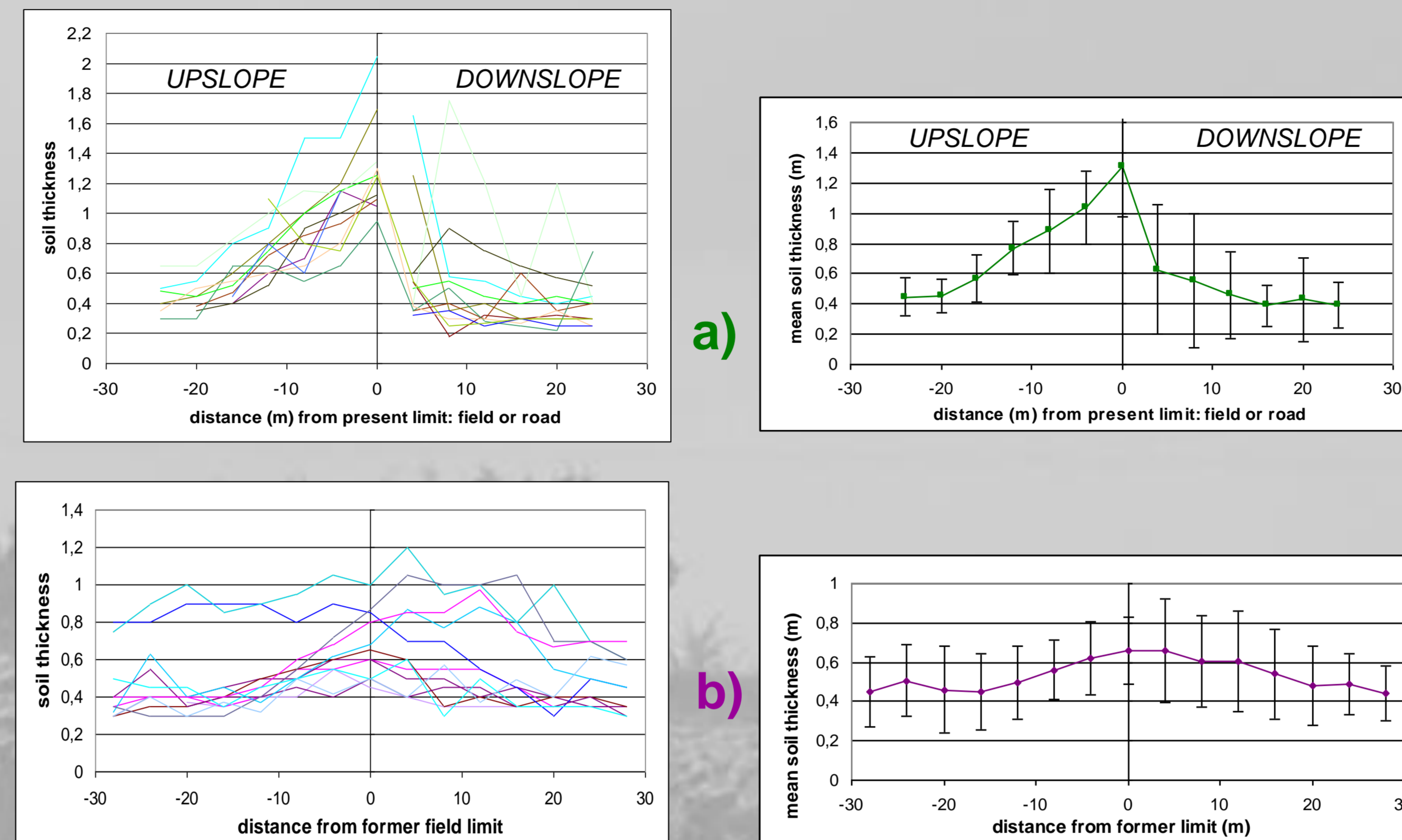


Figure 2: Soil thickness *perpendicularly* to structures: variation relative to distance from field limit or road by transect and by mean +/- standard deviation. a) lynchet b) secondary structures

- **Soil accumulation** for each structure, **thicker for lynchets**
- **Strong asymmetry** for lynchets: soils are thicker upslope the limit and become rapidly thinner downslope
- **Slighter asymmetry** for secondary structures: soils are thicker downslope the former limit

2 – LINKS BETWEEN STRUCTURES AND TOPOGRAPHIC ATTRIBUTES

- Soil accumulations **not well linked** with topographic attributes (Fig. 3).

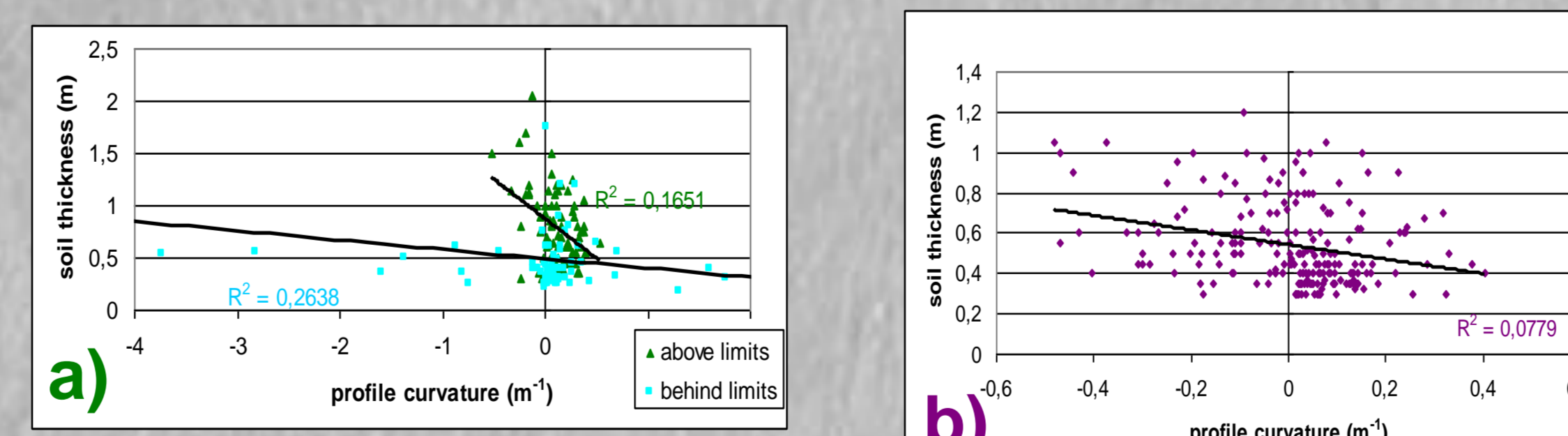


Figure 3: examples of simple linear correlations: here between soil thickness and profile curvature. a) Lynchet. b) Secondary structures

- Multiple correlations (including elevation, slope, planform and profile curvature) improve link with soil thickness ($R^2=0,42$): still **weak for extrapolation**.
- Weak correlations, soil thickness and asymmetries interrogate about **substrate morphology** (Fig. 4).

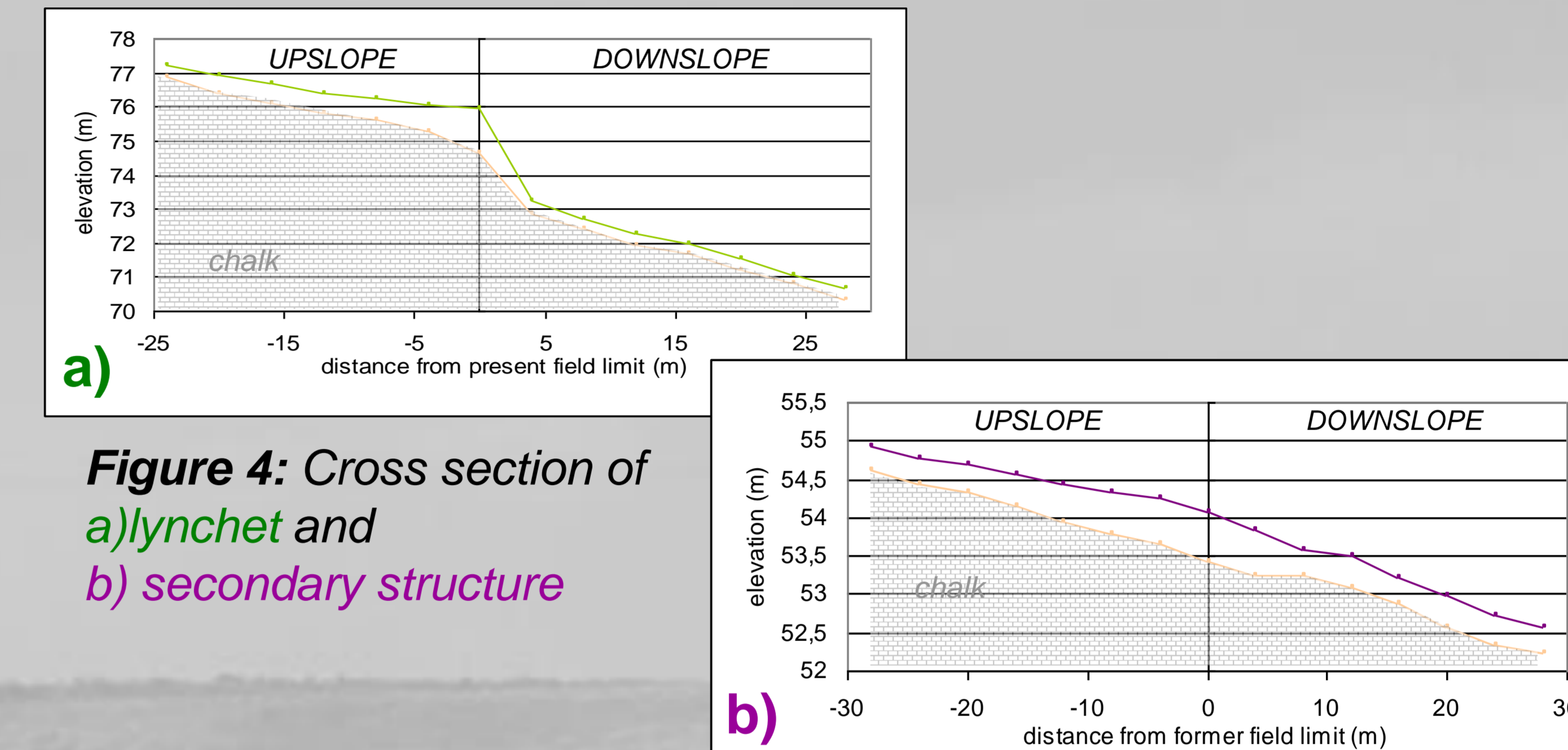


Figure 4: Cross section of a) lynchet and b) secondary structure

- **Substrate morphology modified** downslope present field limits and near some former limits
- Could **explain weak correlations** between soil thickness and topographic attributes

3 – FIRST STUDY ON SURFICIAL RESISTIVITY (Fig. 5)

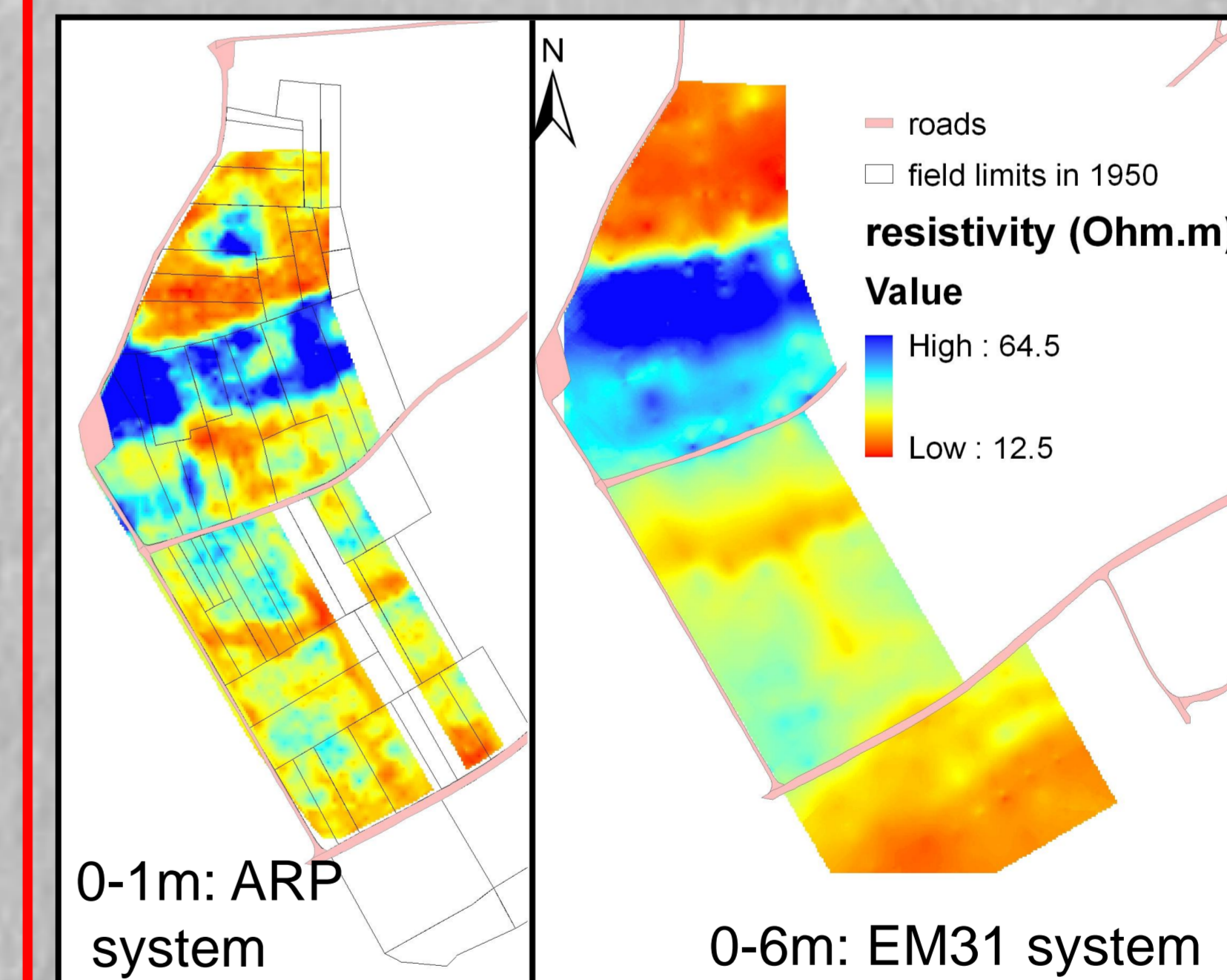


Figure 5: Resistivity at various depths

- Impact of former field limits on surficial resistivity

- But maps and statistics show a significant **disturbance of surficial signals** by background noise due to substrate heterogeneity

4 – CONCLUSIONS

- Soil accumulations due to past and present field limits cannot be estimated by topographic attributes exclusively.
- Irregularity in the substrate morphology due to tillage operations should be taken into account.
- Surficial resistivity has to be further treated from background noise due to substrate heterogeneity to find a better link with soil accumulations.