Soil management impacts on soil structural properties in ten European long-term experiments

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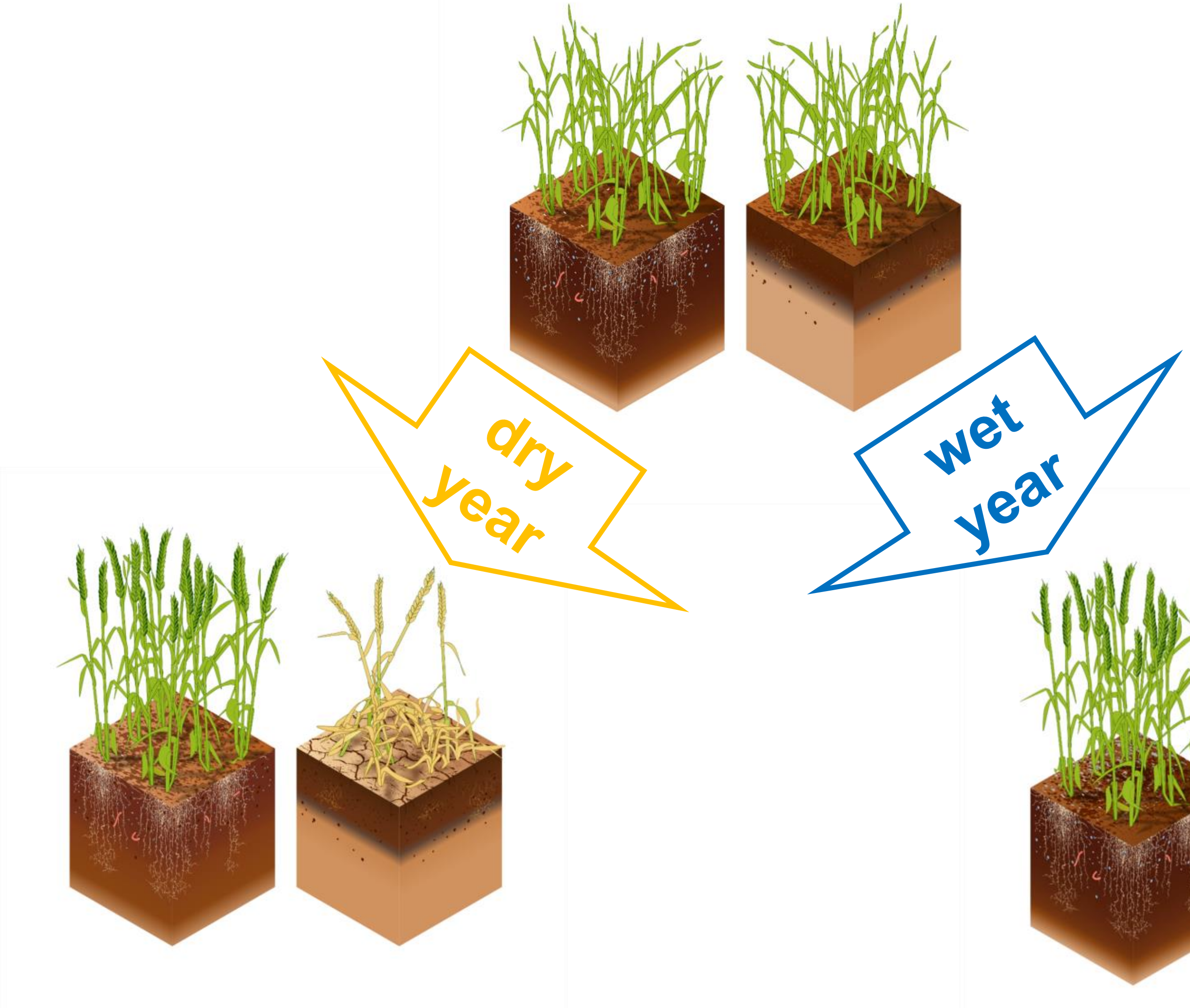
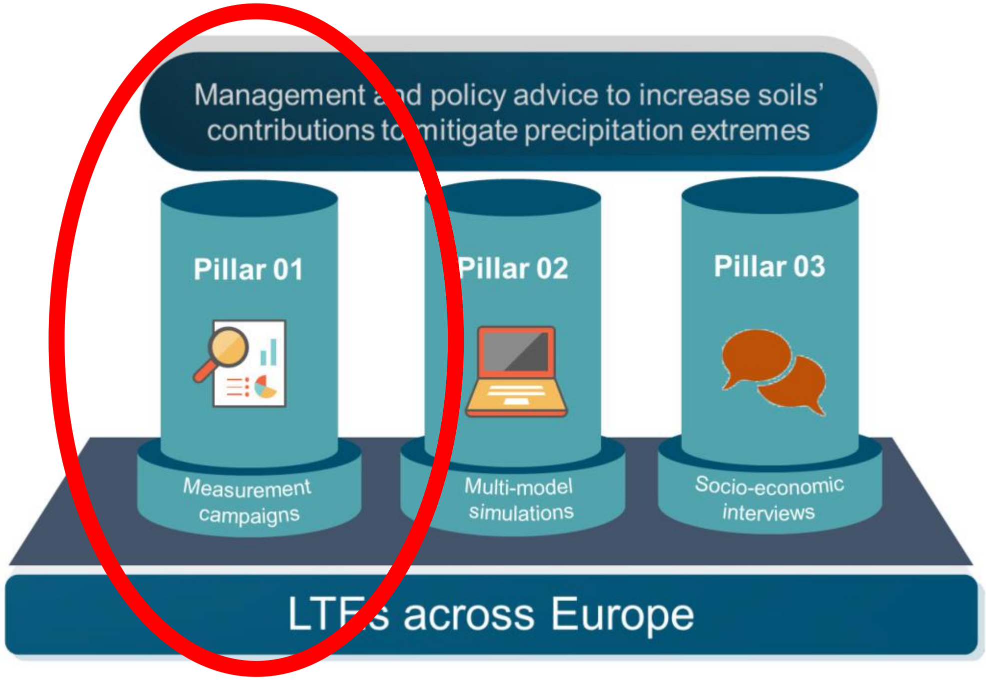
SoilX: Soil management to mitigate climate change-related precipitation eXtremes





focus of this presentation

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Aim and Hypotheses

Aim: Quantification of management effects on climate-change adaptation related soil physical properties in European LTEs

Hypotheses:

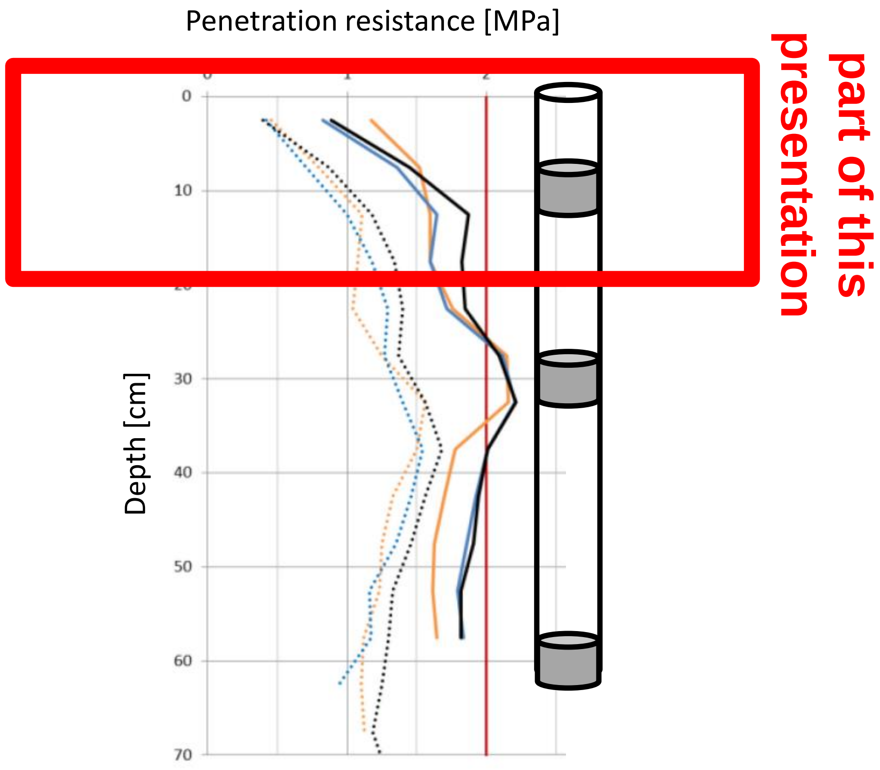
- Higher C input, higher soil cover and lower tillage intensity enhances soil structure directly and indirectly (via soil biota and soil oragnic matter)
- The enhanced soil structure contributes to climate resilience of cropping systems by increasing soil hydraulic conductivity, aggregate stability and soil water retention.

Sampling in ten long-term experiments (LTE)

Map from Metzger (2018), doi.org/10.7488/ds/2416

part of this presentation

	Experiment	Institution	Factors	Treat.	Blocks
1	Säby	SLU	tillage, rotation	3	3
2	CENTS	AU	tillage, org. inputs	4	4
3	BOPACT	ILVO	tillage, org. inputs	4	4
4	Čáslav	CZU	organic inputs	2	4
5	Lukavec	CZU	organic inputs	2	4
6	Hollabrunn	BOKU	tillage	2	3
7	FAST I	AGS	tillage, org. inputs	4	4
8	ZOFE	AGS	organic inputs	2	4
9	P24A	AGS	organic inputs	2	4
10	ROT	INIA	tillage, rotation	4	4



~~111~~ 63 plots x ~~3~~ 1 depths

=

~~333~~ 63 **observations**

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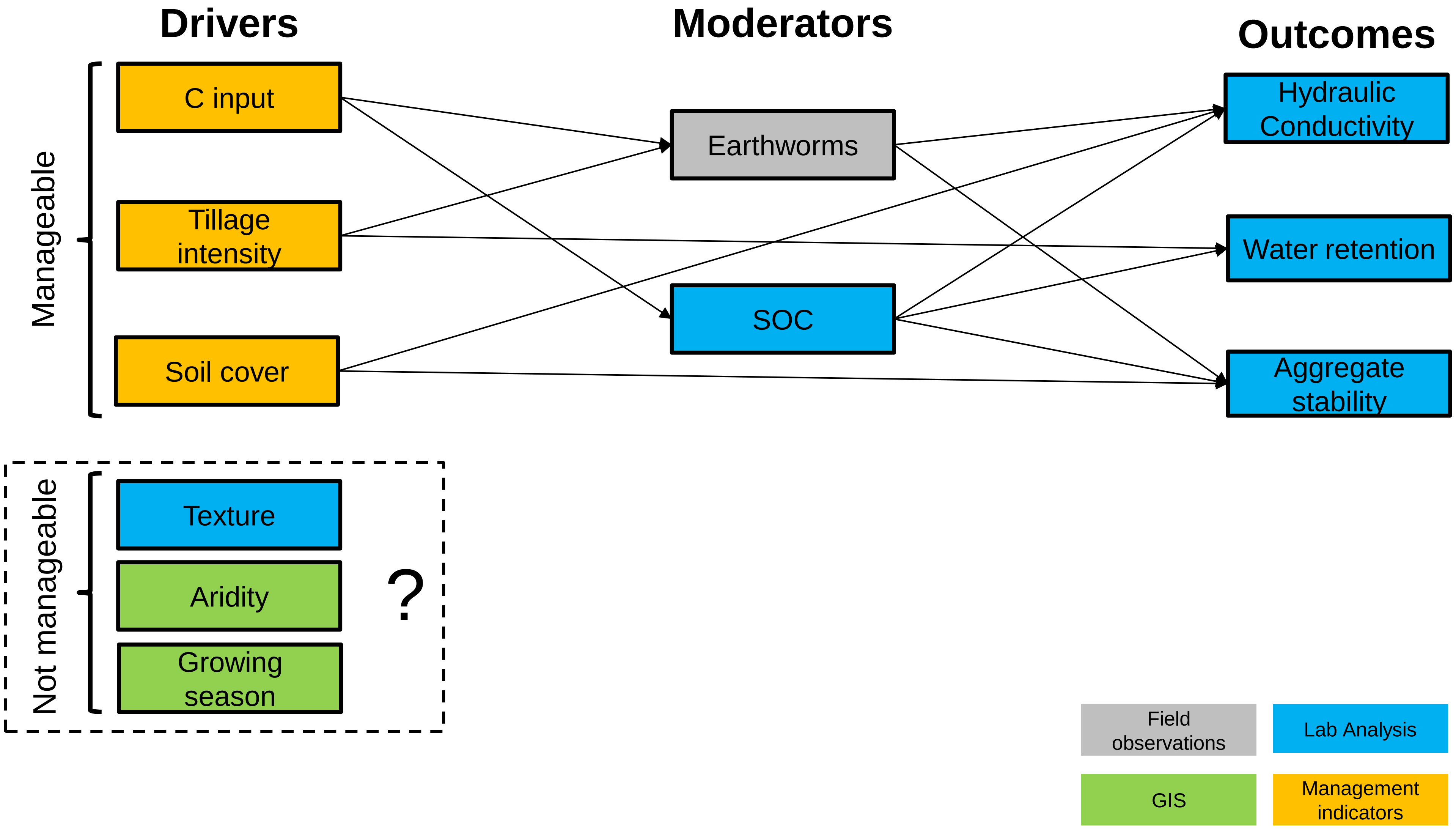
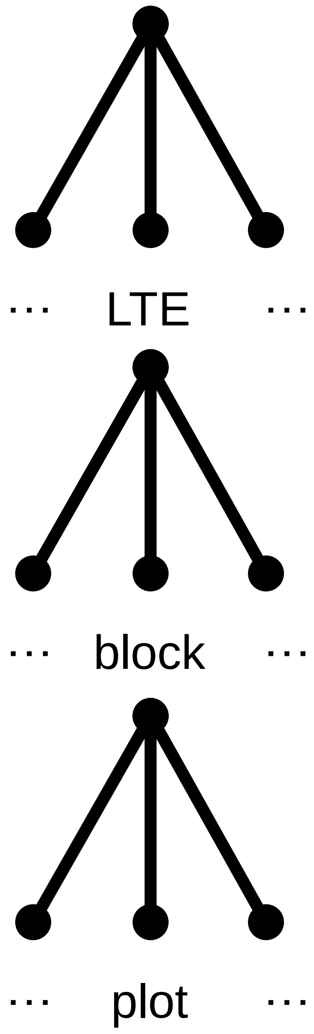
Variables under investigation

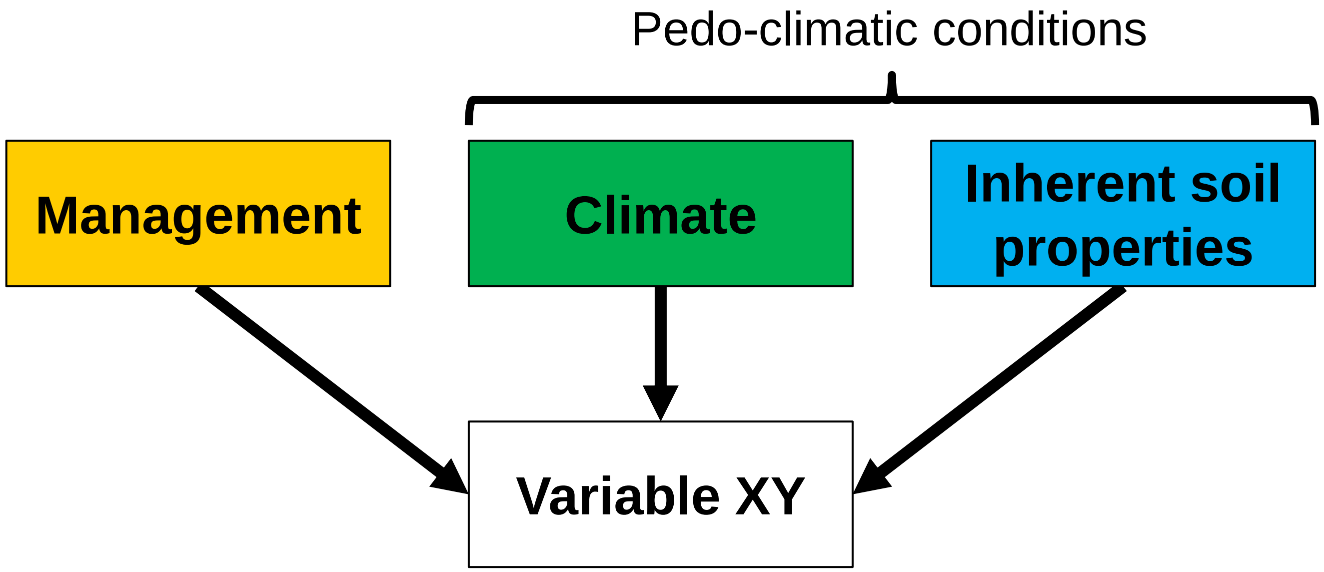
SoilManageR

Poster Session B3



Linear mixed-effect model to disentangle effects

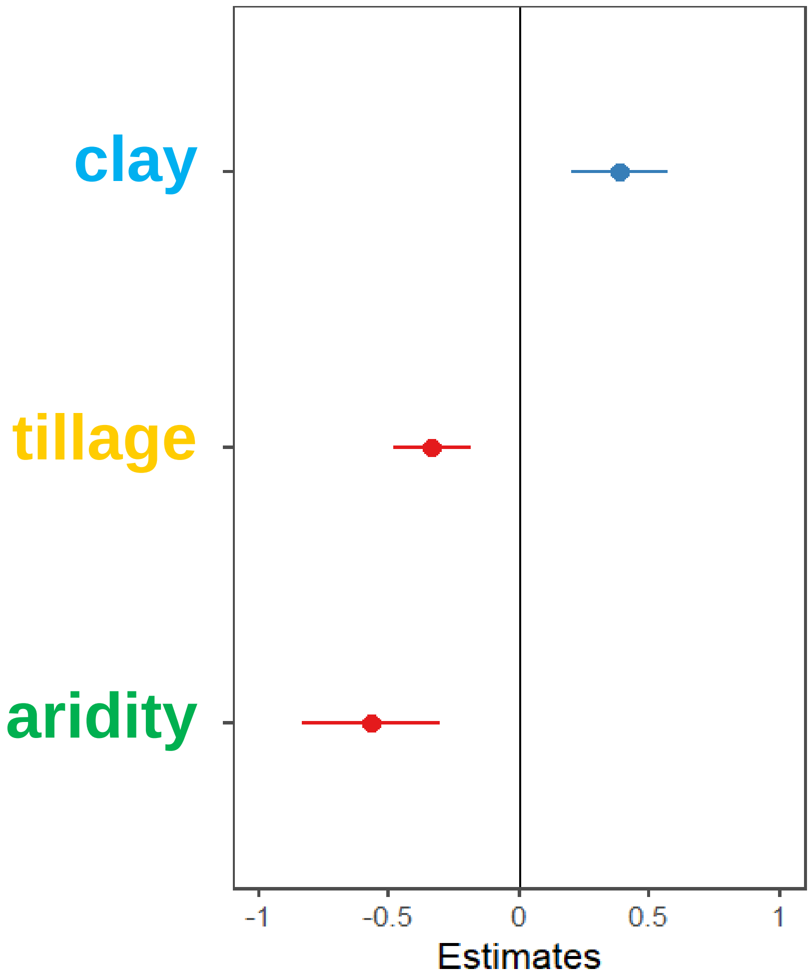




nlme::lme (**Variable XY** ~
Var1 * **Var2** * **Var3** +
Var5 * **Var4** +
Var6,
random = ~ 1 | **LTE / block**)

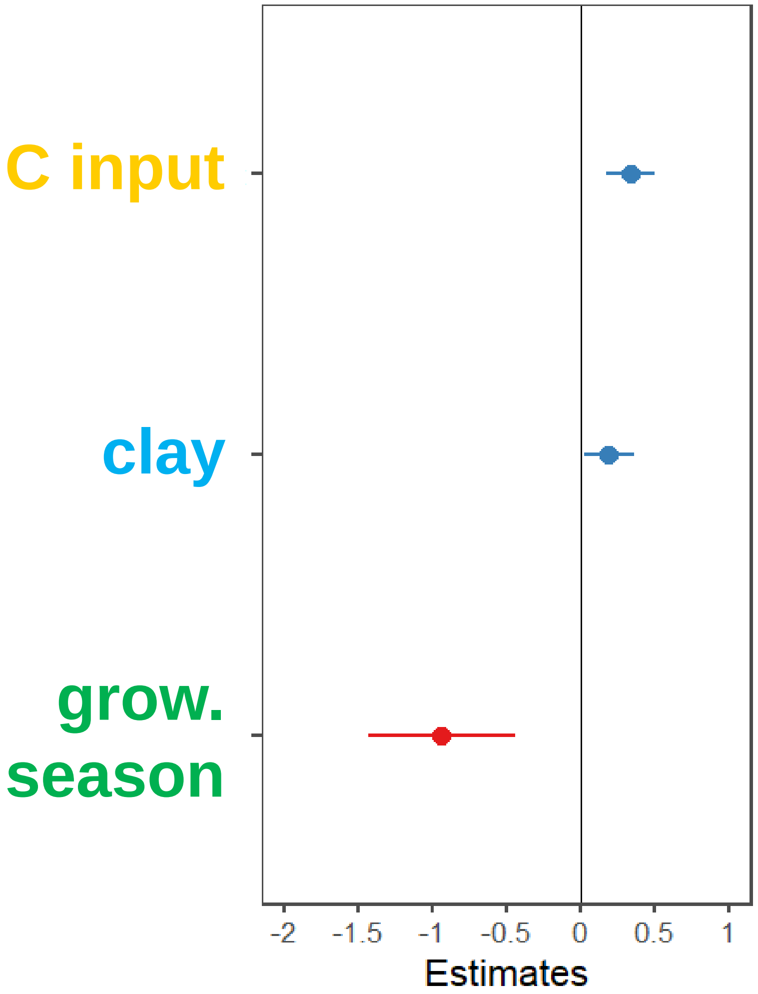
Determinants of earthworm abundance and SOC

Number of earthworms



(6 of 10 LTEs)

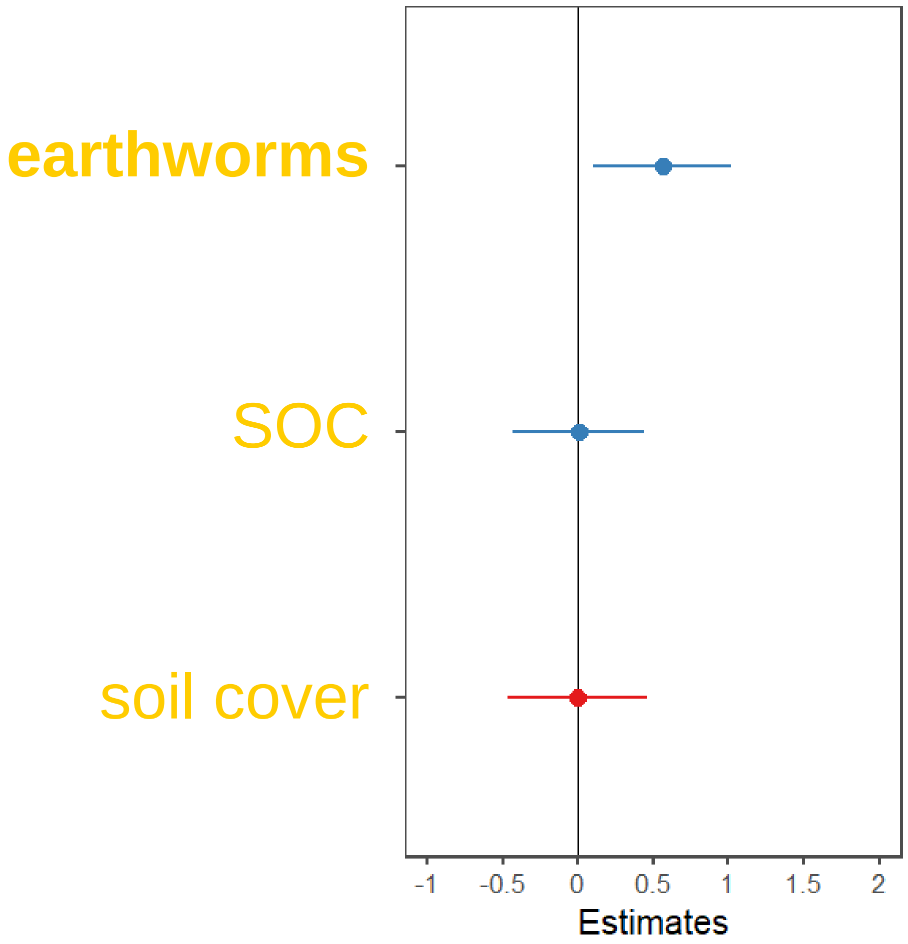
Soil organic carbon content



(7 of 10 LTEs)

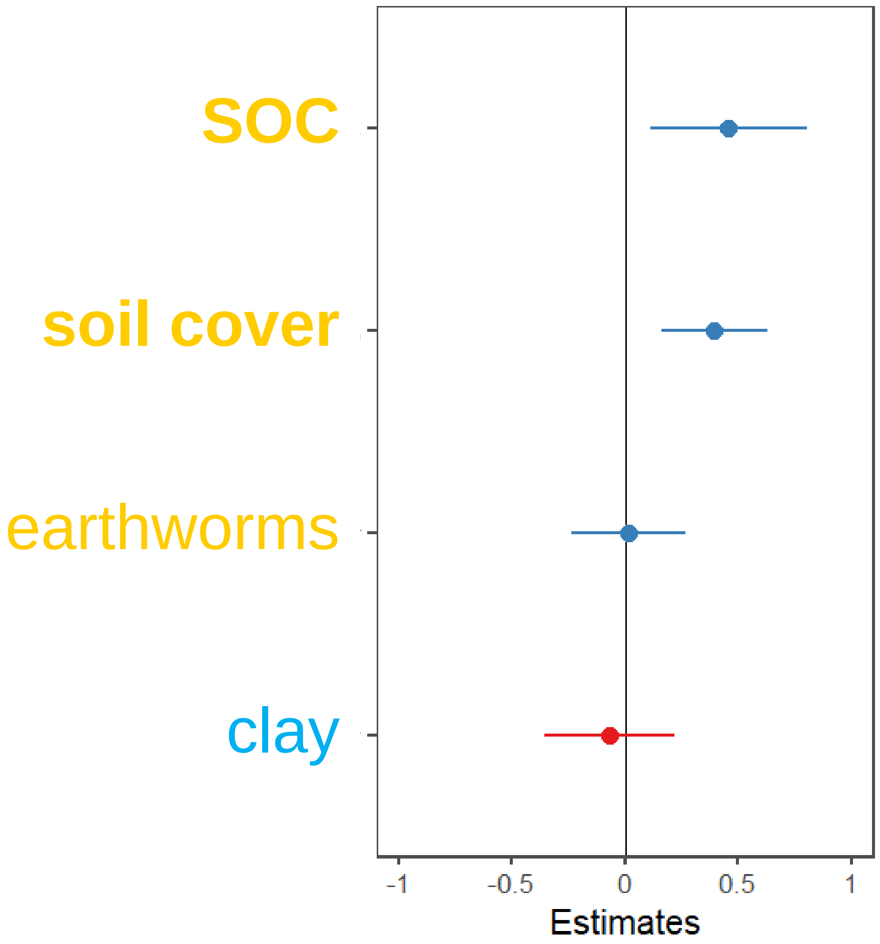
Determinants of K_{sat} and Aggregate Stability

Saturated hydr. conductivity



(6 of 10 LTEs)

Water stable aggregate index



(7 of 10 LTEs)

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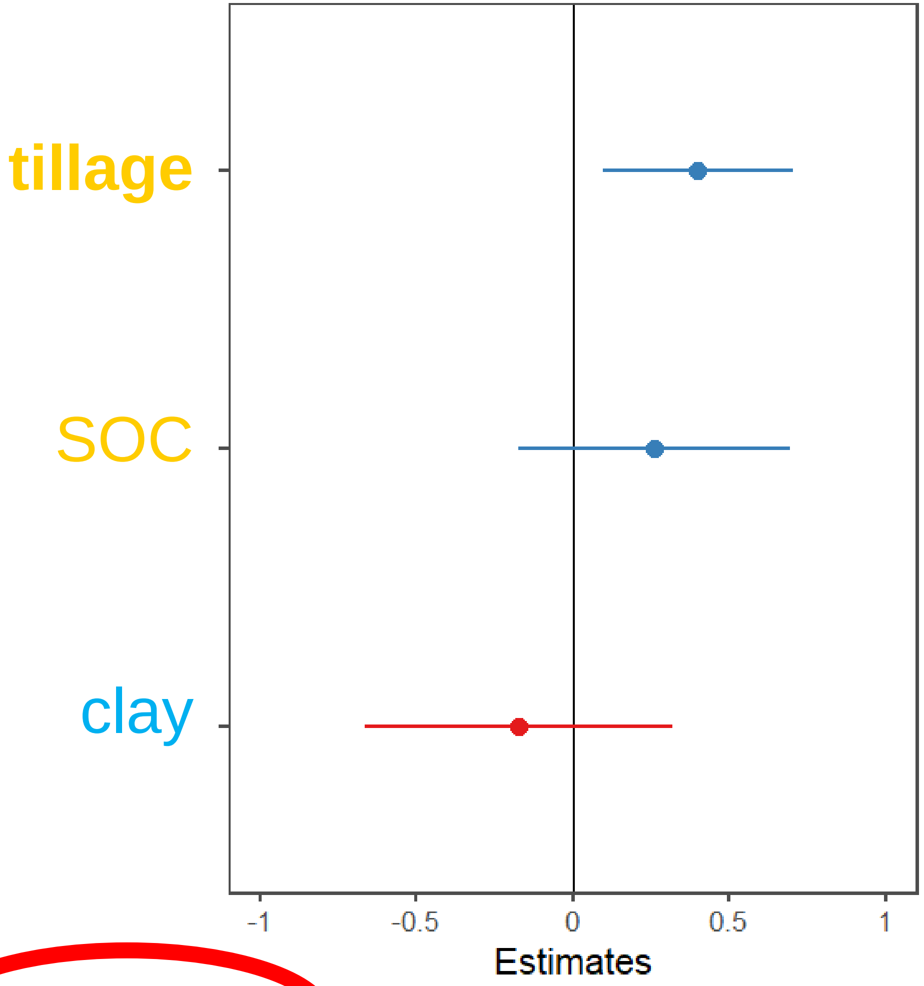
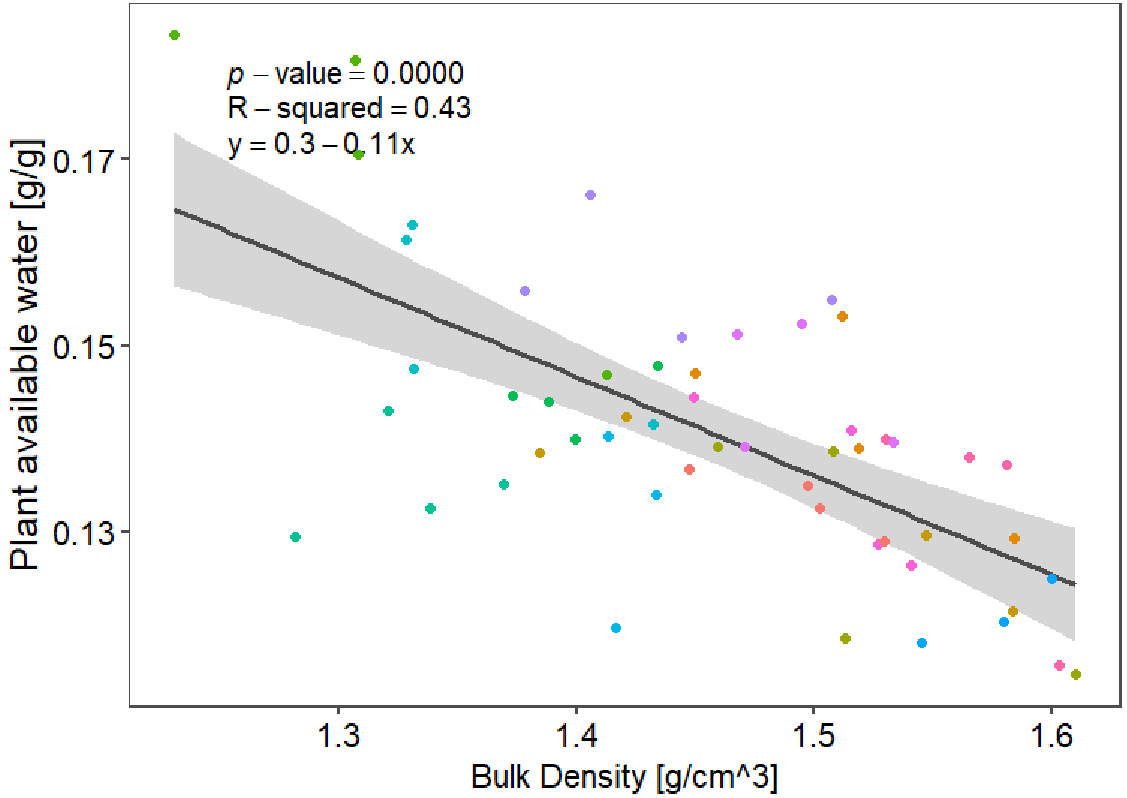
Determinants of plant available water

plant available water (gravimetric)





(**4** of 10 LTEs)

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Preliminary conclusions

Summary:

- Earthworms abundance was driven by tillage intensity, clay content and aridity
- SOC was driven by C input and C mineralisation
- Hydraulic conductivity increased with earthworm abundance
- Aggregate stabilty increased with SOC and soil cover
- Plant available water in the topsoil increased with tillage intensity (or bulk density)

Conclusions:

- Reduced tillage intensity, higher C input and higher soil cover was correlated with soil physical properties relevant in a wet context.
- Less dense soil stored more plant available water.

Further investigations within SoilX

Within WP2:

- More data:
  - Collate data from all ten LTEs
  - Investigation of subsoil data
  - Investigation of more variables (mechanical properties)
- Statistical analysis:
  - Rigorous model selection
  - Use of causal inference or structural equation modeling

Other WPs:

- Feed data into modeling (WP3)

Reflections on further research directions

- Extend the approach:
  - More pedo-climatic contexts
  - More diverse management (LTEs, farmers fields)
  - More dependant variables (e.g. productivity, other soil quality indicators)
  - Derive benchmarks for management intensities to minimize trade-offs
- Digitalize, harmonize and valorize existing management information (LTEs, monitoring schemes, FMIS,…)
- Quantify water fluxes and not only hydrological properties under different management
- New LTEs to test innovative strategies for increased climate resilience
- Further development of mechanistic models to predict management effects under future climate

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any many more…