Mediterranean Agriculture under Global Changes

Assessment of conservation tillage for rainfed agroecosystem

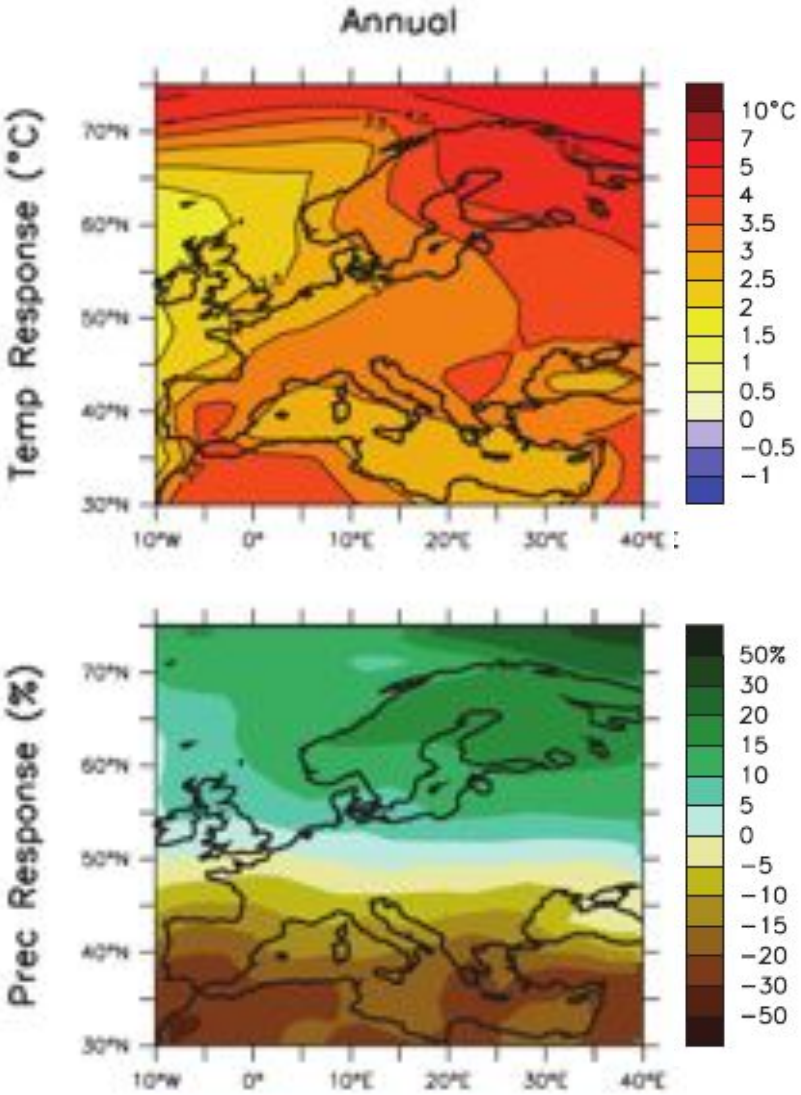
Simon Decock

LABEX OT-Med « Objectif-Terre Méditerranée »

Supervisors : Alberte Bondeau
Wolfgang Cramer

Mediterranean context

1) Increasing water stress



Climate change over Europe 1980-1999 to 2080-2099. MMD-A1B simulations, 21 models *(IPCC, 2007)*

2) Non sustainable pratices

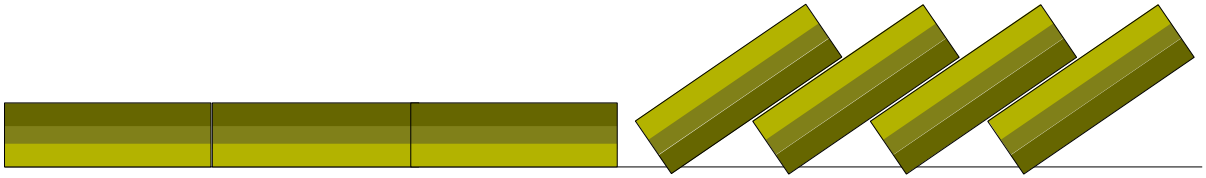
Erosion in vineyard, France *(Llewellyn 2006)*

Salinization in orchard, Sicily *(Crescimanno 2004)*

Groundwater depletion for the year 2000 (mm/yr) *(Wada et al. 2010)*

Intensive tillage

- **Intensive tillage** (conventional tillage) : “tillage system in which a deep primary cultivation, such as mouldboard ploughing, is followed by a secondary soil cultivation to create a seedbed”.(J.M. Holland, 2004)



Inversed soil slices by mouldboard

Sfax, Tunisia

Grenada, Spain

What could be a sustainable system of practices for Mediterranean Agroecosystems under global changes?

1	2	3		

Soil conservation tillage

Direct seeding

principles:

- **Direct seeding without or few soil disturbances**
- Constant **soil coverage**

Constant grass cover

Food and Agriculture Organization of the United Nations

CIHEAM

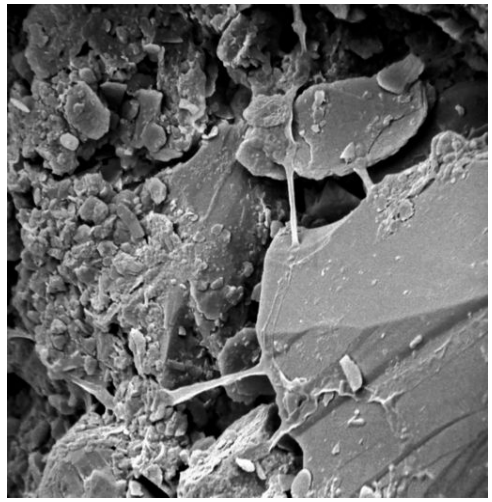
Definitions :

- **No-till** : “planting crops directly into residue that either hasn't been tilled at all”(FAO)
- **Reduced tillage** : “generally a one-pass tillage operation at sowing synchronous with seed placement, typically achieved using full cut-out points, or full cut-out one-way or offset discs to break up the entire soil surface. It may include a shallow cultivation between seasons to control weeds.”(FAO)
- **Crop Residue** : Remains of the crop non exported and left on the ground
- **Cover crop** : Intermediate crop to cover soil between marketable crop

1	2	3	4	

hypothesis

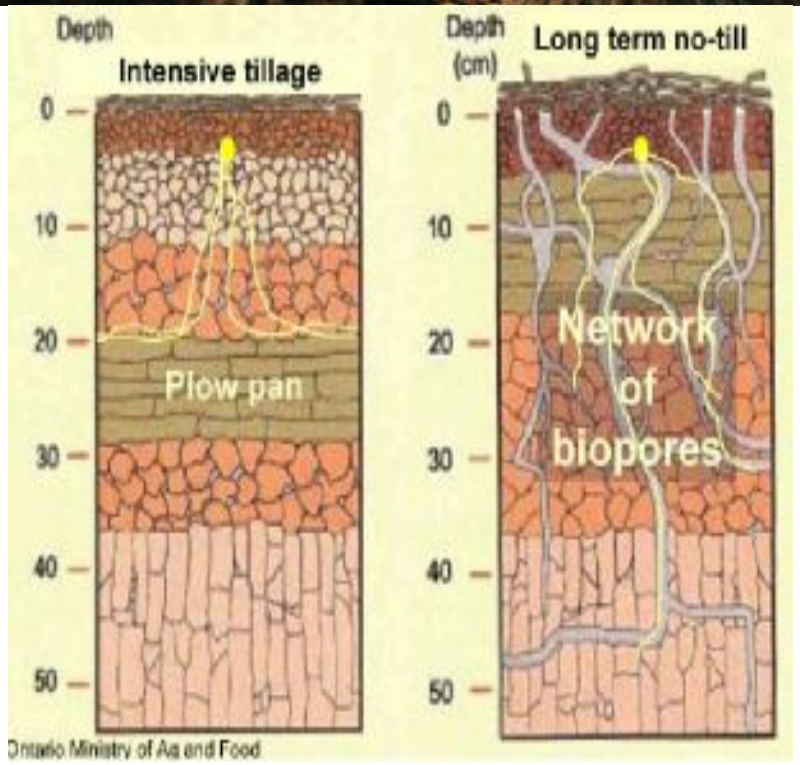
European Atlas of
Soil Biodiversity, 2010



Stabilisation of soil structureby actinomycete filament. Cambridge Stereoscan Microscope

Increasing **soil carbon**

Increasing **soil bidoversity**



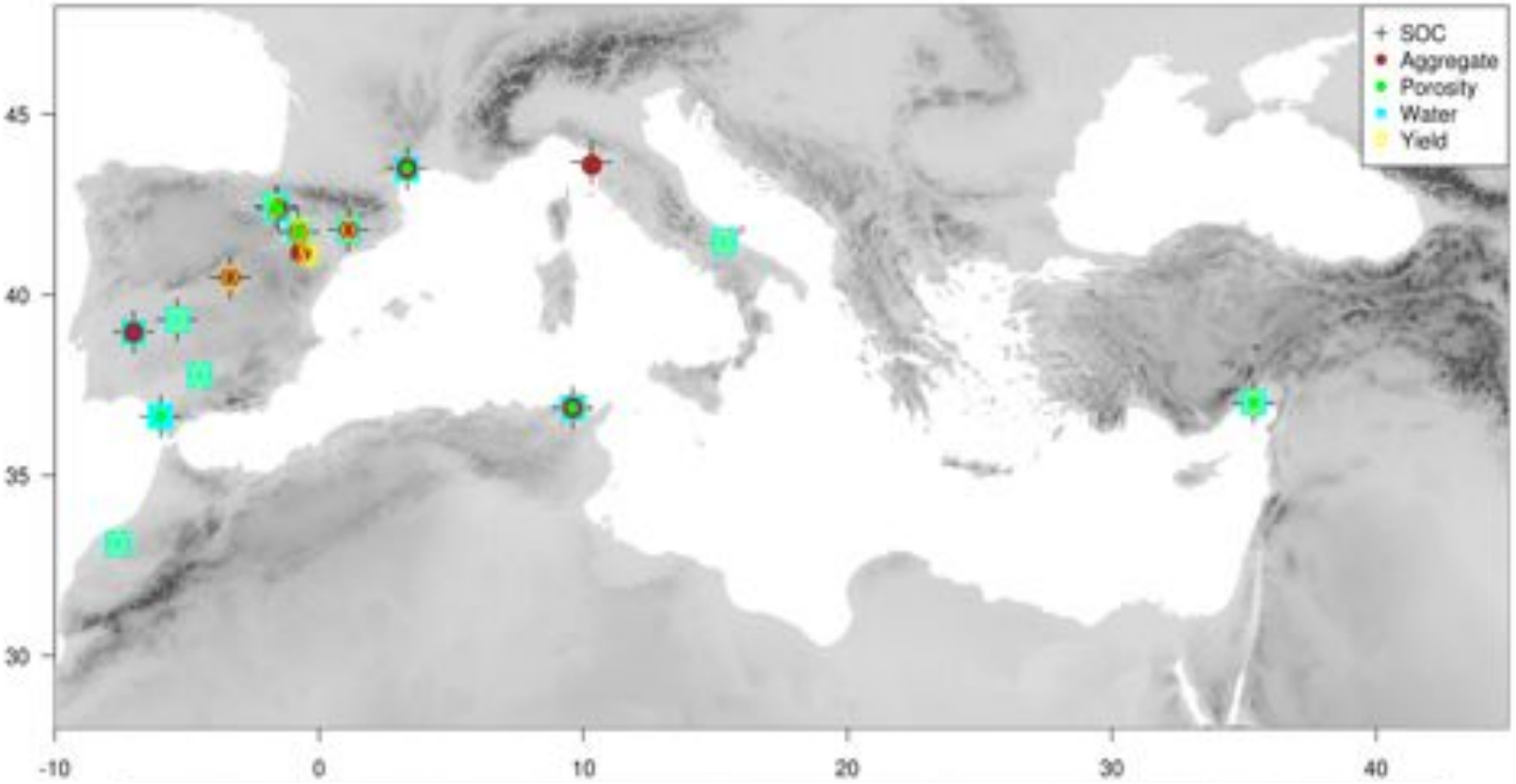
Improve soil **structure**

Improve soil **water cycle**

yield

Bibliographic analysis

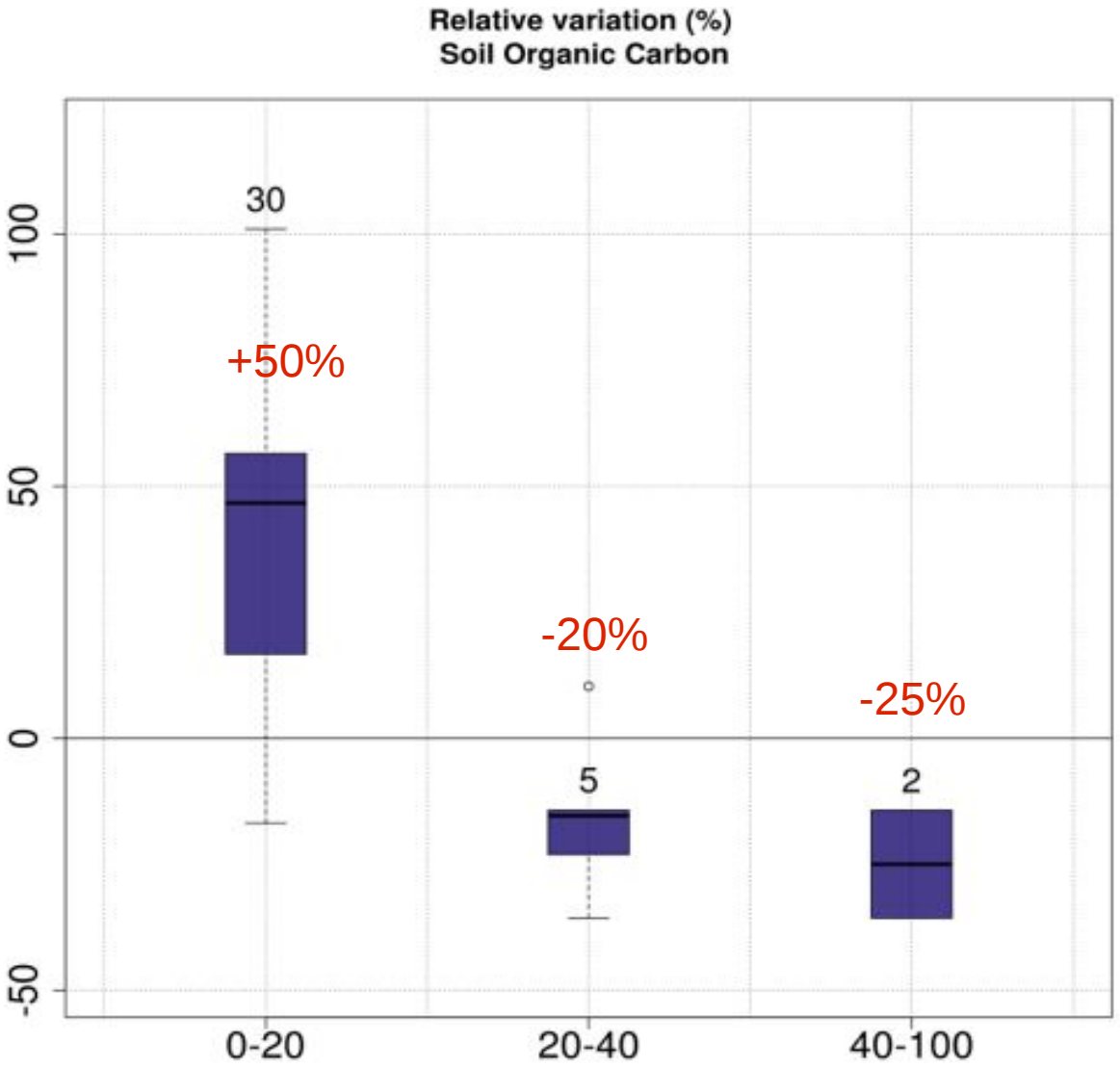
conservation tillage *vs* Intensive tillage



7 countries
300 mm to 870 mm
13°C to 19°C
9 soil classes
9 crop rotations 2 monocultures 1 perennial
4 months to 15 years
3 types of cover (no cover, cover crop, residue)

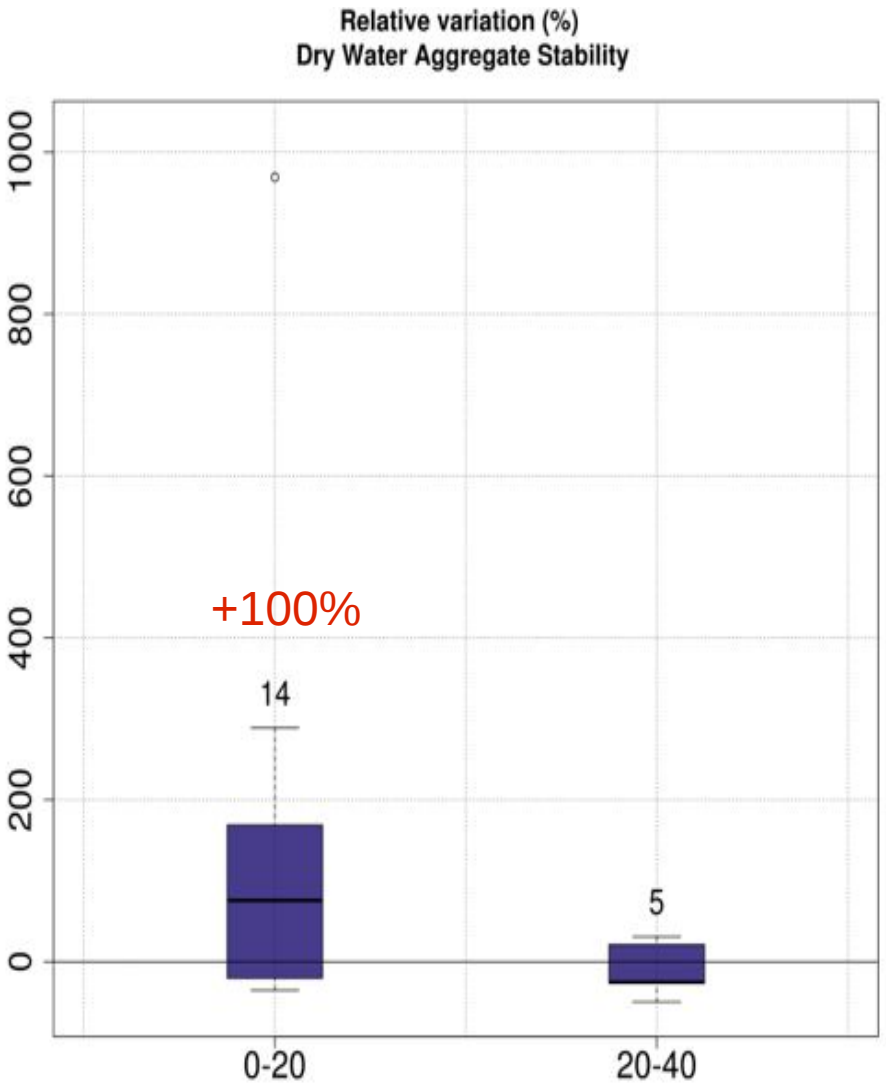
more than 12 variables

Soil Organic Cabon



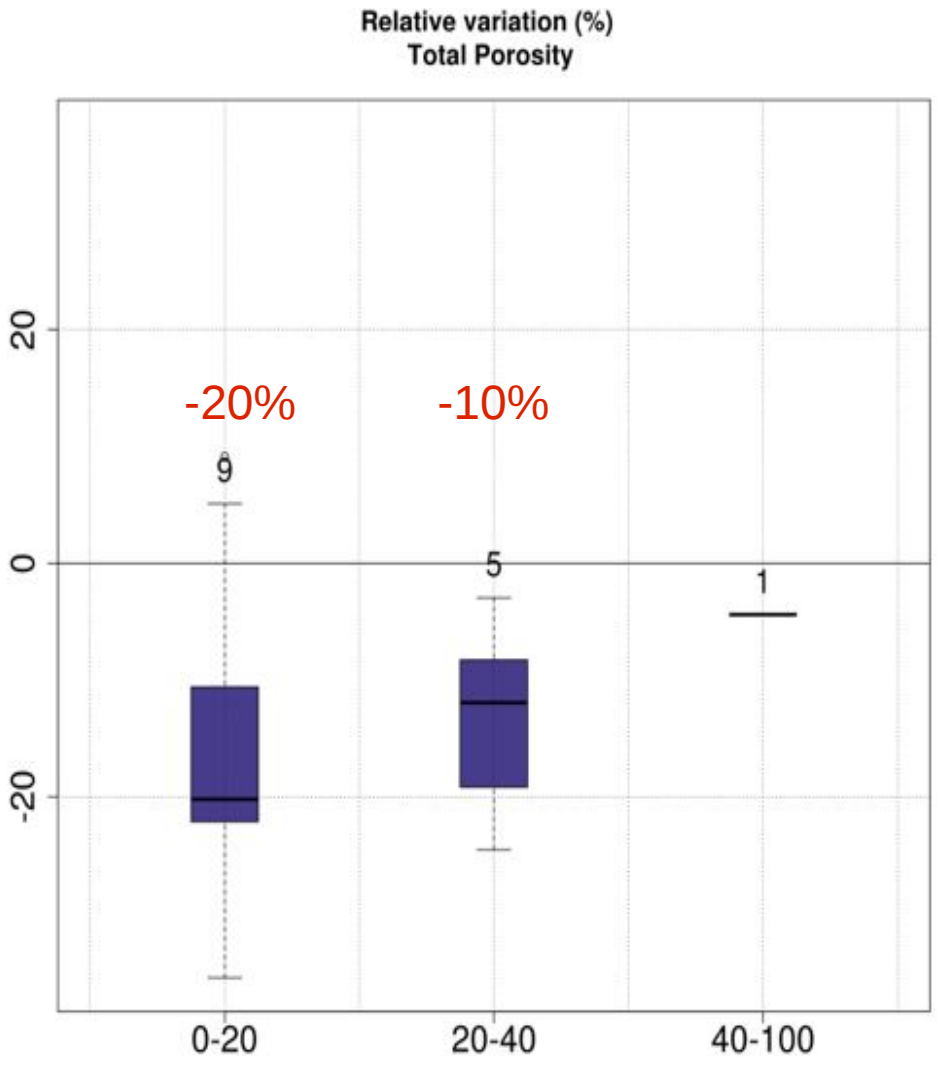
SOC natural enrichment in the upper layer due to degradation of Residues.
SOC supply in the lower layers by tillage removed

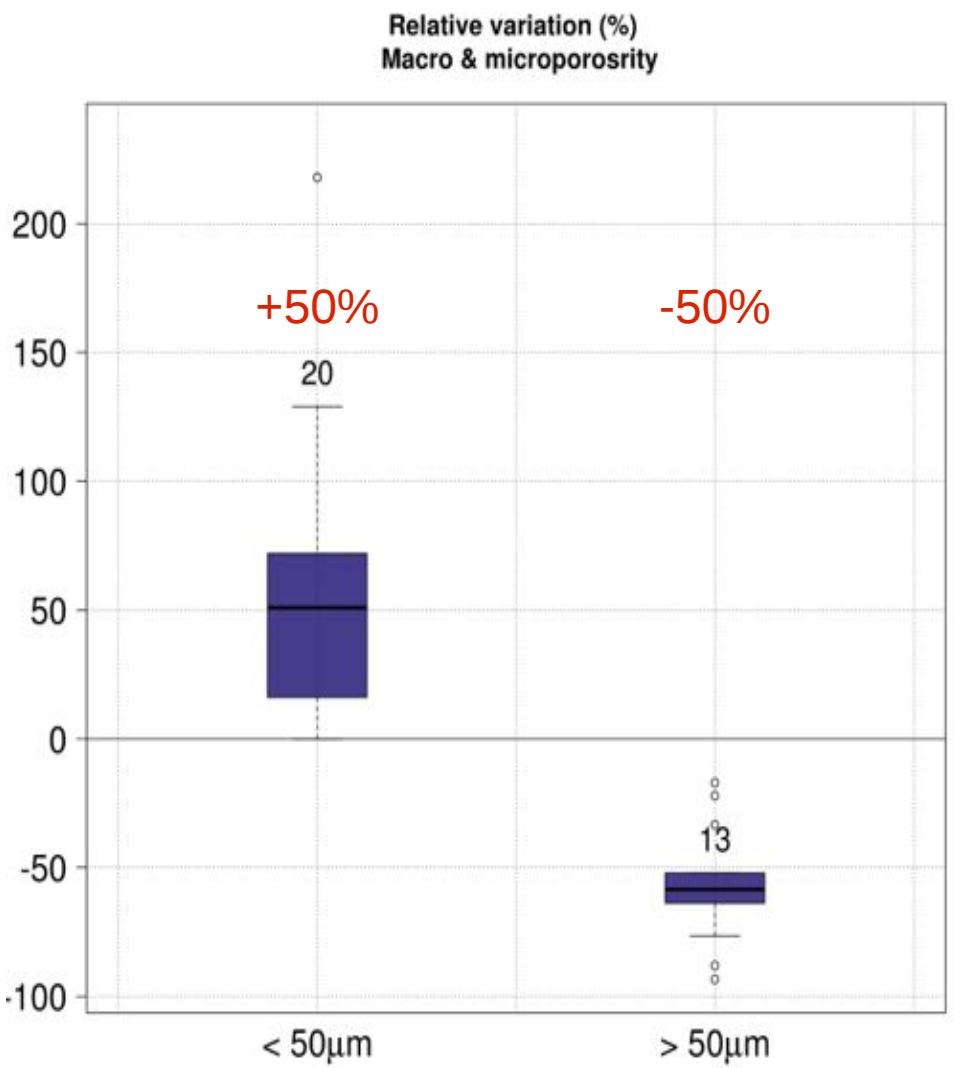
Aggregate Stability



Increase of aggregate stability due to SOC

Porosity

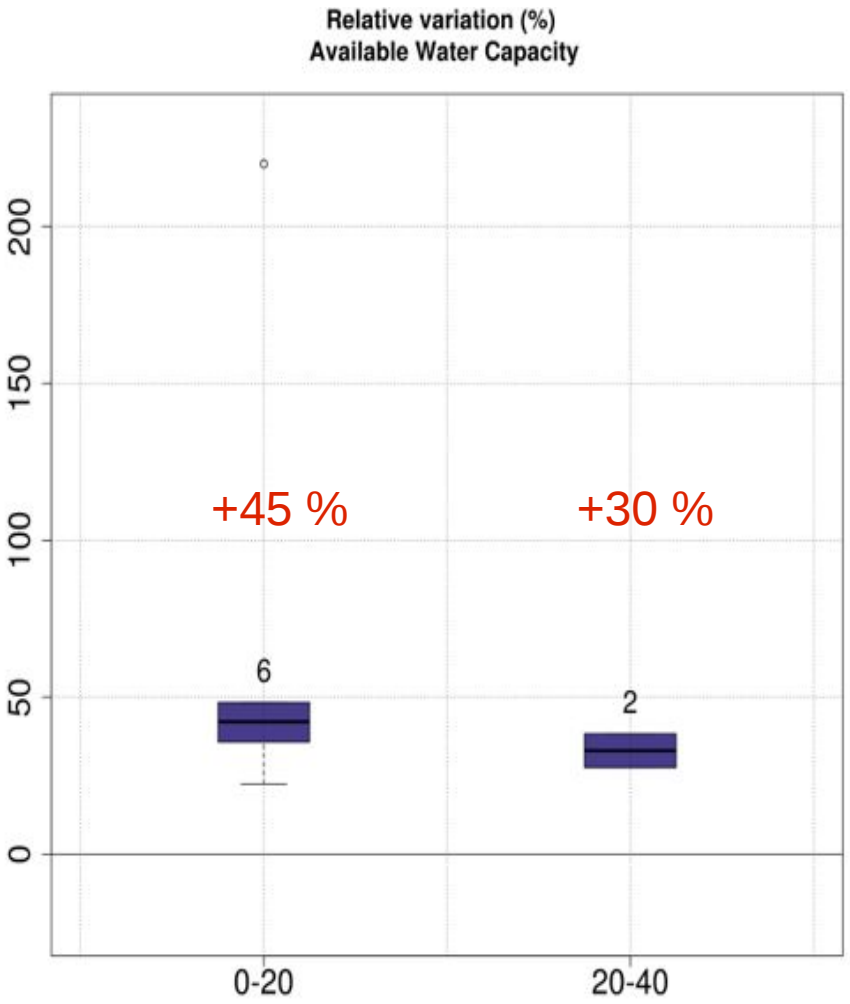


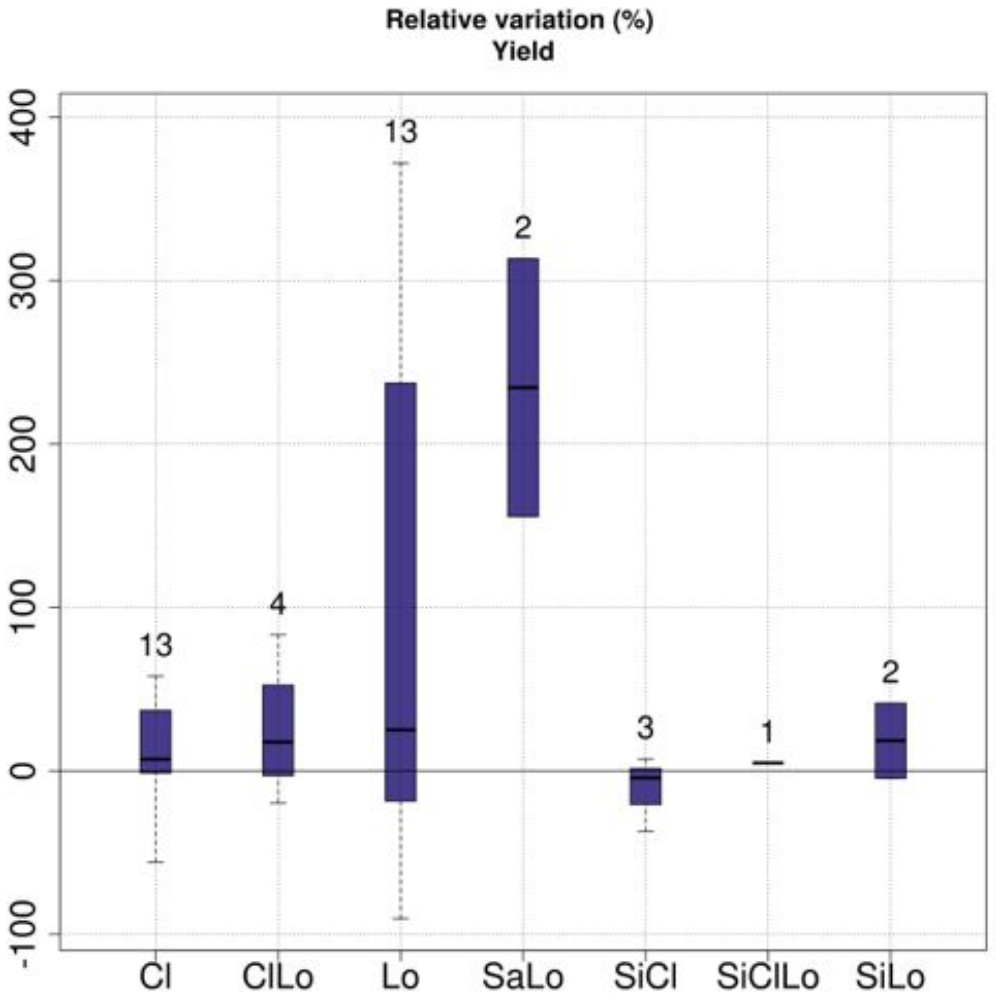


Decrease of total porosity due to pore collapse

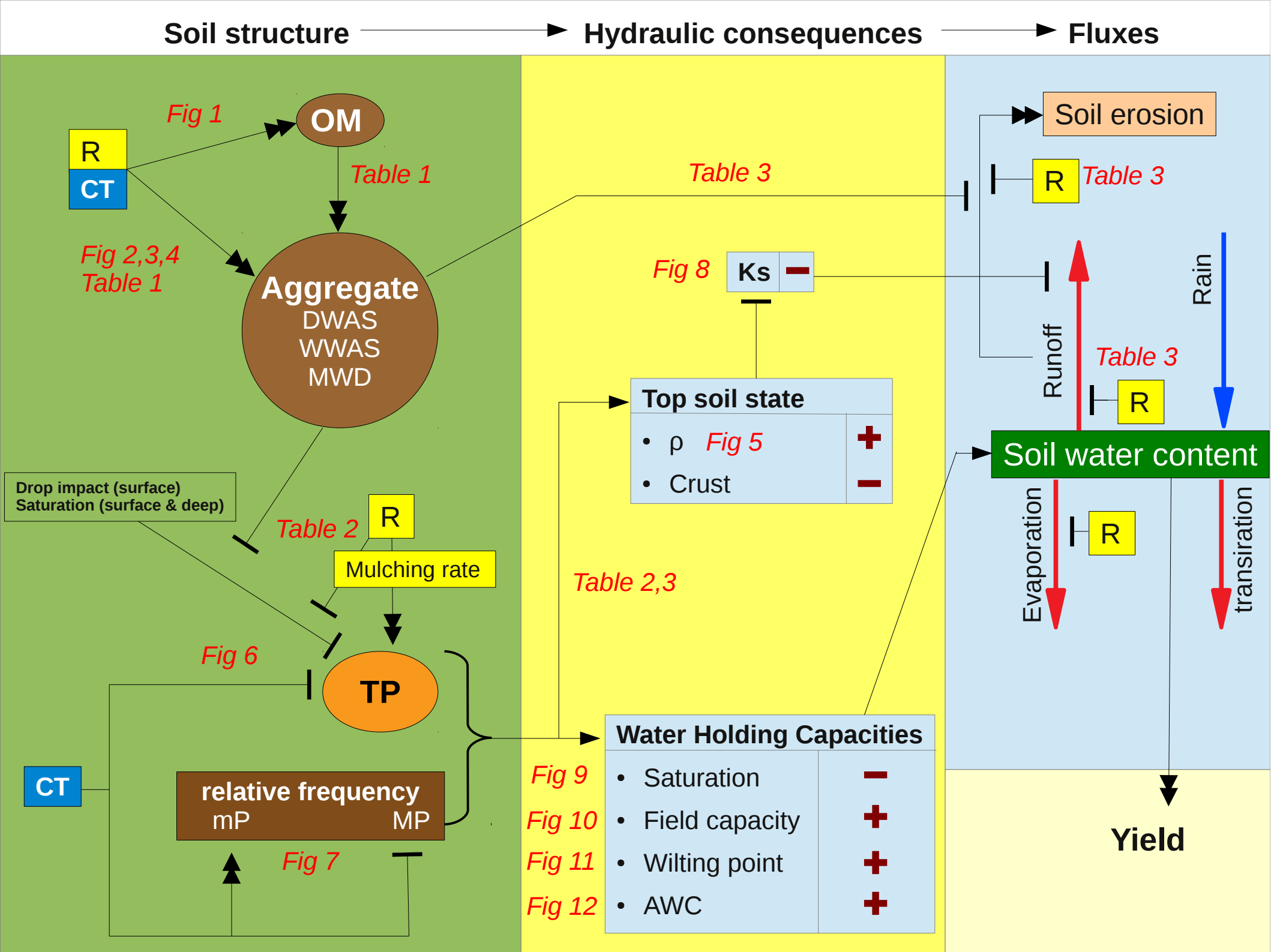
Redistribution of pore volumes

Water and Yield





The soil capacity to hold water for plant is improved
The yield is also better


Soil structure
Hydraulic consequences
Fluxes
Fig 1
OM
R
CT
Table 1
Fig 2,3,4
Table 1
Aggregate
DWAS
WWAS
MWD
Table 3
Soil erosion
R
Table 3
Fig 8
Ks
Rain
Runoff
Table 3
R
Top soil state
• ρ Fig 5
• Crust
Soil water content
Drop impact (surface)
Saturation (surface & deep)
Table 2
R
Mulching rate
Table 2,3
Evaporation
R
transiration
Fig 6
TP
CT
relative frequency
mP
MP
Fig 7
Water Holding Capacities
Fig 9
• Saturation
Fig 10
• Field capacity
Fig 11
• Wilting point
Fig 12
• AWC
Yield

Thank you for your attention and I wish you a green happy new year !