


Tours – 24 au 26 mai 2016



Ecosystem services provided by soils of urban, industrial, traffic, mining and military areas (SUITMAs)

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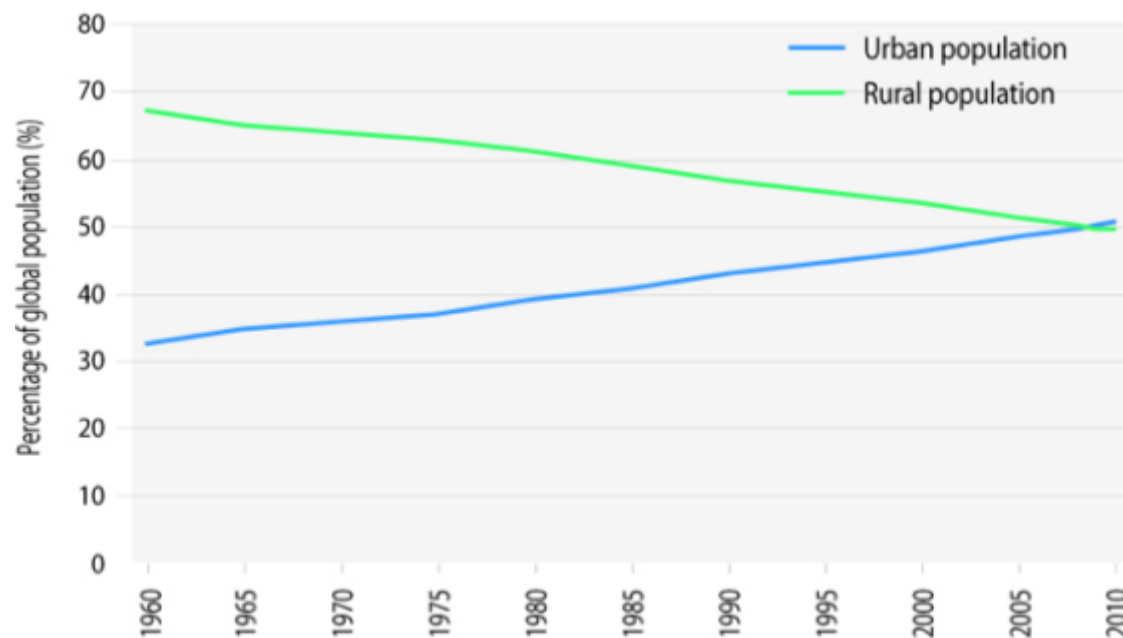
²ECOSYS, AgroParisTech



1. Challenges for urban ecosystems

Artificialization of soils at the surface...

- **50% de la population mondiale vit dans des centres urbains (70% en 2050) + croissance démographique**



JN Population Division. World Population Prospects the 2008 revision. New York, 2009.



World Health
Organization

Percentage of total population living
in urban areas, 1960–2010

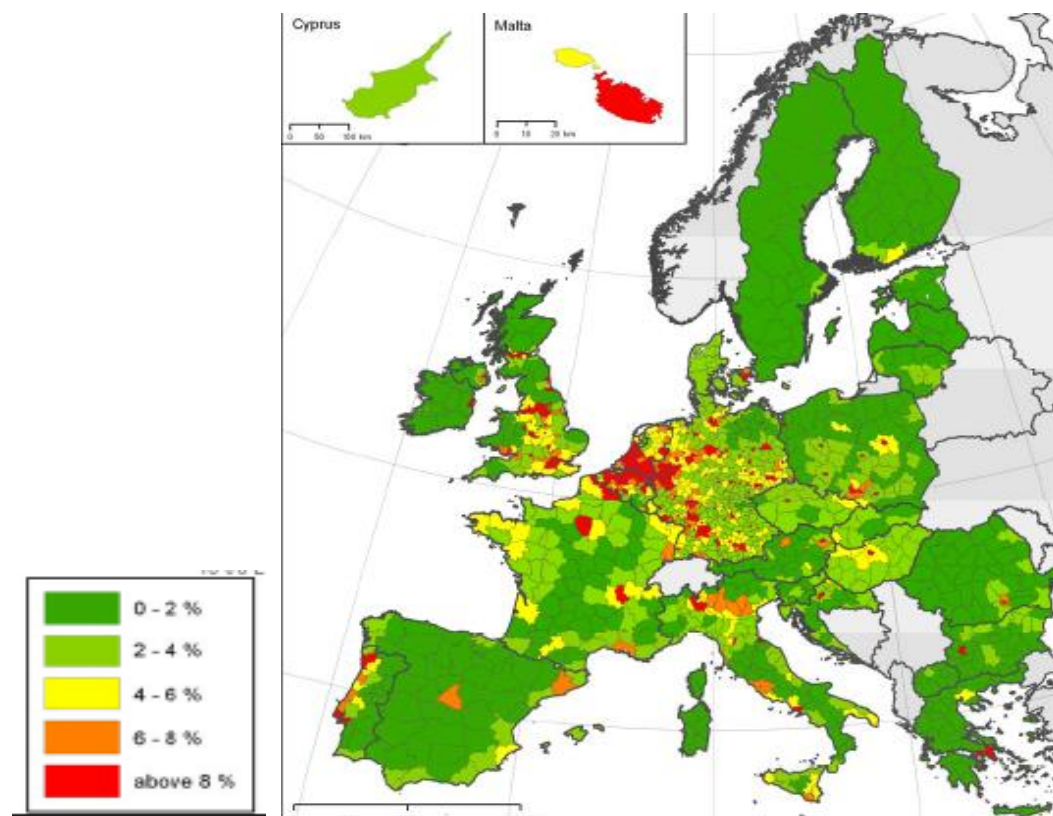
Artificialization of soils at the surface...

- **50% de la population mondiale vit dans des centres urbains (70% en 2050) + croissance démographique**
- **Etalement urbain**



Artificialization of soils at the surface...

- **50% de la population mondiale vit dans des centres urbains** (70% en 2050) + **croissance démographique**
- **Etalement urbain**
- **Scellement**
(UE = 1.000.000 km² sols scellés soit 2,3 % du territoire)



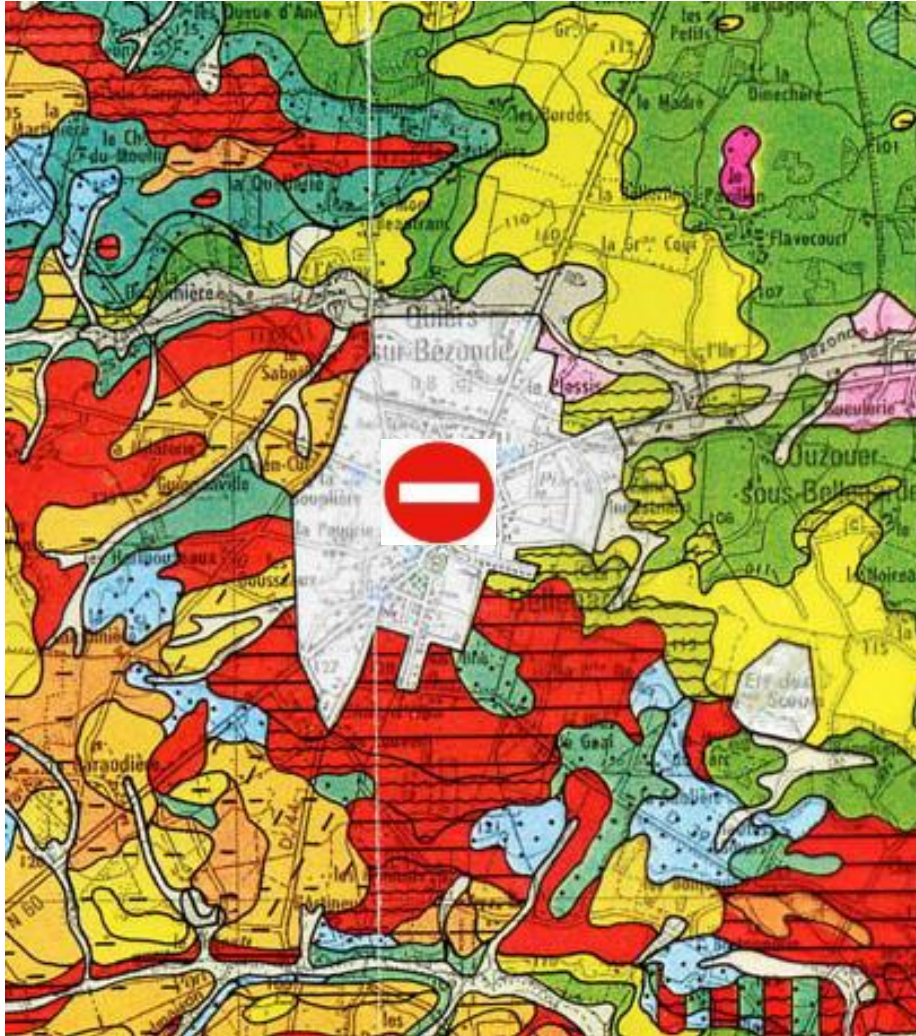
Source EEA-FTSP,
EUSTAT, 2010

... but also in depths

- **Construction de la ville (industrie) sur la ville (industrie)**
- **Cohabitation avec les réseaux/infrastructures enterrées**
- **Contamination diffuse ou concentrée**



Soil scientists have long considered the urban environment as a « forbidden area »

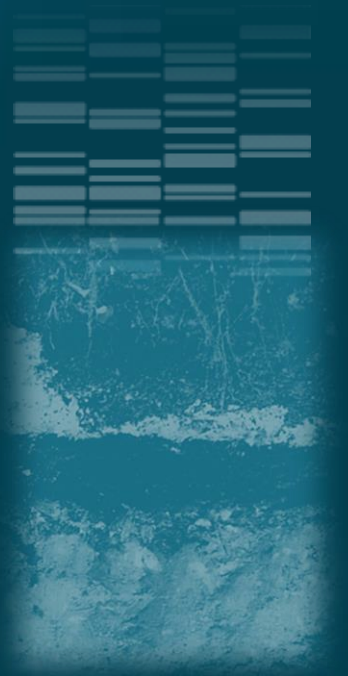


Traditional soil map

Questions
are now being addressed
to Soil Science

- What are the functions of soils in the urban environment?
- How to build sustainable cities suitable for human well-being and preserve our soil capital?
- How to get more ecosystem services from the same surface area?

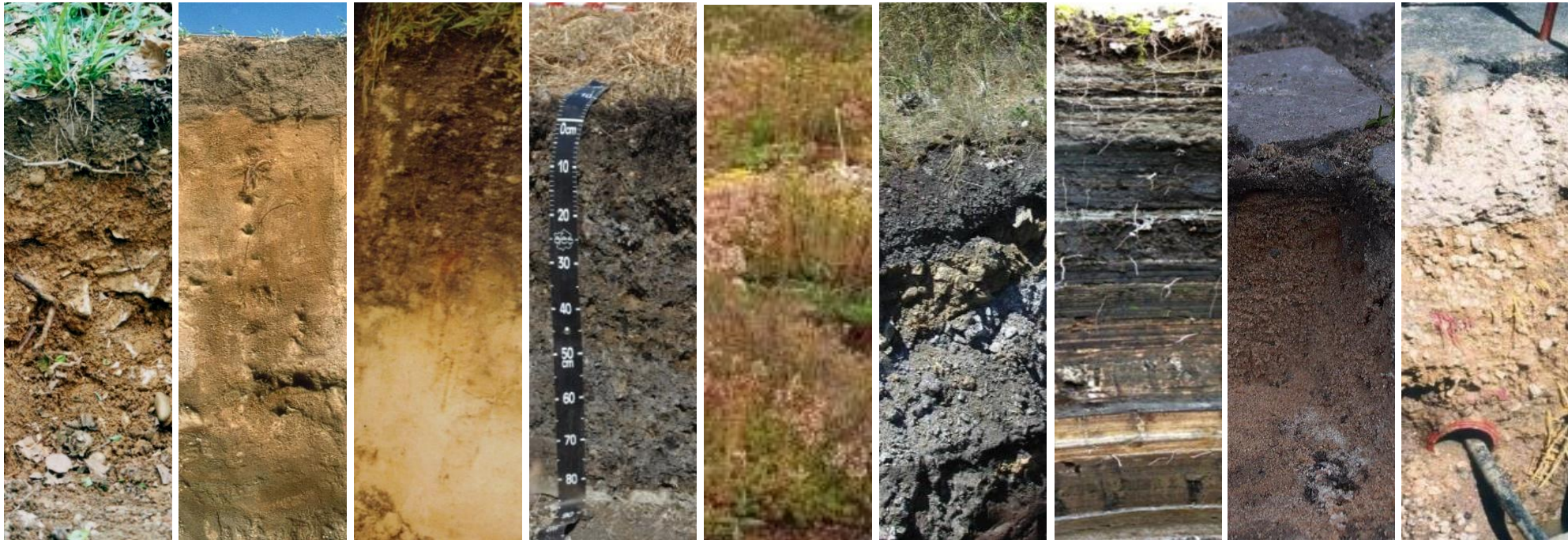
2. SUITMA



Diversity of SUITMA

Soils of Urban, Industrial, Traffic, Mining and Military Areas

- **Strong variability and heterogeneity** (result of the history of the city)



Luvisol
urban forest

Cambisol
urban
agriculture

Anthrosol
horticulture

Constructed
Technosol

Technosol
Green roof

Technosol
Brownfield

Technosol
Decantation
pond

Paved
Technosol

Sealed
Technosol

Increasing human influence

photos Florentin, Huot, Morel, Nehls, Schwartz, Séré

SUITMA characteristics

- **Strong variability and heterogeneity** (result of the history of the city)
- **Original physic-chemical properties**

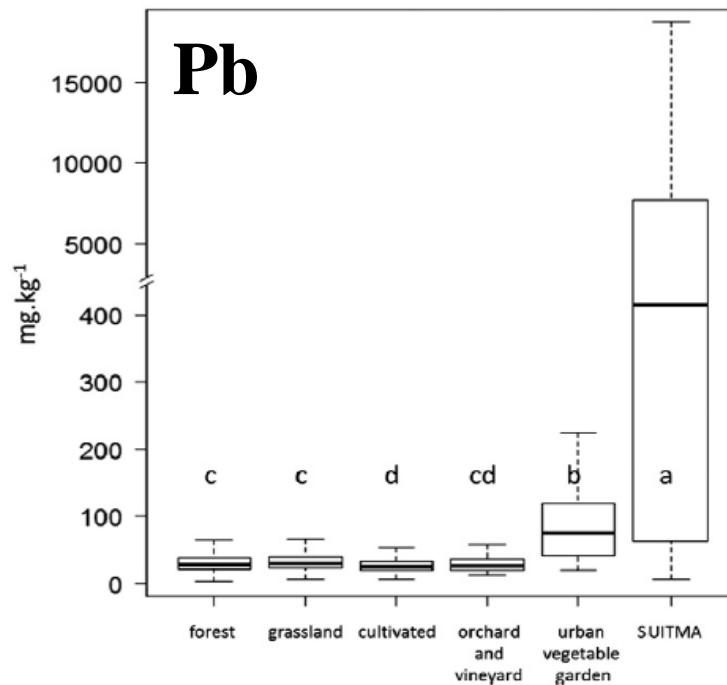


Fig. 9. Distribution of total lead in French topsoils according to land use: forest (n = 582), grassland (n = 623), cultivated (n = 820), orchard and vineyard (n = 48), urban vegetable garden (n = 104) and SUITMA (n = 221). Band inside the box represent the median.

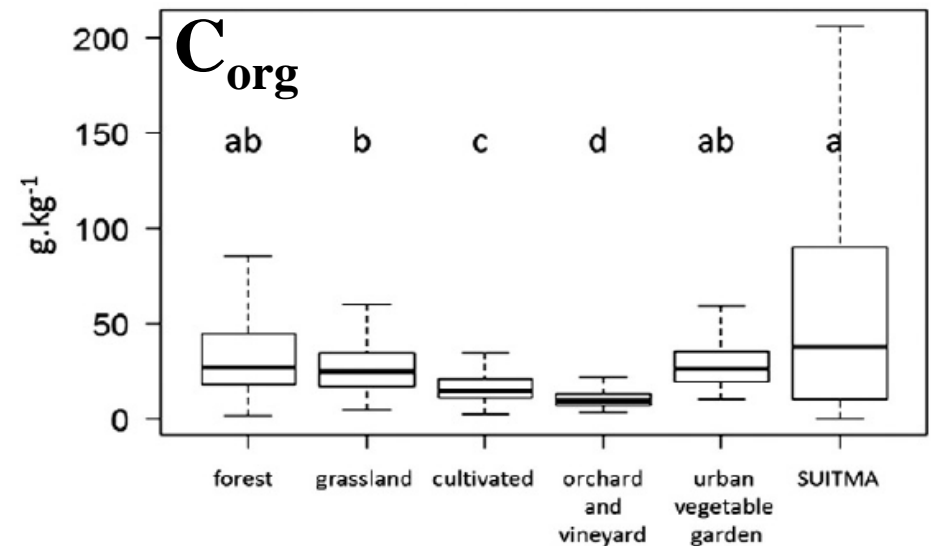


Fig. 2. Distribution of total organic carbon in French topsoils according to land use: forest (n = 582), grassland (n = 623), cultivated (n = 820), orchard and vineyard (n = 48), urban vegetable garden (n = 104) and SUITMA (n = 229). Band inside the box represent the median.

SUITMA characteristics

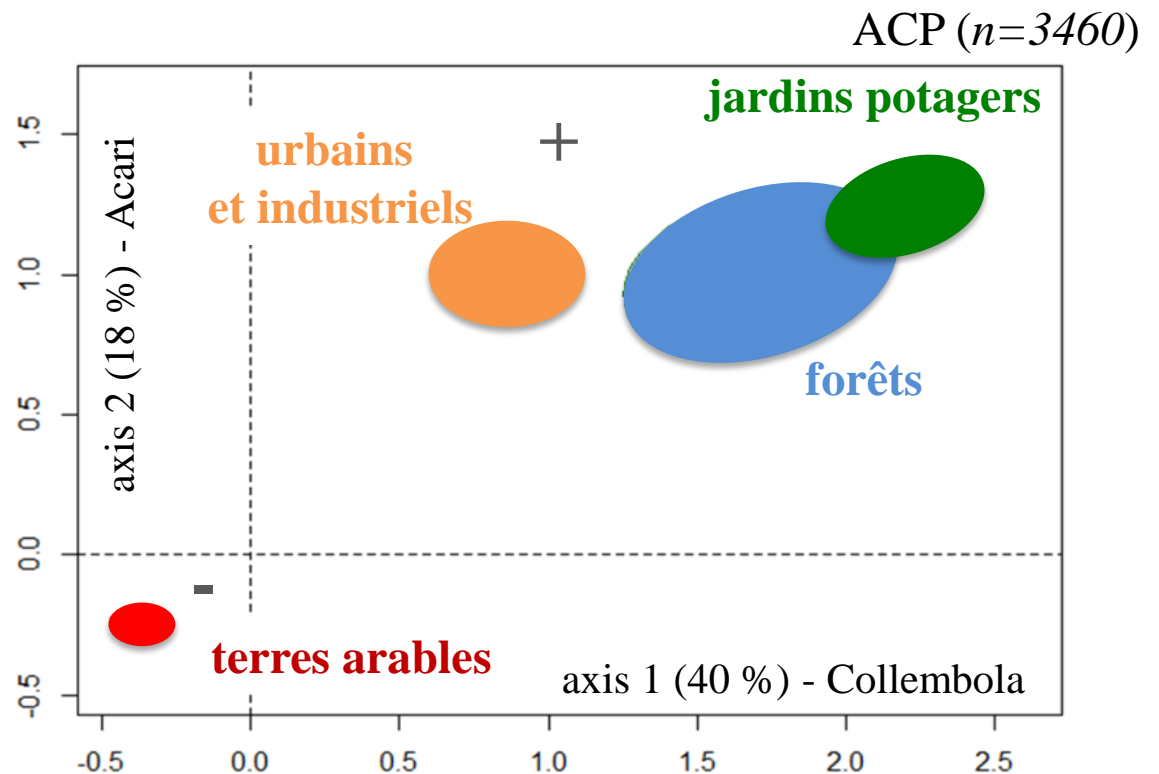
- **Strong variability and heterogeneity** (result of the history of the city)
- **Original physic-chemical properties**
- **Biodiversity reservoir**



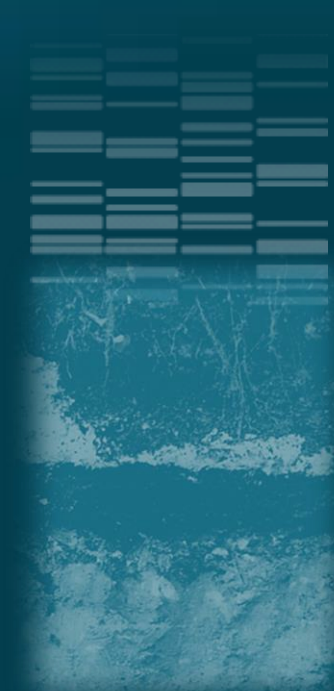
acari



collembola



3. Ecosystem services provided by SUITMA

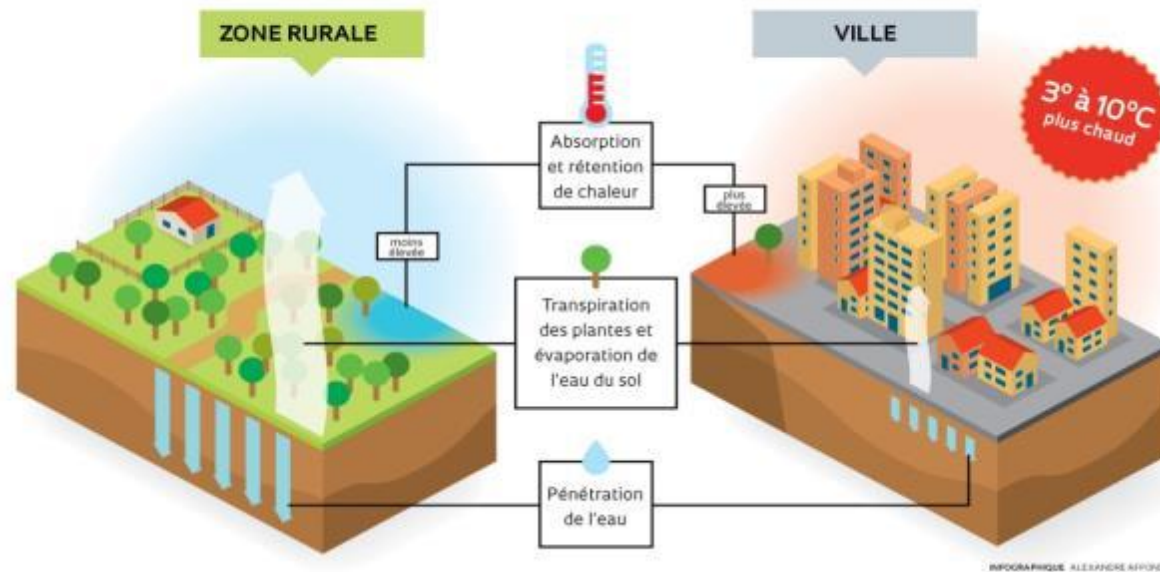


SUITMA can provide various level of ES

- **Sealed SUITMA:**

- *Biomass provisioning* = none to low
- *Climate regulation* = very low

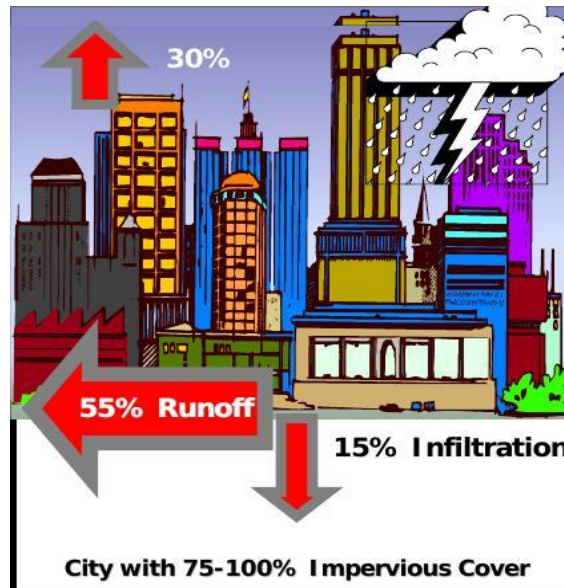
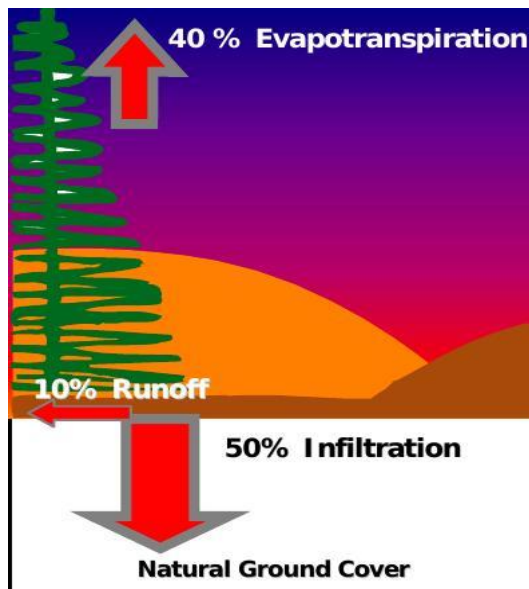
Pourquoi l'effet îlot de chaleur urbain



SUITMA can provide various level of ES

- **Sealed SUITMA:**

- *Biomass provisionning* = none to low
- *Climate regulation* = very low
- *Flood control* = low



SUITMA can provide various level of ES

- **Sealed SUITMA:**

- *Biomass provisionning* = none to low
- *Climate regulation* = very low
- *Flood control* = low
- *Biodiversity reservoir* = very low
- *Human activities & infrastructure* = very high



SUITMA can provide various level of ES

- **Urban/industrial brownfield SUITMA**
 - *Biomass provisioning* = none to low
 - *Climate regulation* = medium
 - *Flood control* = low to medium
 - *Biodiversity reservoir* = medium to high
 - *Human activities & infrastructure* = none to low



SUITMA can provide various level of ES

- **Green roof SUITMA**

- *Biomass provisionning* = medium to high
- *Climate regulation* = medium to high
- *Flood control* = high
- *Biodiversity reservoir* = medium to high
- *Human activities & infrastructure* = low to medium



SUITMA can provide various level of ES

Ecosystem Services		Vegetated pseudo-natural	Vegetated constructed	Dumping	Sealed
Provisioning	Food	++	++	(+)	0
	Fiber/raw materials	++	++(+)	++	0
	Reservoir of minerals	+	+	+++	0
	Fresh index	0	+	0	+++
Regulation	Water storage	++	+++	++	+
	Runoff and flood control	+++	++(+)	+	+(+)
	Pollution attenuation	++	+++	++	+++
	Global climate	+++	++	++	+
	Local climate	+++	++	+	0
	Biodiversity	+++	+++	++	0
	Invasive species	0	++	0	0
	Air purification	+++	++	+	0
Cultural	Noise control	++	+++	++	+
	Recreation/tourism	+++	++	0	0
	Archives of human history	+	+	+++	++
	Landscape	++	+++	+	+
	Education	+++	+++	++	+

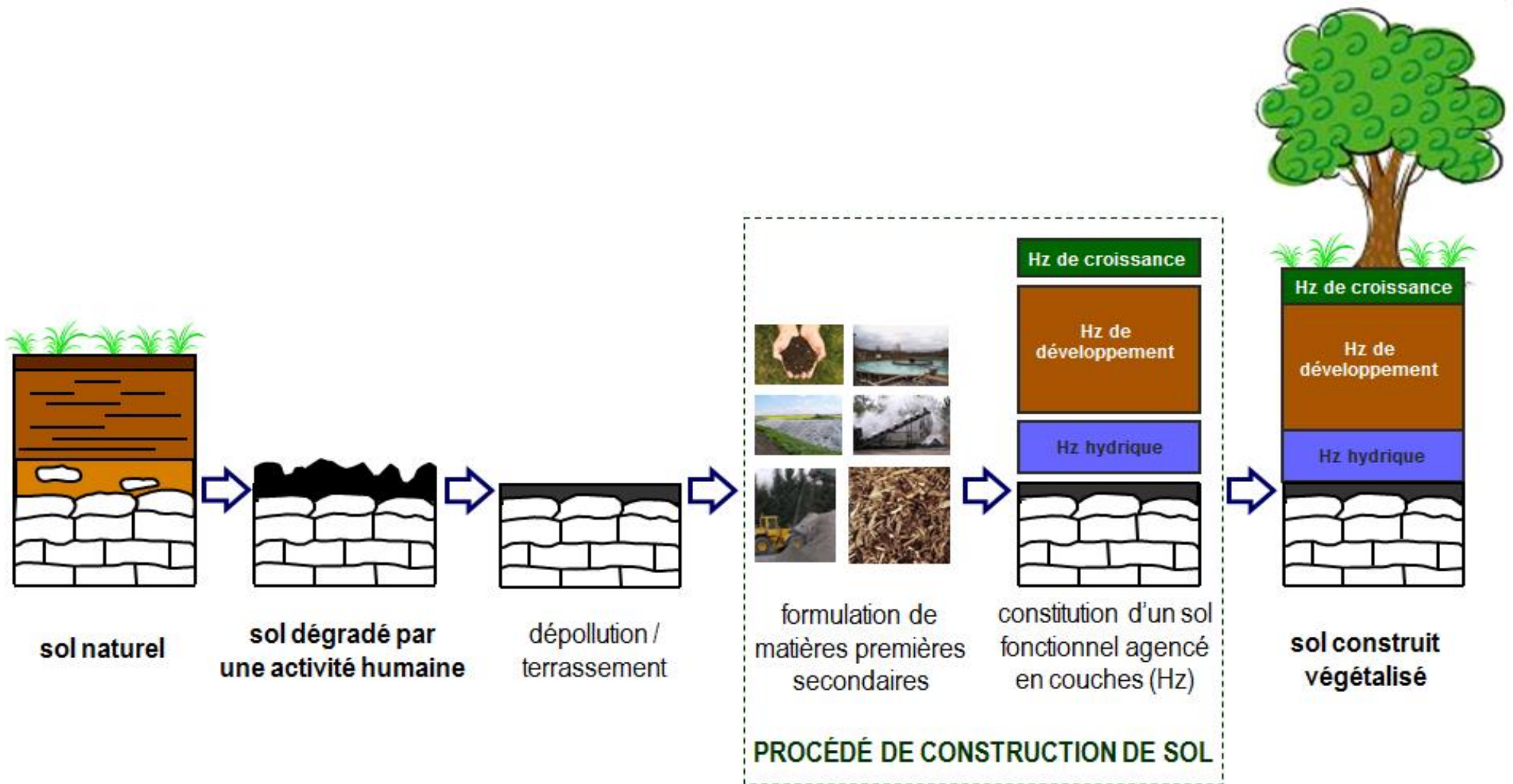
Morel *et al.*,
2015

4. Soil engineering for urban areas

Designing soils to develop
ecosystem services



Soil construction



Brevet VDR/INRA/UL
Séré et al., 2008, JSS

Reclamation of an industrial brownfield

- Landscaping + ecological restoration on a 1 ha former coking plant
- Soil construction process: 8000t papermill sludge, 8000t thermally treated soil, 400t green waste compost

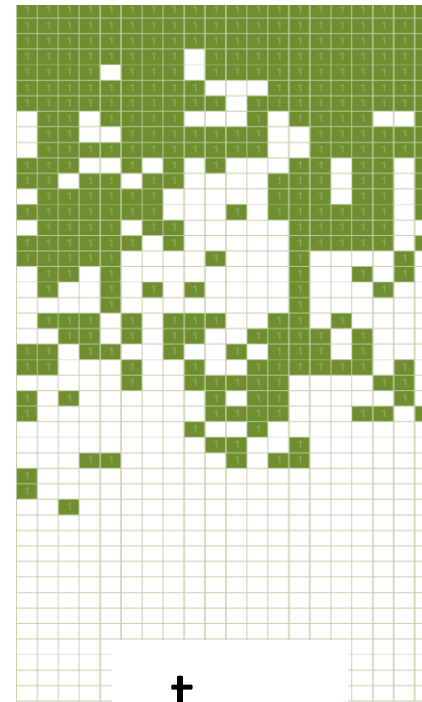
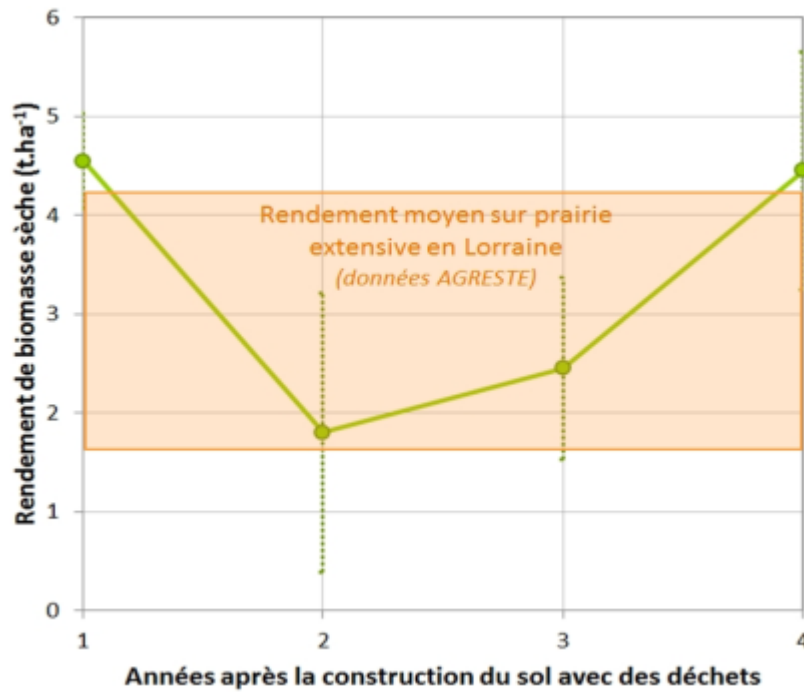


Grassland installation

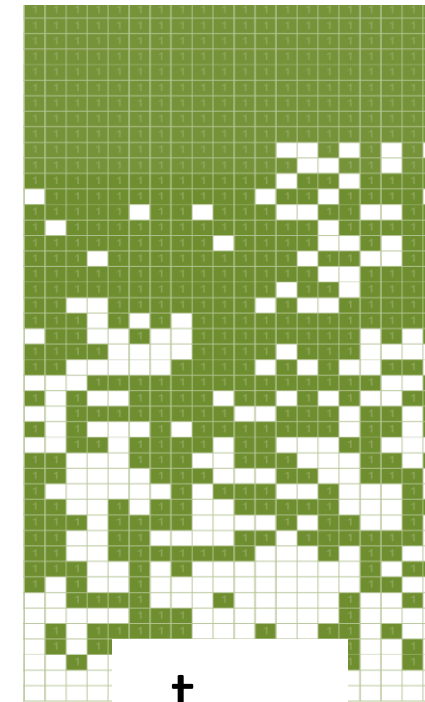


Grassland installation

- Biomass yield similar to natural grasslands
- Good roots development



t_{3ans}



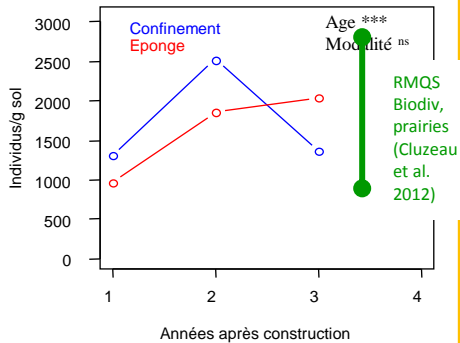
t_{6ans}

Progressive colonisation by fauna

- Biodiversity similar to natural grasslands

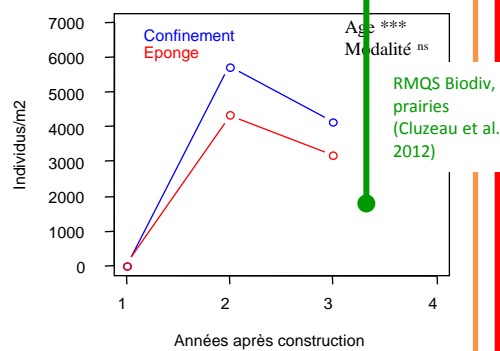
Microfaune

Abondances (Nématodes)

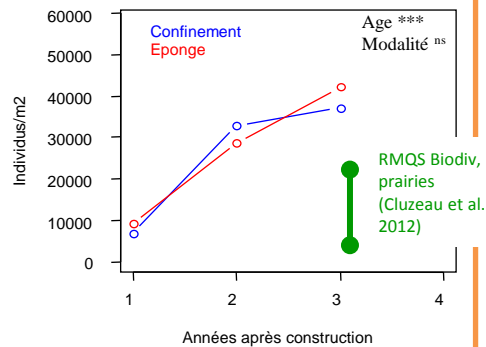


Mésafaune

Abondances (Acariens)

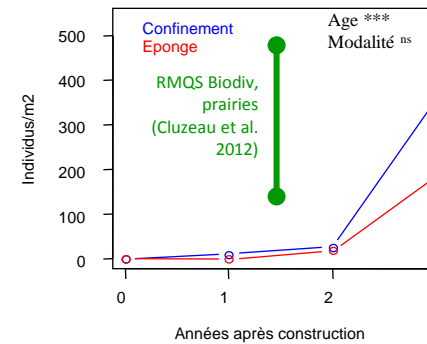


Abondances (Collemboles)

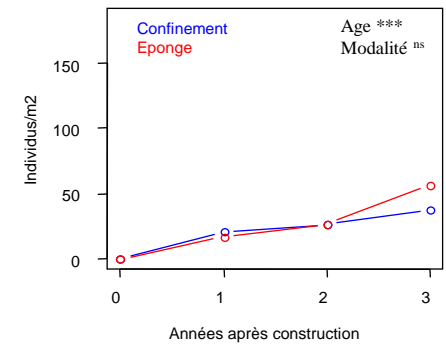


Macrofaune

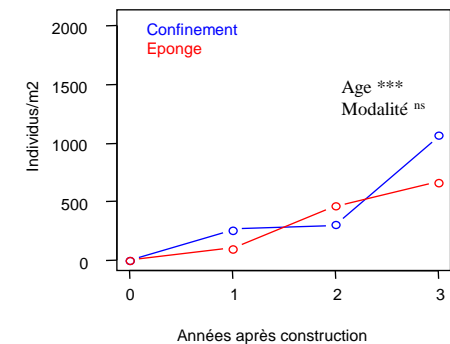
Abondances (Lombriciens)



Abondances (Macrofaune de surface)

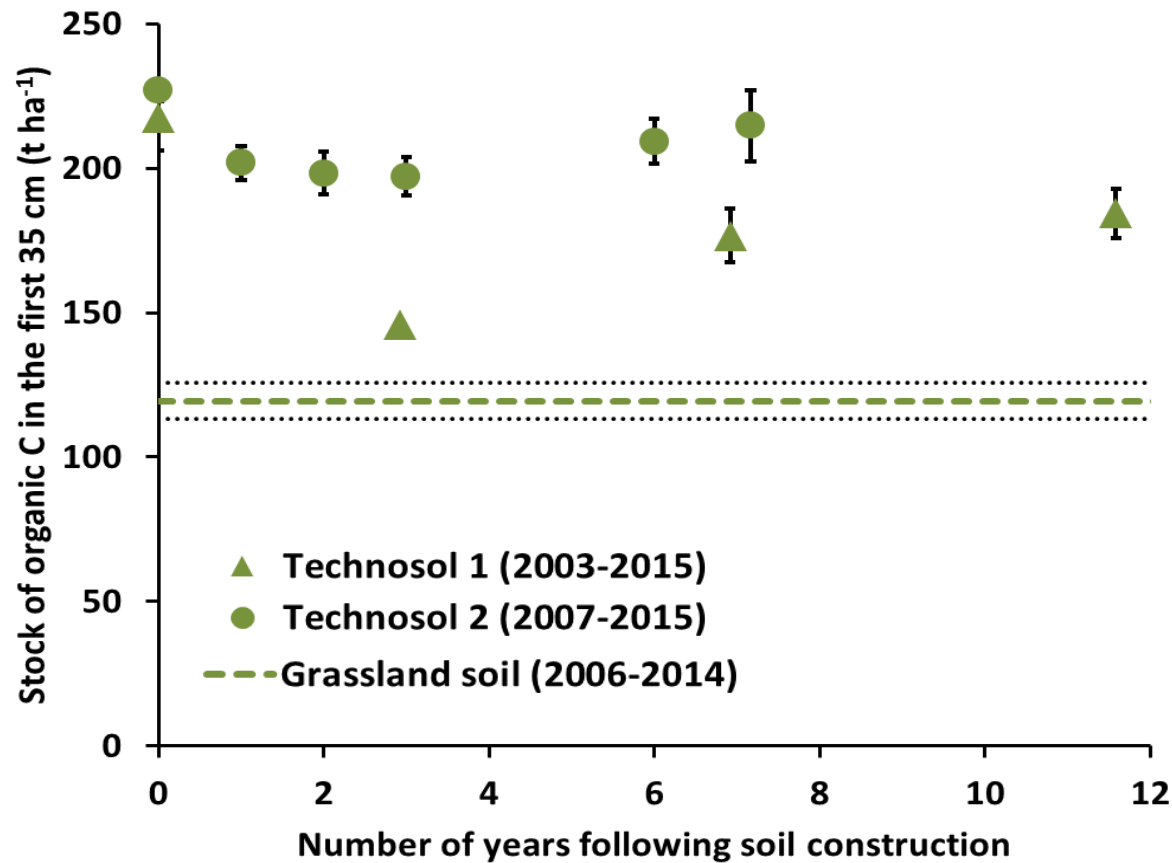


Abondances (Macrofaune du sol)



Long lasting carbon storage

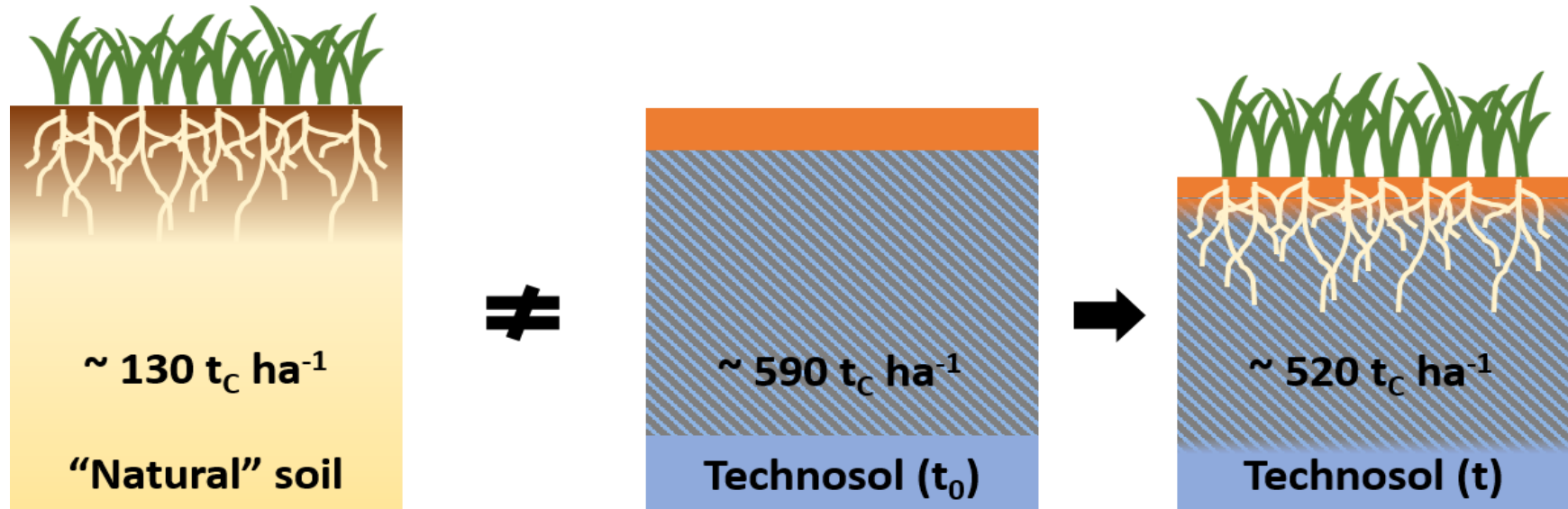
- Stock of C_{org} > natural grassland



Rees *et al.*,
2016, ISMC

Long lasting carbon storage

- Stock of $C_{\text{org}} >$ natural grassland
- Long lasting storage (RothC simulation)



Rees *et al.*,
2016, ISMC



5. Conclusion

Conclusion

- **SUITMA...**
 - are diverse, complex, and distributed heterogeneously
 - are valuable providers of ecosystem services
 - are manageable and designable
- **... to face the major environmental issues of the urban environments**



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