Carbon sinks from re-naturalisation of anthropized and urban environments

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Position paper:
Carbon sinks: What role for research in accelerating their development in France?
https://www.allianceenergie.fr/wp-content/uploads/2022/11/ANCRE-Carbon-sinks_Worksheet-2.pdf

State of play

Urban and highly anthropogenic areas cover a wide range of environments

-> Capture and storage of CO_2 by biomass => carbon sinks

- Green urban spaces
  - parks, gardens, roadside trees and associated soils and substrates
  - urban agriculture
  - greenhouses, especially shared gardens
  - green facades and roofs
- Recently or for decades abandoned industrial wastelands, more or less reinvested by Nature or wastelands in to become (*e.g.* commercial areas)
  - industrial wastelands not been converted into housing (former industrial sites, railway wasteland)
  - military wastelands
  - former mining sites
  - commercial wastelands
- Areas disturbed by civil engineering operation around transport infrastructures, and which have been grassed over
  - In the peri-urban area in the immediate vicinity and on the railway embankments, major highways, airport areas, areas occupied by high-voltage lines, solar panels areas (*e.g.* photovoltaic farms) that do not allow agricultural practices
- Urbanized areas that can be converted into green spaces, such as car free areas spaces in cities where cars are to be removes

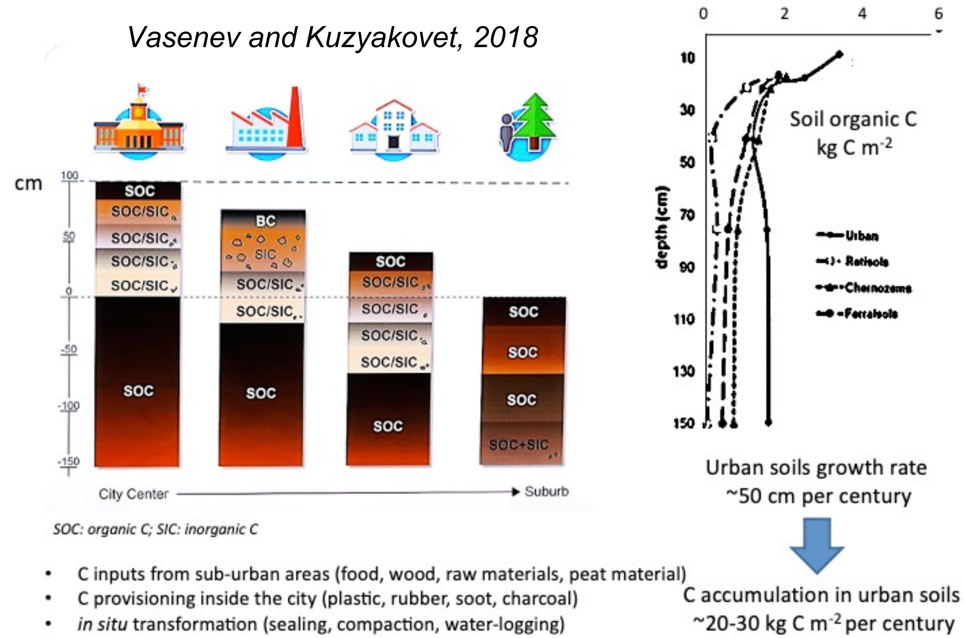
State of play

<u>Specificity of carbon material</u> encountered in urban and/or old industrial soil :

- In old industrial sites dedicated to extraction/transformation of coal and petroleum

-> fossil (coal, oil) or industrial (coke, coal tar…) carbonaceous materials (which can be found beyond a meter deep several decades after the end of the activities)

Demonstration of the existence of a storage potential that can be increased from strategies appropriate management



- Urban / Industrial sites

-> Concrete (stability vs. natural carbonate mineral ?)

Vasenev V. and Kuzyakovet Y. (2018) Urban soils as hot spots of anthropogenic carbon accumulation:Review of stocks, mechanisms and driving factors. Land Degrad. Dev., 29, 1607–1622

State of play (passive renaturation)

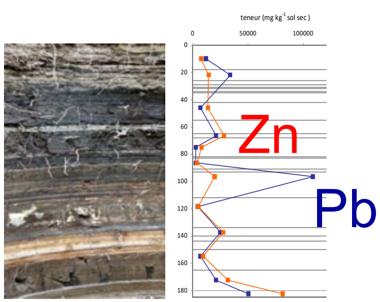
Abandoned highly anthropized environments

-> Installation of vegetation (spontaneous or not), which can evolve into a crop, grassland or forest ecosystem providing a wide range of ecosystem services systems, including carbon storage

Pompey (steel production for the Eiffel tower)
-> Stop in the fifties
2 ha
Highly contaminated
Alluvial forest

Huot et al., 2012

Industrial effluents



Settling pond

Huot H., Faure P., Biache C., Lorgeoux C., Simonnot M.O., Morel J.L.(2012) A Technosol as archives of organic matter related to past industrial activities. Science of the total environment, 487, 389-398.

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Highly contaminated
Alluvial forest

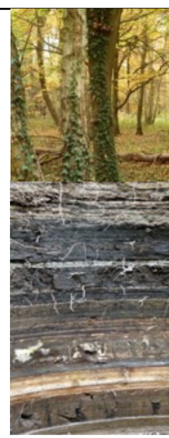
Industrial effluents

decantation

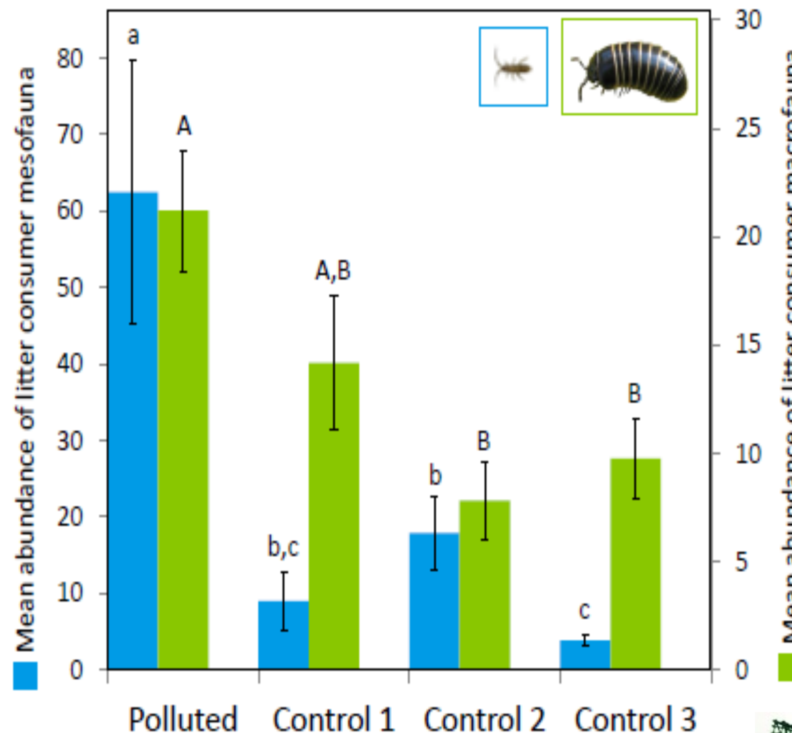
Settling pond

1950-60

Natural installation of plant cover on the Technosol



Huot et al., 2018



ANOVA, Tukey HSD; N=12

Huot H. Cortet J., Watteau F., Milano V., Nahmani J., Sirguey C., Schwartz C., Morel J.L., (2018) Diversity and activity of soil fauna in an industrial settling pond managed by natural attenuation. Applied soil ecology, 132, 34-44.

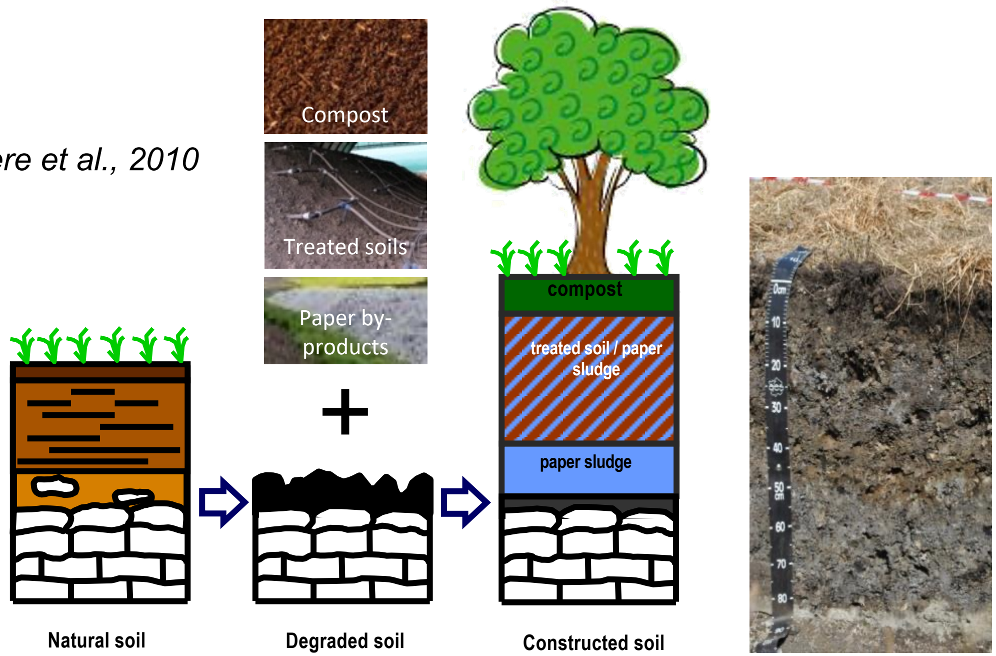
State of play (active renaturation)

Conversion of brownfield sites by revegetation

- landscape purposes
- biomass production,
- mitigation islands of heat
- renaturation,
- restoration of soil functions

-> Soil construction technologies exist in this purpose and already have enabled the renaturation of former industrial and mining sites.

Sere et al., 2010



Industrial wasteland

After restoration of the ecosystem

Sere G., Schwartz C., Ouvrard S., Renat J.C., Watteau F., Villemin G., Morel J.L. (2010) Early pedogenic evolution of constructed Technosols. Journal of Soils and Sediments, 10, 1246-1254.

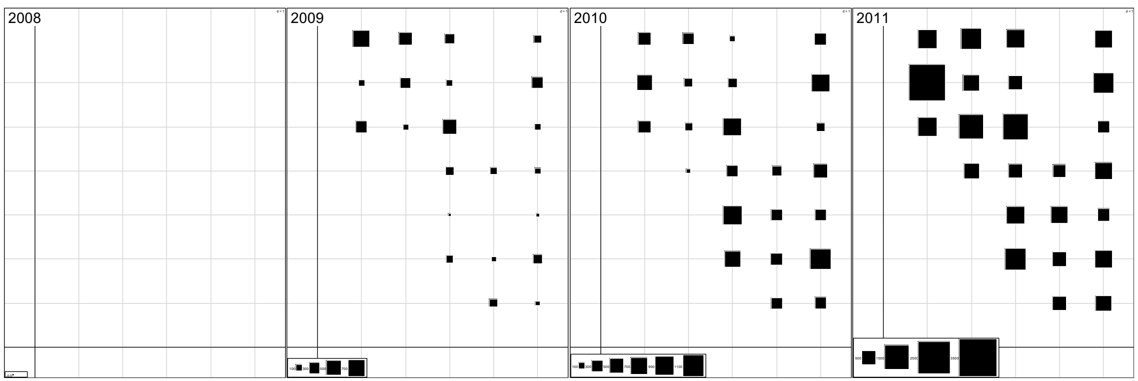
State of play (soil construction: biodiversity)

Multi-functional soils to ensure, over time, a wide range of ecosystem services

Soils analogous to natural soils

-> Biomass supply: energy, fibers, agromining
-> Regulation: filter/exchanges, climate, biodiversity, carbon storage, valorization of urban by-products, protection of natural soils

Hedde et al., 2019



Evolution of soil fauna (worms, springtails…)

⇨ **Support for biodiversity**

Industrial wasteland

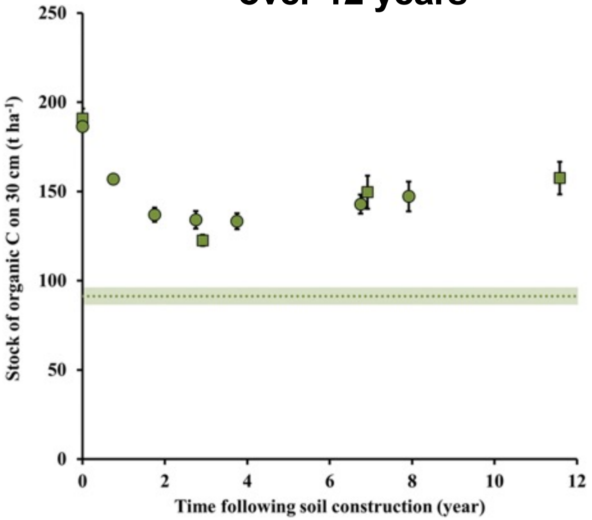
After restoration of the ecosystem

Hedde M., Nahmani J., Sere G., Auclerc A., Cortet J. (2019) Early colonization of constructed Technosols by macro-invertebrates. Journal of Soils and Sediments, 19, 3193-3203.

State of Play (soil construction: biomass production)

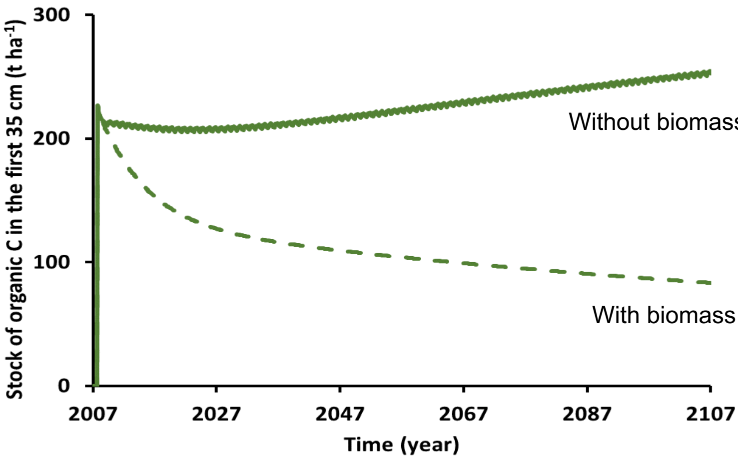
STATE OF PLAY (SOIL CONSTRUCTION : BIOMASS PRODUCTION)

Evolution of the Carbon storage over 12 years



Rees et al., 2019

Evolution of the Carbon storage over one century (RothC)



http://www.lorver.org

Rees F., Dagois R., Derrien D., Fiorelli J.L., Watteau F., Morel J.L., Schwartz C., Simonnot M.O., Sere G. (2019) Storage of carbon in constructed technosols: in situ monitoring over a decade. Geoderma, 337,641-648

Challenges

- The reconversion of urban / industrial wastelands into green spaces could be applied to a larger number of sites intended to be vegetated
- They could also be optimized to increase the quantities and duration of carbon storage, while maintaining or improving ecosystem services

Specific context: development of photovoltaics, leading to compromises to ensure the widest range of ecosystem services

➔Lack of information:

- ➔ on the surfaces concerned (especially municipal parks/gardens, railway lines and urban agricultural plots)
- ➔ current practices that could be developed for storage for surfaces such as edges of road, railways, airports and highly also anthropized recreational areas such as golf courses

➔Land pressure on these areas differs strongly depending on:

- ➔ their location in relation to urban centers (*e.g.* industrial wasteland in urban areas vs. isolated wasteland in rural areas)
- ➔ their potential for storage carbon varies greatly from one point to another

➔Urban management strategies (e.g. greening policy)

Challenges (evaluation of carbon storage)

Estimation of total additional carbon storage potential based on known surface areas and a renaturation of 25% by 2050

Brownfield: area of 530 000 to 705 000 Ha

-> between 3.5 and 4.7 Mt of CO_2 eq by 2050

Airport areas: the total additional storage potential is 0.65 Mt of CO_2 eq (without the assumption of an increase of surface).

Green facade and roofs: 0.13 Mt of CO_2 eq (without surface increase assumption).

Main road: around Kt of CO_2 eq

=> The potential exists but it is not really known.

=> Technologies exist but they could be optimized with the objective of increasing carbon storage while ensuring the provision of essential ecosystem services such as biodiversity

- ➔ determine existing and potential surfaces in urban and anthropized environments
- ➔ Implement the most efficient storage strategies possible (in terms of quantity and durability)
- ➔ integrate into the decision-making process for the use of these surfaces the carbon storage to meet the objective of carbon neutrality in 2050,

=> these storage possibilities have not yet been demonstrated or used

Barriers

Lack or difficulty of realistic estimating

-> the area concerned and the potential carbon storage in the relation to the uses.

Dynamics of the provision of surfaces

-> commercial wasteland, temporary renaturation of wasteland before new use.

Land use competition

-> Urbanization/housing projects, renaturation, energy production.

Simultaneous consideration

-> Carbon storage *vs.* biodiversity, particularly on sites not subject to building development

Lack of information to stakeholders

-> Of transport infrastructures management and technological developments to adopt storage practices (roadsides, railways, airport areas, etc.).

-> Of building constructors and technological developments allowing storage, especially when excavating soil for building construction

Research recommandations

- **Observatories or territorial statistical monitoring to <u>quantify surface area</u>**

  -> mobilization of spatial planning actors (public landholding establishments)

- **Observatories and systems to <u>evaluate practices</u> to quantify their impacts on carbon storage**

  (i) inventory of practices,

  (ii) assessment of the impact in terms of storage,

  (iii) implement the identified stocking practices to optimize these practice and/or their deployment.

- **Carrying out <u>emission balance vs. storage</u>**

  -> in parks, urban agriculture areas and shared gardens (focus on vegetated areas).

- **<u>Build functional soils</u> capable of providing a wide range of ecosystem services (biodiversity, carbon storage, hydrology, oxygen production, pollution):**

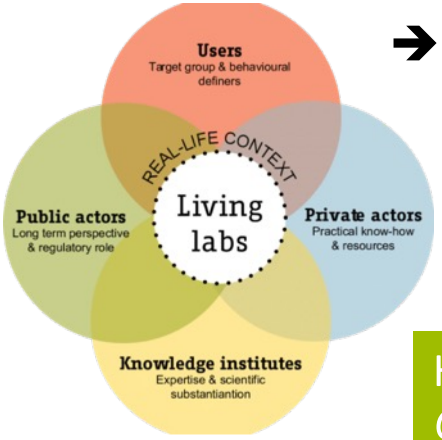
  (i) identify a few pilot sites to make comprehensive radiation balance measurement

  (ii) monitoring cultivation practices in shared gardens or park maintenance

  (iii) make a comparison between the urban and agricultural contexts in terms of practices, impact on carbon and biodiversity and their evolution

Implementing recommandations

- Encourage the development of parks, gardens and forests in urban areas, green roofs and facades
- Promote revegetation of brownfields and renaturation (biodiversity) by optimizing storage carbon
- Develop new storage strategies and practices during remediation of degraded and polluted sites
- Implement tools to raise awareness among land-use planning actors of the need to change practices to increase carbon storage
- Promote a better transfer of knowledge and innovative technologies concerning carbon storage to land-use planning actors (communication, exchanges...)
- Develop public policies that encourage (regulations, taxation, remuneration) the storage of carbon and preserve them over long periods



➔ **Livinb Lab (co-construction of solution)**

-> Associate scientist, stakeholder, industrials and citizens

Horizon Europe MISS-23-SOIL-01-08
Co-creating solutions for soil health in Living Labs

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http://gisfi.univ-lorraine.fr