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► To cite this version:

Beatrice Bechet, Laure Beaudet, Philippe Branchu, Patrice Cannavo, Cécile Delolme, et al.. Soils in the urban critical zone - Analyse of anthropogenic pressures and current proposals to preserve soil functions and ecosystem services. EGU General assembly 2020, May 2020, Online, France. 6 p, 10.5194/egusphere-egu2020-12113 . hal-03135048

HAL Id: hal-03135048

<https://institut-agro-rennes-angers.hal.science/hal-03135048>

Submitted on 26 Mar 2021

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Soils in the urban critical zone –Analyses of anthropogenic pressures and current proposals to preserve soil functions and ecosystem services

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By 2017, the book "Soils within cities" (Levin et al., 2017) is moving away from the description of urban soils to a broader understanding of this compartment of urban ecosystems, including the functions and the services they provide. This approach, which complements the naturalistic description of the soil, corresponds to the concept proposed by the Millennium Ecosystems Assessment (Morel et al., 2015; Walter et al., 2015). It is considered to be relatively anthropocentric and thus favors the integration of the soil in the urban socio-ecosystem.

Considering the soil by both its pedogenesis and functioning in ecosystems induces taking into account the dynamics of this system, but raises, with regard to the literature on urban soils, the existing lack to qualify and quantify the processes of genesis and evolution, especially in relation to ongoing climate change (Baveye et al., 2016). On the other hand, the description of soil ecosystem services (regulation, provisioning, cultural services) immediately reveals the interdependence of soil biophysicochemical processes with those occurring in the hydrosphere, the atmosphere and the biosphere (Adhikari and Hartemink, 2016). In this respect, the soil plays a role of interface, but is deeply disturbed in urban areas.

Soil functions and ecosystem services vs anthropogenic pressures



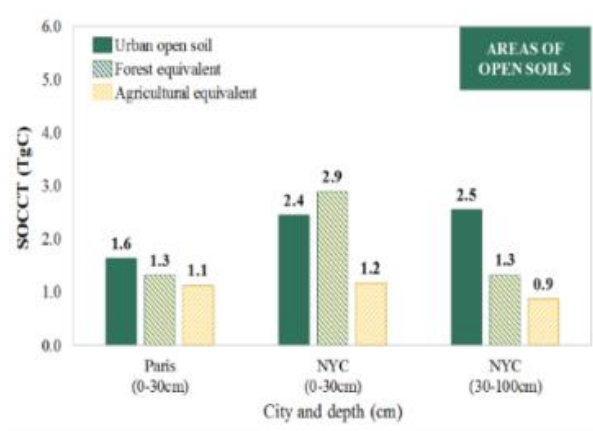
The objective of the communication will be to review the status of urban soil in the "urban critical zone" concept. Through methodologies and results from projects implemented in French major cities that have enabled the development of databases, we will review the classification of these atypical soils and the changes in their properties and functions. Through the definition of the services they provide, we will propose a more integrated vision of this compartment of the urban ecosystem, by specifying the forcing caused by its interface position, but also the opportunities of improvement foreseen by the development of solutions for revegetation and de-sealing. We will see how the timeframe of soil evolution in urban zones can influence the data collection of soil parameters and mapping.

Challenge: preservation of soil functions and 'wise' uses & practices of urban soils

Projects developed at various scales : function/urban project/ urban planning



- Propose a **procedure for evaluating services provided by urban soils at the city scale**
- **Quantify functions of open urban soils:** *e.g.* organic carbon storage
- Propose a **Decision Support System to take better account of soil resource in urban projects** and build cities with a high level of ecosystem services

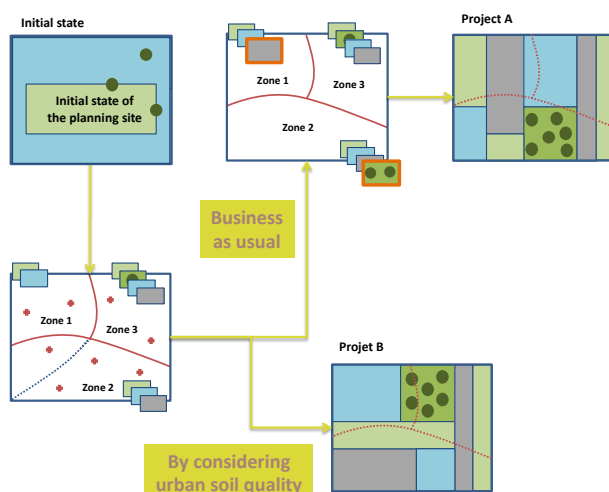


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Organic carbon contents in urban soils are equal or higher than in agricultural and forest soils

DESTISOL

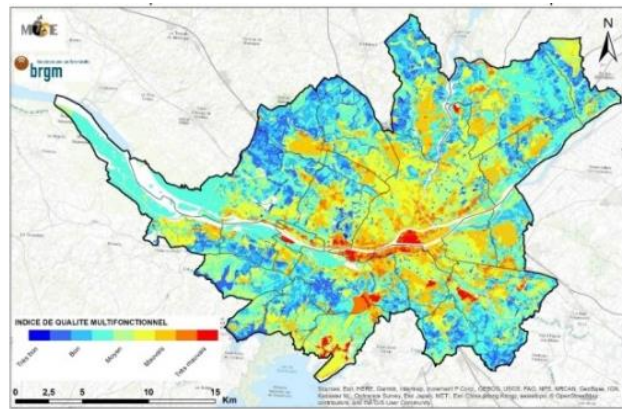
- Assess the **potential of soils on the basis of the ecosystem services they can provide**
- Establish a **zoning on the scale of a site to be developed on the basis of soil indicators**
- **Optimization of urban design by taking urban soil survey into account through the Destisol DSS**



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- **Co-selection** of soils **functions** with stakeholders
- Development of **indicators** and **mapping soil quality with territorial available « data »**
- Test the implementation of methodology in urban planning documents with cities planners

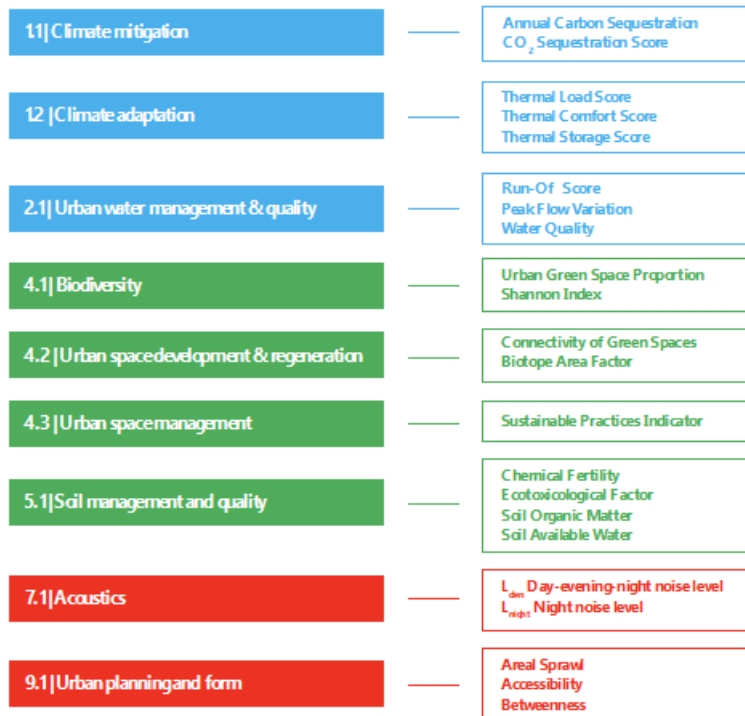


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Technical and participative solutions in European cities (NBS)



To create a **decision support tool** offering a reference base around Nature Based Solutions (NBS), and **providing technical solutions and methods**



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- A city/citizen **co-construction** of a **Healthy Corridor**
- **Territorial NBS**: green spaces and urban agriculture
- **Biophysicochemical quality** to ensure vegetation growing and safe food production



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Some references

Adhikari K, Hartemink AE (2016) Linking soils to ecosystem services — A global review, *Geoderma*, 262, 101-111

Baveye P.C, Baveye J., Gowdy J., 2016. Soil “ecosystem” services and natural capital : critical appraisal of research on uncertain ground, *Frontiers in environmental science*, vol.4, article 41.

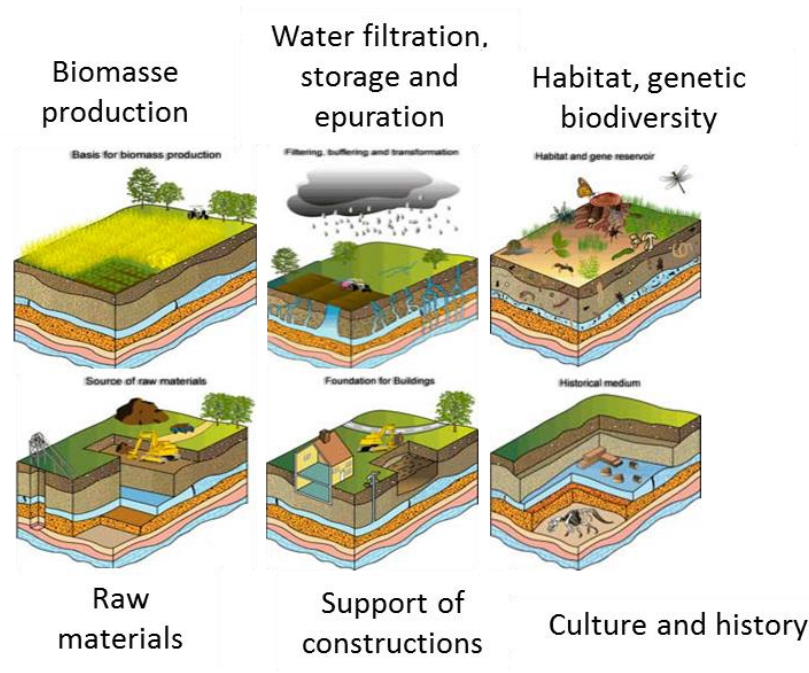
Levin M. J.; John Kim K-H; Morel J L; Burghardt W; Charzynski P; Shaw R K. (2017) Soils within Cities - Global approaches to their sustainable management - composition, properties, and functions of soils of the urban environment, *Catena-Schweizerbart*, 253 pages

Morel JL, Chenu C, Lorenz K (2015) Ecosystem services provided by soils of urban, industrial, traffic, mining and military areas (SUITMAS). *J Soils Sediments* 15:1659-1666.

Walter C., Bispo A., Chenu C., Langlais-Hesse A. et Schwartz C., 2015. Les services écosystémiques des sols : du concept à la valorisation. *Cahier Demeter n°15 Agriculture et foncier*.

Some questions we would like to address

1. Do you address the issue of urban soil in your projects on the critical zone and how (naturalistic description, functioning, soil and society (nature in the city), soil and health)?



2. Urban soils are highly heterogeneous. How do you deal with this in terms of sampling and very high spatial heterogeneity?

Spatial variability of trace elements in allotment gardens of four European cities: assessments at city, garden, and plot scale

Béatrice Bechet^{1,2} · Sophie Joimel^{3,4} · Liliane Jean-Soro^{1,2} · Andrew Hursthouse⁵ · Alaba Agboola⁵ · Teresa E. Leitão⁶ · Hugo Costa⁷ · Maria do Rosário Cameira⁸ · Cécile Le Guern^{2,9} · Christophe Schwartz⁴ · Thierry Lebeau^{2,10}

3. Which typology of urban soils do you use (WRB typology or use of typologies more adapted to your needs (more operational or according to the scales of approach)? Do you develop databases on urban soils and associated mapping (which methodology for the definition of soil units?)?

4. What soil functions and/or ecosystem services provided by soils are you working on and at what scale? Examples : urban soil and climate change ; infiltration and storage of water; CO2 storage; soil support of vegetation; peri(urban)soil and healthy food

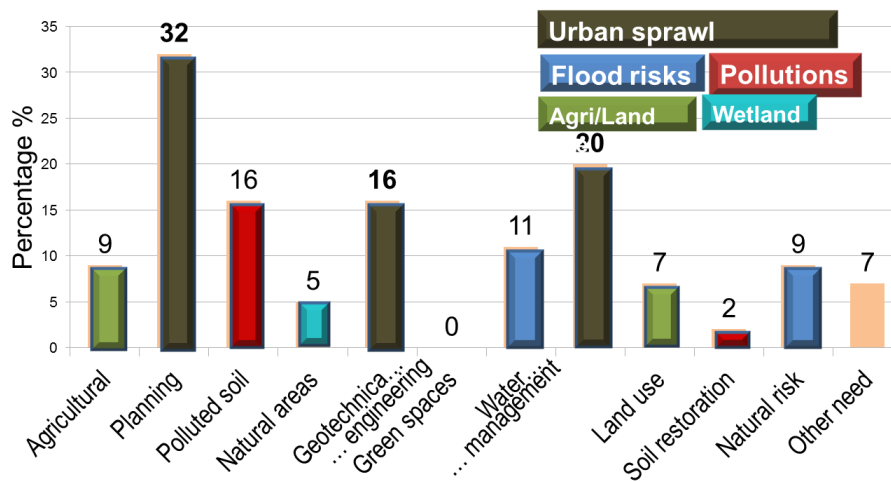
Estimation of soil organic carbon stocks of two cities, New York City and Paris

Aurélie Cambou ^{a, b, h}, Richard K. Shaw ^c, Hermine Huot ^{d, e}, Laure Vidal-Beaudet ^{a, d, e}, Gilles Hunault ^f, Patrice Cannavo ^a, François Nold ^g, Christophe Schwartz ^b

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5. Do you observe a confrontation of functions with uses and practices by urban actors? (cf also chat SSF 8.2 May8th 16.15 MUSE project)



What are soil surveys for? (SUITMA10 conference 2019, Marseille et al., Towards taking into account the multifunctionality of soils in French urban planning regulation - Perspective of territorial stakeholders) © Authors. All rights reserved

6. Do you deal with de-sealing and renaturation issues in your research project? On which aspects? Are you involved in projects on soil desealing?