
HUMUS
HUMANITY
HUMILITY

Humus,

Humus is more important than art, money or success.

Water, air and stone - vitalized through the miraculous symphony of plants, animals and microbes. Life can not exist without death. It is a cycle: the dead feed the living and the living are dying. The longer this process goes on, the more diverse lifeforms emerge and the more humus accumulates. Humus is the basis for all terrestrial ecosystems. For their inhabitants, nothing is more important than humus.

Humanity

Humanity depends on intact ecosystems and fertile soil.

When we started cultivating the land, we were gardeners. The warmer climate and the lush vegetation enabled our ancestors for the first time to stay the year around in one place and to cultivate what they had formerly to search for. It likely started as unintentional manipulation of plant populations and evolved to large-scale engineering of landscapes and ecosystems. Somewhere in between, we stopped to be gardeners. Unable to understand the consequences, we started exploiting the soil.

& Humility

Humility and responsibility will help our species survive.

Planet earth loses its ground. Soil is washed away into rivers and oceans in an ever accelerating speed. Instead of supporting the life processes that naturally lead to humus accumulation, we choose to support erosion. Arrogance and ignorance brought us to this point in history. Humility is the only path to continue. Let's take responsibility for the ecological niche of our species. Let's build humus.


Soil Analysis Workflow
Take soil samples
For each site, multiple samples should be taken (e.g., just below the surface and from 25cm depth)
Fill a Petri dish to the brim with the soil - without pressing.
Add tap water until the soil is saturated. A small drop forms on the edge of the dish when you tilt them to the side.
Leave the samples at room temperature for a minimum of 24h.
Count how many (moving) microorganisms you can find in a certain amount of time (e.g., 2.5 minutes). Do this several times at different locations of the sample
See up the microscope
(illumination, focus, aperture, etc.) and select reasonable magnifications: e.g. 10x objective and 8x eyepiece makes 80x magnification
Place the liquid on a microscope slide and add a coverslip: carefully lay the coverslip on the drop from the side, without any pressure.
Moop

About the installation

Humus, Humanity & Humility is dynamic. The installation as well: constantly modified by ongoing fieldwork, analysis and changing weather conditions.

The visitor is invited to use the microscope if it is switched on, but otherwise requested not to interfere with the measurements.

The installation is divided into two parts:

1. A fieldwork table for microbiological analysis of soil samples (including a microscope, three petridishes, pipettes and glass slides)

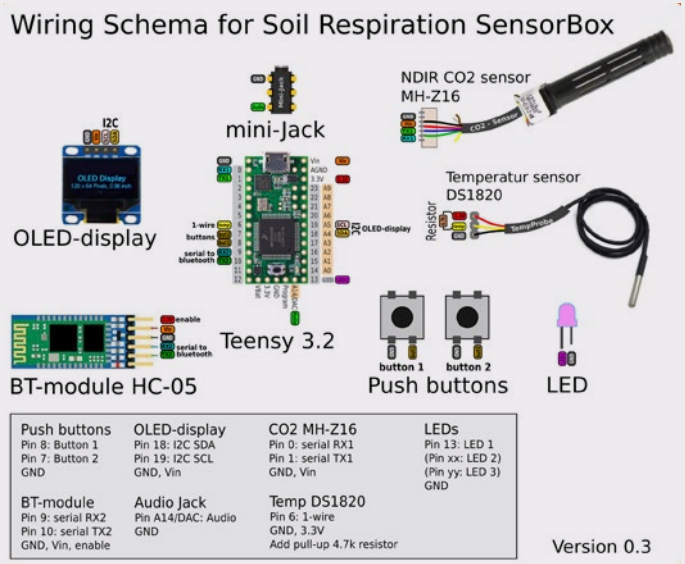
The fieldwork table is used to analyse soil microbe composition with the help of light-microscopy. An experimental approach - 'subjective quantification' - allows rapid and low-tech estimation of microbial prevalence in the observed sample. The method is highly dependent on the observer (subjective) and needs a lot of experience to deliver useful and reproductive results. During this installation, we analyse the relative abundance of nematodes and ciliates in the soil samples by counting how many individuals we find within a 2,5 - 5 min time frame.

Combined with other straightforward techniques, this method will hopefully empower gardeners and farmers to evaluate their soil regeneration efforts without external assistance.

2. Three sampling sites in the courtyard - next to the tree & below the cobblestones (including a shovel, crowbar and a soil respiration chamber).

The 'Soil Respiration Chamber' is a self-made device for the time-resolved measurement of changes in atmospheric CO_2-levels. It consists of a nondispersive infrared CO_2 sensor and a temperature sensor which are connected to a micro-controller (Teensy 3.2). The sensors are situated inside a gently ventilated plastic chamber that is placed on the soil surface.

This allows the observation and quantification of decay processes by measuring the amount of CO_2 that is released on this specific patch of soil. The values are logged for later analysis and shown live on an OLED-display. The soil respiration chamber is very energy-efficient and can be powered by a small solar panel.



Scientific background

Soil respiration

Healthy soil always releases CO_2. When organic matter decays, part of the carbon that was captured from the atmosphere through photosynthesis is released again. The dynamics of carbon release can be very different as they are influenced by the climate, the type of ecosystem, the input of organic matter and the native microbes.

In the tropics, photosynthesis activity, as well as microbial activity is very high – throughout the year. This means that a lot of carbon is sequestered by the plants and transformed into biological material. When the plant dies, most of the material is utilized through a highly diverse food-web of animals, fungi and microbes, who subsequently contribute to plant health. During this cycle of life and death, almost all carbon is released again.

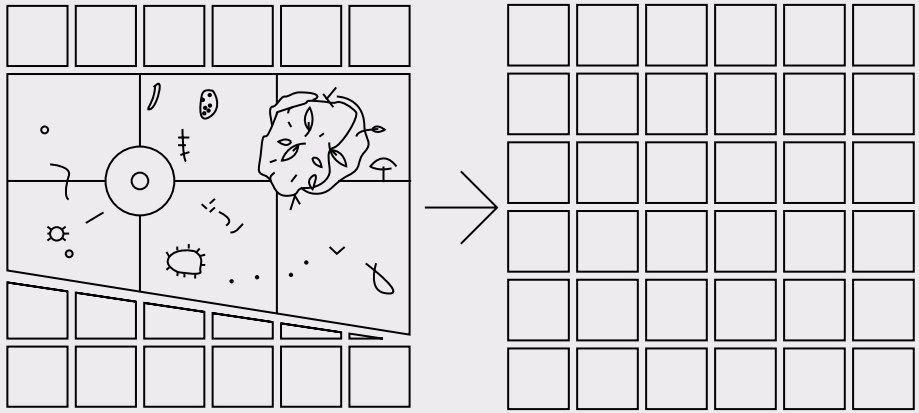
In colder climates with pronounced seasons, photosynthesis as well as microbial activity is lower. Therefore, the carbon that the ecosystem can take up and transform into biological matter is also lower. On the other hand, the process of decay is much slower, which supports the accumulation of organic carbon in the soil: the formation of humus.

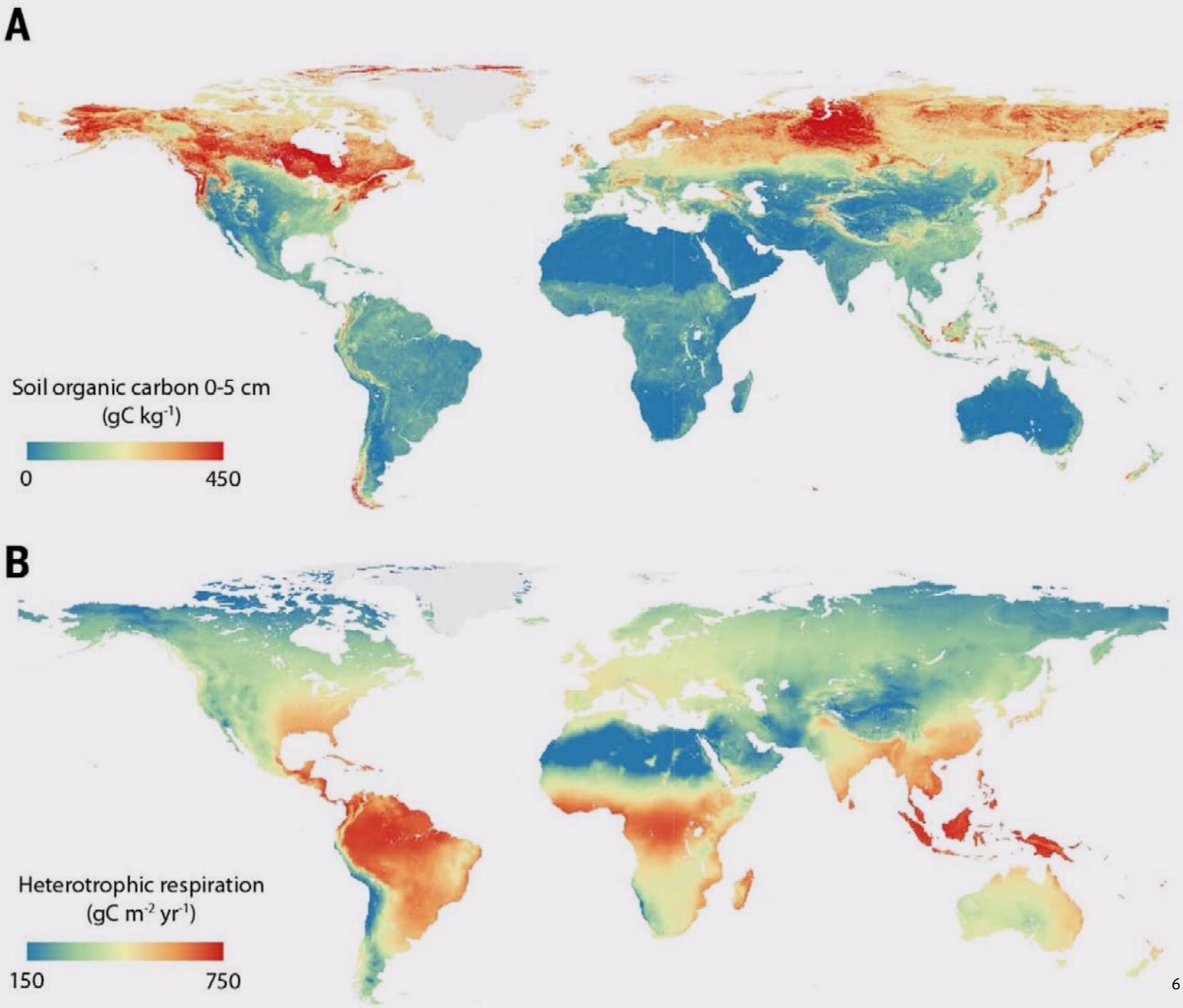
Over millennia, the great landmasses of northern regions accumulated vast amounts of humus and therefore now constitute the major part of worldwide organic carbon storage in soils. Unfortunately, climate change and deforestation are threatening to destabilize the northern ecosystems and accelerate carbon release.

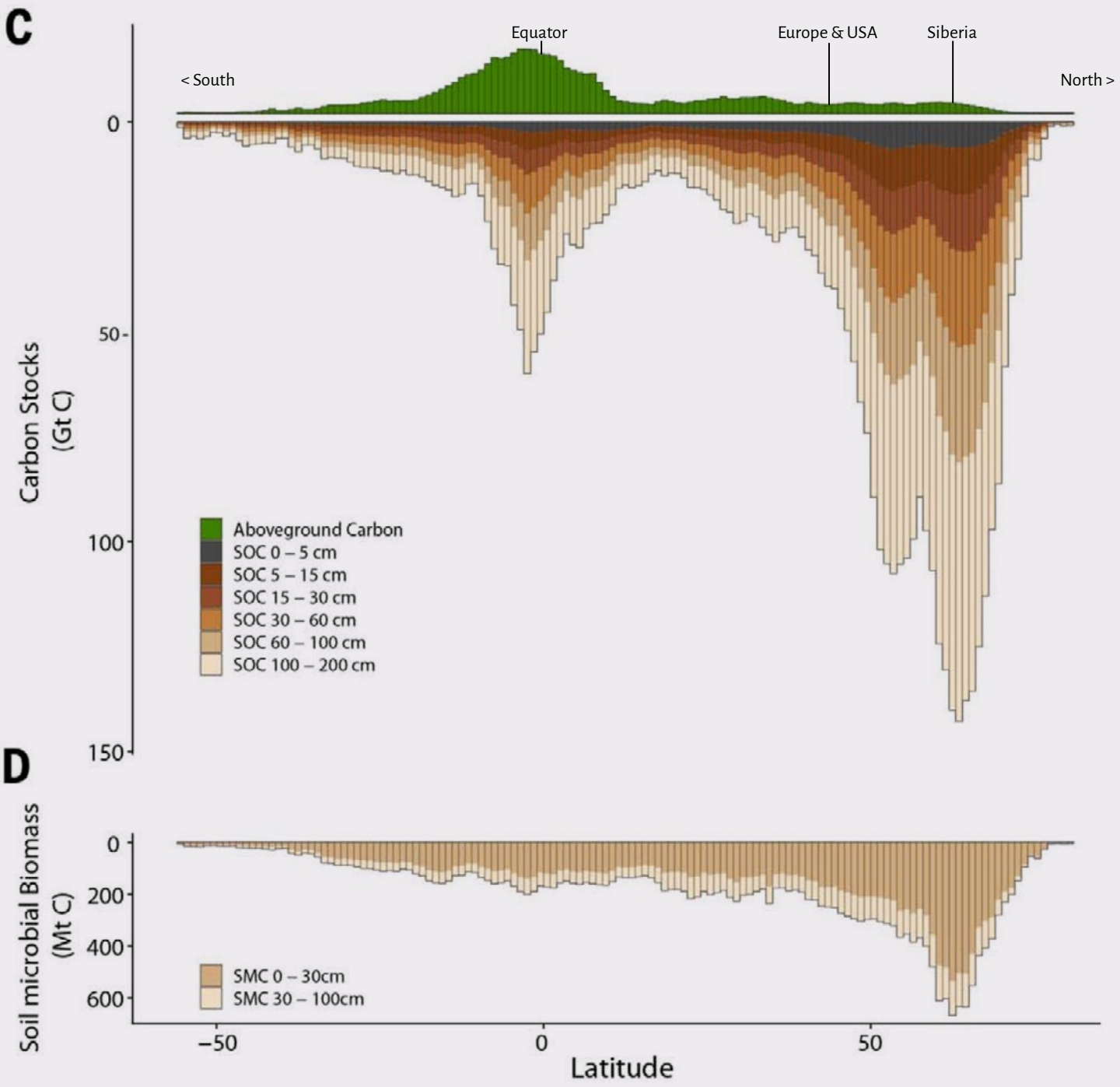
Soil sealing

Building land is dead land.
When the soil is isolated from air and water, all life suffocates. Subsequently also all environmental, economic and social functions of soil are lost.

Between 1955 and 2012 the total surface area of cities in the European Union has increased by 78 %, while the population has grown by only 33 % (European Environment Agency). Most of the land is converted from forests or farmland into building land or infrastructure. The average rate of conversion for Austria is currently around 13 hectares per day: this means that every 8 minutes an area the size of this courtyard disappears.
Day and night.




A
Soil organic carbon 0-5 cm
(gC kg-1)
0
450
B
Heterotrophic respiration
(gC m-2 yr-1)
150
750


C
Equator
Europe & USA
Siberia
< South
North >
0
50
100
150
Carbon Stocks
(Gt C)
Aboveground Carbon
SOC 0 – 5 cm
SOC 5 – 15 cm
SOC 15 – 30 cm
SOC 30 – 60 cm
SOC 60 – 100 cm
SOC 100 – 200 cm
D
Soil microbial Biomass
(Mt C)
0
200
400
600
SMC 0 – 30cm
SMC 30 – 100cm
−50
0
50
Latitude

About HUMUS sapiens

In early 2018 the mikroBIOMIK Society, the Global Hackteria Network and Gasthaus: Fermentation and Bacteria initiated a new regional network focusing around the topics of soil ecology and permaculture from a very transdisciplinary perspective. We believe that diversity is the key to creativity, innovation and a healthy soil. Scientists, biohackers, artists, makers, educators, ecologists and farmers work together to investigate the hidden ecologies in the ground beneath our feet.

Human impact on the soil, especially intensive agricultural practices (deforestation, overgrazing, use of agrochemicals, etc.) and urbanization, leads to compaction, loss of soil structure, nutrient degradation, and contamination – ultimately, the ecosystems break down and the soil is eroded to infertile desert.

HUMUS sapiens aims to re-examine these problems from an ecosystem's viewpoint and to support the paradigm shift from an anthropocentric ideology to a more biocentric philosophy of life.

More Information:
https://mikrobiomik.org/humussapiens

Soil respiration chamber

Collaborative development - inspired by academic research, open-hardware and curiosity about soil microbes. Special thanks to Janne Korhonen, Ecologist at the Institute for Atmospheric and Earth System Research (University of Helsinki).

The exhibited prototype was assembled by Julian Chollet and Marc Dusseiller at RandeLab Soil Retreat, 4-6. May 2018. Since then, the soil respiration chamber was further developed mainly at Lifepatch (Yogyakarta, Indonesia).

More Information:
https://hackteria.org/wiki/CO2_Soil_Respiration_Chamber

Cover: Desert soil near Mitzpe Ramon, Israel
(Photo: Julian Chollet)

Page 3: HUMUS sapiens workshop in Paris
(Photo: Ewen Chardronnet)

Page 6,7: Crowther et al. (2019)
"The global soil community and its influence on biogeochemistry"

Page 8: Soil life of various size
(Drawing: Mona Schreiber)

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HUMUS SAPIENS OPEN SOIL RESEARCH

mikro BIOMIK

Bauhaus-Universität Weimar

ARS ELECTRONICA