



Food and Agriculture
Organization of the
United Nations



GLOBAL SOIL ORGANIC CARBON Map

1.2.0
VERSION

itps

INTERGOVERNMENTAL
TECHNICAL PANEL ON SOILS



Soil organic carbon (SOC) is the carbon that remains in the soil after partial decomposition of any material produced by living organisms. It constitutes a key element of the **global carbon cycle** through atmosphere, vegetation, soil, rivers and the ocean.

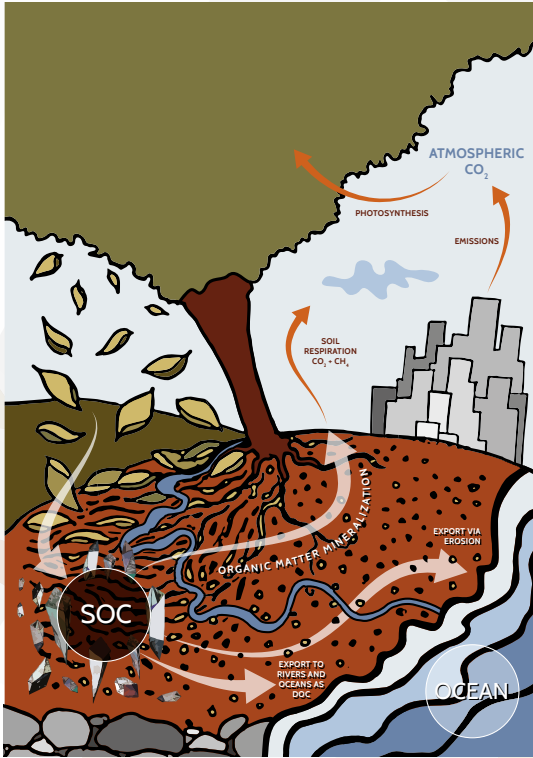


FIG. 1: SOC IN THE GLOBAL CARBON CYCLE

Soils represent the largest terrestrial organic carbon reservoir. Depending on local geology, climatic conditions and land use and management (amongst other environmental factors), **soils hold different amounts of SOC.** The largest amounts of SOC have been estimated to be stored **in the northern permafrost region** with around 190 Pg C in the first 30 cm of the soil (0-30cm)¹, mostly in peat soils. There, **carbon accumulates in soils in huge quantities due to the low temperatures** leading to low biological activity and slow SOM decomposition. The corresponding soil type is called *Histosol* and is characterized by a SOC content of 12 to 18%². In contrast, **in dry and hot regions** such as the Sahara Desert, plant growth is naturally scarce and **only very little carbon enters the soil.** *Arenosols*, the typical soils of these areas, have mostly less than 0.6% SOC³. **Black soils, such as Chernozems, are inherently fertile** because of their relatively high SOC content (over 1%²) and optimal plant growth conditions in terms of nutrient exchange capacity and a well-developed structure enabling sufficient water provision.

SOC is the **main component of soil organic matter (SOM)** and as such constitutes the fuel of any soil. SOM supports key soil functions as it is critical for the stabilization of soil **structure**, retention and release of plant **nutrients**, and allowing **water** infiltration and storage in soil. It is therefore essential to ensuring soil health, fertility and food production. The **loss of SOC indicates** a certain degree of soil **degradation.**

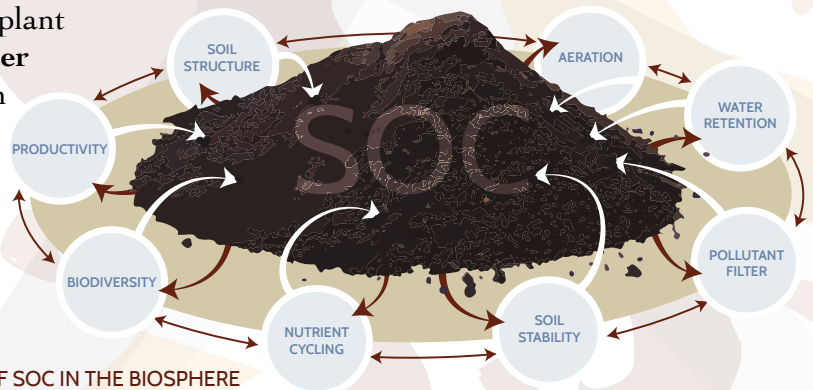


FIG. 2: ROLE OF SOC IN THE BIOSPHERE



FIG. 3: ARENOSOL

Caring for these soils and preserving the SOC they contain can be achieved **through sustainable soil management**, including mulching, planting cover crops, judicious fertilization and moderate irrigation.

Loss of SOC negatively affects not only soil health and food production, but also **exacerbates climate change**. When SOM is decomposed, carbon-based greenhouse gases are emitted to the atmosphere. If this occurs at too high rates, soils can contribute to warming our planet. On the flip side, **many soils have the potential to increase their SOC stocks**, thus mitigating climate change by reducing the atmospheric CO₂ concentration.

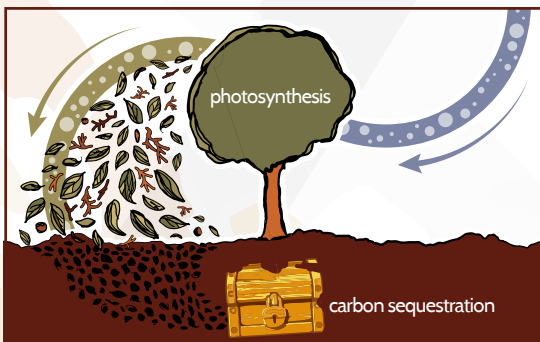


FIG. 5: THE WORLD'S SOILS CAN ACT AS A CARBON SINK

The **Global Soil Organic Carbon Map (GSOCmap)**, a **country driven endeavour**, allows the estimation of SOC stock from 0 to 30 cm. It represents a **key contribution to SDG indicator 15.3.1** which defines the area of degraded land. The GSOCmap represents the **first ever global soil organic carbon assessment produced through a participatory approach** in which countries developed their capacities and stepped up efforts to compile all the **available soil information at national level**.

In many cases, this is paving the way to establishing national soil information systems and represents **the first step toward introducing a soil monitoring program**.



FIG. 4: CHERNOZEM

The GSOCmap provides users with very **useful information** to monitor the soil condition, identify degraded areas, set restoration targets, explore SOC sequestration potentials, support the greenhouse gas emission reporting under the UNFCCC and **make evidence based decisions to mitigate and adapt to a changing climate**.

1. Tarnocai et al. 2009. <https://doi.org/10.1029/2008GB003327>;
2. IUSS Working Group WRB. 2015. <http://www.fao.org/3/a-i3794e.pdf>;
3. Zech et al. 2014. <https://dx.doi.org/10.1007/978-3-642-36575-1>

KICK-OFF
GSOCmap as a contribution to the **SDG indicator 15.3.1**: proportion of **land that is degraded** over total land area.



TECHNICAL SPECIFICATIONS
agreed upon by member countries during the 2nd Workshop of the International Network of Soil Information Institutions (INSII).



NATIONAL SOIL DATA COMPILATION AND HARMONIZATION

Database creation bringing together **recovered** soil legacy data from different institutions, projects and archives; and also harmonization of lab methods and units.



CAPACITY DEVELOPMENT
Over **150 experts** from **110 countries** trained in digital soil organic carbon mapping.



MAPPING BY COUNTRIES

Assessment of different methodologies to predict **SOC stock distribution** and estimate **uncertainty**



GLOBAL DATA HARMONIZATION

including **quality control**, **mosaicking**, **border harmonization** and gap filling

GSOCmap

With more than **1 Million sampling points** behind the GSOCmap, the **country-driven SOC mapping approach** has proved to be successful.

2018

LAUNCH

2017

WORK BY AND WITH COUNTRIES

2016

PREPARATORY WORK

GSOCmap: A COUNTRY-DRIVEN PROCESS

WHAT'S NEXT?

- GSOCmap V2.0 with new and updated national SOC maps
- Full establishment of the Global Soil Information System based on National Soil Information Systems
- Towards a **Global SOC Monitoring System** based on the GSOCmap
- Feasible **Guidelines for measuring, mapping, monitoring and reporting SOC stocks** to be adapted locally

GLOBAL SOIL ORGANIC CARBON MAP (GSOCmap v1.2.0)



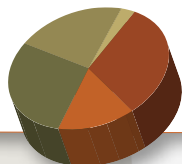
SOC Stocks

TONNES PER HECTARE



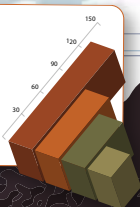
STOCKS BY CLIMATE ZONES

- Arctic
- Boreal
- Temperate
- Subtropics
- Tropics



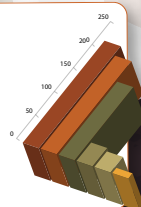
SOIL TYPES (tonnes per hectare)

- Arenosols, Solonchaks and Calcisols
- Acrisols Cambisols and Phaeozems
- Chernozems, Gleysols and Podzols
- Histosols



LAND COVER (petagrams)

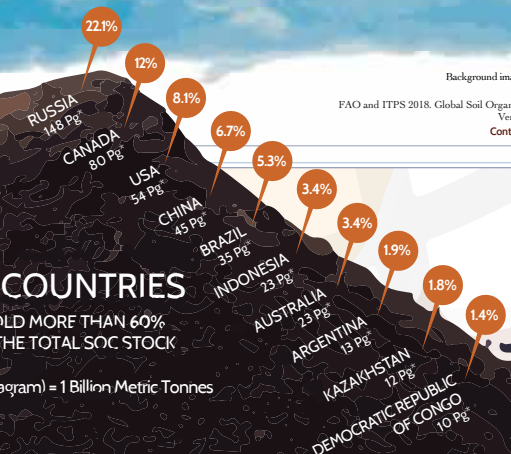
- Forests
- Savannas and shrublands
- Croplands and grasslands
- Mosaic of natural vegetation, croplands and grasslands
- Barren or sparsely vegetated lands
- Permanent wetlands



GLOBAL SOIL ORGANIC CARBON STOCK
0-30 CM:
680 Pg C

10 COUNTRIES
HOLD MORE THAN 60%
OF THE TOTAL SOC STOCK

1 Pg (Petaqram) = 1 Billion Metric Tonnes



Background image source: ESRI, USGS, NOAA
FAO and ITPS 2018. Global Soil Organic Carbon Map - GSOCmap.
Version 1.2.0. FAO, Rome, Italy.
Contact: GSP-Secretariat@fao.org



With the financial support of

