Food and Agriculture Organization of the United Nations

World Soil Day 2017

GLOBAL SOIL ORGANIC CARBON Map

1.0 VERSION

itps
INTERGOVERNMENTAL TECHNICAL PANEL ON SOILS

GLOBAL SOIL PARTNERSHIP

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.

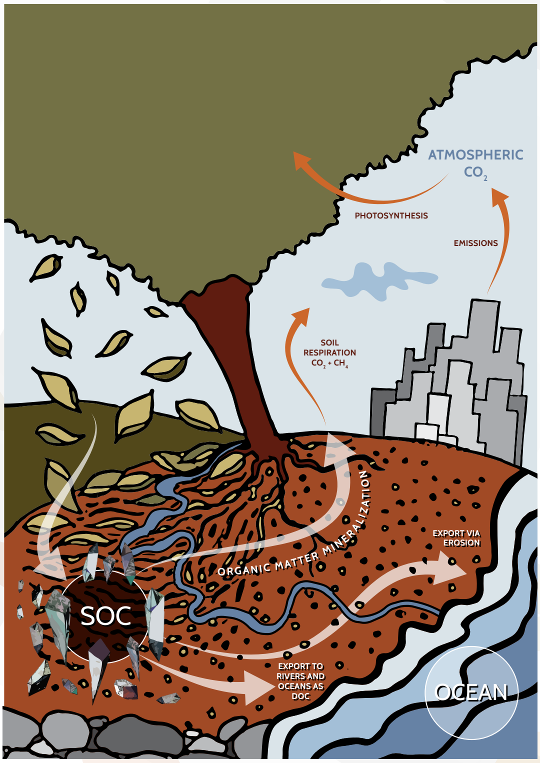


FIG. 1: SOC IN THE GLOBAL CARBON CYCLE

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**.

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% SOC[3]. **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.

Unsustainable management practices such as excessive irrigation or leaving the soil bare **endanger these soils**, causing SOC loss and massive erosion.

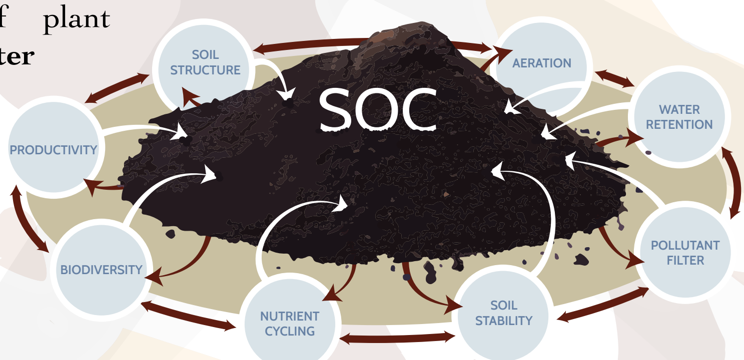


FIG. 2: ROLE OF SOC IN THE BIOSPHERE

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 CO_2 concentration.

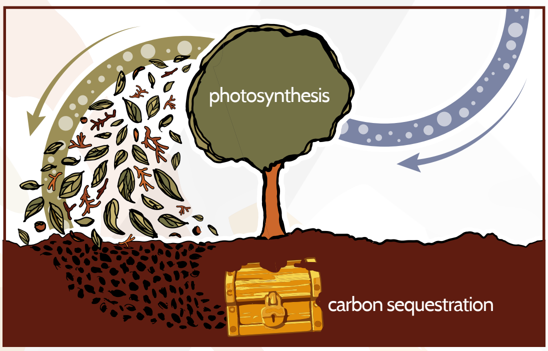


FIG. 5: THE WORLD'S SOILS CAN ACT AS A CARBON SINK

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

GSOCmap: A COUNTRY-DRIVEN PROCESS

2016

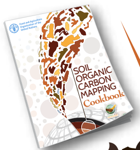
KICK-OFF
GSOCmap as a contribution to the **SDG indicator 15.3.1**: proportion of **land that is degraded** over total land area.

15 LIFE ON LAND

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.



PREPARATORY WORK

2017

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

WORK BY AND WITH COUNTRIES

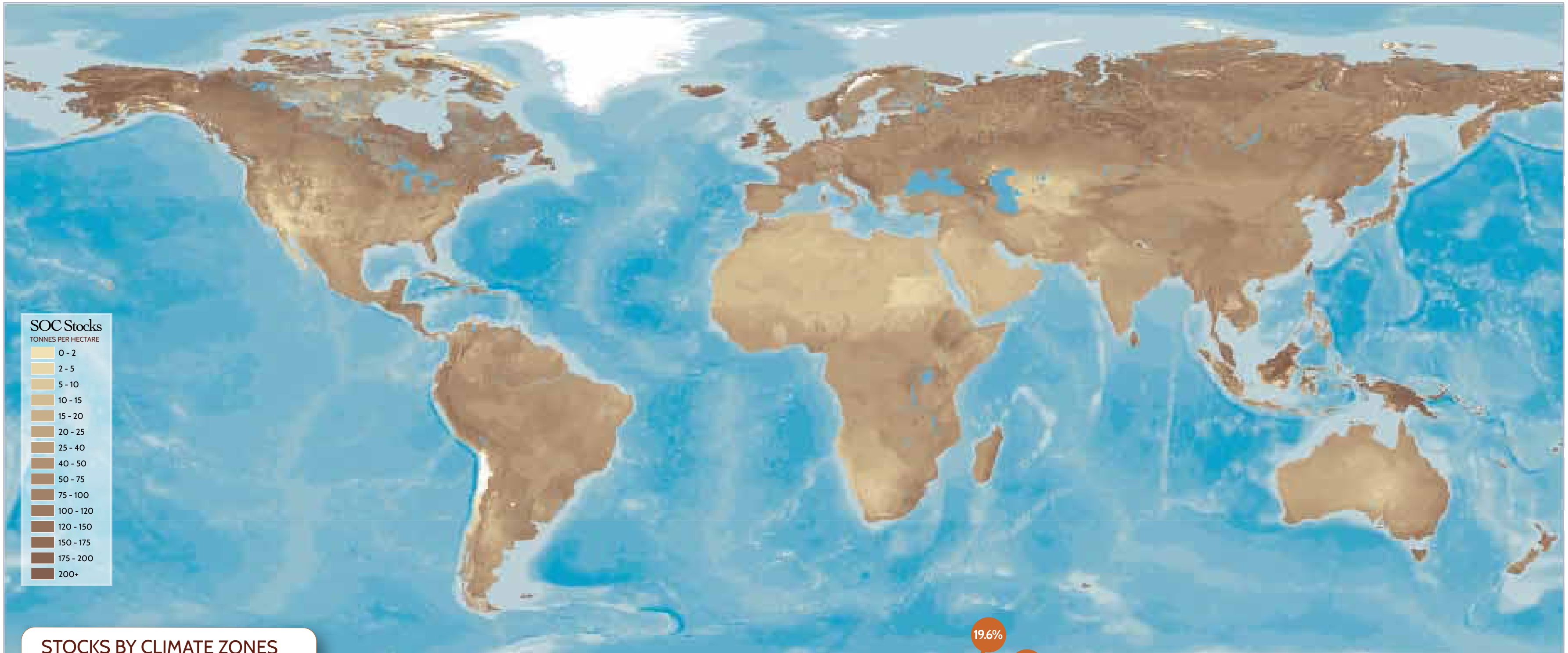
2018

GSOCmap V 1.0
With more than **1 Million sampling points** behind the GSOCmap, the **country-driven SOC mapping approach** has proved to be successful.

LAUNCH

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)*



GSOCmap reflects the status of the world soil information

Background image source: ESRI, USGS, NOAA

Recommended citation:
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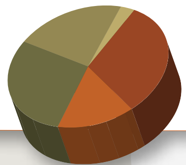
Contact: GSP-Secretariat@fao.org

GLOBAL SOIL PARTNERSHIP

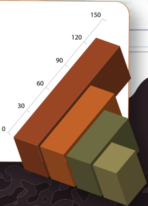
STOCKS BY CLIMATE ZONES

- Arctic
- Boreal
- Temperate
- Subtropics
- Tropics



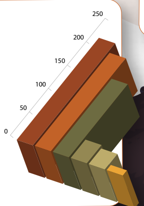
SOIL TYPES (tonnes per hectare)

- 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

Country	Stock*	Share
RUSSIA	133	19.6%
CANADA	86	12.7%
USA	56	8.3%
CHINA	46	6.9%
BRAZIL	36	5.4%
INDONESIA	23	3.4%
AUSTRALIA	23	3.4%
ARGENTINA	13	1.9%
KAZAKHSTAN	12	1.8%
DEMOCRATIC REPUBLIC OF CONGO	10	1.4%

* Petagrams = 1 Billion Tonnes

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