Global Soil Organic Carbon Sequestration Potential Map

GSOCseq

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Technical Workshops. 2020

Talleres - MÓDULOS

Módulo I

- **Día 1: INTRODUCCIÓN** Teórico. Marco conceptual; Modelo Roth C; Aproximación general; Datos de Entrada; Software necesario; Revisión del Procedimiento de inicio a fin y Scripts a utilizar

- **Día 2: PREPARACIÓN DE DATOS.** Teórico – Práctico. Armonización de Datos de entrada y sus scripts. Generación de "target points" donde se correrá el modelo (Caso de ejemplo provisto por GSP).

- **Día 3: CORRIDAS DEL MODELO** Práctico. (Caso de ejemplo provisto por GSP).

- **Día 4: MAPA Y PRODUCTOS** Generación de mapas a partir de salidas del modelo (Caso de ejemplo provisto por GSP).

- **Día 5: CIERRE MÓDULO I RESUMEN** Consultas pendientes. Errores comunes. Reporte Técnico. Preparación para próximas sesiones.

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….Consultas / intercambios
…Procesos pendientes de sesiones anteriores

Resumen

Input data requirements				
Data	**Variables**	**Time series**	**Units**	**Type**
Climatic data	Monthly air temperature	1980-2000; 2001-2020 (or until last year available)	°C	Raster
	Monthly evapotranspiration (Penman-Monteith)	1980-2000; 2001-2020 (or until last year available)	mm	Raster
	Monthly precipitation + irrigation	1980-2000; 2001-2020 (or until last year available)	mm	Raster
Soil data	Topsoil clay content (0-30 cm)	-	%	Raster
	Current Soil organic carbon stocks (0-30 cm)	Latest version of national FAO-GSOC map	$tC\ ha^{-1}$	Raster
Land use/cover	Predominant land use/cover, re-classified into: Minimum: 4 default classes required by model: agricultural crops, grassland/shrubland/savannas ; forests; others Optimum: 11 classes defined in the FAO Global Land Cover - SHARE (GLC-SHARE)	Minimum: representative 2000-2020 (or last year available) Optimum: annual land use 2000 to 2020	1-11	Raster
	Monthly vegetation cover. Obtained from national statistics/local expert knowledge; or derived from NDVI or spectral indexes (see section 3.3.4)	Minimum: average 2015- 2020 (or last year available period) Optimum: monthly soil cover 2000 to 2020	0-1	Raster

Resumen

- Se proporcionarán Capas Globales (CRU, ISRIC,ESA, etc)

- Capas Nacionales!!! En la medida de lo posible
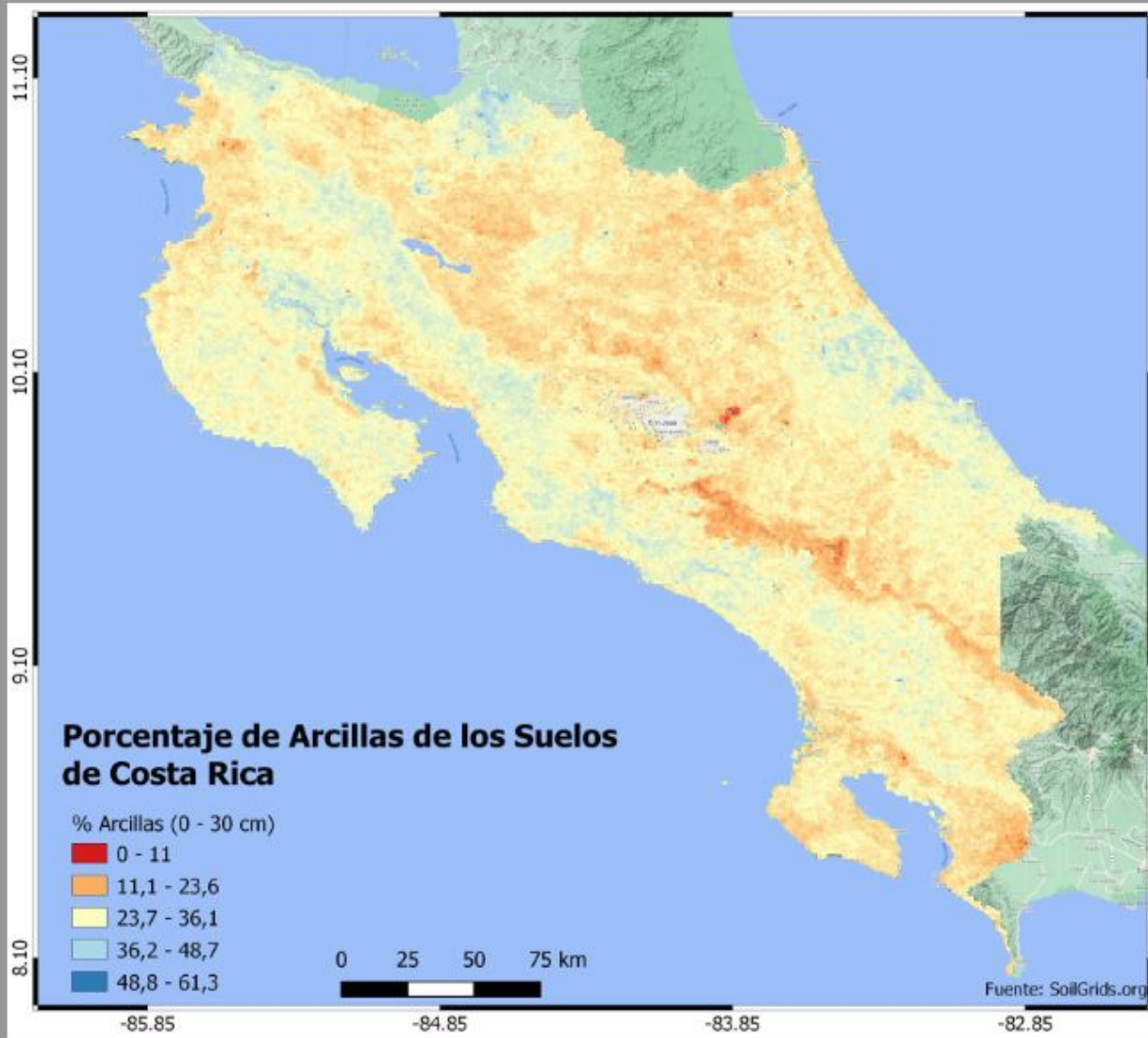
Mapa de Carbono Orgánico

Stock de Carbono Orgánico en Suelos de Costa Rica

Ton/ha (0 - 30 cm)
- 0 - 12,9
- 13 - 68,1
- 68,2 - 123
- 123 - 178
- 234 - 234

0   25   50   75 km

Fuente: Mapa Nacional de Carbono Orgánico del Suelo, 2ed.
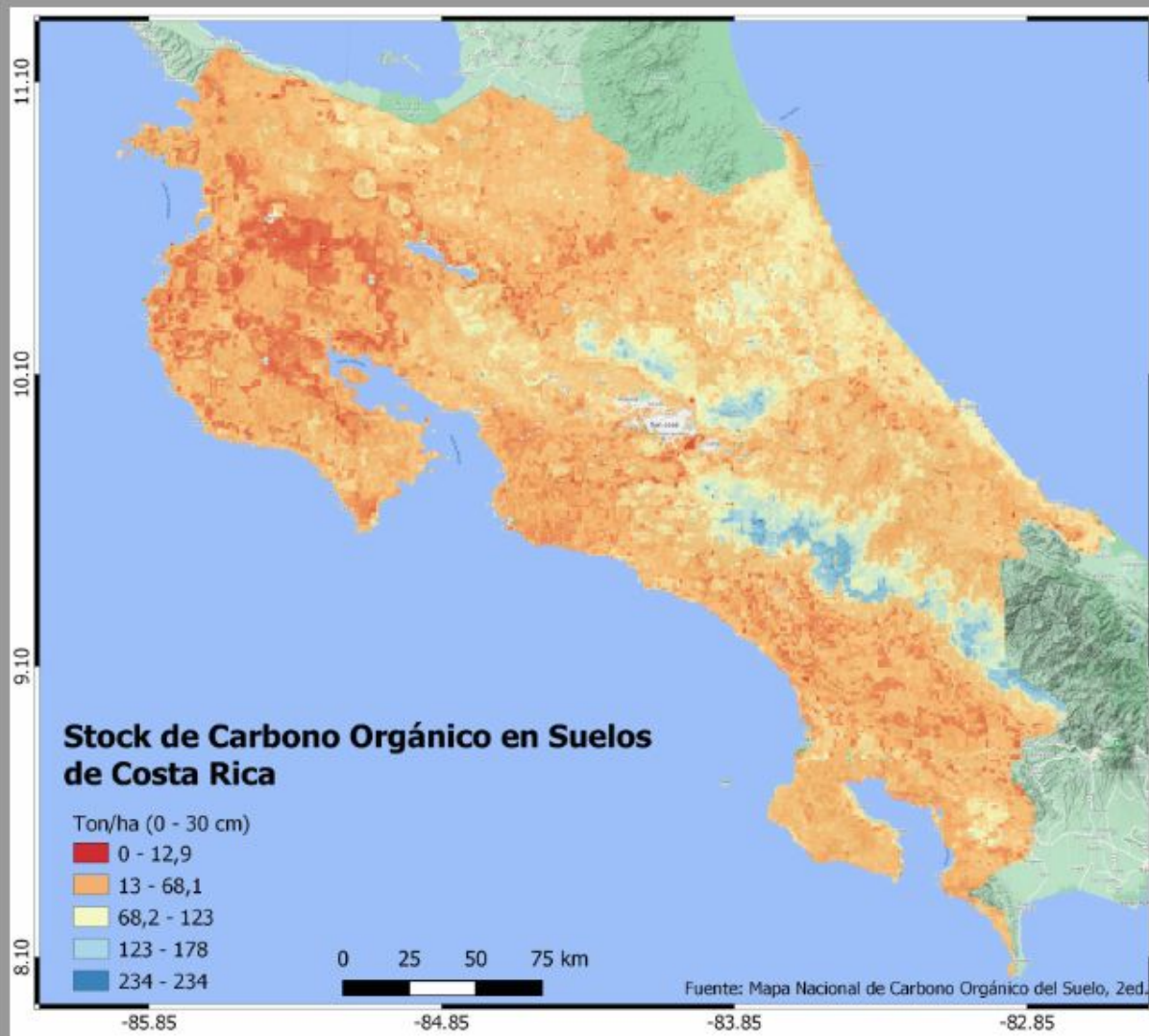
Características:

- Segunda edición
- 1km de resolución espacial.
- Random Forest (49 covariables espaciales)
- Información base: Base de Datos de Suelos de Costa Rica del Centro de Investigaciones Agronómicas de la UCR.

- Idealmente:
- GSOC actualizado
- Promedio, Máx y Mín (a partir de sus +- % uncertainties) para cada pixel
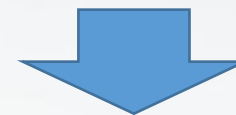
Mapa de Arcillas

Porcentaje de Arcillas de los Suelos de Costa Rica

% Arcillas (0 - 30 cm)
- 0 - 11
- 11,1 - 23,6
- 23,7 - 36,1
- 36,2 - 48,7
- 48,8 - 61,3

Fuente: SoilGrids.org

Características:

- **Ponderación** de las capas de SoilGrids https://files.isric.org/soilgrids/latest/data/clay/
- **Remuestreado** a 1Km de resolución espacial.
- **Revisión** del Mapa de Arcillas de SoilGrids con la base de Datos de Suelos de Costa Rica y el Mapa de Ordenes de Suelos.

- Idealmente:
- Capas nacionales
- Mapas ya generados para GSOC
- Promedio, Máx y Mín (a partir de sus +- % uncertainties) para cada pixel

Variables climáticas

Climate Engine

Evapotranspiración

Temperatura

Precipitación

NCEP Climate Forecast System Reanalysis dataset" (NCEP-CFSR) $1187.5\ Km^2$

Climate Hazards Group InfraRed Precipitation with Station data" (CHIRPS, por sus siglas en inglés) $22.5\ Km^2$.
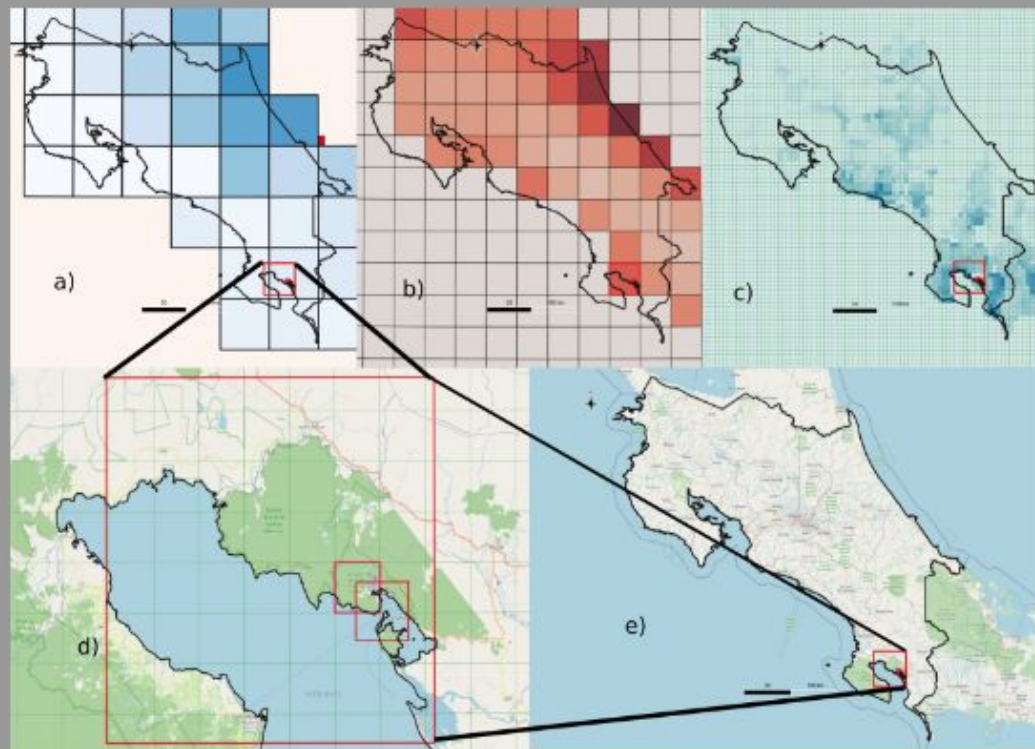
Distintas bases regionales

Alianza Mundial por el Suelo   13.10.2020   RECARBONIZATION OF GLOBAL SOILS   ment for all

Variables climáticas

Evapotranspiración

Precipitación

Temperatura

Diferencias entre tamaños de píxeles: a) Resolución del "Climatic Research Unit Time-series" (CRU), en b), la resolución del NCEP-CFSR para temperatura y evapotranspiración. Enc), se muestra la resolución para los productos CHIRPS de precipitación. En d), el recuadro de laresolución de NCEP-CFSR y precipitación. Finalmente, en e), se muestra el tamaño de pixel deNCEP-CFSR en el contexto de Costa Rica.
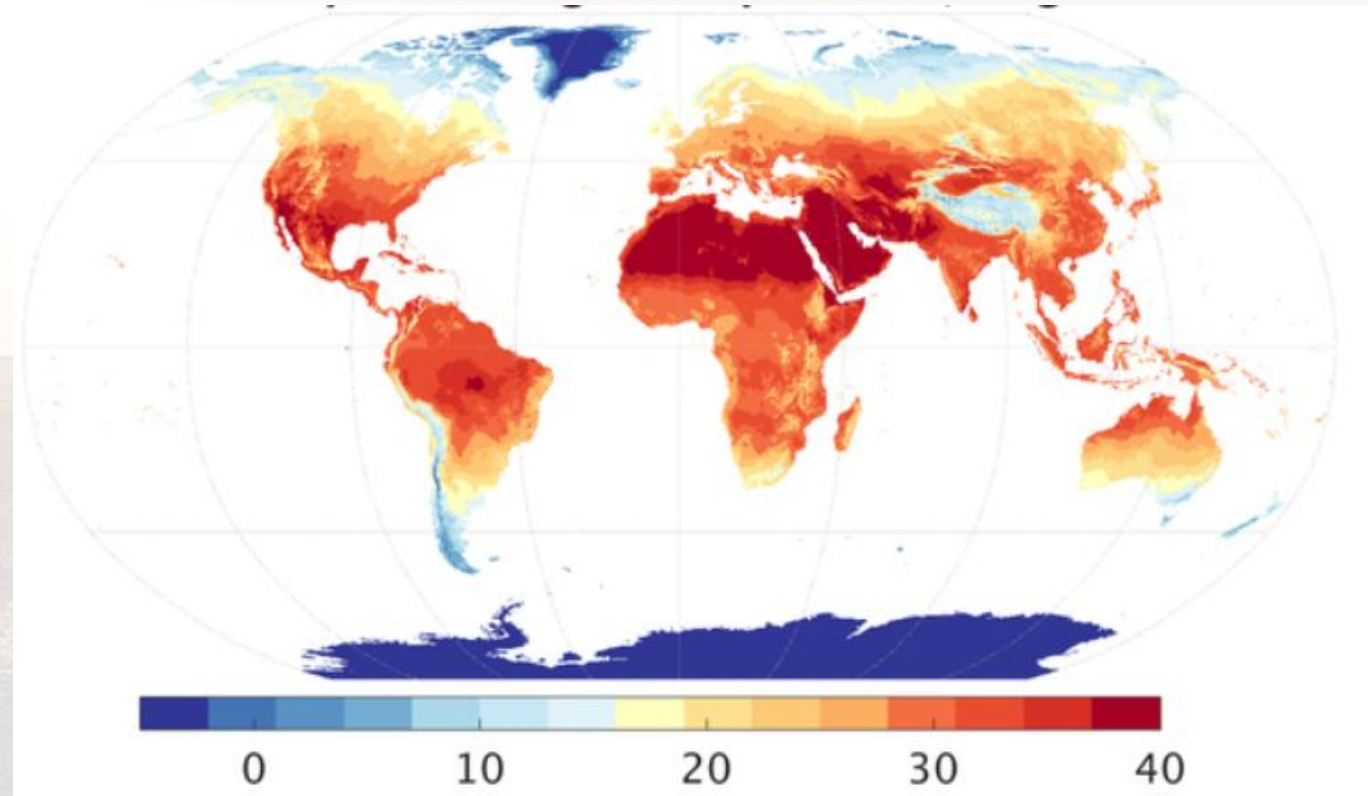
- Idealmente:
- Capas nacionales
- Fuentes regionales que copien mejor/mayor resolución
- Promedio, Máx y Mín (a partir de sus +- % uncertainties) para cada pixel

TerraClimate
scripts de GEE y R

http://www.climatologylab.org/terraclimate.html

- TerraClimate: dataset de datos mensuales desde 1958-2019
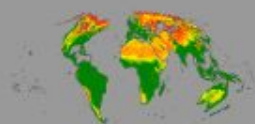- ~4-km
- Scripts de GEE y R para descargar datos

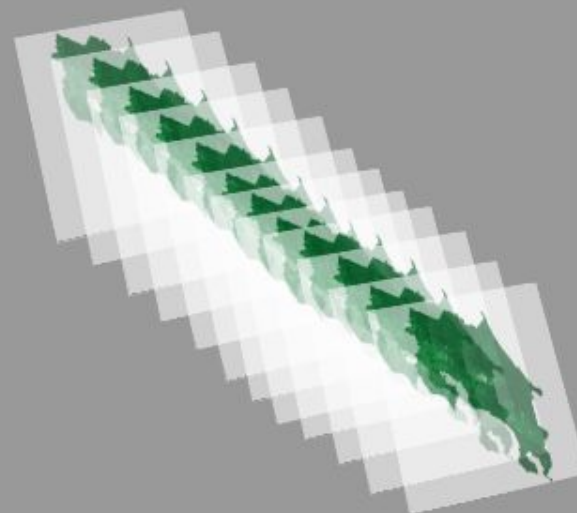promoting sustainable soil management for all

El mapa de cobertura

Se obtuvo de Ïndice Normalizado
de Vegetación
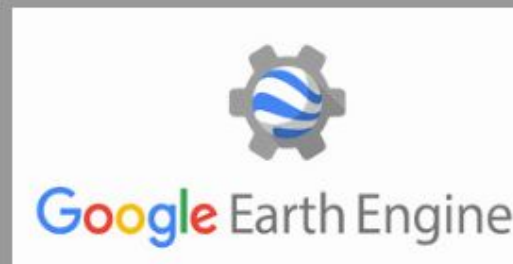
MODIS/006/MOD13A2

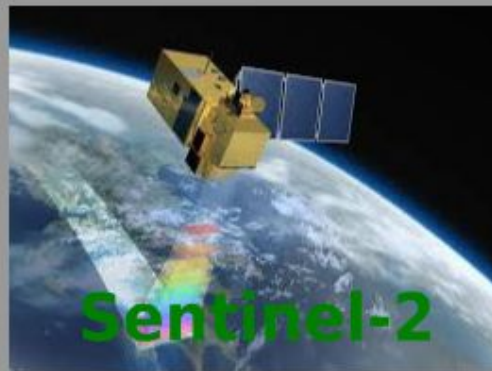1 mapa por mes

El mapa de Uso de la tierra

- Idealmente:
- Capas nacionales
- Fuentes regionales que copien mejor uso de la tierra

Bosque
Cultivos
Infraestructura
Pastos
Agua
Suelo desnudo

Sentinel-2

Google Earth Engine

Bandas utilizadas
B2, B3, B4 y B8
EVI
NDVI
NDWI

RANDOM FOREST

10*10m

Ejemplo

Meta-análisis Búsqueda de datos locales

Ajuste local escenarios y % de incremento en C inputs

Scatter plot: $y = 1.0929x + 0.7381$, $R^2 = 0.8088$. Axes: C inputs SSM practices (tC. ha^{-1}.yr^{-1}) vs C inputs BAU (tC. ha^{-1}.yr^{-1})

Croplands box plot: ΔC input (%) (vs. BAU) for scenarios SSM1 - Low (+10%), SSM2 - Medium (+25%), SSM3 - High (+50%). Scenario.

Grazing lands box plot: ΔC input (%) (vs. BAU) for scenarios SSM1 - Low (+5%), SSM2 - Medium (+30%), SSM3 - High (+70%). Scenario.
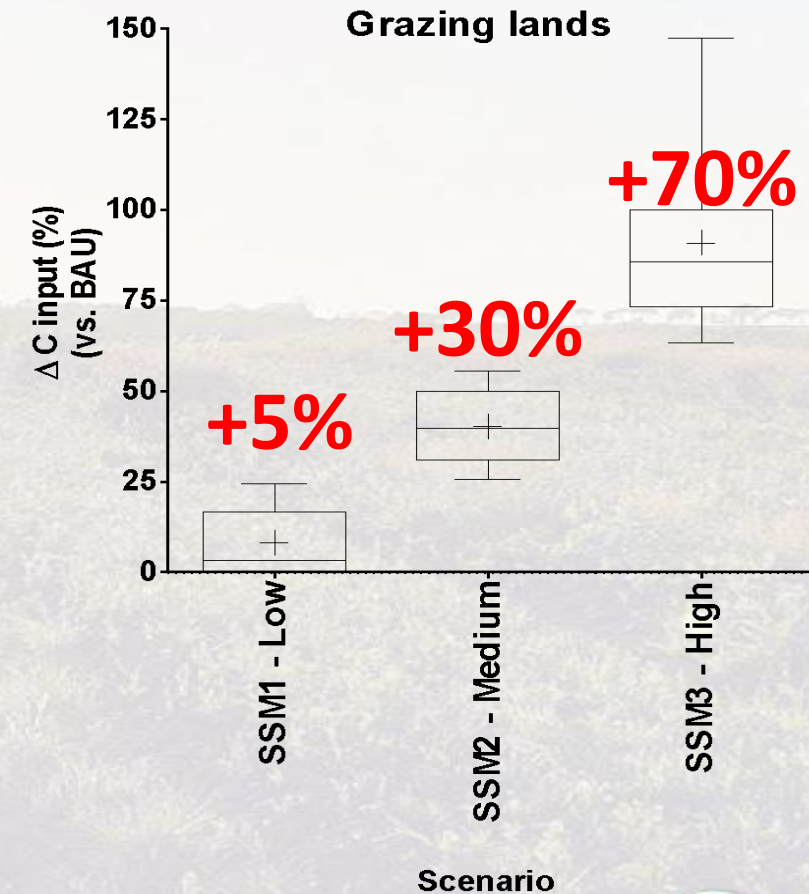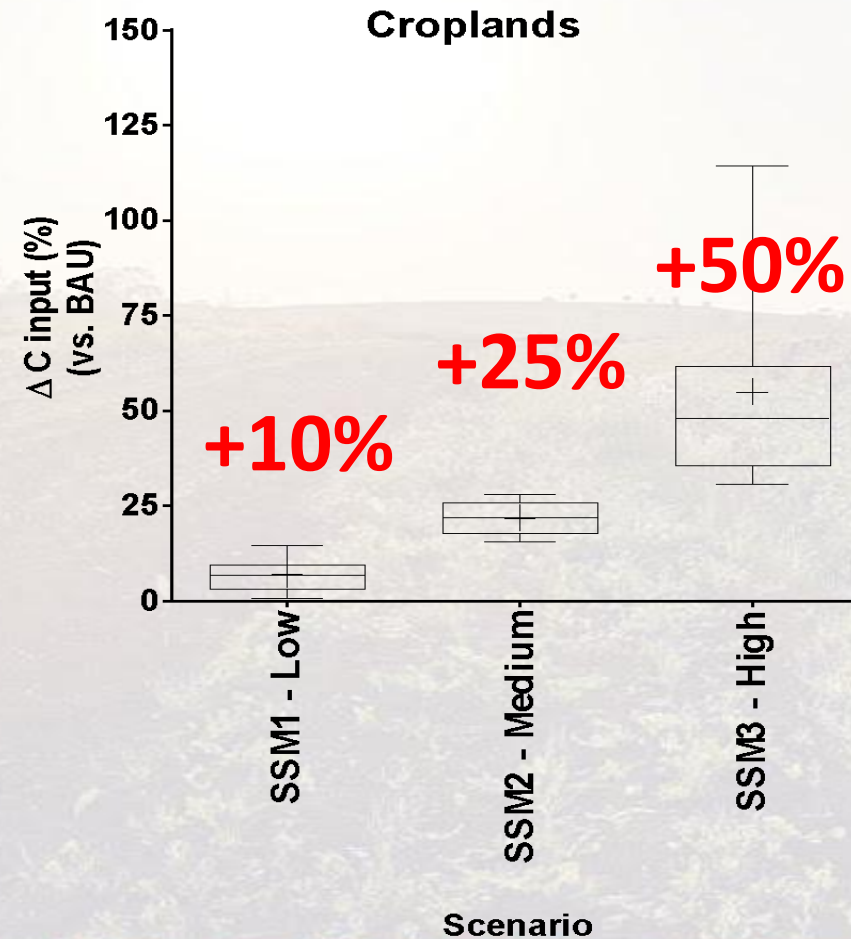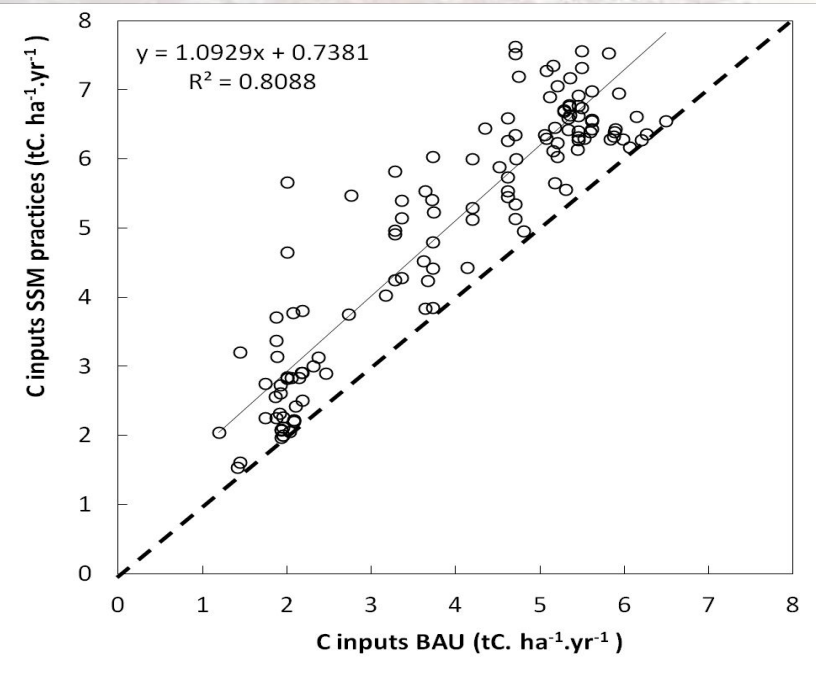
… algunas consideraciones

- Unidades: en especial Mapa de arcilla; GSOC Map
- Tasas de Secuestro: 0-2.5 tC/ha.año;
  - 0.05-0.2 SSM1;
  - 0.1-0.3 SSM2;
  - 0.2-0.6 SSM3
  - (BAU <0;0;>0)

- Puntos con resultados outliers...método de resolución de ecuaciones diferenciales (paquete "soilassessment" vs. "soilR")... En gral <2%puntos...Correr esos puntos con SoilR
-
- Tiempo (Spin up)! Proceso total desde horas a > 15 días
  - Comenzar solo por producto standard (target points en tierras agrícolas)
  - Proceso por provincias; en paralelo

Productos Standard
29 productos (intermedios y finales)

7 Productos Standard Finales con sus uncertainties

- **|_ Maps**
  - **|_ National Absolute SOC Sequestration rate Map for the BAU scenario** *(ISO3CountryCode_* **GSOCseq_ASR_BAU_***Map030.tiff)*
  - **|_ National Absolute SOC Sequestration rate Map for the SSM1 scenario (Low)** *(ISO3CountryCode_* **GSOCseq_ASR_SSM1_***Map030.tiff)*
  - **|_ National Absolute SOC Sequestration rate Map for the SSM2 scenario (Medium)***(ISO3CountryCode_* **GSOCseq_ASR_SSM2_***Map030.tiff)*
  - **|_ National Absolute SOC Sequestration rate Map for the SSM3 scenario (High)***(ISO3CountryCode_* **GSOCseq_ASR_SSM3_***Map030.tiff)*

  - **|_ National Relative SOC Sequestration rate Map for the SSM1 scenario (Low)** *(ISO3CountryCode_* **GSOCseq_RSR_SSM1_***Map030.tiff)*
  - **|_ National Relative SOC Sequestration rate Map for the SSM2 scenario (Medium)***(ISO3CountryCode_* **GSOCseq_RSR_SSM2_***Map030.tiff)*
  - **|_ National Relative SOC Sequestration rate Map for the SSM3 scenario (High)***(ISO3CountryCode_* **GSOCseq_RSR_SSM3_***Map030.tiff)*

  - **|_ Initial SOC Stocks at T0** *(ISO3CountryCode_* **GSOCseq_T0_***Map030.tiff)*

|_ Uncertainty Maps
  - **|_ Uncertainties: National Absolute SOC Sequestration rates for the BAU scenario** *(ISO3CountryCode_* **GSOCseq_ASR_BAU_***UncertaintyMap030.tiff)*
  - **|_ Uncertainties: National Absolute SOC Sequestration rates for the SSM1 scenario (Low)** *(ISO3CountryCode_* **GSOCseq_ASR_SSM1_** *UncertaintyMap030.tiff)*
  - **|_ Uncertainties: National Absolute SOC Sequestration rates for the SSM2 scenario (Medium)***(ISO3CountryCode_* **GSOCseq_ASR_SSM2_** *UncertaintyMap030.tiff)*
  - **|_ Uncertainties: National Absolute SOC Sequestration rates for the SSM3 scenario (High)***(ISO3CountryCode_* **GSOCseq_ASR_SSM3_** *UncertaintyMap030.tiff)*

  - **|_ Uncertainties: National Relative SOC Sequestration rates for the SSM1 scenario (Low)** *(ISO3CountryCode_* **GSOCseq_RSR_SSM1_** *UncertaintyMap030.tiff)*
  - **|_ Uncertainties: National Relative SOC Sequestration rates for the SSM2 scenario (Medium)***(ISO3CountryCode_* **GSOCseq_RSR_SSM2_** *UncertaintyMap030.tiff)*
  - **|_ Uncertienties: National Relative SOC Sequestration rates for the SSM3 scenario (High)***(ISO3CountryCode_* **GSOCseq_RSR_SSM3_** *UncertaintyMap030.tiff)*

- **|_ Documents**
- **|_ Report** (ISO3CountryCode_Report.doc, docx)

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Informe Técnico

Informe Técnico

Country name: Soil Organic Carbon Sequestration Potential National Map. National Report. Version 1.0. Year: 2020

Author One[1], Author Two[2], Author Three[n]
[1]Affiliations author One, email and brief contact details on one line
[2]Affiliations author Two
[n]Affiliations author [n]. Add more institutions as required

Executive summary

Provide a general introduction to the importance of the topic in the country, should state concisely the scope of the report and give the principal findings. Max. 300 words.

Abbreviations - Define abbreviations upon first appearance in the text. Please do
not use non-standard abbreviations unless they appear at least three times in the text. Keep abbreviations to a minimum

1. Introduction

Should include if possible:

- General introduction: importance of SOC stocks and SOC sequestration at country level
- Country context: mention current main agricultural production systems and main products (e.g. top five agricultural products in total production and area); mention land use and management changes in the past decades if relevant, and effects on SOC stocks (cites).
- Mention sustainable soil management practices and business as usual practices in main agricultural regions and productive systems; Range and examples of the effects of sustainable practices on SOC stocks (t C. ha^{-1}yr^{-1}) observed within the country (cites).
- Examples of past use of SOC models in the country to estimate SOC changes (cites).
- Examples of previous SOC sequestration potential national or subnational map/s or projected SOC stocks national or subnational map/s (cites).
- Objective of the national SOC sequestration potential map.
- Institutions involved in the process.

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2. Methods

2.1. Study area

Should include if possible:

- Country area km²
- Total agricultural land area (croplands + grazing lands), and per land use considered in the products.
- Brief description of predominant climate types (e.g. IPCC 2019 or preferred classification). General range in average annual temperature, annual precipitation, annual evapotranspiration.
- Brief description of predominant soil classes at country level (e.g. World Reference Base, 2006 or preferred classification at country level). General range in Clay content (%)
- Orography, general description
- Total SOC stocks (Pg) and range in t C ha⁻¹ (0-30 cm) (GSOC map latest version)
- Figures can be included.

2.2. General Methodology

- Brief description of the methodology (including modifications when applicable), Soil Depth, SOC model (including modifications when applicable) and software used to produce the maps: mandatory maps using standard procedures for harmonization purposes and additional national maps using preferred models and methodologies. Direct reference to FAO-GSP Technical Specifications and Country Guidelines for Global Sequestration Potential Map v1.0 (http://www.fao.org/3/cb0353en/CB0353EN.pdf) if no modifications/adjustments were applied to the original methodology.
- Brief description of the methodology used to estimate uncertainties.

2.3. Input data layers

2.3.1. Climatic data sets

- Climatic variable used for the spatial simulations, data source, time series, units, resolution.
- Downscaling, upscaling procedures when applicable.

2.3.2. Soil data sets

- Soil variable (e.g. clay content) used for the spatial simulations: data source, depth, units, resolution.
- SOC stocks used for model initialization (e.g. GSOC map latest version): data source, depth, units, resolution. Include special time considerations (e.g. year considered to initialize the model; year to which these stocks were assumed to correspond).

2.3.3. Land use and land use change data

- Data source for land cover or land use layers, time series; specific time (if no land use change was considered), resolution.
- Considered and aggregated classes (e.g. croplands, tree crops, grasslands, shrublands) to run the model. Used land use aggregation scheme (e.g. to convert from land cover classes), when applicable.
- Downscaling, upscaling procedures when applicable.

2.3.4. Land management, C inputs and scenarios

- Standard C input increase scenarios (+5, +10, +20 %)
- Modified scenarios according to local data.
- NPP estimation methodology and modifications, when applicable.
- Residue quality (decomposable plant material / resistant plant material, DPM/RPM ratio) assigned to each land us class, when applicable.
- Alternative procedures to estimate C inputs, when applicable.
- Methodology used to estimate monthly vegetation cover when applicable.

2.4. Model/s performance evaluation

As data required to quantify the accuracy of the estimates do not yet exist (projected SOC stocks 2020-2040) the model can be evaluated if it explains past events (ex-post validation). If local results from different management practices on SOC stocks are available (an ad-hoc meta-analysis within country can be conducted; already published results), and the collected activity data allow to perform simulations with these records, model-produced estimates shall be compared with the observed results. References to already published results in the country using the selected SOC model and their validation methodologies should be included.

When available legacy data, please include in this section:

- Description of the methodology used for model evaluation: predicted SOC stocks vs observed SOC stocks. E.g. statistic methodologies used to compare results: R²; Root Mean Squared Error in t C ha⁻¹ and as a % of the observed mean; other preferred statistic methodologies; e.g bias error, d-index, model efficiency (ME), etc.

2.5. Uncertainties

This section should include a brief description of the selected approach to estimate uncertainties (Max/Min variation in SOC stocks from uncertainties in parameters as in GSOCseq Technical Manual v1.0; Montecarlo simulations; other). Include estimated uncertainty (%) in input data layers when available.

3. Results

3.1. Summary and spatial prediction of SOC sequestration rates in Country

This section should include:

- Figures including absolute sequestration rates (in t C ha^{-1} yr^{-1}) for the business as usual scenario and standard +5, 10, +20% scenarios (SSM1-SSM3) (4 maps).
- Figures including relative sequestration rates (in t C ha^{-1} yr^{-1}) for the standard +5, 10, +20% scenarios (SSM1-SSM3) (3 maps).
- *(Results from absolute and relative sequestration rates may be similar depending on input data layers, specially depending on climatic data layers from 2000-2020, and land use layers used in 2000-2020).*
- Figures including absolute and relative sequestration rates if alternative models and methodologies were used.

Figures should include latitude, longitude, scale, and legend.

- Summary / Histogram/ boxplot of absolute and relative sequestration rates for the different scenarios (all land uses grouped)
- Summary / Histogram/ boxplot of absolute and relative sequestration rates for the different scenarios, for the different land uses of choice.
- Summary of projected Total sequestration after 20 years per area unit (in t C.ha^{-1}) and national total SOC sequestration (all modelled area, Pg C)

3.2. Model performance evaluation

- This section should include results from the available model performance evaluation exercises (comparing observed vs simulated SOC stocks):
  - Statistic results (R^2; Root Mean Squared Error in t C.ha^{-1} and as a %, of the observed mean; other preferred statistic methodologies; e.g bias error, d-index, model efficiency, etc) from ad-hoc meta-analysis and model validation exercises, or from already published results in the country using the selected SOC model.
  - General comparison of modelling results and available experimental sequestration rates within a specific region of interest (within the agroecological area where long term experiments were undertaken).

3.3. Uncertainties

This section should include:

- Figures including uncertainties (%, as explained in Technical Manual) in absolute sequestration rates for the business as usual scenario and standard +5, 10, +20% scenarios (SSM1-SSM3) (4 maps).
- Figures including uncertainties (%, as explained in Technical Manual) in relative sequestration rates for the standard +5, 10, +20% scenarios (SSM1-SSM3) (3 maps)
- Figures including uncertainties (%, as explained in Technical Manual) in absolute and relative sequestration rates if alternative models and methodologies were used

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Por unidad de Área

	Area	Average Absolute sequestration			Relative sequestration		
	Km2	Low	Medium	High	Low	Medium	High
			t C . ha-1 yr-1			t C . ha-1 yr-1	
Croplands							
Grasslands							
Tree-crops							
….. (other)							
Average all land uses							

Total País

	Area	Absolute sequestration			Relative sequestration		
	Km2	Low	Medium	High	Low	Medium	High
			Mt C yr-1			Mt C yr-1	
Croplands							
Grasslands							
Tree-crops							
….. (other)							
Total Sum							

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4. Discussion and relevant considerations

If relevant, this section should include:

- a brief interpretation of results
- comparison of results with previous studies within the country or similar agroecological zones, when applicable
- comparison among different methodologies, modifications or different data bases used to generate the products, when applicable
- limitations of the work, relevant comments and considerations
- future requirements to refine the products
- potential uses of the products

5. Acknowledgments

6. References

References should be written in the FAO referencing style available with Mendeley and Zotero. If written manually, they should follow the following criteria:

Data submission

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Data submission

Dat

Upload GSOCseq Layers

GSOCseq layers shall be delivered in GeoTIFF format. GeoTIFF is a standard .tif or image file format that includes additional spatial (georeferencing) information embedded in the .tif file as tags. These are called embedded tags, tif tags. These tags include raster metadata such as spatial extent, coordinate reference system, resolution, no data values.

National Absolute SOC Sequestration rate Map for the BAU *

⬆ Añadir archivo

National Absolute SOC Sequestration rate Map for the SSM1 scenario (Low) *

⬆ Añadir archivo

National Absolute SOC Sequestration rate Map for the SSM2 scenario *

⬆ Añadir archivo

National Absolute SOC Sequestration rate Map for the SSM3 scenario *

all

Data submission

MUCHAS GRACIAS

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