
Food and Agriculture
Organization of the
United Nations
Global
Soil Organic Carbon
Sequestration Potential Map
GSOCseq
Guillermo Peralta
Luciano Di Paolo
Technical Workshops. 2022
GLOBAL SOIL
PARTNERSHIP

Soil Organic Carbon Sequestration Maps

Day 2. Harmonisation and preparation of input layers

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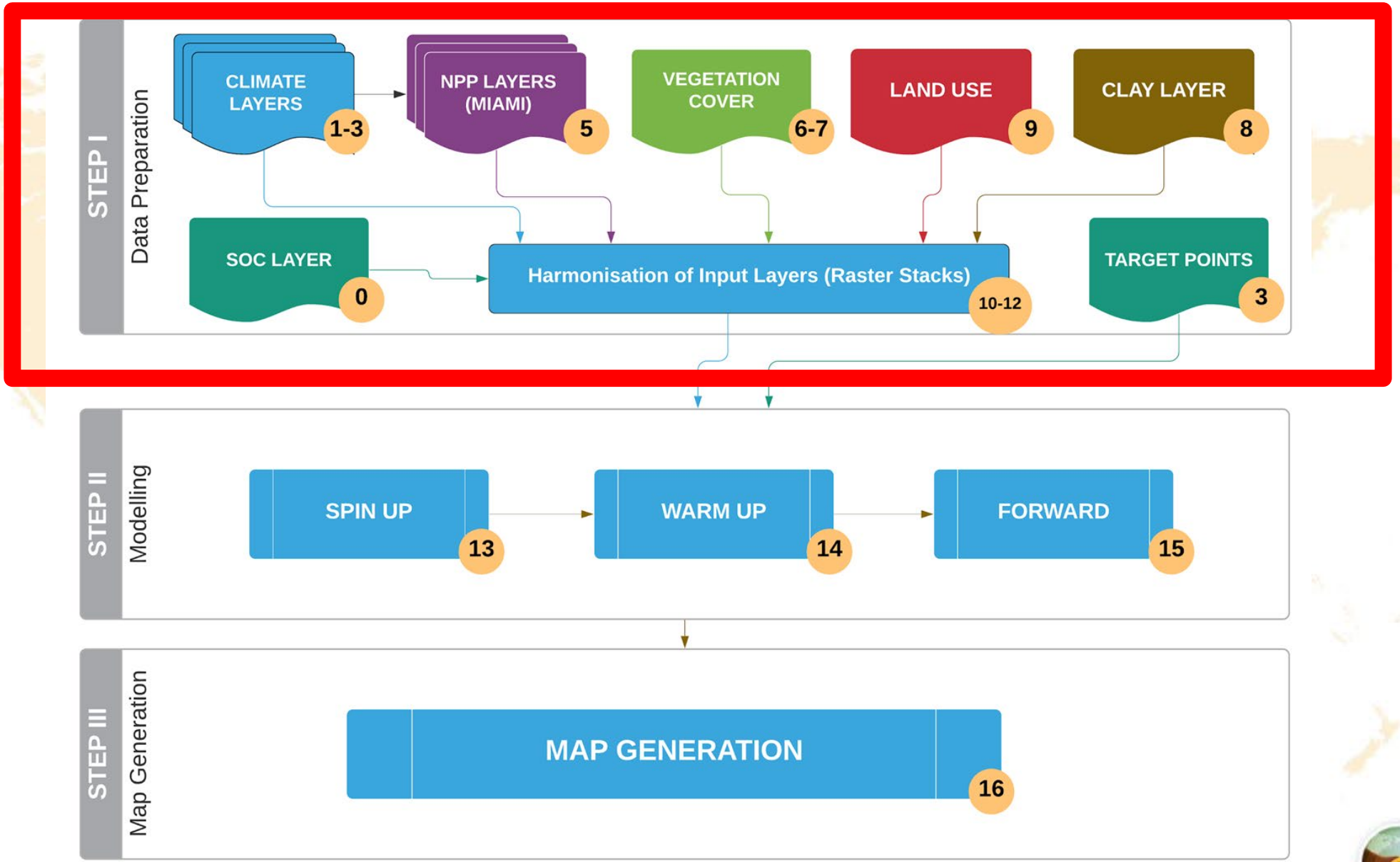
Roadmap

- Preparing vegetation cover, soil, land use **layers**, climate*
- Preparing **“Stacks”** to be used in the modelling phases.
- Preparing “**target points**” where we will run the model.


STEP I
Data Preparation
CLIMATE LAYERS
1-3
NPP LAYERS (MIAMI)
5
VEGETATION COVER
6-7
LAND USE
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CLAY LAYER
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SOC LAYER
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Script Number

Harmonization of climate layers

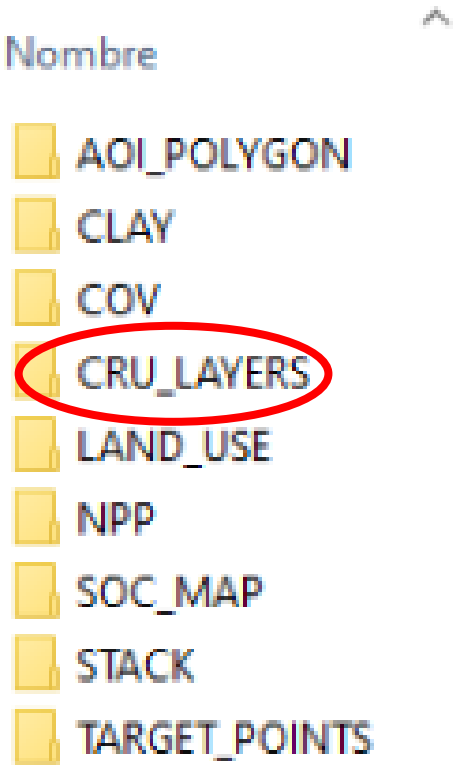
- Script Number 1: CRU_variables_SPIN_UP.R
- Script Number 2: CRU_variables_WARM_UP.R
- Script Number 3: CRU_variables_for_NPP_MIAMI_MEAN_81-00.R

➢ **Layers were already prepared at the global level for you**

➢ **For this exercise we will skip these scripts**

Climate Layers

- Proposed climate layers from Climate Research Unit
- Spatial resolution : 50 km x 50 km / pixel
- One layer per month per year :::: 20 years = 240 layers/climate variable
- Three climate variables :
  - Precipitation (mm/month)
  - Temperature (average °C/ month)
  - Potential Evapotranspiration (mm/month)



SCRIPT NUMBER 1: CRU FILES FOR SPIN UP STACK

Time series: 1981-1990 and 1991-2000

Temperature code block

Inputs:
cru_ts4.03.1981.1990.tmp.dat.nc
cru_ts4.03.1991.2000.tmp.dat.nc

Outputs :
Temp_Stack_81-00_CRU.tif (12 layers. 20 year average per month)
Temp_mean_81-00_CRU.tif (1 layer average)

Precipitation code block

Inputs:
cru_ts4.03.1981.1990.pre.dat.nc
cru_ts4.03.1991.2000.pre.dat.nc

Outputs :
Prec_Stack_81-00_CRU.tif (12 layers. 20 year average per month)
Pre_sum_81-00_CRU.tif (1 layer sum)

PET code block

Inputs:
cru_ts4.03.1981.1990.pet.dat.nc
cru_ts4.03.1991.2000.pet.dat.nc

Outputs :
PET_Stack_81-00_CRU.tif (12 layers. 20 year average per month)

SCRIPT NUMBER 3: CRU FILES FOR NPP MIAMI MODEL

Time series: 1981-1990 and 1991-2000

Temperature code block

Inputs:
cru_ts4.03.1981.1990.tmp.dat.nc
cru_ts4.03.1991.2000.tmp.dat.nc

Outputs :
Temp_Stack_240_81-00_CRU.tif (240 layers, 1 layer per month per year)

Precipitation code block

Inputs:
cru_ts4.03.1981.1990.pre.dat.nc
cru_ts4.03.1991.2000.pre.dat.nc

Outputs :
Prec_Stack_240_81-00_CRU.tif (240 layers, 1 layer per month per year)

SCRIPT NUMBER 2: CRU FILES FOR WARM UP STACK

Time series: 2001-2010 and 2011-2018

Temperature code block

Inputs:
cru_ts4.03.2001.2010.tmp.dat.nc
cru_ts4.03.2011.2018.tmp.dat.nc
Outputs :
Temp_Stack_01-18_CRU.tif (12 layers. 20 year average per month)
Temp_Stack_216_01-18_CRU.tif (216 layers. 1 layer per month per year)

Precipitation code block

Inputs:
cru_ts4.03.2001.2010.pre.dat.nc
cru_ts4.03.2011.2018.pre.dat.nc
Outputs :
Prec_Stack_01-18_CRU.tif (12 layers. 20 year average per month)
Prec_Stack_216_01-18_CRU.tif (216 layers. 1 layer per month per year)

PET code block

Inputs:
cru_ts4.03.2001.2010.pet.dat.nc
cru_ts4.03.2011.2018.pet.dat.nc
Outputs :
PET_Stack_01-18_CRU.tif (12 layers. 20 year average per month)
PET_Stack_216_01-18_CRU.tif (216 layers. 1 layer per month per year)

Script number 5. MIAMI MODEL MEAN 1981-2000
"MIAMI_MODEL_NPP_MIAMI_MEAN_81-00.R"

INPUTS FILES:

COUNTRY_POLYGON.SHP (ROI)

CRU layers from script number 3:
Temp_Stack_240_81-00_CRU.tif (WORLD)
Prec_Stack_240_81-00_CRU.tif (WORLD)

FAO SOC MAP:
GSOCmapV1.6.0.tif

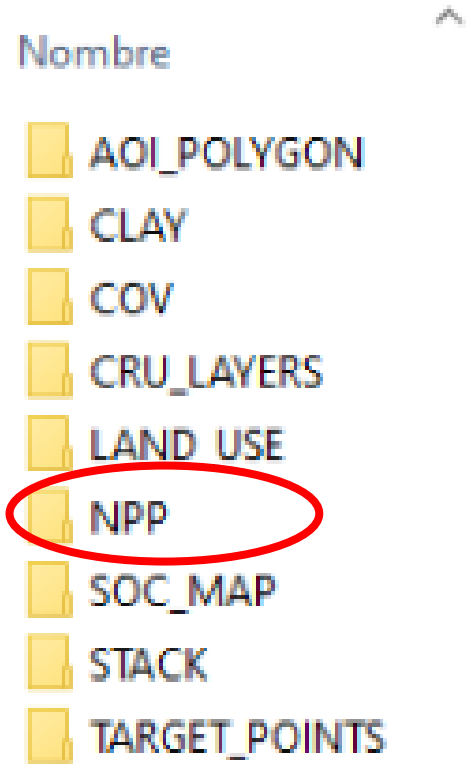
OUTPUTS FILES:

NPP_MIAMI_MEAN_81-00_[country_code].tif (COUNTRY)
NPP_MIAMI_MEAN_81-00_[country_code]_MIN.tif (COUNTRY)
NPP_MIAMI_MEAN_81-00_[country_code]_MAX.tif (COUNTRY)

Net Primary Production Layers (MIAMI MODEL)

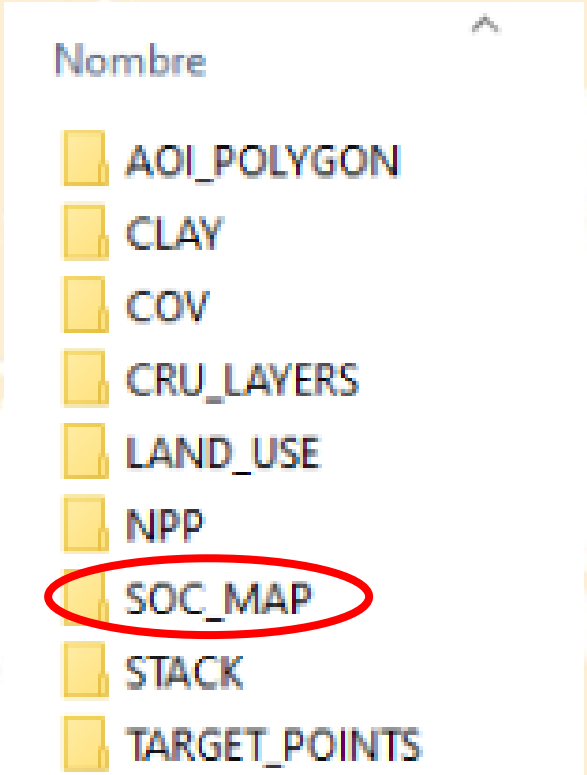
- MIAMI_MODEL_NPP_MIAMI_MEAN_81-00.R

- This script generates three input layers for WARM UP phase



Script number “0” - Soil organic Carbon

- SOC FAO
- Master Layer
- spatial resolution : 1 km x 1km / pixel



SCRIPT NUMBER 0: SOC layer AOI

INPUTS:
FAO SOC MAP:
GSOCmapV1.6.1.tif

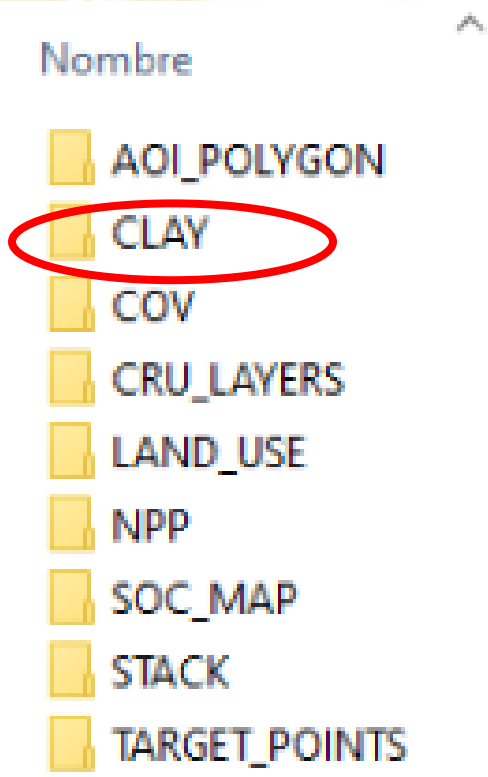
Area of interest (AOI):
COUNTRY_POLYGON.SHP (ROI)

OUTPUTS:

SOC MAP cutted by the AOI
SOC_MAP_[country_code].tif

8_Script_CLAY_from_ISRIC
Clay Layer

- We need a clay layer in the first 30 cm
- Unit : %
- Proposed source . ISRIC
- We will use four layers and we will generate a weighted average



Script number 8. Clay Layer from ISRIC

INPUT DATA:

COUNTRY POLYGON GEOMETRY

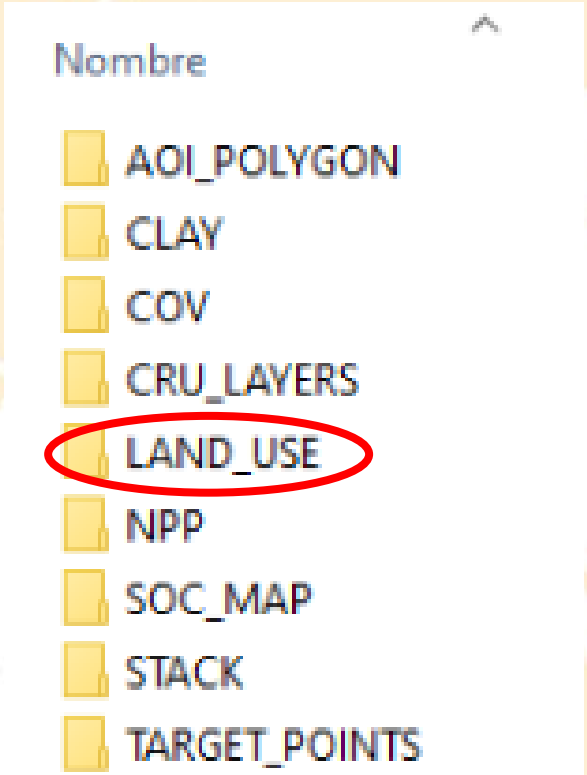
Clay inputs from ISRIC:
CLYPPT_M_sl1_250m_ll.tif
CLYPPT_M_sl2_250m_ll.tif
CLYPPT_M_sl3_250m_ll.tif
CLYPPT_M_sl4_250m_ll.tif

OUTPUTS FILES:

Clay_[country_code]_Avg.tif (1 layer)

9_Land_Use_ESA_to_FAO_classes Land Use

- Proposed land use/cover source : ESA
- We can use different land use layers to simulate the land use change
- All the classes must match those of FAO land use classes:



- # 0 No Data
- # 1 Artificial
- # 2 Croplands
- # 3 Grassland
- # 4 Tree Covered
- # 5 Shrubs Covered
- # 6 Herbaceous vegetation flooded
- # 7 Mangroves
- # 8 Sparse Vegetation
- # 9 Baresoil
- # 10 Snow and Glaciers
- # 11 Waterbodies
- # 12 Treecrops
- # 13 Paddy Fields

Script number 9. ESA Land USE to FAO land USE classes

INPUT DATA:

COUNTRY POLYGON GEOMETRY

SOC Map from FAO (MASTER LAYER):
GSOCmapV1.6.1.tif

ESACCI-LC-L4-LCCS-Map-300m-P1Y-2015-v2.0.7.tif
(ESA Land USE)

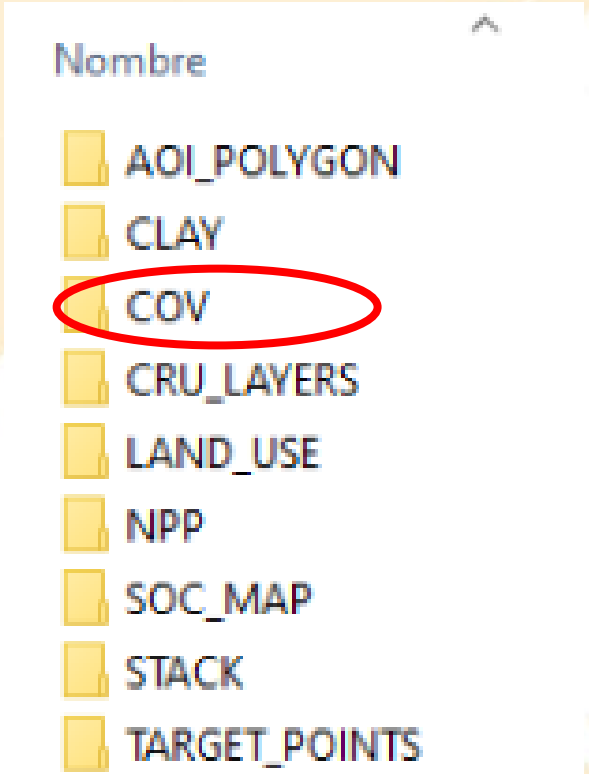
OUTPUTS FILES:

ESA_Land_Cover_12clases_FAO_s.tif (1 layer)

Vegetation cover from Google Earth Engine

- Google earth engine account
- Copy the script and paste it in the code editor
  - https://code.earthengine.google.com/

- Run the code 12 times (one for each month)
- Save them to a google drive account
- Download them

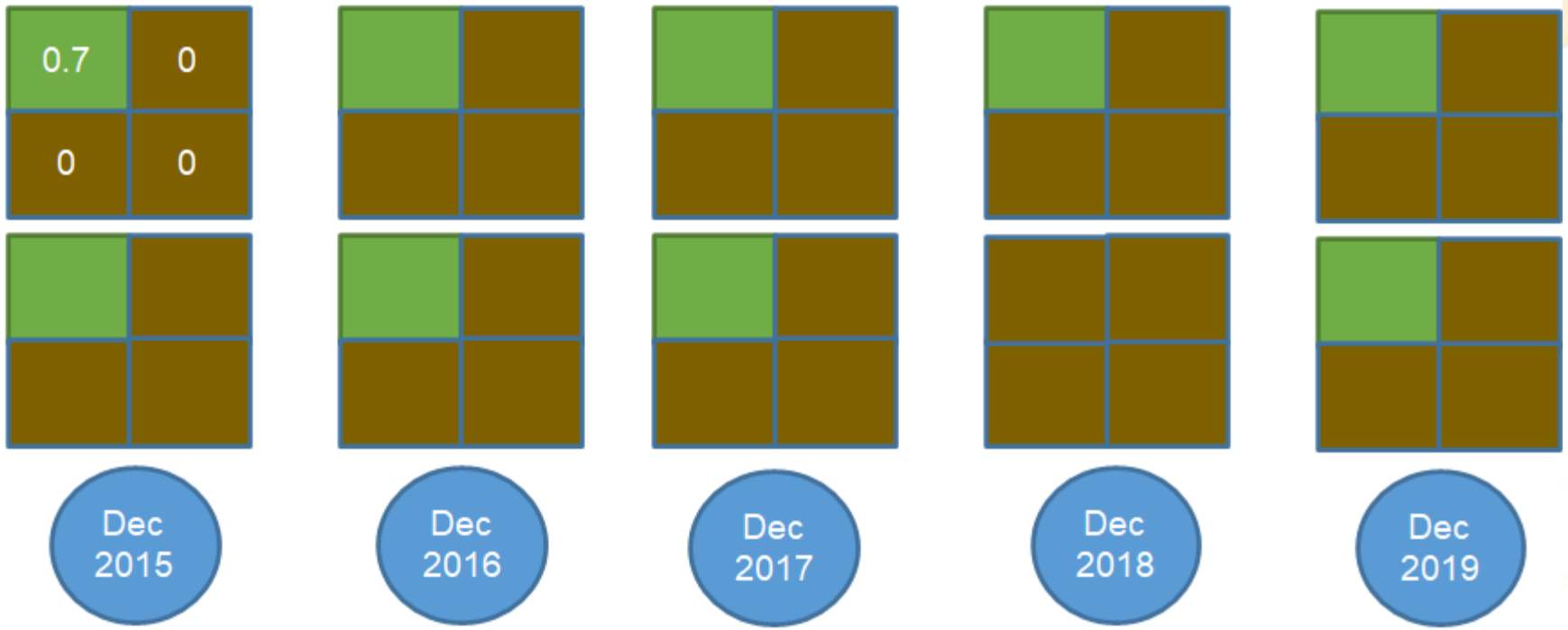


Vegetation cover from Google Earth Engine

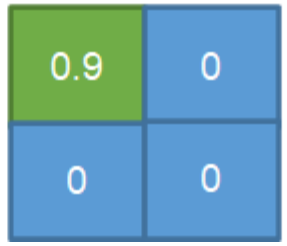
MOD13A2 v006
MODIS/Terra Vegetation Indices 16-Day L3 Global 1 km SIN Grid

365/16 ≈ 22 Layers per year
22/12 ≈ 2 Layers per month

Total images = ~2 Layers per month x years of interest



$$P_{veg} = \frac{Number\ of\ images\ NDVI > 0.6}{Total\ images}$$



Global Soil Organic Carbon Sequestration Potential Map GSOCseq

Script number 6. Monthly Vegetation Cover
Google Earth Engine

THE ALGORITHM MUST BE RUN ONCE FOR EACH MONTH.

INPUT DATA:

COUNTRY POLYGON GEOMETRY

OUTPUTS FILES:

NDVI_2015-2019_prop_gt_06_[country_code**]_MONTH_[NUMBER OF THE MONTH]** (12 LAYERS TO BE SAVED IN A GOOGLE DRIVE ACCOUNT)

Script number 7. Monthly Vegetation Cover Stack

INPUT DATA:

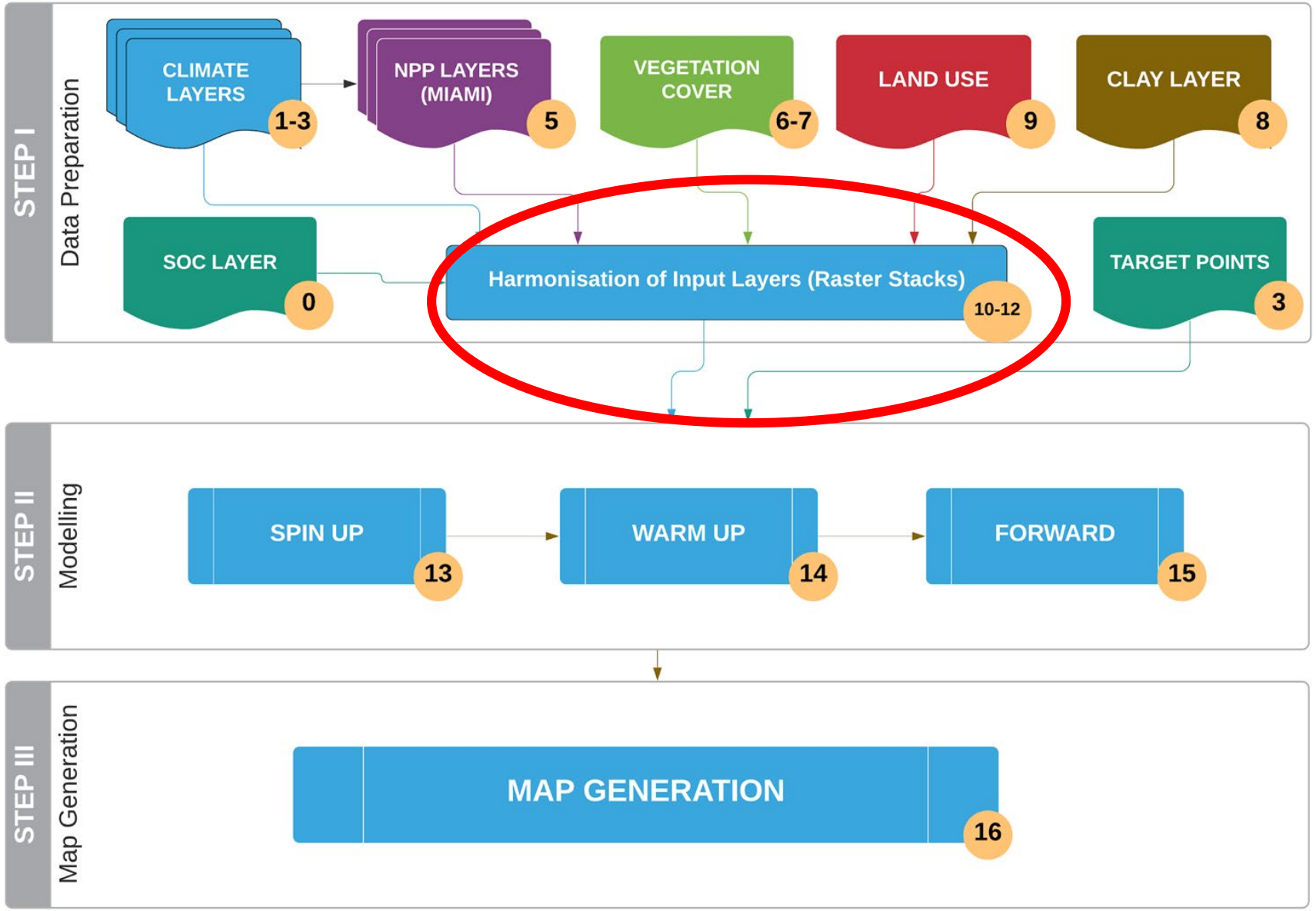
COUNTRY POLYGON GEOMETRY

SOC Map from FAO (MASTER LAYER):
GSOCmapV1.6.1.tif

12 x
NDVI_2015-2019_prop_gt_03_[country_code**]_MONTH_[NUMBER OF THE MONTH]** (12 LAYERS TO BE SAVED IN A GOOGLE DRIVE ACCOUNT)

OUTPUTS FILES:

Cov_Stack_[country_code].tif (12 layer stack)


STEP I
Data Preparation
CLIMATE LAYERS
1-3
NPP LAYERS (MIAMI)
5
VEGETATION COVER
6-7
LAND USE
9
CLAY LAYER
8
SOC LAYER
0
Harmonisation of Input Layers (Raster Stacks)
10-12
TARGET POINTS
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SPIN UP
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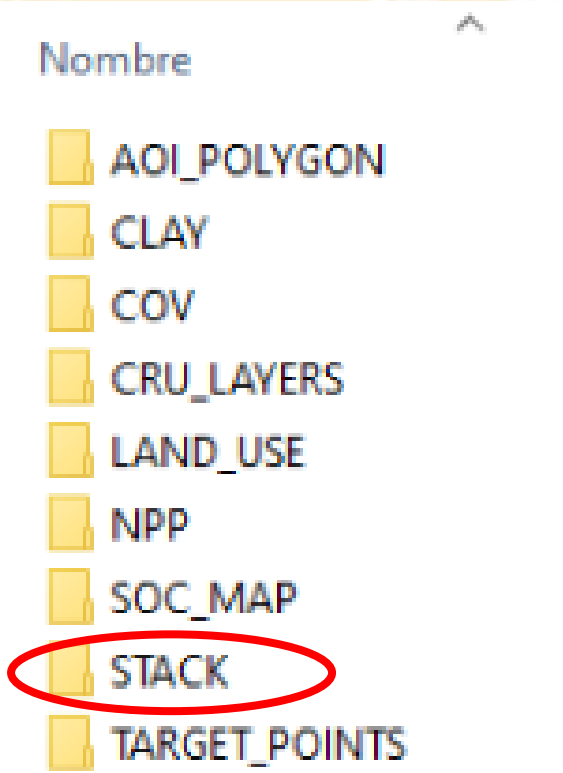
Harmonization of layers. Raster stacks creation

- All data needed for each process will be stacked to a single multiband raster file.
- SPIN_UP_STACK_V2.R
- WARM_UP_STACK_V3.R
- FOWARD_STACK.R



SCRIPT NUMBER 10. SPIN UP STACK

Inputs:

COUNTRY_POLYGON.SHP (ROI)

SOC Map from FAO (MASTER LAYER):
GSOCmapV1.6.1.tif

Clay inputs (from script number 8):
Clay_[country_code]_Avg.tif

CRU layers (from Script number 1):
Temp_Stack_81-00_CRU.tif
Prec_Stack_81-00_CRU.tif
PET_Stack_81-00_CRU.tif

Land Use layer (from script number 9)
ESA_Land_Cover_12clases_FAO_s.tif (1 layer)

Vegetation Cover layer (from script number 7)
Cov_Stack_[country_code].tif (12 layer stack)

Outputs :
Stack_Set_SPIN_UP_[country_code].tif

SCRIPT NUMBER 11. WARM UP STACK

Inputs:

COUNTRY_POLYGON.SHP (ROI)

SOC layer (from script number 10):

SOC_MAP_[country_code].tif

Clay Layer (from script number 8):

Clay_[country_code]_Avg.tif

Vegetation Cover layer (from script number 7): (12 layers)

Cov_stack_[country_code].tif‘

Land Use Stack ,(1 layer per year , 18 years)

DR Stack (1 layer per yead, 18 years)

Outputs :
Stack_Set_WARM_UP_[country_code].tif

CLIMATE LAYERS & NPP LAYERS WILL NOT BE USED AT 1KMX1KM RESOLUTION DUE TO THE WEIGHT OF THE DATA

SCRIPT NUMBER 12. FOWARD STACK

Inputs:

COUNTRY_POLYGON.SHP (ROI)

SOC layer (from script number 10):

SOC_MAP_[country_code].tif

Clay Layer (from script number 8):

Clay_[country_code]_Avg.tif

CRU layers (from script number 2):
Temp_Stack_01-18_CRU.tif
Prec_Stack_01-18_CRU.tif
PET_Stack_01-18_CRU.tif

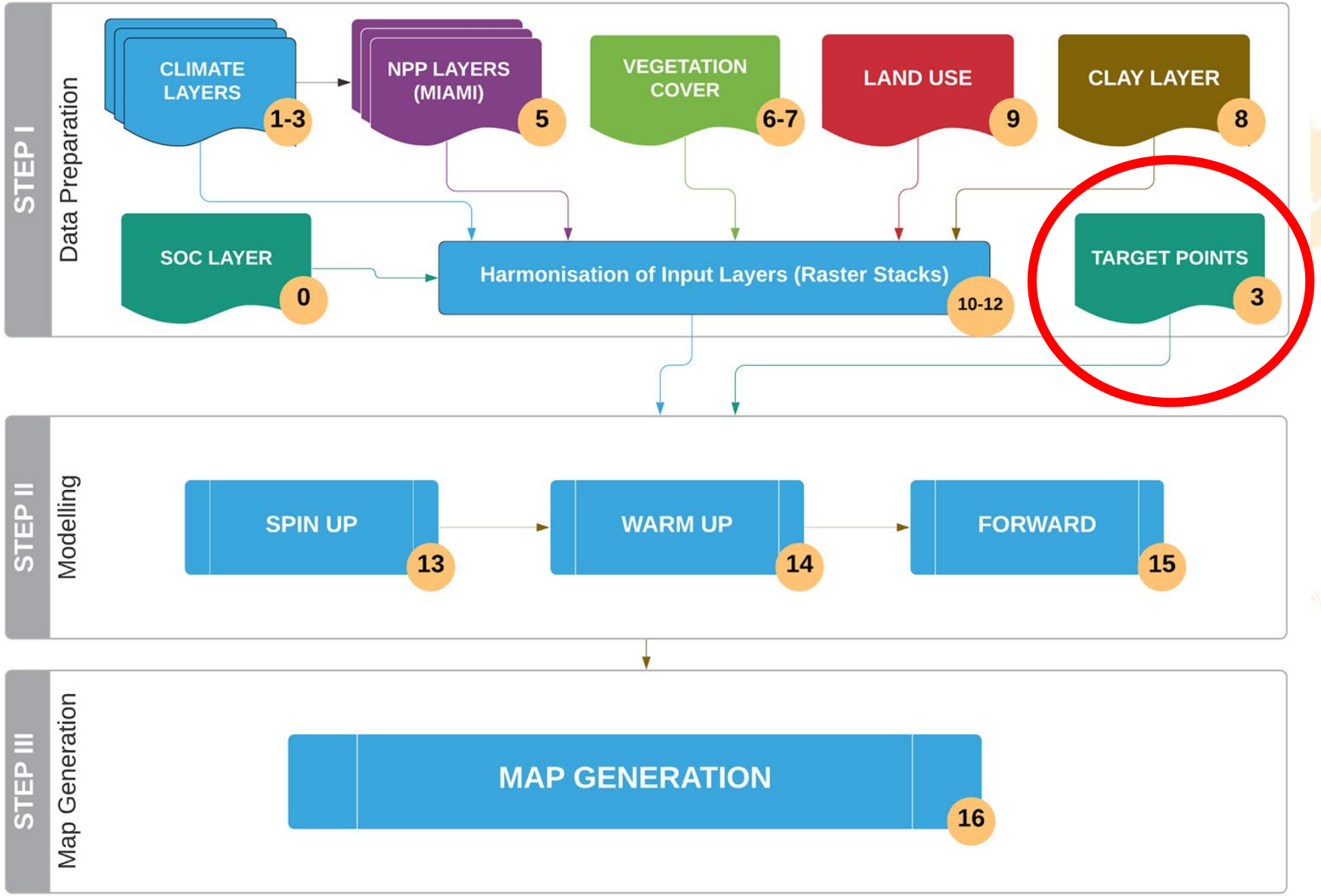
Land Use layer (from script number 10):

LU_res.tif

Vegetation Cover layer (from script number 7):

Cov_stack_[country_code].tif‘

Outputs :
Stack_Set_FOWARD_[country_code].tif


STEP I
Data Preparation
CLIMATE LAYERS
1-3
NPP LAYERS (MIAMI)
5
VEGETATION COVER
6-7
LAND USE
9
CLAY LAYER
8
SOC LAYER
0
Harmonisation of Input Layers (Raster Stacks)
10-12
TARGET POINTS
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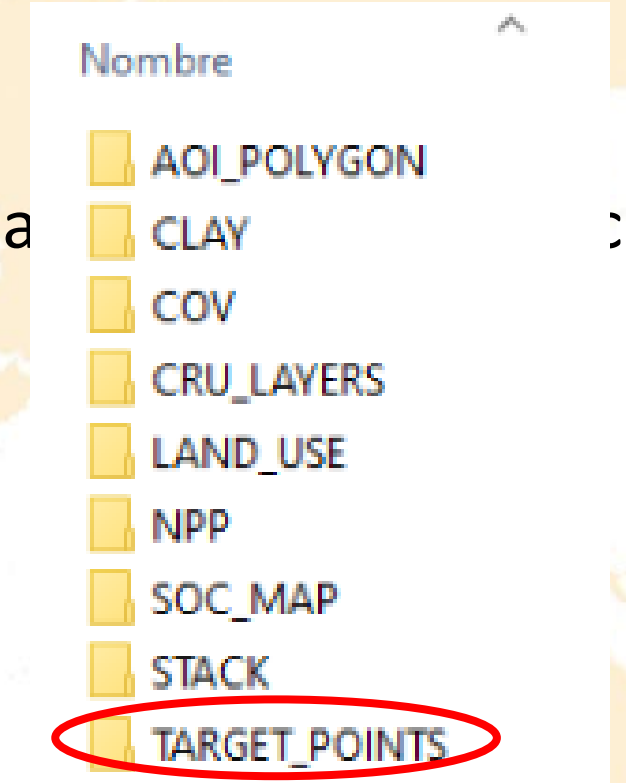
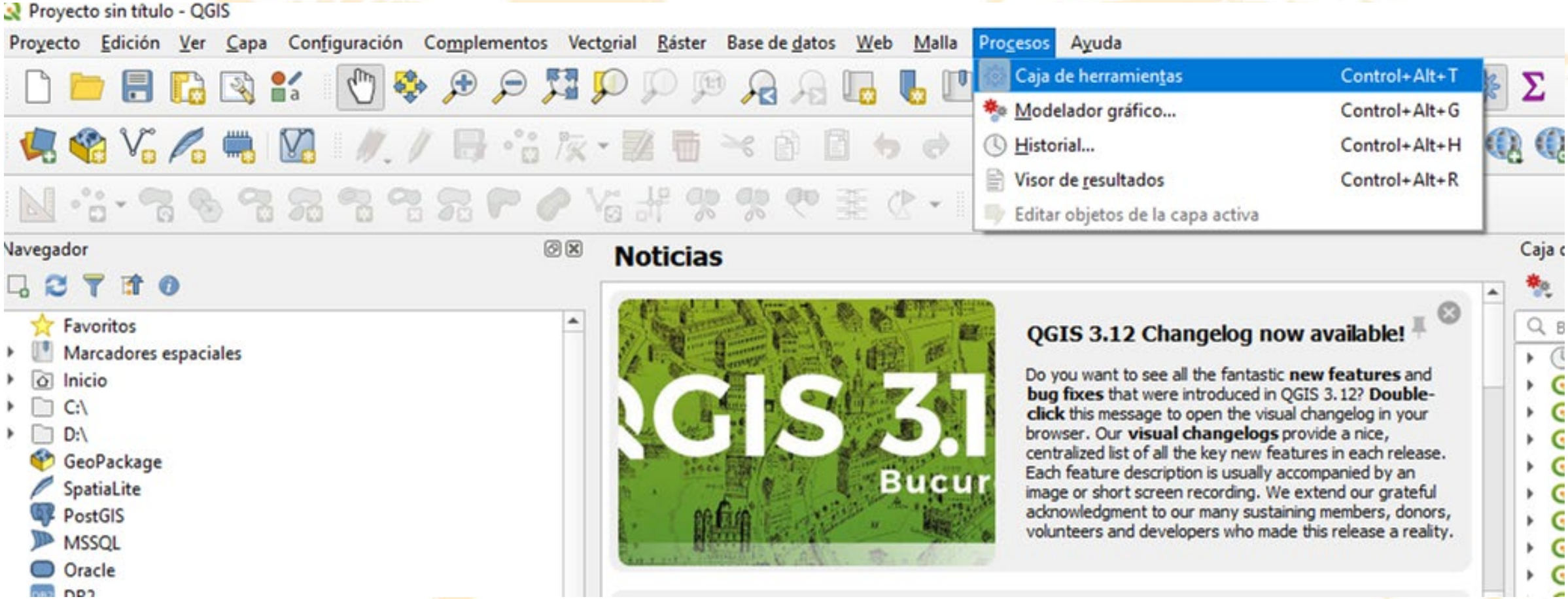
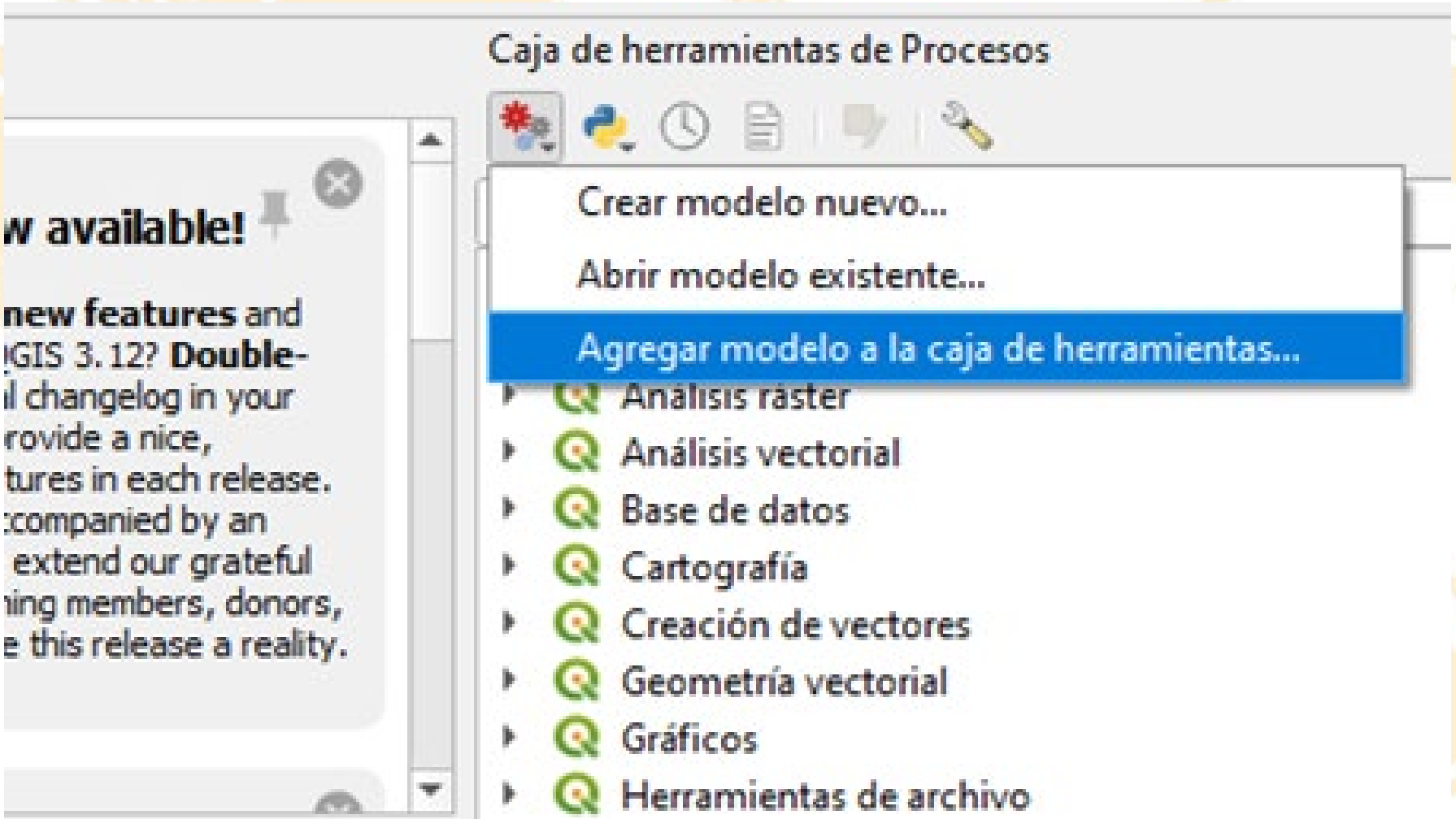
Target Points creation

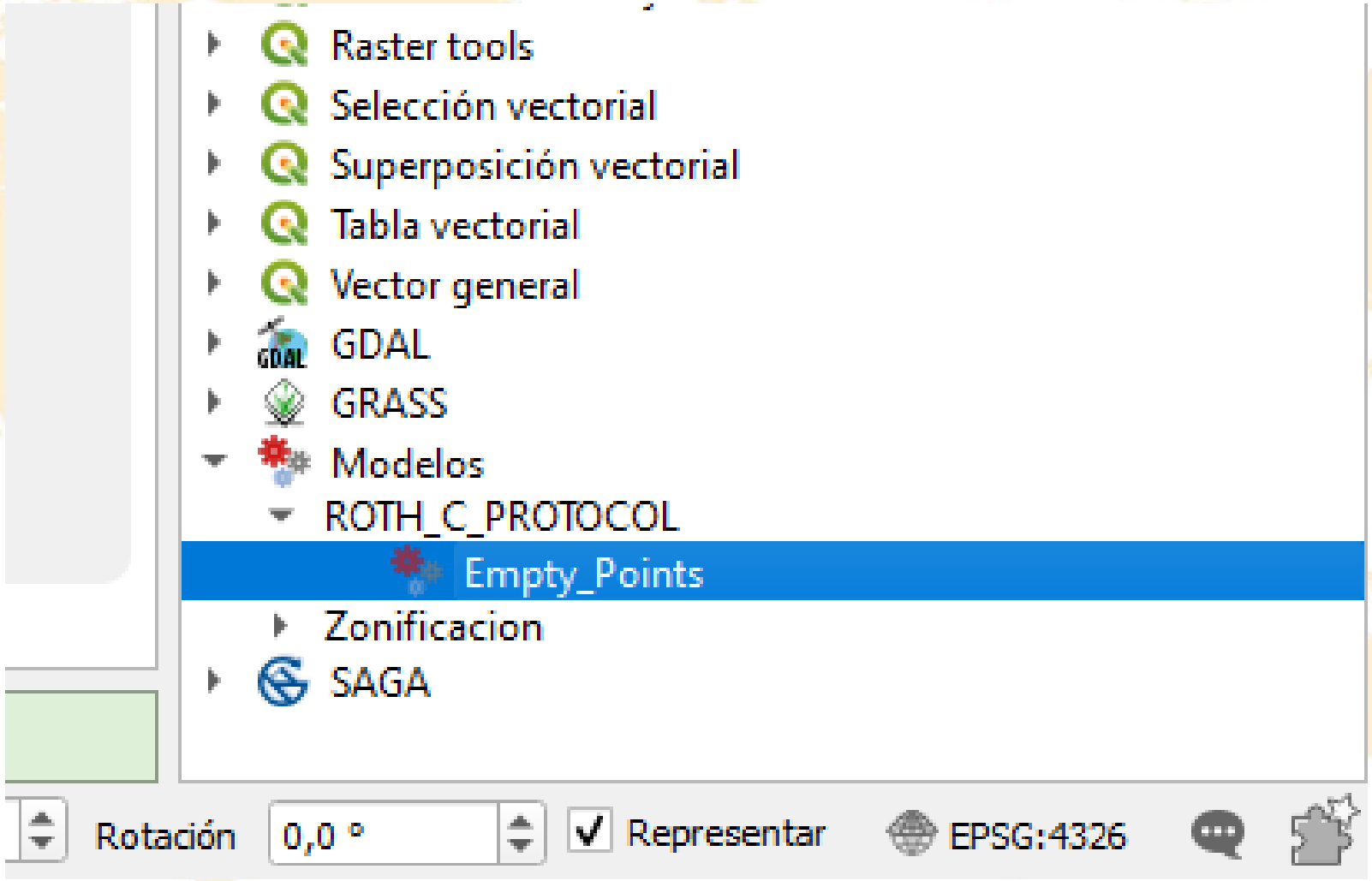
- One point for each pixel of the Land Use la cript number 9
- Qgis 3 model .

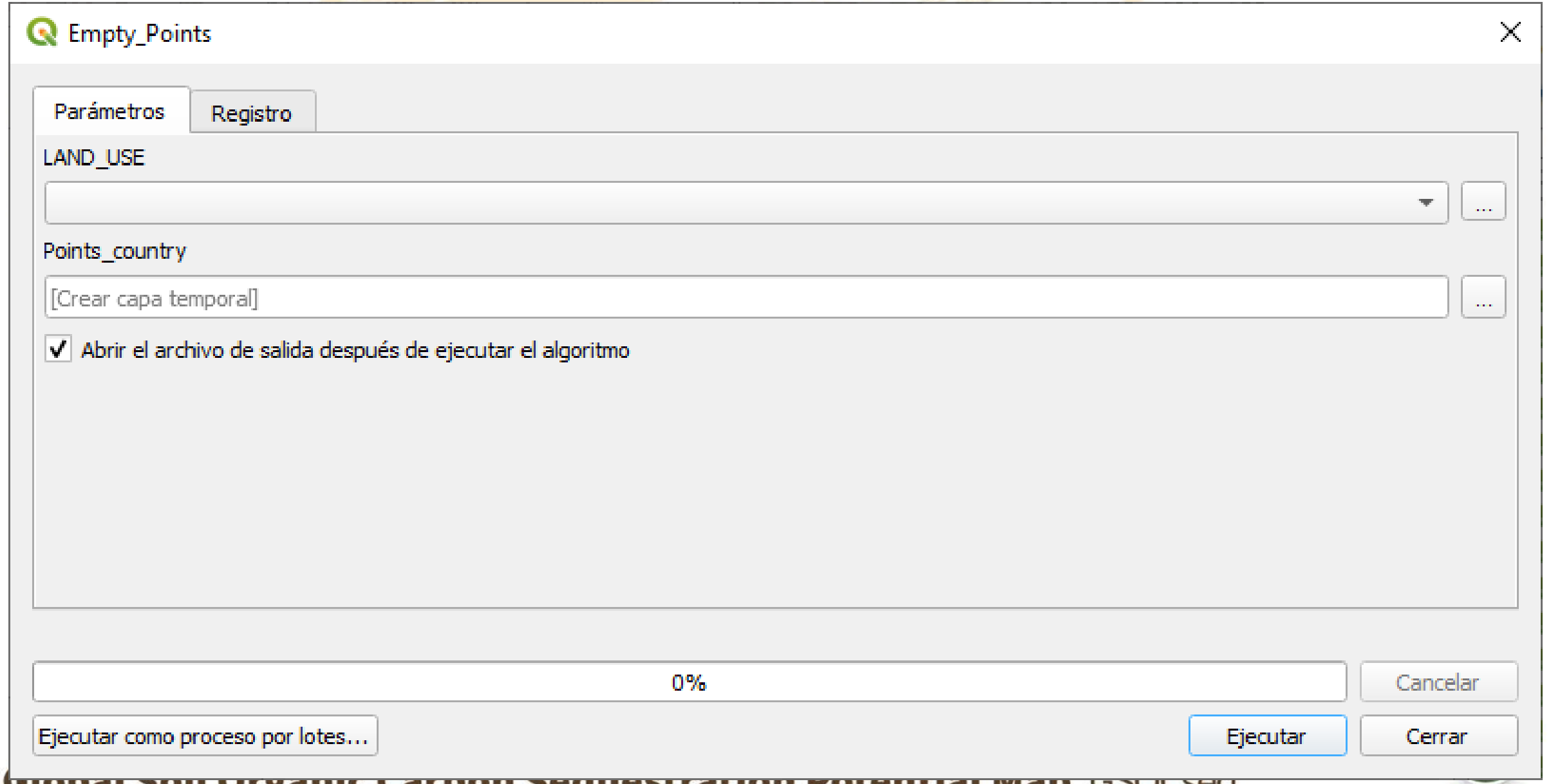


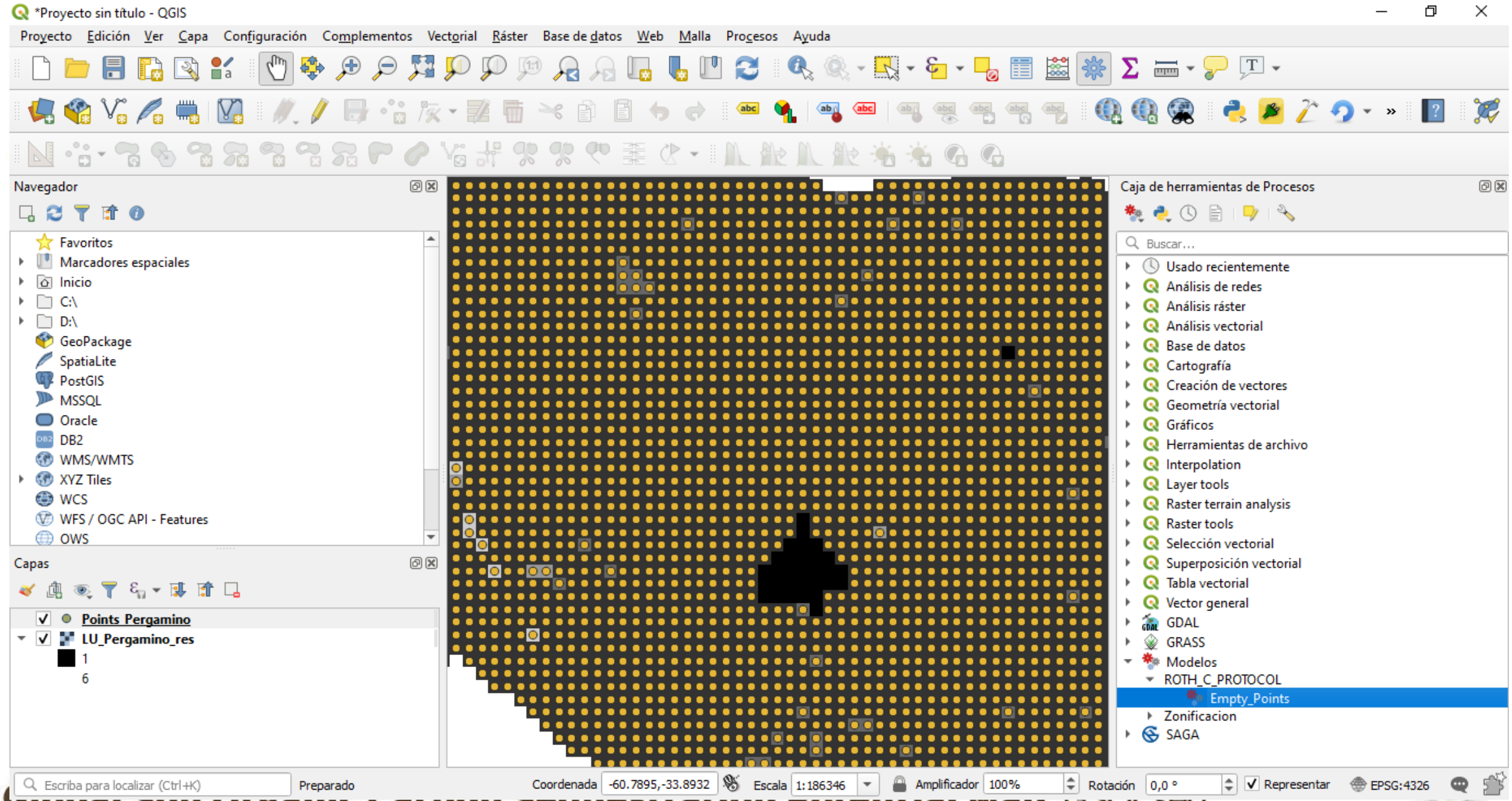

Proyecto sin título - QGIS
Proyecto Edición Ver Capa Configuración Complementos Vectorial Ráster Base de datos Web Malla Procesos Ayuda
Caja de herramientas Control+Alt+T
Modelador gráfico... Control+Alt+G
Historial... Control+Alt+H
Visor de resultados Control+Alt+R
Editar objetos de la capa activa
Navegador
Favoritos
Marcadores espaciales
Inicio
C:\
D:\
GeoPackage
SpatiaLite
PostGIS
MSSQL
Oracle
Noticias
QGIS 3.1
Bucur
QGIS 3.12 Changelog now available!
Do you want to see all the fantastic new features and bug fixes that were introduced in QGIS 3.12? Double-click this message to open the visual changelog in your browser. Our visual changelogs provide a nice, centralized list of all the key new features in each release. Each feature description is usually accompanied by an image or short screen recording. We extend our grateful acknowledgment to our many sustaining members, donors, volunteers and developers who made this release a reality.


Caja de herramientas de Procesos
w available!
new features and
GIS 3.12? Double-
l changelog in your
rovide a nice,
tures in each release.
companied by an
extend our grateful
ing members, donors,
e this release a reality.
Crear modelo nuevo...
Abrir modelo existente...
Agregar modelo a la caja de herramientas...
Análisis ráster
Análisis vectorial
Base de datos
Cartografía
Creación de vectores
Geometría vectorial
Gráficos
Herramientas de archivo


Nombre
0_SOC_MAP
1_CRU_variables
2_MIAMI_NPP
3_GEE_Veg_Cover
4_CLAY
5_LAND_USE
6_ROTH_C_STACK
7_TARGET_POINTS_COUNTRY
8_ROTH_C
9_MAPS
INPUTS
OUTPUTS


Raster tools
Selección vectorial
Superposición vectorial
Tabla vectorial
Vector general
GDAL
GRASS
Modelos
ROTH_C_PROTOCOL
Empty_Points
Zonificacion
SAGA
Rotación
0,0 °
Representar
EPSG:4326


Empty_Points
Parámetros
Registro
LAND_USE
...
Points_country
[Crear capa temporal]
...
Abrir el archivo de salida después de ejecutar el algoritmo
0%
Cancelar
Ejecutar como proceso por lotes...
Ejecutar
Cerrar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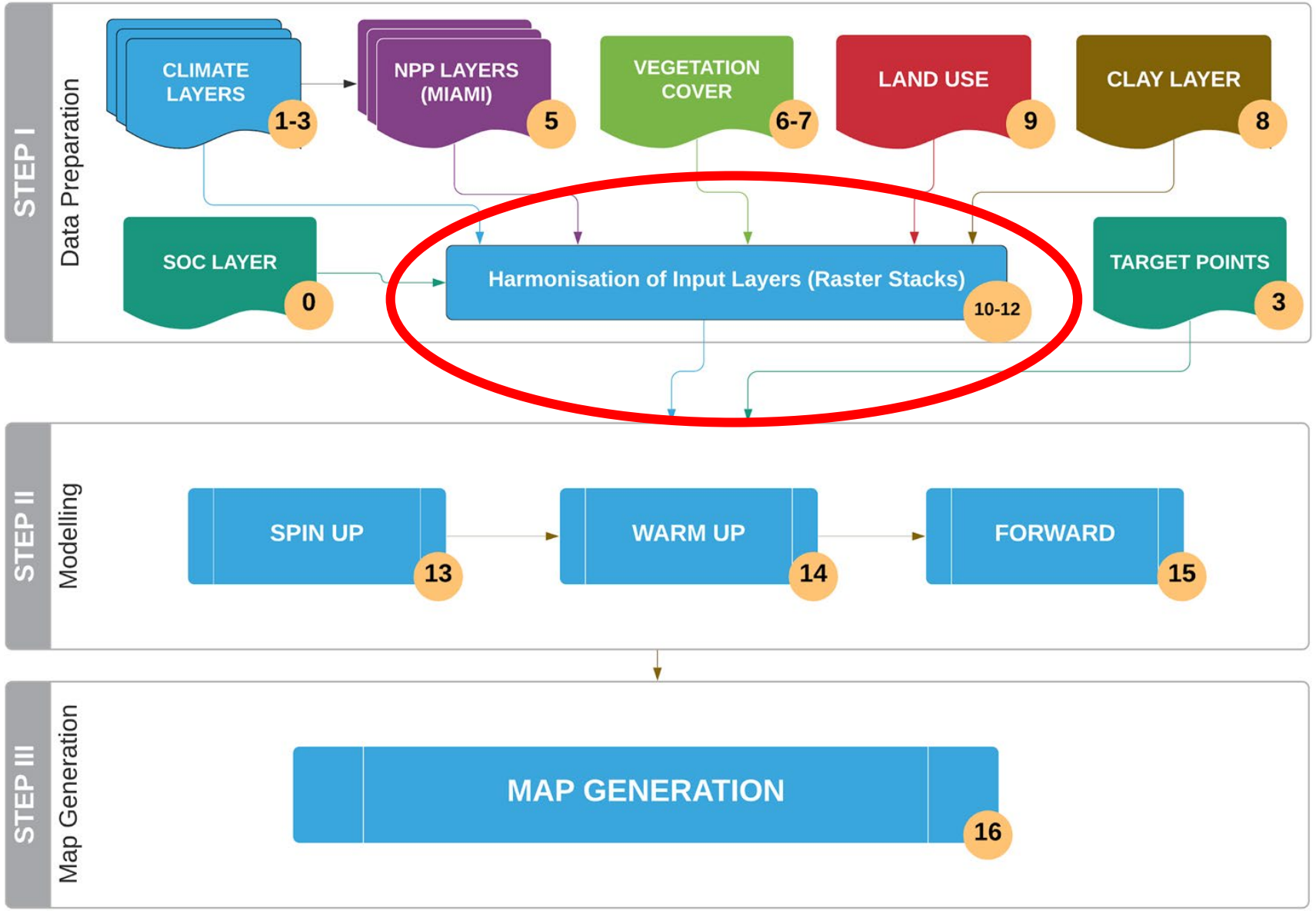
Navegador
Favoritos
Marcadores espaciales
Inicio
C:\
D:\
GeoPackage
SpatiaLite
PostGIS
MSSQL
Oracle
DB2
WMS/WMTS
XYZ Tiles
WCS
WFS / OGC API - Features
OWS
Capas
Points_Pergamino
LU_Pergamino_res
1
6
Caja de herramientas de Procesos
Buscar...
Usado recientemente
Análisis de redes
Análisis ráster
Análisis vectorial
Base de datos
Cartografía
Creación de vectores
Geometría vectorial
Gráficos
Herramientas de archivo
Interpolation
Layer tools
Raster terrain analysis
Raster tools
Selección vectorial
Superposición vectorial
Tabla vectorial
Vector general
GDAL
GRASS
Modelos
ROTH_C_PROTOCOL
Empty_Points
Zonificacion
SAGA
Escriba para localizar (Ctrl+K)
Preparado
Coordenada -60.7895,-33.8932
Escala 1:186346
Amplificador 100%
Rotación 0,0 °
Representar
EPSG:4326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Type of Layer	Script	Objective
SOC layer	0. R- Script number 0	Cut the soc layer by the area of interest polygon
Climate layers	1. R- Script number 1 2. R- Script number 2 3. R- Script number 3	Rearrangement of climate layers (CRU layers from .ncd to .tif)
NPP layers	5. R- Script number 5	Creation of NPP layers
Vegetation Cover (VC)	6. GEE Script number 6 (Google Earth Engine) 7. R- Script number 7	Creation of VC layers
Clay layers	8. R-Script number 8	Obtaining clay contents 0-30 cm from different depths (ISRIC)
Land Use layer	9. R-Script number 9	Re-classification into FAO land cover classes
STACK for SPIN UP	10. R-Script number 10	Stack input data layers for the spin up phase
STACK for WARM UP	11. R-Script number 11	Stack input data layers for the warm up phase
STACK for FORWARD	12. R-Script number 12	Stack input data layers for the forward phase
Target points	13. Qgis model script	Creation of target points
SPIN UP	14. R- Script number 13	Run long spin up phase
WARM UP	15. R- Script number 14	Run warm up phase
FORWARD	16. R- Script number 15	Run forward phase
POINTS TO RASTER	17. R- Script number 16	Rasterize points

TerraClimate