

ANÁLISIS GEOESPACIAL

Ambiente computacional

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UNIVERSIDAD NACIONAL DE COLOMBIA

SEDE MEDELLÍN

Mar. 4 / 2021

TIOBE index - Programming language popularity

Feb 2021	Feb 2020	Change	Programming Language	Ratings	Change
1	2	▲	C	16.34%	-0.43%
2	1	▼	Java	11.29%	-6.07%
3	3		Python	10.86%	+1.52%
4	4		C++	6.88%	+0.71%
5	5		C#	4.44%	-1.48%
6	6		Visual Basic	4.33%	-1.53%
7	7		JavaScript	2.27%	+0.21%
8	8		PHP	1.75%	-0.27%
9	9		SQL	1.72%	+0.20%
10	12	▲	Assembly language	1.65%	+0.54%



Python

Python

Python code is fast to develop: As the code is not required to be compiled and built, Python code can be much readily changed and executed. This makes for a fast development cycle.

Python code is not as fast in execution: Since the code is not directly compiled and executed and an additional layer of the Python virtual machine is responsible for execution, Python code runs a little slow as compared to conventional languages like C, C++, etc.

Python is interpreted: Many programming languages require that a program be converted from the source language, into binary code that the computer can understand. Python does not need compilation to binary code, which makes Python easier to work with and much more portable than other programming languages.

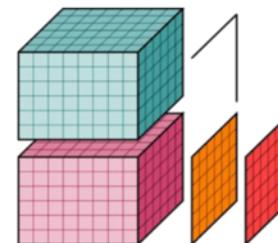
Python is object oriented: Python is an object-oriented programming language. Many modern programming languages support object-oriented

programming. ArcGIS and QGIS is designed to work with object-oriented languages, and Python qualifies in this respect.





StatsModels
Statistics in Python



xarray



scikits-image
image processing in python



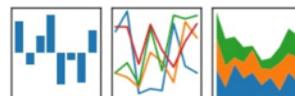
machine learning in Python



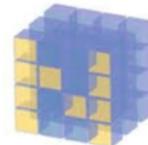
And many,
many more...



pandas
 $y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$



bokeh



NumPy



≡ IP[y]:
IPython





python

```
<base> C:\Users\Edier>python
Python 3.6.3 |Anaconda, Inc.| (default, Oct 15 2017, 03:27:45) [MSC v.1900 64 bi
t (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> print(1+2)
3
>>> for i in range(5):
...     print(i)
...
0
1
2
3
4
>>> _
```



IPython: C:\Users\Edier

```
(base) C:\Users\Edier>ipython
Python 3.6.3 |Anaconda, Inc.| (default, Oct 15 2017, 03:27:45) [MSC v.1900 64 bi
t (AMD64)]
Type 'copyright', 'credits' or 'license' for more information
IPython 6.1.0 -- An enhanced Interactive Python. Type '?' for help.
```

In [1]: type sorted?

Signature: sorted(iterable, /, *, key=None, reverse=False)

Docstring:

Return a new list containing all items from the iterable in ascending order.

A custom key function can be supplied to customize the sort order, and the
reverse flag can be set to request the result in descending order.

Type: builtin_function_or_method

In [2]: type sorted



Spyder (Python 2.7)

File Edit Search Source Run Debug Consoles Tools View Help

C:\Users\eshah\spyder2temp.py

temp.py

```
1 # coding: utf-8
2 """
3 Spyder Editor
4
5 This is a temporary script file.
6 """
7 import sklearn as skl
8 import pandas as pd
9 import statsmodels.api as sm
10 import matplotlib.pyplot as plt
11 from patsy import dmatrices
12 from sklearn.linear_model import LogisticRegression
13 from sklearn.cross_validation import train_test_split
14 from sklearn import metrics
15 from sklearn.cross_validation import cross_val_score
16
17 dta=sm.datasets.fair.load_pandas().data
18 dta['affair']=dta.affairs>0.astype(int)
19 dta.groupby('affair').mean()
20
21 dta.educ.hist()
22 plt.title('Histogram of Education')
23 plt.xlabel('Education level')
24 plt.ylabel('Frequency')
25
26 dta.rate_marriage.hist()
27 plt.title('Histogram of Marriage Rating')
28 plt.xlabel('Marriage Rating')
29 plt.ylabel('Frequency')
30
```

Object inspector

Usage

Here you can get help of any object by pressing **Ctrl+I** in front of it, either on the Editor or the Console.

Help can also be shown automatically after writing a left parenthesis next to an object. You can activate this behavior in Preferences > Object Inspector.

New to Spyder? Read our [Tutorial](#)

Object inspector Variable explorer File explorer

IPython console

Console 9456/A

```
Python 2.7.8 |Anaconda 2.1.0 (64-bit)| (default, Jul 2 2014, 15:12:11) [MSC v.1500 64 bit (AMD64)]
Type "copyright", "credits" or "license" for more information.

IPython 2.2.0 -- An enhanced Interactive Python.
Anaconda is brought to you by Continuum Analytics.
Please check out https://continuum.io/thanks and https://binstar.org
?           -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help       -> Python's own help system.
object?    -> Details about 'object', use 'object??' for extra details.
%gui      -> A brief reference about the graphical user interface.
```

In [1]:

Console History log Python console

localhost:8888/lab

Aplicaciones Grupo Bancolombia... DNINFOA - Univers... Google Earth Engine Google Earth Noticias de Colombia... Principales Noticias... Press | Virgin Radio... Trello

File Edit View Run Kernel Tabs Settings Help

MACHINE LEARNING > NOTEBOOKS

Name	Last Modified
01_Ambiente_de_trabajo.ipynb	a day ago
02_Importar.ipynb	a day ago
03_DataFrame.ipynb	a day ago
04_Procesamiento_dato.ipynb	a day ago
05_EDA.ipynb	a day ago
06_SelecciónVariables.ipynb	a day ago
07_Desbalance.ipynb	a day ago
08_Validation.ipynb	a day ago
09_Algorithm_Tunning.ipynb	a day ago
10_Metric.ipynb	a day ago
11_Bias-Variance_Tradeoff.ipynb	a day ago
12_Cluster.ipynb	23 days ago
13_PCA.ipynb	23 days ago
14_Discriminante.ipynb	23 days ago
15_Regresion_lineal.ipynb	a day ago
16_Regresion_Logistica.ipynb	2 months ago
17_KNN.ipynb	2 months ago
18_SVM.ipynb	a month ago
19_RedesNeuronales.ipynb	2 months ago
20_Ensembles.ipynb	11 days ago
Codigos scatter plot.ipynb	a month ago
Ensemble_simple.ipynb	2 months ago
tree.dot	3 months ago

15_Regresion_lineal.ipynb Markdown Python 3

CURSO: Análisis Geoespacial (Sem02-2019)
Profesor: Edier Aristizábal (evaristizabal@unal.edu.co)
Curso website: <https://unvirtual.medellin.unal.edu.co/course/view.php?id=579>

15: Regresión Lineal

La Regresión Lineal (RL) asume que las variables predictoras tienen una distribución Gaussiana y que no son correlacionables, por lo tanto es importante en el análisis de datos explorar estas condiciones. Adicionalmente, hay que tener en cuenta que los modelos de RL son modelos geométricos, es decir que se basan en calcular las distancias entre la predicción y los datos reales, por lo tanto es importante normalizar o estandarizar los datos.

```
[1]: Para iniciar con la implementación de los modelos RL, primero se importan las librerías a utilizar.
```

```
[1]: from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score, mean_squared_error, mean_absolute_error
import matplotlib.pyplot as plt
import numpy as np
```

En este Taller utilizaremos la base de datos Boston disponible en la librería Sklearn para problemas de regresión. Por lo tanto la cargamos, separamos en datos de entrenamiento y datos de validación con un 30%, y definimos como variables predictoras X , y variable dependiente "y".

```
[3]: from sklearn.datasets import load_boston
boston=load_boston()
X=boston.data
y=boston.target
X_train, X_test, y_train, y_test=train_test_split(X, y, test_size=0.3)
```

Método OLS de la librería statsmodels

localhost:8888/lab

File Edit View Run Kernel Tabs Settings Help

Name / Last Modified

- anaconda3 23 days ago
- Contacts 2 years ago
- Desktop 23 days ago
- Documents 23 days ago
- Downloads 17 minutes ago
- Favorites 2 years ago
- Google Drive an hour ago
- Links a year ago
- Music 2 years ago
- Pictures 9 months ago
- projects 3 months ago
- Roaming 8 years ago
- Saved Games 2 years ago
- Searches 2 years ago
- Tracing 5 months ago
- Videos 2 years ago
- agent.log 2 years ago

Launcher

Notebook

Python 3

Console

Python 3

Other

Terminal

Text File

Markdown File

Show Contextual Help

1 \$ 4

Launcher

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JupyterLab

localhost:8889/lab

File Edit View Run Kernel Tabs Settings Help

Launcher Untitled.ipynb Python 3

Name Last Modified

- anaconda3 a month ago
- Contacts 2 years ago
- Desktop 2 hours ago
- Documents a month ago
- Downloads 2 hours ago
- Favorites 2 years ago
- Google Drive 2 hours ago
- Links a year ago
- Music 2 years ago
- Pictures 9 months ago
- projects 3 months ago
- Roaming 8 years ago
- Saved Games 2 years ago
- Searches 2 years ago
- Tracing 6 months ago
- Videos 2 years ago
- agent.log 2 years ago
- Untitled.ipynb 16 days ago

[2]:
import geopandas
import geopy
import rasterio

[]:

14 Python 3 | Idle Saving completed Mode: Command Ln 1, Col 1 Untitled.ipynb

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Anaconda



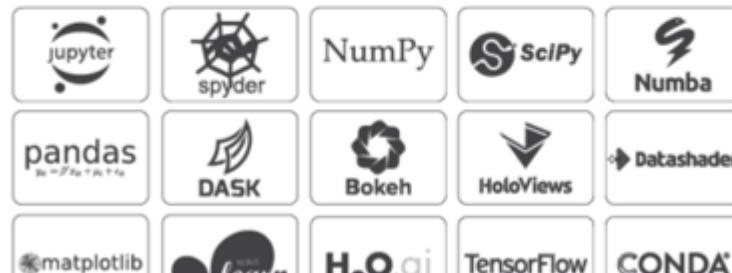
Anaconda Distribution

The World's Most Popular Python/R Data Science Platform

Download

The open-source [Anaconda Distribution](#) is the easiest way to perform Python/R data science and machine learning on Linux, Windows, and Mac OS X. With over 15 million users worldwide, it is the industry standard for developing, testing, and training on a single machine, enabling *individual data scientists* to:

- Quickly download 1,500+ Python/R data science packages
 - Manage libraries, dependencies, and environments with [Conda](#)
 - Develop and train machine learning and deep learning models with [scikit-learn](#), [TensorFlow](#), and [Theano](#)



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ACCEPT

Home Environments Learning Community Documentation Developer Blog Feedback Twitter YouTube GitHub

Sign in to Anaconda Cloud Refresh

ANACONDA NAVIGATOR

Applications on base (root)

Channels

 jupyterlab 0.32.1 <p>An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture.</p> Launch	 notebook 5.5.0 <p>Web-based, interactive computing notebook environment. Edit and run human-readable docs while describing the data analysis.</p> Launch	 qtconsole 4.3.1 <p>PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more.</p> Launch	 spyder 3.2.8 <p>Scientific PYthon Development EnvIRONMENT. Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features</p> Launch
 vscode 1.27.1 <p>Streamlined code editor with support for development operations like debugging, task running and version control.</p> Launch	 glueviz 0.13.3 <p>Multidimensional data visualization across files. Explore relationships within and among related datasets.</p> Install	 orange3 3.13.0 <p>Component based data mining framework. Data visualization and data analysis for novice and expert. Interactive workflows with a large toolbox.</p> Install	 rstudio 1.1.423 <p>A set of integrated tools designed to help you be more productive with R. Includes R essentials and notebooks.</p> Install

Anaconda Navigator

File Help

ANACONDA® NAVIGATOR

Sign in to Anaconda Cloud

Home Environments Learning Communities Documents Development

Search Environments All Channels Update index... X

base (root)

python_foundation ►

Install Packages

79 packages will be installed

	Name	Unlink	Link	Channel
1	geopandas	-	0.7.0	conda-forge
2	*attrs	-	19.3.0	conda-forge
3	*boost-cpp	-	1.72.0	conda-forge
4	*bzip2	-	1.0.8	conda-forge
5	*ca-certificates	2020.1.1	2020.4.5.1	conda-forge

* indicates the package is a dependency of a selected package

Cancel Apply Clear

available matching "geopandas" 1 package selected

The screenshot shows the Anaconda Navigator interface. The search bar at the top right contains the text 'geopandas'. A red box highlights this search term. Below the search bar, a table lists packages matching the search. One row for 'geopandas' is highlighted with a red box. The 'Install Packages' dialog box is open in the foreground, showing a list of 79 packages to be installed, with the first five items listed in the table above. The 'Apply' button in the dialog box is also highlighted with a red box.

Miniconda



○ Miniconda3 4.5.12 (64-bit) Setup



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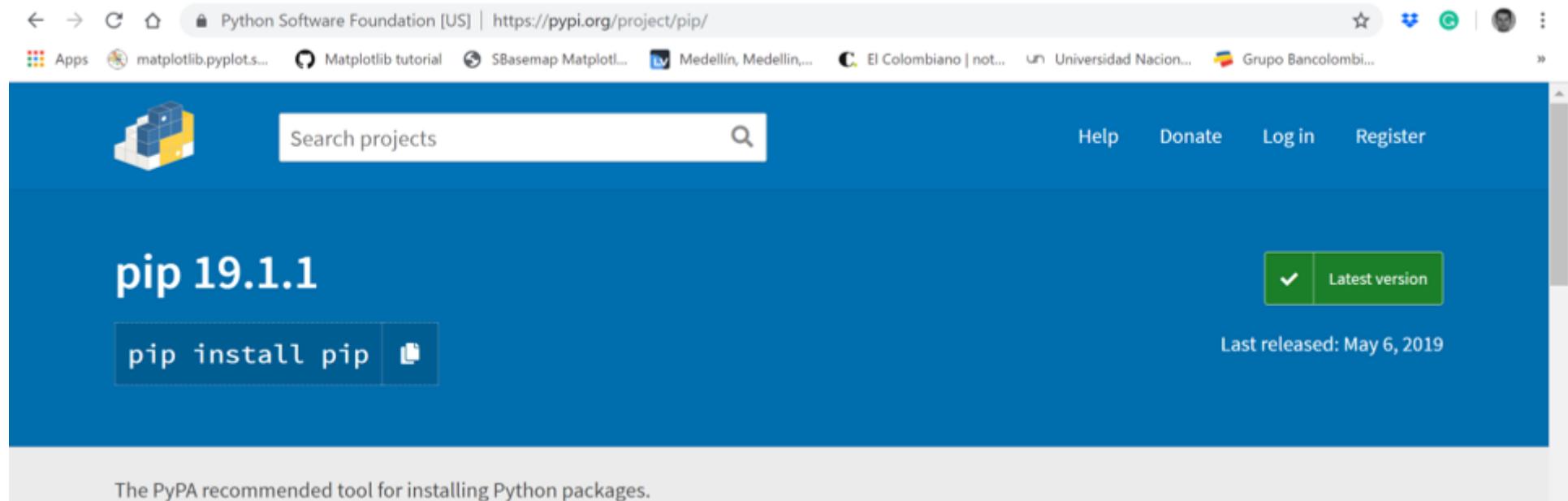


C:\ Command Prompt

Microsoft Windows [Version 10.0.10240]
(c) 2015 Microsoft Corporation. All rights reserved.

C:\Users\Brennan>_





```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.15063]
(c) 2017 Microsoft Corporation. All rights reserved.

C:\Users\mbalslow>cd c:\Python37-32

c:\Python37-32>pip install xlwings
Collecting xlwings
  Downloading https://files.pythonhosted.org/packages/f6/cf/c4e5ba995c6440fff3
f6e846ba0aa92481d8d5c54c27860a324df525802b/xlwings-0.15.1.tar.gz (614kB)
    100% |██████████| 614kB 6.6MB/s
Requirement already satisfied: comtypes in c:\python37-32\lib\site-packages (from xlwings) (1.1.7)
Requirement already satisfied: pywin32>=224 in c:\python37-32\lib\site-packages (from xlwings) (224)
Installing collected packages: xlwings
  Running setup.py install for xlwings ... done
Successfully installed xlwings-0.15.1

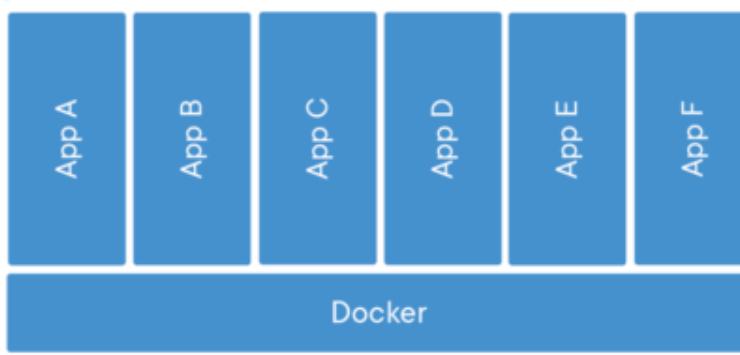
c:\Python37-32>
```

Docker





Containerized Applications



Virtual Machine

App A

Guest
Operating
System

Virtual Machine

App B

Guest
Operating
System

Virtual Machine

App C

Guest
Operating
System

Hypervisor

Infrastructure

Dockerfile



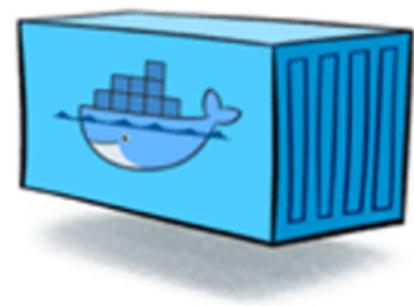
→ Build →

Image



→ Run →

Container



Javascript



{JavaScript}





e!

Object-based

Scripting language & not Java



It runs in a browser

Google Earth Engine



← → C ⌂

https://earthengine.google.com



matplotlib.pyplot.s...

Matplotlib tutorial

SBasemap Matplotl...

Medellín, Medellin...

El Colombiano | not...

Universidad Nacion...

Grupo Bñcolombi...

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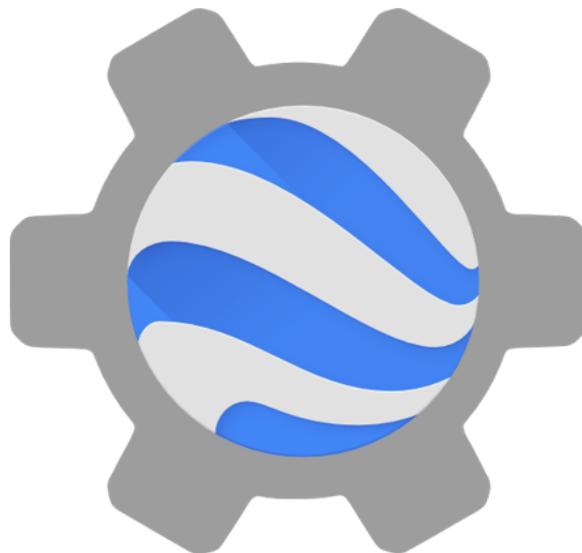


Google Earth



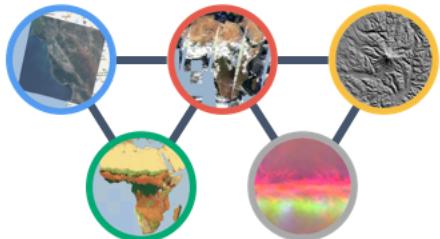
3-D Globe
Visualization

Earth Engine



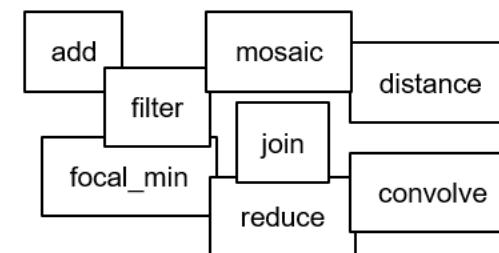
Geospatial
Analysis

Geospatial
Datasets



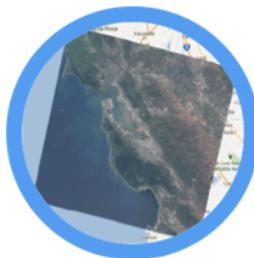
Storage and Compute

Requests Results



Algorithmic
Primitives

The Earth Engine Public Data Catalog



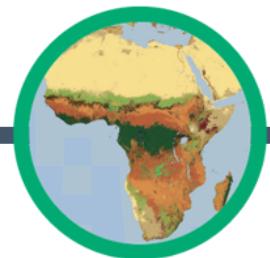
Landsat 4, 5, 7, 8
Raw, TOA, SR, ...



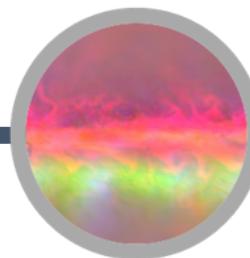
MODIS
Daily, NBAR, LST, ...



Terrain
SRTM, GTOPO, NED,
...



Land Cover
GlobCover, NLCD, ...



Atmospheric
NOAA NCEP, OMI, ...

... and many more, updating daily!

> 200 public datasets

> 4000 new images every day

> 5 million images

> 5 petabytes of data

Sentinel Hub

The screenshot shows the homepage of sentinel-hub.com. At the top, there's a browser header with navigation icons, a lock icon, and the URL 'sentinel-hub.com'. Below it is a toolbar with various links: Apps, Grupo Bancolombia, Google Earth Engine, Keras, Google Earth, Noticias de Colombia, Principales Noticias, Press | Virgin Radio, Trello, and MACHINE LEARNING. The main header features the 'sentinelhub' logo and the text 'member of Euro Data Cube'. To the right are navigation links for Explore, Develop, About, Pricing, and Blog, along with a green 'SIGN IN' button. The background of the page is a space-themed image showing a satellite in orbit against a star-filled sky and a planet below. Overlaid on this image is the text 'CLOUD API FOR SATELLITE IMAGERY' in large white letters, with a smaller line of text 'Browse. Pick. Enhance. Expose.' underneath. A three-bar menu icon is located at the bottom left.

sentinel-hub.com

Apps Grupo Bancolombia... Google Earth Engine Keras Google Earth Noticias de Colombia... Principales Noticias... Press | Virgin Radio... Trello MACHINE LEARNING

sentinelhub member of Euro Data Cube

Explore Develop About Pricing Blog SIGN IN

CLOUD API FOR SATELLITE IMAGERY

Browse. Pick. Enhance. Expose.

≡





SENTINEL PLAYGROUND

Explore [Explore](#) Develop About Pricing Blog [SIGN IN](#)

member of [Euro Data Cube](#)

Explore [Explore](#) [EO Browser](#) [Data](#) [Industries & Showcases](#) [Education](#)

Home / Explore / Sentinel Playground

Sentinel Playground utilizes Sentinel Hub technology to enable easy-to-use discovery and exploring of full-resolution Sentinel-1, Sentinel-2, Landsat 8, DEM and MODIS imagery, along with access to the EO data products. It is a graphical interface to a complete and daily updated Sentinel-2 archive, a massive resource for anyone interested in Earth's changing surface, natural or manmade.

sentinelhub *Playground* 2021-03-03 20 %

Rendering Effects

Custom

Natural color
Based on bands 4,3,2

Color Infrared (vegetation)
Based on bands 8,4,3

False color (urban)
Based on bands 12,11,4

Agriculture
Based on bands 11, 8, 2

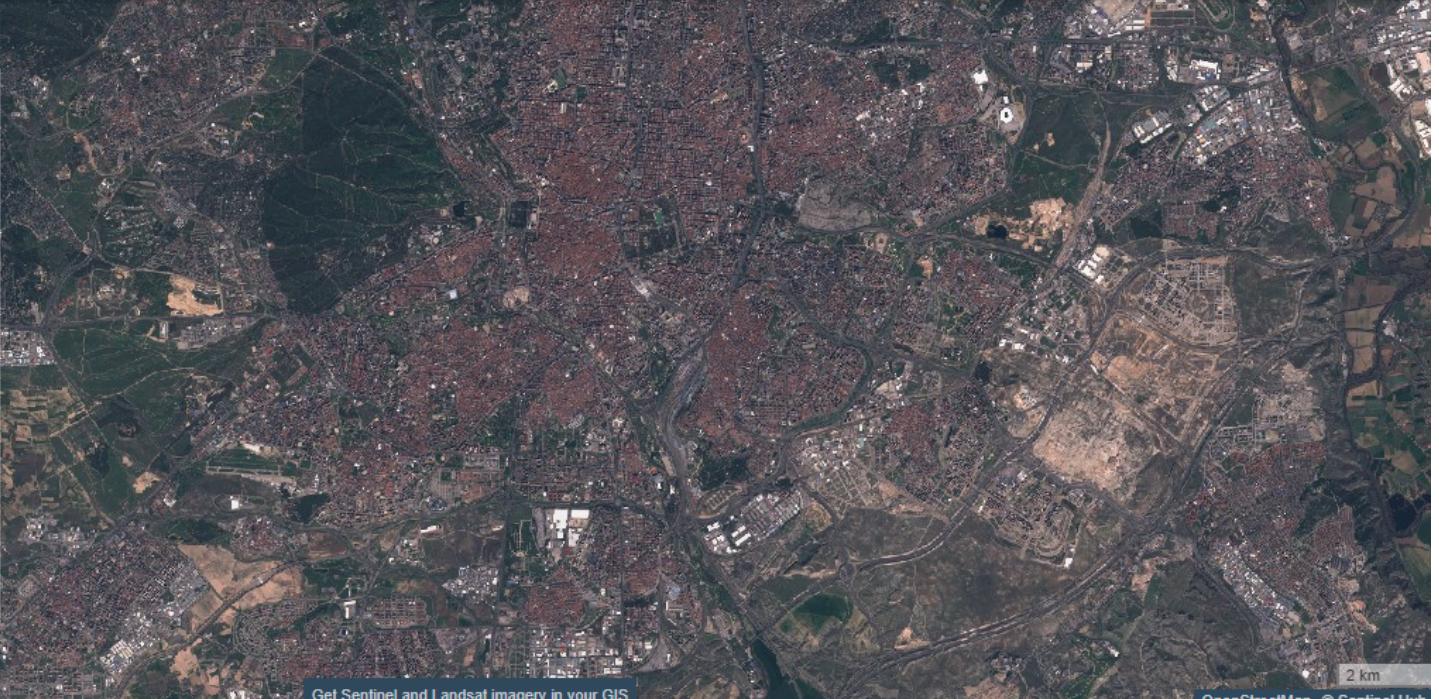
Vegetation Index
Based on combination of bands (B8 - B4)/(B8 + B4)

Moisture Index
Based on combination of bands (B8A - B11)/(B8A + B11)

GENERATE

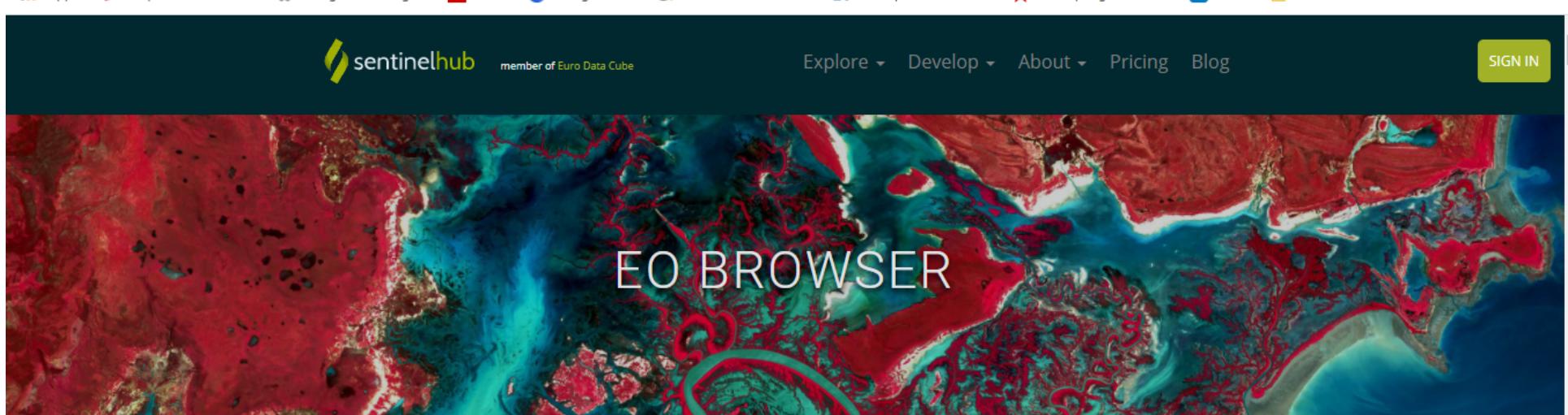
Get Sentinel and Landsat imagery in your GIS

OpenStreetMap © Sentinel Hub



A satellite map showing a large urban area with a grid-like street pattern, surrounded by green fields and some water bodies. The map is displayed in natural color, highlighting different land cover types like urban areas, green spaces, and agricultural fields.





The EO BROWSER

Explore

Home / Explore / EO Browser

EO Browser makes it possible to browse and compare full resolution images from all the data sources we provide. You simply go to your area of interest, select your desired time range and cloud coverage, and inspect the resulting data in the browser. Try out different visualizations or make your own, download high resolution images and create timelapses.



The figure shows the EO Browser interface. The left sidebar contains navigation links like 'Discover', 'Visualize', 'Compare', and 'Pins'. It also includes a 'Data sources' section with checkboxes for various satellite datasets: Sentinel-1, Sentinel-2 (which is checked), Sentinel-3, Sentinel-5P, Landsat, Envisat Meris, MODIS, DEM, Proba-V, and GIRS. Below this is a 'Free sign up for all features' button and a note that it's 'Powered by Sentinel Hub with contributions by ESA v3.0.85'. The main area is a map of Rome and its suburbs, with the city center labeled 'ROME'. The map uses a color-coded legend where green represents land cover, blue represents water bodies, and orange/yellow represents roads or boundaries. Numerous place names are labeled around the map, including Anguillara Sabazia, Formello, Monterotondo, Montanara, Fonte Nuova, Guidonia, Tivoli, Palestrina, Fiuggi, Artena, Colleferro, Anagni, Alatri, and Frosinone. A search bar at the top right says 'Go to Place' and includes icons for a magnifying glass, a stack of three layers, a graduation cap, and a help icon. On the far right, there's a vertical column of icons for different map layers and features.