TERRABRASILIS DATA SOURCE: A PLUGIN QGIS FOR DISSEMINATING DEFORESTATION DATA FROM BRAZIL

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ABSTRACT

Web service technologies such as WMS and WFS have become an active area of research with numerous promising applications in geotechnologies solutions. This paper presents the TerraBrasilis QGIS Python plugin as a contribution to the adoption of open geospatial standards which enable the use of geographical information on GIS applications. This plugin is part of the TerraBrasilis platform for analyzing changes in Brazil's land use and land cover. TerraBrasilis enables access and analysis of deforestation data generated by PRODES and DETER. In the results, we demonstrate the plugin as a viewer and analytic environment for Brazilian Legal Amazon deforestation data.

***Key words** – TerraBrasilis, Geographic Information System, Plugin, PRODES, WMS.*

1. INTRODUCTION

The Earth's surface is changing constantly due to natural causes, but mainly due to human actions. In order to understand this process and to manage the use of natural resources, it is of great importance to measure land-use changes. In Brazil, the continuous monitoring of the biomes land cover is essential, as it provides valuable information on the organization of biodiversity on the earth's surface. This monitoring makes it possible to assist in the management of the national territory and thus guide investments aimed at the conservation and enhancement of natural resources. The National Institute for Space Research (INPE) has performed this monitoring using remote sensing imagery in the context of the Brazilian Amazon Rainforest Monitoring Program by Satellite (PRODES) [1] and the Real-Time System for Detection of Deforestation (DETER) [2] that provides daily data about deforestation and forest degradation. DETER and PRODES data are used to support the monitoring and controlling deforestation and degradation in the Amazon. Both are examples of long term projects mapping land-use changes in the Brazilian Legal Amazon region.

PRODES generates annual maps of clear-cut deforestation for the entire Brazilian Legal Amazon since 1988. Each year, PRODES maps the new increments of deforestation that occurred from 1 August of the previous year to 31 July. Its methodology is based on visual interpretation of medium-resolution images such as Landsat imagery. Starting in 2004, the DETER Project is an early warning system designed to generate alerts of deforestation and degradation to support control actions. Currently, DETER uses WFI sensor images from CBERS-4, 4A and Amazônia-1/INPE satellites with a spatial resolution between 56 and 64 meters and a minimum area for 3 hectares [3]. In addition, other projects are being implemented to monitor the different Brazilian biomes. PRODES, DETER and the land use and land cover mapping system (TerraClass) are part of the Monitoring Program for the Amazon and Other Biomes (PAMZ+), a program developed by the Earth Observation and Geoinformatics Division (DIOTG) and by the Spatial Coordination of the Amazon (COEAM), in the National Institute for Space Research (INPE) [3]. The TerraBrasilis portal makes all PRODES and DETER data available to the public. It is an open spatial data infrastructure that improves the dissemination of the PAMZ+ data by facilitating the visualization, access, query, analysis, of the data generated in the these projects [4].

Geographic Information Systems (GIS) are widely used in different research areas and applications as they have grown over the last 100 years. It is a tool to integrate and visualize heterogeneous geospatial data as well as execute data analysis [5]. QGIS is one of the most popular open-source GIS with increasing importance in the research areas [6].

In this work, we present a QGIS python plugin tool that provides access to the Web Map Service (WMS) services of the Spatial Data Infrastructure and allows the dissemination of information on the TerraBrasilis platform. Section 2 introduces the methodology for creating plugins in QGIS in general. In section 3 describes the QGIS plugin tool and present some examples of its use. Finally, section 4 concludes this paper.

2. MATERIAL AND METHODS

2.1. Development of Plugin for QGIS

The QGIS is one of the most popular open source Geographic Information System (GIS) that runs in different operational systems, includes all the generic GIS functions, features and supports various vector, raster, and database formats and has a user-friendly Graphical User Interface (GUI). In general, GIS platforms use different plugin manager methods and data formats, in particular, the QGIS platform uses Python packages to manage plugins, and all the plugins follow a unified format to adapter platform [7, 8].

QGIS is designed with a plugin architecture, different new features and functions can be added to the application, as plugins. Besides, QGIS plugins are implemented either as Core Plugins, written in C++ or Python languages, maintained by the QGIS Development Team, that are automatically part of every QGIS distribution; or External

Plugins, written in Python. The External Plugins can be stored in the Official QGIS Repository[1] or repositories maintained by the authors. Detailed documentation including usage, minimum QGIS version, authors, and other important information are provided in the Official repository [9].

2.2. TerraBrasilis Platform

The TerraBrasilis platform uses a service-oriented paradigm following international standards for the interoperability of spatial data, in particular it complies with the specifications of the Brazil's National Spatial Data Infrastructure (INDE)[2]. TerraBrasilis can be accessed by distributed clients using services such as OGC's Web Map Service (WMS), Web Feature Service (WFS), Web Service Coverage (WCS) and Catalog Service for the Web (CSW). It enables users to visualize and analyze spatial data in different platforms. TerraBrasilis includes a web-portal entry point that display the geospatial data using maps and dashboards, in which users can interact with different graphics that summarize the data available in the portal in a user-friendly way [4]. TerraBrasilis also provides a web interface[3] to access, query, visualize, process and download the data from the PRODES and DETER database.

2.3. Web Map Service (WMS)

Norms and standards are important to ensure the interoperability of geospatial data and information. They allow the discovery, exchange, integration and usability of spatial information. Standards organizations as Open Geospatial Consortium (OGC) develops the specifications for Web Services (OWS) services and geospatial data sharing. Open Geospatial Consortium (OGC) Web Services (OWS) are services defined by the OGC, allowing a set of geospatial functionality, for instance, services for access, visualization and processing data.

The most known OWS is the Web Map Service (WMS) that makes maps openly available online and can be recognized by clients in different platforms. The WMS provides a Hyper Text Transfer Protocol (HTTP) interface for requesting a map image from vector or raster data from geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request WMS does not contain actual data, but one or more map image, returned as JPEG, PNG and other supported types of image format to be displayed in an application [10].

3. RESULTS AND DISCUSSION

3.1. TerraBrasilis Data Source

The TerraBrasilis Data Source plugin provides access to the WMS services of the Spatial Data Infrastructure TerraBrasilis. The plugin is compatible with QGIS version 3.0 and later versions and is available for free download

from the official QGIS Plugin Repository[4]. The development version is hosted on the project's GitHub TerraBrasilis account (`https://github.com/terrabrasilis/terrabrasilis_datasource/`). To create the plugin, different libraries and Application Programming Interface (API) such as QGIS API, JavaScript Object Notation (JSON) and PyQGIS Developer CookBook[5], were used. Figure 1 shows information about the plugin installed in the QGIS, that can be accessed by means of Manage and Install Plugins tool.
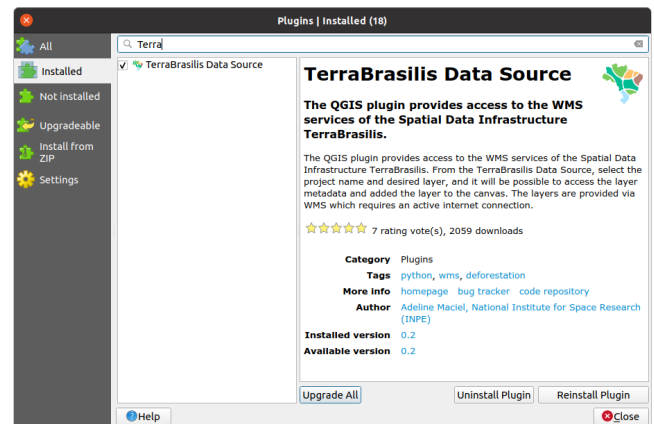

Figure 1: Window with information about the plugin installed.

In the installation, the plugin imports a JSON file from the GitHub TerraBrasilis and saves it inside the default location of the plugin folder in the QGIS 3. The JSON file contains a collection of name/value pairs with all definitions of Project and Layer names that will be used to setup parameters for the WMS connection. Once the user has installed and enabled the plugin of the TerraBrasilis Data Source, it can be accessed via the toolbar or the menu Plugins. The main dialog contains a Project name with the projects separated by biomes, and Layer name, that dynamic refresh layers names according to the Project name combo box (see Figure 2). When switch between layer names is enabled a Metadata Link, that contains a link to see information about the layer. Use Add button to add the geospatial map image within the current canvas. In addiction, a link to access TerraBrasilis portal is also available.
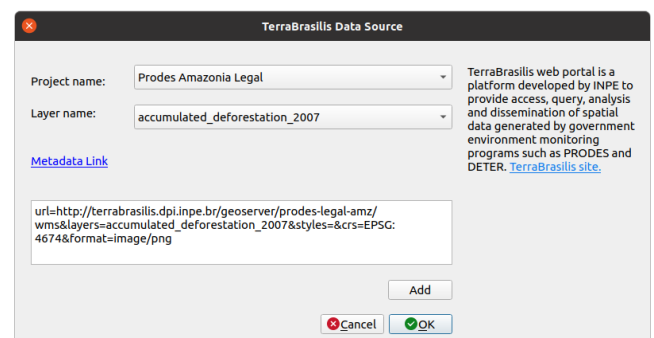

Figure 2: Interface of the TerraBrasilis Data Source Plugin.

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[1]QGIS Repository `https://plugins.qgis.org/plugins/`
[2]INDE `https://inde.gov.br/`
[3]TerraBrasilis `http://terrabrasilis.dpi.inpe.br/`

[4]TerraBrasilis Data Source `https://plugins.qgis.org/plugins/terrabrasilis_datasource/`
[5]PyQGIS Developer Cookbook `https://docs.qgis.org/3.10/en/docs/pyqgis_developer_cookbook/`

The use of this plugin is presented in the Figure 3. It shows an example of addiction of layer named *accumulated_deforestation_2007* from *PRODES Brazilian Legal Amazon* Project name to the QGIS canvas. Following, the layer *hydrography* of the same project name is added too, see Figure 4.
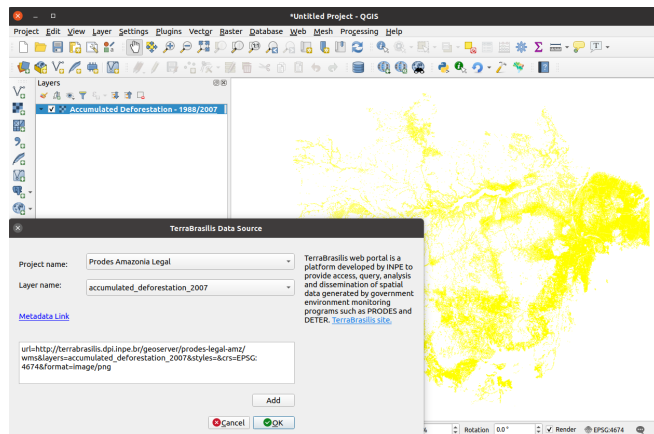

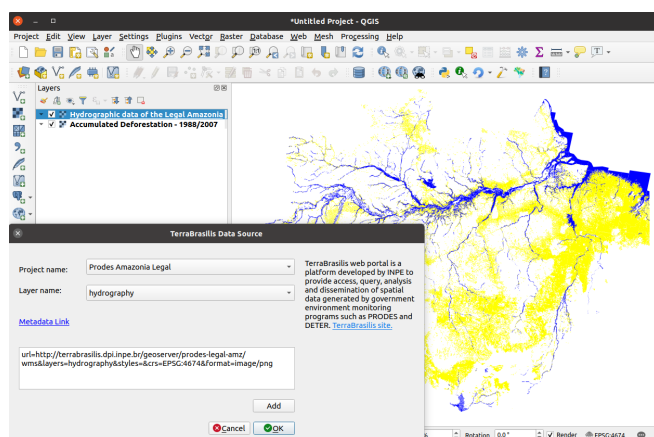**Figure 3: Accumulated deforestation layer for the Brazilian Legal Amazon.**

Figure 4: Added hydrographic data of the Brazilian Legal Amazon.

The plugin treats the layer that has temporal dimension, in other words, a layer that has a set of raster or vector data organized in time, into a group. For each group is enabling the last time variable available in the temporal dimension. For example, Figure 5 shows an example of a layer with a temporal dimension with twenty-two timestamps, the yearly data from 2000 to 2021, that represents the layer *temporal_mosaic_legal_amazon*. A Metadata link was created to facilitate the access of the layer metadata. This allows accessing a web page with all available information about the layer (see Figure 6).

3.2. Contributions from the TerraBrasilis plugin

The QGis plugin to TerraBrasilis contribute with the main goal of the TerraBrasilis Web portal that is to facilitate and promote the use of the data produced in the environment monitoring programs carried out by INPE through its PAMZ+. Furthermore, the plugin offers easy access to the
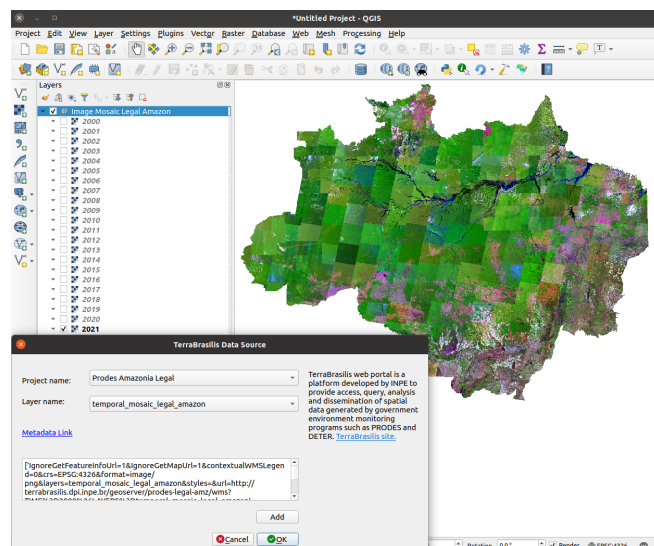

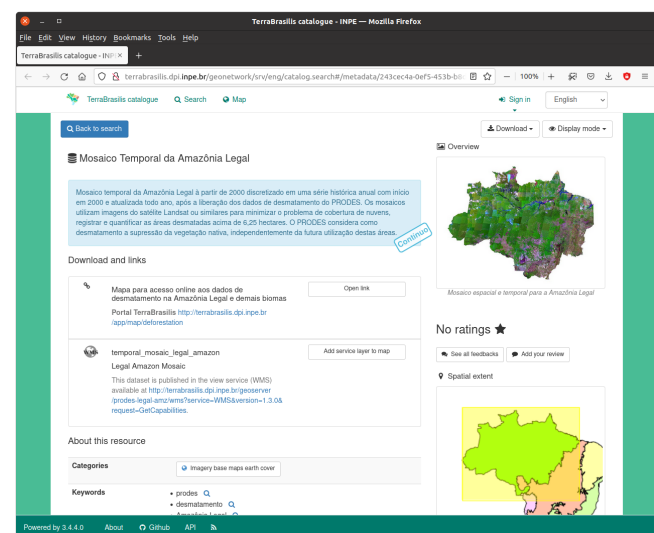**Figure 5: Image mosaic of the Brazilian Legal Amazon from 2000 to 2021, twenty-two years.**

Figure 6: TerraBrasilis catalogue with metadata information about the *temporal_mosaic_legal_amazon* layer.

metadata of the layers, which enables the user to access the metadata about the data and access its applicability and intent use, in a standard way.

With the wide spread of desktop GIS, such as QGIS, the access to distributed geospatial data has become more accessible. Through this plugin, an access abstraction layer was created between the user and the data stored on the server, eliminating the need to manually configure the parameters to establish a WMS connection in the QGIS to access data.

Currently, only part of the layers produced by PRODES project are accessible via the plugin. In the future, we intend to make more layers from the server available and to extend the plugin to support other OWS services, such as the WFS.

4. CONCLUSION

The monitoring of land-use change in Brazilian Biomes is essential to contain and reduce deforestation in it. The projects such as PRODES and DETER monitor deforestation

of the Brazilian Legal Amazon, Cerrado and nowadays other biomes too. The implementation of the plugin was presented as one more tool for the dissemination of the data from TerraBrasilis Web portal. Some examples of usability were presented to demonstrate how the plugin works, and how users can add layers and use them for other purposes. This tool can help users to see the historical land-use change that occurred in a region. The TerraBrasilis enables the analysis of different data, to provide an environment flexible and interactive.

5. ACKNOWLEDGEMENT

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