ISSN 1831-9424

European Commission

Geospatial Analysis Tools supporting the Risk Assessment of the Regulation on deforestation-free supply chains

A guide to visualize and interact with GFC2020 using the JRC IMPACT Toolbox and other applications

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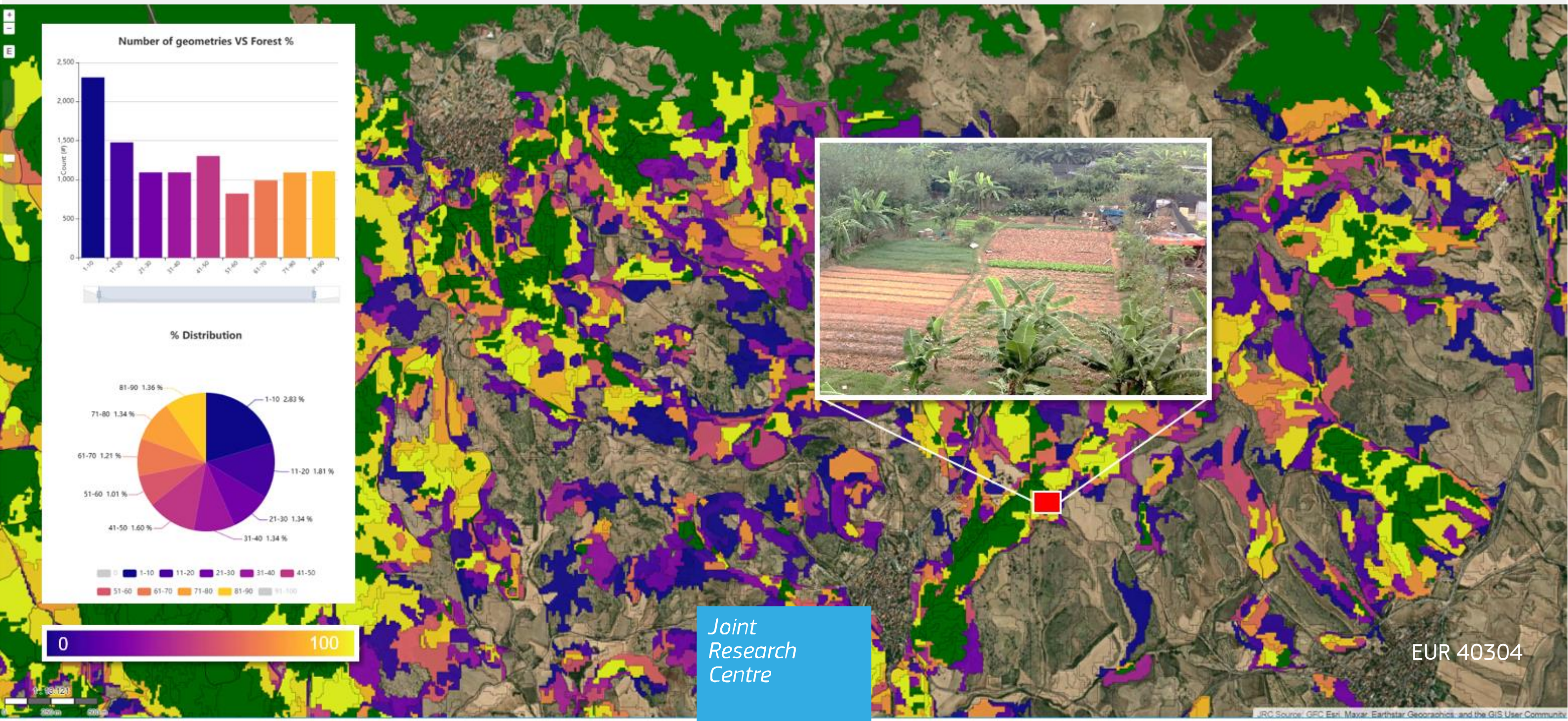
2025



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JRC141229

EUR 40304

PDF ISBN 978-92-68-27056-1 ISSN 1831-9424 doi:10.2760/5075197 KJ-01-25-257-EN-N

Luxembourg: Publications Office of the European Union, 2025

How to cite this report: Simonetti, D., Degreve, L., Bourgoin, C., Achard, F. and Colditz, R., *Geospatial Analysis Tools supporting the Risk Assessment of the Regulation on deforestation-free supply chains,* Publications Office of the European Union, Luxembourg, 2025, https://data.europa.eu/doi/10.2760/5075197, JRC141229.

Contents

Abstract

The JRC developed and updates the Global Forest Cover map for the year 2020 (GFC2020) as a support tool for the implementation of the EU Regulation on deforestation-free supply chains (Regulation (EU) 2023/1115, in short EUDR). The report serves stakeholders, foremost operators and traders concerned with the risk assessment as set out in article 10 of this regulation, to assess the requested geospatial information against the GFC2020 map. The report describes basic procedures for data visualization and intersection for three freely available software tools: the JRC IMPACT Toolbox, Quantum GIS and Google Earth Engine. To facilitate the assessment, the JRC developed an extension for the IMPACT Toolbox, tailored to the demands of data viewing and intersection in the context of the EUDR.

Foreword

Forests are home to a great deal of biodiversity and harbour enormous amounts of global carbon on land. They filter the air we breathe and contribute to the regulation of global fluxes of heat and moisture. Forests provide sustainable materials for a thriving bioeconomy, and their social and cultural values are immeasurable, not only for indigenous communities.

Statistics from the FAO Global Forest Resources Assessment 2020 report a loss of forest area equivalent to the size of 25 football fields every minute between 2015 and 2020. Today, global forests continue to shrink in area and to degrade in functionality as an ecosystem. This causes a loss of biodiversity, a reduction in terrestrial carbon stock leading to higher CO_2 levels in the atmosphere, and a deterioration of the quality of life for many people around the world.

The European Union decided to act by addressing the Union's demand for commodities and products that significantly contribute to global forest loss and forest degradation. The EU Regulation on Deforestation-free supply chains (EUDR) takes a novel approach, prohibiting the placing on the EU market, or the export from it, of cattle, cocoa, coffee, palm oil, rubber, soya and wood, if they are produced on land that was deforested after 2020. The implementation requires that operators and traders provide, inter alia, the geolocation of the sourcing area. Even though not specifically mentioned in the Regulation, maps can effectively help assess the deforestation risk in the Due Diligence process.

To this end, the Joint Research Centre (JRC), the European Commission's scientific and knowledge service, developed a global forest cover map for the year 2020 (GFC2020). This map is a harmonised and globally consistent representation of the presence and absence of forests at a 10-meter spatial resolution. In December 2024, the JRC released the second version of this map, taking into account user feedback, revised data and additional data that became available during the year 2024. The map has 91% overall accuracy.

Since the release of the GFC2020 map, a number of EUDR stakeholders expressed the need for guidance and tools to access this dataset for their specific regions and retrieve information for their own geolocation information on plots of land. With this report the European Commission responds to this demand with a guidance document that is written in simple technical language. It provides step-by-step instructions for three applications of free software tools that can be used by anyone to visualise and quantitatively assess forest presence from GFC2020 or any other existing forest cover map within their plots of land. We hope that this will facilitate data analysis for the risk assessment of deforestation and contribute to the implementation of the EUDR.

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Acknowledgements

We are grateful for technical support, feedback and comments received during numerous discussion from (in alphabetic order): Silvia Carboni (European Dynamics Luxembourg S.A.), Giovanni Caudullo (Arcadia SIT s.r.l.), and Andrea Marelli (Arcadia SIT s.r.l.). We sincerely thank the anonymous reviewer for valuable comments and constructive suggestions, which have significantly contributed to improving the quality of our manuscript.

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Executive summary

Policy context

The EU Regulation on Deforestation-free supply chains (Regulation (EU) 2023/1115; EUDR) sets out rules and obligations for commodities and relevant products to be placed or made available on the EU market or exported from it. Cattle, cocoa, coffee, oil palm, rubber, soya and wood must be deforestation-free, produced in accordance with legislation in the producing country and covered by a due diligence statement that includes the geolocation of the place of origin. The EU Observatory on deforestation and forest degradation hosts global forest maps and spatial forest and forestry-related information and facilitates access to scientific information on supply chains, linking deforestation, forest degradation and changes in the world's forest cover to Union demand for commodities and products. Specifically, the map of Global Forest Cover for the year 2020 (GFC2020) could support the implementation of this Regulation by informing the risk assessment by operators and traders.

Aim of the report

The report addresses stakeholders concerned with the geospatial implementation of the EUDR. The report describes procedures to view or intersect geospatial information with GFC2020 or other appropriate sources such as forest maps available at national or regional level. Geospatial information are points or polygons provided by or available to the user that could be included in a due diligence statement and submitted to the EUDR Information System. Such analysis could mainly concern operators and traders during the phase of risk assessment. Other actors such as NGOs and businesses interested or engaged in assuring compliance of their materials with the EUDR may also have an interest in undertaking such checks voluntarily.

Stakeholders welcomed the JRCs initiative to produce GFC2020 but noted that the map is difficult to use and needs some knowledge and experience in geospatial data handling. Analysis over larger areas or quantifications may require geospatial analysis tools or other advanced technologies, which are not readily available to all stakeholders. Making best use of the additional time to prepare for the implementation before the EUDR goes into application by 30 December 2025, this report responds to the stakeholders' requests. Following the instructions in this user manual, stakeholders will be in a position to undertake visualizations and basic quantitative geospatial analysis.

Main outcomes

The report presents in simple technical language the step-by-step procedures for two main challenges that stakeholders may frequently encounter: 1) visualize points and polygons on top of GFC2020 or other national or regional maps of forest cover for the year 2020 and 2) assess points and polygons against maps. The latter is a procedure of intersection between geospatial data sources that results in a quantification of how many points or polygons coincide with forest in GFC2020 or other relevant sources and where these spatial coincidences are located.

The report focuses on three freely available tools to address the challenges described above. The IMPACT Toolbox is a JRC in-house geospatial data analysis environment that works also on IT infrastructure with low processing power and in places with severe Internet bandwidth limitations. In the context of this report, the JRC developed a data analysis module tailored to specific needs under the EUDR. This tool simplifies data intersection between the users' geospatial information and maps, including on-demand data download for the area of interest. Quantum GIS (QGIS) is a generic open source Geographical Information System (GIS), for which we only introduce very essential functionalities to perform the necessary tasks. The same procedures will be found in other freely available or proprietary GIS and can be applied analogously. Google Earth Engine (GEE) hosts a copy of the GFC2020 map and offers analysis possibilities over very large areas, yet some coding experience may be necessary.

Related and future JRC work

The JRC will continue improving GFC2020 and consolidating the preliminary map on Global Forest Types for the year 2020 (GFT2020) to support the assessment of potential forest degradation. The JRC could, occasionally and upon request, organize short training sessions to demonstrate processes with the tools presented in this report.

Quick guide

The report describes simple processes of data analysis in three freely-available software tools: the IMPACT Toolbox developed by the JRC, QGIS and Google Earth Engine. Using simple technical language, the chapters describe how to visualize points and polygons on top of GFC2020 and quantitative analysis by intersection of points and polygons with the map.

1 Introduction

1.1 Policy context

Deforestation and forest degradation are major drivers for global greenhouse gas emissions and biodiversity loss (Barlow et al., 2016, Bourgoin et al 2024, Harris et al., 2021). In this context, the EU adopted the Regulation on deforestation-free supply chains (EUDR; EU 2023). In force since 2023 and going in application on 30 December 2025[1], this regulation sets out rules and obligations for a set of commodities and related products associated with deforestation and forest degradation when placing or making available on the EU market or exporting from it. Specifically, cattle, cocoa, coffee, oil palm, rubber, soya and wood are prohibited on the EU market unless they are 1) deforestation-free, 2) legally produced according to the laws in the producing country, and 3) covered by a due diligence statement. Deforestation-free refers no conversion of forest land use to agriculture (deforestation) and no conversion among specific forest types[2] (forest degradation) after 2020. Due diligence has to be documented and assured by operators and traders and checked by competent authorities that were appointed by Member States. Operators and traders have to provide information, including the geolocation of where commodities and related products were produced, and depending on the region assess and possibly mitigate the risk.

The EUDR Information System[3] (IS) has been developed by the European Commission (EC) as a registry of Due Diligence Statements (DDS). It streamlines the creation and electronic submission of DDS by operators, traders and their representatives. Also, it makes the DDS available to other actors in the supply chain and eventually to competent authorities to demonstrate that products are deforestation free and comply with the other requirement of the EUDR.

The EUDR notes several tools and mechanisms that could support the implementation of the EUDR. As one of those tools, the EU Observatory on Deforestation and Forest Degradation (EUFO) hosts global forest maps and spatial forest and forestry-related information. It facilitates access to scientific information on supply chains for public entities, consumers and business, linking deforestation, forest degradation and changes in the world's forest cover to Union demand for, and trade in, commodities and products[4]. The Joint Research Centre (JRC), the European Commission's scientific and knowledge service, is in charge of the EUFO.

Upon request by DG Environment[5], the JRC produced and improves the map of Global Forest Cover for the year 2020 (GFC2020; Bourgoin et al. 2024, Bourgoin et al, 2025a). Specifically, this map could support the implementation of the EUDR by informing the risk assessment by operators and traders. Given the definition of deforestation with the cut-off date 31 December 2020 and the

[1] Co-legislators adopted a postponement for entering into application by one year (EU 2024). The regulation will become applicable on 30 December 2025; for small and medium enterprises as of 30 June 2026.

[2] Forest type conversions that qualify as forest degradation include: 1) Primary forest converted to planted forest, plantation forest or other wooded land and 2) naturally regenerating forest converted to plantation forest or other wooded land.

[3] Art 33 of the EUDR (EU 2023); Commission Implementing Regulation (EU) 2024/3084 (EC 2024); The Information System of the Deforestation Regulation - European Commission

[4] The EU Observatory on Deforestation and Forest Degradation (EUFO) was announced in the Commission Communication on Stepping up EU Action to Protect and Restore the World's Forests. (COM(2019) 352).

[5] Amendment to the Administrative Agreement ENV N° 09029901/2021/852710/AA/ENV.F.3 - JRC N ° 35920 NFP, and Administrative Agreement ENV N°090201/2024/923161/AA/ENV.F1 - JRC N° 36816 NFP

geolocation requirement for commodities and related products in the due-diligence statement, operators and traders could link declared points or polygons to maps or other spatial data, e.g., geotagged photos, to inform their risk assessment. This report contributes with extra guidance to the simplification the EU undertakes for implementing the EUDR.

While well received, stakeholders consulting GFC2020 noted technical challenges with data handling. It requires several steps and some knowledge about geospatial data and tools to view points or polygons on GFC2020 or satellite images or to assess if they intersect with forest in a map. This is particularly challenging for stakeholders concerned with the implementation of the EUDR who use geospatial data for the first time. Besides operators and traders who have the obligation to submit DDS, there are voluntary actors, e.g. NGOs or businesses that want to ensure compliance of their value chain with the EUDR. Also users with some experience in geospatial data processing found it challenging to cope with large data volumes, the tiling of data for download, a complex coding environment of some tools, etc.

1.2 Objectives of the report

This report is a user manual that aims to serve stakeholders with no or little experience in geospatial data processing, assessing points or polygons against GFC2020. It contributes with guidance to the simplification the EU undertakes for implementing the EUDR[6].

Chapter 2 of this report describes the requirements and considerations regarding geospatial data that can be used as input datasets within the proposed tools. It indicates the access and download possibilities for GFC2020 and introduces an open-access test dataset, intended to facilitate the replication of the Geographical Information System (GIS) operations detailed in this report.

The report presents three freely-available software tools that allow to view points or polygons on GFC2020 or other existing maps and to assess if they intersect with forest in such maps. The tools are:

1. IMPACT Toolbox: a JRC in-house desktop application with a specific interface for the EUDR presented in chapter 3,
2. Quantum GIS (QGIS) presented in chapter 4,
3. Google Earth Engine (GEE) presented in chapter 5.

Each chapter describes the respective tool in simple technical language with the following content:

- Getting started with the tool: installation, set-up and quick overview.
- Viewing of geospatial information: load map data or background satellite images via web services or as downloaded product into the application and visualize the geolocation data (points and polygons) that indicate the sourcing areas of commodities and related products.

[6] https://ec.europa.eu/commission/presscorner/detail/en/ip_25_1063

- Intersecting points and polygons with GFC2020 or other maps of relevance for the EUDR implementation: retrieving information for points or polygons by vertex as binary feedback (presence/absence) or intersect polygons by area against the map and retrieve agreement by percentage.

While outlining the potentials for a cost-efficient implementation of the risk assessment, operators and traders need to be aware of the non-legal status of the EUFO and specifically GFC2020. The EUDR 1) does not foresee a mandatory use of maps, 2) other maps than GFC2020 have at least equal value, and 3) results for an analysis of GFC2020 against points and polygons are not legally binding. An intersection of a point or polygon with forest in GFC2020 does not legally imply "deforestation" nor does an intersection with non-forest in GFC2020 legally imply "no deforestation".

2 Geospatial data and considerations

2.1 Global Forest Cover map for the year 2020 (GFC2020)

The Global Forest Cover map for the year 2020 (GFC2020; Bourgoin et al. 2024, Bourgoin et al, 2025, Colditz et al. 2024, Colditz et al. 2025) is one of the data sets specifically produced for the EUDR implementation and hosted on the EUFO. This map is a harmonized, globally consistent representation of forest presence or absence at 10m spatial resolution, meeting the definition of forest according to the EUDR. GFC2020 is a support tool, offered free-of-change by the EU that may be used by operators or traders to help inform the risk assessment. It is specifically noted that GFC2020 is:

1. non-mandatory: there is it is no obligation to use GFC2020 or any other map,
2. non-exclusive: any other map has at least the same value and importance than GFC2020 in the implementation of the risk assessment, and
3. non-legally binding: results from an analysis of points or polygons declared in a due diligence statement against GFC2020 have no legal status or value.

In the context of the risk assessment, the JRC recommends to use this map together with other spatial and non-spatial datasets to gather and strengthen evidence that sourcing areas are deforestation free (Verhegghen et al., 2024). Member State competent authorities could use this map as a first filter to identify areas which should be checked further.

The definition of forest as set out in the EUDR (similar to the FAO-FRA (FAO 2018)) is based on forest land use and physical characteristics with minimum thresholds for tree height (5m), tree cover density (10%) and area (0.5ha). Especially the land use concept and aspirational elements in the definition, such as the ability to reach those physical thresholds at maturity, impose significant challenges when mapping forest from remotely sensed data. In short, not every parcel of land stocked with trees is a forest, e.g. agricultural tree plantations are excluded from the forest definition. Likewise, forest land use can be temporarily unstocked, e.g., after harvest or natural disturbances. GFC2020 addresses these challenges by combining readily available global data layers that indicate the potential existence of forest or the absence thereof. In a first step, the map combines several data sets to include areas with a potential existence of forest land use; next, data layers are used to exclude areas that do not belong to forest land use. The mapping approach of GFC2020 undergoes improvements based on user feedback, newly available or revised input data. In the currently available second version of the map, the JRC improved the detection of forest/non-forest, e.g. in Western Africa with an accurate separation between agricultural areas of coffee and cocoa plantations *versus* forest.

The global map accuracy of GFC2020 is 91%, which is above average for globally produced data sets. The forest area in the map has a commission error (the probability that the map indicates forest which did not exist in 2020) of 18% and an omission error (the probability that the map does not indicate forest) of 8%; hence the risk of overestimating forest area is higher. This is reflected in area totals: Globally GFC2020 maps 4,562 million ha of forest (Bourgoin et al. 2025a, Colditz et al. 2025); for comparison the global forest area in FAO-FRA is 4,058 million ha (FAO 2020). By the end of 2025, we foresee further updates of GFC2020 and a consolidation of the Global map of Forest Types for the year 2020 (GFT2020)[7].

GFC2020 has been made available on the EUFO and other locations:

— For visualization:

  - EU Forest Observatory website: https://forest-observatory.ec.europa.eu/forest/rmap
  - Web Mapping Service (WMS): https://ies-ows.jrc.ec.europa.eu/iforce/gfc2020/wms.py?

— For download and analysis:

  - ForObs website with download in tiles in GeoTIFF format: https://forobs.jrc.ec.europa.eu/GFC
  - Google Earth Engine (GEE) asset for download or analysis-ready processing: https://developers.google.com/earth-engine/datasets/catalog/JRC_GFC2020_V2

— Metadata: JRC Data catalogue: http://data.europa.eu/89h/e554d6fb-6340-45d5-9309-332337e5bc26

2.2 Geolocation in due diligence statements for EUDR Information System

The EUDR requires operators and traders to provide the geolocation of all plots of land from which a commodity or a product has been sourced[8]. The EUDR defines geolocation as the geographical location of a plot of land by means of latitude and longitude coordinates with at least six decimal digits. Plots of land larger than four hectares must be provided as polygons with sufficient vertices to describe the perimeter; for all other plots a single point is deemed sufficient. Annex 1 contains relevant elements of the EUDR that refer to the geolocation requirements.

The geolocation has to be provided along with other obligatory information in the due diligence statement. Due diligence statements will be ingested in the EUDR IS, a data base maintained by the European Commission. Besides data assimilation and storage, the EUDR IS allows for an effective exchange with other systems and data. Article 33 of the EUDR (EU 2023) outlines general principles of the EUDR IS and procedures are further detailed in Implementing Regulations (EC 2024).

Guidance (EC 2025a) for the EUDR confirms that geolocation for all plots of land are an integral part of the information requirements in the due diligence process. This means that a due diligence statement without complete geolocation information will be considered incompliant. Updated Frequently Asked Questions (FAQ; EC 2025b) for the implementation of the EUDR clarifies further requirements how geolocation information needs to be collected and submitted to the EUDR IS. Elements with relevance for geospatial data analysis in the context of this report concern:

[7] Recently, the JRC also produced a preliminary map of Global Forest Types for the year 2020 (GFT2020). This product is undergoing consolidation and should support the implementation of the risk assessment of forest degradation. Given its current status, this map will not be subject to this report, but the technical tools presented in this report can be used in a similar fashion to analyse GFT2020.

[8] Specific conditions and requirements for the required information at set out in Art 9 of the EUDR, including requirements for cattle.

- File format: The EUDR IS only supports submissions in the non-proprietary GeoJSON file format.[9] This format can store point and polygon geometries in the same file. The order of coordinates is longitude followed by latitude.
- Maximum file size: The EUDR IS only supports submissions up to 25 mega bytes (MB) file size. This corresponds to approximately 1 million coordinates per file.
- Precision of coordinates: The EUDR IS only supports coordinates with a precision of six decimal digits in latitude and longitude. Coordinates with higher precision (more than six decimal digits) will be truncated. Coordinates with lower precision (less than six decimal digits) will be filled with trailing zeros.
- Coordinate system for geolocations: The EUDR IS only supports WGS-84 datum following the EPSG-4326 projection standard.[10]

Annex 2 contains relevant elements from the before-mentioned documents and provides technical specifications which are relevant in the context of geospatial analysis.

2.3 Geolocation data in geospatial analysis tools

Geospatial analysis tools may read and process geolocation data differently compared to the EUDR IS. This section does not aim to give an overview but focuses on a few important issues that can be frequently encountered, also in geospatial analysis tools not presented in this report.

While the GeoJSON file format can be read by most tools, internal data processing may not handle mixed geometry types; that is storing points and polygons together in one file. A frequently used proprietary file format is ESRI Shapefile (*.shp). Shapefiles are limited to store only one geometry type. When reading or importing GeoJSON files, the user may be required to select the geometry type. The user could generate files with different geometry types and conduct the analysis in for the whole data set in multiple steps. Another requirement for other geospatial file formats, including Shapefiles, is the generation of an attribute table. The two-dimensional table contains entries for each geometry element in rows and a set of features that can be freely defined, for each geometry in columns. This table may only contain the obligatory "ID" column that is internally linked with geometric features, here points and polygons. Shapefiles store the attribute table in a separate dbase file (*.dbf) with the same filename as the shapefile.

Geospatial files may handle data with the same geometry differently depending on the level of aggregation or grouping. For instance, a county may be composed of several islands that are not geometrically connected. Geospatial tools can handle geolocation data in a way that by clicking on one island the tool selects all islands that belong to this country (so called multi-part polygons). In this case the attribute table has one entry (row) that contains data for all polygons that belong to it. Alternatively, the same data could be stored in individual polygons that are geospatially distant from each other (single-part polygons). Here, the attribute table has one row for each polygon. Conversion between both ways of data handling can be performed in many environments via

[9] https://geojson.org/

[10] https://epsg.org/home.html

operations known as “dissolve” for aggregation or “undissolve”, “multipart-to-singlepart” or “explode” for disaggregation.

The maximum file size of 25 MB as defined for the EUDR IS (section 2.2) does not apply to geospatial analysis tools. Of course there are physical or computational limits to the file size but they depend on the local processing power and storage capacity and the specific requirements and limitations of the geospatial tool and the IT operating system.

When handling data or importing external data, the user should be aware which element in the coordinate correspond to latitude and longitude. By default, GeoJSON stores first the longitude and next the latitude. Many tools have the means to read coordinates in the desired order. If the order is unknown, there is only the possibility to test via plausibility, i.e. display the geometries on the map and assess which way is the right presentation. In most cases this plausibility test will indicate which coordinate corresponds to longitude and latitude, but ambiguity may remain if the location has similar values for longitude and latitude (e.g. the pairs of coordinates is near 10 degrees latitude and longitude).

Most geospatial analysis tools offer a wide variety of projections. Many tools project the data “on the fly” or offer means for re-projection in case data sets such as the geolocation and the map have different projections. Thus a geospatial analysis tool will produce a correct or approximately correct analysis, relating the geolocations to areas in the map. However, analysis in the GIS between data with different projections could reveal incorrect spatial colocations.

Finally, before conducting quantitative analysis in a geospatial analysis tool, the user should ensure that the whole set of geolocations is covered with information on forest/non-forest in the map. The intersection will retrieve information from this map, whether there is data or not, and may not display “no data” in the final output.

2.4 Test dataset for this manual

Figure 1 shows the test dataset on top of the Global Forest Cover map for the year 2020, version 2 (GFC2020 v2) layer, depicted in green, and a satellite images from Google in the background. The dataset is a spatially defined collection of geographic features, stored in GeoJSON format, and designed for testing or demonstration purposes. Located at approximately 7.8°W, 45.8°N, it contains a mixed geometry structure of polygon and point data types. Specifically, the test dataset includes 12 distinct polygon features, each assigned identification numbers (“id” field) from 1 to 12, and 8 point features, identified with numbers 13 through 20.

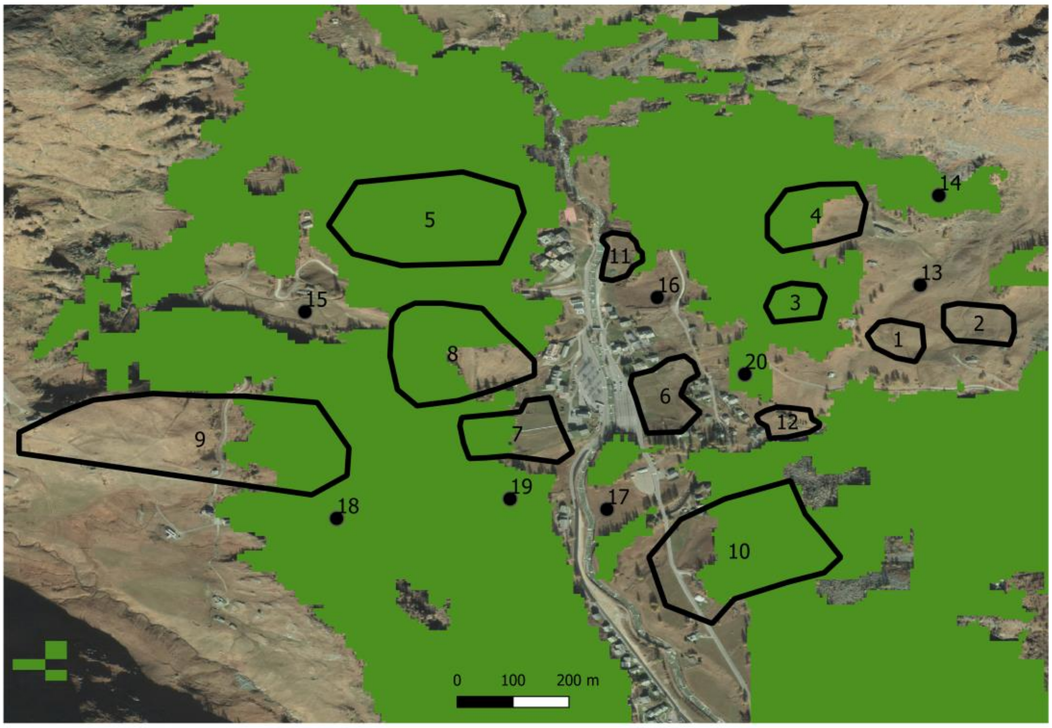
The test dataset is open source and freely accessible at:

- ForObs website[11] (compressed folder containing GeoJSON and ESRI Shapefiles)
- GEE asset (table id)
    - Shapefile (point features): ”projects/JRC/TestData_points”
    - Shapefile (polygon features): ”projects/JRC/TestData_polygons”

[11] https://forobs.jrc.ec.europa.eu/static/gfc2020/TestData.zip

- Shapefile (polygon vertices): "projects/JRC/TestData_polygons_vertices"

Figure 1. GeoJSON test dataset (7.8°W, 45.8°N) visualized on GFC2020 v2 (green), containing 12 polygons (id 1-12) and 8 points (id 13-20).



Source: JRC. Background data: Google, © 2024 Maxar Technologies.

3 IMPACT Toolbox

The JRC IMPACT Toolbox is a free and open-source application that simplifies remote sensing and geospatial analysis for non-specialists, providing a GIS environment for image processing and map editing. It enables users to perform tasks like the mapping and monitoring of land cover and verification activities. In the context of the EUDR and subject of this report, the JRC added a specific module that supports visualization and straight-forward analysis of geolocation data and maps, foremost GFC2020.

3.1 Getting started with the IMPACT Toolbox

Download and install the IMPACT_Toolbox_v5.x.exe (select the latest version) from the official website[12] and follow the wizard to complete the setup. It is recommended to install the IMPACT Toolbox on a separate drive, such as (D:) or (E:), rather than the primary Windows system drive (C:). Once installed, the user interface will appear automatically in your default web-browser. Please note the DOS console showing status logs represents the local IMPACT processing server. Keep it open to guarantee the normal execution of the application. After download and installation, the IMPACT Toolbox functions completely on the client (user) side using exclusively the local computational resources. Access to online web-services (namely WMS) and automatic data download from the JRC server depend on internet connectivity. User data, e.g. the geolocation data, are not shared or uploaded to the JRC server.

For **Mac OS** or **Linux** operating systems, IMPACT Toolbox is distributed via a Docker image. It is therefore necessary to have Docker installed on your system (please refer to the official website[13]). Follow the instructions to complete the installation before proceeding with the download and execution of the "START_impact.sh" file available on the abovementioned IMPACT website.

To (re)launch the IMPACT Toolbox, simply double-click on the START_Impact[14] file to initiate the program (Figure 2) or type "http://127.0.0.1:8899/IMPACT" in your browser (for non-Windows users). Place all the data files (GeoTIFF, GeoJSON or ESRI Shapefile) you would like to work with, in the DATA folder.

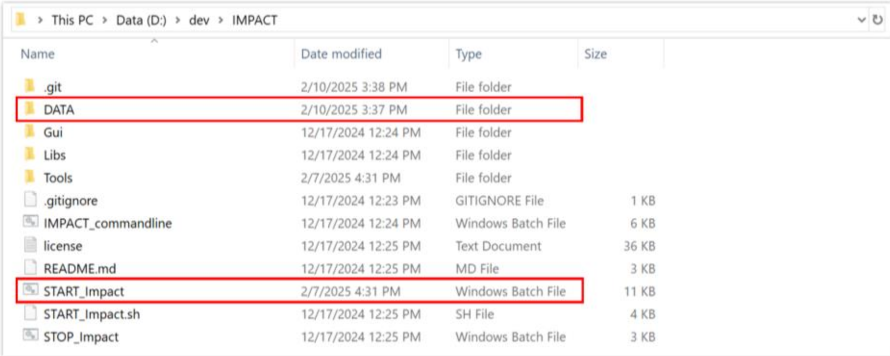
In the eventuality that your network requires a **proxy authentication**, in order to access JRC services and resources (namely the GFC2020), insert your credentials in the IMPACT Toolbox "Setting Panel" and save your changes. However, IMPACT Toolbox could work completely offline making use of local resources (raster and vector data).

[12] https://forobs.jrc.ec.europa.eu/IMPACT

[13] https://docs.docker.com/get-started/get-docker/

[14] The complete filename is "START_Impact.bat"

Figure 2. Structure of the IMPACT Toolbox directory under Windows. Note that the common file name extensions might be hidden and the content might differ in another operating system.



Source: JRC.

Updating IMPACT Toolbox: users are notified when a new version or bug-fix is available. In Windows, it is sufficient to accept the update via the popup message while in other operating systems the command "*docker pull mydronedocker/impact5*" triggers the download of the latest image.

This report refers to IMPACT Toolbox v5.214 beta. Future releases may slightly differ from the guidance and figures shown in this report.

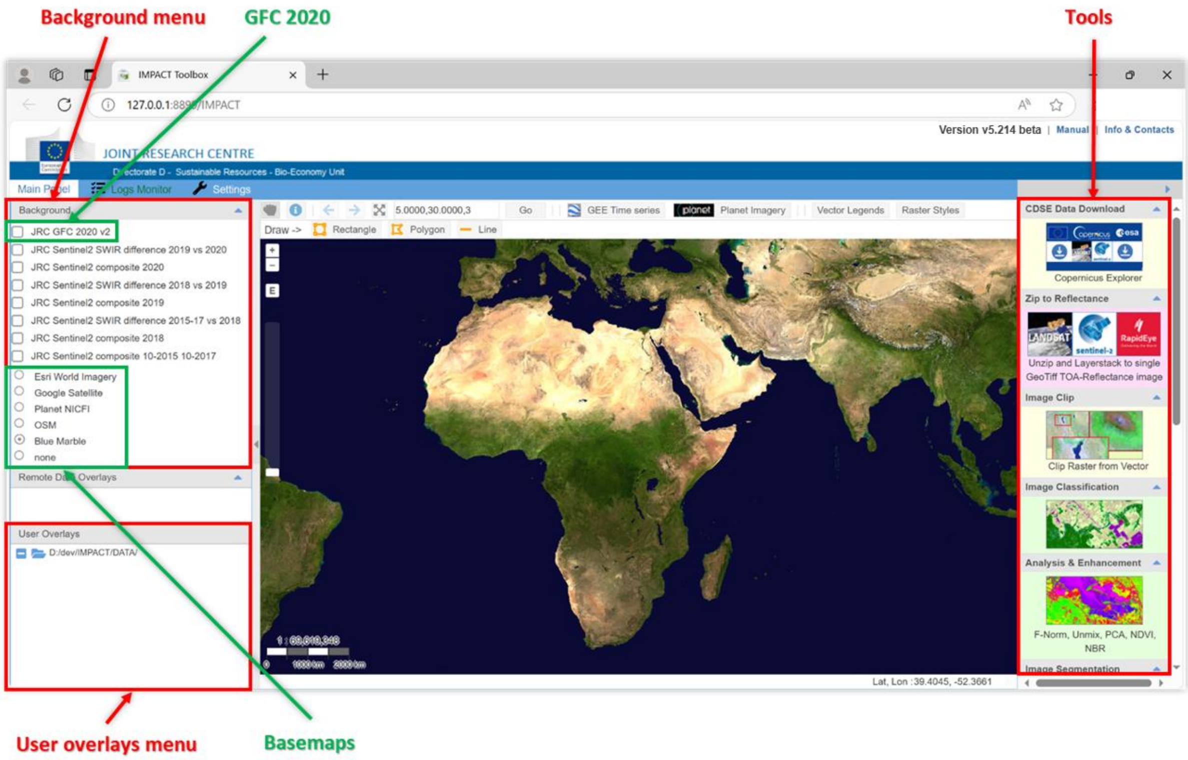
3.2 Viewing of geospatial information with IMPACT Toolbox

3.2.1 Viewing GFC2020 as web mapping service

To facilitate the visualization and browsing of the GFC2020 product, the **WMS service** has been integrated in the Background menu located on the left side of the IMPACT Toolbox interface and named "JRC GFC2020 vX[15]" (Figure 3).

[15] "X" is the number of the current version of GFC2020.

Figure 3. IMPACT Toolbox Interface.



Source: JRC. Background data: Blue Marble.

3.2.2 Viewing downloaded maps

Any **raster map in GeoTIFF format** (.tif) could be visualized in the IMPACT Toolbox by copying or moving the files into the DATA folder (Figure 2). New file(s) are automatically visualized and become accessible via the User Overlays menu, located at the bottom left panel (Figure 3). Right-click on the file to change the band combination and colour contrast.

Even though the IMPACT Toolbox offers an automatic download of the GFC2020 product via the EUFO module, the operator could also **manually download** it from the ForObs website[16] by selecting the tile(s) that overlap with the area of interest. When using this manual download option, it is worth noting that, in case two or more tiles are needed to cover the study site, the operator has to either merge the individual tiles into a single mosaic (see the IMPACT Toolbox online guide[17]) or perform multiple intersections between vector and raster tiles. We therefore encourage the operator to take advantage of the automatic data acquisition and merging performed within the EUFO module.

[16] https://forobs.jrc.ec.europa.eu/GFC

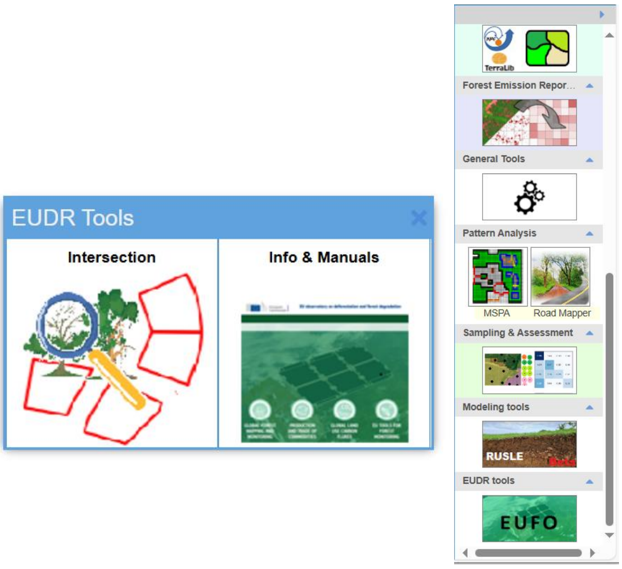
[17] https://forobs.jrc.ec.europa.eu/IMPACT

3.3 Intersection of geospatial information with GFC2020

This section describes the key steps to perform the so called "zonal statistics" operation between a set of geolocation data and map in raster format. Despite the possibility of using advanced, independent and fully customizable IMPACT processing modules, the EUFO tool aims to i) streamline the extraction of statistics including the automatic download of the GFC2020 forest map, ii) offer an easy way to identify geometry with potential high forest coverage and iii) automatize the generation of reports.

To launch the EUFO tool and **intersect maps with a vector file**, scroll on the right-hand tools menu to the EUDR tools, which is denoted by a green icon labelled EUFO. Click on this icon and select the Intersection option (Figure 4).

Figure 4. IMPACT Toolbox - EUFO Tools - Intersection.



Source: JRC.

The EUFO tool seamlessly supports input files in either GeoJSON, containing single or multiple geometries types, or ESRI Shapefile formats which handles one geometry type per file (see section 2.3). The following sections describe the intersection between the GFC2020 (or any raster map provided by the operator) and geometries, without distinguishing between single or multiple geometry types. Execution mode "Vertices" intersects points and each individual vertex of polygons against the map. Execution mode "Geometry" intersects points and polygons by their area[18].

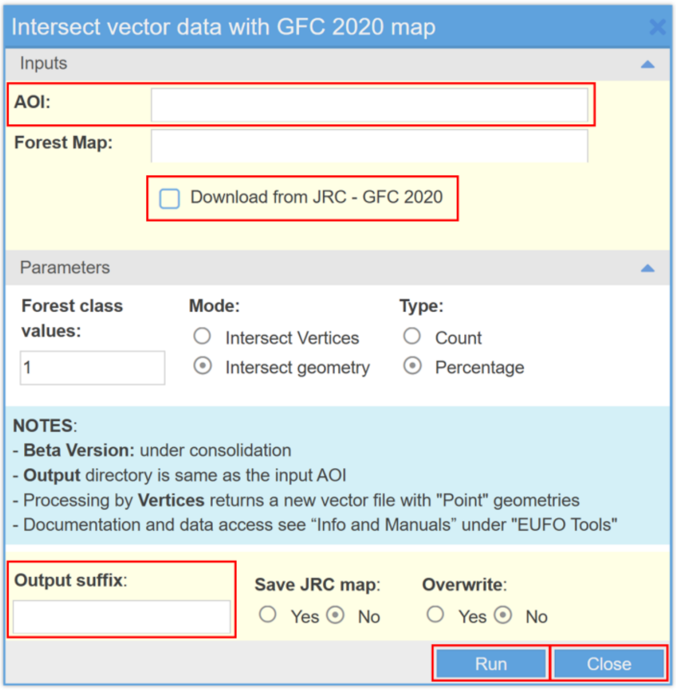
3.3.1 Intersect polygons by area with GFC2020 via automatic map download

Open the assessment tools for intersection as shown in Figure 4 and described in section 3.3.

[18] As the area of a point is zero, the intersection for point by area returns presence (100%) or absence (0%) of forest in the map.

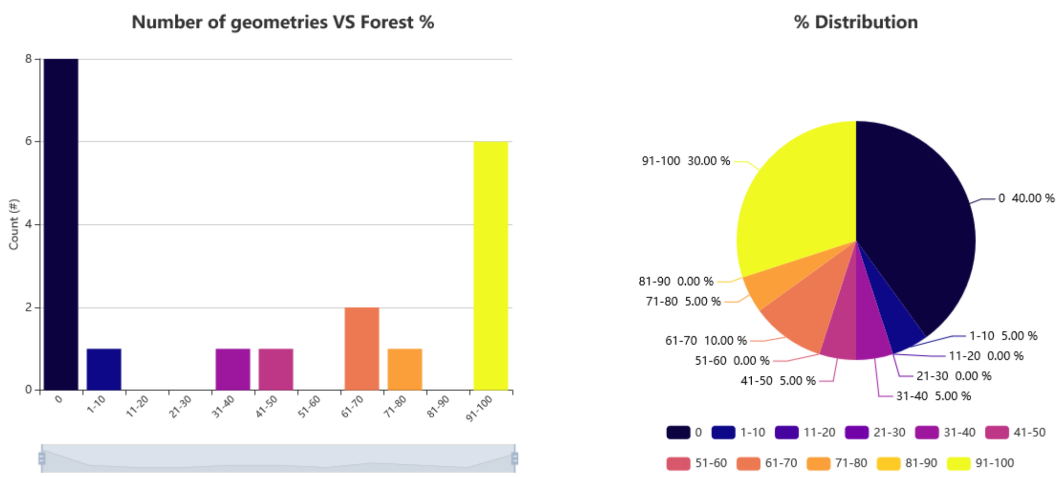
For the **Intersection** (Figure 5), select the file containing your geometry (GeoJSON or ESRI Shapefile) from your DATA folder using the file picker next to the "AOI" (Area of Interest) field. Flag the checkbox next to "Download from JRC – GFC2020" to trigger the automatic download of the GFC2020 map portion covering the selected AOI. Keep the default settings for "Mode" (option "Intersect geometry") and "Type" (option "Percentage"). Enter a suffix for your output file and make use of the "Save JRC map" option to keep a copy of the downloaded map for further use. Use the "Overwrite" option whenever an output file should be overwritten. Click the "Run" button to execute the process.

Figure 5. IMPACT Toolbox – Intersect vector data with GFC2020 map (Type: Percentage).



Source: JRC.

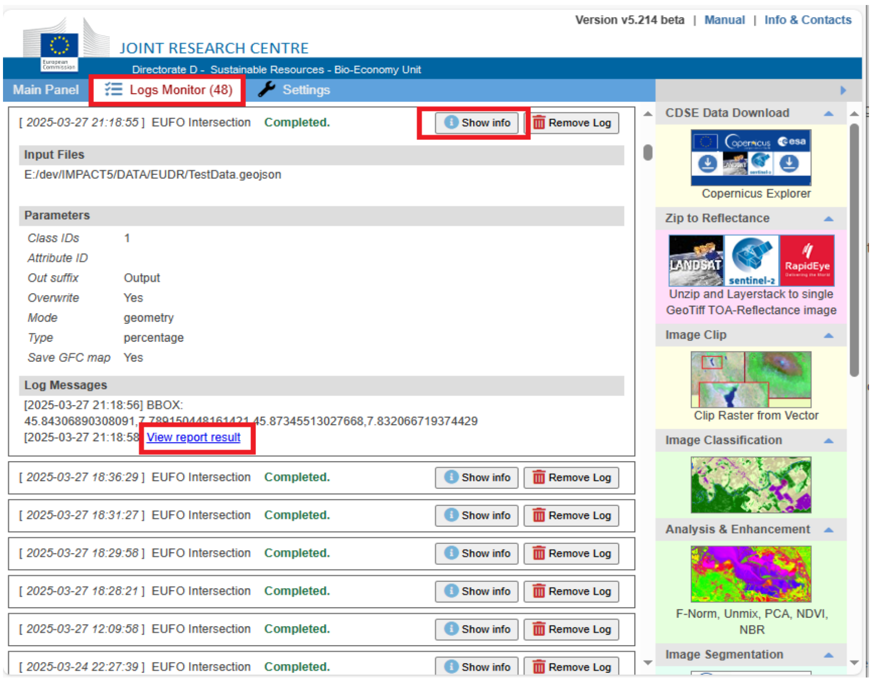
Figure 6. IMPACT Toolbox – Intersection report.



Source: JRC.

The algorithm generates a **statistical description in an html report**, which is displayed automatically (for Windows users) in a new page in your browser (Figure 6). This page provides interactive statistics from the latest intersection. The **histogram** shows the number of polygons for each forest percentage (grouped in ranges of 10% spanning from 0 to 100%). The x-axis represents the percentage categories, and the y-axis shows the number of geometries (points or polygons) in each category. Similarly, the **pie chart** displays the relative proportion of each category to the total. The user can interact with the graphs using the slider or (de)activating categories from the legend. For non-Windows users, the link to the .html report, as well as the parameter used during the processing, can be retrieved at any time from the "**Logs Monitor**" window as shown in Figure 7.

Figure 7. IMPACT Toolbox Logs Monitor window.

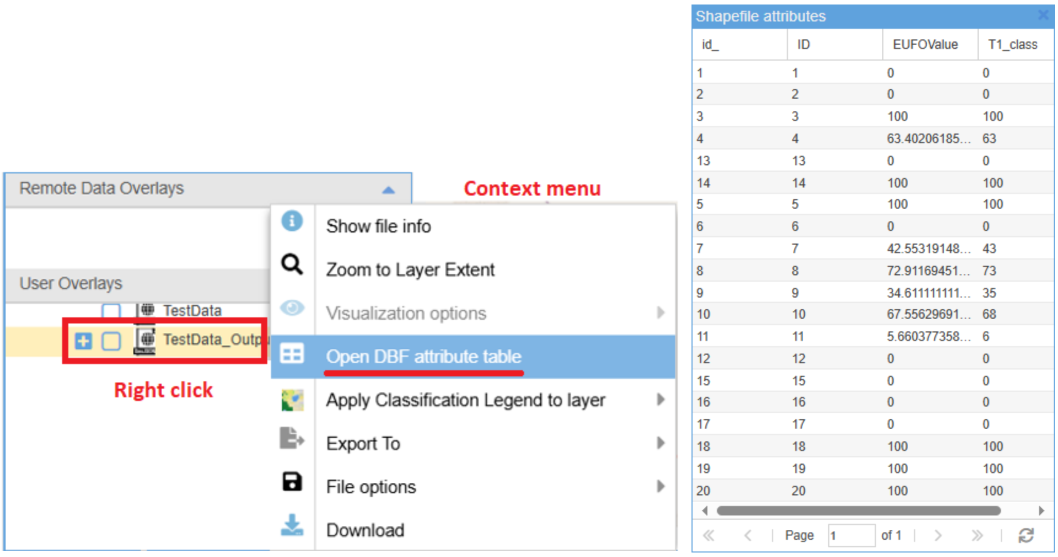


Source: JRC.

A **new output file** will be visible in the Users Overlay panel (Figure 3), keeping the original input file basename and the output suffix as provided by the user (see Figure 5). The content of the output file in tabular format can be visualized using the context menu (via the right-click on the file itself) and selecting the "Open DBF" options (Figure 8). The newly created file inherits all attributes from the input plus two extra fields named "EUFOValue" and "T1_class" containing the percentage of forest within each geometry and a discrete value for display, respectively. Whenever the "ID" attribute is not present in the input file, it is automatically created. If the "id" (lowercase) attribute appears in the input file, the output file retains a copy of its value in a new attribute named "ID" while the original "id" attribute is renamed to "id_".

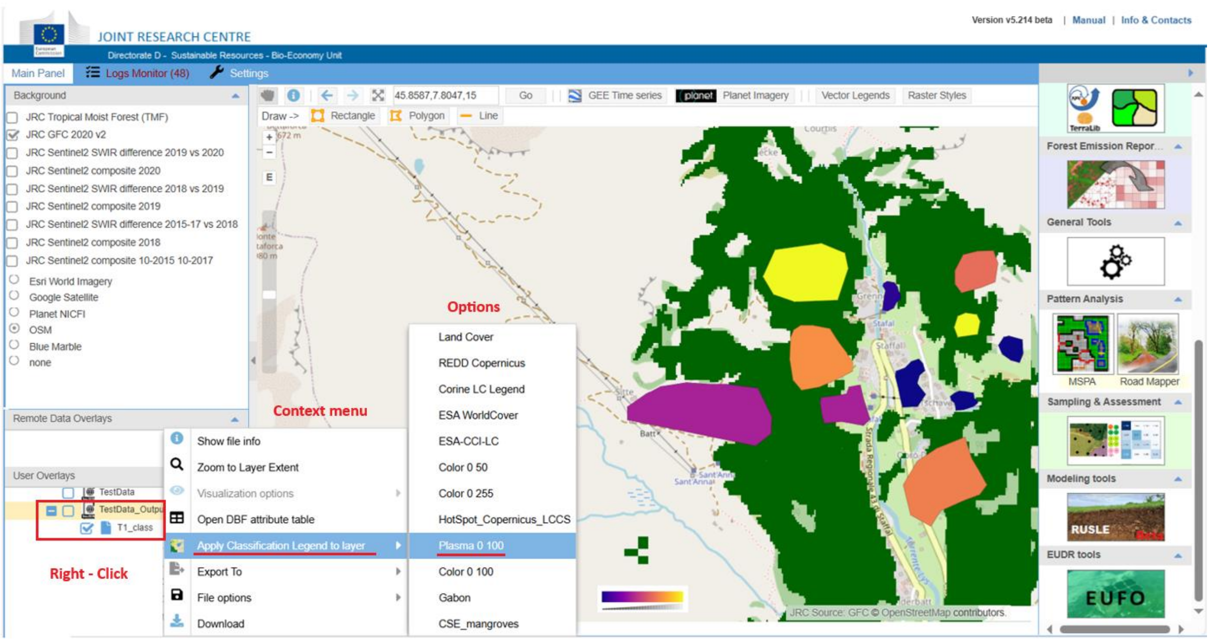
To visualize the percentage of forest in GFC2020 for each polygon, right-click on the file and select "Apply Classification Legend to layer" (Figure 9) and choose a colour palette (e.g., Plasma 0 100). A right-click on the file and "Zoom to Layer Extent" will adjust the viewer to display the full extent of geometries. Darker purple colours indicate low forest coverage and light orange shows higher values (Figure 9). In the same menu, the user may modify the opacity of the layer and the thickness of the geometry contour.

Figure 8. Attribute table containing an identifier, the "EUFOValue" representing the forest percentage within the geometry and the "T1_class" attribute containing a discrete rounded "EUFOValue" for visualization purposes.



Source: JRC.

Figure 9. Steps for applying a classification legend to the output file and rendering by using the default Plasma palette colour on top of Open Street background and forest from the GFC2020 in dark green.



Source: JRC. Background data: Open Street Map.

An ancillary **CSV file** with the content of the GeoJSON (or ESRI Shapefile) in a tabular and coma-delimited format (geometries excluded), is automatically created and saved in the directory of the input file within the IMPACT Toolbox DATA folder.

The above-mentioned exercise shows the outputs produced by the EUFO module when requesting the percentage of forest within the geometry. When **changing the parameter "Type" from "Percentage" to "Count"** (see Figure 5), the module stores the number of forest pixels in each geometry into the attribute “EUFOValue”. As an example, the feature identified with ID=10 in Figure 8 reports the number of forest pixels in the GFC2020 equal to 810 instead of the percentage of forest cover of about 67.5%. The structure of the report and the output files remain the same.

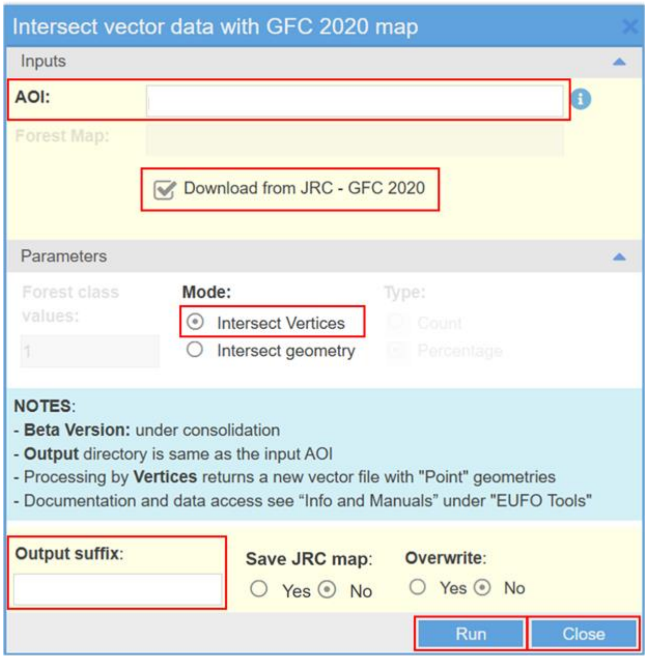
3.3.2 Intersect vertices with GFC2020

This section describes the workflow for intersecting points or the vertices of a set of polygons with the GFC2020 forest. Is worth mentioning that in polygons the first and the last vertex of each geometry are identified by the same coordinates and thus coincide. Although this duplication is not observable in the map, the output files (GeoJSON, ESRI Shapefile and text outputs like *.csv) report those overlapping vertices as separate items, each with its own unique “ID”.

Open the assessment tools for intersection as shown in Figure 4 and described in section 3.3.

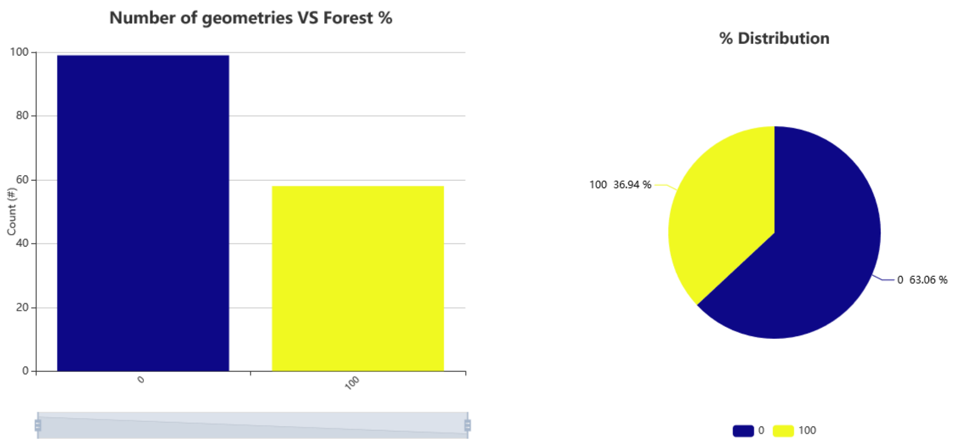
For the **Intersection** (Figure 10), select the file containing your geometry (GeoJSON or ESRI Shapefile) from your DATA folder using the file picker next to the “AOI” (Area of Interest) field. Select the checkbox next to “Download from JRC – GFC2020” for automatic download of the relevant area in GFC2020. Select “Intersect vertices” in the execution “Mode”; this inactivates all options under “Type”. Enter a suffix for your output file and flag, if needed, the “Save JRC map” option to keep a copy of the downloaded map for further use. Use the “Overwrite” option whenever an output file should be overwritten. Click the “Run” button.

Figure 10. IMPACT Toolbox – Intersect vector data with GFC2020 map from IMPACT (Mode: Vertices).



Source: JRC.

Figure 11. IMPACT Toolbox – Intersection report using vertices.

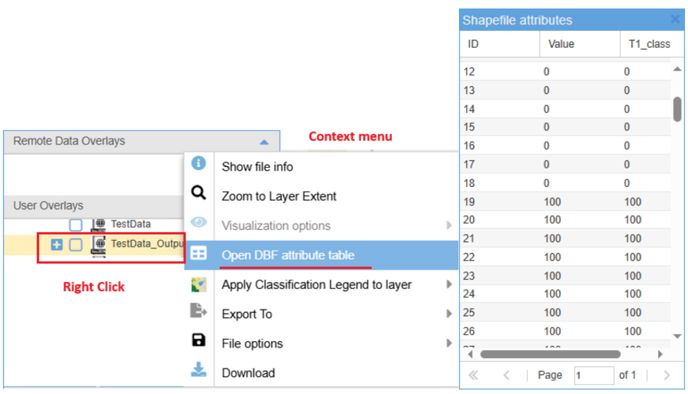


Source: JRC.

The algorithm generates **statistical description in the intersect report**, which will be displayed automatically (for Windows users) in a new .html page in your browser (Figure 11). This page provides interactive statistics from the latest intersection. The **histogram** shows the number of vertices falling outside forest pixels (0%) or inside (100%). The x-axis represents the percentage categories, and the y-axis shows the number of geometries (points or polygons) in each category. Similarly, the **pie chart** displays the relative proportion of each category. The operator can interact with the graphs using the slider or (de)activating some categories from the legend. For non-Windows users, the link to the .html report, as well as the parameter used during the processing, can be retrieved at any time from the "**Logs Monitor**" window as shown in Figure 7.

A **new output file** will be visible in the Users Overlay panel (Figure 3), keeping the original input file basename and the suffix (Figure 10). The content of the output file in tabular format can be visualized using the context menu (via the right-click on the file itself) and selecting the "Open DBF" options (Figure 12). As each vertex is assessed individually, the newly created file does not inherit any information from the input file but simply contains a list of vertices extracted from the geometries with a sequential "ID", the associated attribute "EUFOValue" (0 or 100) and the "T1_class" attribute for visualization purposes.

Figure 12. Attribute table containing identifier, "EUFOValue" representing forest absence for the vertex (0%) or presence (100%) and "T1_class" attribute containing a copy of the "EUFOValue" for visualization purposes.

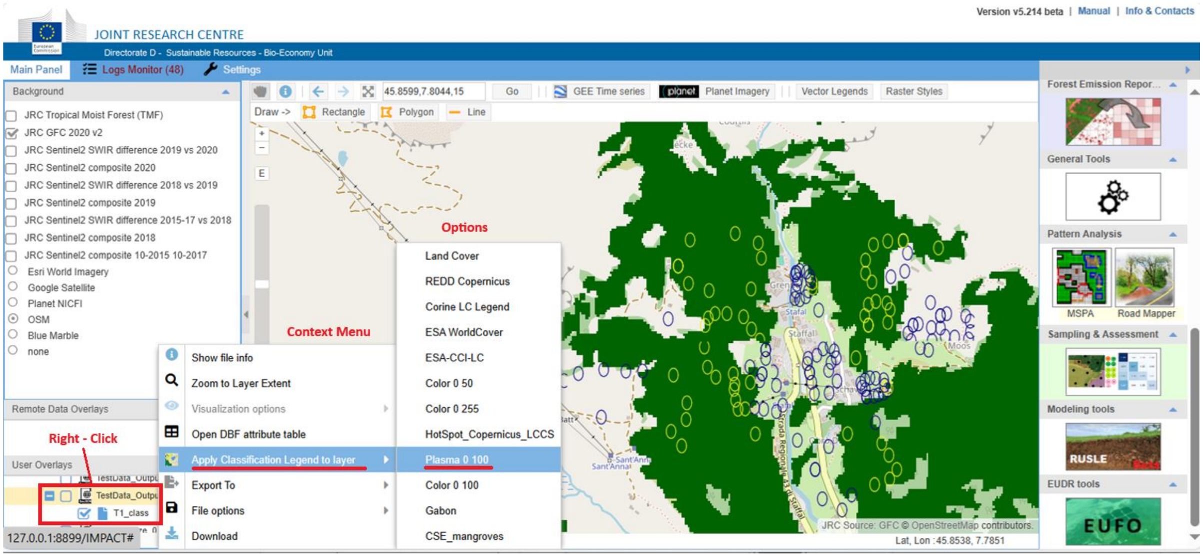


Source: JRC.

An ancillary **CSV file** with the content of the output vector file in a tabular and coma-delimited format (geometries excluded), is automatically created and saved in the same directory of the input file within the IMPACT Toolbox DATA folder. Column "EUFOValue" indicates the absence (0) or presence (100) of GFC2020 forest pixels per vertex. Column "T1_class" is created automatically by the IMPACT Toolbox for visualization purposes.

To visualize the percentage of forest in GFC2020 within each vertex, right-click on the file and select "Apply Classification Legend to layer" (Figure 13) and choose a colour palette (e.g., Plasma 0 100). A right-click on the file and "Zoom to Layer Extent" will adjust the viewer to display the full extent of your geometries. Darker purple colours indicate no forest and light orange shows forest. In the same context menu, the user may modify the opacity of the layer and the thickness of the geometry contour from the "Visualization options" item.

Figure 13. Visualization of vertices with the Plasma classification legend on top of OSM base map and the GFC2020 in dark green.



Source: JRC. Background data: Open Street Map.

3.3.3 Intersect polygons or vertices with previously downloaded GFC2020 map or any land cover or land use map with single or multiple forest classes

This section describes the workflow for intersecting a set of geometry with a previously downloaded and saved GFC2020 forest map composite (via the "Download from JRC" option in IMPACT Toolbox), individual tiles downloaded from JRC ForObs website[19], or any raster map available to the user. The intersection could be done similarly for geometries or vertices, computing the percentage or the count of forest pixel.

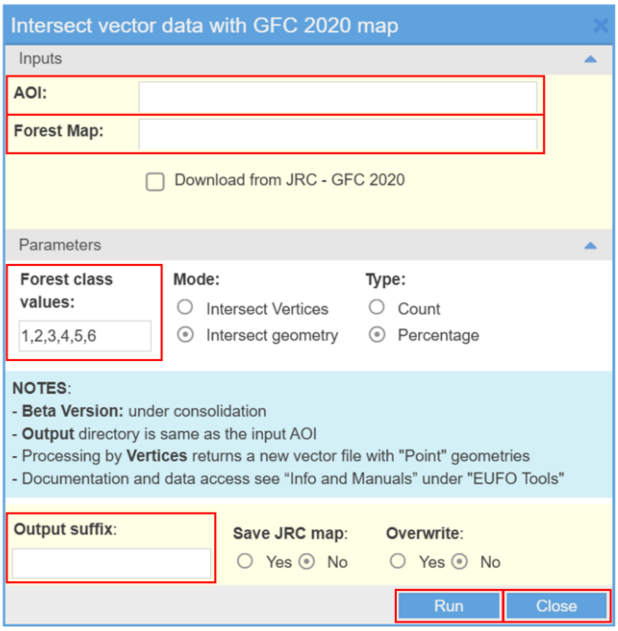
For the **Intersection** (Figure 14), select the file containing your geometry (GeoJSON or ESRI Shapefile) from your DATA folder using the file picker next to the "AOI" (Area of Interest) field.

[19] https://forobs.jrc.ec.europa.eu/GFC

Select desired "Forest Map" with the file picker and indicate under "Forest class values", the class IDs that indicate forest in that map[20]. Several IDs for forest may be specified, also in non-consecutive order, by delimiting values with comma. Select the desired mode and type of analysis as documented in sections 3.3.1 and 3.3.2. Enter a suffix for your output file. Click the "Run" button to execute the intersection process.

For the report structure, output files format and rendering options, please refer to sections 3.3.1 and 3.3.2.

Figure 14. IMPACT Toolbox – Intersect vector data with multi-class map.



Source: JRC.

3.4 General remarks

— The IMPACT Toolbox is a stand-alone application that after download and installation operates solely on the client (user) side. No data from the client are shared with IMPACT Developers or JRC servers.

— It is highly recommended to enable the automatic GFC2020 download to ensure a complete spatial overlap between the reference vector file and the map.

— Geometries falling outside the reference raster map (might only occur with user datasets) will receive a value of -1 and are listed in the final report in a dedicated "Warning" section.

[20] The IDs corresponding to forest classes in the map e.g. "10,12,110". Multiple numbers need to be coma delimited. When using the GFC2020 map, the forest ID is 1.

— The EUFO module supports GeoJSON files containing any geometry types; however, statistics with multi-polygon, multi-point or multi-line might not be meaningful. For instance, an analysis of a GeoJSON file with polygons and point using the analysis mode "Intersect geometry" with type "percentage" will generate values of 0 or 100% for points.

— The EUFO module supports a variety of vector and raster projections via "on-the-fly" reprojection. It is worth noting that slightly different results may be obtained when carrying out an actual reprojection.

— All pixels of the map intersecting with the input geometry are considered in the computation of the statistics.

— The format (GeoJSON or ESRI Shapefile) of the output file matches the input file type. At any time, the operator can convert between the 2 formats using the context menu ("Export to") accessible with the right-click on the file itself.

— As stated in section 1.1, operators and traders could link declared points or polygons to maps or other spatial data, e.g. geotagged photos. The IMPACT Toolbox offers a dedicated module "Photos to MAP" accessible under the "Sampling & Assessment" button (Figure 15), to facilitate the bulk overlay of georeferenced images in .jpg format (e.g. from phones or cameras) with a geospatial dataset or map. All images stored within the selected folder under /DATA are parsed to generate a new XML file containing metadata and GPS coordinates. This new file can be visualized directly in IMPACT Toolbox or used with external software e.g. Google Earth. Please refer to the IMPACT Toolbox manual[21] for further details.

— We kindly invite users of the IMPACT Toolbox to acknowledge the tool when publishing their results by citing this section of the User Manual.

Figure 15. "Photos to Map" IMPACT Toolbox module.

Source: JRC.

[21] https://forobs.jrc.ec.europa.eu/IMPACT

4 QGIS

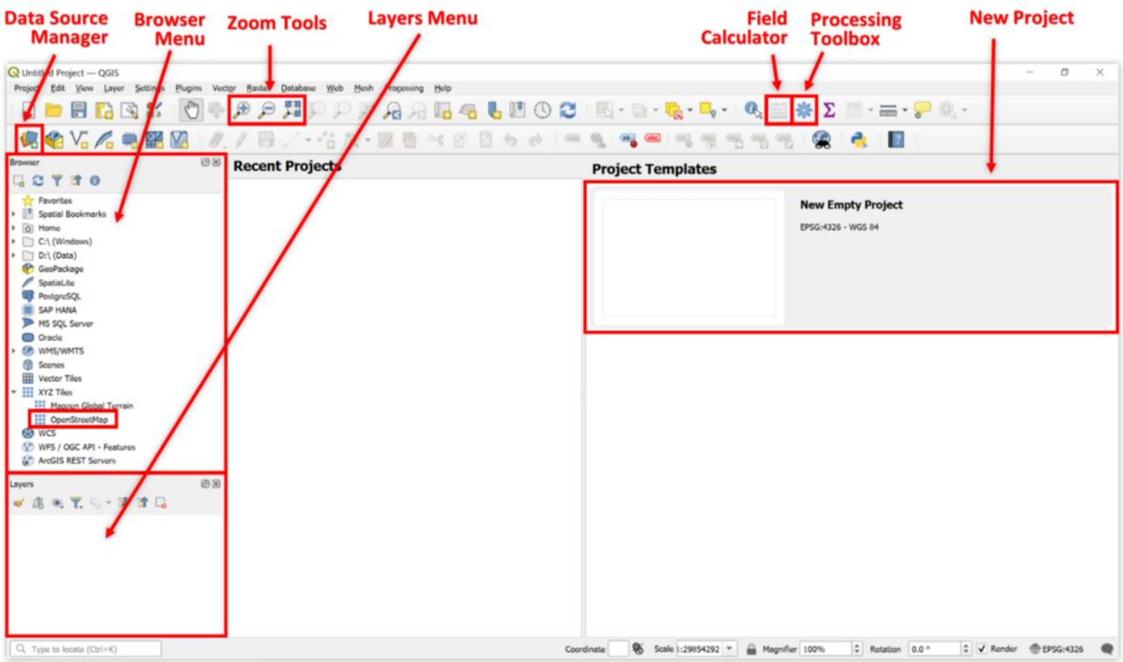
QGIS (Quantum Geographic Information System) is a free and open-source desktop GIS application that allows users to create, edit, visualize, analyse, and publish geospatial information. It supports a wide range of vector and raster data formats, and its extensive plugin architecture enables users to customize and extend its functionality for diverse GIS tasks. QGIS is widely used by professionals, researchers, and enthusiasts for mapping, spatial analysis, and data management.

4.1 Getting started with QGIS

Download and install QGIS from the official website[22]. Follow the installation instructions to complete the setup. Note that QGIS version 3.18 was used in this guide.

Launch QGIS and create a **New Empty Project** (Figure 16).

Figure 16. QGIS Home Page.



Source: QGIS 3.18.

4.2 Viewing of geospatial information with QGIS

4.2.1 Viewing of background layers

Add a base map. In the Browser menu, open the "XYZ Tiles" section and double-click, e.g. on "Open Street Map" (see Figure 16). This tool can also be found after clicking on the Layer tab > Add Layer > Add XYZ Layer. To load Google satellite imagery as base map, right-click on the "XYZ Tiles" tool

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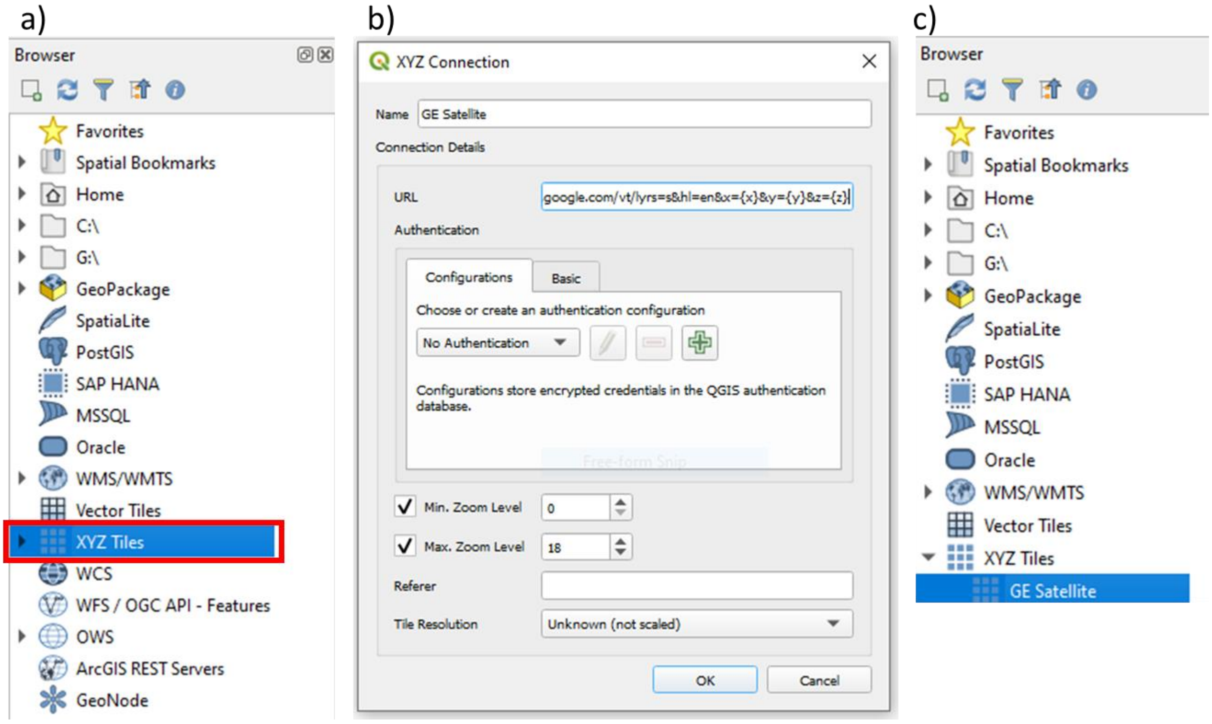
[22] https://www.qgis.org/download/

from the Browser menu, select “New Connection”, paste the following URL: “http://mt0.google.com/vt/lyrs=s&hl=en&x={x}&y={y}&z={z}” into the field “URL” after specifying a name (e.g. “GE Satellite”) and finally double click on the layer to add it to your Layers list (Figure 17).

Figure 17. Adding Base Maps in QGIS Manually: a) right-click on the XYZ Tiles tool; b) establish the connection by specifying the name and the URL of the base map and c) double-click on the added base map to add it to the layers list.



Source: QGIS 3.18.

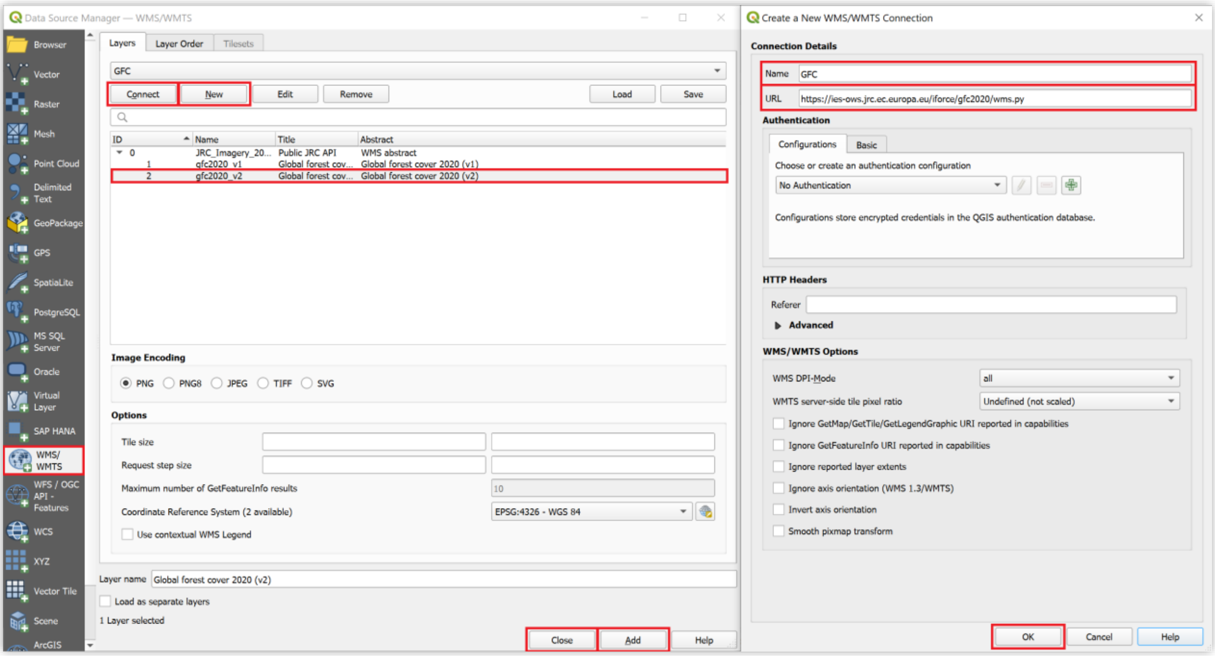
4.2.2 Viewing GFC2020 as web mapping service

To **visualize the GFC2020 map**, reopen the “Data Source Manager” and select “WMS/WMTS” in the left lateral menu (Figure 16). Click on the “New” button to create a new WMS connection (Figure 18), and enter a name for the connection in the “Name” field (e.g. “GFC”). In the “URL” field, enter the following address: “https://ies-ows.jrc.ec.europa.eu/iforce/gfc2020/wms.py”. Click “OK” to save the connection. Then, click “Connect” to establish the connection, select the “gfc2020_vX[23]” layer of interest and click on “Add” to upload the GFC2020 map to your project. Finally, close the tab.

To **change the order of layers**, e.g. to visualize the shapefile on top of the raster data, right-click on the shapefile layer in the “Layers” menu (Figure 16) and select “Move to Top”. Then, right-click again and select “Zoom to Layer(s)”.

[23] “X” is the number of the current version of GFC2020

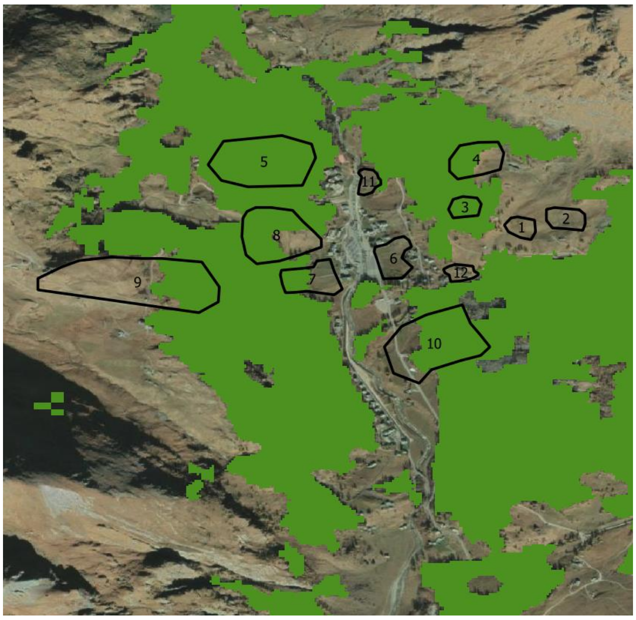
Figure 18. Data Source Manager – WMS/WMTS.



Source: QGIS 3.18.

Use your mouse scroll wheel or the built-in zoom in/out tools (Figure 16) to explore your data on the basemap and get an idea of its spatial extent (see result in Figure 19).

Figure 19. GFC2020 overlaid with the polygons from the test dataset and Google satellite images in the background.



Source: QGIS 3.18. Background data: Google, © 2024 Maxar Technologies.

4.2.3 Viewing downloaded maps

Download GFC2020[24]. Click on the tile(s) that overlap with the area of interest. If using the test dataset, the overlaying tile is "JRC_GFC2020_V2_N50_E0"[25].

Load raster data. Click on the "Open Data Source Manager" button in the top toolbar (Figure 16). Select "Raster" on the left lateral menu (Figure 20). Click on the "..." Browse button next to Raster Dataset(s) and select the GFC2020 tile(s) that you downloaded. Click the "Add" button to integrate the raster data into your project. Forest pixels have a value of 1 and non-forest pixels are have a value of 0.

Figure 20. Data Source Manager – Raster.

Source: QGIS 3.18.

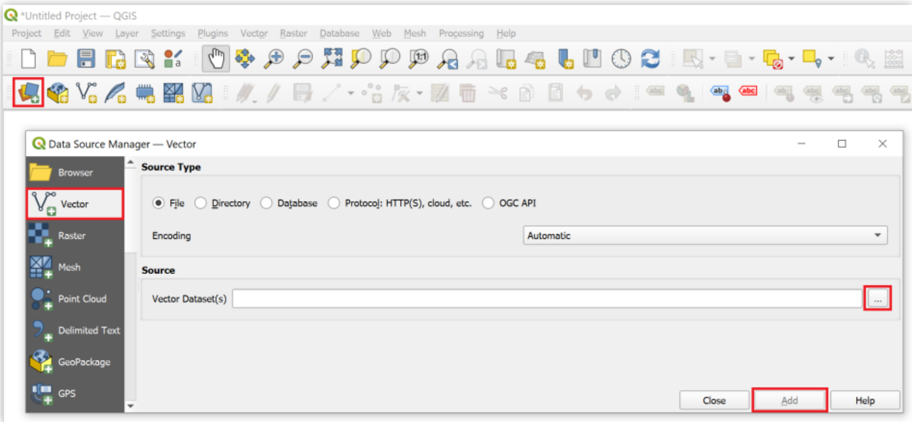
4.2.4 Viewing of geolocation data

To **import geolocation data,** click the "Data Source Manager" button in the top left corner of the QGIS window (Figure 16), and select Vector on the left lateral menu. Then, click on the "..." Browse button next to Vector Dataset(s) and select your vector file (Figure 21). Click the "Add" button to integrate your dataset to the project. You can also drag and drop the .shp (or GeoJSON) file into the QGIS canvas to directly upload your data.

[24] https://forobs.jrc.ec.europa.eu/GFC

[25] Direct download of the test tile is available at: https://ies-ows.jrc.ec.europa.eu/iforce/gfc2020/download.py?version=v2&type=tile&lat=N50&lon=E0

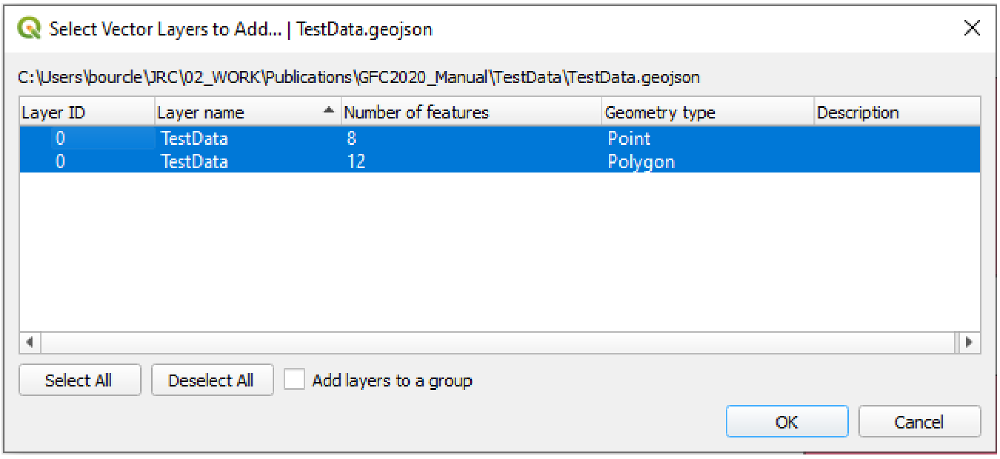
Figure 21. Data Source Manager - Vector.



Source: QGIS 3.18.

When a GeoJSON file is selected, a prompt appears to specify the geometry types to import (Figure 22). For our test dataset, selecting both "point" and "polygon" will import them as distinct layers.

Figure 22. For GeoJSON file, select the type(s) of geometry to load.

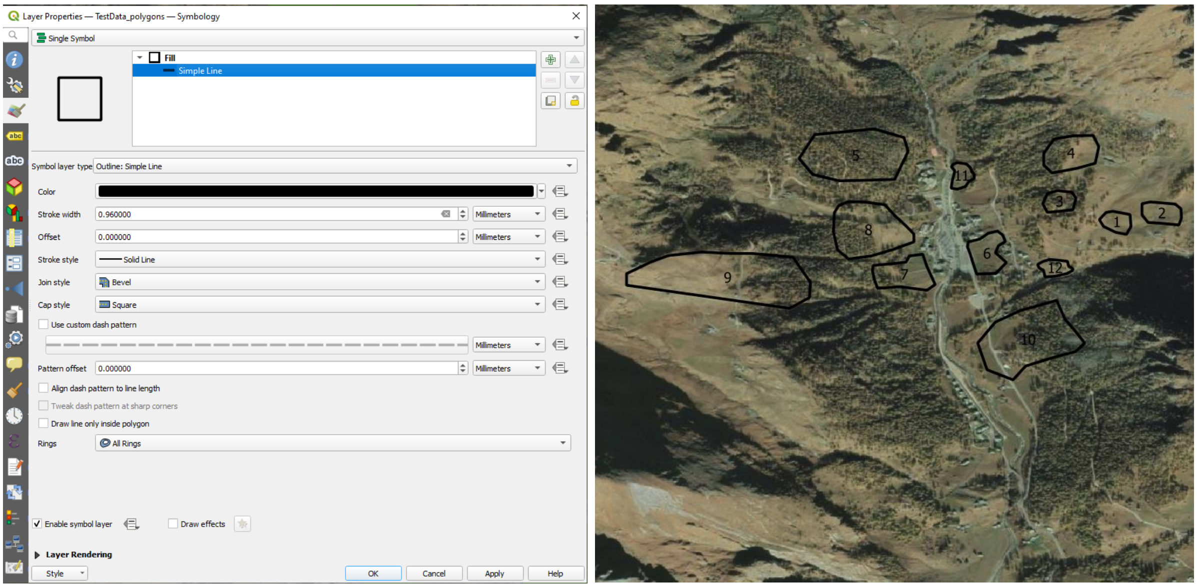


Source: QGIS 3.18.

To **zoom to your added** data, right-click on the layer in the "Layers" menu (Figure 16) and select "Zoom to Layer(s)".

To **modify the symbology** of your added point or polygon data, right-click on the layer in the "Layers" menu (Figure 16), select "Properties…" then "Control feature symbology" (third tool) and click on the "Simple fill" symbol layer type (Figure 23). For polygon features, we recommend setting the fill colour to transparent (accessible via the drop-down menu) and modifying the stroke colour and width to improve the visualization against the GFC2020 map. Default outlines can be applied by clicking on the "Fill" symbol layer type.

Figure 23. Symbology panel to edit the layout of the vector data (left panel). Polygons from the test dataset overlaid on top of Google satellite images and labelled on basis of the built-in id field (right panel).



Source: QGIS 3.18. Background data: Google, © 2024 Maxar Technologies.

4.3 Intersection of geospatial information with GFC2020

This section describes the key steps to perform the so called "zonal statistics" operation between a set of geolocation data and a map in raster format. QGIS handles only one geometry type at the time (i.e. if there is mixed geometry, QGIS needs to intersect points and polygons in separate steps). The following sections detail the intersection between a downloaded tile of interest from GFC2020 (or any raster map provided by an operator) and geometries defined by points, polygon vertices, or polygon area.

Important: When a geometry overlaps with multiple tiles of the GFC2020 dataset, it is necessary to first combine these tiles into a single raster. This merge must precede the zonal statistics operations described in subsequent sections. To perform the merge, access the "Merge" tool via the Raster tab > Miscellaneous > Merge. Select multiple GFC2020 tiles as input data, set the output data type to "Byte," define a name and location for the output file, and initiate the process by clicking "run"[26].

4.3.1 Intersection with points

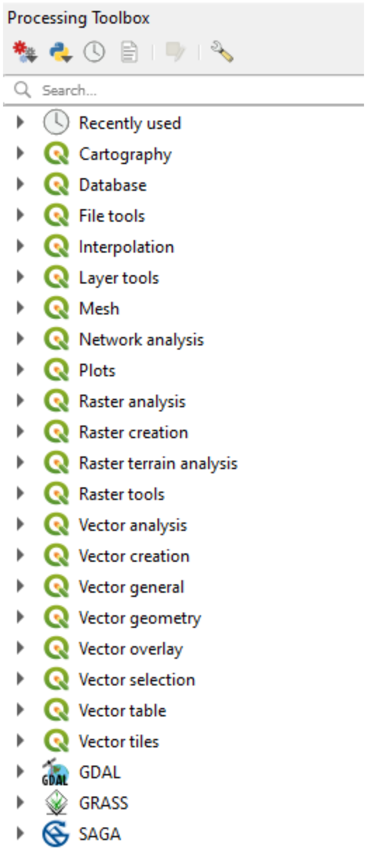
To **intersect GFC2020 with points** and extract forest presence/absence for each location using the Processing Toolbox in QGIS, first open the toolbox by selecting the Processing Toolbox icon (Figure 16) or by navigating to Processing (tab) in the menu bar and select Toolbox. Next, type "Sample raster values" in the search bar of the Processing Toolbox (Figure 24). In the tool parameters (Figure 25), select the Input layer, choose your point geolocation data file. For Raster layer(s) to sample, select the GFC2020 raster. In the Output column prefix field, enter "FOREST".

[26] For more information on raster manipulation: https://docs.qgis.org/3.40/en/docs/training_manual/rasters/data_manipulation.html

Finally, click Run. This will add the forest presence (value 1) and absence (value 0) from GFC2020 as a new attribute to your point layer (the point ID column remains), as shown in Figure 25.

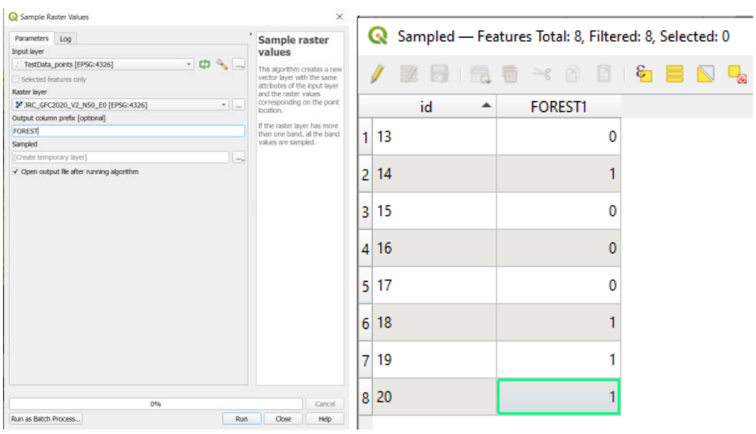
Export to CSV. To save the attribute table with the extracted GFC2020 values to a CSV file, right-click on the output layer in the Layers menu (Figure 16), go to Export > Save Features As..., select "Comma Separated Value [CSV]", and specify the file name and location.

Figure 24. Processing Toolbox.



Source: QGIS 3.18.

Figure 25. Extraction of forest presence/absence for each point with the Sample Raster Values tool (left panel). Attribute table of the output file (right panel).



Source: QGIS 3.18.

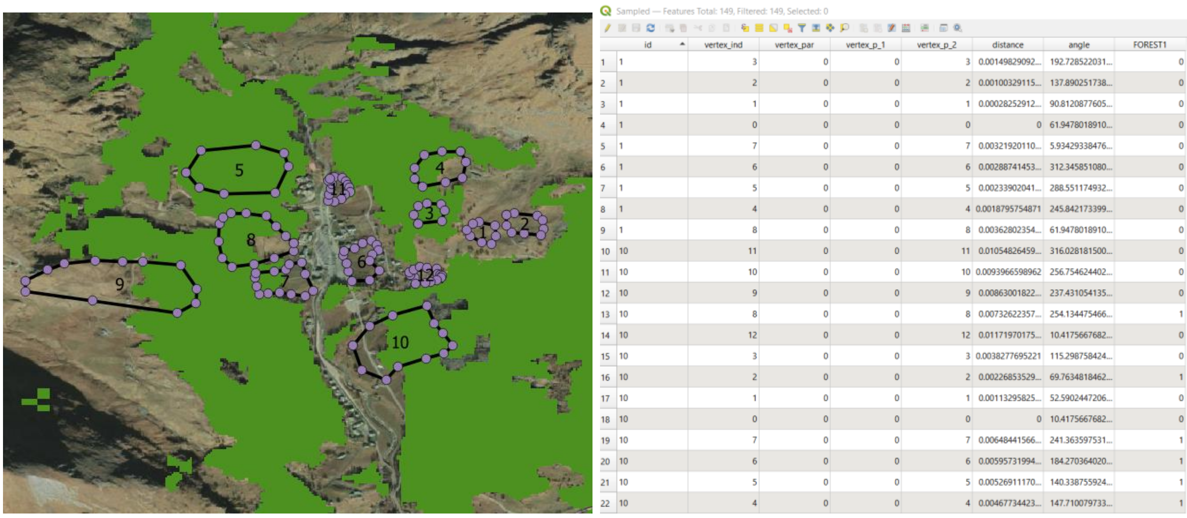
4.3.2 Intersection with polygons by vertices

To **extract vertices from your polygon data** and sample raster values, open the Processing Toolbox (Figure 16) and search for the "Extract vertices" tool in the Processing Toolbox's search bar (Figure 24). For the Input layer, choose your polygon geolocation data. For the Output layer, specify a name for the new point layer that will represent the vertices of your polygons and click "Run".

Once the vertex points layer is created, use the "**Sample raster values**" tool again (see section 4.3.1 and Figure 25). For the Input layer, select the newly created vertex point layer. For Raster layer(s) to sample, select the GFC2020 raster. In the Output column prefix field, enter "FOREST" and click "Run".

Figure 26 shows the vertices of each polygon. Additional fields are added in the attribute table indicating the vertex index ("vertex_ind"), the vertex's part ("vertex_par") and its index within the part, distance along original geometry ("distance") and bisector angle of vertex for original geometry ("angle"). The "id" column, referring to the id of each polygon feature, is kept.

Figure 26. Creation of the polygon vertices (purple dots) from the test polygon dataset using the "Extract vertices tool" (left panel). Extraction of forest presence/absence for each polygon vertex and visualization of the output attribute table (right panel only shows results for polygon ID "1" and "10"). Column "Forest1" contains the result of the extraction.



	id	vertex_ind	vertex_par	vertex_p_1	vertex_p_2	distance	angle	FOREST1
1	1	3	0	0	3	0.00149829092...	192.728522031...	0
2	1	2	0	0	2	0.00100329115...	137.890251738...	0
3	1	1	0	0	1	0.00028252912...	90.8120877605...	0
4	1	0	0	0	0	0	61.9478018910...	0
5	1	7	0	0	7	0.00321920110...	5.93429338476...	0
6	1	6	0	0	6	0.00288741453...	312.345851080...	0
7	1	5	0	0	5	0.00233902041...	288.551174932...	0
8	1	4	0	0	4	0.0018795754871	245.842173399...	0
9	1	8	0	0	8	0.00362802354...	61.9478018910...	0
10	10	11	0	0	11	0.01054826459...	316.028181500...	0
11	10	10	0	0	10	0.0093966598962	256.754624402...	0
12	10	9	0	0	9	0.00863001822...	237.431054135...	0
13	10	8	0	0	8	0.00732622357...	254.134475466...	1
14	10	12	0	0	12	0.01171970175...	10.4175667682...	0
15	10	3	0	0	3	0.0038277695221	115.298758424...	0
16	10	2	0	0	2	0.00226853529...	69.7634818462...	1
17	10	1	0	0	1	0.00113295825...	52.5902447206...	0
18	10	0	0	0	0	0	10.4175667682...	0
19	10	7	0	0	7	0.00648441566...	241.363597531...	1
20	10	6	0	0	6	0.00595731994...	184.270364020...	1
21	10	5	0	0	5	0.00526911170...	140.338755924...	1
22	10	4	0	0	4	0.00467734423...	147.710079733...	1

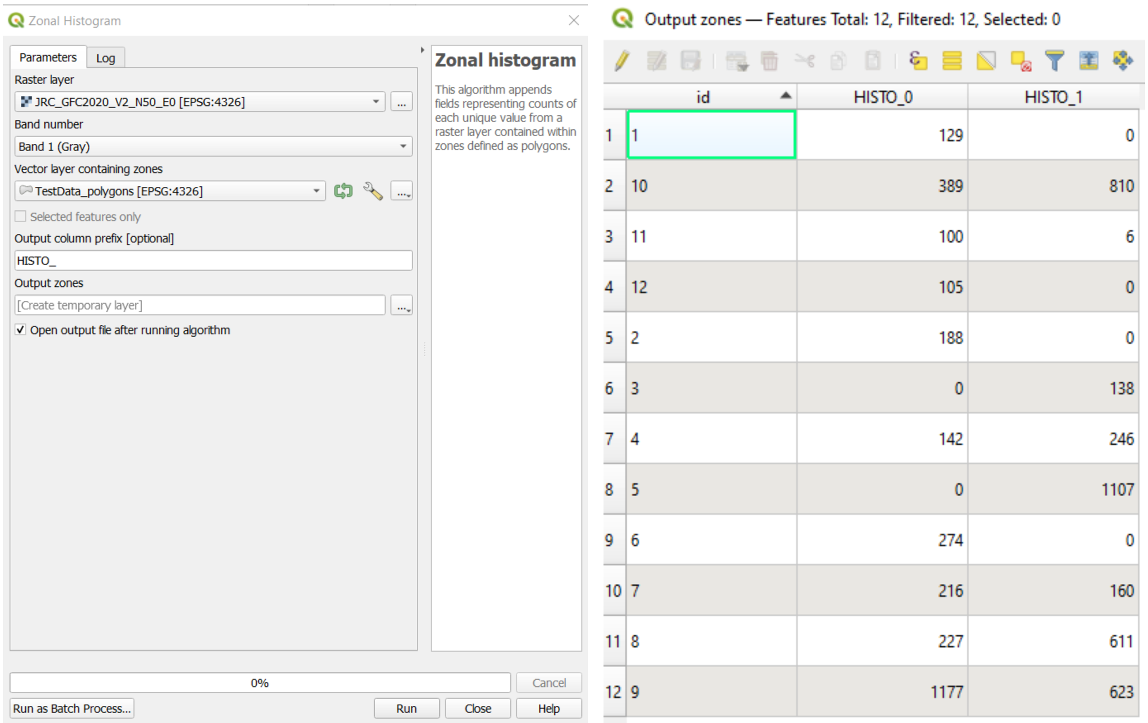
Source: QGIS 3.18. Background data: Google, © 2024 Maxar Technologies.

4.3.3 Intersection with polygon by area

This section describes the workflow for calculating the forest cover percentage or presence/absence of forest cover in a polygon, using GFC2020 forest area statistics within polygon data as an example. Note that this section is designed for shapefile format where each polygon is recording a unique and individual entry in the attribute table. Important: If an entry in the attribute table consists of multiple polygons, the user needs to execute the "**Multiplepart to Singleparts"** tool from the Processing Toolbox before proceeding[27].

In the top toolbar, select "Processing" > "Toolbox" to **open the Processing Toolbox** (Figure 16). In the Processing Toolbox, navigate to the "Raster analysis" section and double-click on "Zonal Histogram". Select the polygon geolocations as the "Vector layer containing zones", the GFC2020 raster as the "Raster layer" in the Zonal Histogram dialog (Figure 27). Click "Run" to execute the Zonal Histogram algorithm. Your layer list will be updated with a new layer called "Output zones". You can also decide to save it as a permanent shapefile layer. This output layer will provide the total number of non-forest pixels (field HISTO_0) and forest pixels (field HISTO_1) for each polygon feature. Note that the sum of forest pixels can also be retrieved via the "Zonal statistic" tool from QGIS's Processing Toolbox.

Figure 27. Zonal Histogram to extract the count of forest and non-forest pixels for each polygon (left panel). Attribute table of the output file containing the count of non-forest pixels (HISTO_0) and the count of forest pixels (HISTO_1) after intersection with GFC2020.



	id	HISTO_0	HISTO_1
1	1	129	0
2	10	389	810
3	11	100	6
4	12	105	0
5	2	188	0
6	3	0	138
7	4	142	246
8	5	0	1107
9	6	274	0
10	7	216	160
11	8	227	611
12	9	1177	623

Source: QGIS 3.18.

Following this computation, you can now derive the percentage of forest cover and/or determine the presence or absence of forest cover for each feature in your polygon data. Note that a polygon is considered to have forest cover if it overlaps with at least one forest pixel from GFC2020. Right-click on the new "Output zones" layer, open its attribute table and then click on "Open Field Calculator" in the top bar menu:

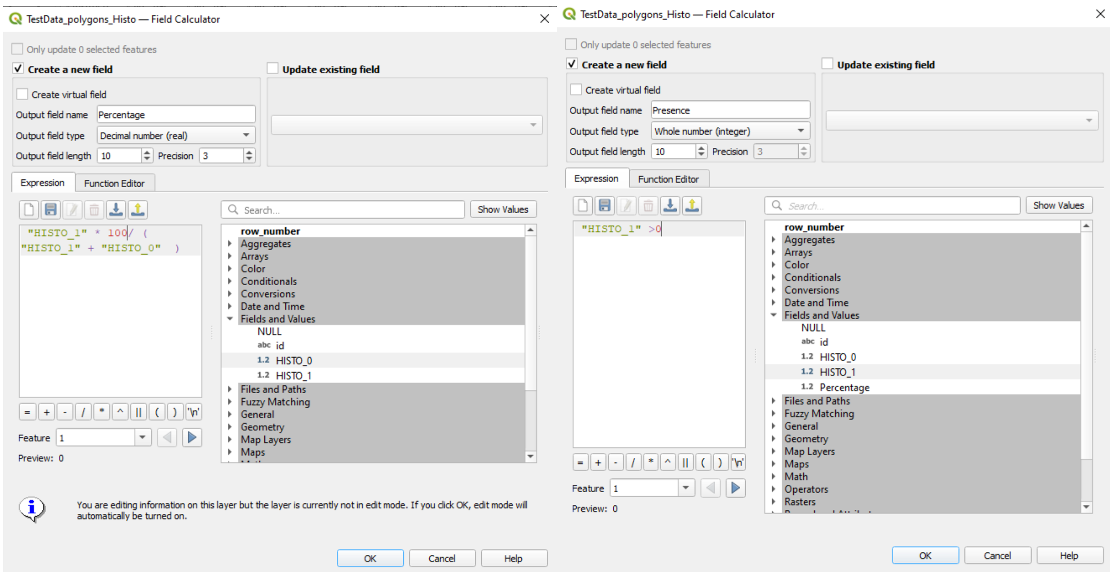
[27] For more information: https://docs.qgis.org/3.40/en/docs/user_manual/processing_algs/qgis/vectorgeometry.html#multipart-to-singleparts

— **To derive the percentage of forest cover:** In the Field Calculator (Figure 28, left panel), enter "Percentage" in the “Output field name” field and select “Decimal number (real)” as the “Output field type”. In the formula field, enter ‘"HISTO_1" * 100/ ("HISTO_1" + "HISTO_0")’ and click “OK” to compute the percentage of forest cover into a new field of the attribute table.

— **To derive the presence/absence of forest cover:** In the Field Calculator (Figure 28, right **panel)**, enter "Presence" in the “Output field name” field and select “Whole number (integer)” as the “Output field type”. In the formula field, enter ‘"HISTO_1" >0’ and click “OK” to reclassify the count of forest pixels within each polygon into a simplified binary forest presence (1) / absence (0) information.

Exit the editing mode by clicking on the “toggle editing mode” in the top bar menu and save the changes.

Figure 28. Field Calculator to compute the percentage of forest cover (left-panel) and to derive the forest presence/absence (right-panel) for each feature of the polygon data.



Source: QGIS 3.18.

Figure 29 shows the final attribute table. To **Save the data**, right-click on the polygon layer in layers menu (Figure 16) and select “Export” > “Save Features As.” Choose the “Comma Separated Value [CSV]” format and specify the directory and file name. Click “OK” to export the data.

Figure 29. Final attribute table displaying the count of non-forest pixels (HISTO_0), the count of forest pixels (HISTO_1), the percentage of forest cover and the forest presence/absence from GFC2020 for each polygon.

	id	HISTO_0	HISTO_1	Percentage	Presence
1	1	129	0	0	0
2	10	389	810	67.556	1
3	11	100	6	5.660	1
4	12	105	0	0	0
5	2	188	0	0	0
6	3	0	138	100.000	1
7	4	142	246	63.402	1
8	5	0	1107	100.000	1
9	6	274	0	0	0
10	7	216	160	42.553	1
11	8	227	611	72.912	1
12	9	1177	623	34.611	1

Source: QGIS 3.18.

5 Google Earth Engine (GEE)

Google Earth Engine (GEE) is a cloud-based platform that provides access to a vast catalogue of satellite imagery and geospatial datasets, enabling large-scale analysis of the Earth's surface (Gorelick et al., 2017). It offers powerful tools and APIs for processing and visualizing this data, facilitating applications in fields like environmental monitoring, land cover change detection, and climate research.

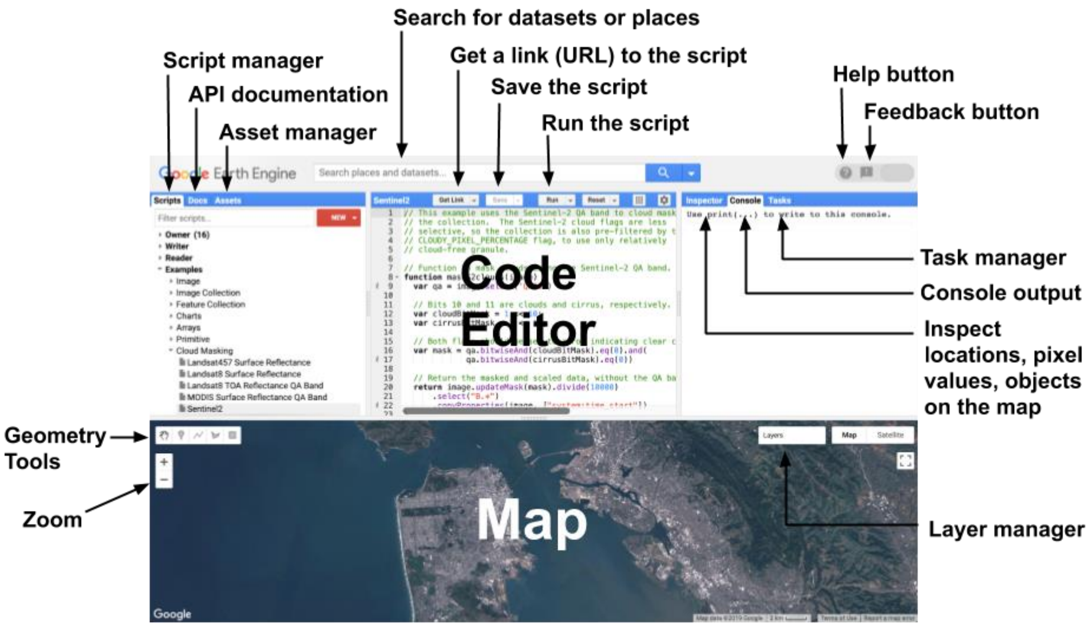
The complete GEE code for visualizing the GFC2020 map and performing intersections with vector data, using the test dataset as an example, is available[28]. This code is broken down into multiple steps, each explained in the following sections.

5.1 Getting started with GEE

Navigate to the Google Earth Engine web interface[29] and **create an account**. Follow the on-screen instructions to complete the account setup and initialization process.

Familiarize yourself with the Google Earth Engine development environment and the Earth Engine Code Editor by **following the official tutorial[30]** provided by Google. This tutorial will introduce you to the key features and functionality and helps you to get started with your projects.

Figure 30. Components of the Earth Engine Code Editor.



Source: Google Earth Engine.

[28] https://code.earthengine.google.com/e6c9f21b3b0aa096389443ab3172ec1f

[29] https://code.earthengine.google.com/

[30] https://developers.google.com/earth-engine/guides/playground

5.2 Viewing of geospatial information with GEE

5.2.1 Viewing GeoJSON files with GEE

For **GeoJSON file import**, copy and paste the code from Box 1 into the code editor (see Figure 30). Replace the text "Paste GeoJSON Geometry Here" with your GeoJSON plain text.

Box 1. Javascript code to add your GeoJSON to the GEE code editor.

```
var geojson = // Paste GeoJSON Geometry Here //

function fromGeoJSON(geojson) {
  var features = ee.FeatureCollection(geojson.features)
  return features
}

var table = fromGeoJSON(geojson)
```

Add your GeoJSON file to the map visualizer. Copy and paste the code in Box 2 into the code editor. Place this code after your previously written code. Click the “Run” button to visualize your GeoJSON data on the GFC2020 map. You can then use your mouse scroll wheel or the built-in zoom in/out tools to explore and interact with the data.

Box 2. Javascript code to add your GeoJSON to the GEE map viewer and to center the map view to the GeoJSON’s bounding box.

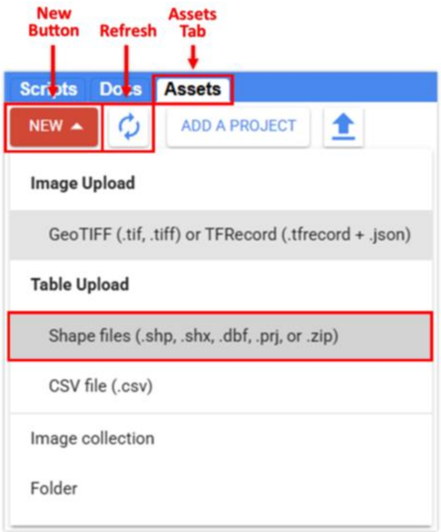
```
Map.addLayer(table, {}, 'JSON');
Map.centerObject(table);
```

Note that this import method has a **file size limitation**. If you encounter issues with the Google Earth Engine interface freezing during the import process, we recommend waiting for a short period to allow the code to execute.

5.2.2 Viewing Shapefiles with GEE

To **import your shapefile**, click on “Assets” > “New” > “Shapefiles” and select your source files (Figure 31). Ensure that your ".shp" file is accompanied by the required ".dbf" and ".shx" files, and select all three files. Click “Upload” to start the process.

Figure 31. GEE Code Editor – Assets Tab.

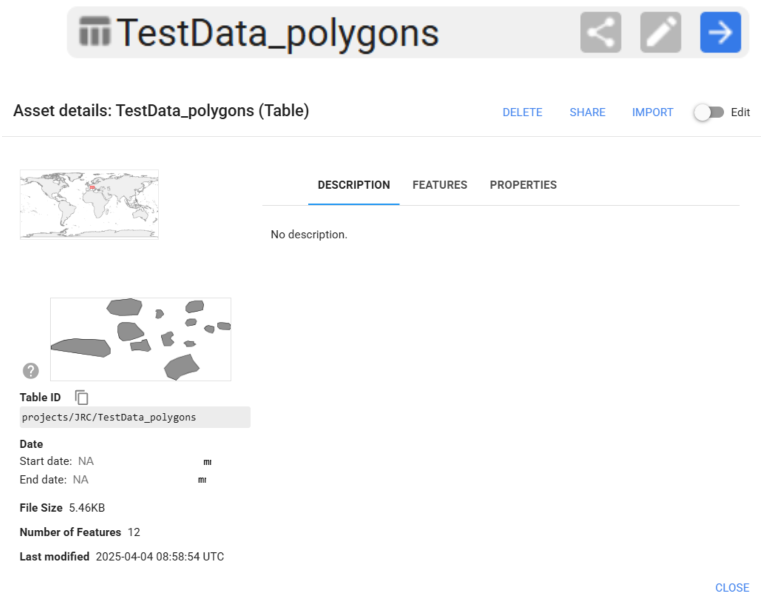


Source: Google Earth Engine.

Wait for your files to be uploaded, and refresh your assets to verify the upload status (Figure 31). **Monitor the upload progress** in the "Tasks manager" (Figure 30), located in the top right corner of the GEE online interface.

Import your shapefile into your script. Go to the "Assets manager" (Figure 30) and select the Cloud Assets section. Click on the arrow icon next to your uploaded shapefile (Figure 32). The other option to import your shapefile is to left-click on the asset of interest, copy the table ID (e.g. "projects/JRC/TestData_polygons") and replace it in the code presented in Box 3.

Figure 32. Import the uploaded shapefile into the code editor: Navigate to the asset of interest in the Asset manager and click on the blue arrow to import into the code editor (top panel) or get the table id of the asset of interest from the Asset details window (bottom panel).



Source: Google Earth Engine.

Box 3. The following code loads a shapefile dataset from an asset's table ID and stores it under the variable table (first line). The rest of the code shows examples of how to load the different geometries of the test dataset.

```
var table = ee.FeatureCollection('projects/ee-
yourrepository/assets/yourshapefile');
////Test dataset
//var TestData_points =
ee.FeatureCollection('projects/JRC/TestData_points');
//var TestData_polygons =
ee.FeatureCollection('projects/JRC/TestData_polygons');
//var TestData_vertices =
ee.FeatureCollection('projects/JRC/TestData_polygons_vertices');
```

Add your shapefile to the map visualizer. Copy-paste the code from Box 4 into the code editor. Place this code after your previously written code. Click the "Run" button to visualize your shapefile and use your mouse scroll wheel or the built-in zoom in/out tools to explore your data.

Box 4. Javascript code to add your shapefile to the GEE map viewer and to center the map view to the shapefile's bounding box.

```
Map.addLayer(table, {}, 'Shapefile');
Map.centerObject(table);
```

5.2.3 Viewing GFC2020 with GEE

Visualize the GFC2020 data from the Google Earth Engine catalogue. Access the catalogue and search for the latest GFC2020 map version, e.g. by placing in the search prompt "JRC GFC2020" Click the "Open in Code Editor" button to open the sample code provided by Google and the JRC in the GEE code editor. Alternatively, you can create a new script and copy-paste the code below (Box 5). The following code uses the GFC2020 Version 2 corresponding to the latest version available at the time of this report. Click the "Run" button to **visualize the GFC2020** map.

Box 5. Javascript code to add the GFC2020 V2 map to the GEE code viewer.

```
var image2020 = ee.ImageCollection('JRC/GFC2020/V2').mosaic();

var visualization = {
  bands: ['Map'],
  palette: ['4D9221']};

Map.setOptions('SATELLITE');
Map.addLayer(image2020, visualization, 'EC JRC Global forest cover 2020 -
V2');
```

5.3 Intersection of geospatial information with GFC2020

The LoopFeatures function in Box 6 intersects the GFC2020 dataset with GeoJSON or Shapefile data, handling points, polygons, or mixed geometries. As a result of this intersection, it calculates and adds “forest” and “non-forest” columns to each feature, containing the respective pixel counts[31].

Box 6. Javascript function to intersect any geospatial information with GFC2020.

```
var AllClasses = ee.Image.cat(
      image2020.unmask().eq(1).rename('forest'),
      image2020.unmask().eq(0).rename('nonforest'))
var LoopFeatures= function(feature) {
  var vals = AllClasses.reduceRegion({
    reducer: ee.Reducer.sum(),
    geometry: feature.geometry(),
    scale: 10,
    maxPixels: 8e9,
    bestEffort:true
  });
  return ee.Feature(null, vals).copyProperties(feature,
feature.propertyNames());
};
```

5.3.1 Intersection with points

The “LoopFeatures” function in Box 7 is applied to the “TestData_points” variable, which contains point geometries. The resulting CSV file indicates forest absence (0) or presence (1) in the “forest” field.

Box 7. Javascript intersecting the test point shapefile with GFC2020.

```
var TestData_points_GFC2020 = TestData_points.map(LoopFeatures)

Export.table.toDrive({
  collection: TestData_points_GFC2020,
  folder: 'DownloadFromGEE',
  description: 'TestData_points_GFC2020',
  fileFormat: 'CSV'
});
```

5.3.2 Intersection with polygons by vertices

The “LoopFeatures” function in Box 8 is applied to the “TestData_vertices” variable, which contains shapefile vertices geometries. The resulting CSV file indicates forest absence (0) or presence (1) in the “forest” field.

[31] The “AllClasses” variable is hardcoded with non-forest (0) and forest (1) to generate forest/non-forest columns in the output CSV.

Box 8. Javascript intersecting the test polygon vertices shapefile with GFC2020.

```
var TestData_vertices_GFC2020 = TestData_vertices.map(LoopFeatures)
Export.table.toDrive({
  collection: TestData_vertices_GFC2020,
  folder: 'DownloadFromGEE',
  description: 'TestData_vertices_GFC2020',
  fileFormat: 'CSV'
});
```

5.3.3 Intersection with polygons by area

The "LoopFeatures" function in Box 9 is applied to the "TestData_polygons" variable, which contains shapefile vertices geometries. The resulting CSV file indicates forest pixels counts and non-forest pixels counts in the "forest" and "nonforest" fields.

Box 9. Javascript intersecting the test polygon shapefile with GFC2020.

```
var TestData_polygons_GFC2020=TestData_polygons.map(LoopFeatures);

Export.table.toDrive({
  collection: TestData_polygons_GFC2020,
  folder: 'DownloadFromGEE',
  description: 'TestData_polygons_GFC2020',
  fileFormat: 'CSV'
});
```

5.3.4 Intersection with GeoJSON data

The "LoopFeatures" function in Box 10 is applied to the "table" variable, which contains the combined point and polygon geometries. The resulting CSV file indicates forest pixels counts and non-forest pixels counts in the "forest" and "nonforest" fields. For GeoJSON files, the "id" field is automatically renamed to "system:index", whereas it remains unchanged for shapefiles (Figure 33).

<u>Important:</u> It is worth noting that the ee.Reducer.sum() in GEE computes a weighted sum of pixels within a region. A pixel is included if at least ~0.5% of its area intersects the region. The pixel's weight is determined by the fractional overlap with the region. This approach generates counts with decimal values that might differ from the one reported in other application described in the previous sections.

Box 10. Intersecting the GeoJSON test file with GFC2020.

```
var TestData_GeoJSON_GFC2020=table.map(LoopFeatures);

Export.table.toDrive({
  collection: TestData_GeoJSON_GFC2020,
  folder: 'DownloadFromGEE',
  description: 'TestData_GeoJSON_GFC2020',
  fileFormat: 'CSV'
});
```

Figure 33. Output csv file after intersecting GFC2020 with the GeoJSON test file.

	A	B	C
1	system:index	forest	nonforest
2	1	0	110.4039
3	2	0	159.7176
4	3	118.8353	0
5	4	213.7137	124.2941
6	13	0	1
7	14	1	0
8	5	952.651	0
9	6	0	237.6118
10	7	136.6039	185.7451
11	8	517.4157	204.6824
12	9	539.9333	1003.388
13	10	696.9608	335.2431
14	11	4.078431	87.29804
15	12	0.552941	89.38824
16	15	0	1
17	16	0	1
18	17	0	1
19	18	1	0
20	19	1	0
21	20	1	0

Source: Excel.

6 Conclusions

This report provides guidance to stakeholders interested in the geospatial implementation of the EUDR. It provides step-by-step procedures to visualize geolocation data on top of forest maps and intersections between vector data and forest maps to obtain quantitative information. The main focus for comparison is on the Global Forest Cover map for the year 2020 (GFC2020). To facilitate the quantitative process in the context of the EUDR, the JRC extended the existing IMPACT Toolbox, an in-house software for geospatial analysis. The user guide also describes similar procedures for QGIS and Google Earth Engine. The user should find similar functionality in other freely available or proprietary tools.

The user may obtain slightly different results for some geolocations or area totals when carrying out geospatial analysis with different tools. There are multiple reasons including:

— Handling of different projections. Many tools can handle different projections "on-the-fly" but results can differ when data are transformed

— Ambiguity in the data locations. Geographical data (maps and geolocation data) are provided with a specific level of precision. When intersecting the precision may impact the result

— Ambiguity in the geolocation of GFC2020. We found small differences in geolocation between data provided for download and stored on GEE, which may also depend on the geospatial tools that is used for analysis. In the third version of GFC2020 we will try to overcome these issues.

— In the analysis of this report we compare or intersect vector data with no area (points or vertices for polygons) against pixels which represent an area. Geospatial analysis tools handle the overlap between points/vertices and pixels in different ways, especially for area calculations.

Most sections in this report focus on the use of the Global Forest Cover map for the year 2020 for risk assessment. However, the user may use any other data set, including confidential data or data with license constraints to which he may have access. The functionalities described in this report can be applied analogously. In this context it is worth noting the "convergence of evidence" approach, which combines multiple open and public data layers for robust risk assessment. An example is the Open Foris Whisp[32] tool (D'Annunzio et al., 2024). Developed by FAO and partners under the Sustainable Agriculture for Forest Ecosystems Programme and powered by Google, Whisp incorporates GFC2020 among other data sources to extract zonal statistics from user-defined geometries. This process facilitates plot-level risk assessment by reporting the geospatial analysis in a structured, tabular format, demonstrating how diverse data can be integrated for detailed spatial analysis.

Some functionalities described in this report are tuned to the binary case of forest/non-forest. The forthcoming consolidated Global Forest Type map for the year 2020 will contain three forest type classes, which will require some adjustment. Corresponding guidance and adjusted tools will be provided along with the reports that document the consolidated mapping approach.

Colocation of point or polygon geolocation data with forest in a map does not automatically mean that this plot of land is incompliant with the EUDR. Such plots of land should undergo further assessment to conclude on the risk of deforestation. Likewise the user should not assume that

[32] https://openforis.org/solutions/whisp/

colocation of points or polygons with non-forest indicates compliance. Competent authorities may undertake further checks, and only those institutions are legally entitled to conclude about compliance and incompliance. When using geospatial data in the implementation of the EUDR, notably in the phase of the risk assessment, it can be recommended to make comparisons of geolocation against multiple maps, including also, to the extent possible, national and regional sources (Verhegghen et al 2024) that should meet the relevant definitions as set out in article 2 of the EUDR. Convergence towards forest may be a strong signal for a high deforestation risk and *vice versa.* That said, no map is able to guarantee 100% accuracy at plot level, unless this dataset is specifically produced for small areas considering the specific local conditions. The operator or trader is free to choose among any kind of information to support the risk assessment. Specifically, there is no obligation to use GFC2020 and this map has no superior status over other maps or information.

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List of abbreviations and definitions

Abbreviations	Definitions
AOI	Area Of Interest
API	Application Programming Interface
CSV	Comma-Separated Values (file)
DBF	dBASE File format contains feature attributes, used together with ESRI Shapefiles
DDS	Due Diligence Statement
DG ENV	Directorate-General for the Environment
DOS	Disk Operating System
EC	European Commission
EPSG	European Petroleum Survey Group
ESRI	Environmental Systems Research Institute, Inc
EU	European Union
EUDR	EU Regulation on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation
EUFO	EU Observatory on deforestation and forest degradation
FAO	Food and Agriculture Organization of the United Nations
FAQ	Frequently Asked Questions
FRA	Global Forest Resources Assessment
GEE	Google Earth Engine
GeoJSON	Geographic data structures using JavaScript Object Notation
GeoTIFF	Geographic Tag Image File Format

Abbreviations	Definitions
GFC2020	Global Forest Cover for the year 2020
GFT2020	Global Forest Types for the year 2020
GIS	Geographical Information System
GPS	Global Positioning System
HTML	Hypertext Markup Language
ID	Identifier
IS	Information System
IT	Information Technology
JPG	Joint Photographic Experts Group
JRC	Joint Research Center
LCLU	Land Cover and Land Use
NGO	Non-Governmental Organization
OSM	Open Street Map
QGIS	Quantum Geographic Information System
SHP	Shapefile format for geospatial vector data, developed and regulated by ESRI
SHX	Shape Index File, this is a mandatory file for ESRI Shapefiles
SWE-C	Single Window Environment for Customs
URL	Uniform Resource Locator
V1	Version 1
V2	Version 2
WGS-84	World Geodetic System 84

Abbreviations	**Definitions**
WMS	Web Map Service
WMTS	Web Map Tile Service
XML	Extensible Markup Language

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Annexes

Annex 1. References to geolocation in the EUDR

Article 2 (Definitions): "(28) 'geolocation' means the geographical location of a plot of land described by means of latitude and longitude coordinates corresponding to at least one latitude and one longitude point and using at least six decimal digits; for plots of land of more than four hectares used for the production of the relevant commodities other than cattle, this shall be provided using polygons with sufficient latitude and longitude points to describe the perimeter of each plot of land;"

Article 9 (Information requirements): "(1) Operators shall collect information, documents and data which demonstrate that the relevant products comply with Article 3. For this purpose, the operator shall collect, organise and keep for five years from the date of the placing on the market or of the export of the relevant products the following information, accompanied by evidence, relating to each relevant product: [...] (d) the geolocation of all plots of land where the relevant commodities that the relevant product contains, or has been made using, were produced, as well as the date or time range of production; where a relevant product contains or has been made with relevant commodities produced on different plots of land, the geolocation of all different plots of land shall be included; any deforestation or forest degradation on the given plots of land shall automatically disqualify all relevant commodities and relevant products from those plots of land from being placed or made available on the market or exported; for relevant products that contain or have been made using cattle, and for such relevant products that have been fed with relevant products, the geolocation shall refer to all the establishments where the cattle were kept; for all other relevant products of Annex I, the geolocation shall refer to the plots of land;"

Article 33 (Information system): "(2) Without prejudice to the fulfilment of obligations established in Chapters 2 and 3, the information system shall provide at least the following functionalities: [...] (d) where possible, the conversion of data from relevant systems to identify the geolocation;"

Annex II (Due diligence statement): "Information to be contained in the due diligence statement in accordance with Article 4(2): [...] (3) Country of production and the geolocation of all plots of land where the relevant commodities were produced. For relevant products that contain or have been made using cattle, and for such relevant products that have been fed with relevant products, the geolocation shall refer to all the establishments where the cattle were kept. Where the relevant product contains or has been made using commodities produced in different plots of land, the geolocation of all plots of land shall be included in accordance with Article 9(1), point (d)."

Annex 2. Technical elements from Frequently Asked Questions[33] regarding the provision of geolocation with relevance for data analysis

"7.1. What is the Information System and the 'EU Single Window'? (UPDATED)

[33] https://circabc.europa.eu/ui/group/34861680-e799-4d7c-bbad-da83c45da458/library/e126f816-844b-41a9-89ef-cb2a33b6aa56/details

The Information System (IS) is the IT system which contains the DDS submitted by operators and traders to comply with the requirements of the Regulation. The Information System is operational and provides users with the functionalities listed in Art. 33(2) of EUDR. Its functionalities are further set out in Commission Implementing Regulation (EU) 2024/3084.

The EU Single Window Environment for Customs (EU SWE-C) established by Regulation (EU) 2022/2399 is a framework that enables interoperability between customs systems and non-customs systems, such as the Information System established pursuant to Art. 33 of the Regulation. The central component of EU SWE-C, known as the EU Customs Single Window Certificates Exchange System (EU CSW-CERTEX), will interconnect the Information System with national customs systems and will enable sharing and processing of data submitted to customs and non-customs authorities by economic operators. The EU Customs Single Window will thus ensure information sharing in real-time and digital cooperation between customs authorities and competent authorities in charge of enforcing non-customs formalities, including in the field of environmental protection."

"7.5. Can the system help farmers identify the geolocation? Will orthophotos or satellite images be available for the map tool in the Information System? (UPDATED)

The Information System acts as the repository of the due diligence statements submitted by operators and traders pursuant to Art. 4(2) and Art. 5(1) EUDR. As such, it does not provide software or tools to identify geolocations coordinates, as it is not a primary tool for mapping coordinates.

The Information System utilizes Open Street Map (OSM) as its source for storing geographical information related to various countries involved in the system. However, it is not a comprehensive Geographic Information System (GIS) tool with advanced features such as background satellite images. The system offers functionalities to select, enter, adjust, and visualise geolocation coordinates. While the Information System provides a platform for users to manage their geolocation data, users may wish to verify the accuracy of their geolocation information using other tools and resources, including free online map services."

"7.7. Who can view the geolocation data stored in the Information System? (UPDATED)

The responsible authorities that enforce the EUDR by checking the information submitted by operators and traders under this Regulation will have access to the geolocation data submitted by the operators and traders. In addition, those supply chain members that have access to the DDS via reference number and verification number will have access if the user that submitted the statement allowed to reveal the geolocation."

"7.8. Which data format is needed for the geolocation to be uploaded in the Information System?

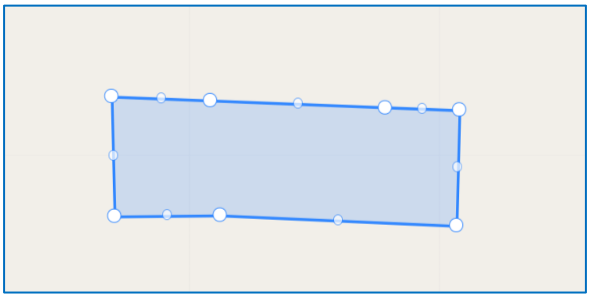
Operators can provide geolocations in the Information System either by manual entry or by uploading them in a file. The format of the supported files in the Information System is GeoJSON. The Information System supports currently WGS-84 coordinate format, with EPSG-4326 projection"

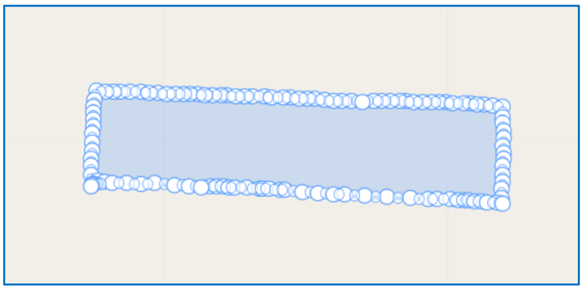
"7.16. What if the size of the DDS exceeds the maximum file size of 25 MB? (NEW)

The 25 MB file limitation allows for more than 1 million geolocation points, or polygon vertexes in total.

In case the total size of the file exceeds the 25 Mb limitation there are multiple ways to decrease the size of the files. It is recommended to provide points instead of polygons for areas lower than 4 hectares and for products in the cattle supply chain. Furthermore, users can choose a resolution which decreases the details of the approximation whilst remaining a legitimate and complete representation, by e.g. providing a point only at the beginning and end of a straight line representing a side of the area or providing significant corner points instead of points every 0.5 meters to approximate a line.

In practice, when describing a rectangle shape, a geolocation can for example be described with 7 corner points instead of 168 corner points:





Free-to-use or commercial solutions exist to simplify compress polygon files. Furthermore, users should aim at localising the origin of their products accurately, and at limiting declaration in excess to the minimum. Further information as well as workarounds for main technical concerns are available in the GeoJSON file description[34]."

"7.17. What if the geolocation file consists of different number of digits than required by the Regulation? (NEW)

According to Art. 2(28) the geolocation coordinates shall be provided by using at least 6 decimal digits both for latitude and longitude coordinates. When the user uploads geolocation files into the Information System, the system automatically validates the number of digits. To ensure a smooth data upload the system provides flexibility by automatically adjusting to six digits, and i) if the number of the provided digits is less than 6 then fills the remaining digits with zeroes, or ii) if the number of digits is more than 6 then cuts the irrelevant digits to reduce the file size of the uploaded file."

"7.26. Why is only GeoJSON format allowed for uploading geolocation data in a file? (NEW)

GeoJSON is a general standard and the only non-proprietary system which allows submission of the extra properties needed, and where a very specific coordinate system is enforced. Using multiple formats in the Information System would increase the risk of erroneous or inaccurate information. The exclusive use of GeoJSON was announced in April 2024, allowing all stakeholders to prepare their respective systems accordingly."

[34] https://green-forum.ec.europa.eu/deforestation-regulation-implementation/information-system-deforestation-regulation_en#the-eudr-information-system

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