Space Intelligence
120 George Street
Edinburgh, EH2 3ES, Scotland, UK
enquiries@space-intelligence.com
www.space-intelligence.com

Validation report

Brazil EUDR maps accuracy assessment

External report

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Report Authors

Chris Andrews, Kristian Bodolai, Thom Brade, Paula Nieto Quintano

UK company number SC595836
VAT number GB342811714.

Executive Summary

This report details an accuracy assessment undertaken for the land cover maps produced by Space Intelligence for Brazil. Specifically, we evaluated the Forest / Non-forest accuracies of Space Intelligence Land cover maps done under the EUDR forest definition for the 2020 - 2024 period at a 10m pixel resolution.

We performed this accuracy assessment using a stratified random sampling, based on a statistically robust best-practice assessment. Each point was annotated using high resolution data by ecological experts.

We find that Space Intelligence maps have an overall Forest / Non-forest accuracy exceeding 94%.
Additionally, we performed a comparative analysis with the JRC GFC v2 open source maps. We found that Space Intelligence had a greater overall accuracy (91.1% of the JRC GFC v2 product vs 94.6% of Space Intelligence maps).

Brazil validation assessment case study

1. Introduction

This report details an accuracy assessment undertaken for Brazil to evaluate the Forest / Non-forest accuracies of Space Intelligence Land cover maps done under the EUDR forest definition. It also includes a map accuracy comparison with the second version of the Joint Research Centre's (JRC) Global Forest Cover map for the year 2020 (JRC GFC v2)[1].

The Brazil land cover maps were created at 10 m pixel resolution for the years 2020 and 2024 (figure 1), including a change map between those dates. They were done using HabitatMapper, which combines remotely-sensed data and ecological expertise within our own machine learning framework, which is locally calibrated to capture regional factors such as national forests definitions, seasonality, cloud cover impact and more.
The maps follow the EUDR forest definition: "Land spanning more than 0.5 ha with trees higher than 5 m and a canopy cover of more than 10%, or trees able to reach those thresholds in situ, excluding land that is predominantly under agricultural or urban land use."

Figure 1. Land cover map of Brazil for 2024.

[1] Bourgoin, Clement; Verhegghen, Astrid; Degreve, Lucas; Ameztoy, Iban; Carboni, Silvia; Colditz, Rene; Achard, Frederic (2024): Global map of forest cover 2020 - version 2. European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/e554d6fb-6340-45d5-9309-332337e5bc26

2. Methodology

We follow probability sampling theory and documented good practices to calculate statistically robust estimators for areas and different accuracy metrics, as detailed in Stehman et al (2014)[2] and Olofsson et al (2014)[3].

2.1. Sampling design

A stratified random sample of 578 points was created to cover forest / non-forest for the 2024 map (Figure 2). Each point represents a 10mx10m pixel in our maps, and was annotated using high resolution data in Google Earth, Planet monthly mosaics and Sentinel-2 data. This sample allows us to evaluate different maps and report their accuracies, as well as the unbiased areas for each class.

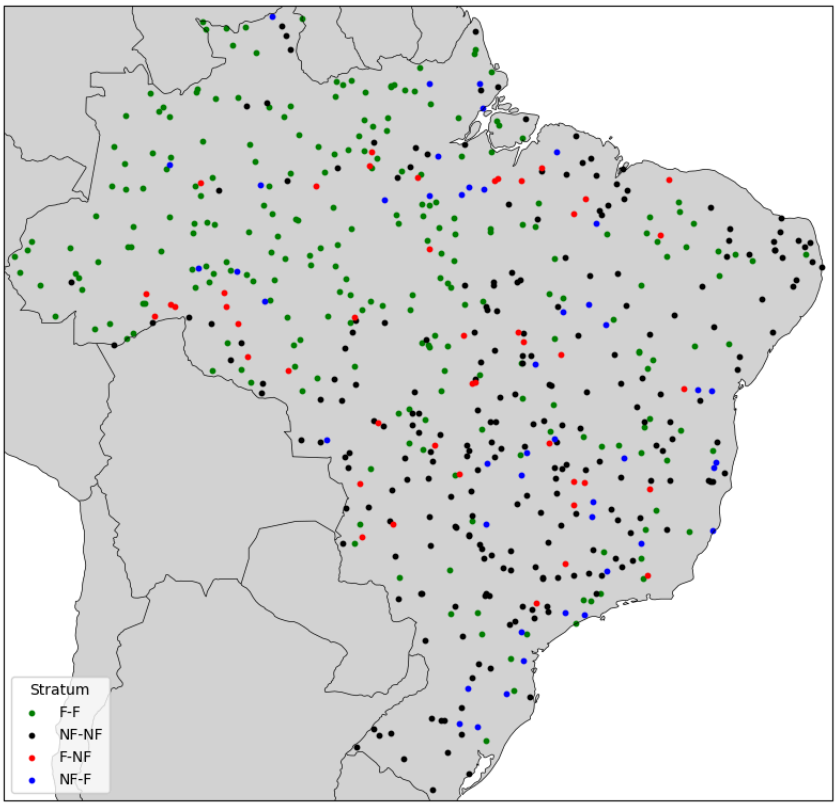

Figure 2: Samples used for the analysis.

[2] Stehman, Stephen. (2014). Estimating area and map accuracy for stratified random sampling when the strata are different from the map classes. International Journal of Remote Sensing. 35. 10.1080/01431161.2014.930207.
[3] Olofsson, P; Foody, G M.; Herold, M; Stehman, S V.;. Woodcock, C E; Wulder, M A.
Good practices for estimating area and assessing accuracy of land change, Remote Sensing of Environment, Volume 148, 2014, Pages 42-57, ISSN 0034-4257, https://doi.org/10.1016/j.rse.2014.02.015.

2.2. Response design

A blind (without map information) assessment was completed for all points using the best available high-resolution optical mosaics and temporal mosaics of medium resolution imagery from Sentinel-2[4] and Landsat[5] satellites and Planet[6] imagery. During point assessment, assessors followed a decision tree (figure 3) to reliably classify each point as either Forest or Non-forest in 2020 and 2024 according to the EUDR Forest Definition. Assessment was undertaken in QGIS[7] software.

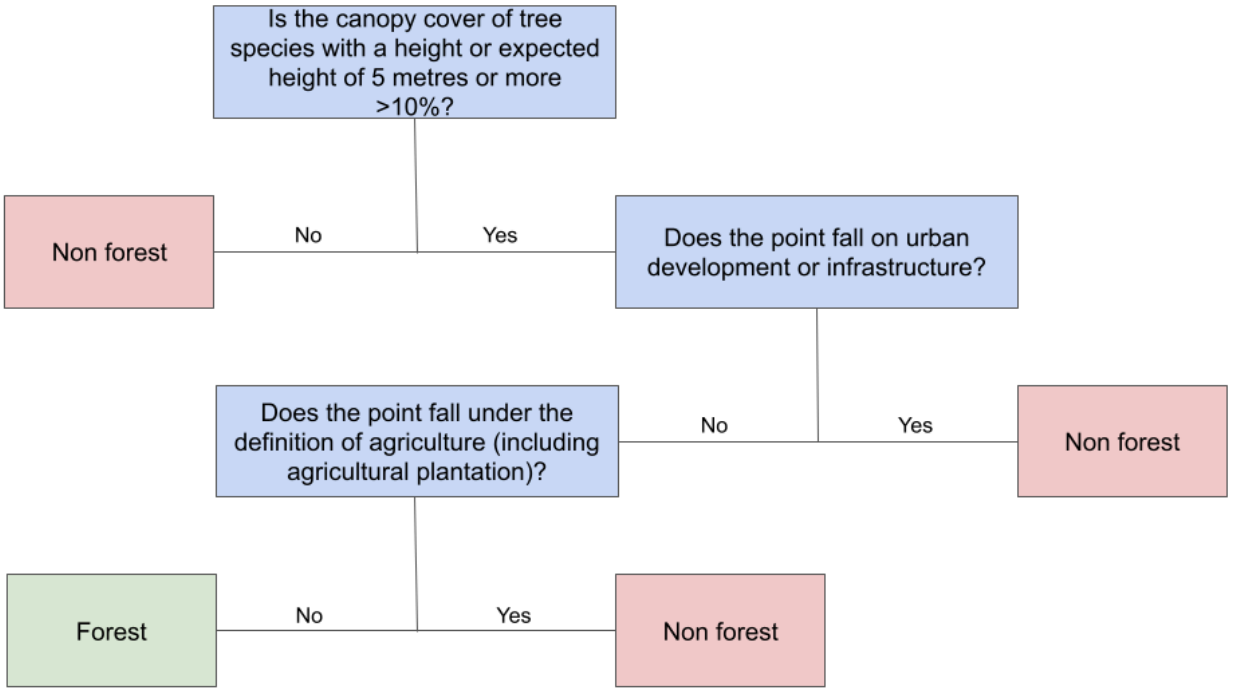

Figure 2: Decision tree used when assessing each point per year. 'Agricultural plantation' is defined as "land with tree stands in agricultural production systems, such as fruit tree plantations, palm oil plantations, olive orchards and agroforestry systems where crops are grown under tree cover".

2.3. Statistical estimators

We use the stratified estimators defined in Stehman (2014), which allow us to calculate accuracies, map areas and uncertainties when the map classes are different from the stratification used to generate the sample. This enables us to assess and compare different products, once agreement between mismatching grids is well defined.

We use them to report accuracies and map areas at the 90th confidence interval.

[4] Copernicus Sentinel data 2020 and 2024, processed by ESA
[5] Landsat imagery courtesy of the U.S. Geological Survey
[6] Imagery Planet Labs PBC. This data has been provided under the NICFI Satellite Data Program
[7] QGIS.org, 2025. QGIS Geographic Information System. QGIS Association. http://www.qgis.org

3. Results

Space Intelligence EUDR maps - F/NF for 2024

Overall forest/non-forest accuracy (the number of correctly mapped reference sites) exceeded 94% for the 2024 map (Table 1). User's and Producer's accuracy for forest and non-forest had well constrained uncertainties with lower bounds exceeding 90% in all cases. High User's accuracies indicate that the class predicted in the map is very frequently the class identified in the reference data collection (that there is minimal commission). High Producer's accuracies indicate that the class identified in the reference data collection is very frequently predicted by the map (that there is minimal omission).

Table 1. Accuracy of the Space Intelligence 2024 map

	User's accuracy (%)	Producer's accuracy(%)	Overall accuracy (%)
Forest	93.7 ± 2.5	96.2 ± 1.7	-
Non-forest	95.6 ± 2.1	92.7 ± 2.7	-
OA	-	-	94.6 ± 1.7

Map intercomparison

We performed a comparison of the accuracy of our Space Intelligence maps with the second version of the Joint Research Centre's (JRC) Global Forest Cover map for the year 2020 at 10-meter spatial resolution (JRC GFC v2). This open sourced map was created to support the EUDR by providing a clear representation of forest presence and absence as of the 2020 cut-off date.

Table 2 shows the results of the accuracy assessment of the JRC GFC v2, with an overall accuracy of 91.1%. Table 3 shows the comparison of the accuracies between Space Intelligence maps and the and the JRC GFC v2, with Space Intelligence maps having a greater overall accuracy.

Table 2. Accuracy of the JRC GFC v2 for 2020

	User's accuracy (%)	Producer's accuracy(%)	Overall accuracy (%)
Forest	89.2 ± 2.8	95.4 ± 2.0	-
Non-forest	93.7 ± 2.7	85.6 ± 3.7	-
OA	-	-	91.1 ± 2.1

Table 2. Comparative Accuracy Metrics - Forest/Non-Forest (F/NF) for 2024

Product	User's accuracy (%)		Producer's accuracy(%)		Overall accuracy (%)
	F	NF	F	NF	
Space Intelligence	93.7 ± 2.5	95.6 ± 2.1	96.2 ± 1.7	92.7 ± 2.7	94.6 ± 1.7
JRC GFC v2	89.2 ± 2.8	93.7 ± 2.7	95.4 ± 2.0	85.6 ± 3.7	91.1 ± 2.1