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Accuracy Assessment of the Preliminary Global Forest Type 2020 Map

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Executive Summary

- In December 2024, the European Commission's Joint Research Centre released a preliminary Global Forest Type 2020 map as an optional tool to help assess the risk of deforestation and forest degradation on the plot of land from which forest and wood products originated.
- While this map may serve as an initial screening tool to assess deforestation risk, due to its inconsistent accuracy in identifying forest types, it may not be useful for degradation compliance assessments under the European Union Deforestation Regulation.
- In this study, accuracy of the European Union Joint Research Centre Global Forest Type 2020 map was assessed using two independent data sets:
    - Using national plot-based forest inventory data from US Forest Service Forest Inventory and Analysis program;
    - Using stand-level, private company, forest inventory data in two states in the southern US.
- The national data assessment indicates that accuracy in identifying planted pine stands was limited, with only 53% correctly classified.
- The assessment of stand-level data sets shows that accuracy was low for nonforest areas (21%) and naturally regenerating forest stands (30%).
- The national data set suggests the map may be reliable for broadly detecting deforestation but is likely inadequate for identifying forest degradation, as defined by the European Union Deforestation Regulation. Stand-level data indicate the map's performance can vary substantially at finer spatial scales and is unreliable in identifying naturally regenerated pine stands. Accurate determination of naturally regenerated stands is a critical component of forest degradation assessments required by European Union Deforestation Regulation.
- These findings highlight that accuracy trends are highly context dependent.

1.0 Introduction

1.1 Main Obligations and Scope of the European Union Deforestation Regulation

The European Union Deforestation Regulation (EUDR), which was enacted June 29, 2023, is a policy instrument adopted to minimize European Union (EU) contributions to global deforestation and forest

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degradation through its consumption of associated commodities. Per the EUDR, deforestation is defined as the conversion of forests to agricultural use, regardless of whether the cause is human induced or natural (e.g., fire). However, if the forest is allowed to regenerate without conversion, it is not deemed deforested, and products from such areas may be eligible for market placement in the EU. Forest degradation, in contrast, refers to structural changes in forest cover, specifically conversion of primary forests or naturally regenerating forest stands into planted stands. Under the EUDR, any operator or trader placing products on the EU market, or exporting them from the EU, must demonstrate that they are not sourced from land subject to deforestation or forest degradation. Compliance requires geolocation data to trace commodities to the specific plot of origin and evidence that production adhered to legal frameworks in the source country. To support implementation, a phased timeline was adopted, with the EUDR becoming applicable December 30, 2025, for large and medium-sized enterprises, and June 30, 2026, for micro and small enterprises.

1.2 Use of Maps and Observation-Based Tools by the European Commission

In December 2024, the European Commission's Joint Research Centre (EU JRC) released a preliminary Global Forest Type (GFT) 2020 map2 as an optional tool to help assess the risk of forest degradation on the plot of land from which wood products originated. The map depicts four land classes (primary forest, naturally regenerating forest, planted/plantation forest, and nonforest area) in the baseline year of 2020. The map was created by combining several existing spatial data sets with global coverage. It is important to note that errors in this map could affect US wood producers' ability to export products to the EU. However, no information on map accuracy has been provided by EU JRC or the European Commission.

1.3 Collaboration Between US Forest Service and Private Sector Stakeholders

Through a collaborative effort between National Council for Air and Stream Improvement, Inc. (NCASI), National Alliance of Forest Owners, and US Forest Service (USFS), we assessed the accuracy of the EU JRC Global Forest Type map by comparing mapped outputs against two independent reference data sets. Specifically, our objectives were as follows:

1. Quantify map accuracy for each classification using plot-based National Forest Inventory (NFI) as validation data.
2. Assess classification accuracy through a case study in the southeastern US using stand-level forest inventory data from private forest lands.

2.0 National Assessment

2.1 State of US Forests

The US currently contains more than 250 million hectares of forest (USDA n.d.), approximately 56% of which is privately owned (Oswalt et al. 2019; USDA Forest Service 2023). Although public lands include planted forest stands, most planted forest stands occur on private land (85%). Within the US-planted forest stands, 90% of the area is planted with one of six species (USDA n.d.): loblolly pine (*Pinus taeda*) (59%), Douglas-fir (*Pseudotsuga menziesii*) (14%), slash pine (*P. elliotti*) (7%), red pine (*P. resinosa*) (4%), longleaf pine (*P. palustris*) (3%), and ponderosa pine (*P. ponderosa*) (3%) (Figure 1). Planted forest stands in the Pacific Northwest subregion are predominantly Douglas-fir (83%), while in the Pacific Southwest subregion, ponderosa pine is most common (59% of area planted). The South Central and the Southeast are predominantly loblolly pine (91% and 68%, respectively). In the Northeast, North Central, Great

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[2] European Commission. 2020. "Global Map of Forest Types 2020—Data Access: About the Data." https://forobs.jrc.ec.europa.eu/GFT

Plains, and Intermountain subregions, no single species accounts for more than 50% of the area planted. Planted stands are currently rare in Alaska and Hawaii.

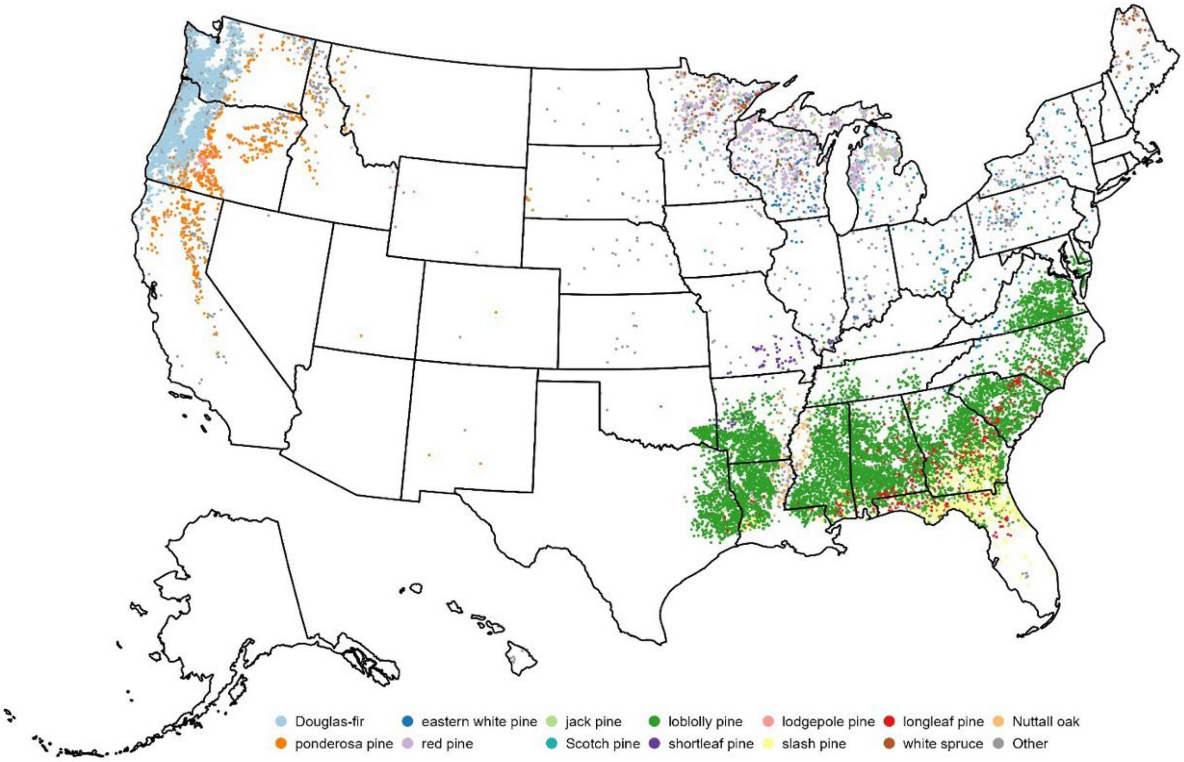

Figure 1. *Map showing Forest Inventory and Analysis plots classified as planted forest*

2.2 Comparing Different Data Sets

To evaluate how well these stand types are represented on the EU JRC map, we conducted a national-scale accuracy assessment using plot-level data from the US NFI conducted by the US Forest Service, Forest Inventory and Analysis program. This inventory includes over 320,000 systematically distributed plots that are sampled on a 5- to 7-year cycle in the eastern US and 10-year cycle in the western US. Each plot consists of four, 14.6-m-diameter subplots, and plots can be subdivided into different conditions based on differences in ownership, forest type, stand age, or other key characteristics. For this assessment, we classified each plot as nonforest area, naturally regenerating forest stand, or planted forest stand. We included only plots sampled in 2020 or later to align with the GFT 2020 map, resulting in 115,757 systematically distributed validation points.

We compared classification labels from the JRC map and NFI plots to calculate the overall accuracy of the JRC map. We calculated balanced accuracy as the average of the recall (true positive rate) for each classification, ensuring that each classification contributed equally to the overall accuracy metric regardless of its prevalence. To assess accuracy for each classification (e.g., naturally regenerating forest, planted forest, or nonforest area), we calculated user accuracy, producer accuracy, and F1 scores for each classification. Producer's accuracy measured how well a reference (actual) classification had been correctly mapped, calculated as the number of correctly classified samples divided by the number of reference samples for that class (i.e., it reflects omission error). User's accuracy measured reliability of the map classification, calculated as the number of correctly classified samples divided by the number of samples labeled as that classification in the map (i.e., it reflects commission error). The F1 score combined producer's and user's accuracy as their harmonic mean, providing a single metric that balanced both types of error. To account for spatial variation in sampling intensity, we also evaluated accuracy at the state level.

Understanding producer accuracy vs. user accuracy:

- *Producer accuracy* indicates how often the map finds something when it is really there. For example, if there are 100 planted forest stands on the ground, how many does the map correctly identify? It is a measure of how much the map misses or overlooks what is on the ground.
- *User accuracy* indicates how often the map is right when it says something is a certain type of forest. For example, if the map says a stand is planted forest stand, how likely is it to actually be a planted forest stand? It is a measure of how much you can trust the map's labels.

Overall, balanced accuracy of the JRC map against the NFI data was 81%. Accuracy for the entire US was relatively high for the nonforest class and naturally regenerating forest stands, but accuracy for planted forest stands was much lower (<68%) across accuracy measures (Table 1). These patterns suggest that although the map may be sufficient for detecting deforestation events at broad scales (conversion to nonforest area), its lower accuracy for planted forest stands limits its utility for identifying areas of forest degradation, a key compliance requirement under the EUDR.

Table 1. *Overall, within-class accuracy, based on a subset of validation data that equalizes sampling intensity across states*

Forest Type Class	User Accuracy	Producer Accuracy	F1 Score
Naturally regenerating	0.85	0.79	0.82
Planted	0.43	0.68	0.53
Nonforest	0.95	0.95	0.95

Accuracy was variable at the state level, especially in the South Central and Southeast regions of the US (Figures 2–4). Some states were not analyzed in the state-level assessment because there were so few plots representing planted stands for validation (Figure 3). For naturally regenerating forest stands, classification performed well for most states, with particularly strong accuracy across northern states (F1 > 0.8). Accuracy was much more variable for planted stands. States with extensive managed forests, such as those in the Southeast and Pacific Northwest, generally showed poor (F1 < 0.6) to moderate accuracy (F1 < 0.8). Other regions showed very poor accuracy (F1 < 0.2), likely due to scarcity of planted stands in these areas. The nonforest area classifications demonstrate consistently high accuracy across nearly all states (Figure 4). Collectively, these maps highlight the overall reliability of the JRC map for identifying naturally regenerating and nonforest areas, while underscoring significant challenges in mapping planted stands accurately, particularly in certain regions or states with a small number of planted stand plots.

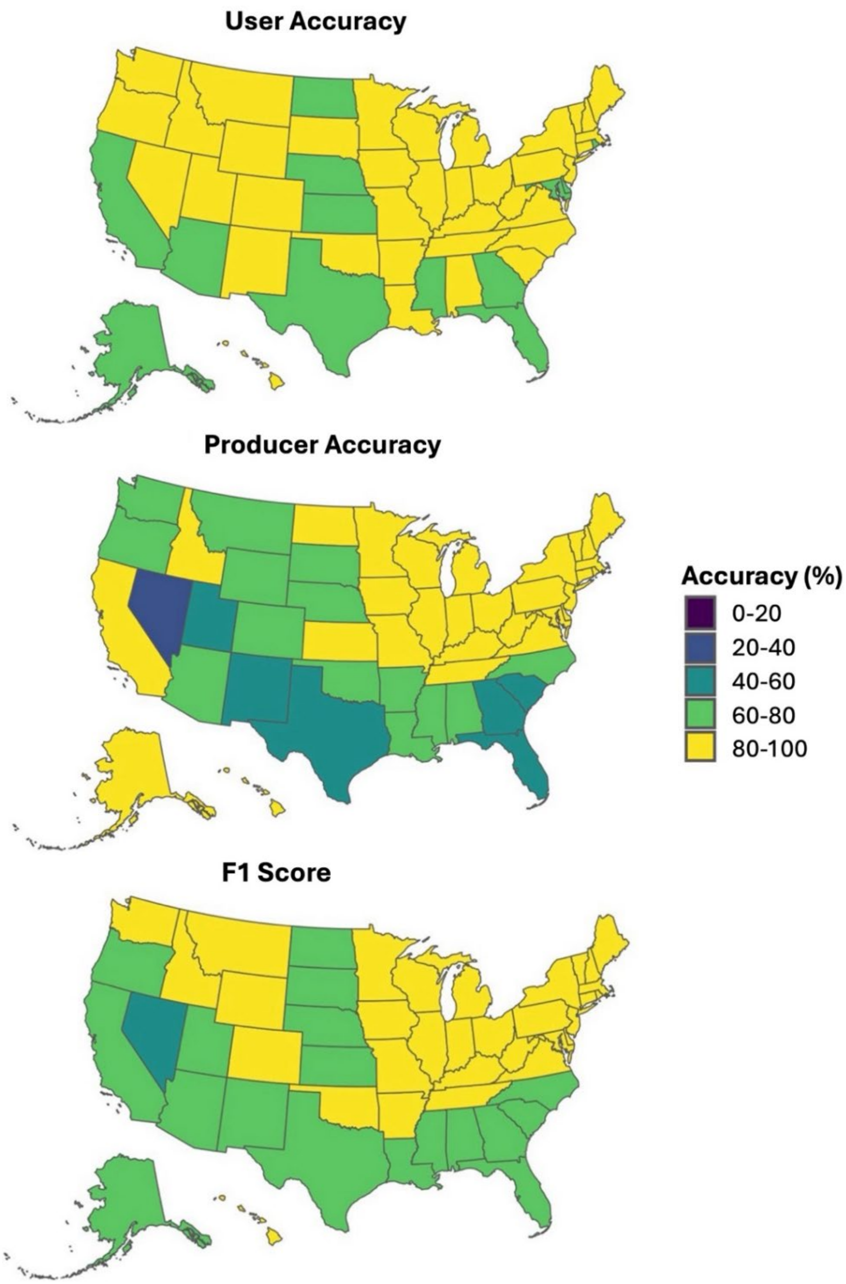

Figure 2. *State-level classification accuracy for naturally regenerating forest stands in the EU JRC Global Forest Type 2020 map based on NFI validation data. The top map shows user accuracy, which indicates how often the map's label is correct. The middle map shows producer accuracy, which reflects how often the real-world condition is correctly captured by the map. The bottom map shows F1 score, calculated as the average of user and producer accuracy. Accuracy values are grouped into five classes based on performance: 0%–20% (dark purple), 20%–40% (blue), and 40%–60% (teal) represent low accuracy; 60%–80% (green) represents moderate accuracy; and 80%–100% (yellow) represents strong accuracy.*

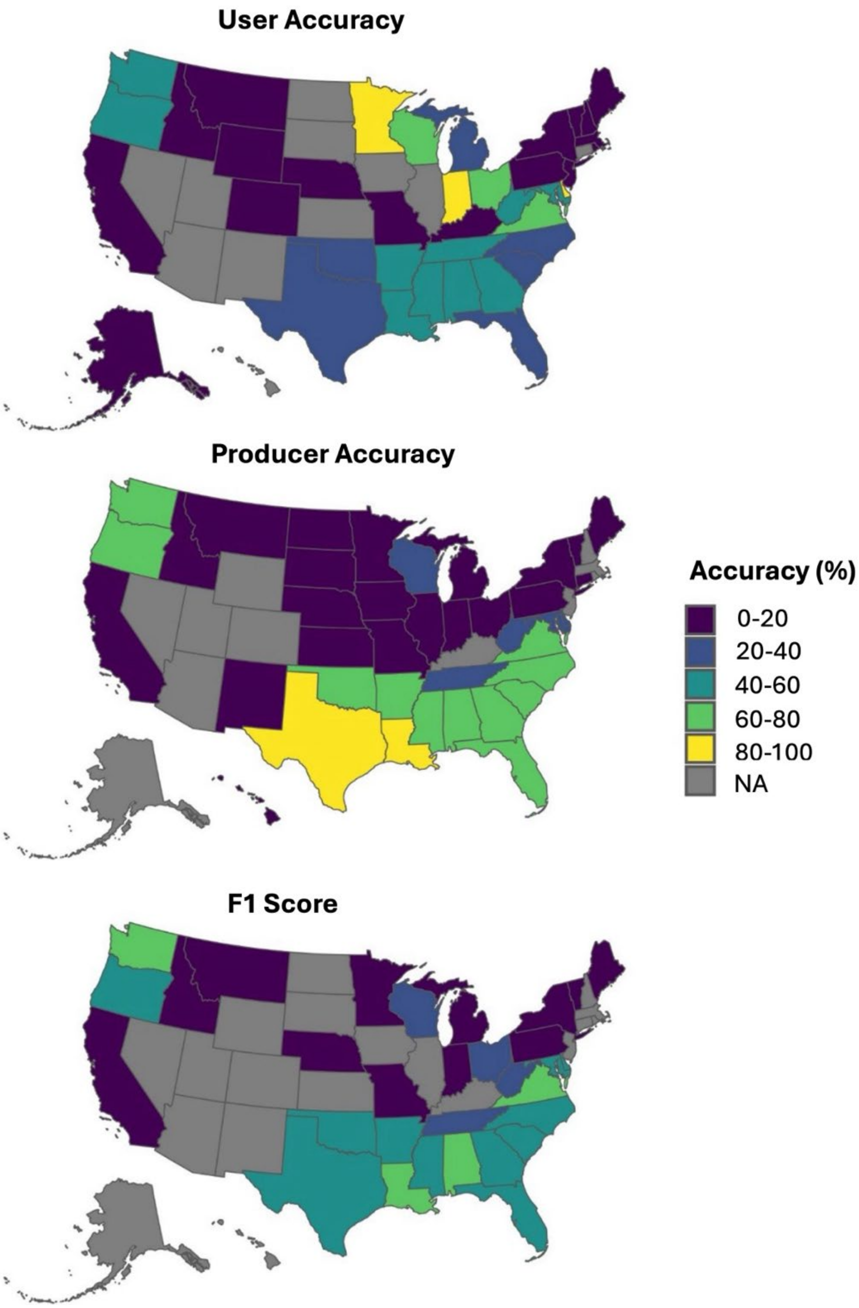

Figure 3. *State-level classification accuracy for planted forest stands in the EU JRC Global Forest Type 2020 map based on NFI validation data. The top map shows user accuracy, which indicates how often the map's label is correct. The middle map shows producer accuracy, which reflects how often the real-world condition is correctly captured by the map. The bottom map shows F1 score, calculated as the average of user and producer accuracy. Accuracy values are grouped into five classes based on performance: 0%–20% (dark purple), 20%–40% (blue), and 40%–60% (teal) indicate low accuracy; 60%–80% (green) indicates moderate accuracy; and 80%–100% (yellow) indicates strong accuracy. States shaded in gray (NA) had insufficient planted plots for reliable accuracy estimation.*

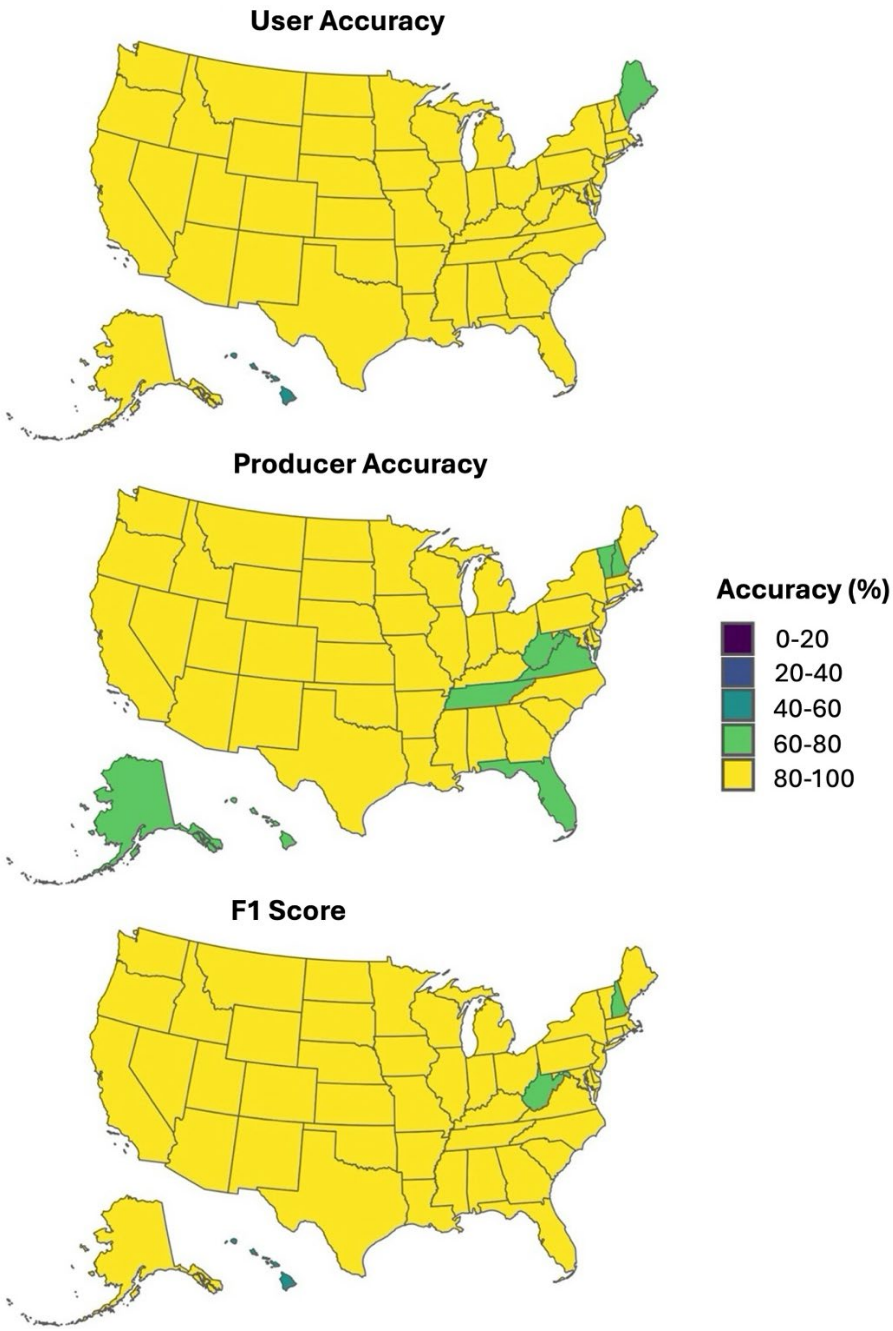

Figure 4. *State-level classification accuracy for nonforest areas in the EU JRC Global Forest Type 2020 map based on NFI validation data. The top map shows user accuracy, which indicates how often the map's label is correct. The middle map shows producer accuracy, which reflects how often the real-world condition is correctly captured by the map. The bottom map shows F1 score, calculated as the average of user and producer accuracy. Accuracy values are grouped into five classes based on performance: 0%–20% (dark purple), 20%–40% (blue), and 40%–60% (teal) indicate low accuracy; 60%–80% (green) indicates moderate accuracy; and 80%–100% (yellow) indicates strong accuracy.*

3.0 Case Study: Southeastern United States

The southeastern US is a global leader in wood production (USDA Forest Service 2023), making it a critical region for testing the accuracy of the Global Forest Type maps. We partnered with a large forest landowner to assess the accuracy of the EU JRC map using stand-level inventory data across Alabama and Mississippi (>400,000 hectares). Inventory data were derived from an integrated resource inventory system and geographic information system. Timber inventory data collection and verification techniques included using industry standard field sampling procedures and proprietary remote sensing techniques (i.e., lidar-derived forest structure metrics) in some geographies. We cross-referenced stand-level inventory metrics with the EU JRC map to calculate user accuracy, producer accuracy, and F1 scores for three forest stand classifications (e.g., naturally regenerating forest stands, planted forest stands, and nonforest area). These data offered higher accuracy and provided more coverage than systematically distributed NRI plots, enabling an assessment of map accuracy specifically in operational landscapes with more precise data.

In a comparison between the JRC map and stand-level data in these two southern states, balanced accuracy was 43%. Although 83% of actual planted stands were correctly identified by the map on the case study land in these two states, only 76% of the areas identified as the "planted forest" classification were planted forests. Further, the classifications of natural forests and nonforest areas had very poor accuracies, both in terms of how well they were represented (producer accuracy) and how often they correctly predicted a classification (user accuracy). The case study reinforces the presence of significant inaccuracies in the JRC map. For example, in these two states, the JRC map had very poor accuracy for naturally regenerating and nonforest classifications, which would complicate reliable detection of both forest degradation and deforestation at the operational or landowner scale.

These results highlight the risk for both false positives and false negatives in EUDR compliance assessments and demonstrate the need for additional validation or calibration of the EU JRC map, particularly in regions with large amounts of area classified as planted forest stands.

Table 2. *Overall within-class accuracy based on stand-level private industrial inventory classes compared with the EU JRC Global Forest Type map 2020*

Forest Type Class	User Accuracy	Producer Accuracy	F1 Score
Naturally regenerating	0.35	0.25	0.30
Planted	0.76	0.83	0.79
Nonforest	0.20	0.22	0.21

4.0 Discussion

4.1 General Conclusions

Our results revealed both strengths and limitations of the EU JRC Global Forest Type 2020 map. Nationally, the map performed well in distinguishing nonforest and naturally regenerating forest stands, which is promising for broad-scale applications, such as national reporting or compliance checks where these classes dominate. However, planted stands, a key concern for US exporters given the EUDR forest degradation definition, were routinely not mapped accurately. Nationally, planted stands were often misclassified, given the poor accuracy of the PRC map (F1 = 0.53). The accuracy for the planted stands classification varied significantly among states, with many states showing very poor results.

The southeastern US case study illuminated additional concerns. In the sample area of the case study, the map only correctly classified naturally regenerating and nonforest areas at 30% (F1 ≤ 0.30). Several factors may explain this divergence. First, stand-level inventory (industry standard field sampling procedures combined with lidar) in the case study likely captured fine-scale structural attributes specific to managed stands that were not adequately captured using the NFI plot-based data or by the JRC map (e.g., streamside management zones that often result in pockets of hardwood trees being present within planted pine stands). This may also have contributed to the poor performance for naturally regenerating and nonforest classifications in the case study, reflecting a mismatch between the resolution of the stand-level inventory data and the coarser resolution of the EU JRC map (~10 m). In highly heterogeneous landscapes, even small patches of forest or nonforest areas within a raster cell can lead to misclassification when validated against more precise ground-truth data. Additionally, management histories (e.g., recent harvesting, regeneration activities) may create transitional stand conditions that are difficult to assign confidently to a single classification based on remote sensing (i.e., satellite data) or other more coarse data sets.

The European Commission JRC published an accuracy assessment of the GFT 2020 map (European Commission: Joint Research Centre 2025). Their validation data were developed by interpreters who visually assessed remotely sensed imagery. While interpreters were initially asked to assign forest class labels (e.g., naturally regenerating or planted stands), these labels were primarily used to diagnose classification errors. However, given the difficulty of reliably distinguishing classifications using satellite imagery alone, the analysts were eventually limited to the binary distinction of forest vs. nonforest areas. Furthermore, the overall accuracy of the JRC map was reported as 91% in this assessment, which is significantly higher than the two accuracy assessments presented here. When reclassifying our results to match this binary forest/nonforest framework, the national assessment showed fairly similar performance (balanced accuracy of 85%), but the case study remained much lower (balanced accuracy of 45%). These discrepancies may reflect our use of independent ground-based and lidar-derived validation data sets, which better captured fine-scale forest structure and management histories that may not be visible in satellite data alone. For example, planted forest stands may be classified as nonforest by interpreters if recently harvested, even when regeneration is underway but not yet detectable in imagery (see Figure 8C in European Commission: Joint Research Centre 2025).

Recent national-scale analyses also reinforce the challenges of aligning forest classification systems with EUDR compliance goals. Renwick et al. (2025) evaluated agriculture-driven deforestation across the US and found that gross forest conversion to agriculture has been minimal, less than 0.04% annually, yet identified substantial uncertainty at subnational scales due to definitional inconsistencies and limitations of land use detection methods. Their findings highlight that even in low-risk countries with robust monitoring programs, the spatial resolution, definitional ambiguity, and classification errors inherent in current data sets complicate parcel-level verification and may challenge the effectiveness of a gross deforestation-based compliance standard.

4.2 Final Remarks

Taken together, these findings highlight that the EU JRC map provides a useful first step for approximating forest classification at large scales. However, its accuracy is likely not sufficient to assess compliance with EUDR requirements on its own. The map's limitations are particularly significant when it comes to reliably identifying planted stands, an essential distinction for US exporters seeking to demonstrate that wood products are not sourced from areas affected by forest degradation, as defined by the EUDR. For exporters and regulators, these findings underscore the need for complementary data sources (e.g., company-level inventories, high-resolution local assessments) to accurately verify the forest status of production areas, which is also noted in the Global Forest Type 2020 accuracy assessment (European Commission: Joint Research Centre 2025).

References

European Commission: Joint Research Centre, R. Colditz, A. Verhegghen, S. Carboni, C. Bourgoin, M. Duerauer, N. Mansuy, T. De Marzo, et al. 2025. Accuracy Assessment of the Global Forest Cover Map for the Year 2020: Assessment Protocol and Analysis. JRC141231. Luxembourg: Publications Office of the European Union. https://data.europa.eu/doi/10.2760/7632707.

Oswalt, Sonja N., W. Brad Smith, Patrick D. Miles, and Scott A. Pugh. 2019. Forest Resources of the United States, 2017: A Technical Document Supporting the Forest Service 2020 RPA Assessment. General Technical Report WO-97. Washington, D.C.: US Department of Agriculture, Forest Service, Washington Office. https://doi.org/10.2737/WO-GTR-97

Renwick, Katherine M., Christopher W. Woodall, Christopher Mihiar, Lara T. Murray, Reid Lewis, Peter C. Beeson, and John Coulston. 2025. "Evaluating the Current Status of Agriculture-Driven Deforestation Across Jurisdictional Scales in the United States Using Foundational, Federal Datasets." Environmental Research Letters 20, no. 7. https://doi.org/10.1088/1748-9326/addc83

USDA (US Department of Agriculture) Forest Service. 2023. Future of America's Forest and Rangelands: Forest Service 2020 Resources Planning Act Assessment. General Technical Report WO-102. Washington, D.C.: US Department of Agriculture, Forest Service.
https://www.fs.usda.gov/sites/default/files/fs_media/fs_document/2020-RPA-Assessment.pdf

USDA (US Department of Agriculture) Forest Inventory and Analysis Program. n.d. Forest Inventory EVALIDator web application, Version 2.1.2. St. Paul, MN: Department of Agriculture, Forest Service, Northern Research Station. https://apps.fs.usda.gov/fiadb-api/evalidator.

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