

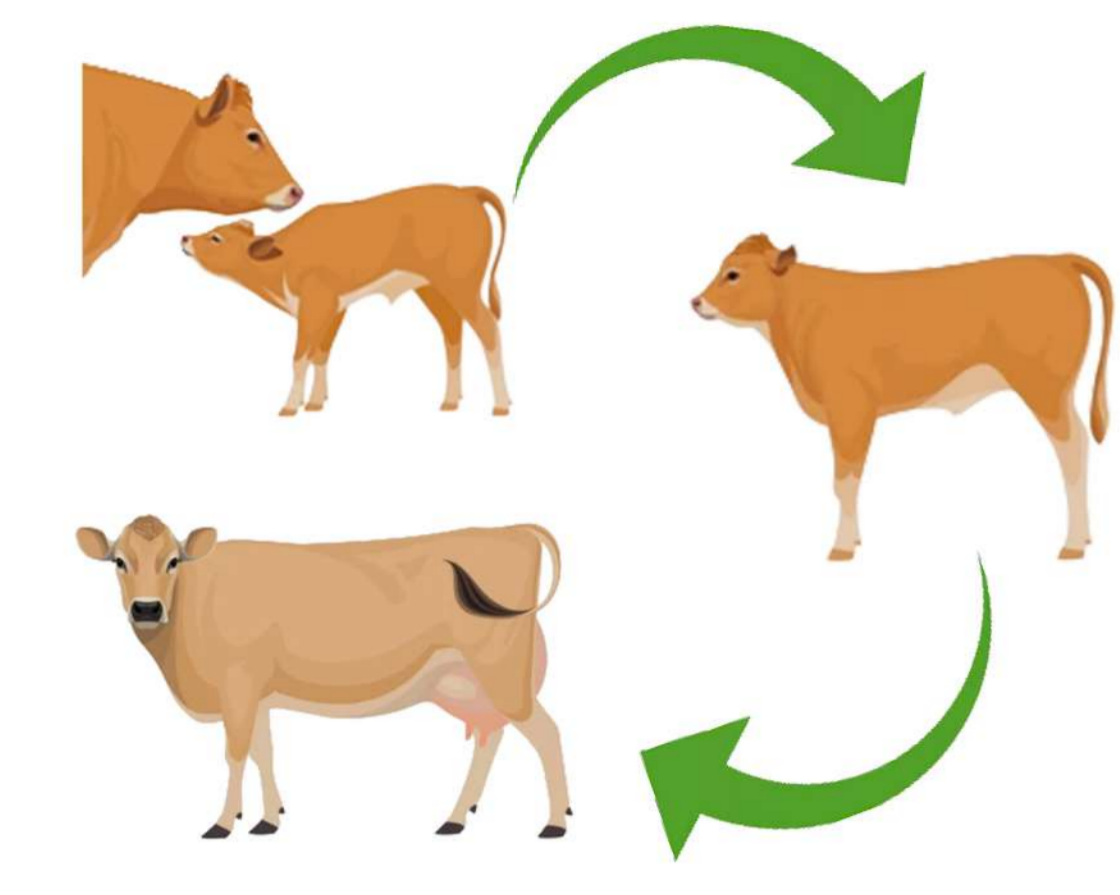
Evaluating different classification methods to effectively delineate tree cover on cattle farms in Colombia

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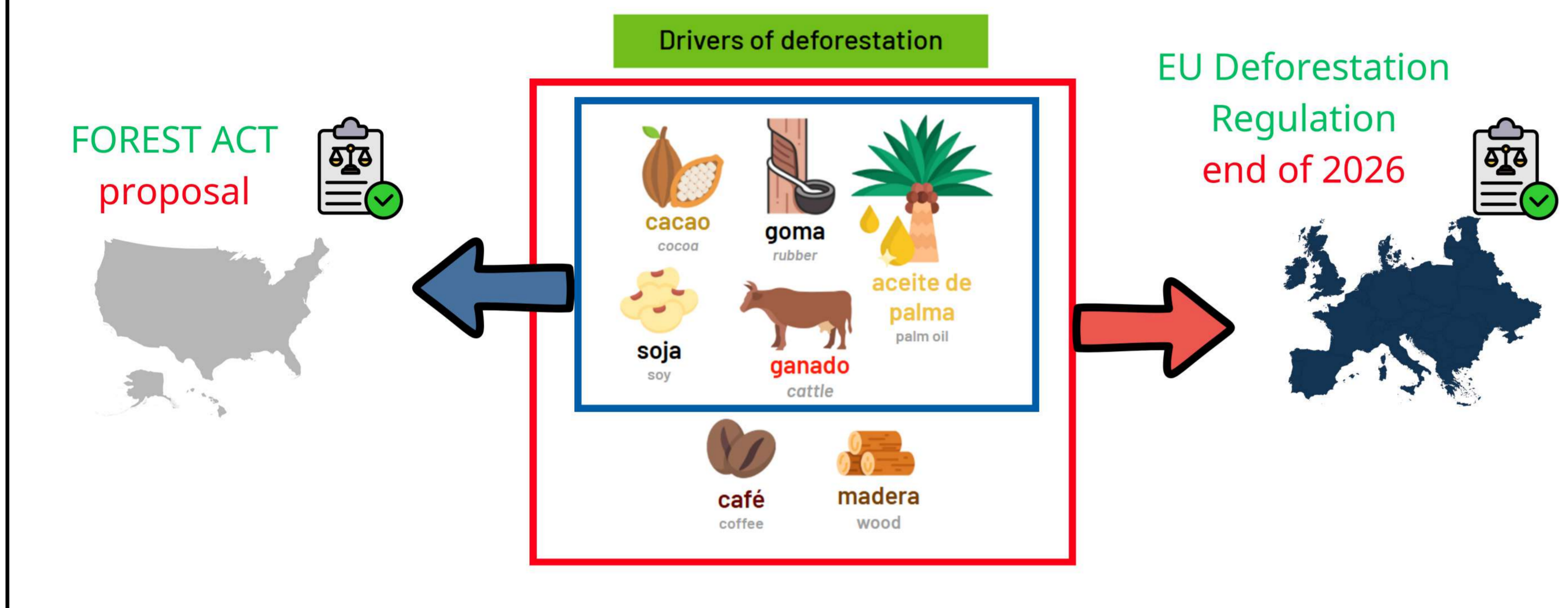
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I. Colombia's Beef market faces Green deadlines



Beef production in Colombia wants to further the growth of beef production by **opening trade with the EU and USA**; however, footprinting the commodity-linked deforestation is mandatory.



II. Taking advantage of Remote Sensing

This study aims to determine whether **accurate and robust annual forest cover detection models can be developed for the cattle ranches in the Republic of Colombia**, using remote sensing, freely available satellite data, ground truth data, and drone images. This is to monitor deforestation relevant to regulatory requirements.

III. Joint partnership between Colombia and Japan



The study is a part of a collaborative project between Japan and Colombia under the **Science and Technology Research Partnership for Sustainable Development (SATREPS) program**.

IV. Case study on two distinct ranches in Colombia

South America

Monteria, Colombia

El Rosario ranch

Costa Rica ranch

Satellite data (Sentinel 1, Sentinel-2)

Dominant grass types found in the 2 ranches

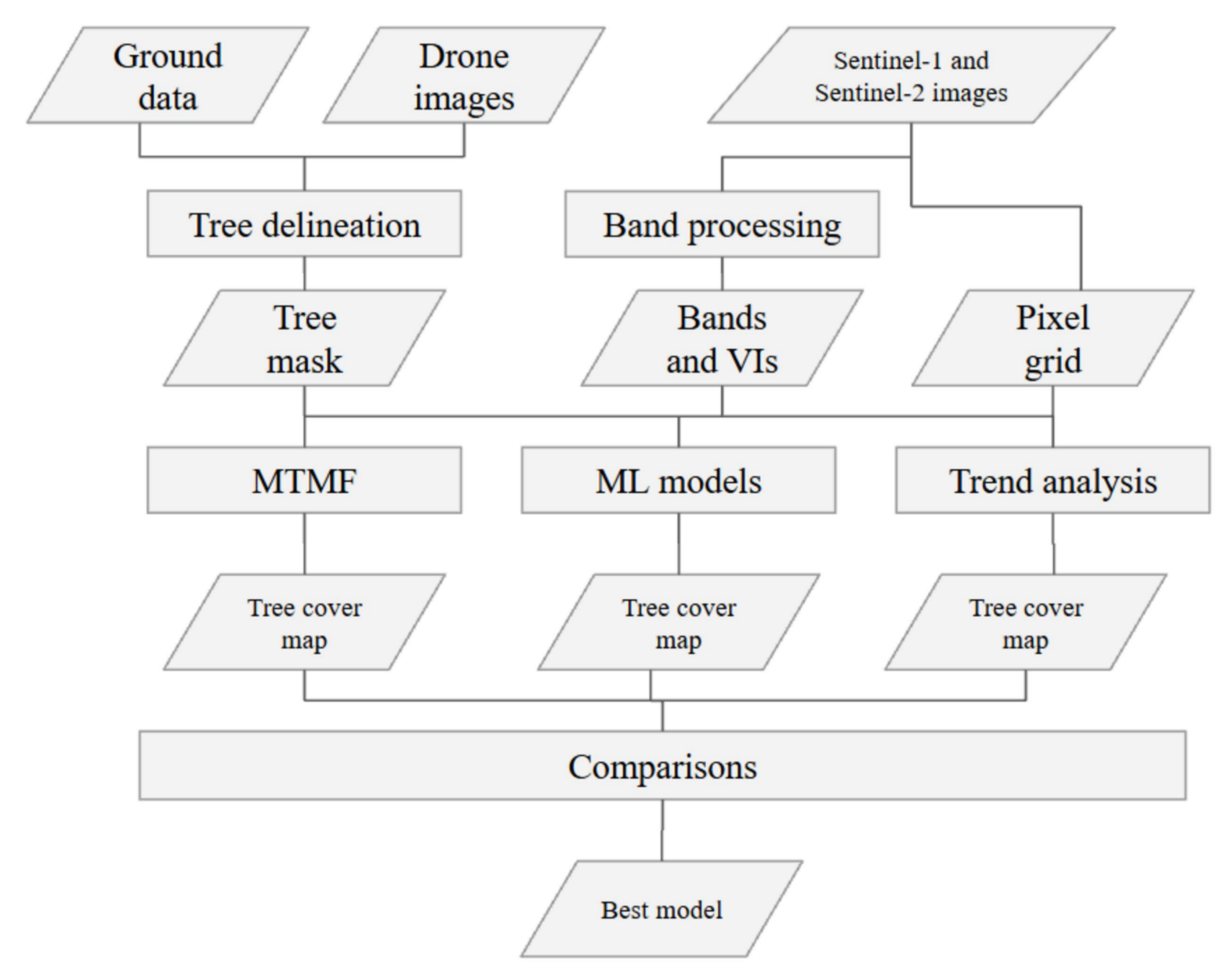
Mombasa, Toledo, Estrella

Training and validation data was built using tree inventory survey and drone images.

V. How did we do this?

Monthly cloud cover assessment was conducted first on the study areas from 2020 using Sentinel-2's Cloud Probability collection. This was conducted to determine if annual forest cover assessment is feasible in the region.

Then, **different land classification methods were evaluated to determine which best fits the application utilizing Sentinel-1 and 2 data**. The diagram below shows the workflow of the study.



To ensure model's robustness, each model was tested on both ranches. Lastly, the methods were evaluated according to the accuracy metrics and also its integrability with the on-going farm management system in Colombia.

VI. Best remote sensing technique to the study

The assessment showed that at least a month of cloud-free satellite data can be generated for each year.

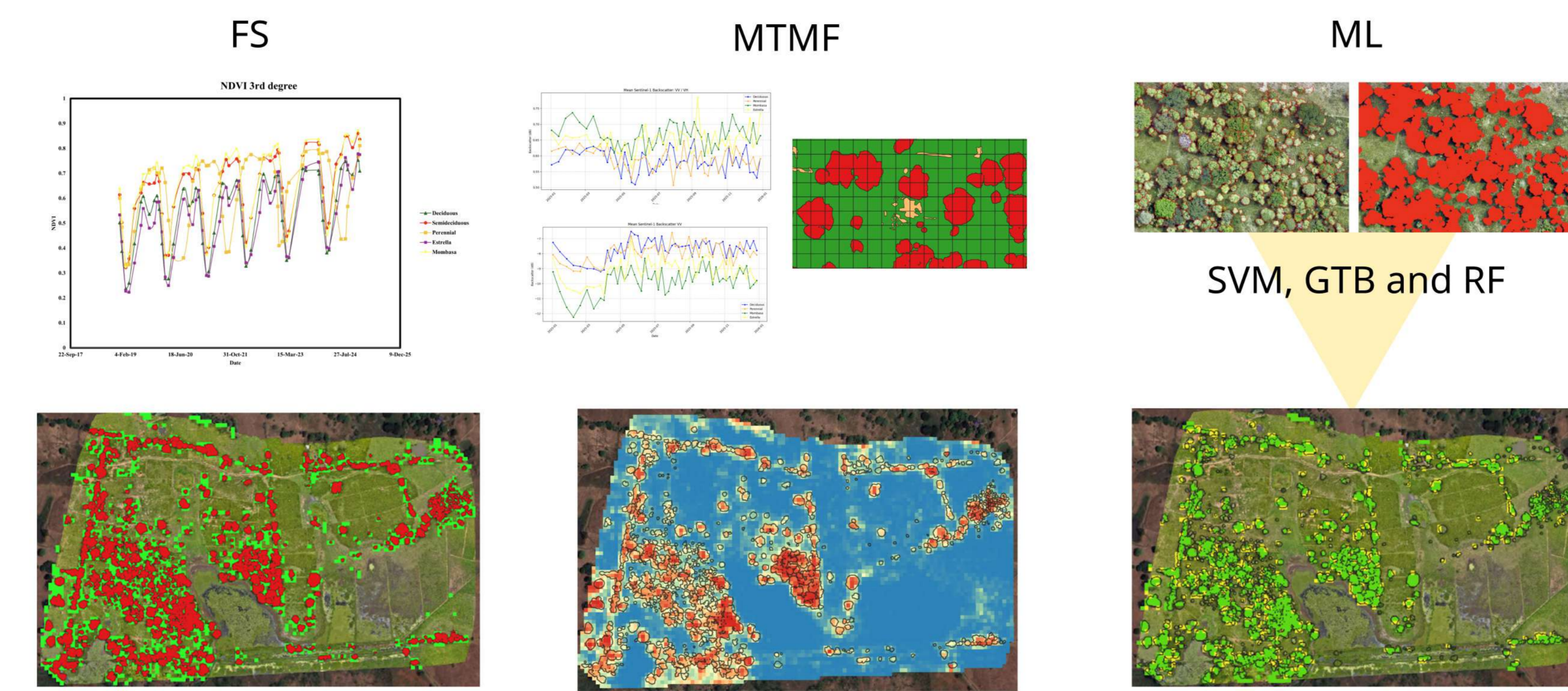
Months with monthly cloudless composite images of El Rosario

year \ month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020	○	○										
2021												
2022												○
2023		○			○							
2024							○	○				○

Each method's implementation utilized two different approaches on building training dataset, vector-based approach and grid-based approach.



Then, different land classification methods were evaluated to determine which best fits the application utilizing Sentinel-1 and 2 data: random forest (RF), support vector machine (SVM), gradient tree boost (GTB) machine learning models, mixed tuned match filtering (MTMF), trend analysis using fourier series (FS) and combination of these methods.

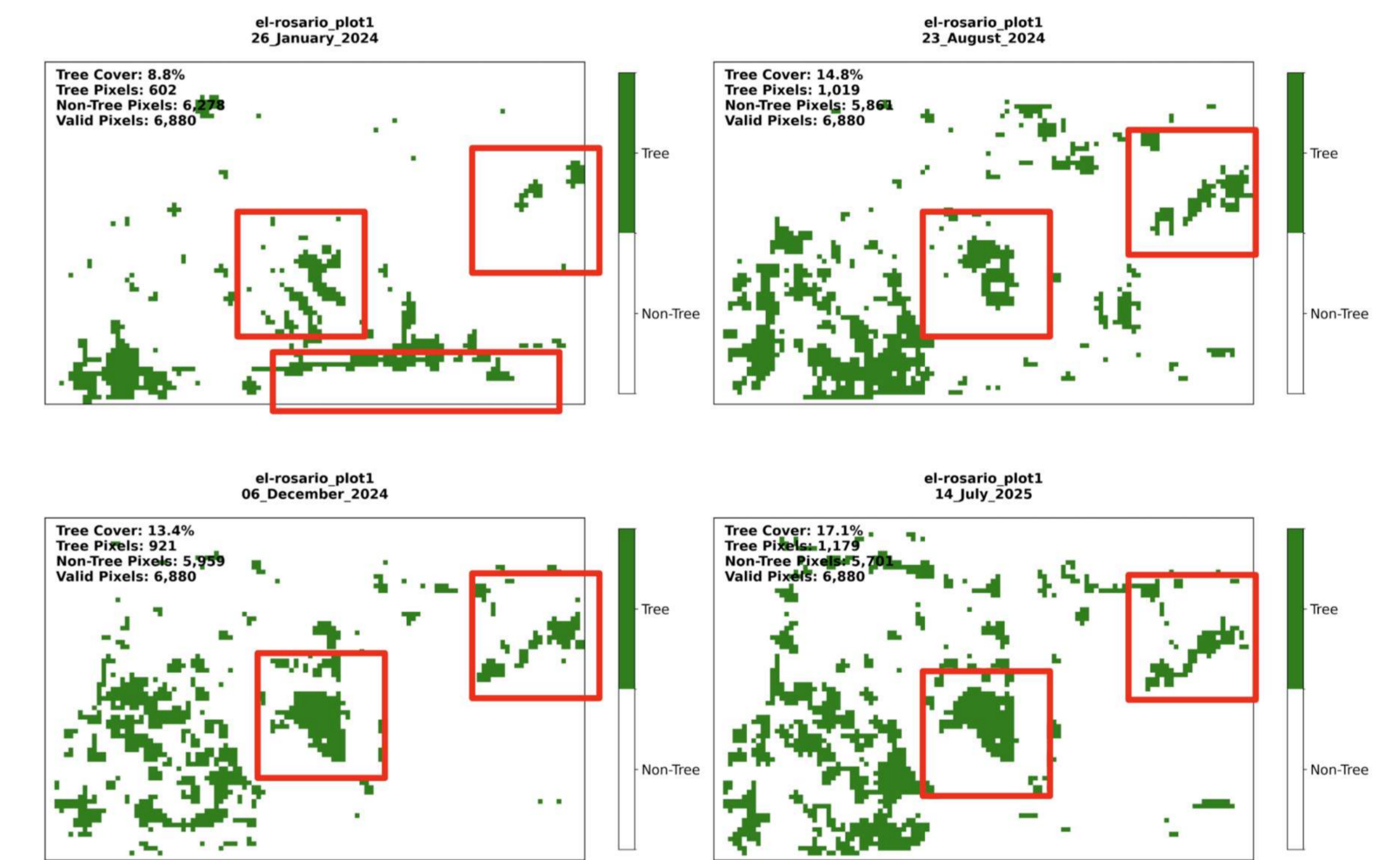


The best method identified was the RF using grid-based approach, producing an accuracy of 88.58%, and with the advent of freely accessible geospatial platforms such as Google earth engine, its integrability to any current system is very straightforward.

VII. Applying to Colombia's beef market

Annual forest cover mapping:

- Generated annual forest cover maps and detected forest cover loss.



- Compliance assurance:
- Fulfills risk assessment requirements for EUDR and FOREST Act.
 - Can be integrated with the Grass-fed certification system.

Beef production blueprint:

- Created clear picture of beef production impact.
- Increase beef value.



VIII. Conclusions

Accurate forest monitoring is feasible for regulatory needs using accessible data and robust machine learning, enabling sustainable trade and environmental conservation.