IECF 2024 Conference
The 4th International Conference on Forests
23–25 September 2024 | Online
MDPI

Aerophotogrammetry and artificial intelligence to quantify trees and palms in Amazon native Rainforests

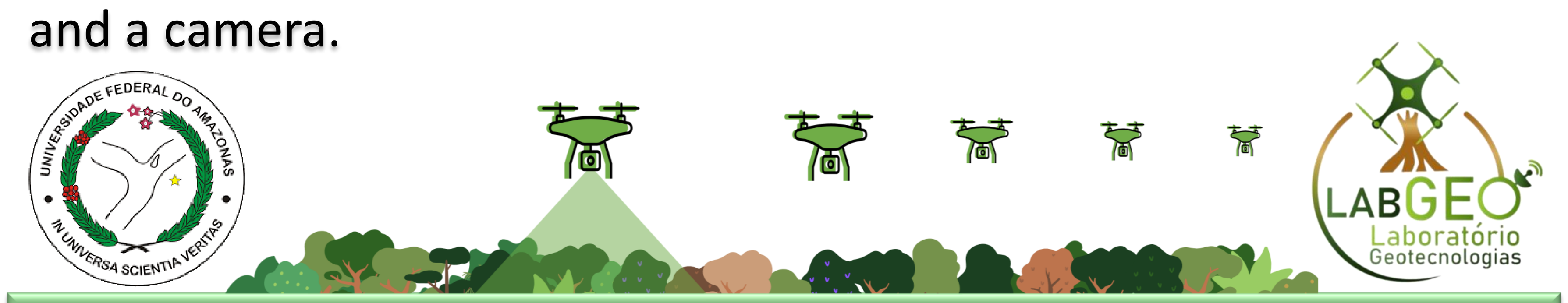
Savanah Franco de Freitas 1, Juliana Sousa de Holanda 1, André Luiz Alencar de Mendonça 1
Federal University of Amazonas, engflorsav@gmail.com 1

INTRODUCTION & AIM

The **Amazon rainforest** is composed of **dense**, **large** and **diverse vegetation**; this implies arduous data collection to study forest dynamics. To assist with these studies, **remotely piloted aircrafts (RPAs) can be used to collect images of the forest to acquire characteristics such as the height of the forest, used for biomass and carbon calculations**.

Figure 1. Amazon rainforest as seen in Manaus City.

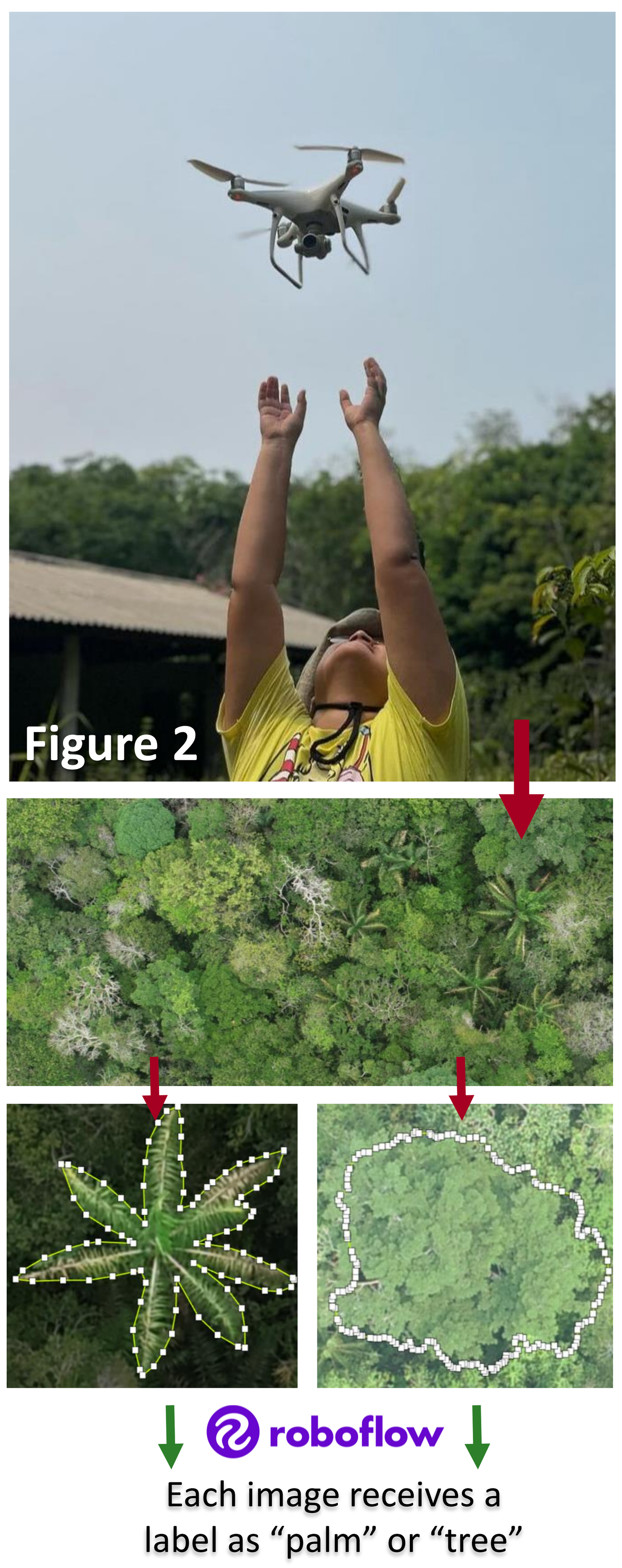
This technology with machine learning can help in the processing of extensive data; however, it has not yet been applied to Amazon forests, and it offers an opportunity to improve the accuracy of carbon estimates. The aim of this study was to investigate the performance of the artificial intelligence (AI) YOLOv5 in a Google Colab environment to count palms and trees in aerophotogrammetric images captured with the DJI Phantom 4 Pro and a camera.



METHOD

After the images acquisition in field (Figure 1), the images were manipulated using roboflow, to be separated for the AI phases. For those in question, we used Google Colab with free access. Figure 2 is an example of how an image is manipulated.

The models were evaluated using the AI metric mean average precision (mAP) and the remote sensing (RS) metrics omission, commission errors and accuracy[1,2].



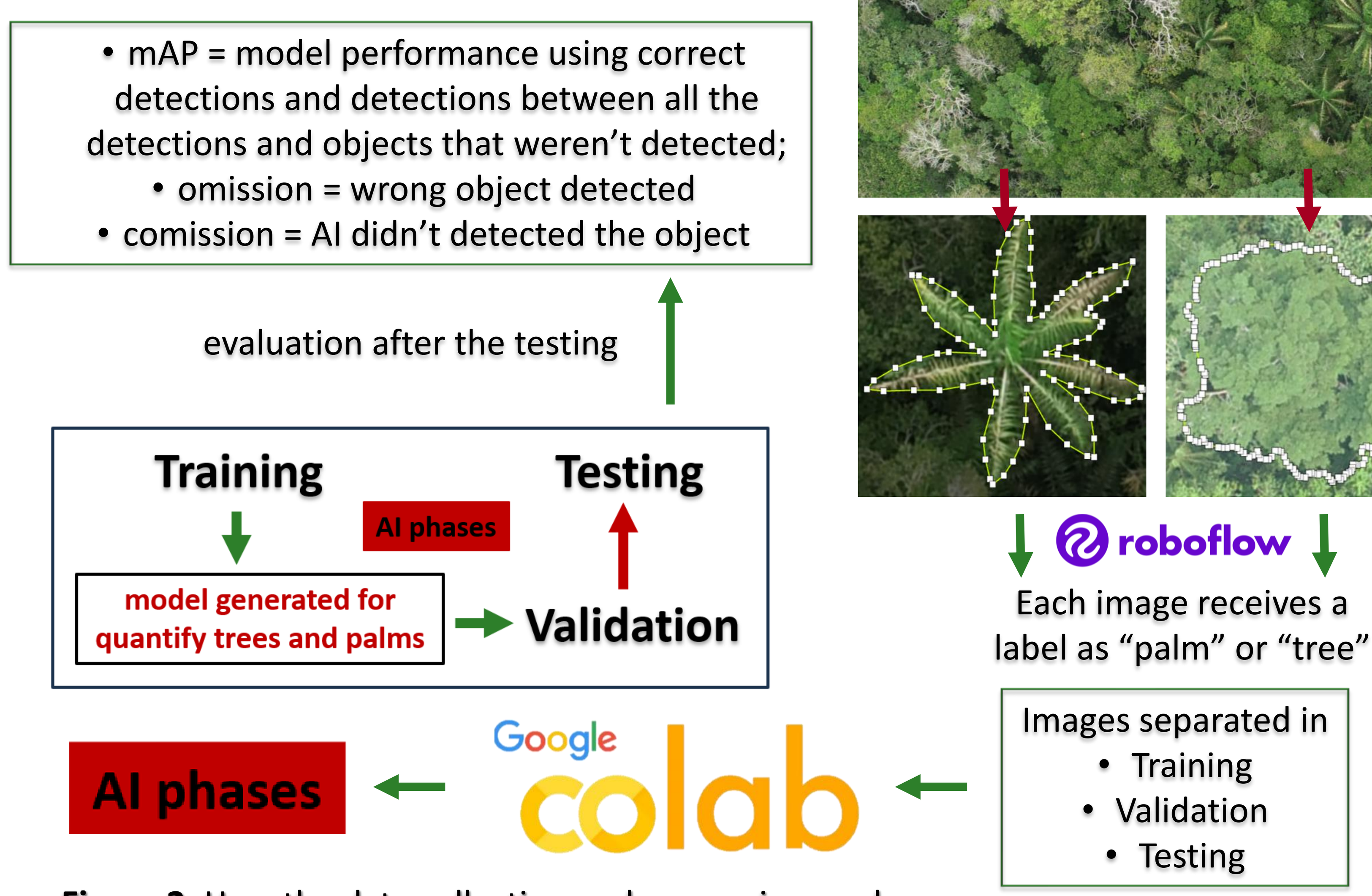


Figure 2. How the data collection and processing works.

RESULTS & DISCUSSION

Table 1. AI and RS metrics results for palms and trees models.

Model	Accuracy	Omission	Commission	mAP	Hours
Palm	26-38%	65-75%	4-20%	65-74%	3 to 14
Tree	23-61%	39-77%	1-5%	64-76%	3 to 17

The best model for palms achieved 38% of accuracy with ≤ 20% of commission, this means that it works well and mostly of the palms where correctly detected (Table 1, Fig. 3). Unfortunately, omission obtained high rates, where the model confuses trees and palms (Fig. 5). After 17 hours, the best model for detect trees (Fig. 4) achieved an 76% mAP, with also high rates of omission and 28% of accuracy.

Figure 3. Palms detected correctly.

Another model achieved 53% accuracy and an 64% mAP for trees model. The performance (mAP) was considerated the most important metric in forestry studies where remote sensing metrics were not considered[3,4].

Figure 4. Trees detected correctly.

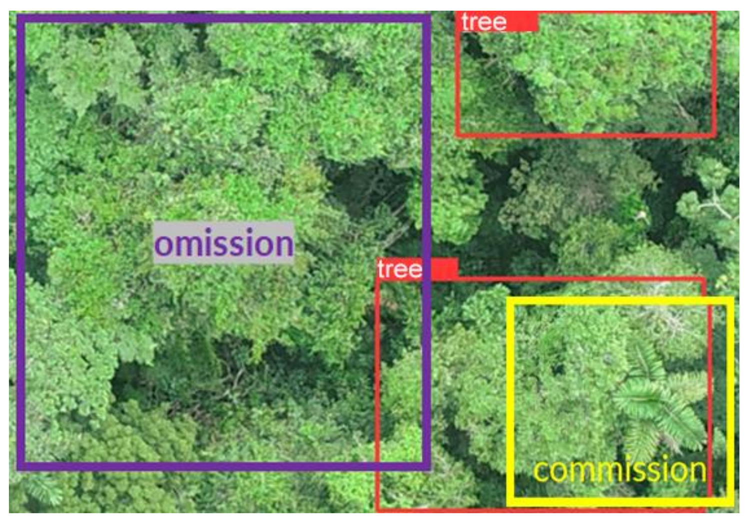


Figure 5. Omission and commision errors, palm identified as tree.

In this study, mAP and RS metrics were considerate with the same importance. The RS metrics are compared to real field data, and it is crucial that the model can satisfy both metrics. In contrast, none of the models satisfied both AI and RS metrics, which would be crucial to minimize errors and to apply an AI in forestry.

CONCLUSION

it is possible to say that the models performed well, but not as expected, so it is recommended to use more different images of the objects in the AI phases, such as different shapes and colors, to improve AI for forestry applications, in order to satisfy RS metrics as well as AI metrics.

REFERENCES

Henderson, P.; Ferrari, V. End-to-End Training of Object Class Detectors for Mean Average Precision. Lecture Notes in Computer Science. Springer International Publishing, 2017. 198–213.
Ferreira, E.; Dantas, A. A. A.; Morais, A. R. De. Exatidão na classificação de fragmentos de matas em imagem do satélite Cbers-CCD, no município de Lavras, MG. Simpósio Brasileiro de Sensoriamento Remoto, p. 887–894, 2007.
Ferreira, M.P.; Almeida, D.R.A.D.; Papa, D.D.A. *et al.* Individual Tree Detection and Species Classification of Amazonian Palms Using UAV Images and Deep Learning. Forest Ecology and Management 2020, doi:10.1016/j.foreco.2020.118397.
Xiong, Y.; Zeng, X.; Chen, Y. *et al.* An Approach to Detecting and Mapping Individual Fruit Trees Integrated YOLOv5 with UAV Remote Sensing; EARTH SCIENCES, 2022.