

Exploring using Google Earth Engine and GIS to assess the impacts of climate change and land use change on the Haouzia forest (Morocco)

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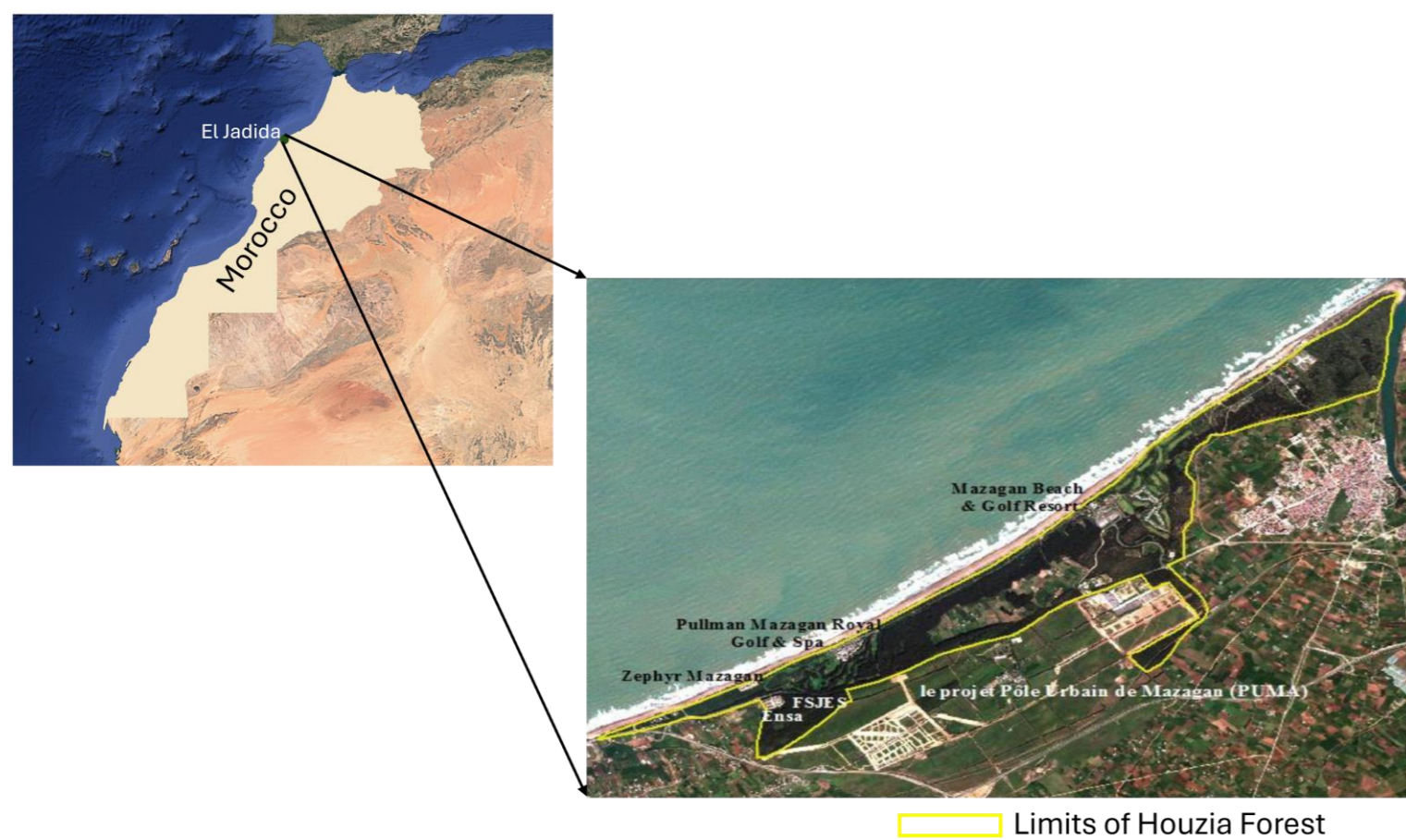
INTRODUCTION & AIM

Climate change and land use changes constitute significant threats to natural ecosystems and water resources. In Morocco, the Haouzia forest is under increasing pressure from rapid urban expansion, leading to forest degradation, loss of biodiversity and ecosystem disruption [1].

The aim of this study is to characterize land-use changes in the Haouzia forest in the last 35 years, quantify the fragmentation of this predominantly eucalyptus forest and identify the main factors behind its decline. Using Google Earth Engine (GEE), Geographic Information Systems (GIS) [2] and field observations, this research provides valuable information for sustainable forest management and urban planning.

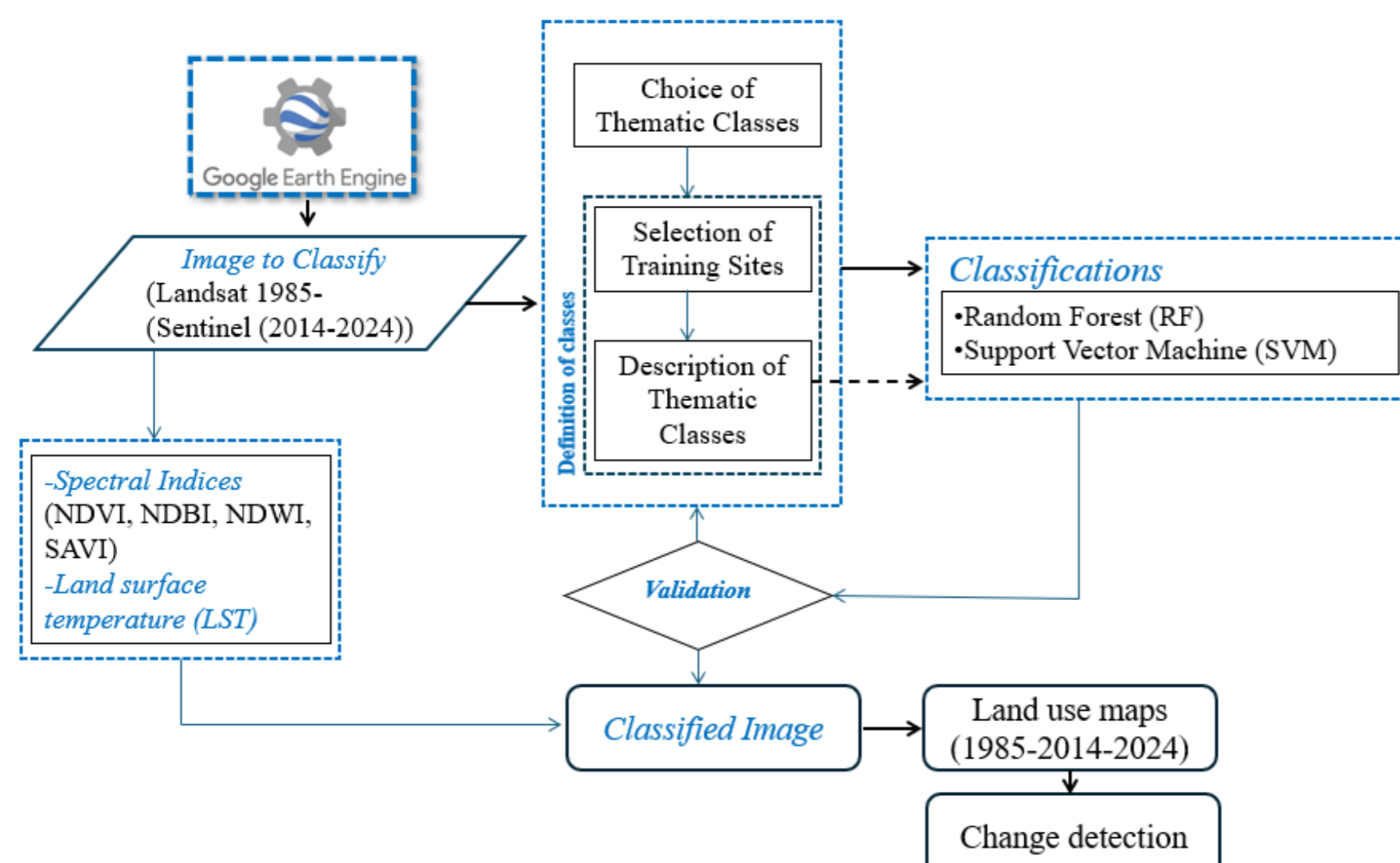
STUDY AREA

The Haouzia forest is located on the Moroccan Atlantic coast between the city of Azemmour to the northeast and the city of El Jadida to the southwest. Its Lambert coordinates are 33°15'49 "N and 8°24'46 "W. Located at Lambert coordinates 33°15'49 "N and 8°24'46 "W, it extends for around 6 kilometers in a northeast-southwest direction. The forest is dominated by eucalyptus, with pockets of acacia and araucaria near the coast.



METHOD

The adopted methodology is summarized in the following flowchart:



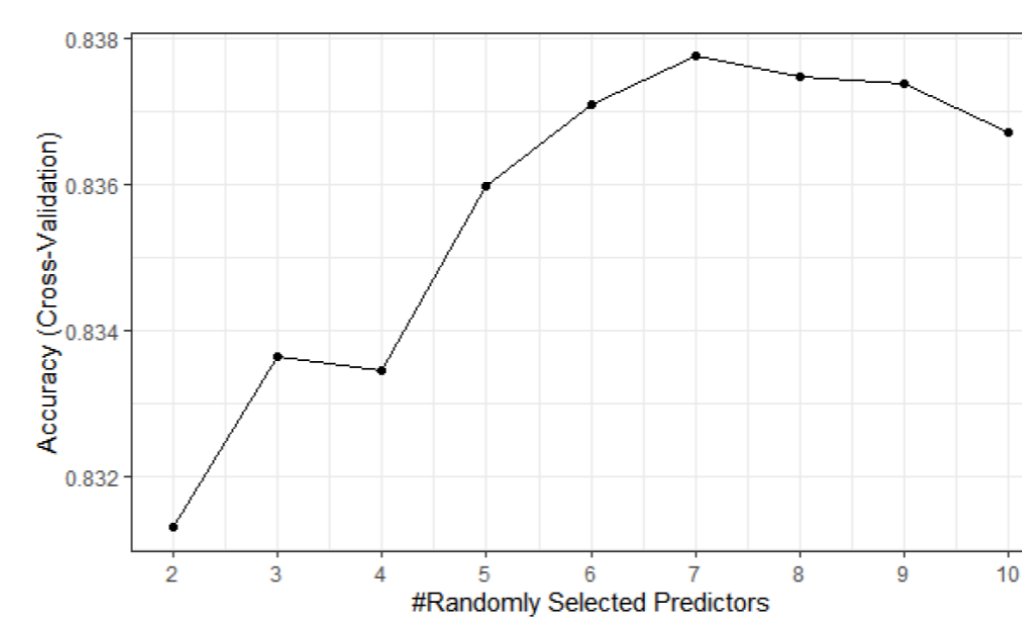
CONCLUSION

The urban expansion, including the development of tourism infrastructure and educational establishments, has significantly impacted the Haouzia forest. These developments have resulted in marked fragmentation and deforestation, leading to the loss of small forest fragments and a reduction in tree density. To assess these changes, two methods were tested: Support Vector Machine (SVM) and Random Forest (RF). The results obtained with RF are superior and enable a detailed analysis of deforestation dynamics. These forest losses contribute to climate change by reducing carbon sequestration and exacerbating the effects of climate regulation, soil protection and biodiversity loss. It also exacerbates soil erosion and degradation. GIS and GEE tools are essential for monitoring these changes and for sustainable ecosystem management.

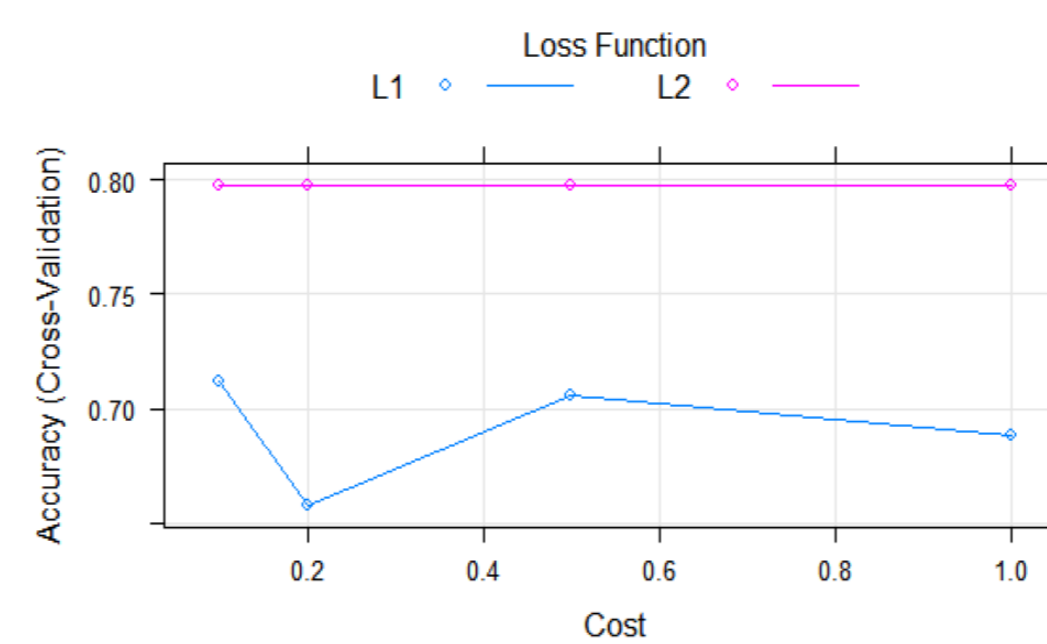
RESULTS & DISCUSSION

Overall Performance Comparison of Classification Algorithms

Random Forest (RF)



Support Vector Machine (SVM)

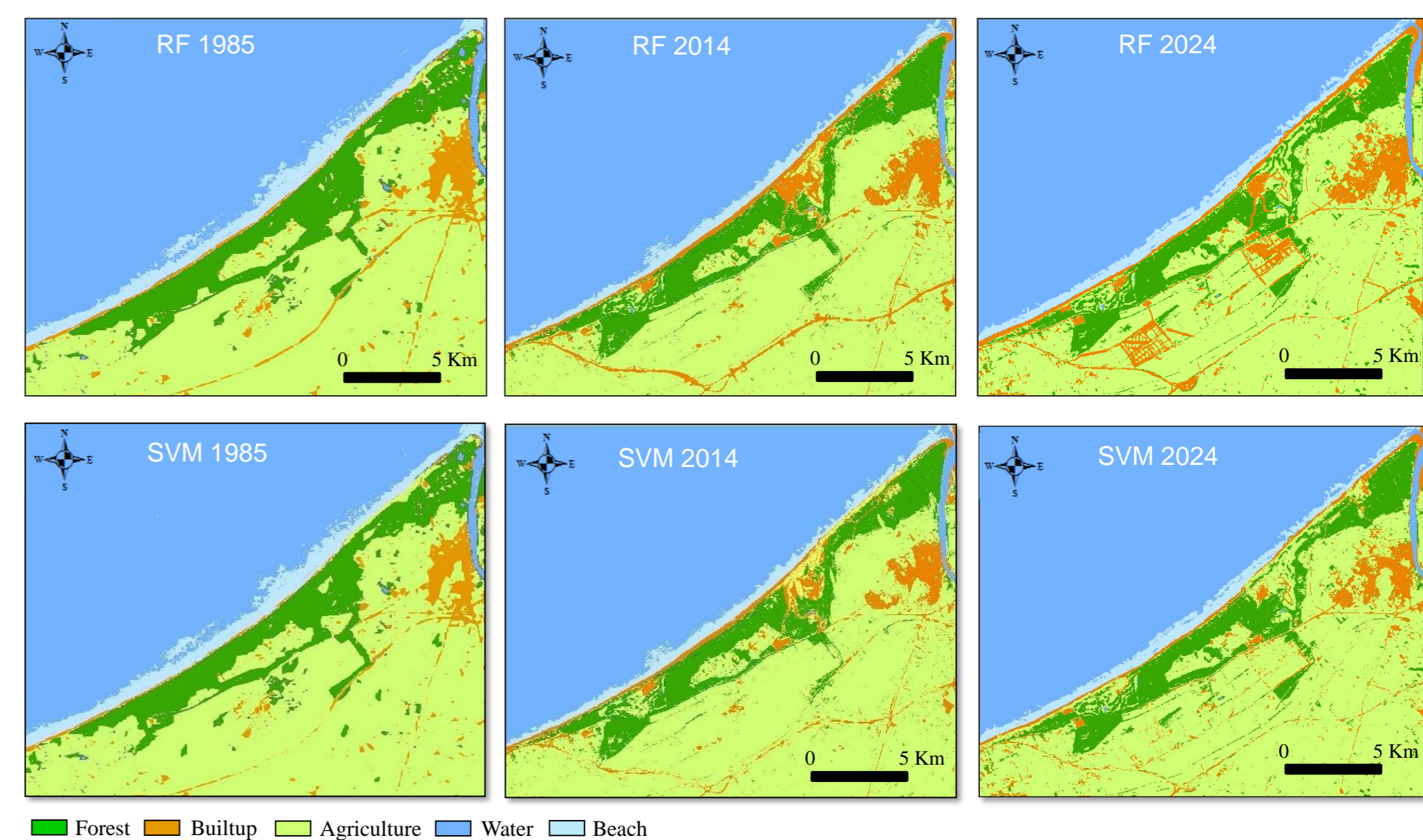


Overall Statistics

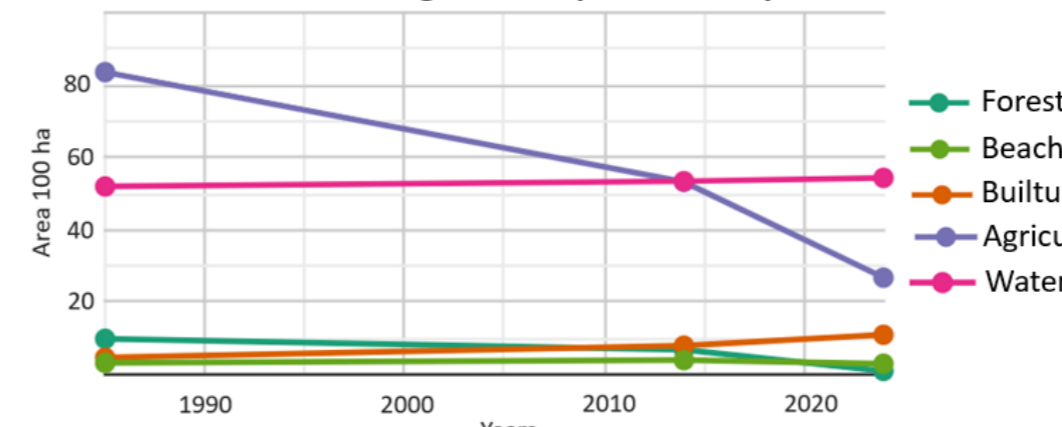
	RF	SVM
Accuracy	0,912	0,83
Kappa	0.879	0,736
95%CI	(0.89, 0.924)	(0.79, 0.855)

The RF model performed better with narrower confidence intervals (95% CI: [0.89; 0.924]) than the SVM (95% CI: [0.79; 0.855]). These results indicate that the RF model is more appropriate for this dataset, thanks to its ability to handle random variables efficiently and maintain stable performance even with complex data [3].

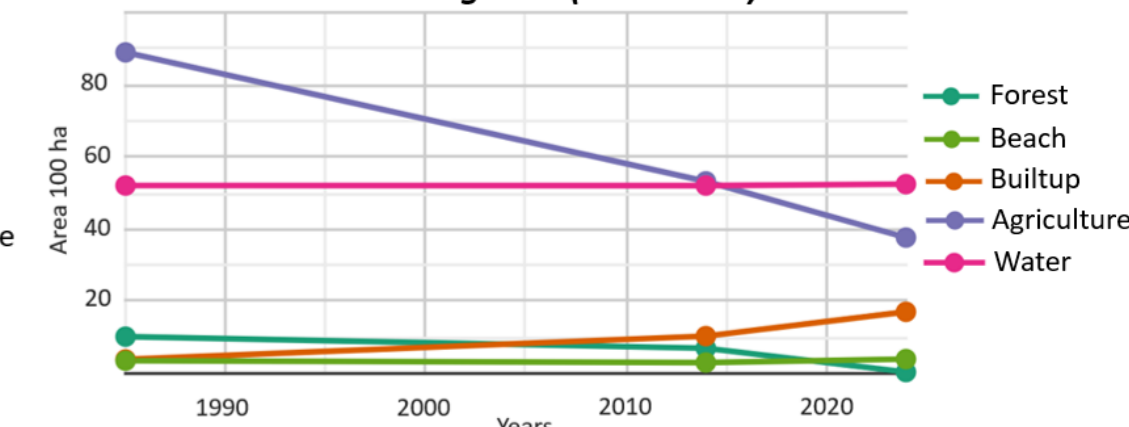
Spatiotemporal land use change dynamics between 1985 and 2024 in the Houzia forest



Area changes SVM (1985-2024)



Area changes RF (1985-2024)



The comparison of land use in general and wooded areas in particular between the three dates reveals that the Haouzia forest cover lost 421.19 ha between 1985 and 2014 (from 1021.32 ha in 1985 to 600.13 ha in 2014) and 559.8 ha between 2014 and 2024 (from 600.13 ha in 2014 to 40.3 ha in 2024)

REFERENCES

- [1] El Mjiri, I., Rahimi, A. and Bouasria, A. 2020. Urban Sprawl Evolution and Soil Artificialization Assessment by Using Satellite Data from 1985 to 2019: Case of El Jadida Metropolitan in Morocco. 2020 Second International Sustainability and Resilience Conference: Technology and Innovation in Building Designs(51154). <https://doi.org/10.1109/IEEECONF51154.2020.9319958>.
- [2] Carine, N. M. A., Marc, Y. T., Jean-Robert, K. S., Arnel, K. K., Vincent, A. T., & Patrice, J. J. (2023). Cartographie des unités d'occupation du sol du District d'Abidjan depuis le cloud Google Earth Engine, sur la base des images optiques Sentinel-2 et des algorithmes de Machine Learning. International Journal of Innovation and Applied Studies, 40(1), 310-332.
- [3] Grimaj, M. (2024). Utilisation du Machine Learning pour la cartographie de la répartition annuelle des espèces végétales sur le Sahel selon les facteurs environnementaux (Doctoral dissertation, IAV Hassan II).