Quantifying invasion levels by alien plant species in La Réunion Island

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INTRODUCTION

- La Réunion : over-representation of alien plants species : + 2000 species >> ~ 800 native species

Several impacts Human health , economic cost , destruction and alteration of habitats, alteration of ecological processes, competition with native species, …

- Lack of knowledge about the general distribution of alien plants species

→ Data exist : + 30 years of surveys but insufficient spatial data on the distribution of invasive species

- Invasion data is required to inform alien plant clearing

Invasion by *Rubus alceifolius* *in an indigenous forest*

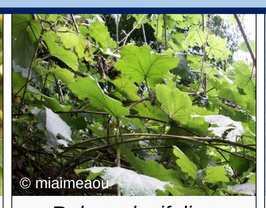
SCIENTIFIC QUESTIONS

- What is the pattern of invasion (all species combined) at the island scale ?
- Which factors explain the different levels of invasion ?

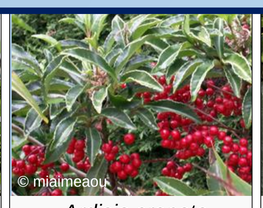
SPECIES

Psidium cattleianum 5040 obs.

Litsea glutinosa 2404 obs.

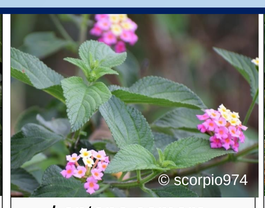


Rubus alceifolius 2100 obs.

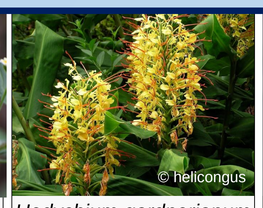


Ardisia crenata 1871 obs.

Syzygium jambos 1865 obs.

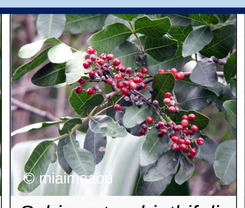


Lantana camara 1571 obs.

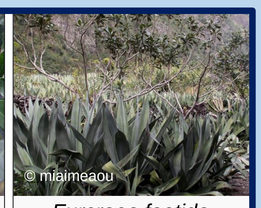


Hedychium gardnerianum 1326 obs.

Ageratina riparia 1277 obs.

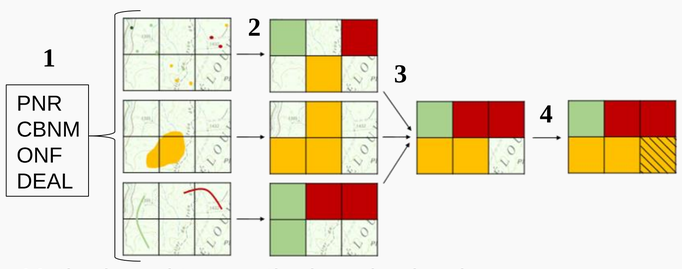


Schinus terebinthifolia 1263 obs.



Furcraea foetida 1164 obs.

INVASION LEVELS



Method used to map the invasion levels

1: Survey data from different organisations

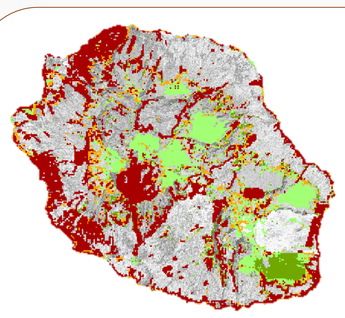
2: Extrapolation into grid cells of 250x250 m

3: Combine all the information in an unique map

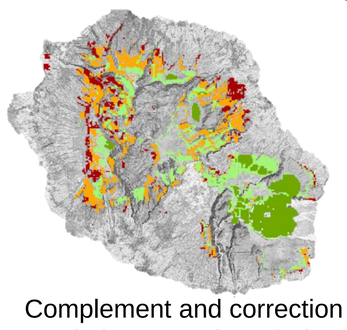
4: Organisation of workshops with experts to complete the map

Distribution of the invasion level (%)

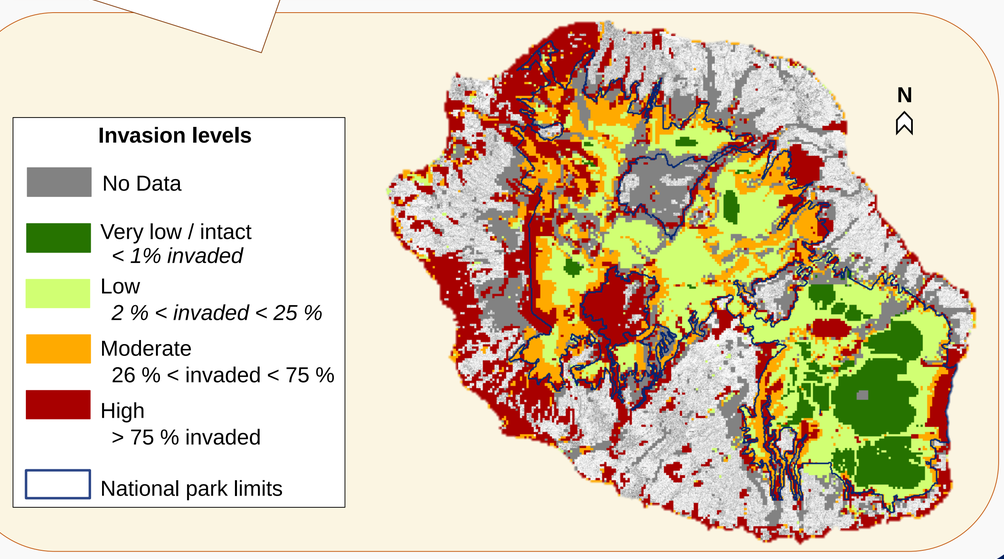
Invasion level	Invasion percentages within natural habitats	
	Inside the national Park (94 902 ha)	Outside the national Park (3895 ha)
Very low / intact	16 %	0 %
Low	35 %	6 %
Moderate	23 %	11 %
High	16 %	26 %
No Data	10 %	57 %



Survey data

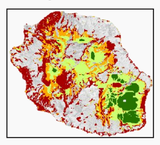


Complement and correction made by expert knowledge



FACTORS ASSOCIATED

Abundance data of invasive alien species



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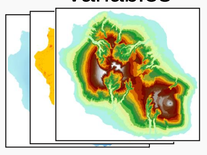
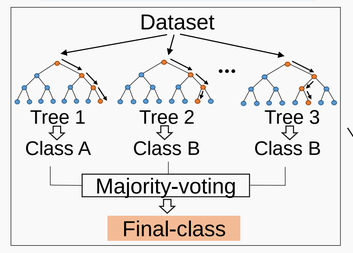
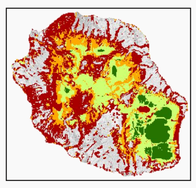
Climatic, topographic and anthropogenic variables



Random Forest



Projection in space



Potential distribution of invasion level

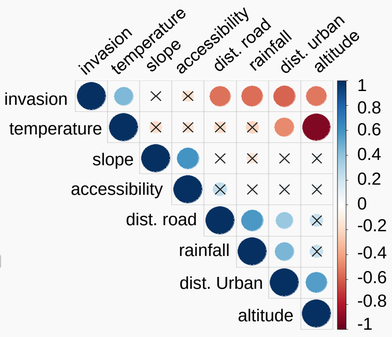
Variables used to modelling invasion abundance

Climatic	Anthropogenic	Topographic
Temperature	Distance to roads	Vegetation
Rainfall	Distance to urban areas	Geomorphology
	Accessibility	Slope
		Altitude

Model : invasion ~ climatic variables
Estimate error rate : 39,76 %
Variables importance : rainfall > temperature

Model : invasion ~ topographic variables
Estimate error rate : 36,85 %
Variables importance : altitude > slope > vegetation > landform

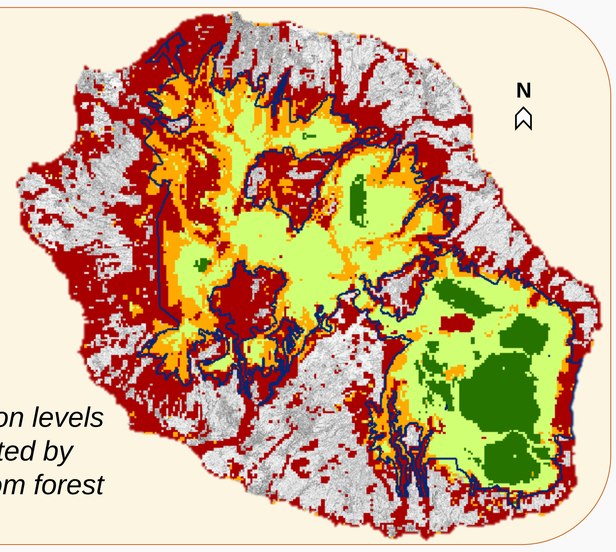
Model : invasion ~ anthropogenic variables
Estimate error rate : 38,95 %
Variables importance : dist. urban > dist. roads > accessibility



Correlation matrix

Model : invasion ~ rainfall + altitude + dist. urban areas + accessibility
Estimate error rate : 23.23 %
Variables importance : rainfall > dist. urban areas > altitude > accessibility

Parsimonious model



Invasion levels predicted by Random forest

Model : invasion ~ all variables

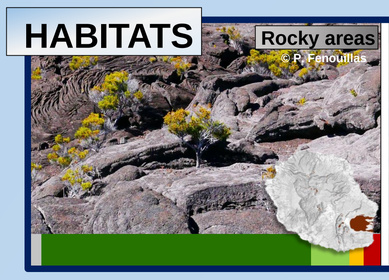
Estimate error rate
18.99 %

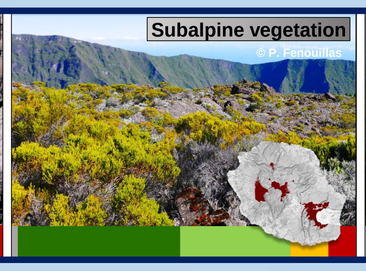
11.2 % | 19 % | 38.7 % | 9.9 %

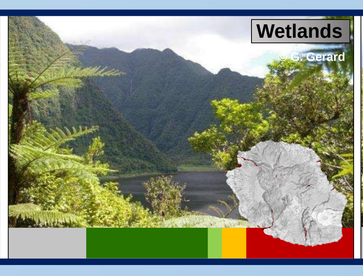
Variables importance

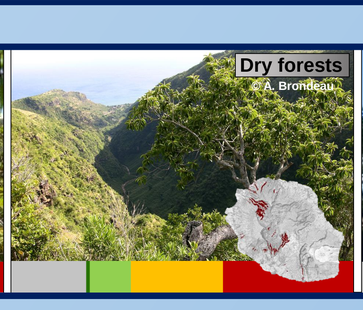
rainfall > altitude > dist. urban areas > vegetation > accessibility > dist. roads > temperature > slope > landform

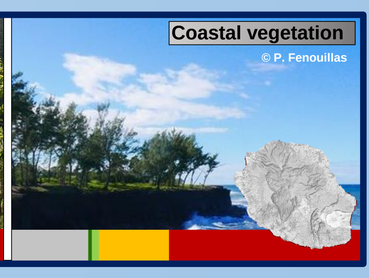
HABITATS











CONCLUSION

This study resulted in the first map of the general distribution of alien plants species in La Réunion. Four level of invasion are identified: Very low to intact, Low, Moderate and High. Data and expert knowledge allowed us to report on the state of conservation of 90 % of the national park area. Within the national Park, more than 50% of the habitats remain weakly invaded but 39 % of these habitats are threatened because of the invasion state (moderate to high). The natural habitats outside the national Park are mostly invaded.
Random forest provided a good prediction rate of 81 % for invasion level. Simplified models using the different types of variables (climatic, anthropogenic and topographic) are equivalent in terms of prediction rates. Rainfall, altitude and distance to urban areas are the three most important factors explaining the invasion level.

PERSPECTIVES

This study is part of a larger project of alien plants clearing prioritization. These first results have helped to identify conservation issues at the island scale and will guide future identification of clearing sites against alien plants.
Distribution maps at the species level are envisaged.