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Predicting tiger mosquito breeding sites through earth observation and statistical analysis

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Introduction

Aedes albopictus is the main vector of arboviruses like dengue and chikungunya in Reunion Island. Recently, vector control services have been collecting in-situ data on potential breeding sites covering about 10% of the districts of the island.

This study investigates the capability of environmental features extracted from remote sensing data to be used in the prediction of the distribution of potential breeding sites of *Ae. albopictus* at Reunion Island.

A 3 steps approach:

1

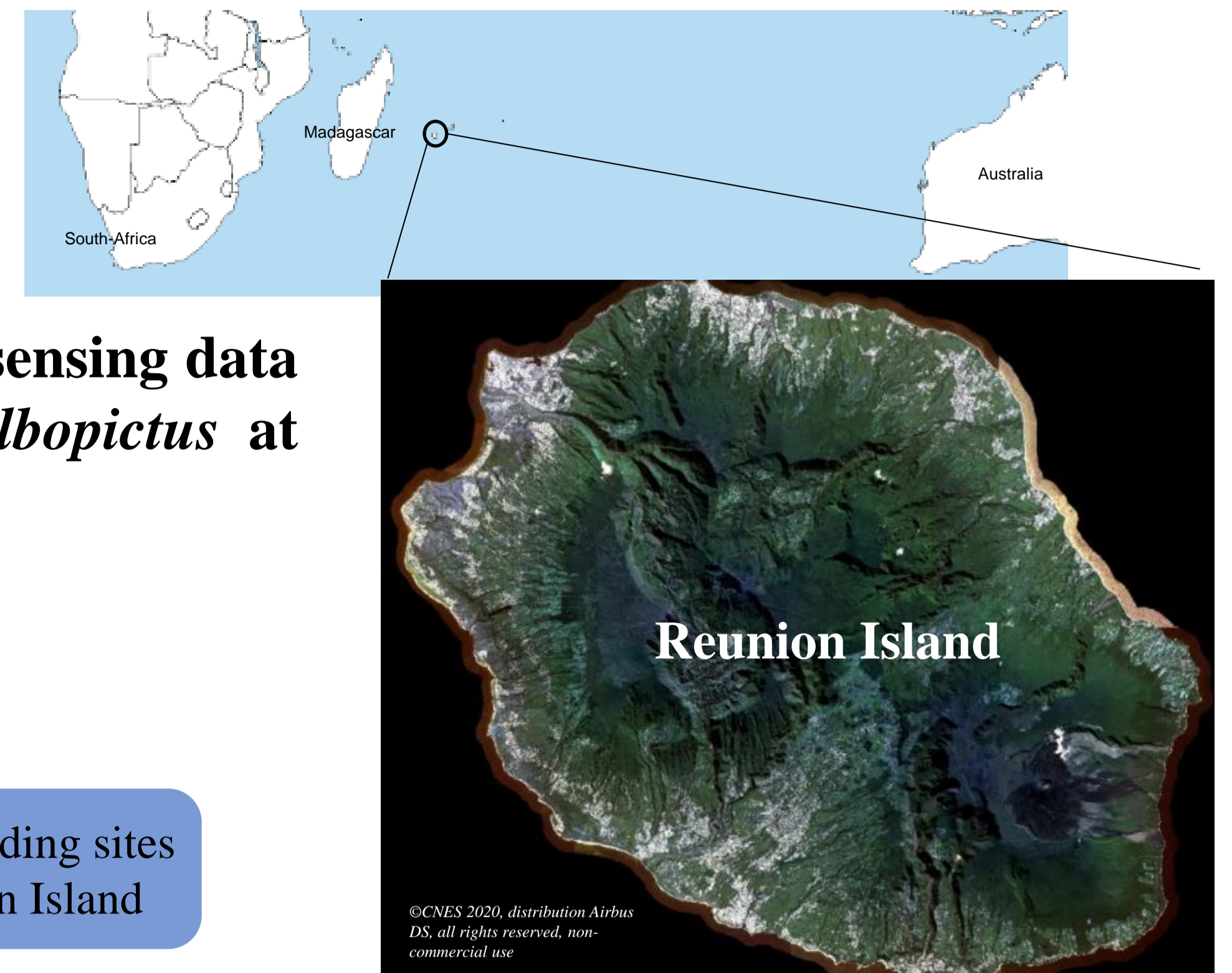
Extract relevant landscape indicators of the urban environment from very high spatial resolution imagery

2

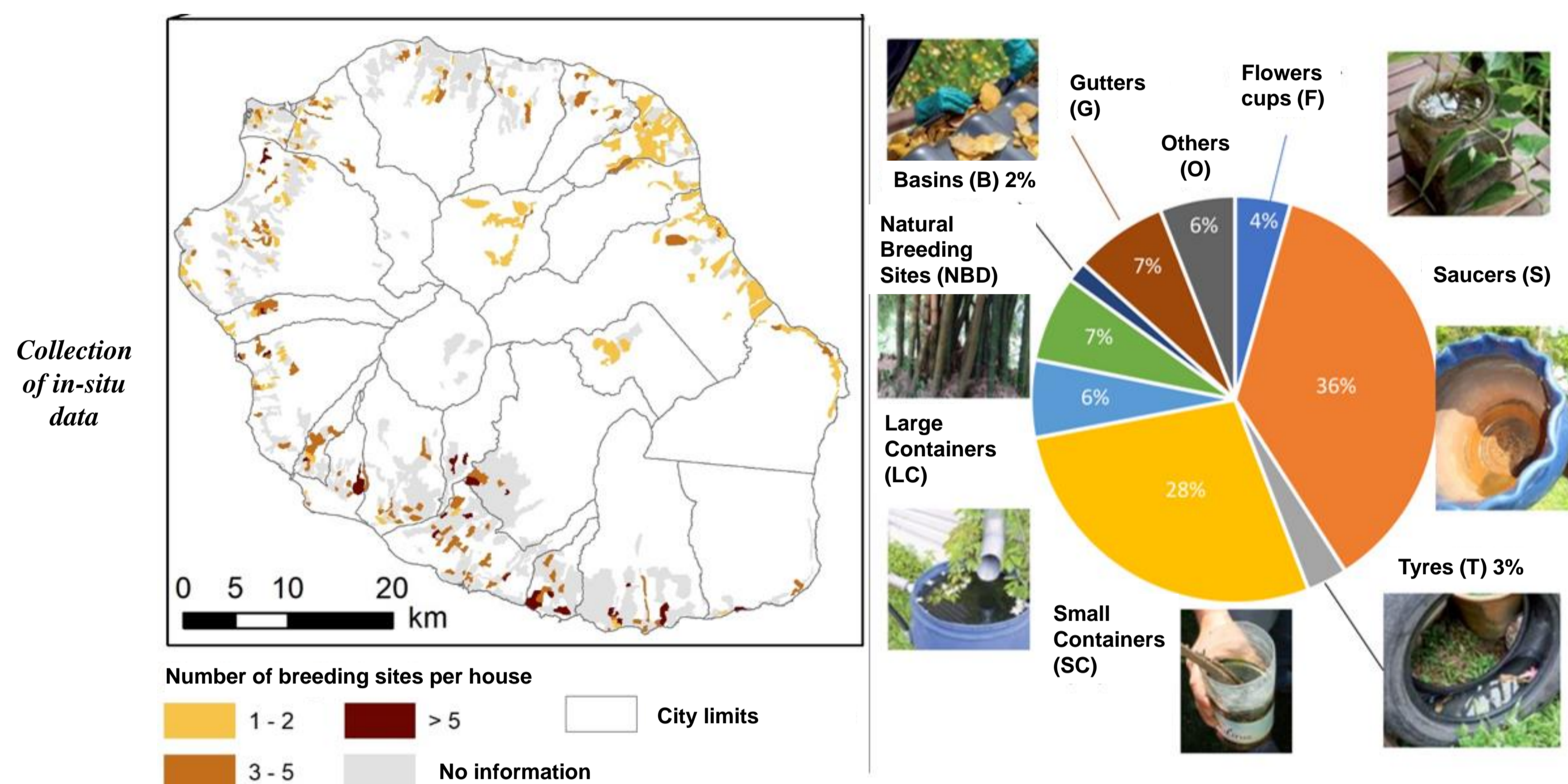
Identify correlations between landscape indicators, climate variables and breeding site data

3

Predict spatially the number of breeding sites over the entire territory of Reunion Island

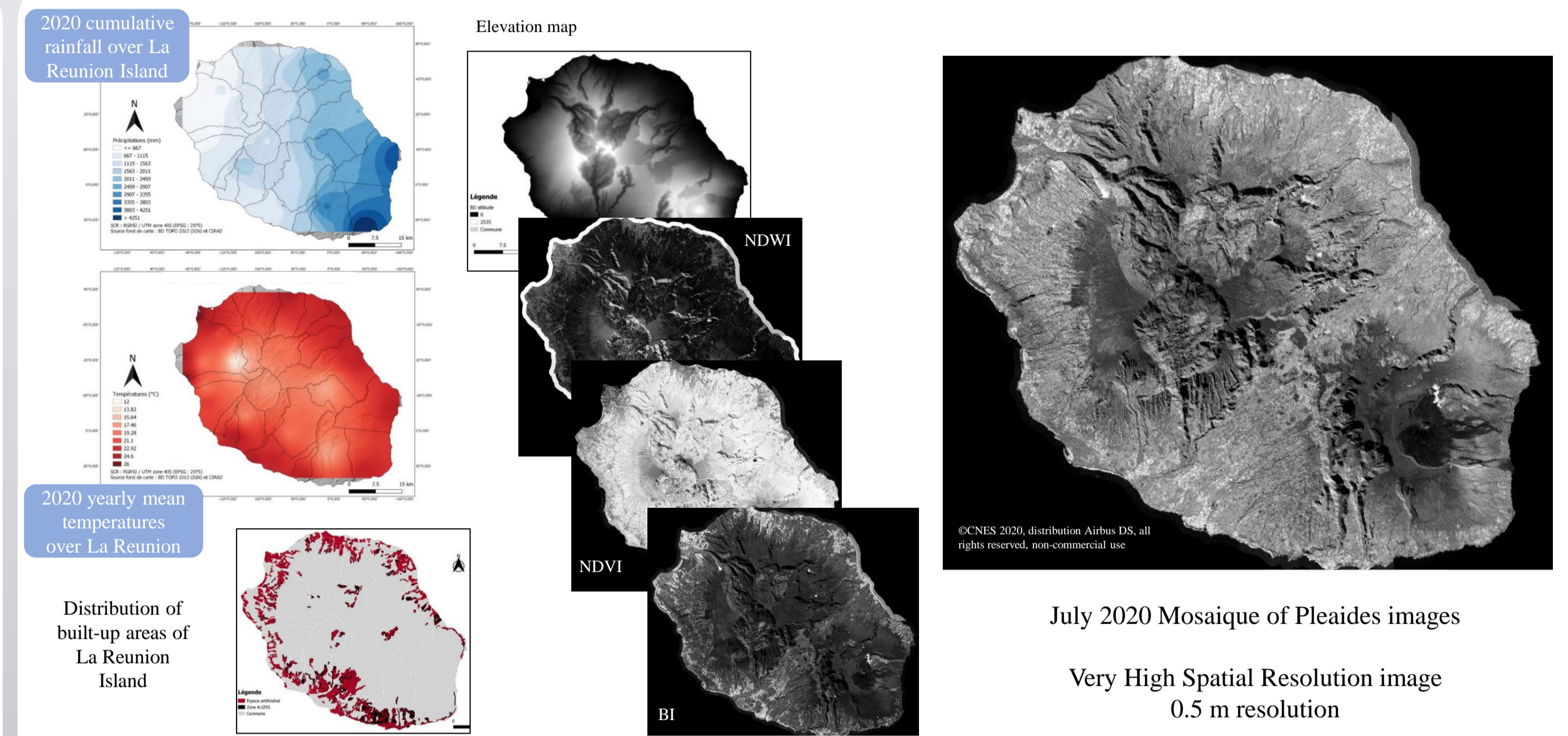


In situ Data



In situ data on types and number of breeding sites were collected between January 2020 and March 2022 over 10 % of the urban territory of Reunion Island by the Regional Health Agency (ARS).

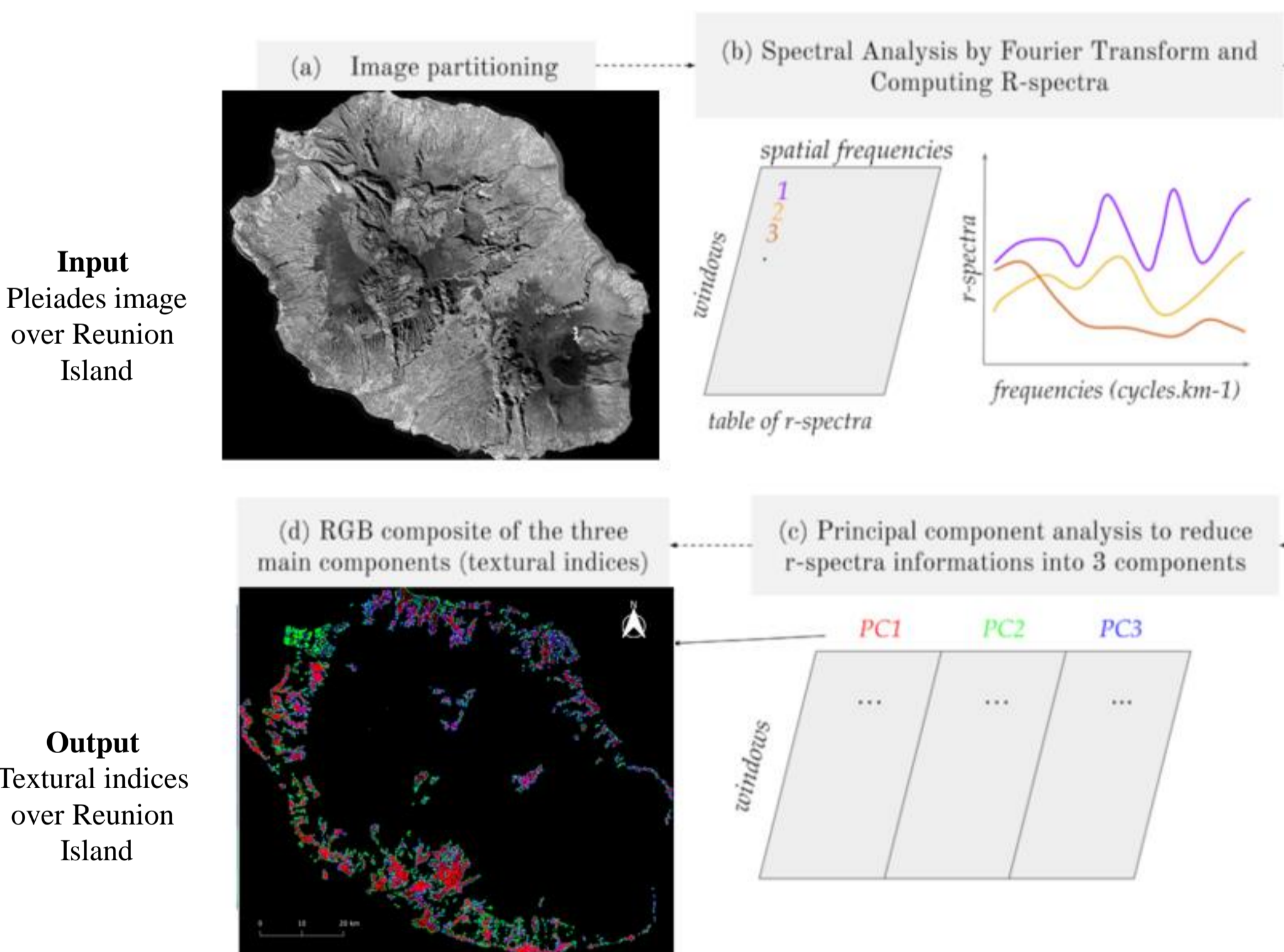
Environmental, climatic and remotely-sensed data



Spectral indices were calculated from a very-high resolution Pléiades mosaic from 2020 over the island, while data on the annual cumulative rainfall and the annual average temperature were obtained from the Météo-France / CIRAD network (aware.cirad.fr). Elevation and built up areas come from the BDALTI and BDTOPO

Methods

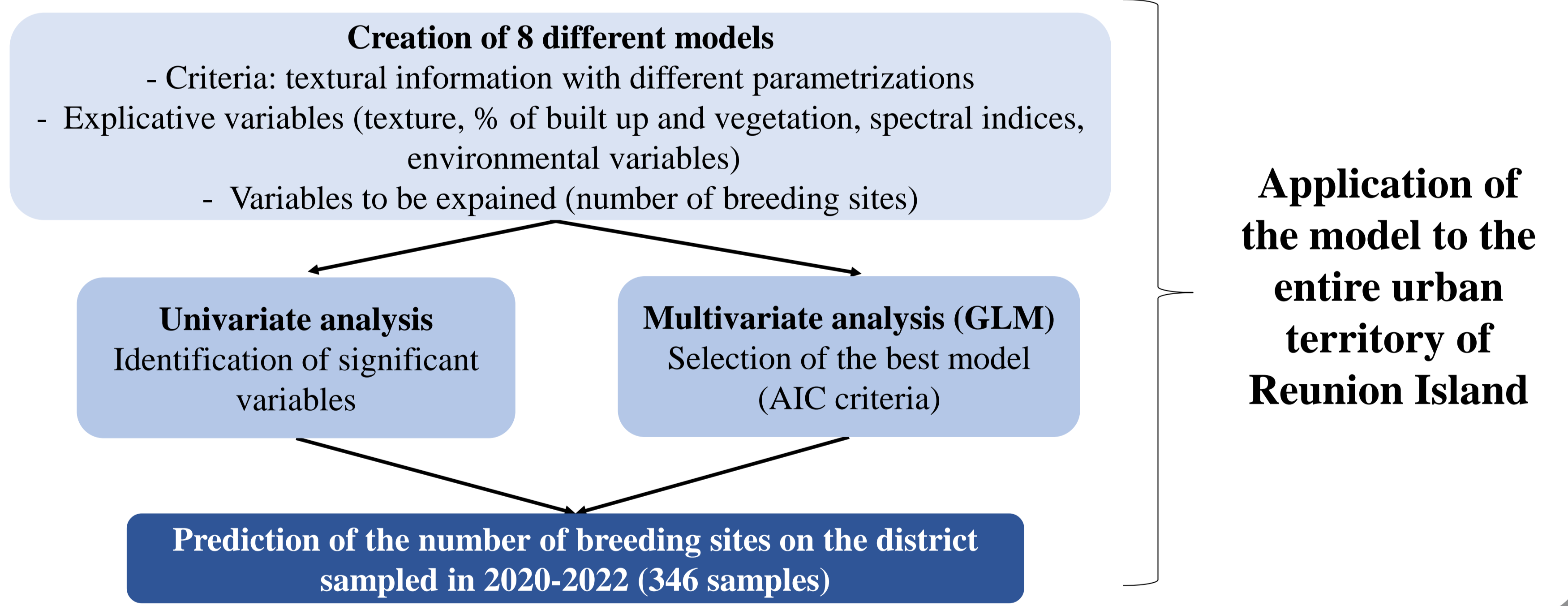
Textural information over urban areas was extracted from the Pléiades mosaic, using the FOTOTEX Method (Teillet et al., 2021).



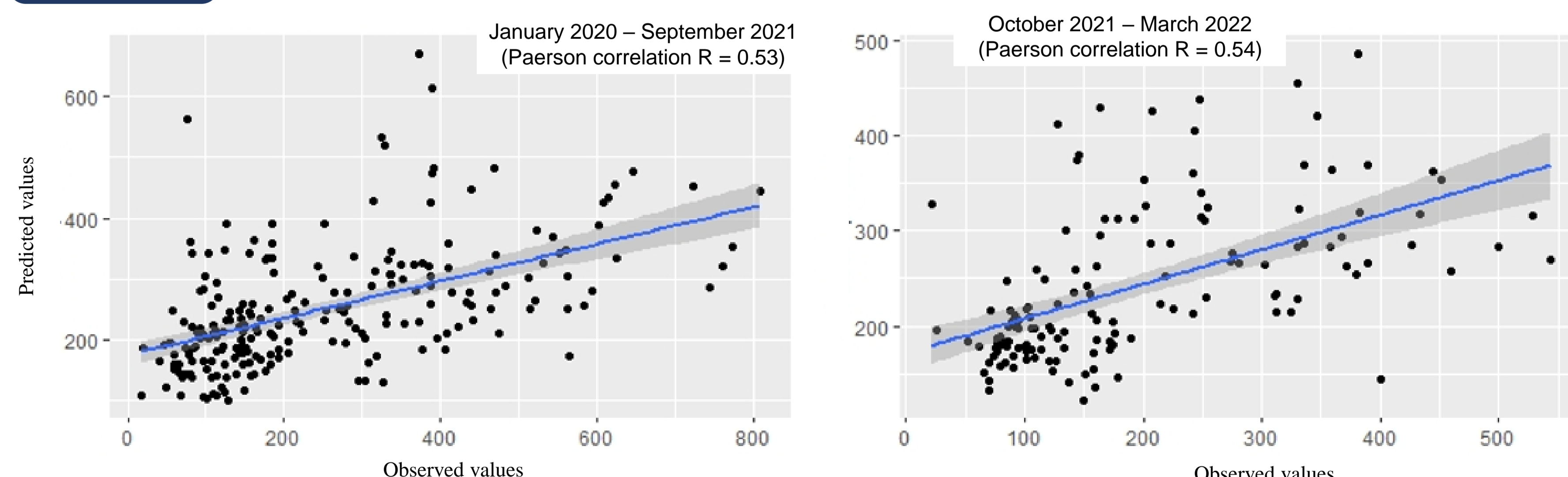
For each district sampled in 2020-2022, we analyzed the correlations between :

- the number of potential observed breeding sites
- the mean values of textural and spectral indices, as well as the mean precipitation and annual temperature, through both univariate and multivariate analysis

→ The most significant variables were eventually combined using a generalized linear model.



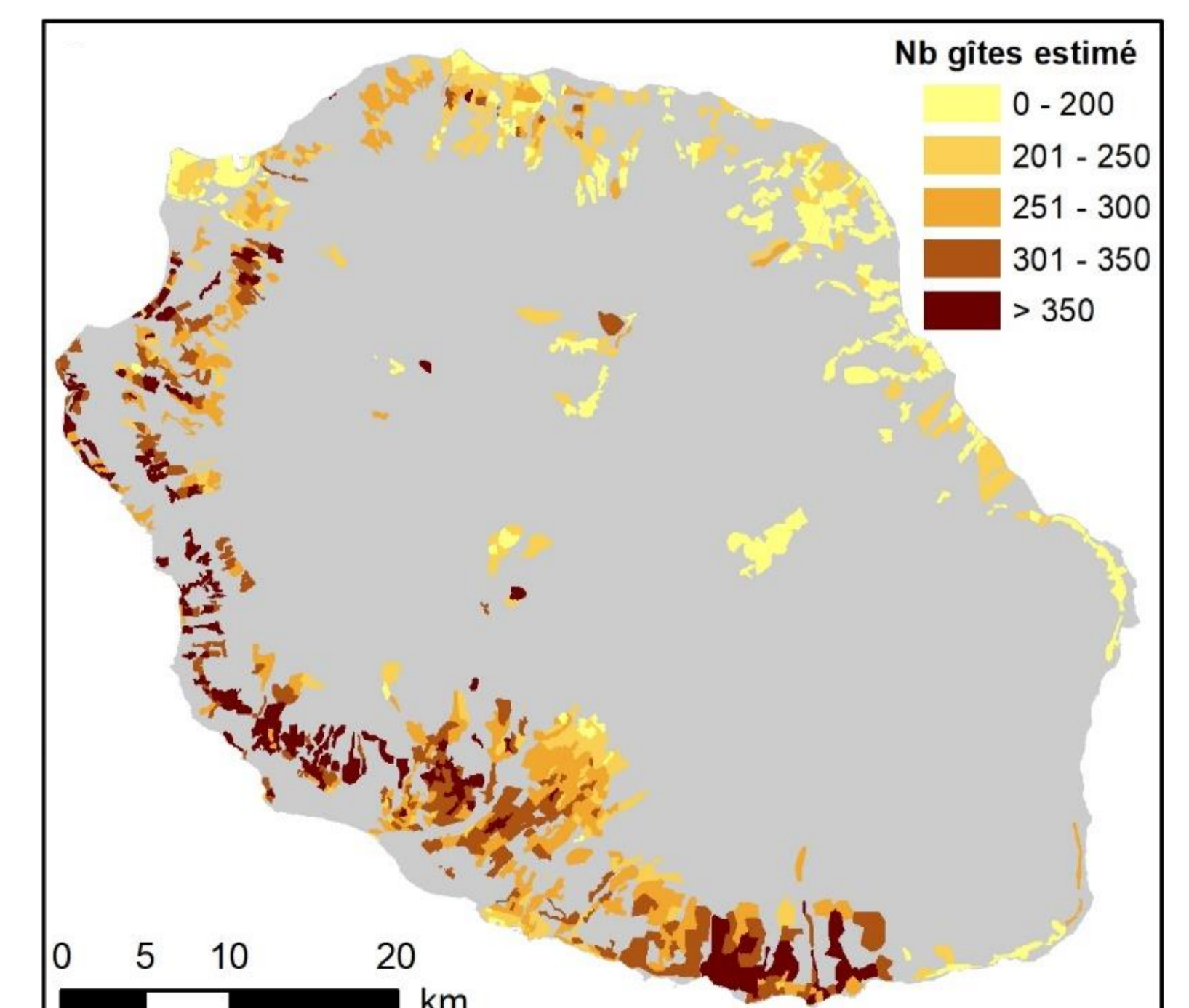
Results



Positive correlation with NDVI, temperature, % built up and vegetation, and texture
Negative correlation NDWI, Brightness Index and rainfall

Using the best model identified by the GLM and AIC, we predicted the number of breeding over the urban areas of Reunion Island

Estimation of the number of breeding sites over inhabited areas in Reunion Island



Conclusions

- Textural indices highlight different district typologies based on spatial arrangements between buildings and vegetation.
- Using a GLM for statistical analysis, we found that the correlation between combined environmental variables and *in situ* data on breeding sites of *Ae. albopictus* is significant.
- This statistical relationship makes it possible to use earth observation environmental variables as predictors of the number of potential breeding sites for all areas in the island.

Acknowledgments

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