Identification of isolated tsetse populations candidate for eradication using friction models in West-Africa

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Introduction

African Animal Trypanosomosis

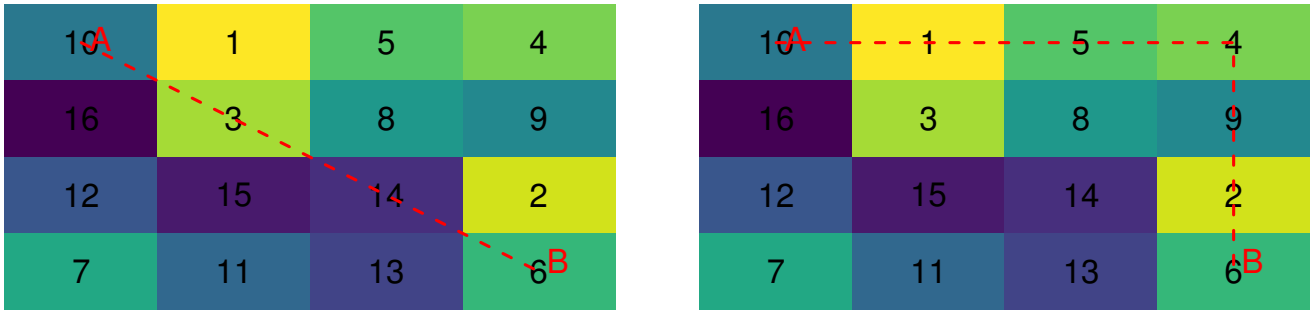
- Major constraint to cattle production in many African countries
- Tsetse target of the Pan African Tsetse and Trypanosomosis Eradication Campaign
- Optimization of the eradication campaigns through the use of modeling

Why looking for isolated populations ?

- Population that has little mixing within same species
- In case of extinction of a given population the risk of reinvasion is low
- Isolated populations are perfect candidate for eradication

What is friction ?

- Resistance of the landscape to animal movement



Goal of the study

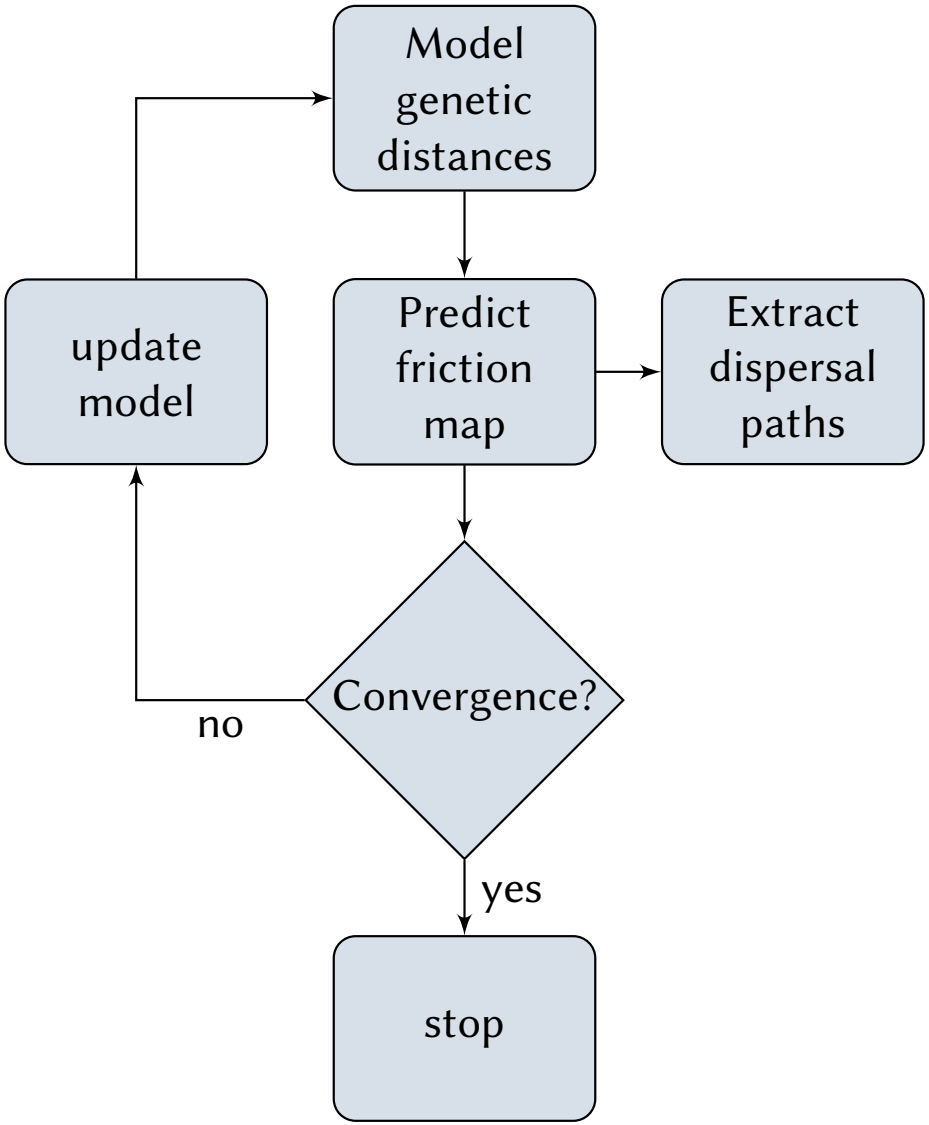
- Predict the genetic distance between 37 populations of *G. p. gambiensis*
- Map natural barriers to genetic flow between population (**friction**)
- Locate candidate populations for eradication

Methodology

Methodology

- Genotyping **37 populations** (1158 flies) using 7 microsatellites
- Exploration of relationship between genetic distance and environmental data
- Identification of **tsetse dispersal paths** using an iterative least-cost distance process of fitting friction
- Prediction of *G. p. gambiensis* **distribution** in the study area
- Combination of distribution and landscape friction to locate isolated patches

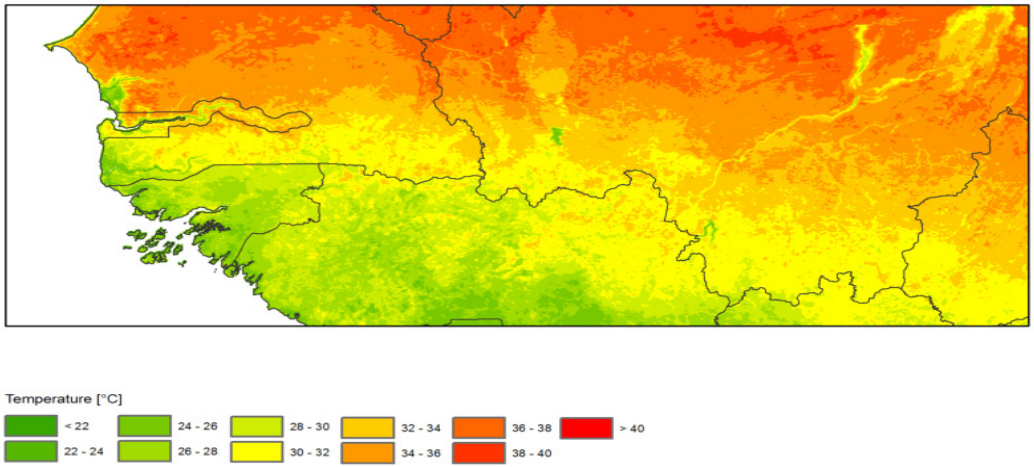
Methodology

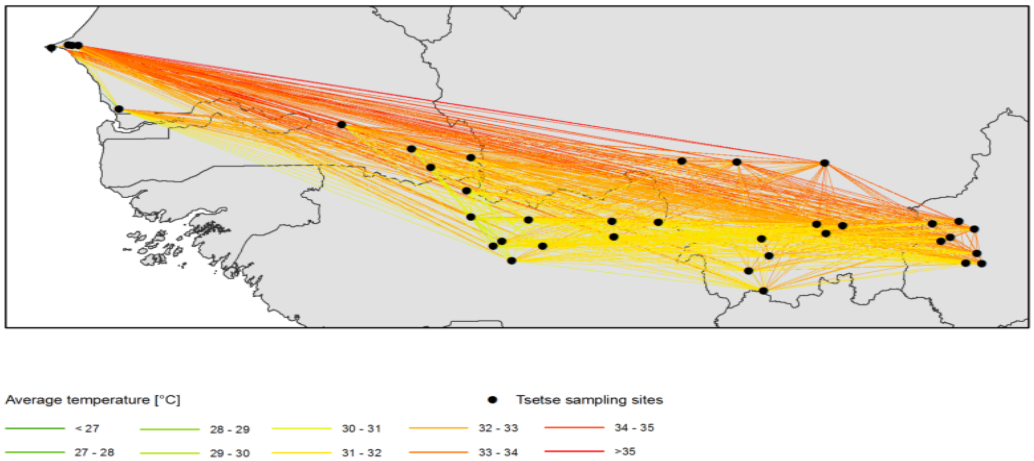


Explanatory variables

Land Surface Temperature

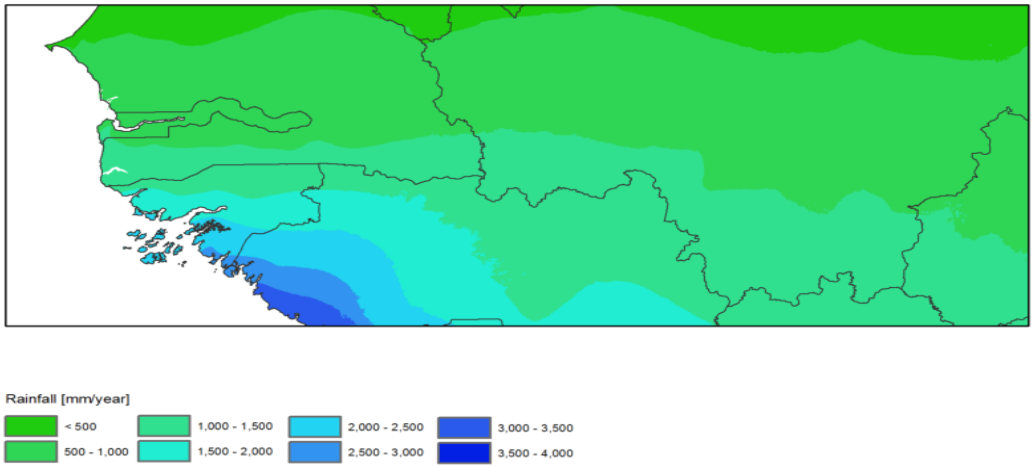
- Thermal data are critical in tsetse ecology
- Land Surface Temperature from MODIS

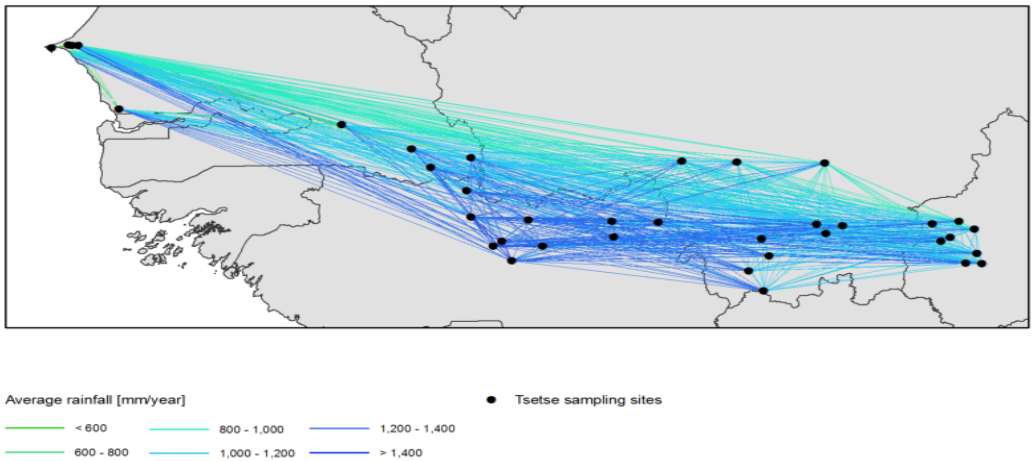




Precipitation

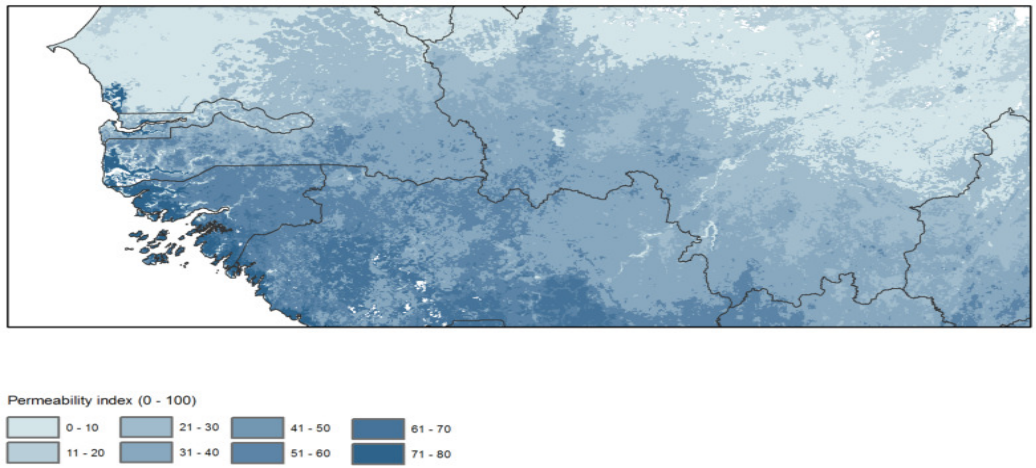
- Precipitation allow better dispersal
- FAO rainfall estimate

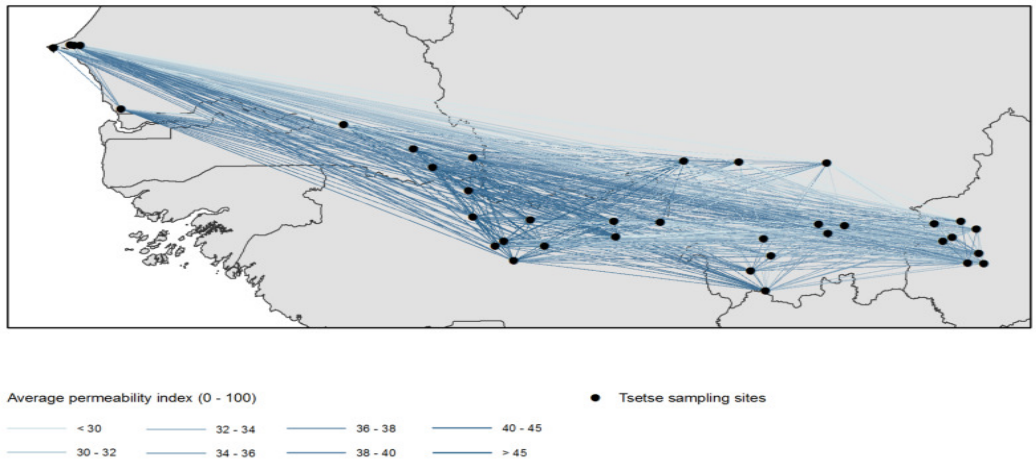




Expert based permeability index

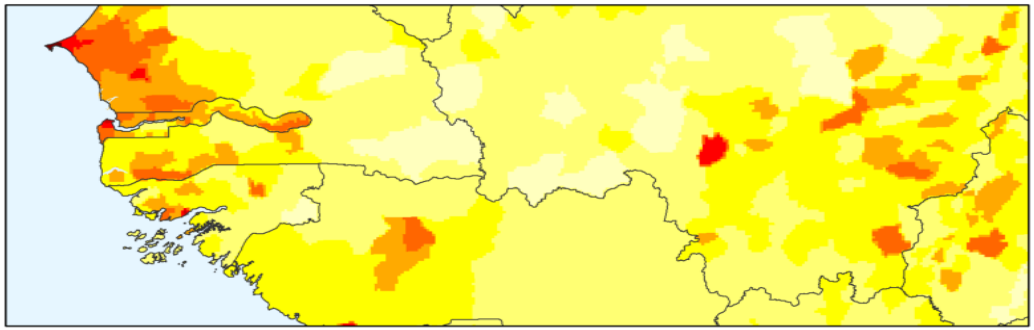
- Expert based index
- Built on top of land cover data

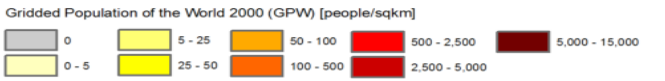


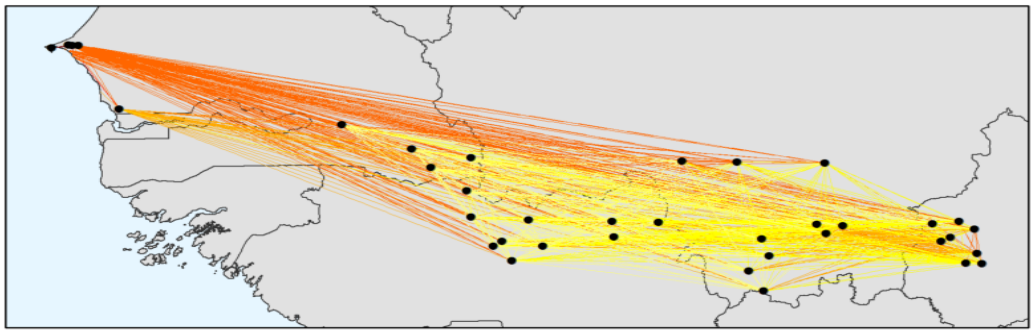


Human population

- Human Population
- Data from the GPW project

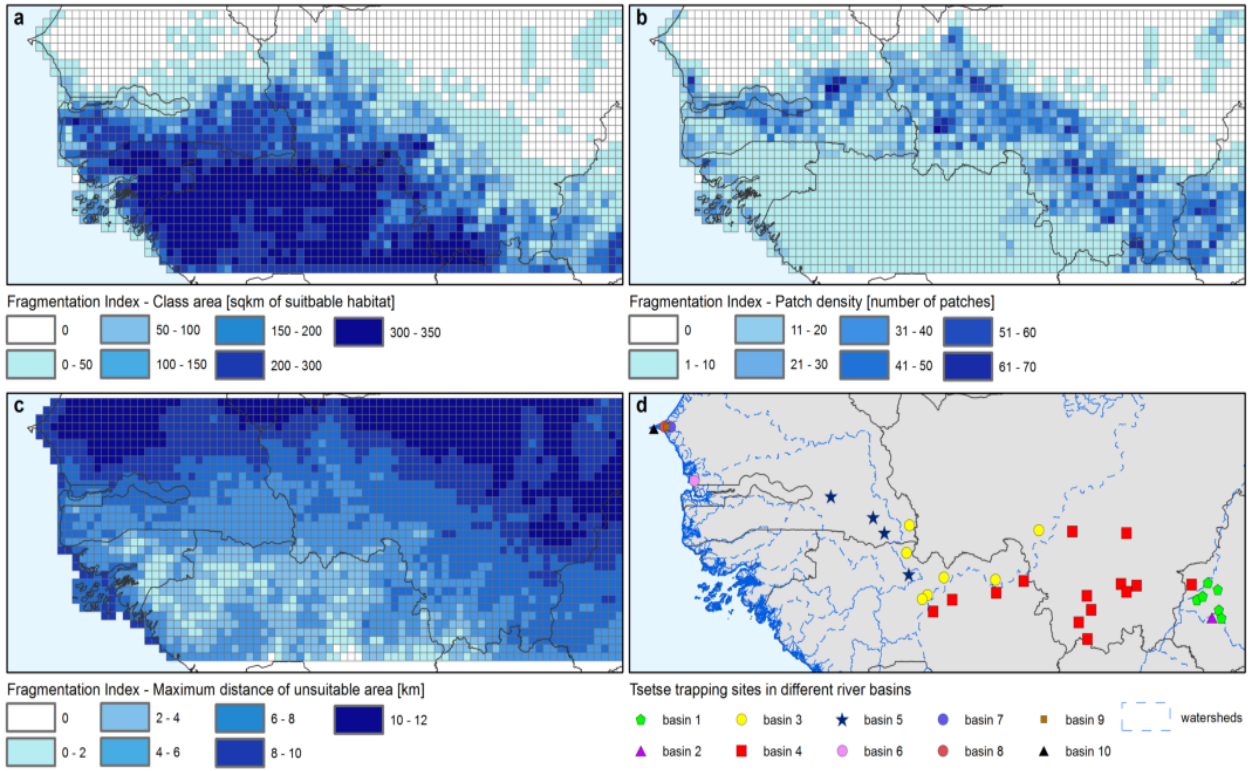






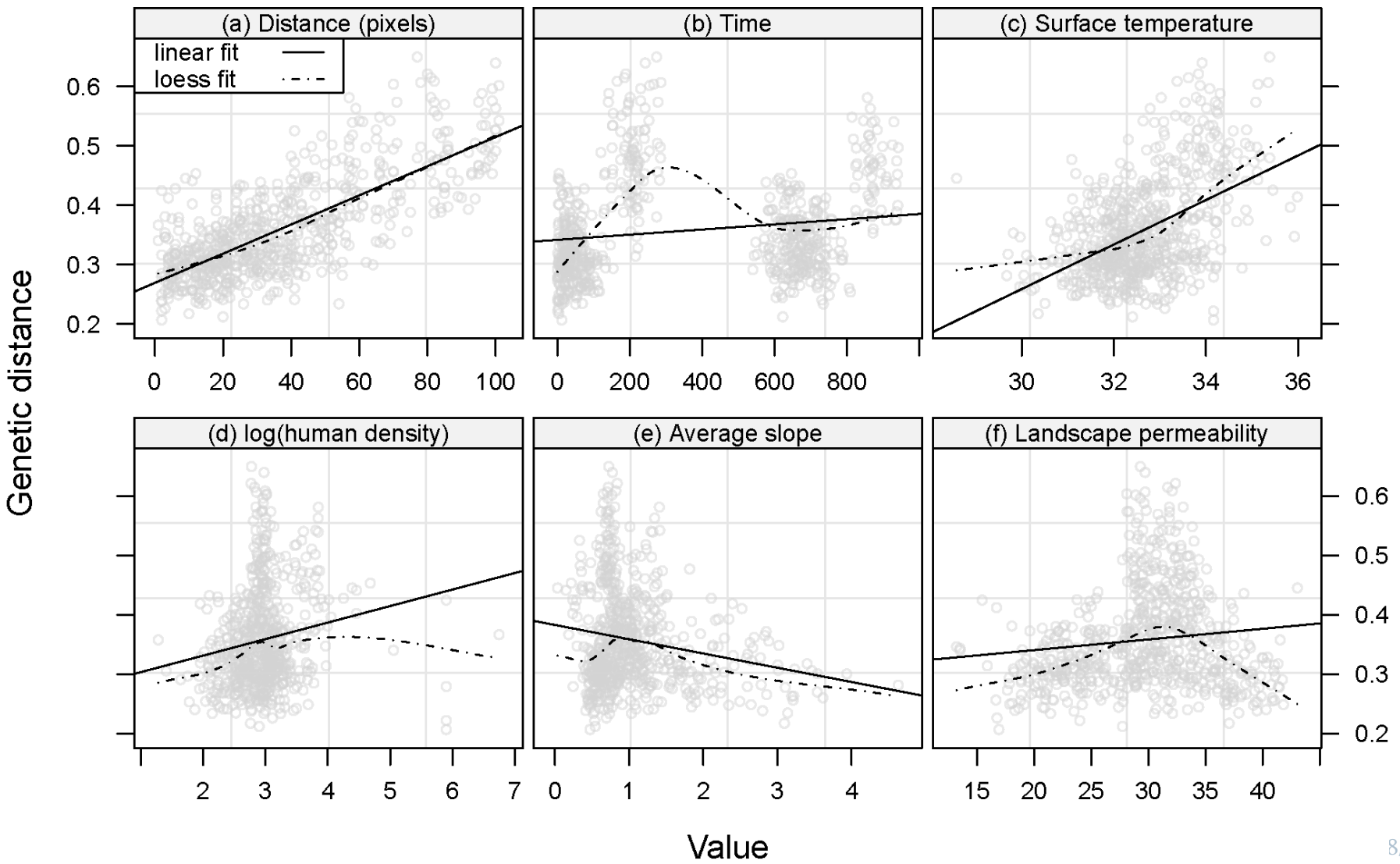
Habitat fragmentation

- Habitat fragmentation statistics
- Based on MODIS tree cover data

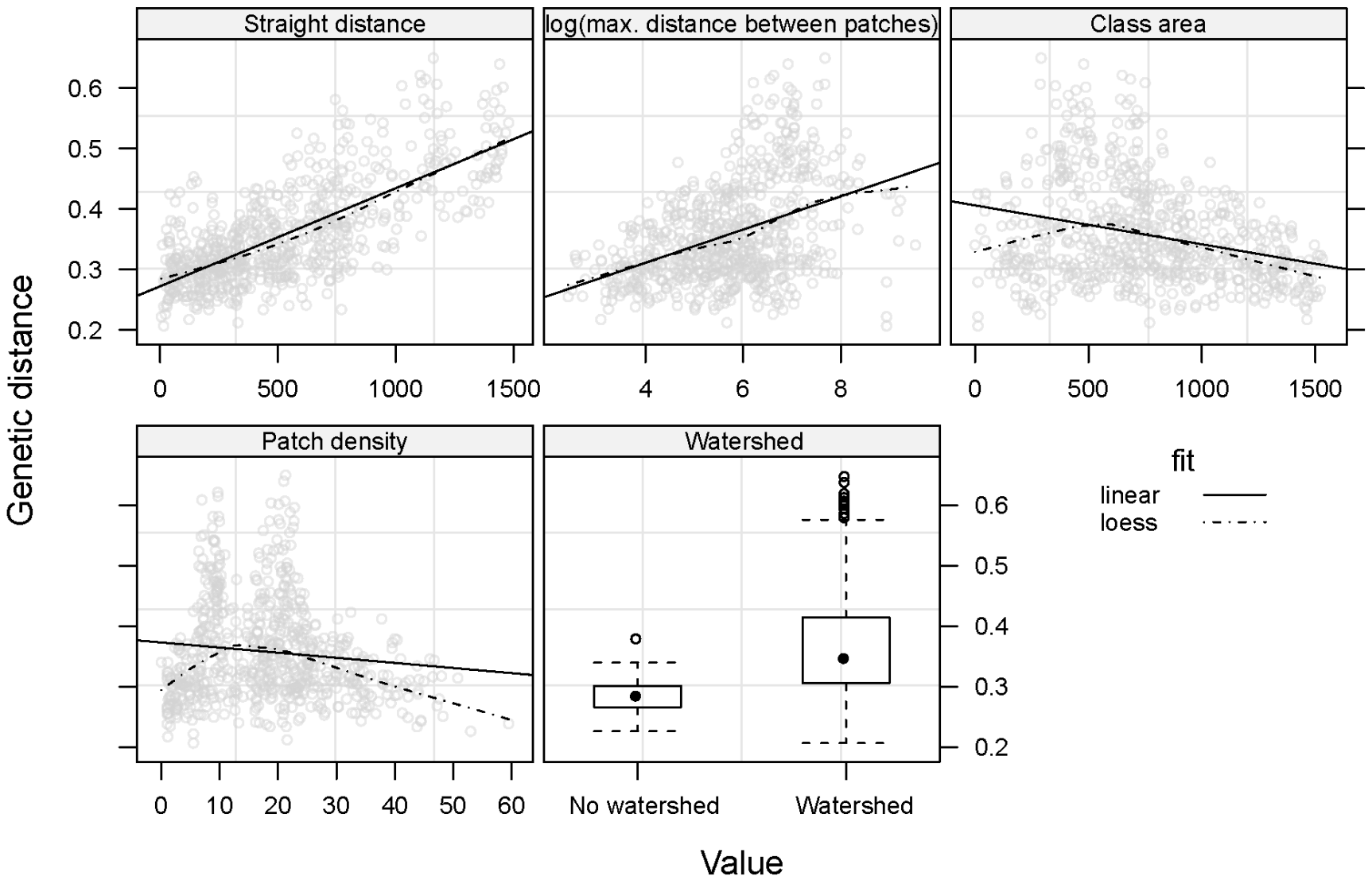


Results

Relationships with the genetic distance

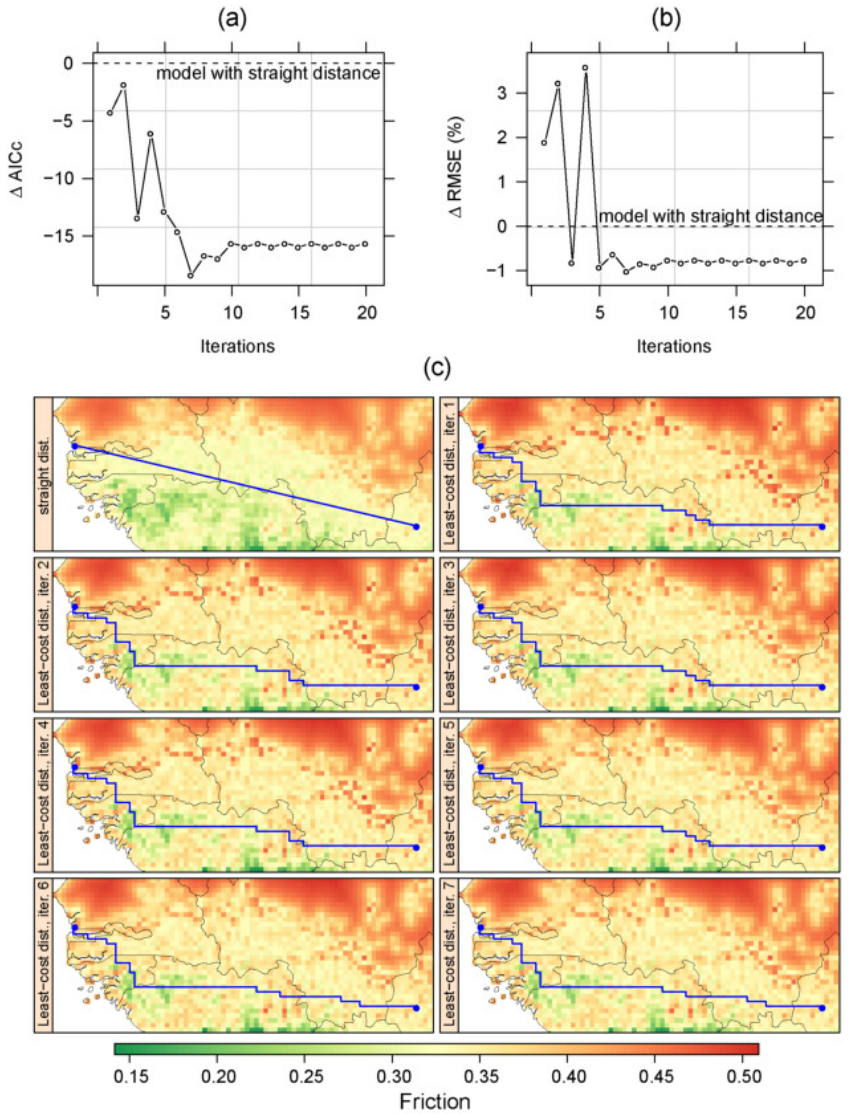


Relationships with the genetic distance



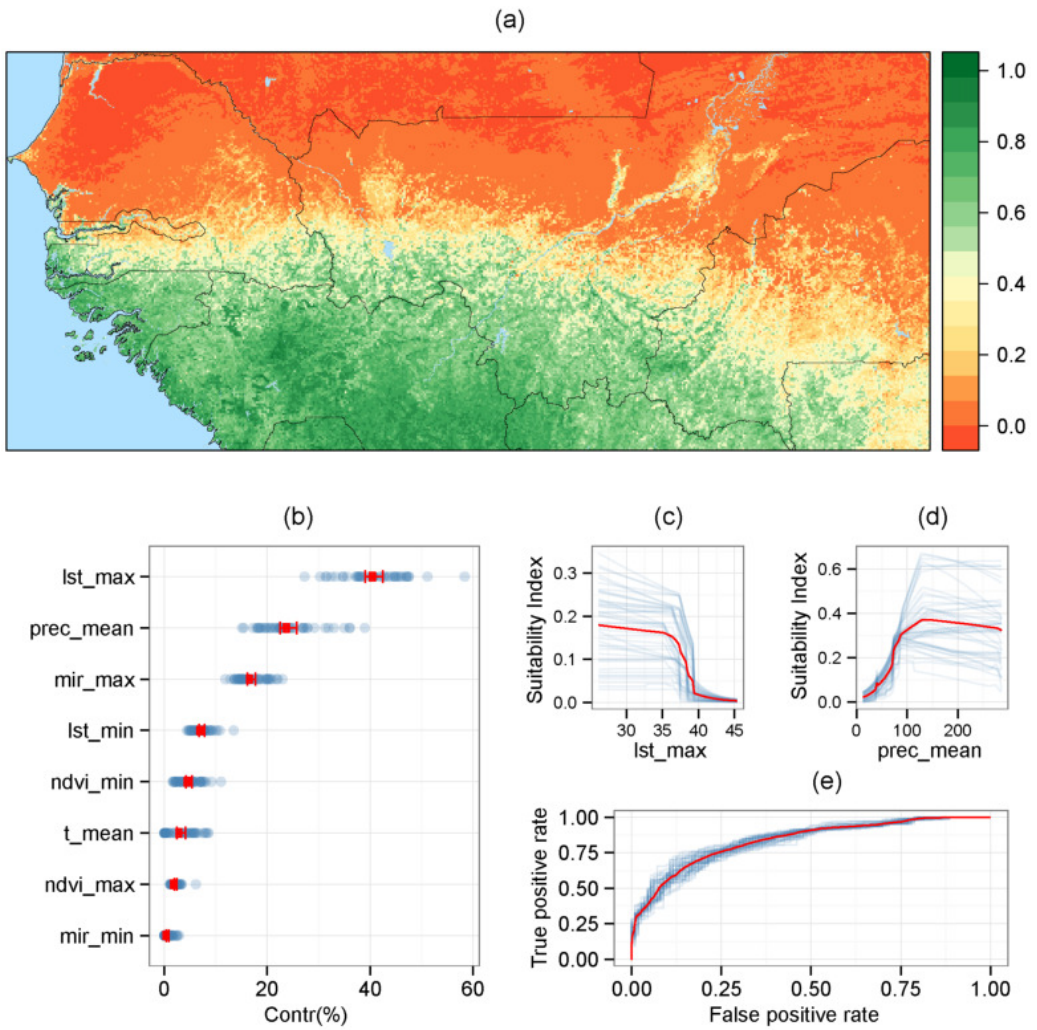
Mapping friction

- Iterative process between two populations
- Two indicators of model quality (lower value is good)
- Quick convergence of the model



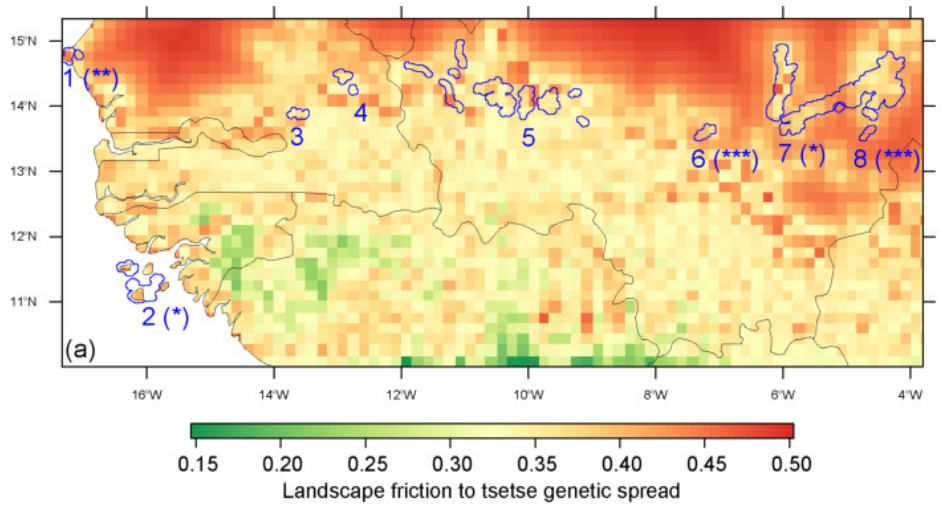
Regional tsetse distribution model

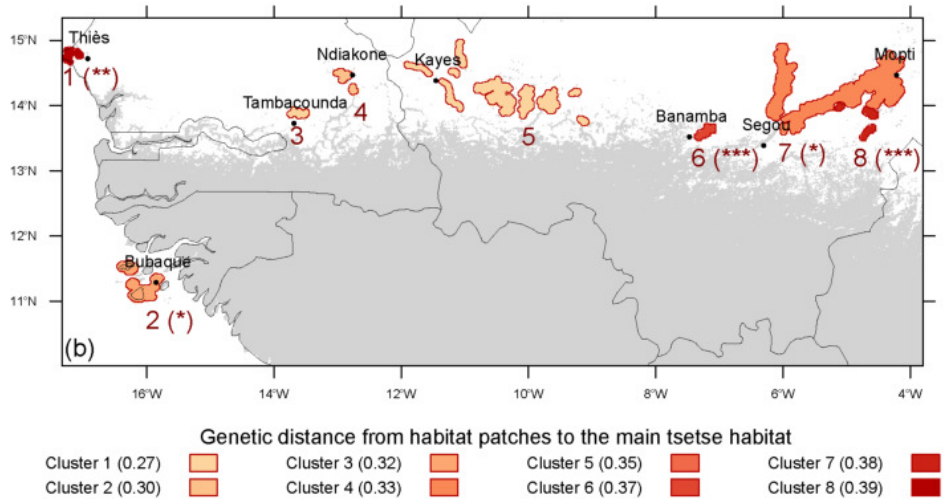
- Distribution of *G. p. gambiensis*
- Good predictive power
- Coherent response curves



Isolated populations candidate for eradication

- 8 potential isolated populations identified





Conclusions

Closing Thoughts

- A new tool for prioritization of tsetse control: **8 candidate populations** for eradication identified in West Africa
- Necessity to conduct local studies to confirm the distribution limit and isolation status
- Possibility to plug an economic model to map benefit-cost of the control
- Scalable and applicable to all species for control or conservation purposes

Thanks

Bouyer, J., et al., Mapping landscape friction to locate isolated tsetse populations candidate for elimination. Proceedings of the National Academy of Sciences of the United States of America, 2015. 112: p. 14575-14580.