Simulating future changes: anthropogenic pressures in a Brazilian semi-arid watershed

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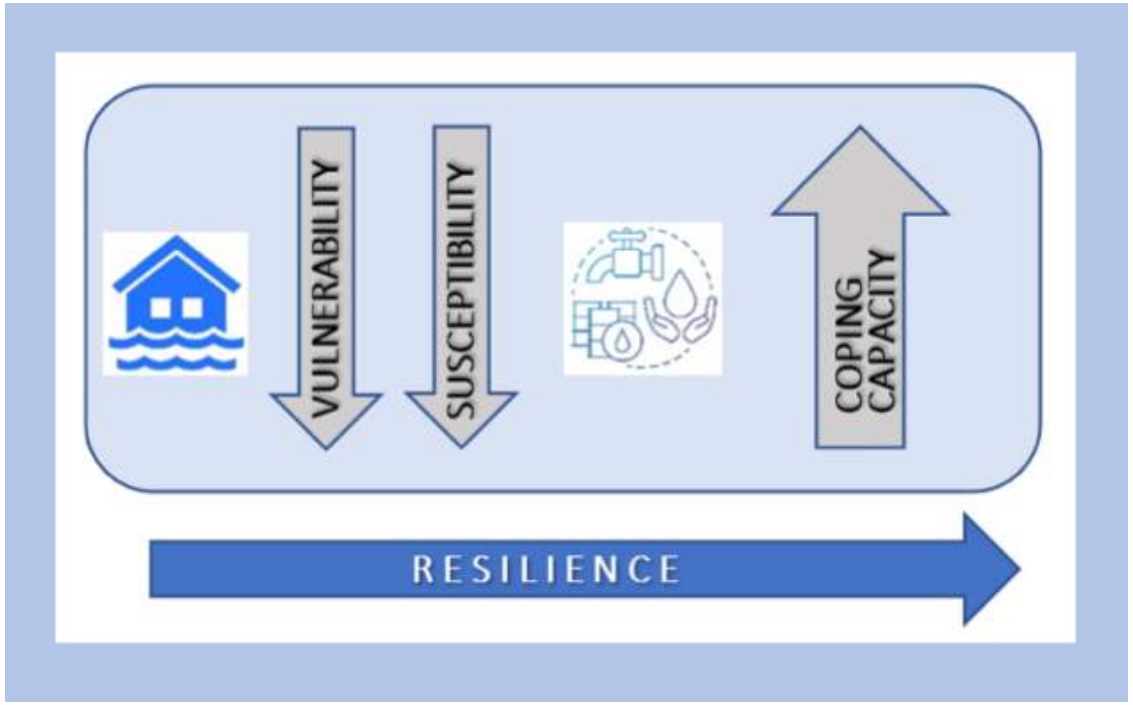
Overview

- Predictive LULC future scenarios: what for?
- A semi-arid large-scale water diversion context
- Modelling procedures
- Explanatory variables and assumptions
- Transition rules and Calibration
- Future scenarios: different views of the same results

Predictive LULC scenarios: what for?

If we can predict a scenario, we may be able to…



… improve coping capacity before a hazard

…minimize impacts (reducing susceptibility)

…reduce vulnerability

…increase resilience to future extreme events

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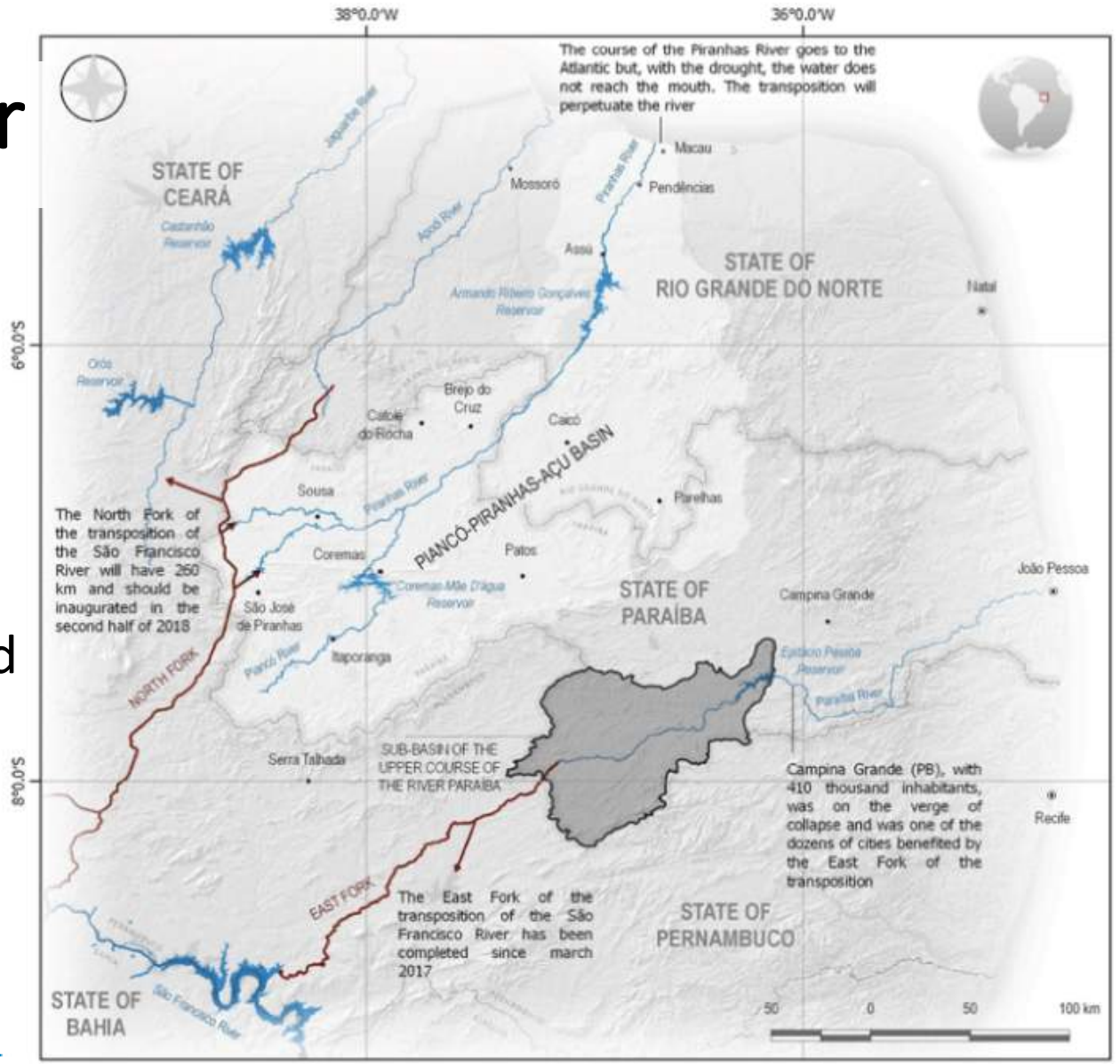
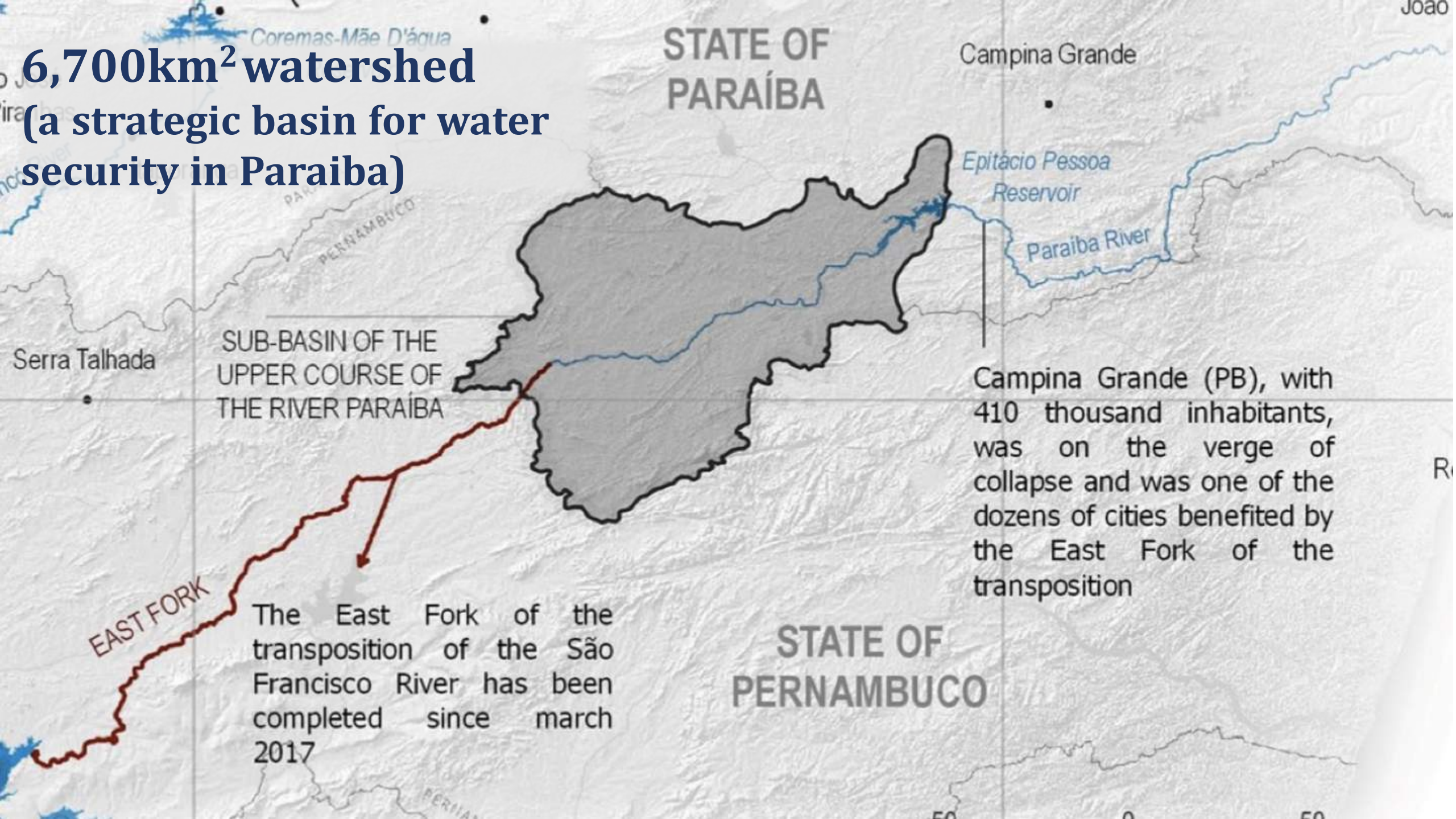
A semi-arid large-scale water diversion context

- Water use conflicts
- Frequent (and sazonal) droughts
- PISF: two main forks (North and East)
- A large-scale diversion to transfer water from the São Francisco River Basin to other semi-arid areas in a massive inter-basin water transfer
- a hope of **water security** for more than 12 million people




6,700km² watershed
(a strategic basin for water security in Paraiba)
STATE OF PARAÍBA
Campina Grande
Epitácio Pessoa Reservoir
Paraiba River
SUB-BASIN OF THE UPPER COURSE OF THE RIVER PARAÍBA
Serra Talhada
Campina Grande (PB), with 410 thousand inhabitants, was on the verge of collapse and was one of the dozens of cities benefited by the East Fork of the transposition
EAST FORK
The East Fork of the transposition of the São Francisco River has been completed since march 2017
STATE OF PERNAMBUCO

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Modelling procedures

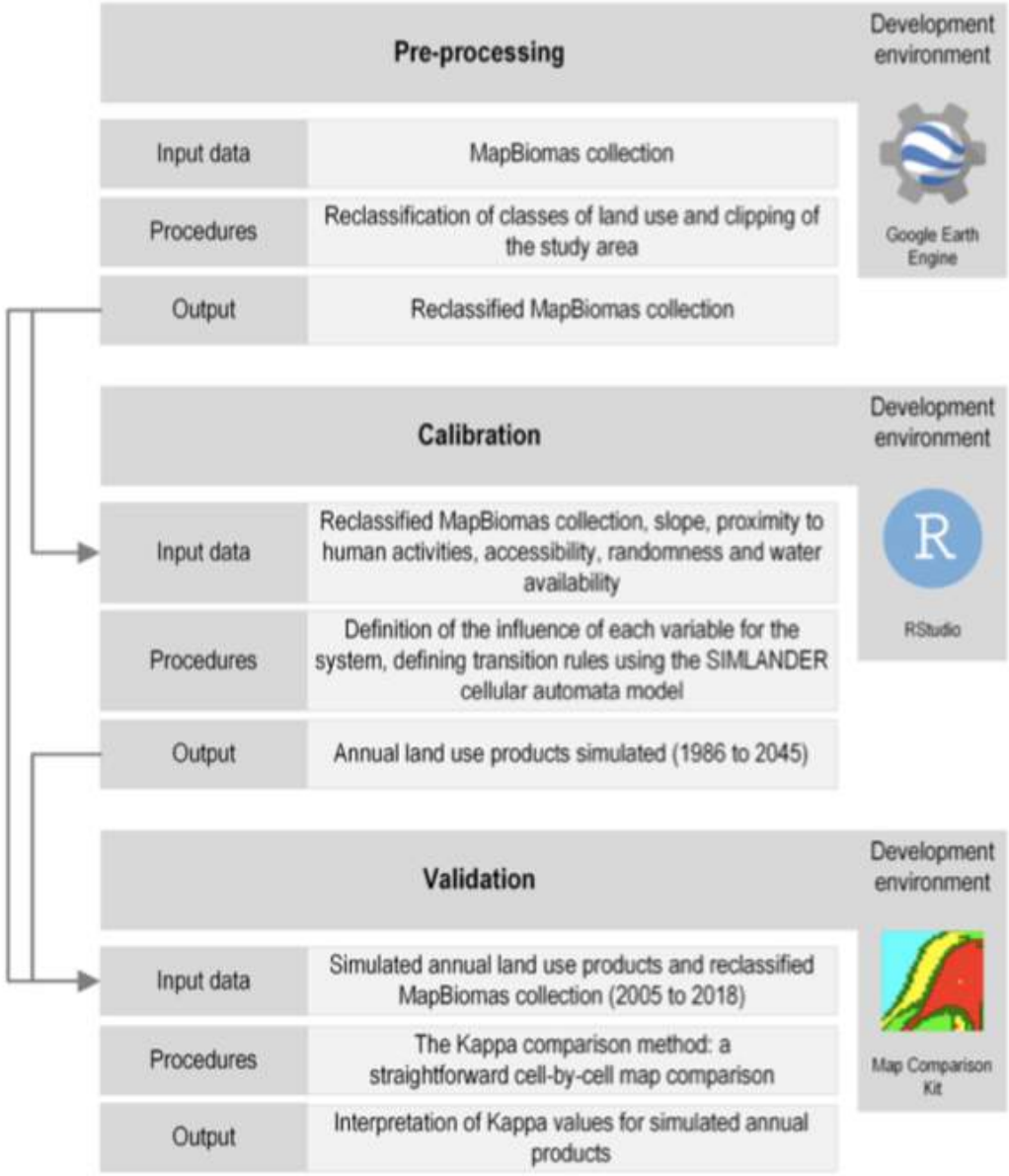
Remote Sensing (RS) Imagery series (1985 to 2018) from Mapbiomas
(Google Earth Engine)

Explanatory variables selection: how is changes happening?
Which are the most important drivers?

SIMLANDER: SIMulation of LAND use change
R Script - cellular automata land use model (Hewitt et al., 2013)

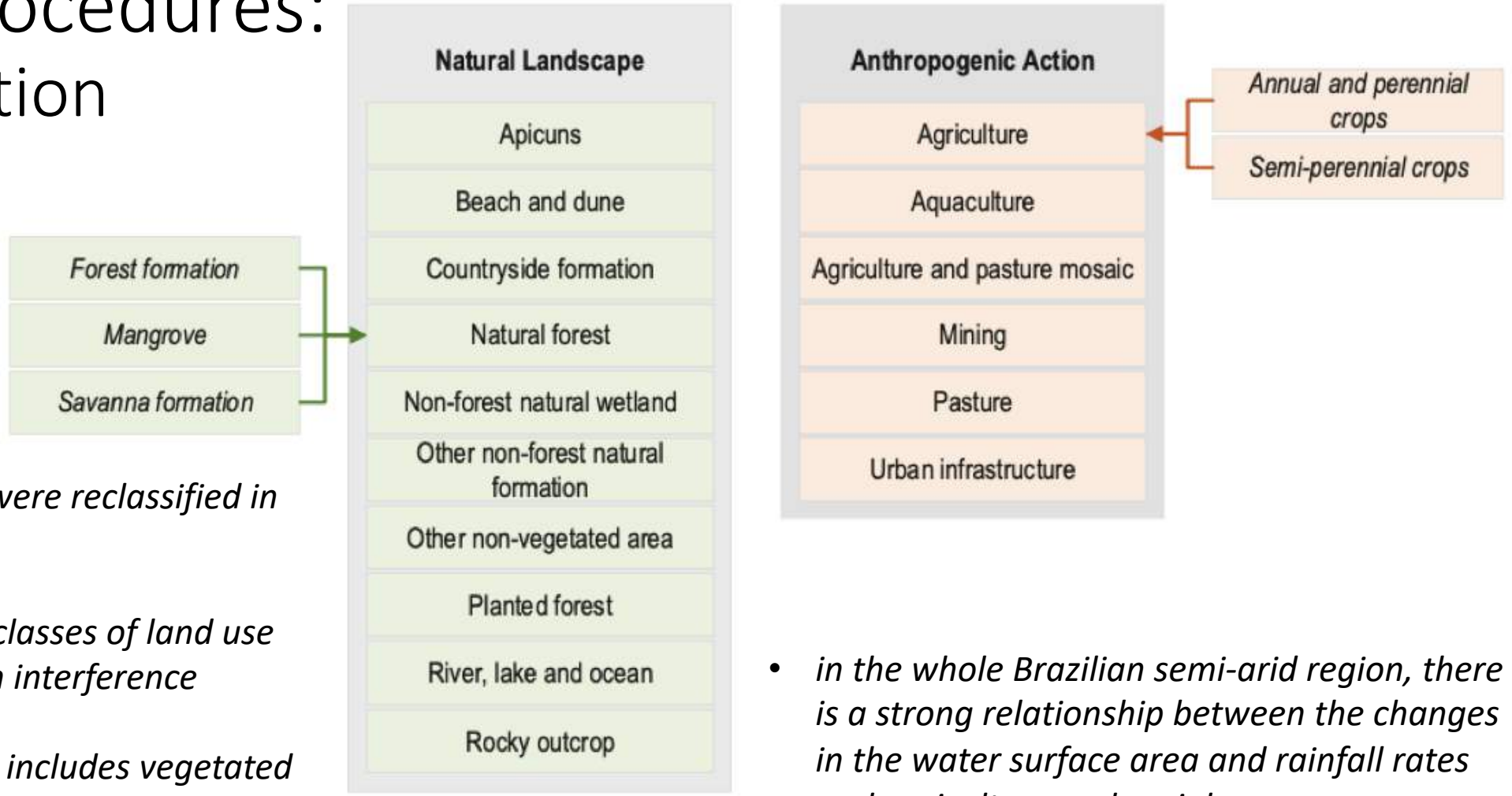
Validation: *Kappa* comparison (cell-by-cell)

Future scenarios (2019 to 2045)



Modelling procedures: input data edition

MAPBIOMAS



- *MapBiomas LULC classes were reclassified in two groups*
- *Anthropic action includes classes of land use directly affected by human interference*
- *Natural Landscapes group includes vegetated areas and all water bodies*

- *in the whole Brazilian semi-arid region, there is a strong relationship between the changes in the water surface area and rainfall rates and agriculture and social pressures*

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Explanatory Variables and assumptions

Variable	Assumption	References	Data Source
Slope	Flat areas attacts human activities (crops, livestock or settlements).	Gounaridis et al. (2019) Li et al. (2018) Shu et al. (2020)	SRTM
Neighbourhood Influence	Land use change tends to attract more land use changes	Barreira-Gonzalez and Barros (2017) Li and Yeh (2020) Newland et al. (2018)	Baseline: Mapbiomas LULC 1985
Randomness	Vacant areas under high pressures can always change by random factors. Includes this probability in the model	Batty (1997), Louis and Nardi (2018), Mustafa (2018)	Collection of R routines
Accessibility	The more accessible is an area, the more deforestation and changes observed over the years	Falah et al. (2020), Gharbia et al. (2016), Osis et al (2019)	DNIT data (National Transportation infrasctructure Department)
Access to water	Historically settlements start or spread out close to water bodies or some water availability	Fitawork et al. (2020), Gounaridis et al. (2019), Keshtkar and Voigt (2016), Osis et al. (2019)	AESA – State Water Agency

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Transition rules and calibration

- Transition model suggested by SIMLANDER (the coefficients assigned based on the calibration process results)

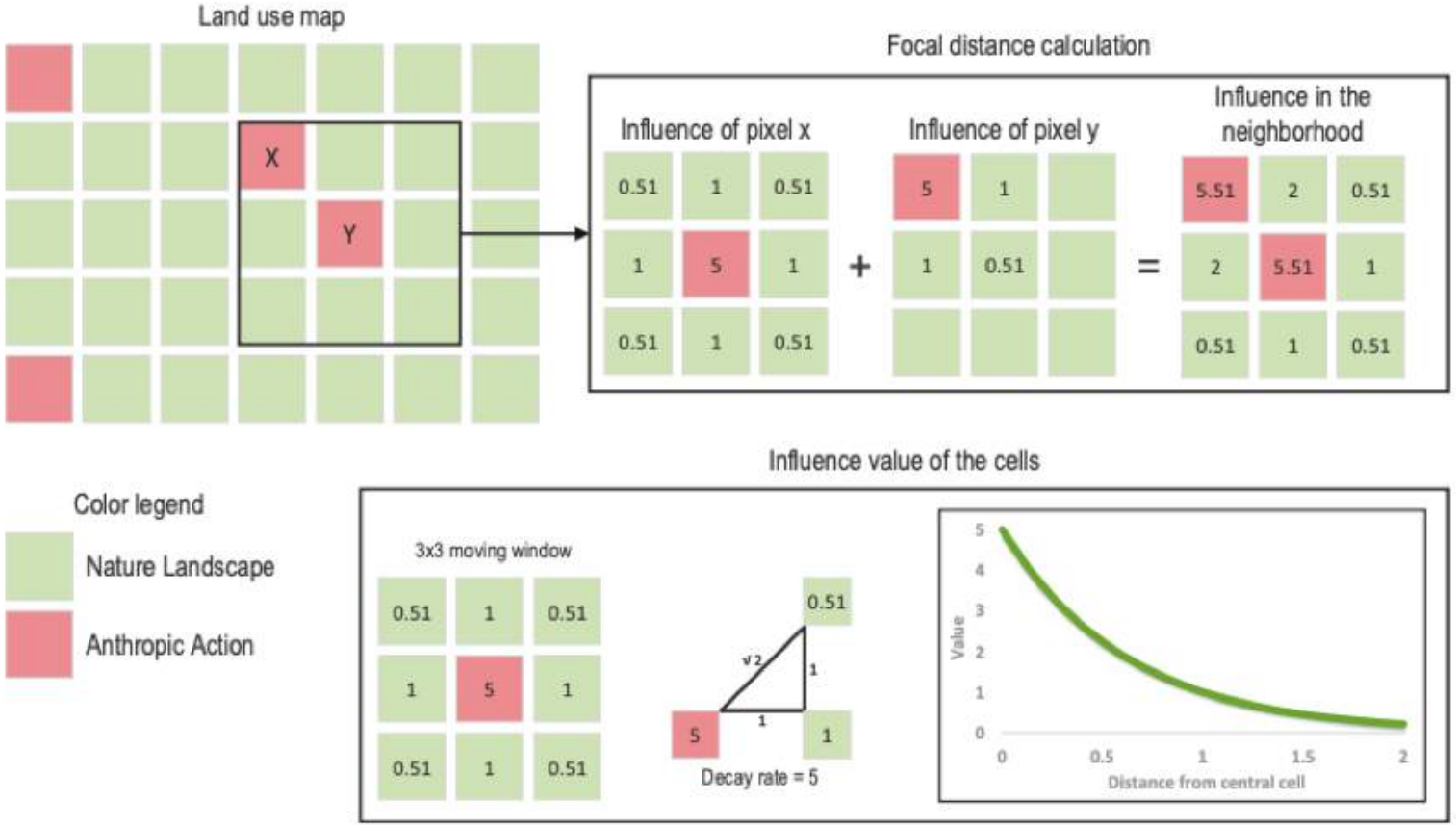
- Roodposhti et al. (2020) developed an automatic detection of the neighbourhood rule. The model automatically tests different sizes and values for pixels of the moving window.

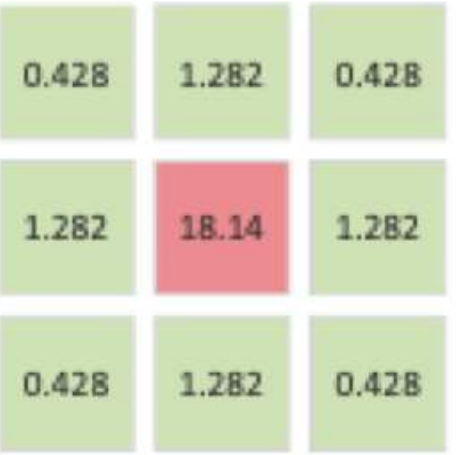
- At the end of running several parameters are considered for electing a window that best represents the neighbourhood influence in the study area.

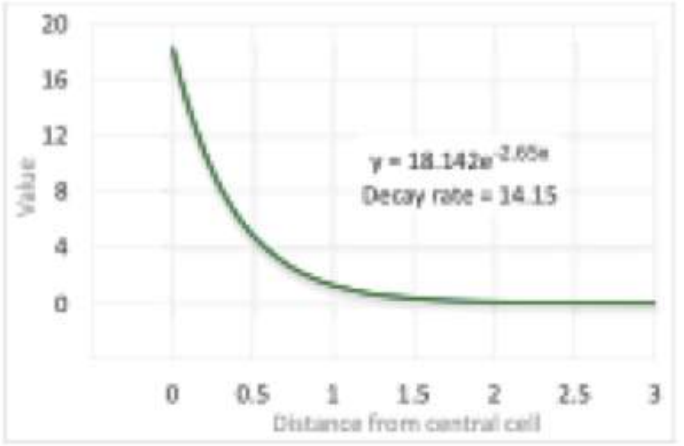
- The *Kappa* comparison method was used; this method analyses two types of similarity: quantitative similarity and spatial similarity.

Moving Window

Calibration based on Roodposhti et al. (2020): automatic detection of neighborhood rule







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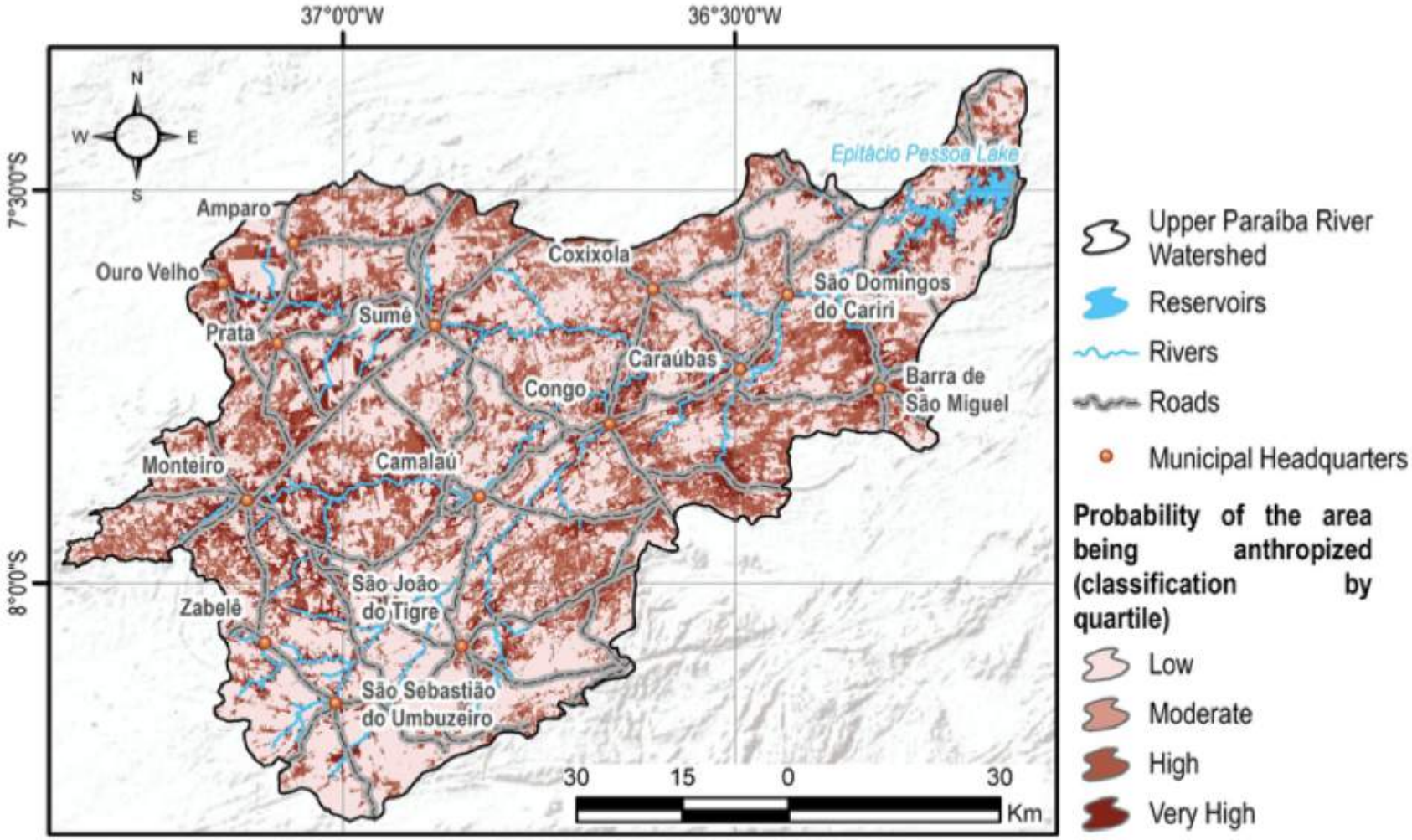
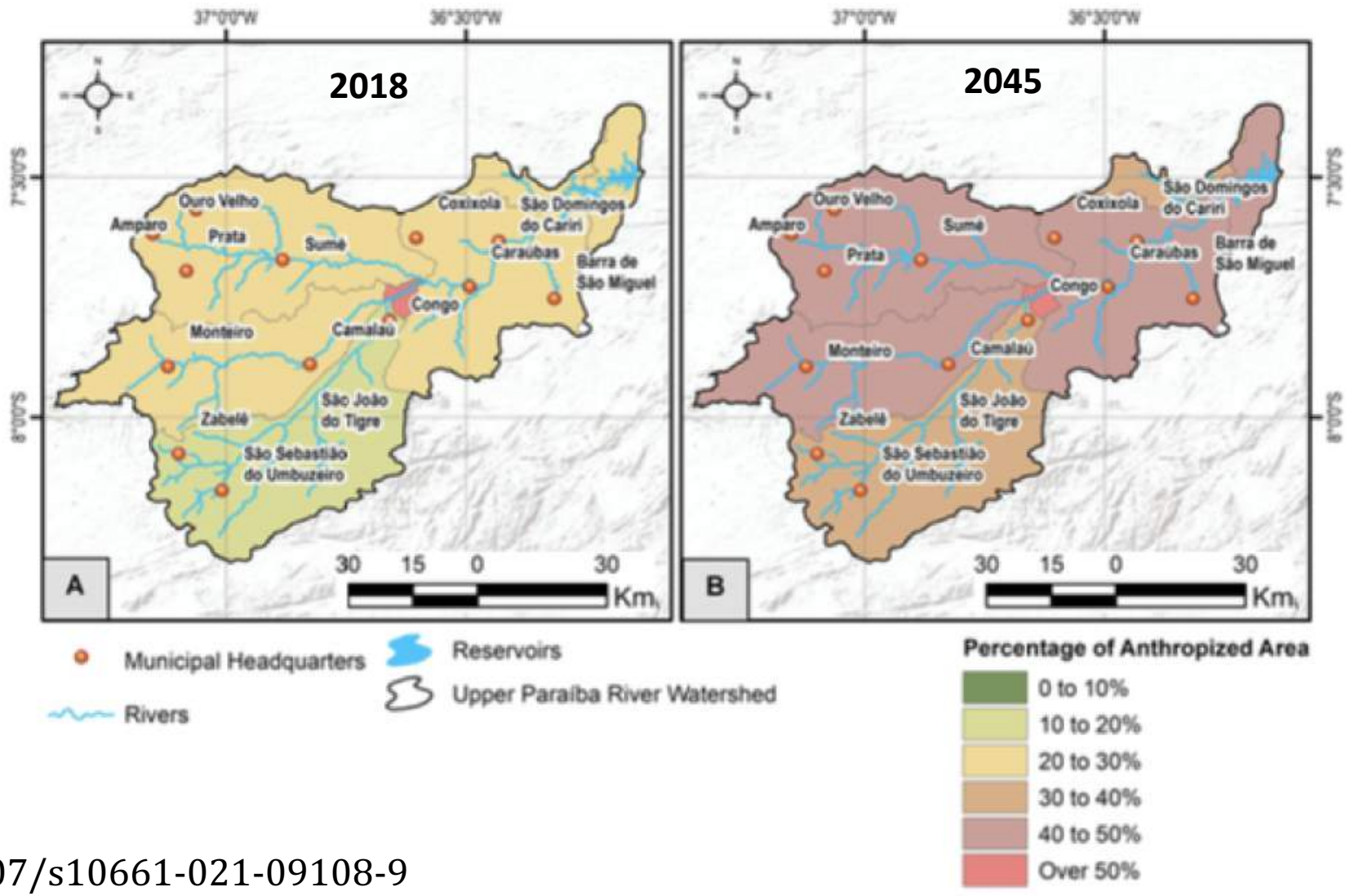
Results

- Reduction of 737 km² of natural land cover between the years 2019 and 2045
- The spatial distribution of anthropogenic interference predicted a more significant degradation in the central region of the basin
- The simulation suggests an intense anthropogenic action in the basin's central region



- The results highlight the potential for applying the model in large areas
- one of the model's main difficulties is distributing the anthropic cells over the years more realistically
- LULC does not follow a predictable trend, as it is constantly influenced by external factors (such as economic growth, availability of resources, and public policies).



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Thank you!

Obrigada!

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FapesQ-PB
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