Direction
de l'Observation de la Terre

Environnement, Santé et Développement dans le contexte du CES Paysage

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Alberto Giacometti , *Piazza*, 1947–48 , Peggy Guggenheim Collection

En quête de dialogue …

ce qui est en dessous des chapeaux

Liniers, *Auteur de bandes dessinées argentines.*

Qui sommes nous ...

Pogrammes institutionnels
espace et société

***L**aboratório de **i**nvestigação*
*de **S**istemas **S**ócio-Ambientais*

***L**aboratoire de **r**echerche*
*sur les **S**ystèmes **S**ocio-environnementaux*

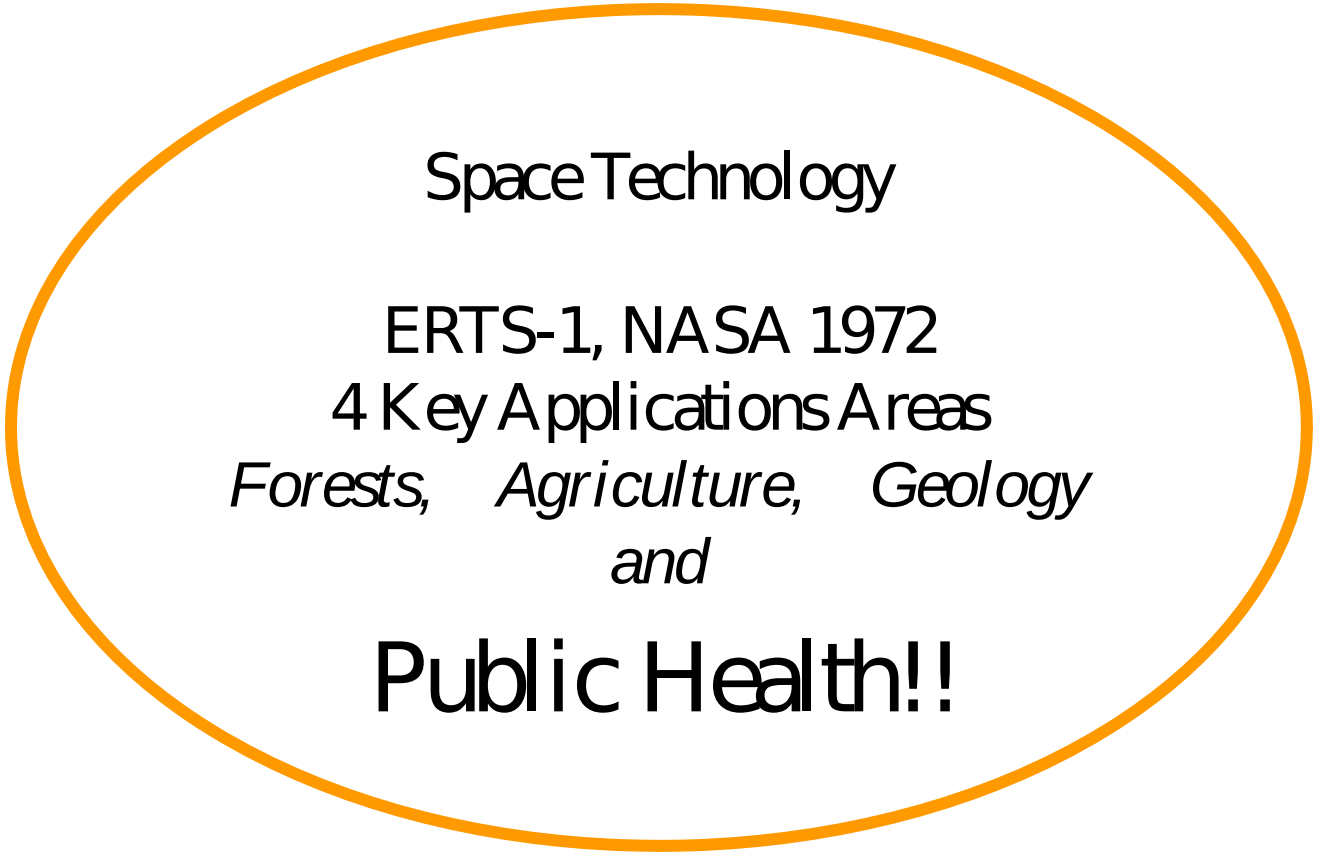
Première partie

Enjeu Géneral

EO and Health: In Search of the Lost Time

Next July, 47 Years of *Earth Observation Satellites Programs* around the World !

Operational Landmark - Action



‘At the end of the day, we will not be judged on these infrastructures, but rather on the results they deliver.’

Barbara J. Ryan [1]
Director, GEO Secretariat [2012-2018]

(1) at the *First Eye on Earth User Conference*.Dublin, Ireland. 5 March 2013

… in dealing with Health Issues a very complex set of interacting systems is involved !!

Intervening Variables:

A Lot of Important things beyond Climate&Weather and Environmental Data

Socio-Demographic data

Urbanisation Process

Economic Development Strategies

Health Services

The social production of the spaces of our daily lives

some of them leave footprints at the

Land Use and Land Cover Datasets

From an EO Perspective, it means:

Landscape as a Mediator

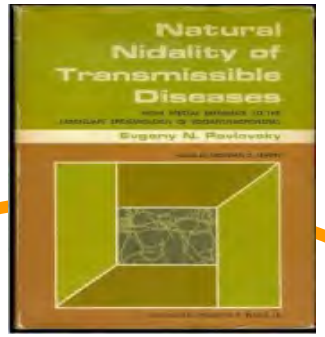
Un point de départ de cette réflexion repose sur la possibilité d'utiliser une lecture particulière du concept de **paysage** dans le cadre d'une **stratégie de médiation**.

Systèmes Théorico-Conceptuels

Santé-Environnement

Pathogenic Complex

Max Sorre, ~1933 (1951)



Natural Foci
Natural Nidality

Evgenii Pavlovsky, ~1939, 1966(1964)

SORRE, M. *Complexes pathogènes et géographie médicale*. *Annales de géographie* **1933** ; **235** :1-18.

PAVLOVSKY, E.N. *On Natural Foci of Infection and Parasitic Diseases,* *Vestnik Akad. Nauk SSSR 10, 98–108 (**1939**).*

PAVLOVSKY, E.N. *Natural Nidality of Transmissible Diseases, With Special Reference to the Landscape Epidemiology of Zooanthroponse.* *Urbana, Ill.: University of Illinois Press, **1966**.(1964, in Russian)*

"Le citoyen est l'individu dans un lieu."

SANTOS, Milton (2007) *O Espaço do Cidadão,* Edusp, 7ed. São Paulo. ***1ed. Nobel, São Paulo, 1987***

Milton Santos
(Brotas de Macaúba, BA, 1926 – São Paulo, 2001)

Systèmes Théorico-Conceptuels

Santé-Environnement-**Développement**

L'idée que l'action humaine produit de l'espace, transforme la paysage, et donc, l'idée que l'espace géographique est une production sociale

Cela apportera une approximation entre les concepts de **paysage et de territoire**

Systèmes Théorico-Conceptuels

Santé-Environnement-**Développement**

Paysage ~ Territoire == Le *Paysage* est *Territoire*

Paisagem ~ Território == A *Paisagem* é *Território*

Landscape ~ Territory == The *Landscape* is *Territory*

en français, portugais et anglais!

Systèmes Théorico-Conceptuels:
Implications Méthodologiques

***A evolução da doença de Chagas no Estado de São Paulo*. Silva, Luiz Jacintho da. Hucitec, São Paulo, 1999 (Revisão comentada da Tese de 1981)**

***L´évolution de la maladie de Chagas dans l'État de São Paulo*. Silva, Luiz Jacintho da. Hucitec, São Paulo, 1999 (compte rendu commenté de la thèse de doctorat, 1981)**

Pathogenic Complex

Landscapes~Territories*
Patterns&Processes
Opportunities (and Risks!) for
RS Imagery Data & Geotechnologies + Socio-Economic-Demographic Data + Field Data
+
Spatial Analysis Methods Methodologies&Tools
+
Local Knowledge
(Field work)

Natural Foci Natural Nidality

EO Data + Socio-Economic-Demographic Data + Integrative Spatial Methodologies

EO&Public Health Possible Conceptual Framework

Deuxième partie:

Comme les Données d´Observation de la Terre son Utilisées ?

Quelques possibilités …

… qui illustrent les défis !!

1. *Hantavirus* dans le Cerrado Paulista

2. *Paludisme* dans la région Métropolitaine de Manaus

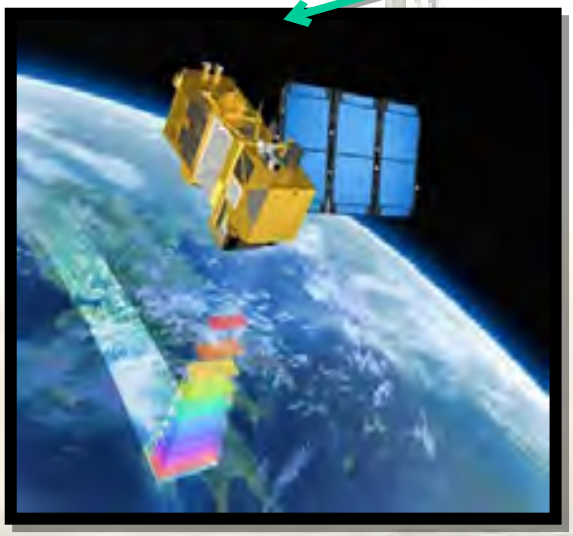
3. *Une Expérience en construction:*

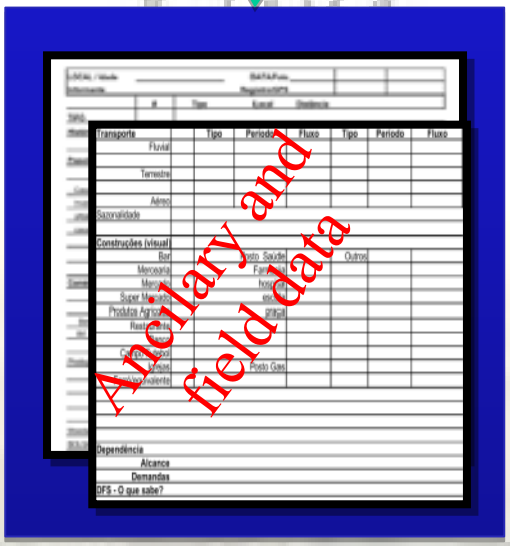
Le lien
santé, environnement et développement
dans la région d'Alto Juruá, Acre

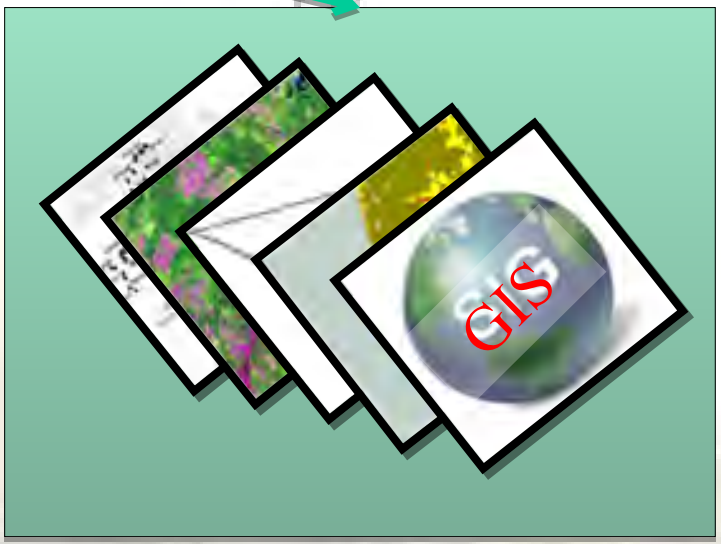
Base Méthodologique: Aspects Généraux

Landscape Observed with Remote Sensing Image Data

Combined use of data and tools



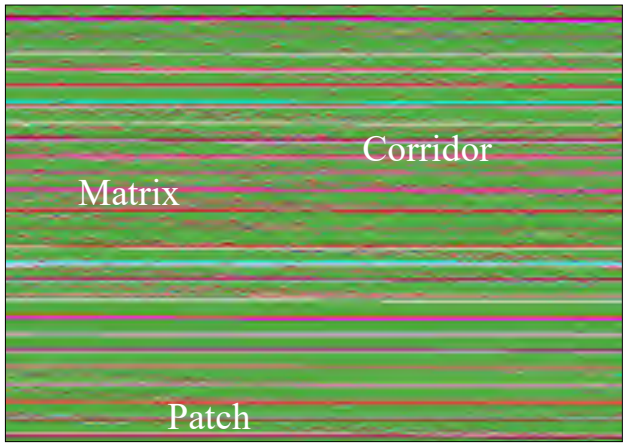




Alberto Giacometti , *Piazza*, 1947–48 , Peggy Guggenheim Collection

Landscape Analysis: Structural, Functional and Contrast Metrics

I

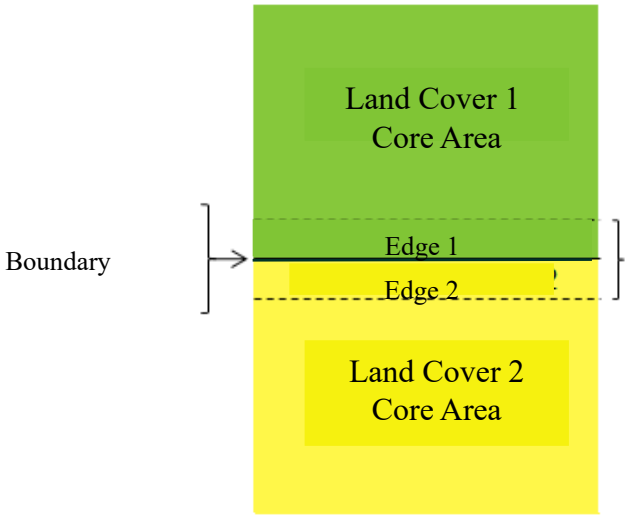


Structural Analysis: Landscape composition and spatial configuration

Functional Analysis: Parameterization

II

Edge, border and boundary.

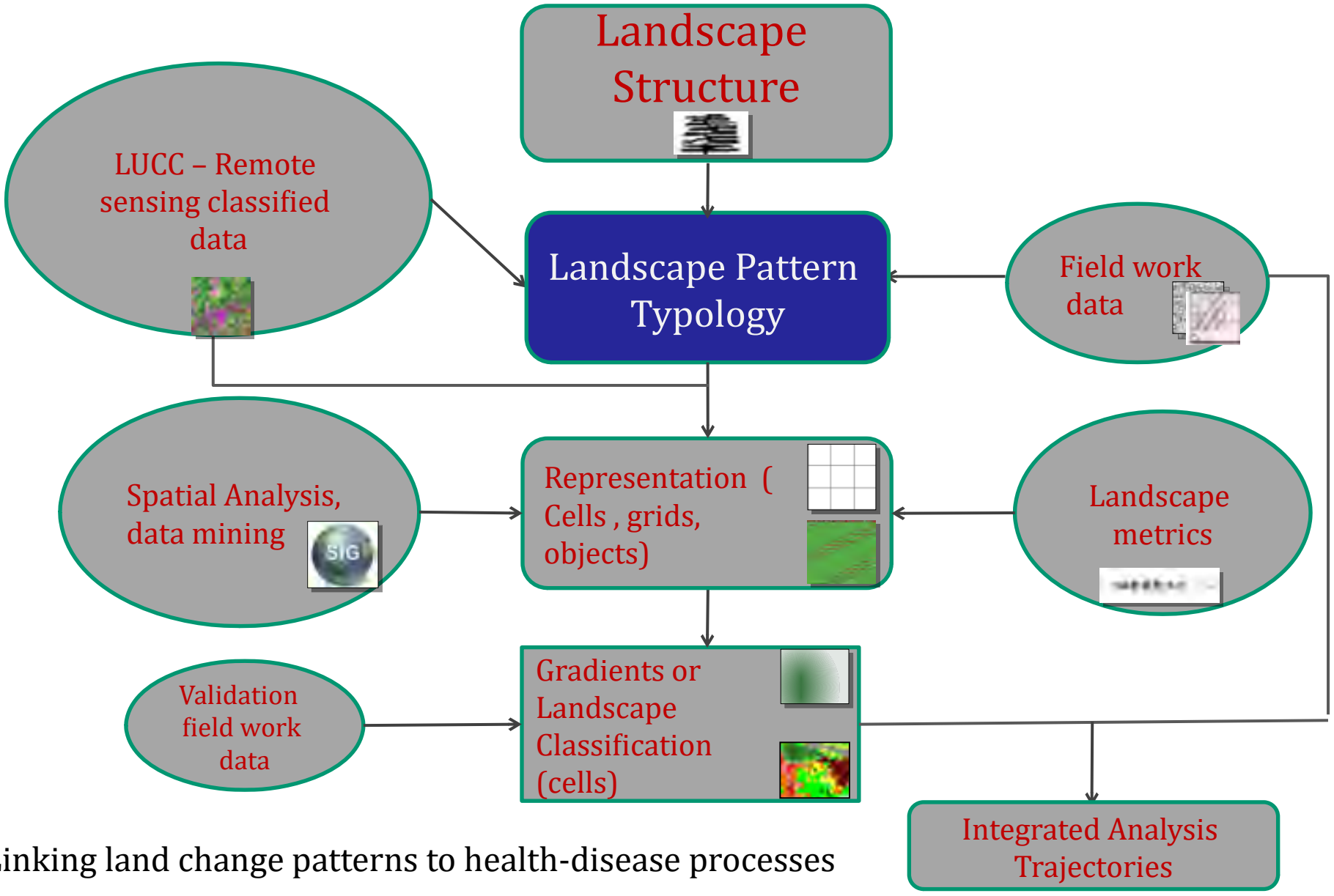


Border Zone

Edge Contrast analysis: Potential Contact

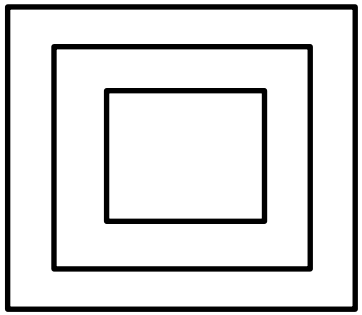
Source: Becker (2018) - Adapted from Forman (1995).

I. The Landscape as a Mediator concept articulating different scales of analysis and data: Structural Analysis

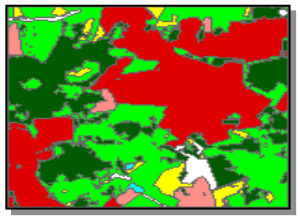


Linking land change patterns to health-disease processes

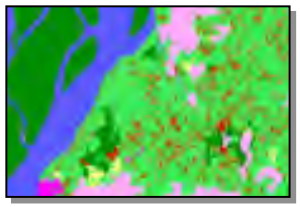
Typology of Landscape Patterns related to the presence/absence of Vectors (Reservoir) and Human Activities



1. Defining the appropriated size of the cells taking into account the dimension and spatial arrangements of landscape elements inside the cells.



TerraClass Santarém, PA



TerraClass Mocajuba,PA

2. Defining a landscape typology related to the presence of the vector and human activities according to the cell composition and spatial arrangements of the landscape elements in each landscape pattern.

Exemplo: Dengue Fever, (Reis, 2011)
Rio de Janeiro

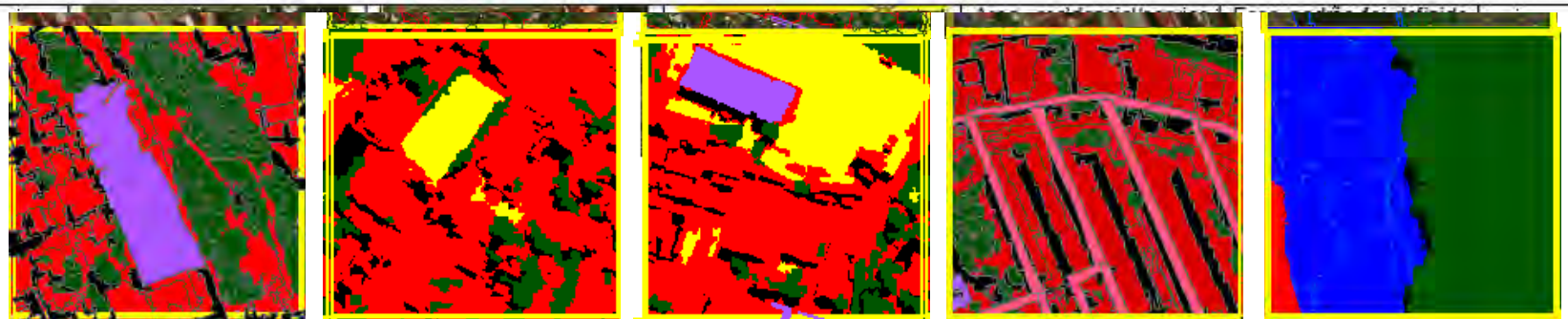
Ikonos, 1m

Reis (2011)

Landscape Patterns Typology

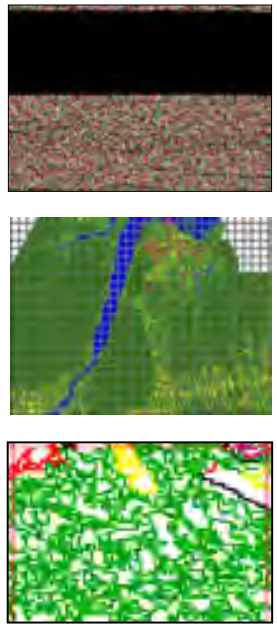
PPU I | PPU II | PPU III | PPU IV | PPU V

Identificação dos Padrões de Paisagem Urbana (PPU)	Padrão de Paisagem Urbana Imagem Quickbird 3(R)2(G)1(B)	Padrão de Paisagem Urbana Imagem Quickbird com os segmentos classificados vazados	Padrão de Paisagem Urbana Imagem classificada	Descrição do Mosaico do Padrão de Paisagem Urbana.	Caracterização dos elementos presentes no Padrão de Paisagem Urbana.	Importância epidemiológica e entomológica
PPU I		 Área residencial/serviço Sombra Arruamento pavimentado	 Área residencial/serviço Sombra Arruamento pavimentado	Area residencial/serviço muito densa. Quando residencial, as habitações são do tipo unifamiliar justapostas, sem presença de jardins ou quintais. O sombreamento é denso. O arruamento é denso e pavimentado. Não há áreas com vegetação, imóveis não residenciais (galpões) e nem áreas não edificadas.	Esse padrão foi definido considerando as classes área residencial/serviço, sombra e arruamento, descrita a seguir: - Classe área residencial/serviço – 60% de polígonos da classe residencial/serviço variando em tamanho de 3 m² a 8.000 m² e com formato irregular. - Classe sombra – 40% de polígonos da classe sombra variando em tamanho entre 23 m² a 2.253 m² com forma alongada e bordas irregulares. -Classe rua pavimentada – muito densa.	1) Relativo ao homem: área de alta densidade de ruas, que favorece a alta circulação de pessoas entre qualquer ponto da região. 2) Relativo ao vetor: área densamente habitada onde os recipientes com água podem estar localizado a céu aberto sem o devido cuidado e muito sombreada. Essa junção pode contribuir para a formação de micro-climas favoráveis ao desenvolvimento dos imaturos da espécie.



Mining Landscape Patterns

KORTING et al. (2008)



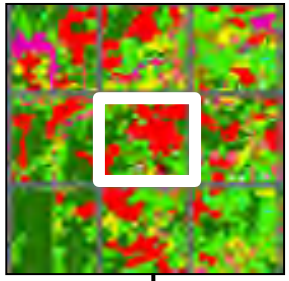
Input data:
Categorical
maps or image
and grid cell

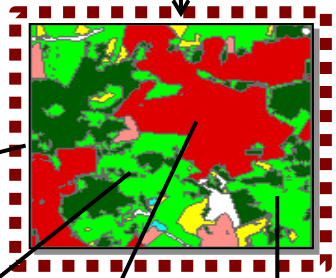
Attributes
extraction
and
Training

Classification

Results

Validation





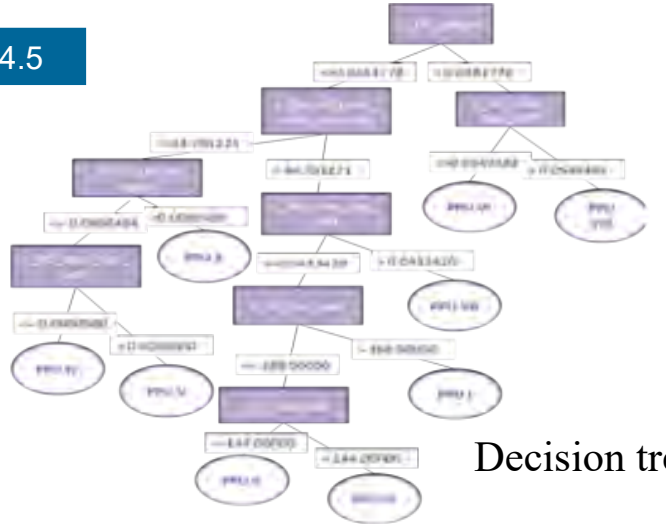
Shape

Density

Size

Composition

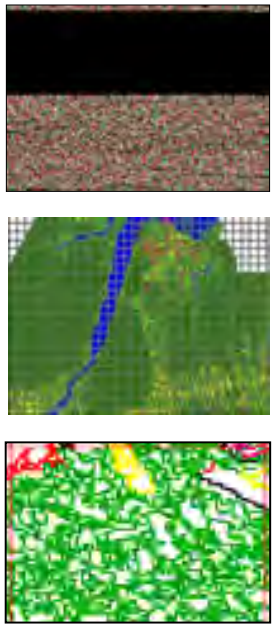
C4.5



Decision tree

Mining Landscape Patterns

KORTING et al. (2008)



Input data:
Categorical
maps or image
and grid cell

Attributes
extraction
and
Training

C4.5

Classification

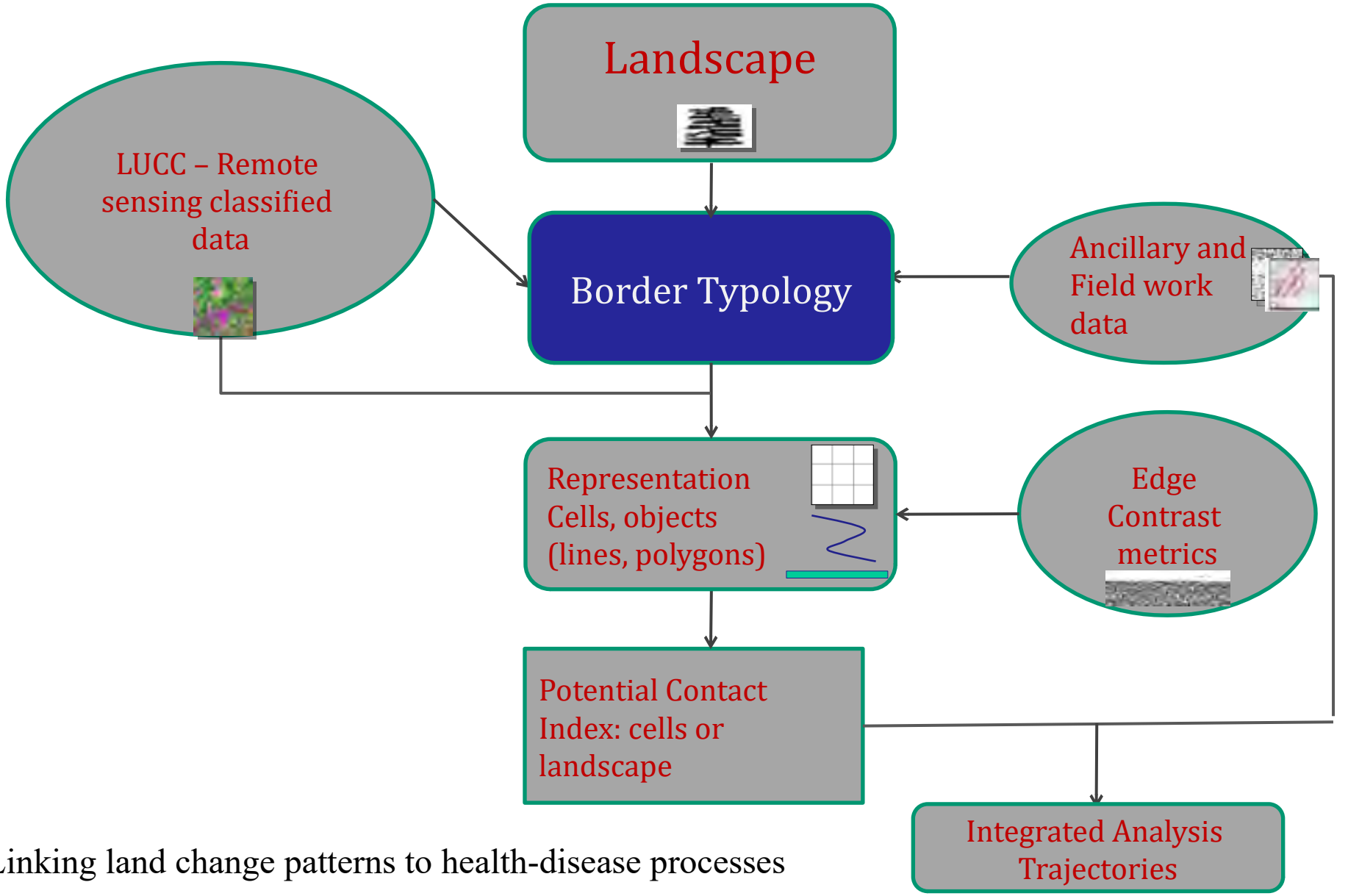
Results

Validation

Landscape Pattern
Classification

Reis (2011)

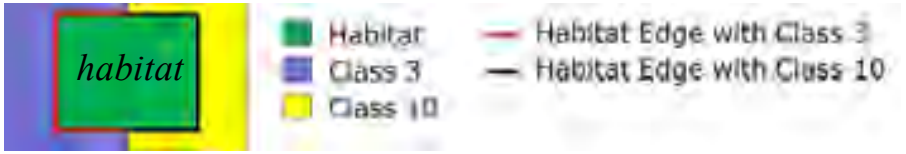
Border Analysis



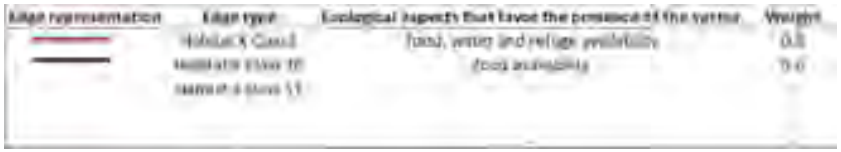
Linking land change patterns to health-disease processes

Analysis under two points of view: **Vectors X Humans**

1. Edges of the vector habitat X Land use classes

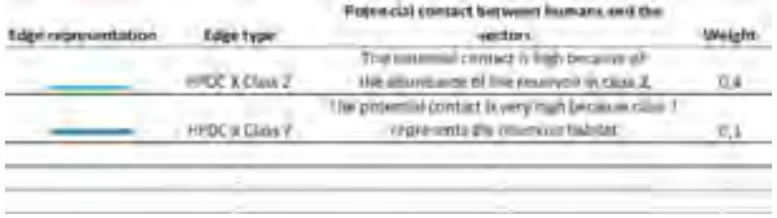


Typology



2. Edges of classes with population density X Land use classes

Typology



Contrast Edge Metrics

Based on:

- The Lenght of edge of specific patch types;
- Dissimilarity between patch types (edge contrast weight)*

* It´s the degree of contrast between a habitat patch and the surrounding landscape

(P1) Edge Contrast Index

$$ECON = \frac{\sum_{k=1}^{m} (p_{ijk} \cdot d_{ik})}{p_{ij}} (100)$$

p_{ijk} = length (m) of edge of patch ij adjacent to patch type (class) k.
d_{ik} = dissimilarity (edge contrast weight) between patch types i and k.
p_{ij} = length (m) of perimeter of patch ij.

(C1) Contrast-Weighted Edge Density

$$CWED = \frac{\sum_{k=1}^{m} (e_{ik} \cdot d_{ik})}{A} (10{,}000)$$

e_{ik} = total length (m) of edge in landscape between patch types (classes) i and k; includes landscape boundary segments involving patch type i.
d_{ik} = dissimilarity (edge contrast weight) between patch types i and k.
A = total landscape area (m^2).

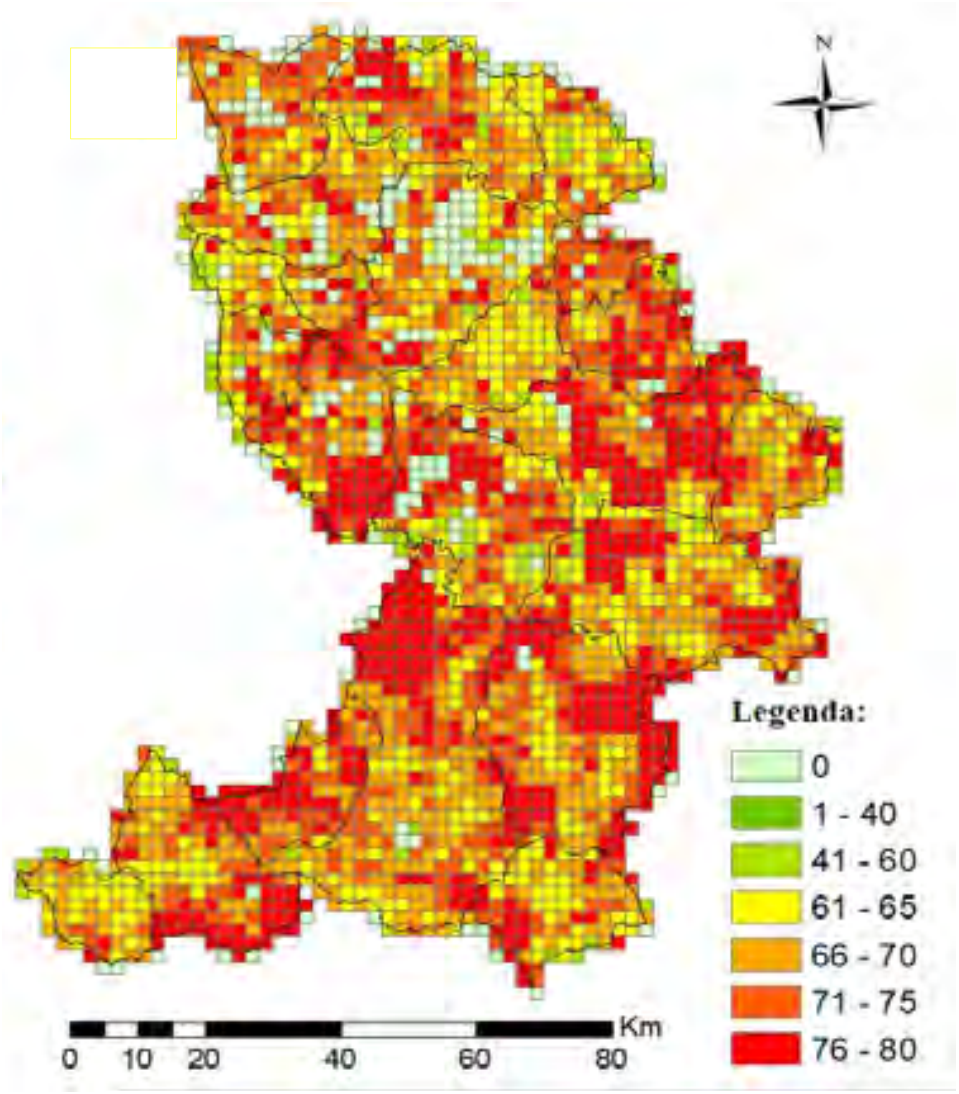
(C2) Total Edge Contrast Index

$$TECI = \frac{\sum_{k=1}^{m} (e_{ik} \cdot d_{ik})}{\sum_{k=1}^{m} e'_{ik}} (100)$$

e_{ik} = total length (m) of edge in landscape between patch types (classes) i and k; includes landscape boundary segments involving patch type i.
e'_{ik} = total length (m) of edge in landscape between patch types (classes) i and k; includes the entire landscape boundary and all background edge segments, regardless of whether they represent edge or not.
d_{ik} = dissimilarity (edge contrast weight) between patch types i and k.

Fragstats - McGarigal, 2015

Contrast Edge Index indicating Potential Contact



Furtado, 2018

1. *Hantavirus* dans le Cerrado Paulista

Michelle Andrade Furtado. *O complexo da hantavirose em um polo sucroalcooleiro do estado de são paulo investigado pela análise funcional da paisagem* . PhD Thesis. Graduate Program in Earth System Science. INPE. Supervised by Isabel Escada&Miguel Monteiro. Fevereiro de 2018

Michelle Andrade Furtado. *Le complexe d'hantavirus dans un pôle sucroalcooleiro de l'état de São Paulo étudié dans le cadre d'une analyse fonctionnelle du paysage.* Thèse de doctorat. Programme d'études supérieures en sciences du système terrestre. INPE. Supervisé par Isabel Escada & Miguel Monteiro. Février 2018

Hantavirous Transmission Cycle

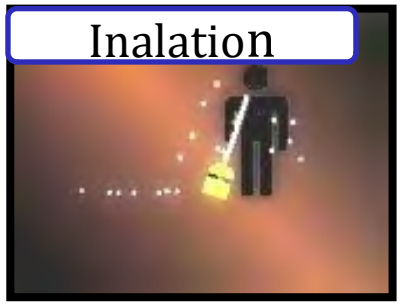
Necromys lasiurus

Mouse infected by Hantavirous

Horizontal Transmission

Cardiopulmonary Syndrome - SCPH

Inalation



Epidemiologic Profile

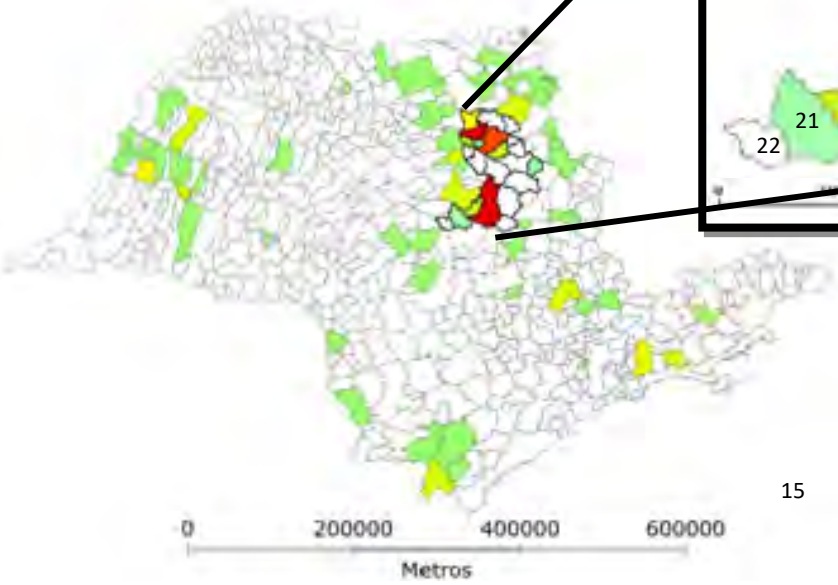
- High lethality 56%
- Rural zone – 53%
- Workplace - 50%
- Man – 79%
- White Race – 65%
- Age: 20 to 39 - 54%

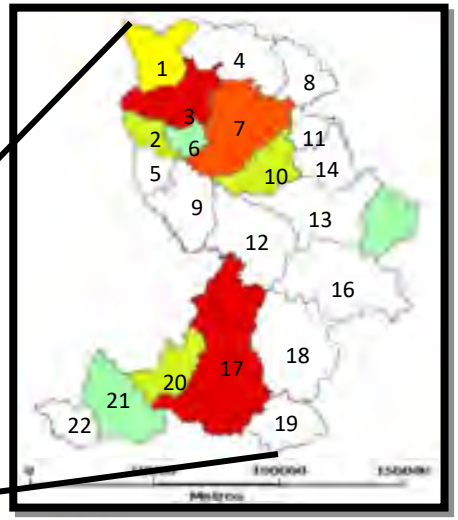
Study Area

2 Hantavirous cases from 2001 – 2012
São Paulo State

Sugar cane expanded from
^{2} in 1996 to 55.906 km^2
in 2016 in São Paulo State (IBGE, 2016).

1 Pontal
2 Barrinha
3 Sertãozinho
4 Jardinópolis
5 Pradópolis
6 Dumont
7 Ribeirão Preto
8 Brodowski
9 Guatapará
10 Cravinhos
11 Serrana



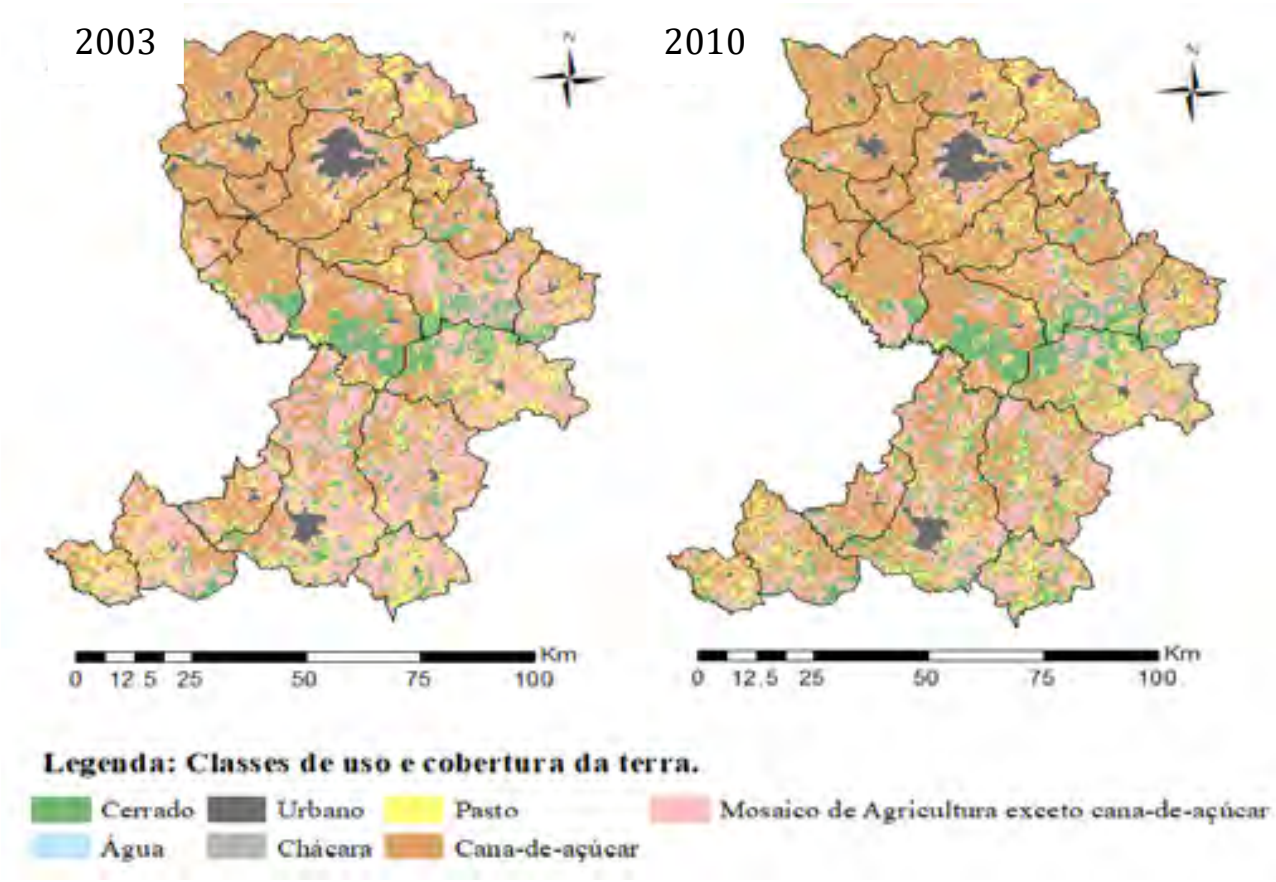


15

Legend: Number of cases

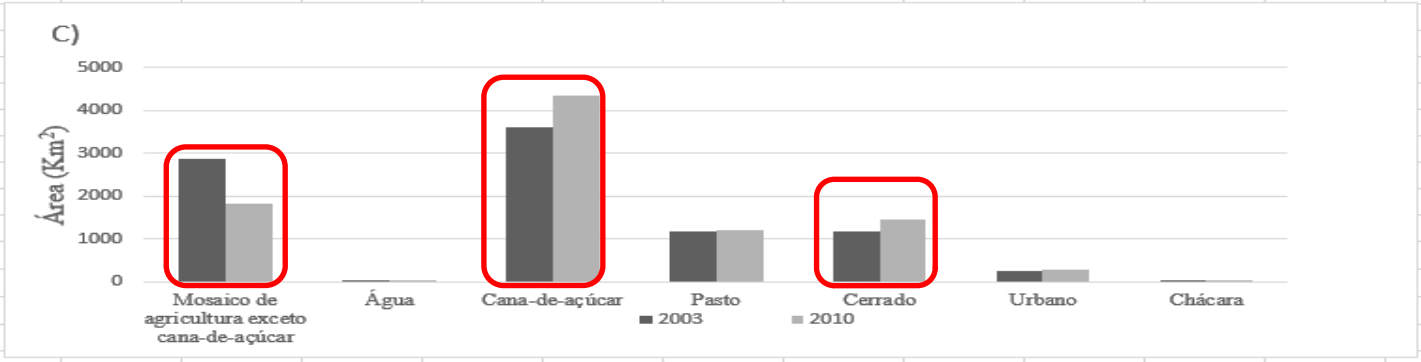
- 1 – 2
- 3 – 4
- 5 – 8
- De 9 – 11
- De 12 – 14
- 0

Landscape: Spectral Classification (Landsat)



Sugar cane area increased replacing other crop areas

Accuracy was estimated with 2000 randomic samples



Typology of Landscape Pattern Relevant for SCPH Complex

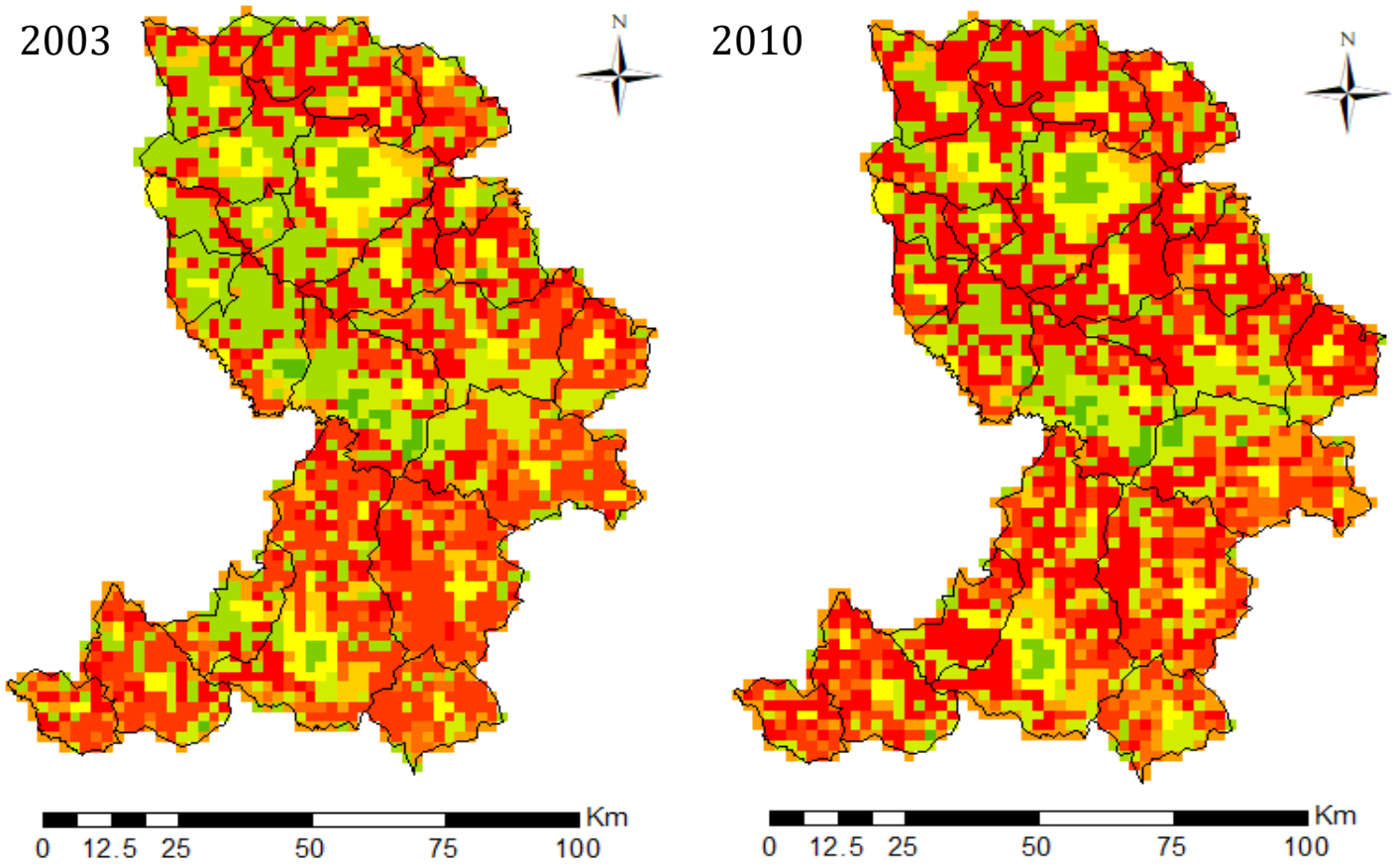
Padrão	Padrões de paisagens	Composição celular	Roedores que podem ser encontrados neste padrão da paisagem
Cerra	Fragmentos Florestais Isolados Rodeados por Cana de açúcar 	Célula entre 3% e 12% da Classe Floresta Célula com mais de 30% da classe Cana de açúcar e menos de 25% das outras classes	***Rhipidomys mastacalis*** (Vieira et al., 2009); ***Oligoryzomys nigripes*** (Vieira et al., 2009); Suzán e col. (2006) ***Oryzomys sp*** (Goodin et al., 2006); ***Mus musculus*** (Umetsu e Pardini, 2007); ***Calomys tener*** (Umetsu e Pardini, 2007); ***Necromys lasiurus*** (Umetsu e Pardini, 2007); ***Akodon montensis*** (Goodin et al., 2006);
Urba	Floresta Fragmentada Rodeados por Mosaico de Agricultura exceto cana de açúcar 	Célula entre 3% e 12% da Classe Floresta Célula com mais de 30% da classe Mosaico de Agricultura exceto cana e menos de 25% das outras classes	***Rhipidomys mastacalis*** (Vieira et al., 2009); ***Oryzomys sp*** (Umetsu e Pardini, 2007); ***Oligoryzomys nigripes*** (Vieira et al., 2009); Suzán e col. (2006), ***Mus musculus*** (Umetsu e Pardini, 2007), ***Calomys tener*** (Umetsu e Pardini, 2007); ***Necromys lasiurus*** (Umetsu e Pardini, 2007); ***Akodon montensis*** (Goodin et al., 2006);

Cerra… Urba… Mosa… cerra… Cerra… H.

Urba… Chác… Mosa… Pasto… Mosa… açúcar e mosaico de cobertura (PIX)

Cana de açúcar e mosaico de cobertura (PX)	Altíssima relevância para o complexo do SCPH.

Strutural Classification of Landscape Patterns



Legenda: Padrões de paisagem de interesse para o SPH.

PI	PIII	PV	PVII	PIX
PII	PIV	PVI	PVIII	PX

PIV	46%	PIII	-43%
PX	72%	PIX	-50%

Border Typology: Edge Contrast Potential Contact

Analysis under two perspectives:

- *Rodent (habitat Class - Cerrado) – 5 Classes*
- *Human (high density population: Urban and Small farms classes)*

Contrast Edges	Weight	Ecological Attributes associated to the rodent abundance
Cerrado X Urbano	0.4	Disponibilidade de alimentos, como restos de comida e lixo.
Cerrado X Chácara	0.5	Disponibilidade de comida, como rações mal armazenadas para animais e lixo Fornece abrigo, principalmente em casas ou barracões com frestas que facilitam a entrada desses roedores.
Cerrado X Pasto	0.6	Abrupta, porém, como os roedores são generalistas, eles também são encontrados em áreas de pastagens e com uma alta soropositivdade para o hantavirus.
Cerrado X Agricultura	0.8	Roedores encontrados com alta abundância devido a disponibilidade de comida e abrigo, podendo gerar novos micro-habitats. Além de ser destacado como um importante fator para maior soropositividade do hantavírus.
Cerrado X Cana de açúcar	0.8	Trabalhos mostram que esses roedores podem ser encontrados até com maior abundância em lavouras de cana de açúcar do que em remanescentes florestais nativos. Nos canaviais eles conseguem abrigo, alimento e água roendo os caules de cana de açúcar.

Border Typology: Edge Contrast Potential Contact

Analysis under two perspectives:

- *Rodent (habitat Class - Cerrado)*
- *Human (high density population: Urban and Small farm classes) – 4 classes*

Edge Contrast	Weight	Potential contat between humans and rodent hantavirous reservatoir
Urbano e Chácara X Agricultura	0.6	Alta abundância de roedores e alta soropositividade
Urbano e Chácara XCana de açúcar	0.6	Cada vez mais trabalhos vêm relacionando os casos de HPS com a expansão das áreas de cana de açúcar.
Urbano e Chácara X Pasto	0.5	Se alimentam da semente do capim, sendo bastante encontrados nesse tipo de paisagem.
Urbano e Chácara X Cerrado	0.8	Habitat natural do roedor *Necromys lasiurus*

Analysis by Contrast Metrics

- **TECI** (magnitude do contraste)

$$TECI = \sum$$

rimento total (m) das bordas entre as classes *i* e *k* em cada

do contraste das bordas entre as classes *i* e *k*.

- **CWED** (magnitude do contraste e abundância)

$$CWED = \frac{\sum_{k=1}^{n}(e_{ik} * d_{ik})}{A}$$

primento total (m) das bordas entre as bordas *i* e *k*,
a célula.
o do contraste das bordas entre as bordas *i* e *k*.
A – Área total da paisagem (m) na célula.

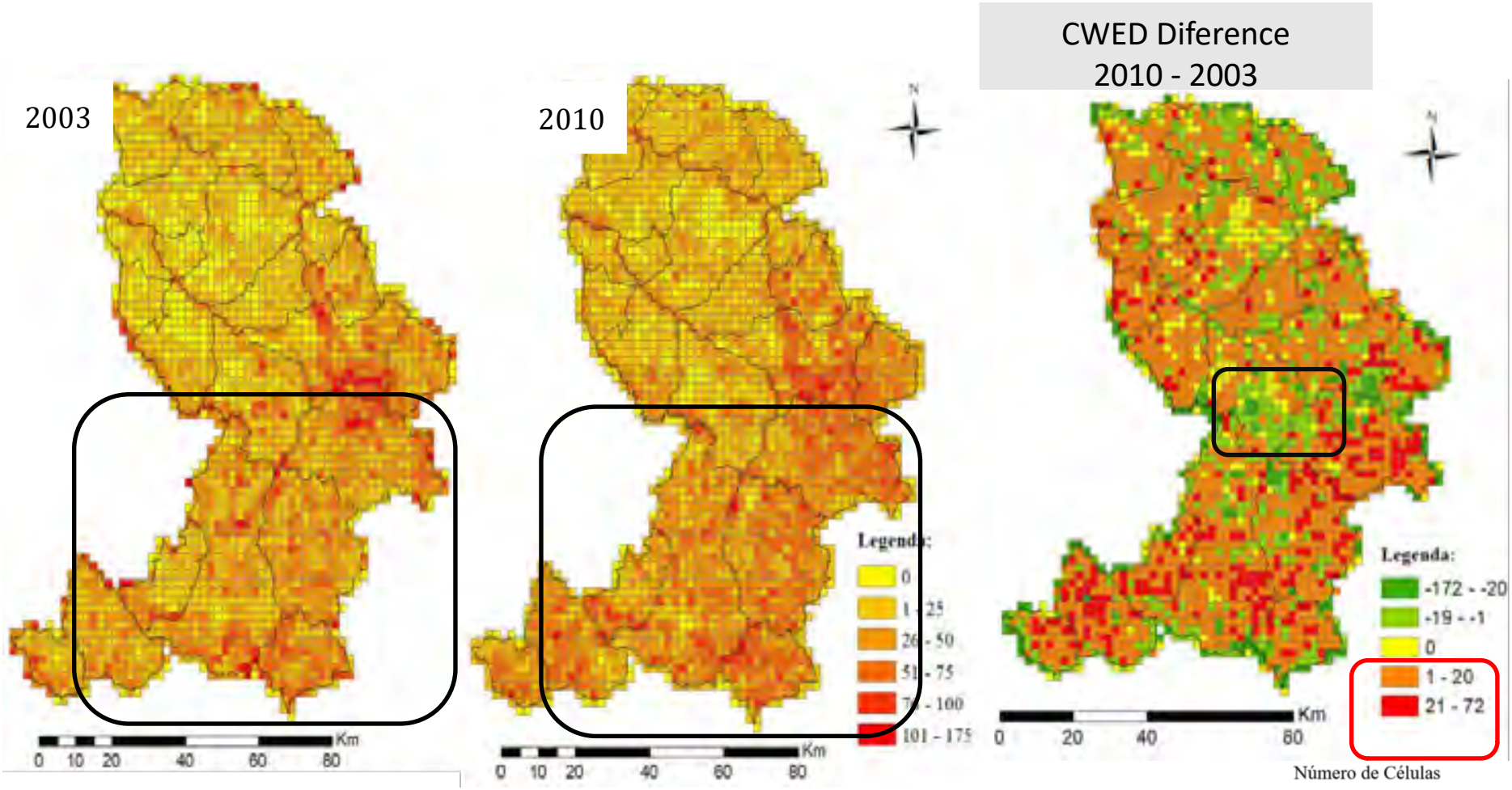
- **Comprimento das bordas**

$$C = e_{ik}$$

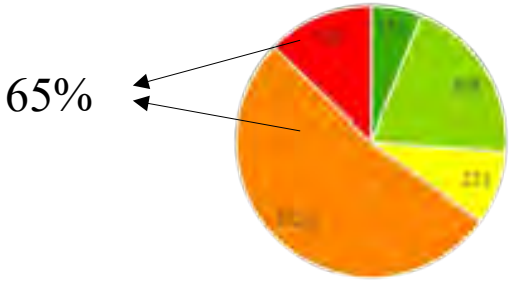
e_{ik} = Comprimento total (m) das bordas entre as classes *i* e *k* em cada célula.

d_{ik} = peso do contraste das bordas entre as classes *i* e *k*.

CWED estimated for Cerrado Class: Rodent Habitat

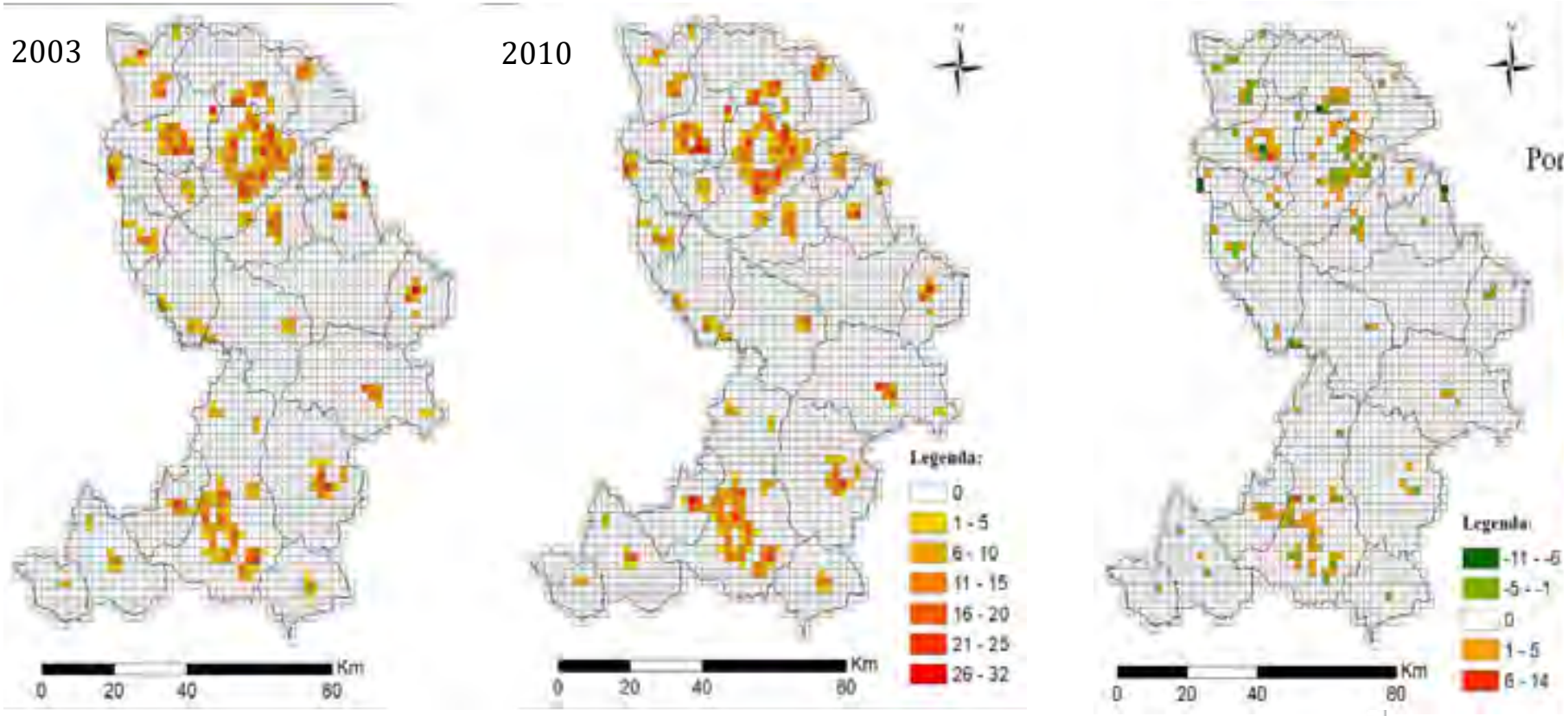


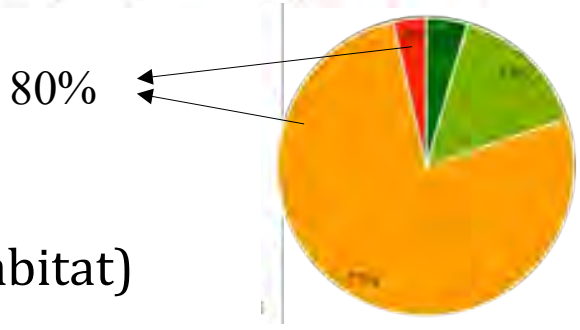
- Increase of SCPH edges from 2003 - 2010
- Expansion of sugar cane/cerrado edges
- More fragmented landscape in this area, but..
- Until 2010 there were few cases of hantavirous



CWED estimated for *urban and small farm Class*

CWED Diference
2010 – 2003





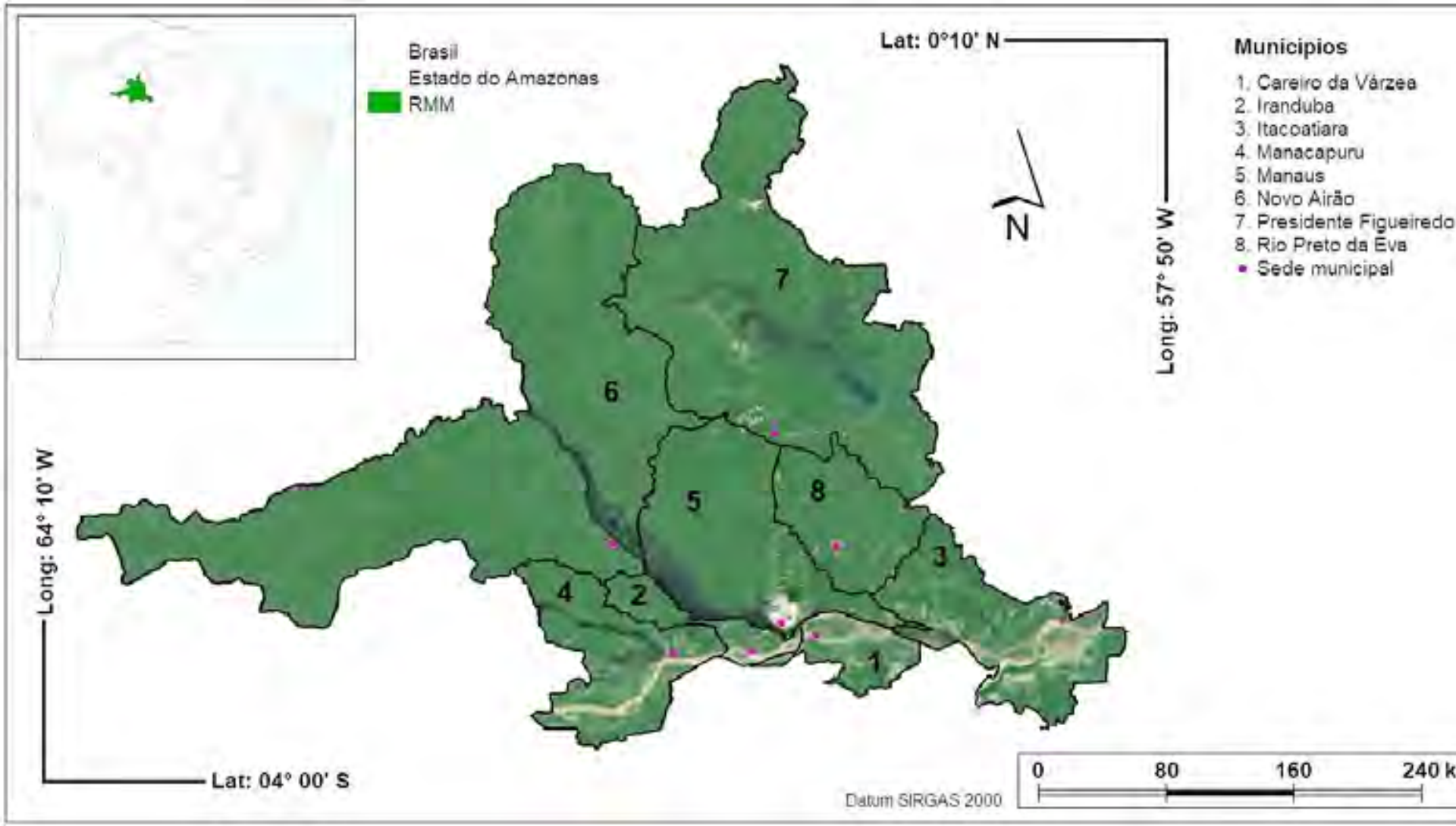
- Few edges and Lower CWED
- Predominance of sugar cane and other crops edges
- These classes are neighbors of cerrado class (rodent habitat)

2. *Paludisme* dans la région Métropolitaine de Manaus

Jaidson Nandi Becker. *Mobilidade Humana e Heterogeneidade Espacial: Novos elementos para o Estudo da Malária na Região Metropolitana de Manaus",* . PhD Thesis. Graduate Program in Earth System Science. INPE. Supervised by Isabel Escada&Miguel Monteiro. Maio de 2018

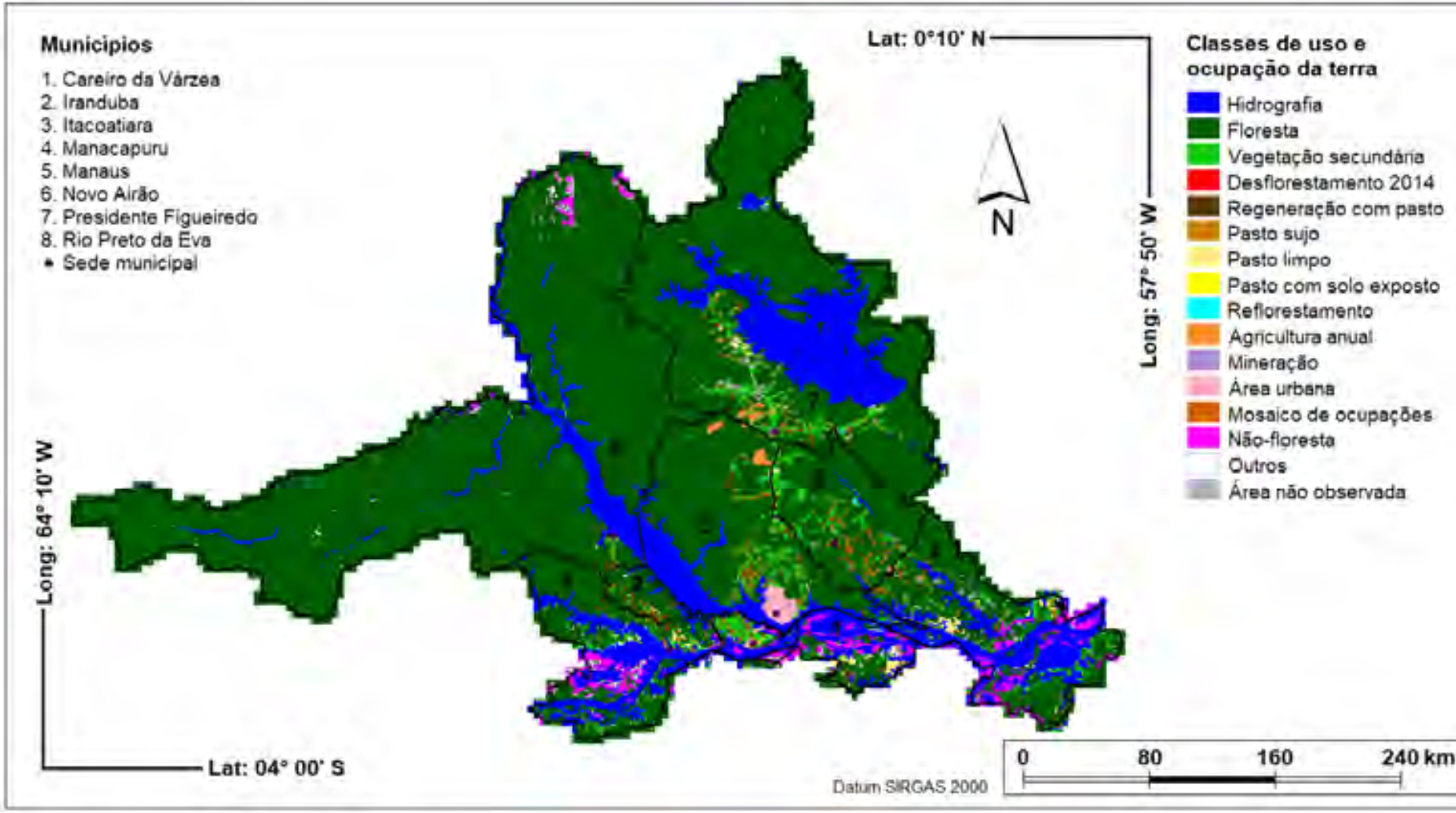
Jaidson Nandi Becker. *Mobilité humaine et hétérogénéité spatiale: Nouveaux éléments pour l'étude du paludisme dans la région métropolitaine de Manaus* . Thèse de doctorat. Programme d'études supérieures en sciences du système terrestre. INPE. Supervisé par Isabel Escada & Miguel Monteiro. Mai 2018

Study Area: Metropolitan Region of Manaus - RMM

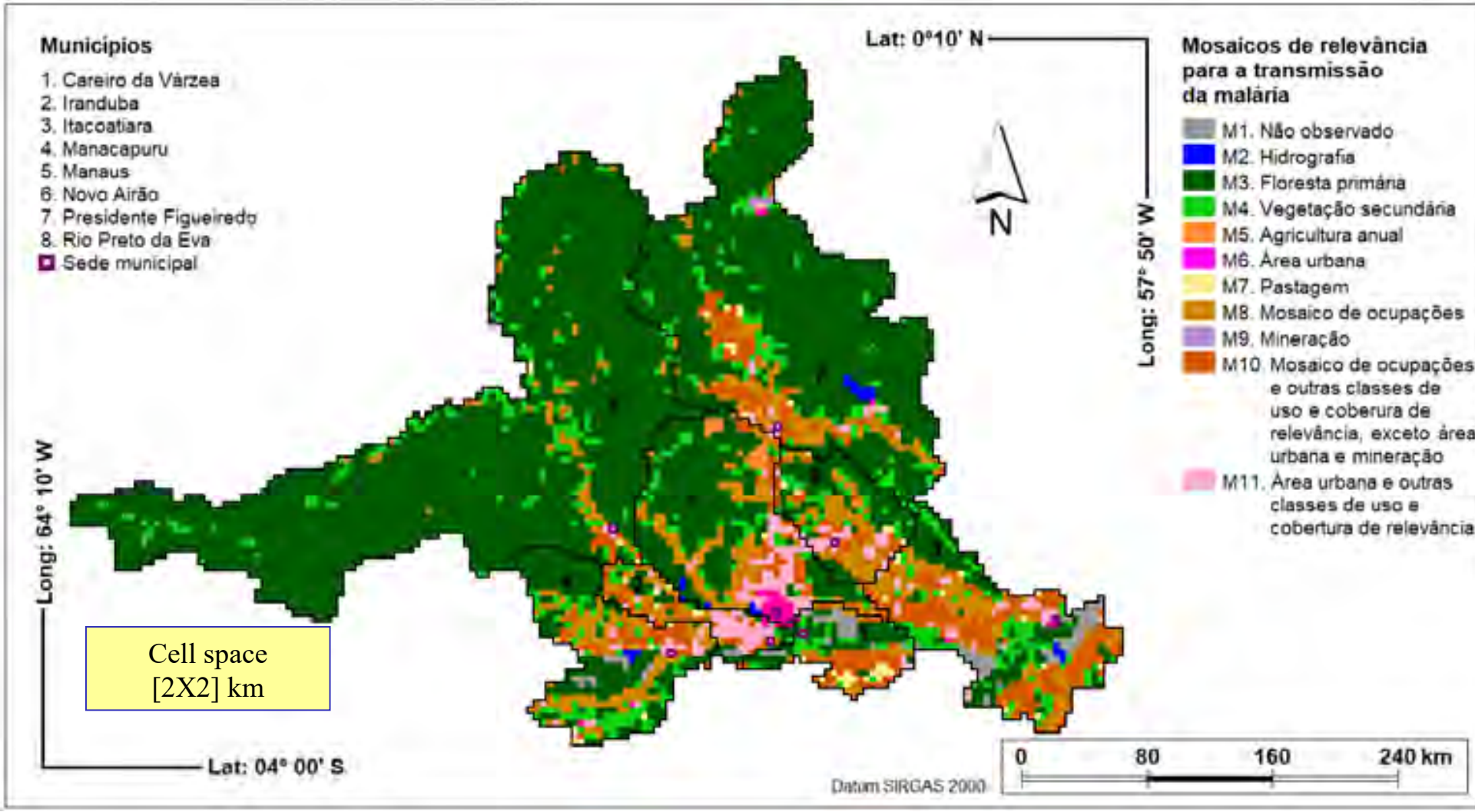


Land Use and Land Cover in RMM em 2014

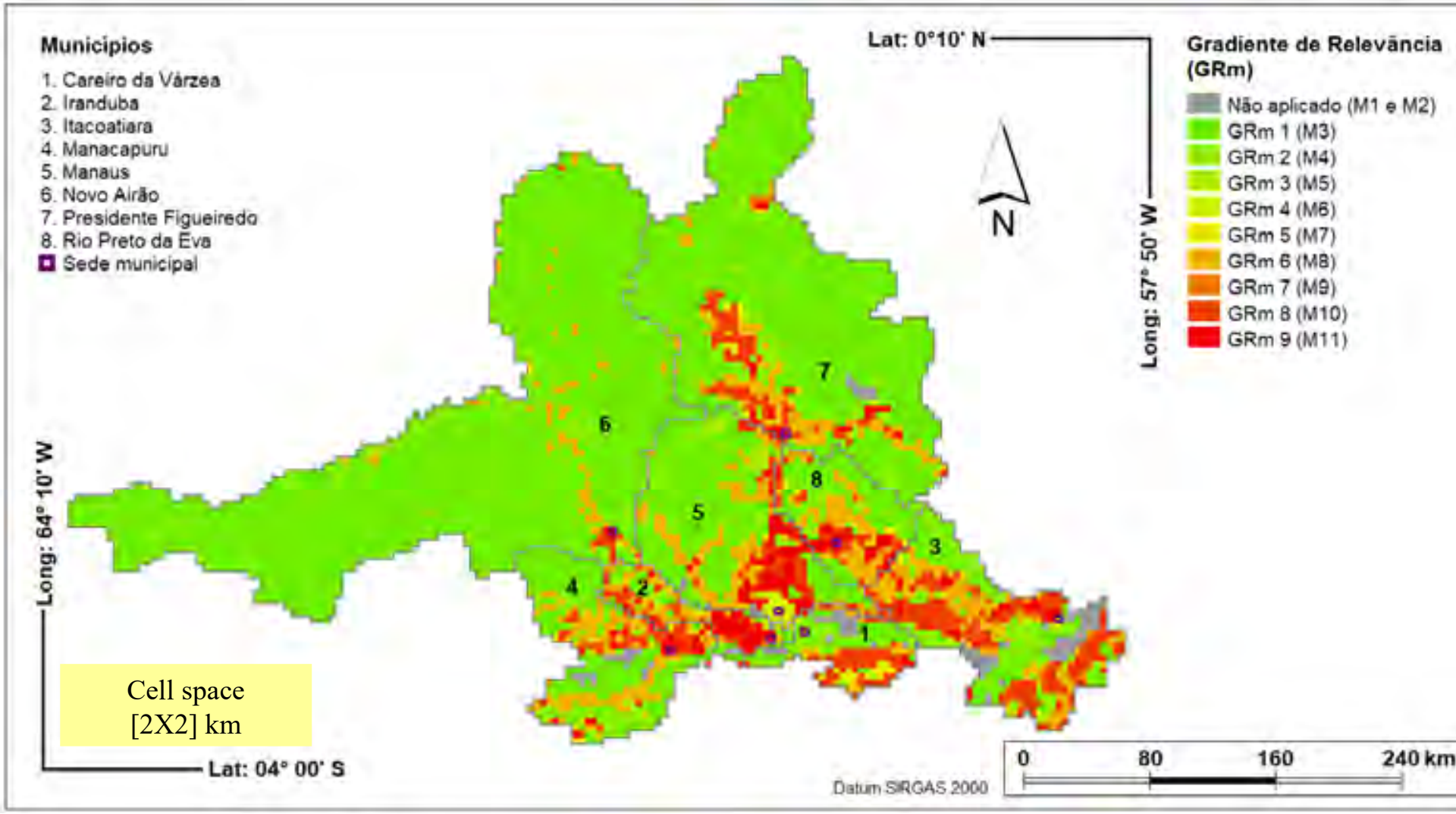
(Terraclass)



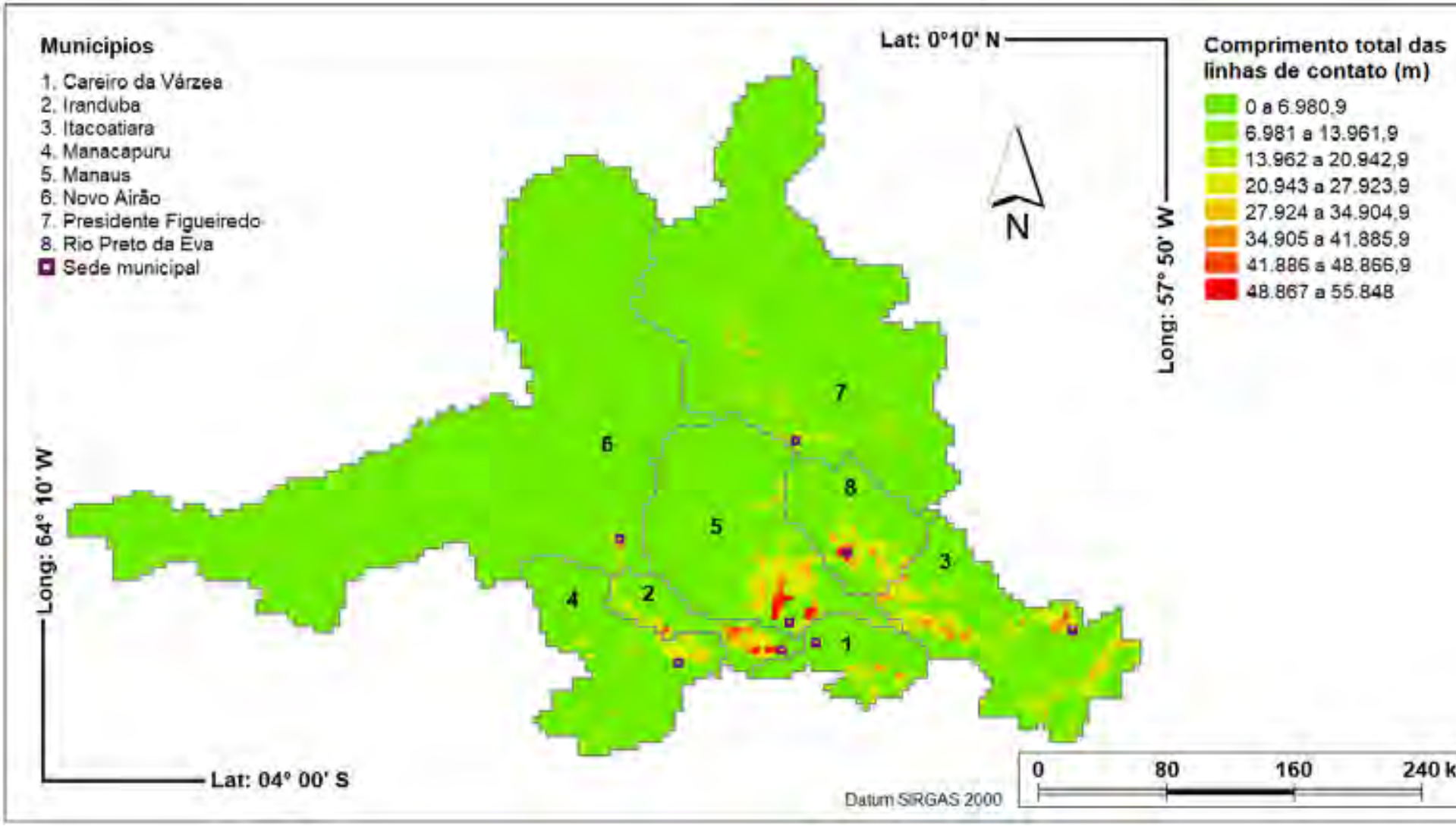
Landscape Mosaics for RMM in 2014



Gradient of Relevant Landscape for Malaria Transmission (GRM) in Manaus Metropolitan Region in 2014



Contrast Index for RMM in 2014.

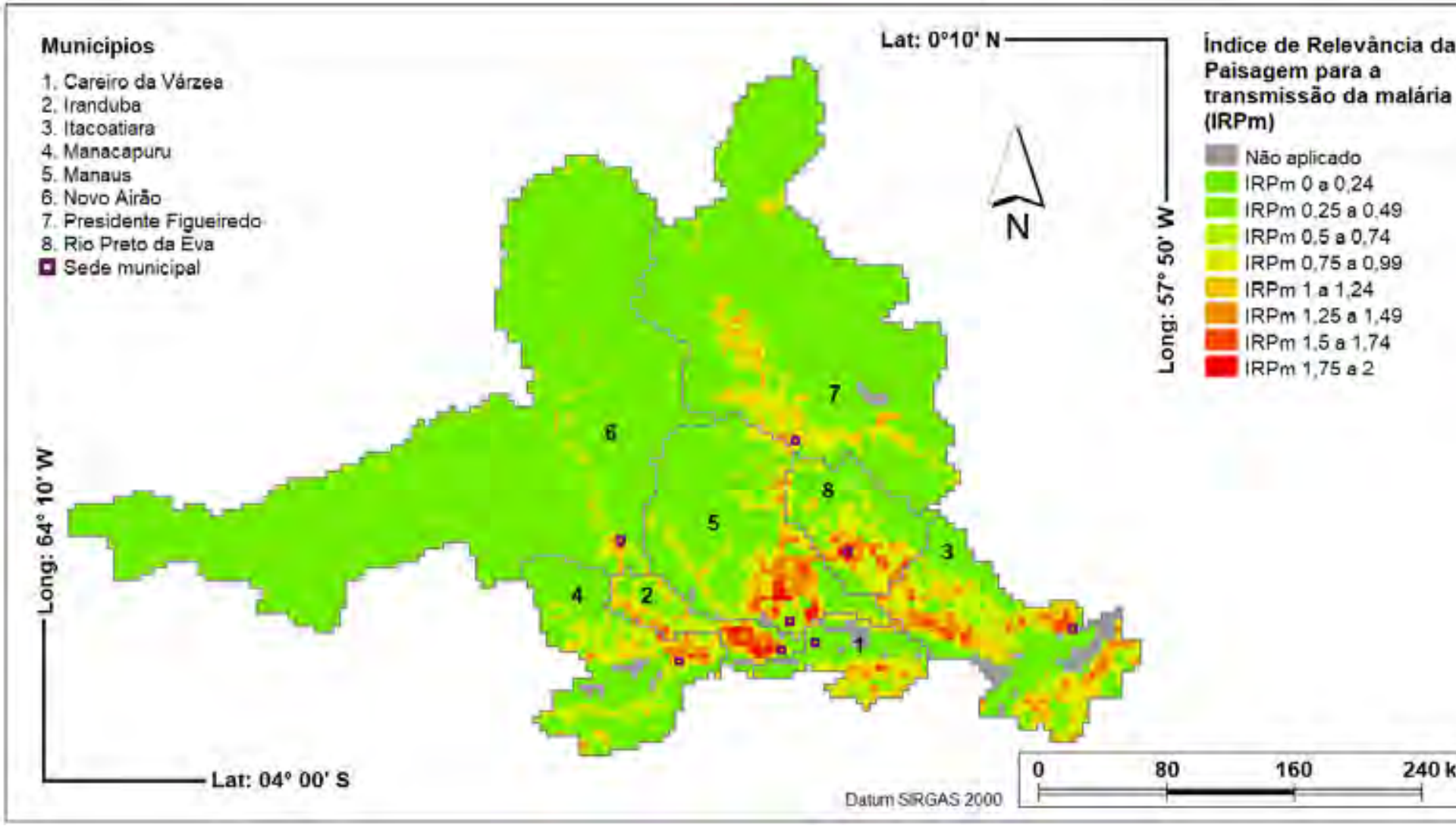


(GRM)

(Contrast Index - C)

Landscape Relevance Índex for Malária Transmission (IRPm)
RMM - 2014

Landscape Relevance Index for Malária Tranmission (IRPm) for RMM, 2014



The proposed and tested methodology can be replicated to any region of the *Legal Amazon*, using the same *data sources* (**SIVEP-malaria and TerraClass Project**). A better assessment must be done. It can be easily adapted to different scales of time and space.

The continuity of the data produced (*and made available*) by SIVEP-Malaria and the TerraClass Project, provides a perspective for the operationalization and replication of the methodology developed.

3. Une Expérience en Construction: *santé, environnement et développement* dans la région d'Alto Juruá, Acre

ECOLUVA-JURUÁ:

Economic Development Pathways, Production Landscapes Units and Mosquito-Borne Diseases in the Alto Juruá, Acre, Brazilian Amazonia

Raquel M Lana
Claudia T Codeço

Ministério da Saúde
FIOCRUZ
Fundação Oswaldo Cruz

Ana Paula Dal´Alasta
Antonio Miguel V. Monteiro
Maria Isabel Sobral Escada
Anielli Souza
Silvana Amaral

INPE
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Alto Juruá Region

currently 90% of Acre's malaria cases are concentrated here

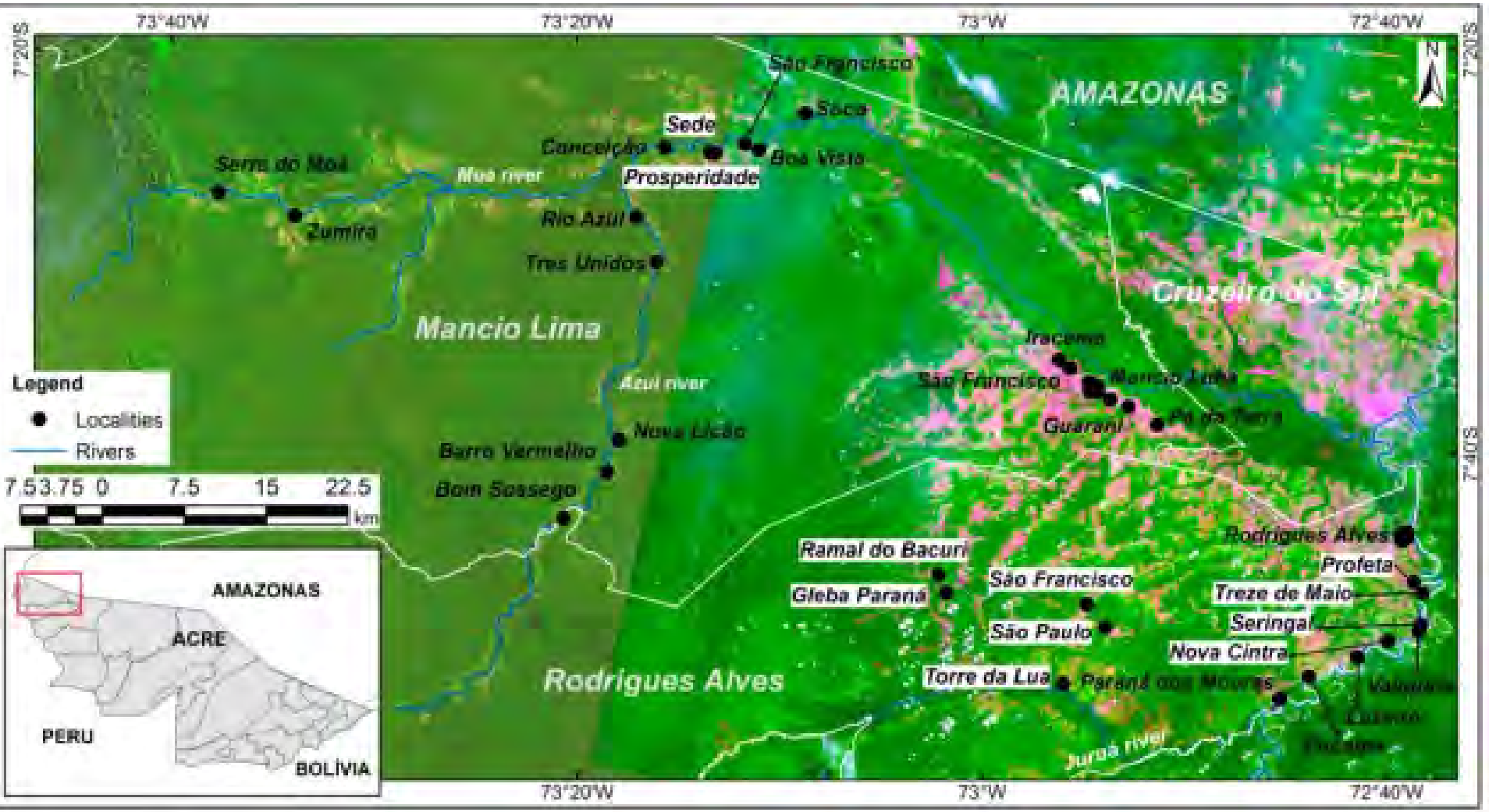


Figure 1. Malaria hotspot in northwest Acre, Brazil. The dots indicate the localities included in the study.

Alto Juruá Complex Landscape

Case Study: ECOLUVA-JURUA

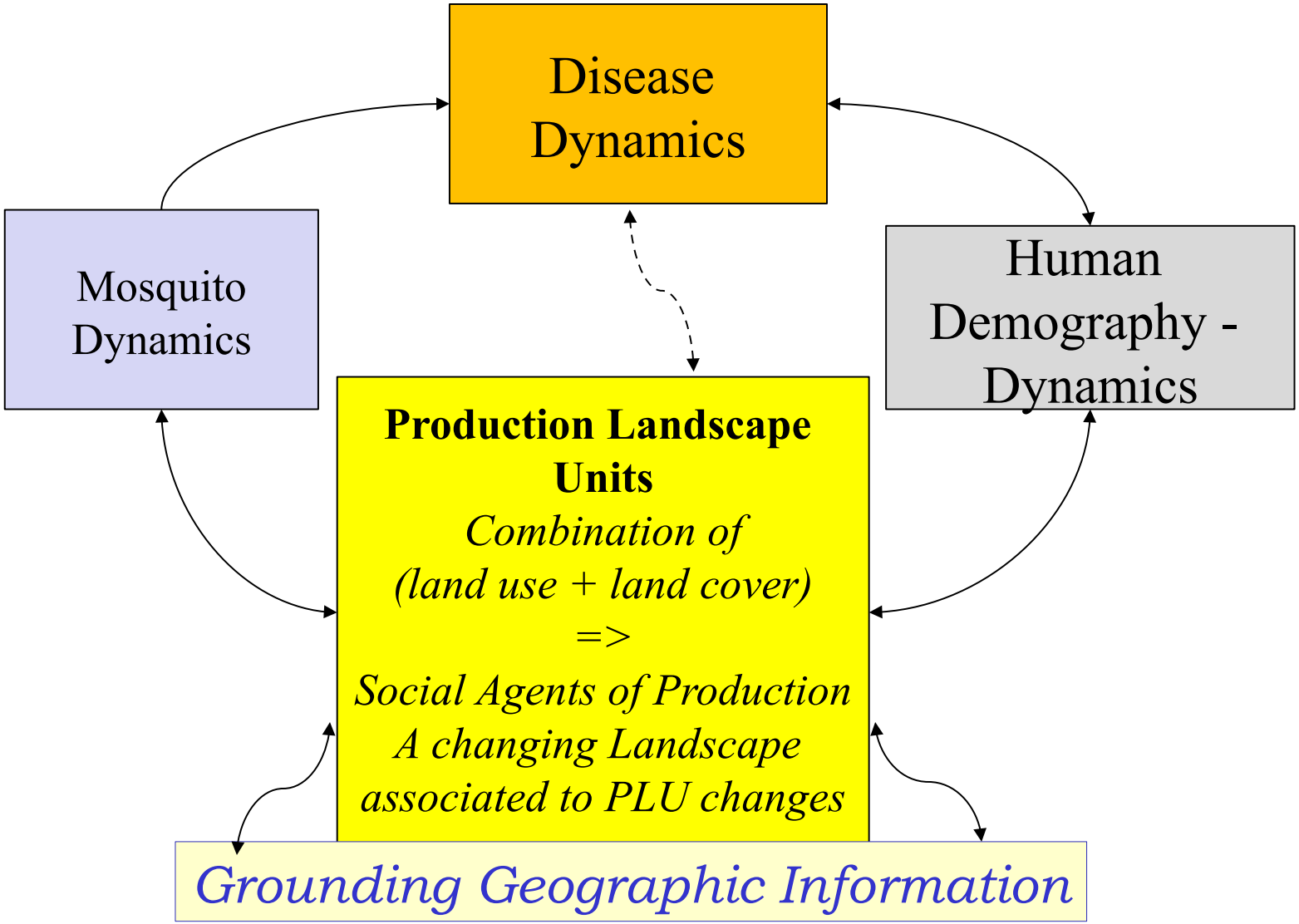
Represents the *epidemiological dynamics* of **malaria** associated with trajectories of change of the production systems - forest, agroforestry and **agricultural production chains -**

Case Study: ECOLUVA-JURUA

- produced by a set of heterogeneous Social *Agents* that live and circulate in a mosaic of environmentally and socially sensitive *landscape units*, called *Production Landscape Units (PLU)*, represented in a *cell grid* world and its association with health intervention scenarios.

General Framework: *Dynamics*

Spatially-Explicit Agent-Based Model *Geographically Grounded*



The ***Economic Development Pathways***:
a Typology oriented by the *footprints* of the *Productive Systems** left over the ***Landscape***

the ***Landscape*** *as a* ***Mediator*** *for the Regio* *its* ***Modes of Production***

Francisco de A. Costa
Economist, UFPA-NAEA

Cambridge Schoolar, 2019

* Based upon the ´Technological Trajectories´ concept developed for the Amazon Region by Francisco de Assis Costa:

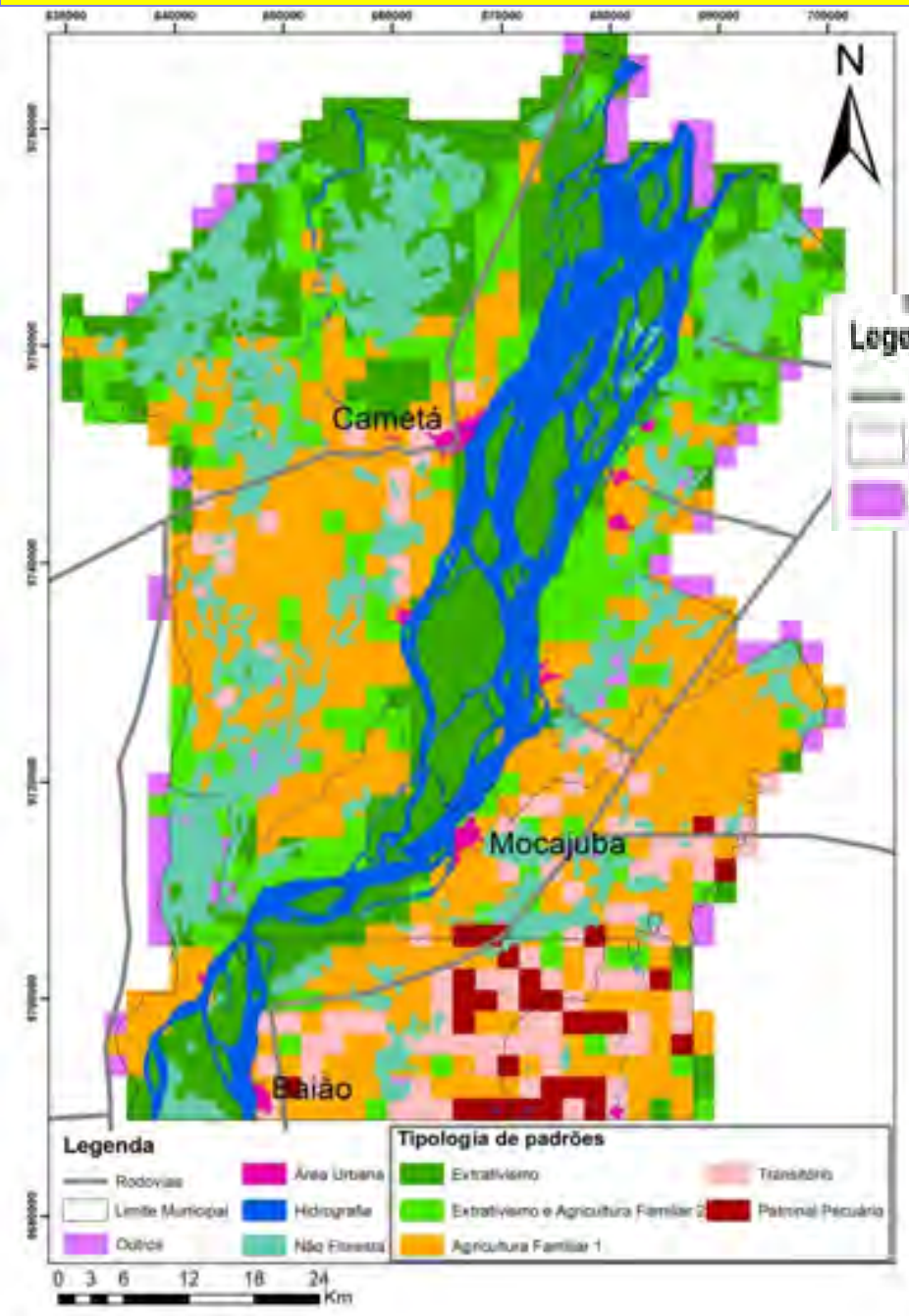
(1) *Trajetórias Tecnológicas como Objeto de Política de Conhecimento para a Amazônia: uma metodologia de delineamento.* Rev. Bras. Inov. / Braz. Inov. J., Campinas (SP), v.8, n. 1, 2009.

(2) *Mercado e produção de terras na Amazônia: avaliação referida a trajetórias tecnológicas.* April 2010 Boletim do Museu Paraense Emilio Goeldi:Ciencias Humanas

(3) *A Brief Economic History of the Amazon (1720-1970).* Hardcover, 348 pages. Published February. 1st ed. 2019 by Cambridge Scholars Publishing

Mapping *Technological Trajectories* in an *Açai Production Region* – Mocajuba, PA

Input Data:
TerraClass-2014 refined with RapidEye
Data Mining, Boosting 99



Confusion Matrix

Training Sample Error (0.0%)

```
 (a)   (b)   (c)   (d)   (e)   (f)    <-classified as
----  ----  ----  ----  ----  ----
  28                                   (a): class AgFamiliar1
        24                             (b): class ExtAgFamiliar2
              18                       (c): class Extrativismo
                    9                  (d): class Outros
                          18           (e): class Patronal
                                28     (f): class Transitorio
```

Test Samples Error (11.6%)

```
 (a)   (b)   (c)   (d)   (e)   (f)    <-classified as
----  ----  ----  ----  ----  ----
  11                             3     (a): class AgFamiliar1
        18                             (b): class ExtAgFamiliar2
   1     1    26                       (c): class Extrativismo
   1                5                  (d): class Outros
                          5     1      (e): class Patronal
   1                      2    11     (f): class Transitorio
```

The Malaria Landscapes:

Placing together

health,environment and development strategies

a *Typology* oriented by the *Productive Systems* in the Alto Juruá, Acre

Set of variables

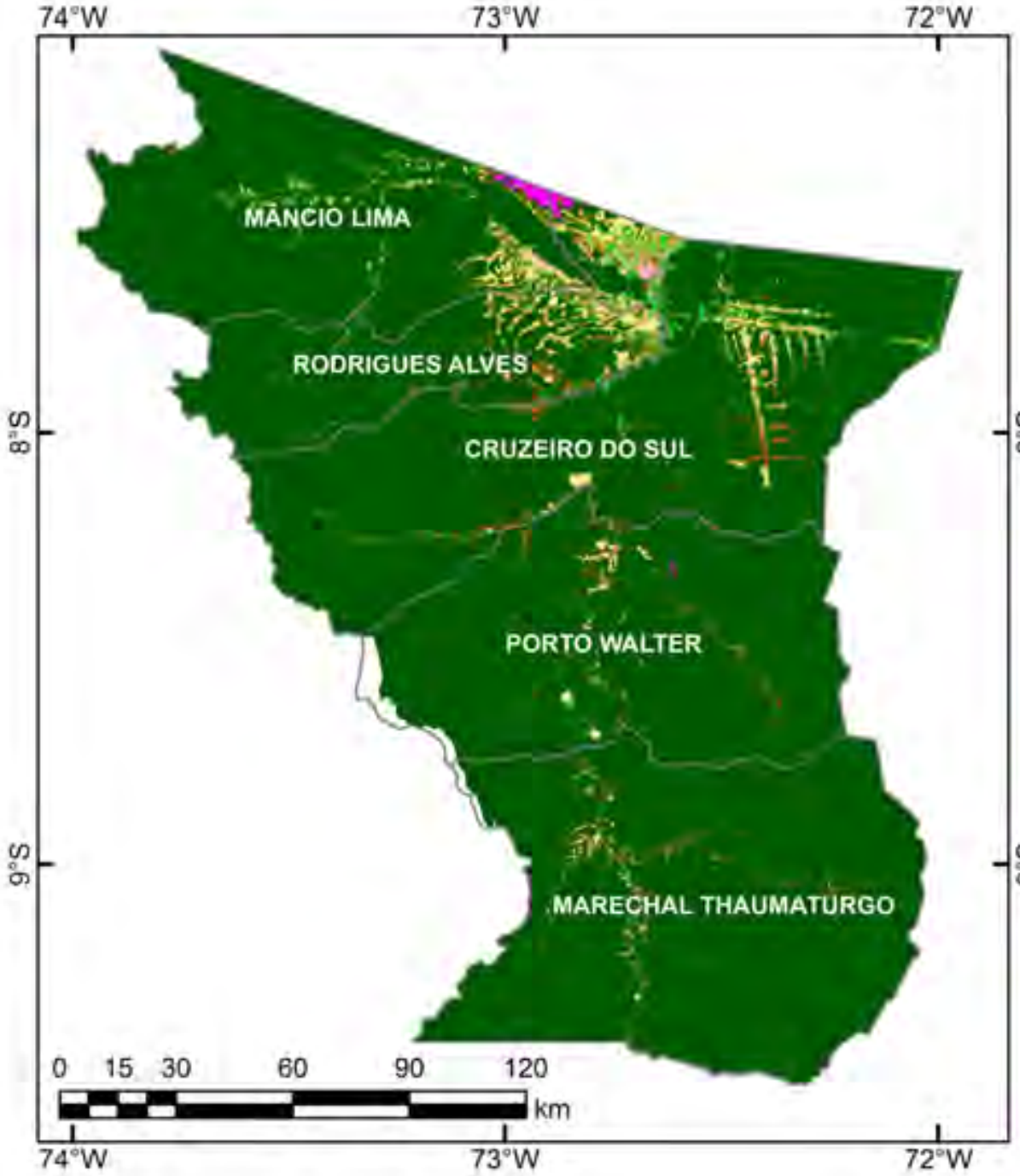
Variable/theme	Description	Source/ more information
Land use and land cover	% land use and land cover classes in the municipality	TerraClass (2014) - shapefile/ - matriz (30 x 30m)
Protected area	% protected area in the municipality	ICMBio or INCRA - spatial limits; - class (integral or sustainable use, indigenous area)
Settlements projects	Location of the settlements projects	INCRA - spatial limits; - creation date; - name and type (PA, PDS, PAE); - number of family; - area - implementation stage; Avaliable on: http://acervofundiario.incra.gov.br/acervo/acv.php
urban population	Ratio between urban population and the total population (state, municipality and census tract)	Population - Census 1991, 2000 and 2010 - spatial data
rural population	Ratio between rural population and the total population (state, municipality and census tract) (state, municipality and census tract)	
Sex ratio	Number of men for each group of 100 women (state, municipality and census tract)	
total dependency ratio	Ratio between the age group of the population defined as economically dependent (those under 15 years of age and those of 60 and over) and the potentially productive age group (between 15 and 59 years of age). (state, municipality and census tract)	
Age pyramid	Graph showing the distribution of the population in age groups (state, municipality)	
"rural" or "urban"	Official classification of what is rural and urban (municipal law). Census tract are classified in 8 levels (gradient of spatial forms) *spatial limits (census tract/ for all Brazil)	
Statistical grid	Total population per cell (resolution: 2km and 250m) Demographic density (conversion grid to raster - resolution: 250m)	Grid. Each cell has: - population/ - total of men/ - total of women Data from Census (2010)
Rural establishments engaged in fish farming	Ratio between rural establishments engaged in fish farming and the total rural establishments	Source: Censo Agropecuário (2006 and 2017 - preliminary data) Scales: region; state; municipality
Fish production	Production (tons)	Source: Censo Agropecuário (2006 and 2017 - preliminary data) Scales: region; state; municipality
Local participation in regional production of fish farming	Ratio between local production of fish farming and the regional production (for sale)	Source: Censo Agropecuário (2006 and 2017 - preliminary data)
Value of fish farming production in relation to temporary crops	Ratio between the value of fish farming production and the value of the temporary crops production. (2013 and 2016)	Scales: region, state, municipality Source: PPM (2013; 2016); PAM (2013; 2016) Declared data
Participation of fish farming in the GDP	Ratio between value of fish farming production in the GDP at current prices	Year: 2015 Scales: municipality Source: PPM and IBGE (GDP)
Rural establishments	Lot size	CAR - Cadastro Ambiental Rural - Spatial limits Declared data by the land owner
	Lot size	SIGEF - INCRA and MDA

Different and Heterougeneous Datasets

- Land use and land cover (TerraClass, 2014)
- Protected area (ICMBio, 2018)
- Population (Demographic Census 2010 – IBGE)
- Land structure (CAR – 2018; SIGEF – INCRA)
- Land production – Economy
  (Censo Agropecuário; PAM; PPM)
- Local Surveys (*when available*)

Alto Juruá Region

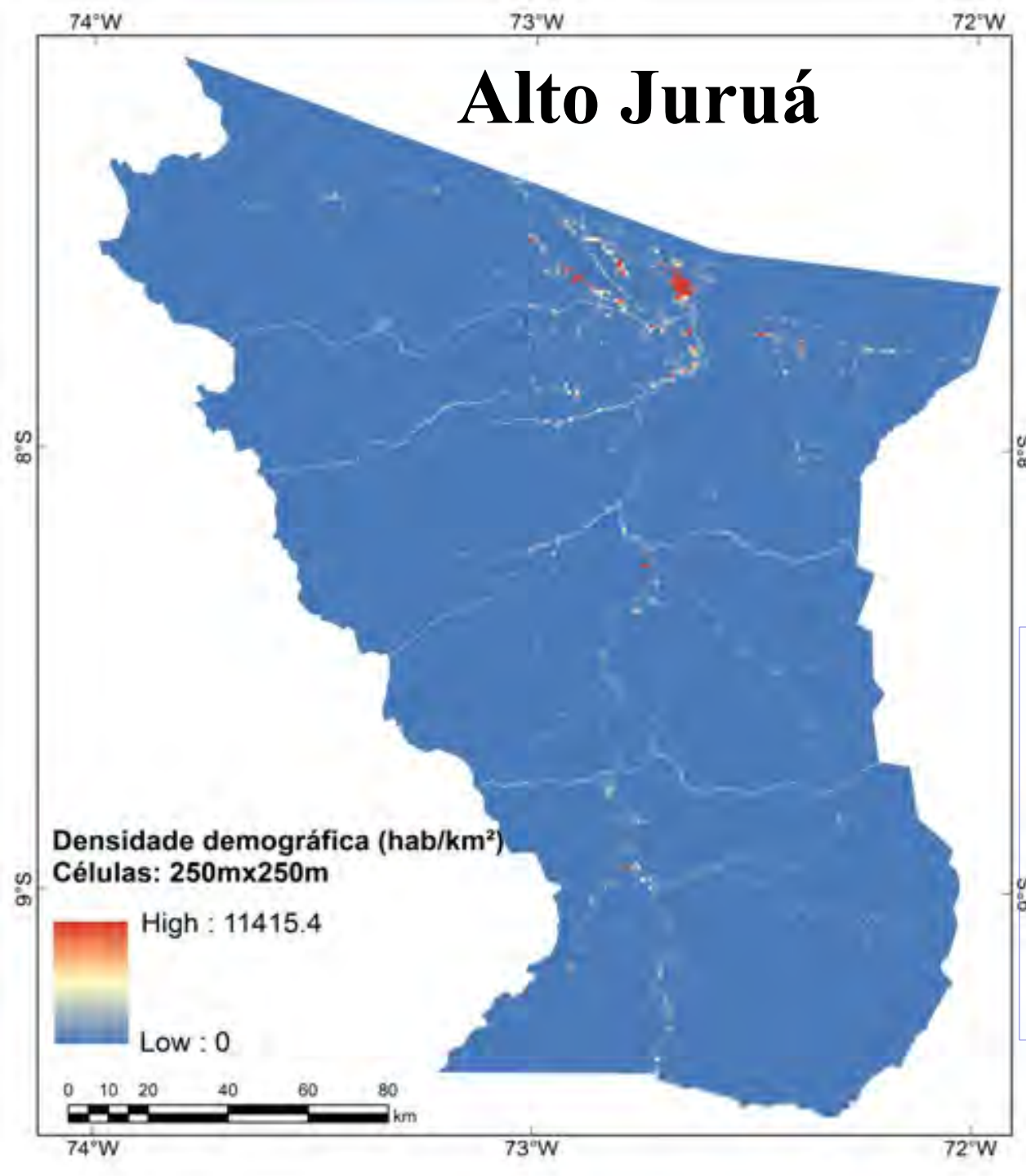
Micro-region of Cruzeiro do Sul, AC



Legend

- AGRICULTURA_ANUAL
- AREA_NAO_OBSERVADA
- AREA_URBANA
- DESFLORESTAMENTO
- FLORESTA
- HIDROGRAFIA
- MINERACAO
- MOSAICO_DE_OCUPACOES
- NAO_FLORESTA
- OUTROS
- PASTO_COM_SOLO_EXPOSTO
- PASTO_LIMPO
- PASTO_SUJO
- REFLORESTAMENTO
- REGENERACAO_COM_PASTO
- VEGETACAO_SECUNDARIA

Data TerraClass - 2014



Demographic Density

From Datasase:
Statistical Population Grid
Cells: [1km x 1km]
rural areas
[25m x 250m]
urban areas

Demographic Density (hab/km²)
Cells: [250m x 250m]
Conversion: *grid to raster*

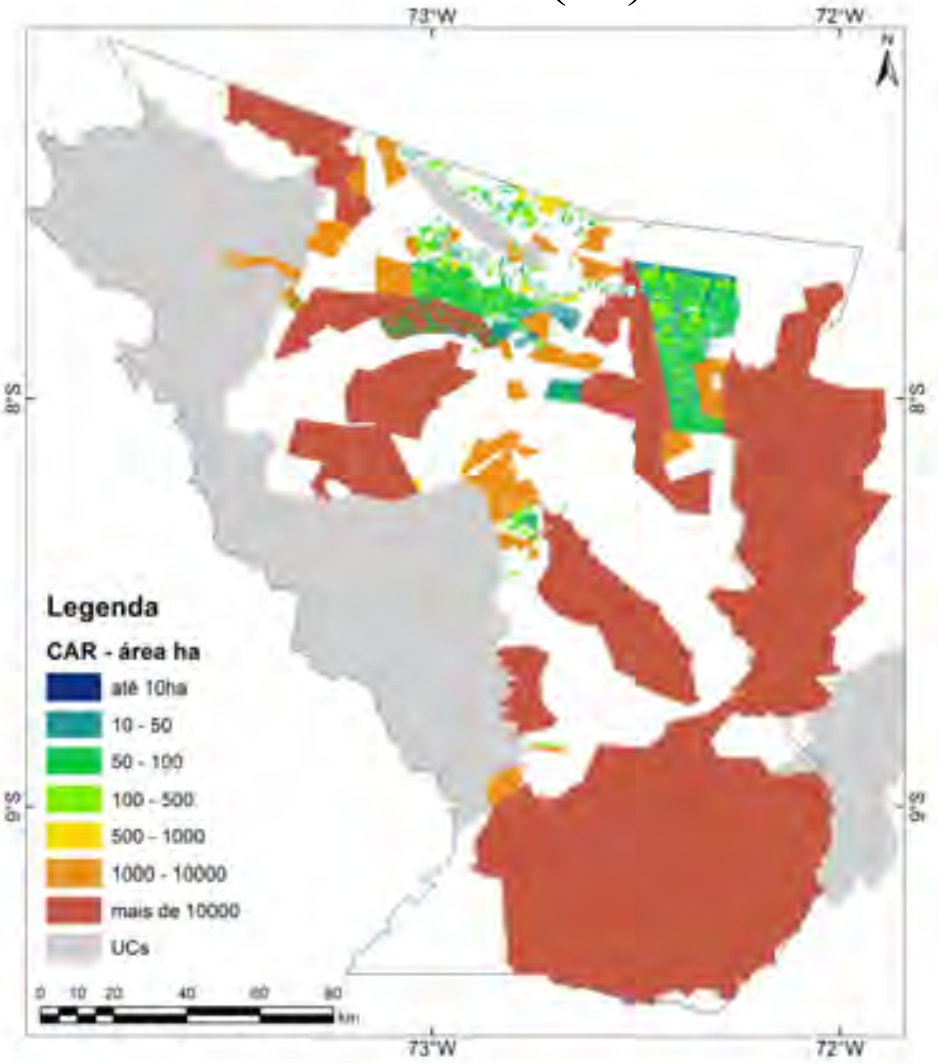
Database Producer:
Censo demográfico 2010, IBGE

Census Data, IBGE - 2010

CAR – Cadastro Ambiental Rural *(Cadastre de l'environnement rural ??)*

Lots CAR - UC

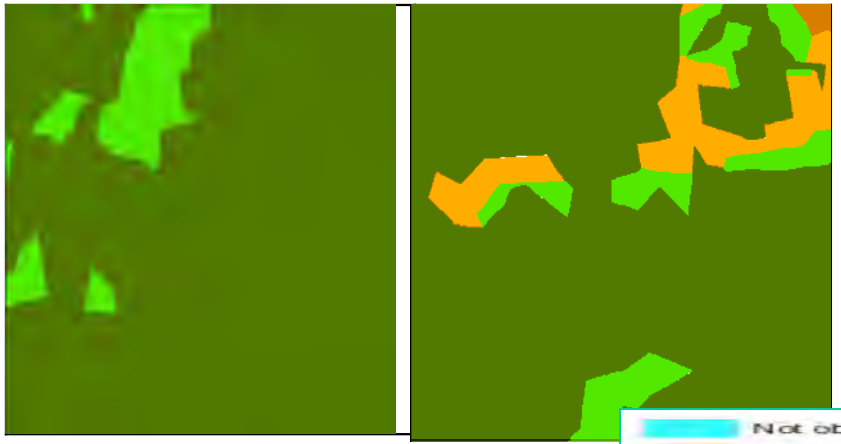
Lots CAR – area (ha)



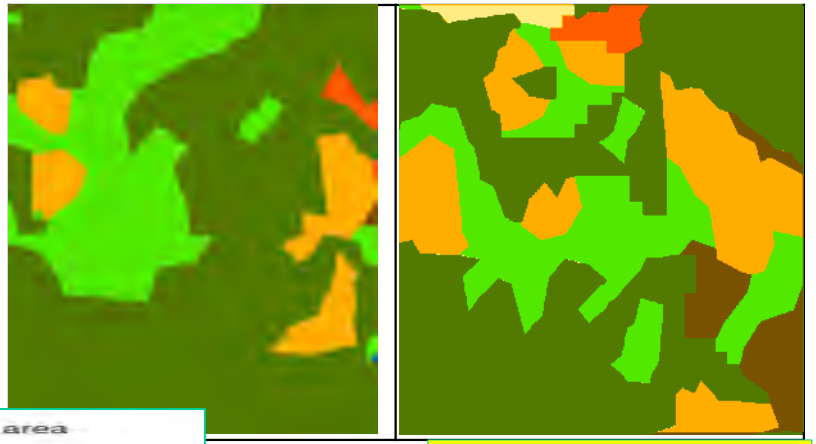
Source: SICAR

CAR Data, SICAR – Serviço Florestal Brasileiro

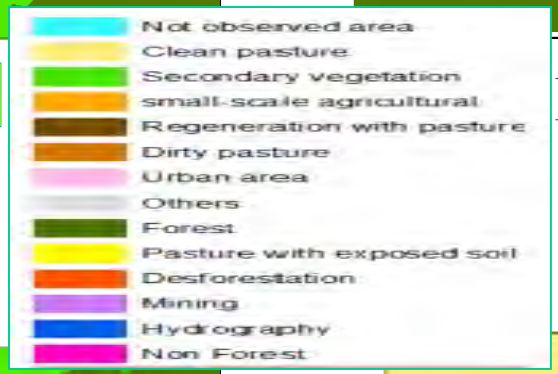
LPU *Typology* – *Landscape Production Units* for Juruá

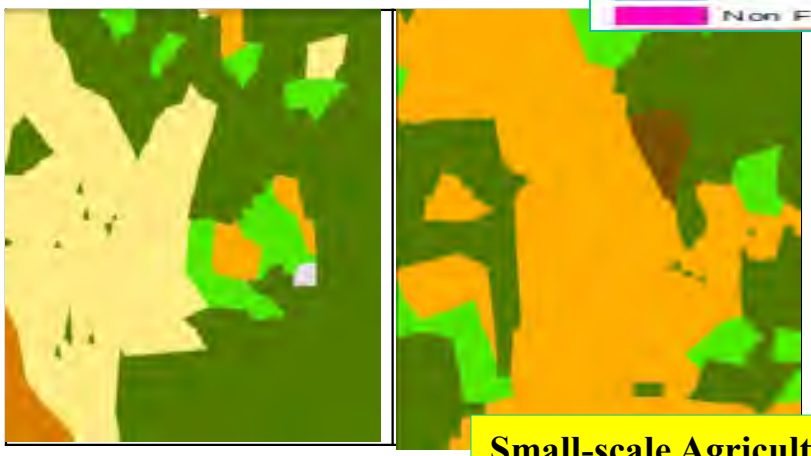


LPU 1 **Extractivist**

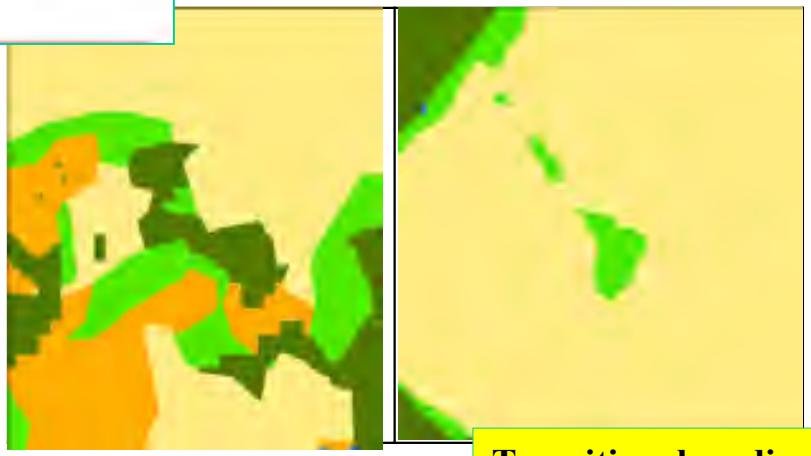


LPU 2 **Small-scale Transitional Frontier Agricultural System**



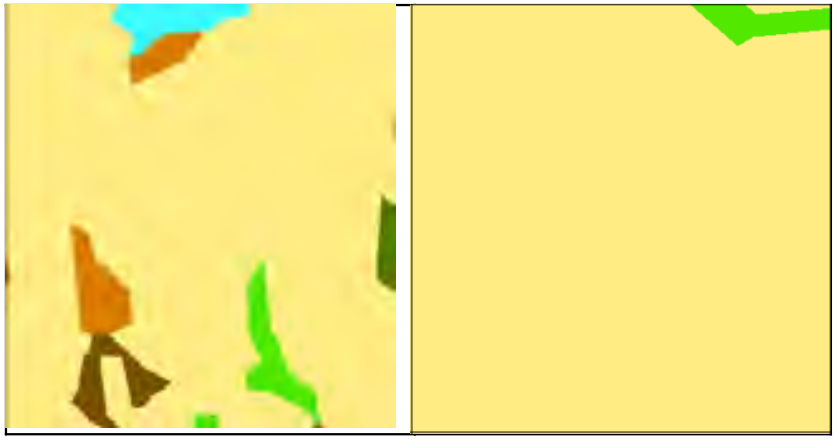


LPU 3 **Small-scale Agricultural System**



LPU 4 **Transitional medium-scale agriculture**

LPU – *Landscape Production Units* for Juruá



LPU 5

Large Farmers

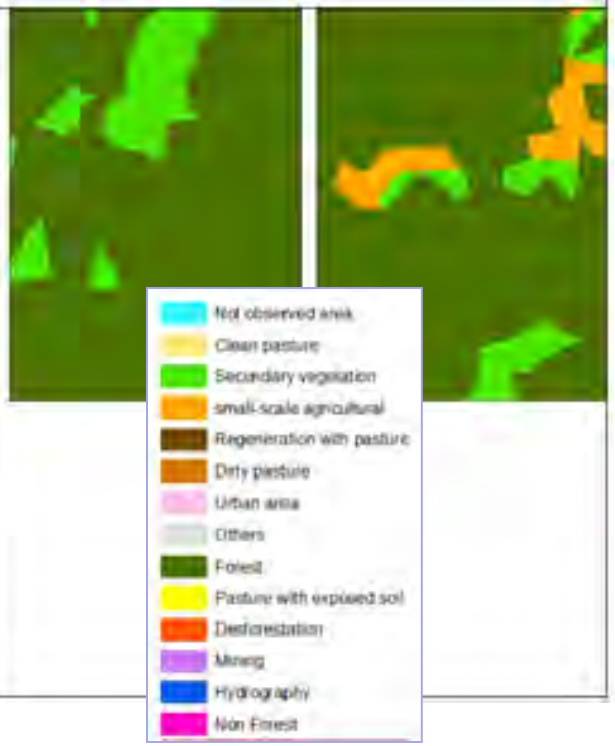
LPU 6

Urban Fringe

- Not observed area
- Clean pasture
- Secondary vegetation
- small-scale agricultural
- Regeneration with pasture
- Dirty pasture
- Urban area
- Others
- Forest
- Pasture with exposed soil
- Desforestation
- Mining
- Hydrography
- Non Forest

LPU 7

City

PLU	Description	Landscape Composition	Landscape Pattern
PLU 1 Extrativista **Extractivist**	The *rivers* and the *forest* are the fundamental *natural common resources* for the *Life Support System* of the population groups living in these units. In addition, the land - especially for manioc production - is also an important element. In general, the land is collective. ***Actors***: Riverine and traditional occupation ***Activities***: Extractivism combined with a shifting **cultivation** subsistence farming system and subsistence livestock. Complementary Fishing and Hunting. ***Land Structure:*** Collective land system or small parcels (without a title of land ownership), in general, *without* strict limits. The Life Support System is dependent on significant forest areas. Occupation along the rivers. Unimodal Mainly - by the fluvial network.	Extensive and continuous patches of forest; isolated fragments of secondary vegetation; there may or may not be the presence of rivers and isolated patches of small-scale agriculture	

PL4 Agricultura de média escala transitório **Transitional medium-scale agriculture**	The *land* for medium-scale agriculture or medium scale livestock in extensive breeding managment is the fundamental resource. The crops, when present, is for the production of cattle (cattle feed). A more *homogeneous* landscape cover mosaic. The *market forces*, at a local and regional scale, is the main operator at these units and the fundamental component in the decision making cycle of the *household* units. ***Actors*:** medium farmers ***Activities*:** Medium scale agriculture or medium scale livestock in extensive breeding management oriented to Beef production. Fish farming (large fish farmers - owners with several fish ponds) can be carried out combined with cattle breeding activities. ***Land Structure*:** intermediate parcels due to the aggregation of other lots (purchase or acquisition - between 100ha and 400ha - up to 4 módulos fiscais). There is no collective land. Mainly Modal - by the road network.	Extensive and dense patches of clean grass; small and isolated fragments of forest and secondary vegetation; in some landscapes isolated small-scale farming plots may occur.		
PLU 5 Grandes produtores/fazendeiros **Large Farmers**	The *land* for large scale livestock in extensive breeding managment or as a reserve of value (speculation) is the fundamental resource. A terra, utilizada para a pecuária de larga escala em manejo extensivo de criação ou como reserva de valor (especulação) é o recurso fundamental. Forest cover, in general, is no longer present and agriculture, when present, is for the production of cattle (cattle feed). The landscape, in general, is homogeneous composed of pastures or regeneration (in cases of land as a reserve of value). ***Actors*:** More capitalized farmers. ***Activities*:** large scale livestock in extensive breeding management oriented to Beef production. Production flow depends on a road network with good traffic conditions and Port infrastructure. ***Land Structure*:** Large parcelss due to the *aggregation* of other lots by *land* purchase backed by a bank (public or private) finance line. *In general above 400ho*. There is no *collective land*. Low to intermediate *occupancy density*, generally	Extensive, continuous and dense patches of clean pasture; few isolated fragments of secondary vegetation; isolated patches of dense grass and regeneration with grass can run in the landscape.		

Troisième partie:

Besoin/Demande en Produits Spatialisés

Quatrième partie:

Pour Produire quels Resultáts

Results and Products that can Bridge the Gap between *Research* and *Services* in **Public Health Operational Programs**

Health Surveillance Secretary

National Level

State Level

Level

M

Although, **free tools**, **free data** and **free knowledge** are important parts of building these **bridges**, the essential and most difficult one is …

Peopleware

+

Long standing financed Institutional Networks!

Santa Cruz do Capibaribe, PE. Réunion de mobilisation avec des agents de santé communautaires et action avec les écoles. Lancement du programme de lutte antivectorielle (Dengue). Méthodologies intégrées *paysage-territoire* dérivées du réseau SAUDAVEL

Merci!

Foto: Isabel Escada, Baixo Tocantins, Mocajuba, PA