



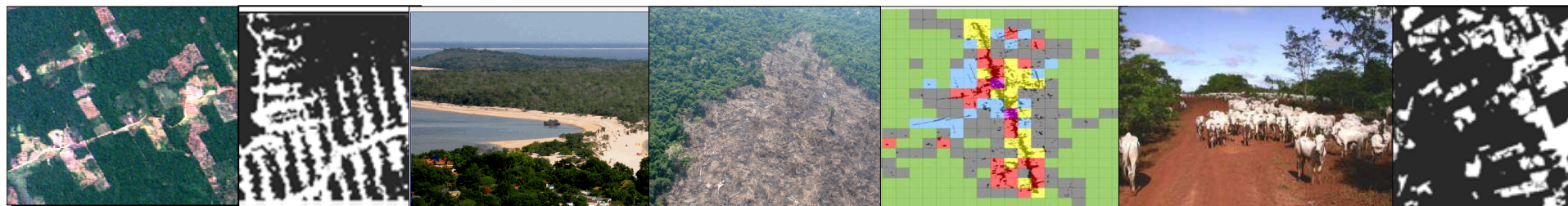
MINISTÉRIO DA CIÊNCIA E TECNOLOGIA
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

VII SEMINÁRIO TÉCNICO CIENTÍFICO DE ANÁLISE DOS DADOS DO DESMATAMENTO
Brasília, 20 a 21 de maio de 2010.

Análise da Expansão da Fronteira Agropecuária da Amazônia

1997 a 2009

Maria Isabel S. Escada
isabel@dpi.inpe.br





Novas Fronteiras da Amazônia

(Becker, 2004;2005)

- Anos 70/80 - Fronteira induzida pelo Estado. Objetivo: expandir a economia e promover o povoamento para a integrar a Amazônia com as regiões sul e sudeste.
- Final do anos 90 - a Fronteira induzida principalmente por interesses econômicos privados avançando em diferentes regiões da Amazônia.

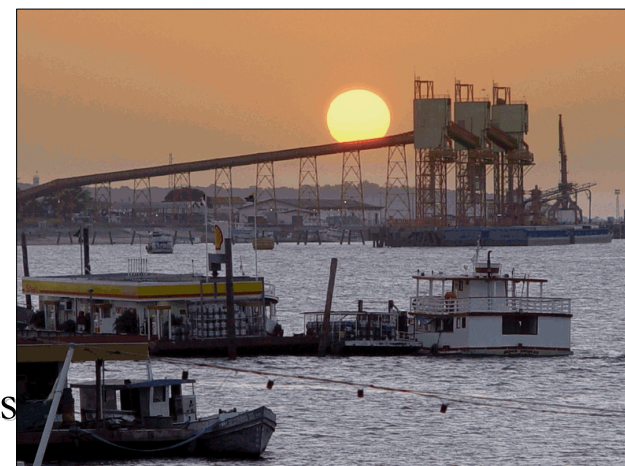


Novas Fronteiras da Amazônia

(Becker, 2004;2005)

Características da fronteira do século XXI:

- Maior conectividade e acesso
- Ativada por diferentes atores com capital privado:
 - Agroindústria: Soja, pecuária, Mercado de terras Milho, Cana;
 - Expectativa da construção de novas redes de transporte;
- Frentes Localizadas

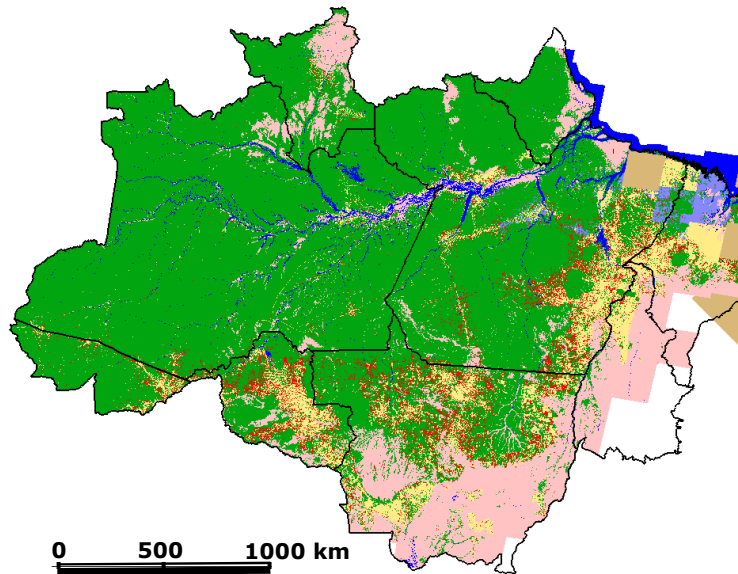
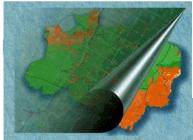


Santarém, PA – Porto graneleiro da Cargill 2005. Foto: Carlos Stefen

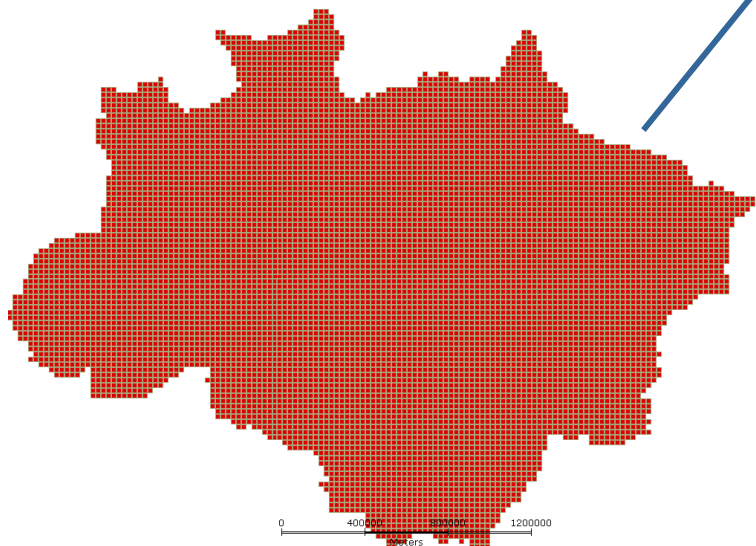


Expansão da Fronteira Agropecuária da Amazônia

- Explorar hipóteses das fronteiras da Amazônia observando sua aderência em relação à dinâmica regional e local, a partir dos dados de desmatamento (1997 a 2009).
 - Em escala regional (células com resolução de 25 X 25 km);
 - Em escala local - Análise de Padrões de Desmatamento.
Estudo de caso: A região de São Félix do Xingu



<http://www.obt.inpe.br/prodes/>



<http://www.dpi.inpe.br/terralib/>

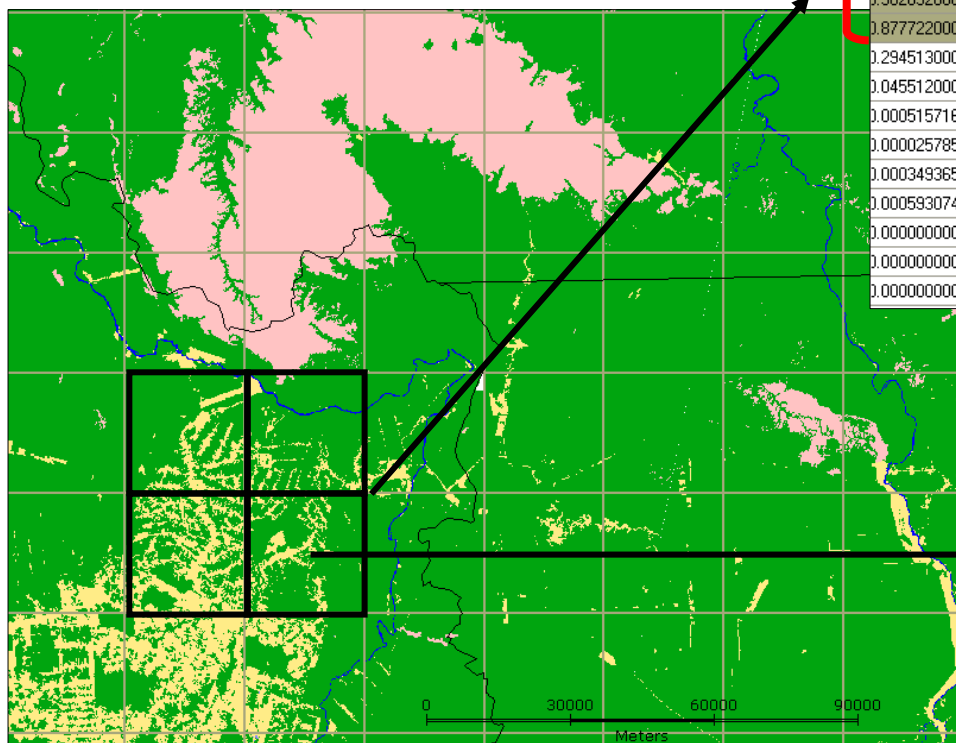
Ferramentas e Dados utilizados

- **SPRING – Dados Prodes 1997- 2009 Mosaicos. (Res. Espacial = 120 m)**
- **Banco de dados celular – 25 X 25 Km e 10 X 10 km - TerraView/TerraLib.**
- **Indicadores de Desmatamento (Padrões)**
 - **Incremento por período (%):**
 - 1997 a 2000
 - 2000 a 2003
 - 2003 a 2006
 - 2000 a 2006
 - 2000 a 2009
 - **Desmatamento acumulado (%):**
 - Até 1997
 - Até 2000
 - Até 2003
 - Até 2006
 - Até 2009

Preenchimento de células

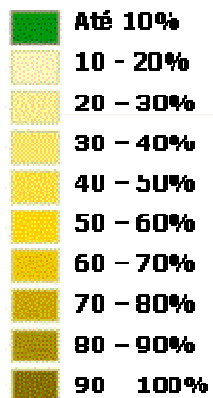
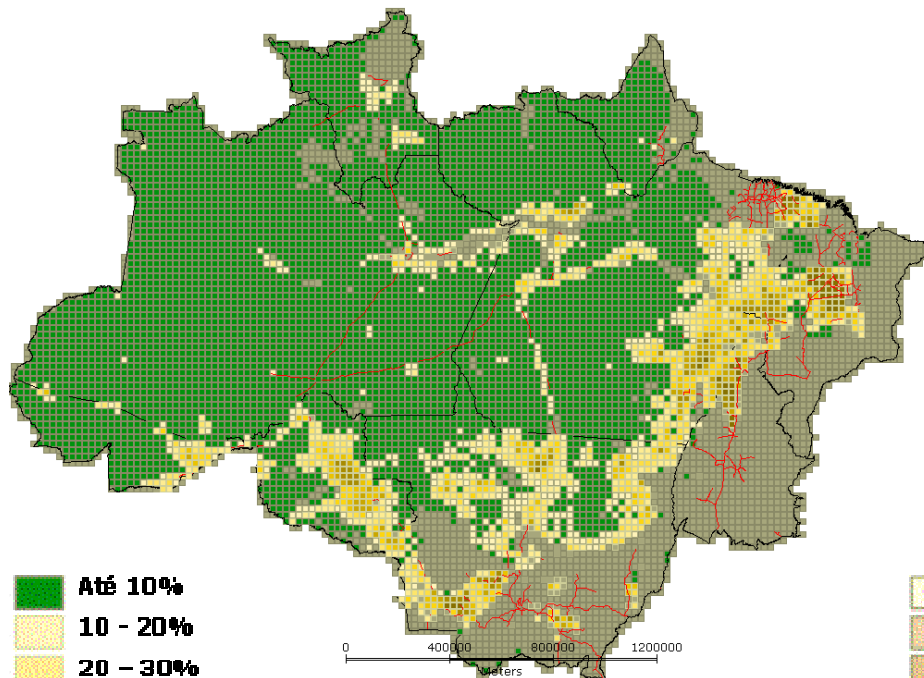
- Porcentagem de cada classe

acum2003_0	acum2003_3	acum2003_6	acum2003_4	acum2003_8	acum2003_5	acum2003_7
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0.000038678700000	0.975387000000000	0.000000000000000	0.003313480000000	0.021260400000000	0.000000000000000	0.000000000000000
0.000747789000000	0.975774000000000	0.000000000000000	0.003339260000000	0.020138700000000	0.000000000000000	0.000000000000000
0.000142334000000	0.997179000000000	0.000000000000000	0.000000000000000	0.002678470000000	0.000000000000000	0.000000000000000
0.000077357500000	0.981383000000000	0.000000000000000	0.000090250400000	0.018449800000000	0.000000000000000	0.000000000000000
0.000000000000000	0.999446000000000	0.000000000000000	0.000000000000000	0.000554395000000	0.000000000000000	0.000000000000000
0.402375000000000	0.597548000000000	0.000000000000000	0.000000000000000	0.000077357500000	0.000000000000000	0.000000000000000
0.994514000000000	0.005486330000000	0.000000000000000	0.000000000000000	0.000000000000000	0.000000000000000	0.000000000000000
0.902852000000000	0.097148100000000	0.000000000000000	0.000000000000000	0.000000000000000	0.000000000000000	0.000000000000000
0.877722000000000	0.115912000000000	0.000000000000000	0.000116455000000	0.001449220000000	0.004800540000000	0.000000000000000
0.294513000000000	0.695727000000000	0.000000000000000	0.000000000000000	0.002797760000000	0.006962170000000	0.000000000000000
0.045512000000000	0.946365000000000	0.004499630000000	0.000000000000000	0.000000000000000	0.003622910000000	0.000000000000000
0.000515716000000	0.977296000000000	0.002501220000000	0.000012892900000	0.018913900000000	0.000760682000000	0.000000000000000
0.000025785800000	0.999923000000000	0.000000000000000	0.000000000000000	0.000051571600000	0.000000000000000	0.000000000000000
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0.000593074000000	0.999407000000000	0.000000000000000	0.000000000000000	0.000000000000000	0.000000000000000	0.000000000000000
0.000000000000000	1.000000000000000	0.000000000000000	0.000000000000000	0.000000000000000	0.000000000000000	0.000000000000000
0.000000000000000	0.998981000000000	0.000000000000000	0.000000000000000	0.001018540000000	0.000000000000000	0.000000000000000
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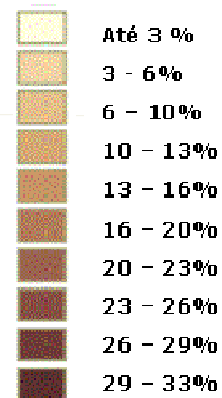
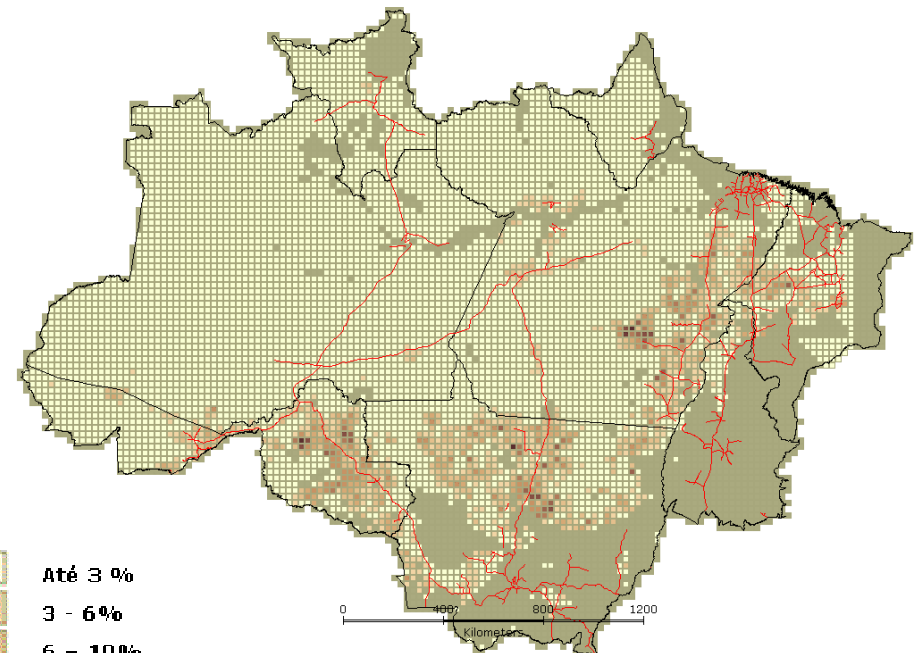
625 km²

Análise de padrões de desmatamento



1997

■ Nuvem, rios, não floresta

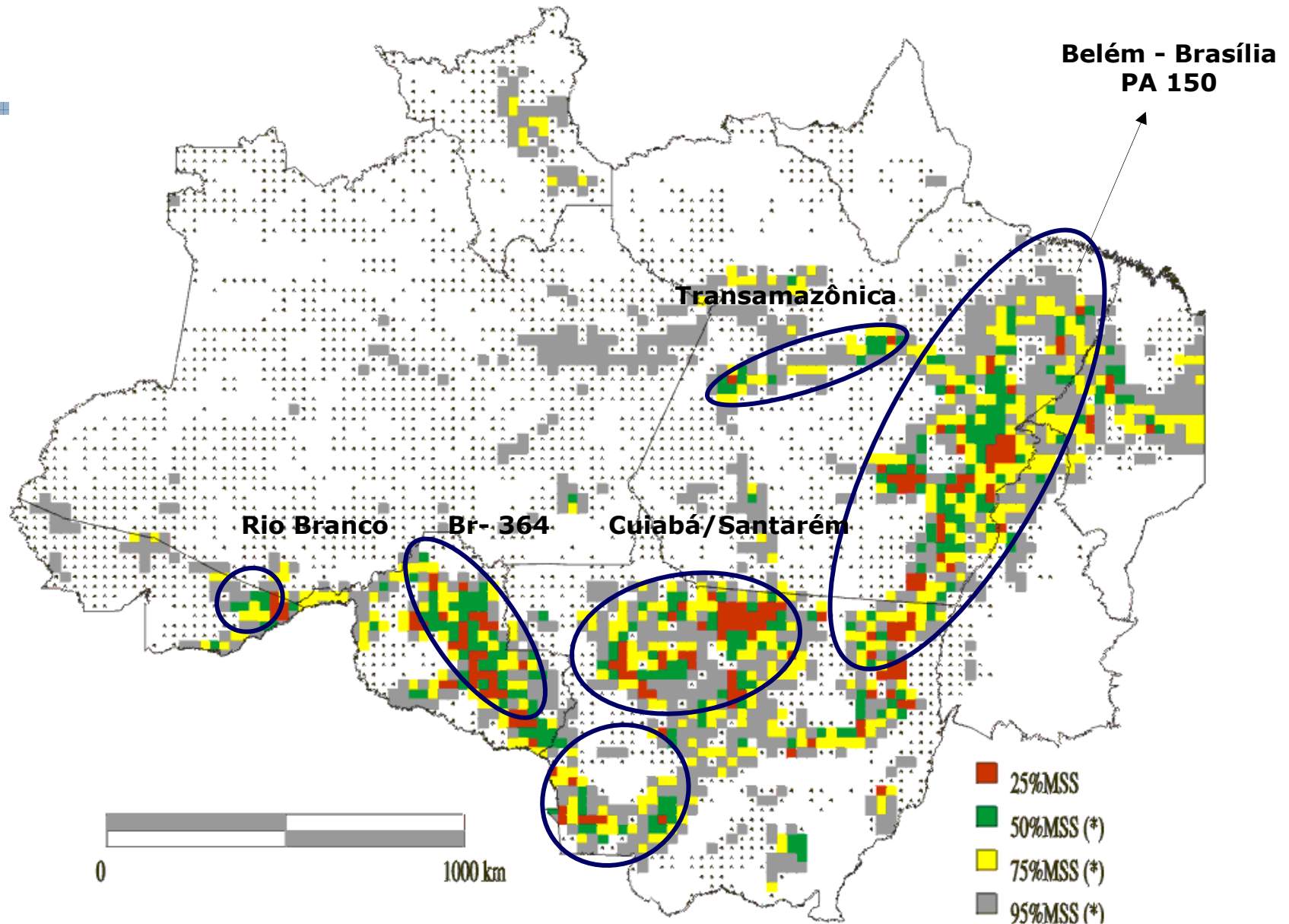


1997 a 2000

■ Nuvem, rios, não floresta

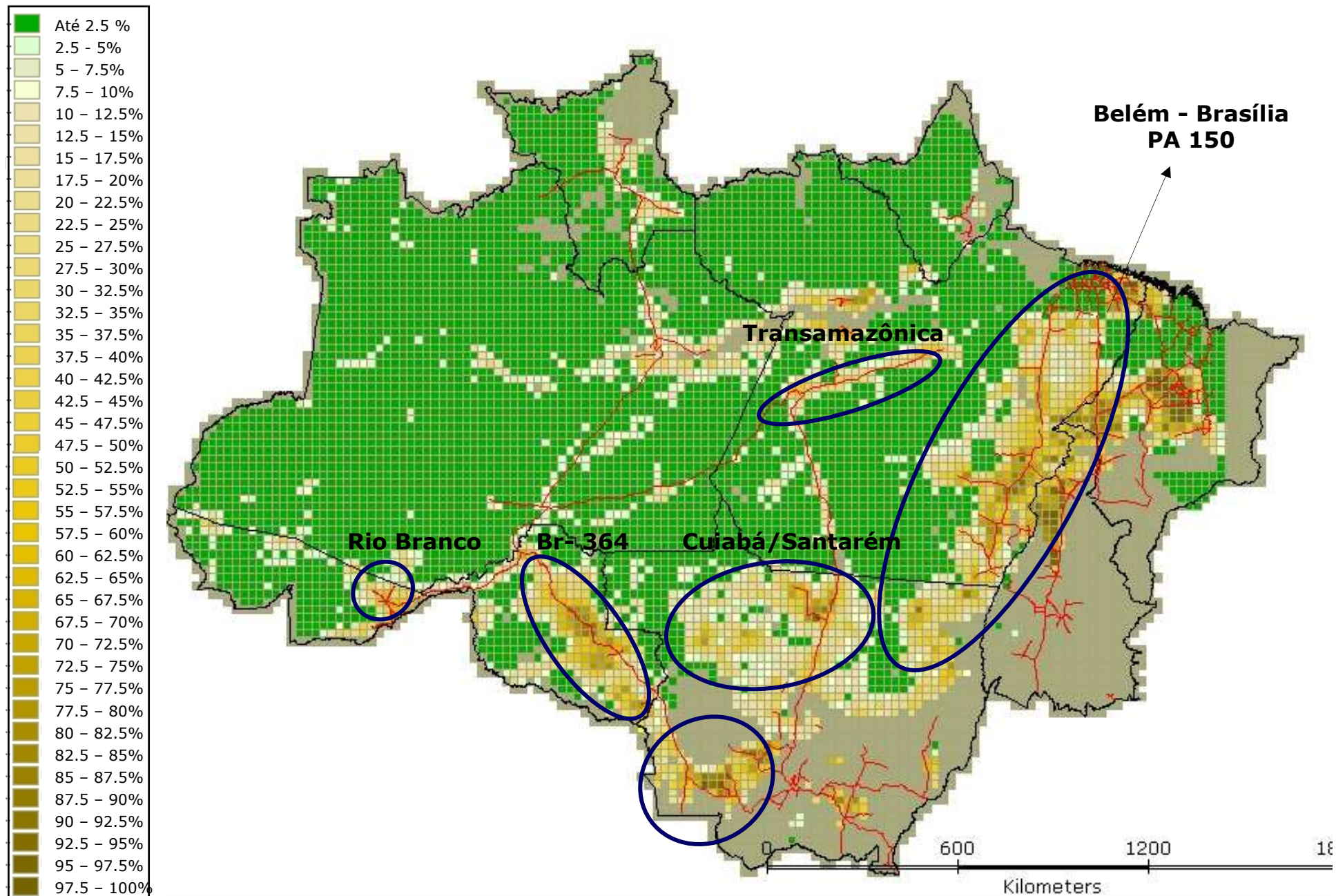


Legal Amazônia 1991-1996 Deforestation

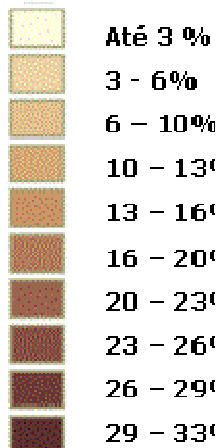
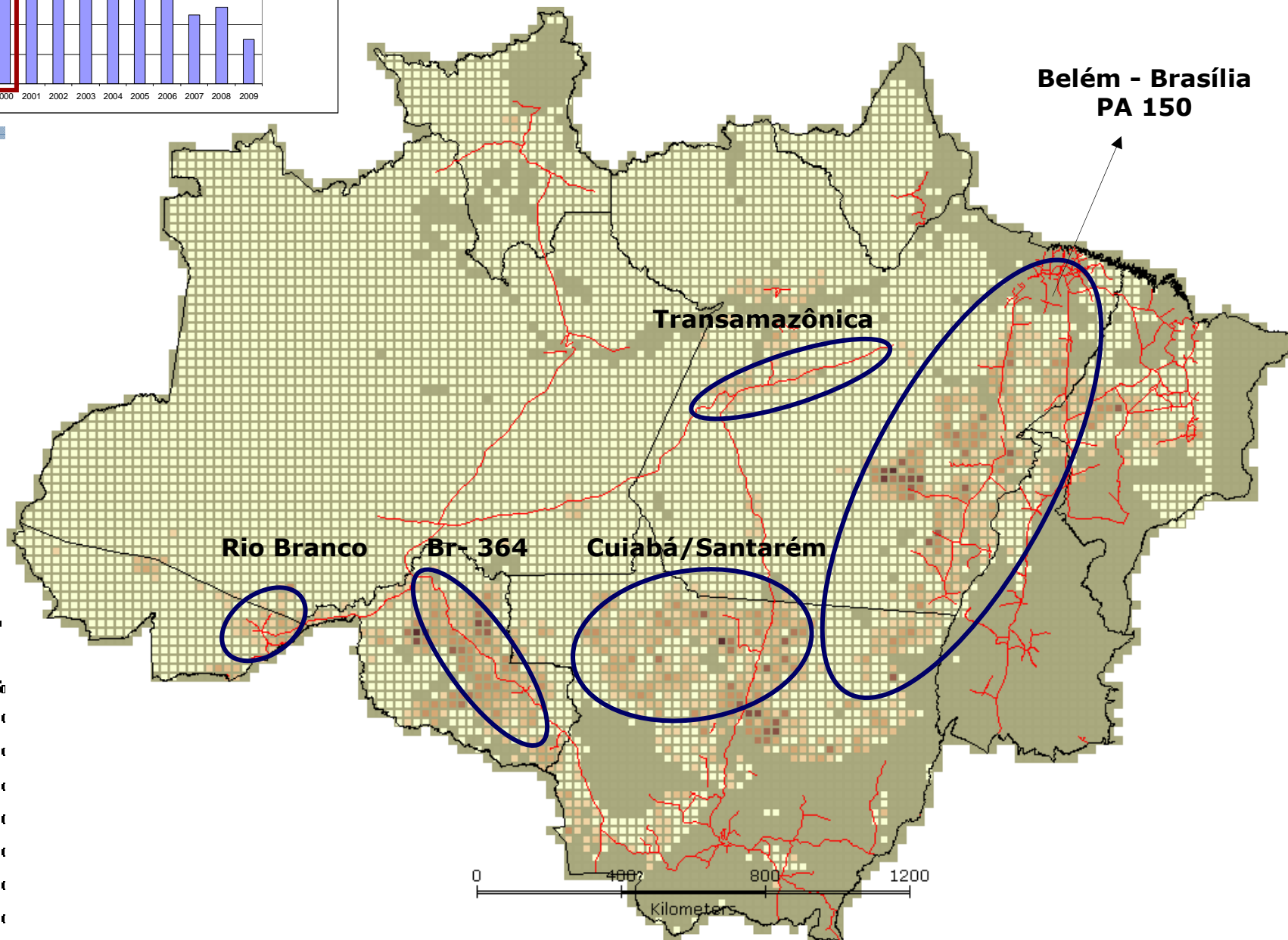
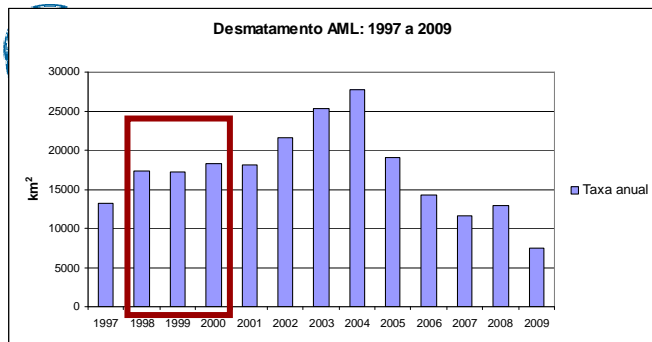




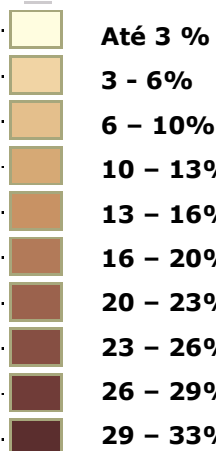
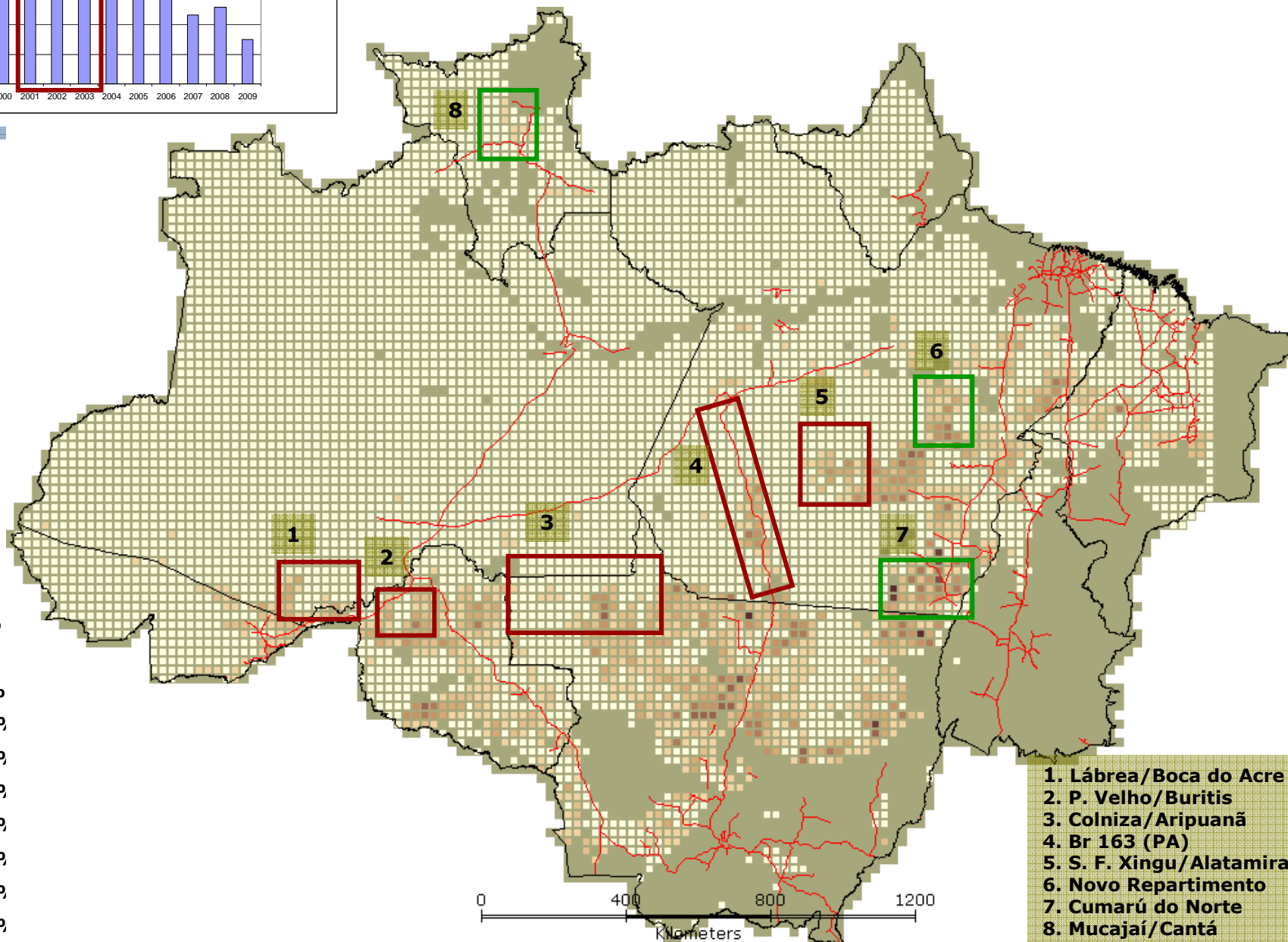
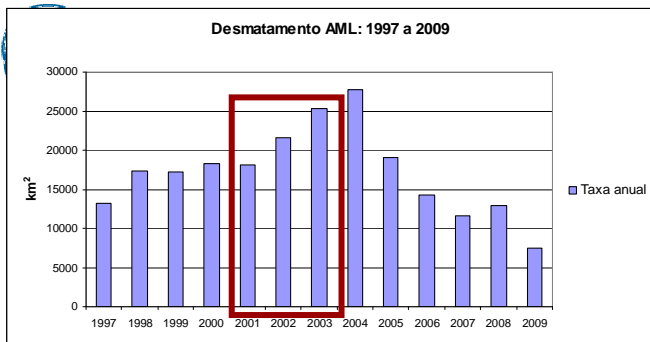
Desmatamento Acumulado - 1997



Incremento - 1997 a 2000

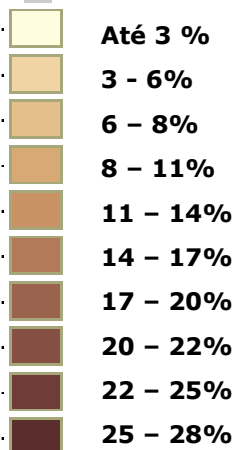
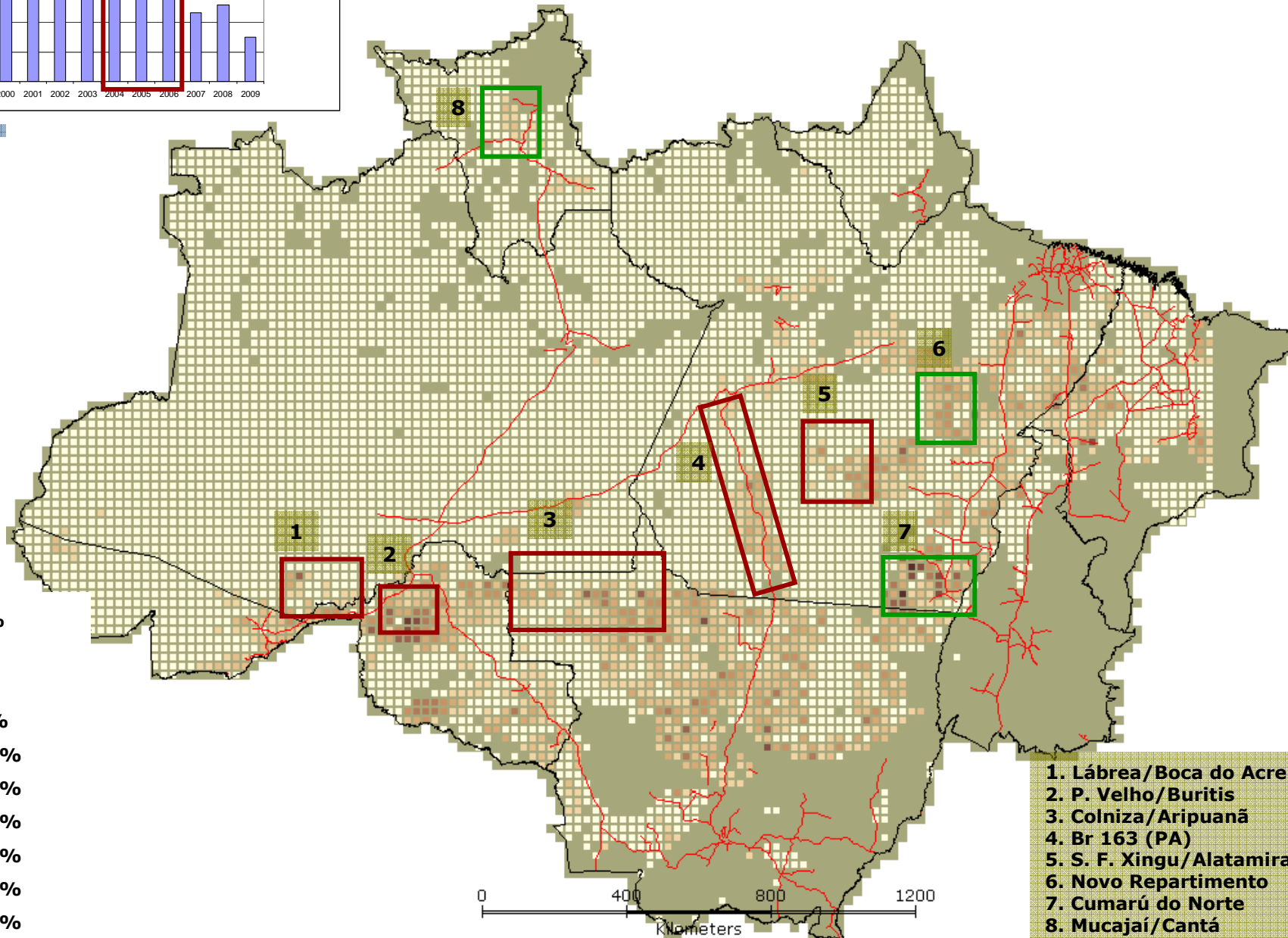
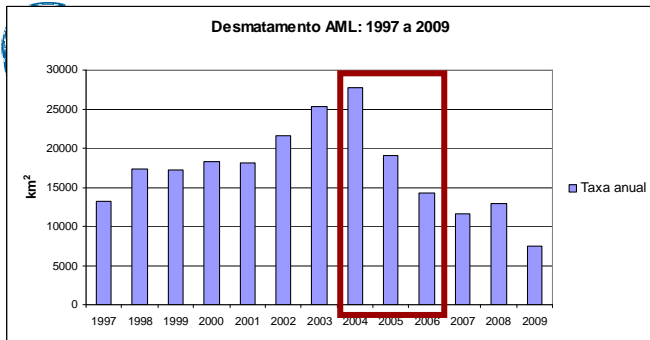


Incremento – 2000 a 2003



1. Lábrea/Boca do Acre
2. P. Velho/Buritis
3. Colniza/Aripuanã
4. Br 163 (PA)
5. S. F. Xingu/Alatamira
6. Novo Repartimento
7. Cumarú do Norte
8. Mucajaí/Cantá

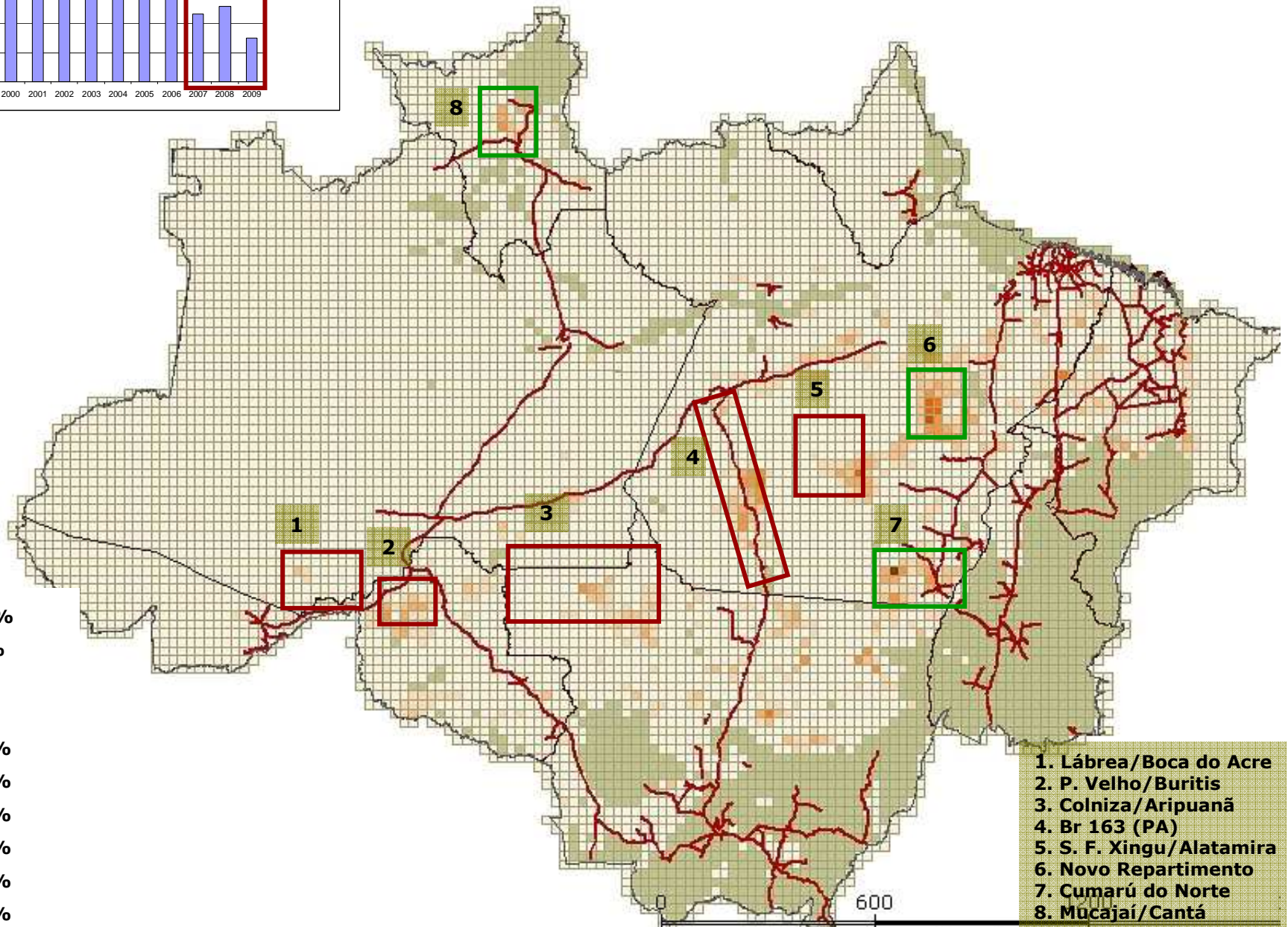
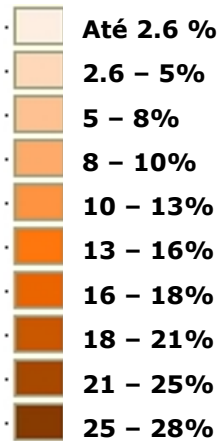
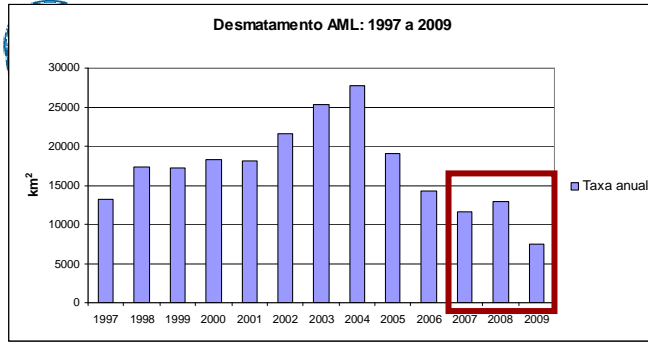
Incremento – 2003 a 2006



- 1. Lábrea/Boca do Acre
- 2. P. Velho/Buritis
- 3. Colniza/Aripuanã
- 4. Br 163 (PA)
- 5. S. F. Xingu/Alatamira
- 6. Novo Repartimento
- 7. Cumarú do Norte
- 8. Mucajaí/Cantá



Incremento – 2006 a 2009

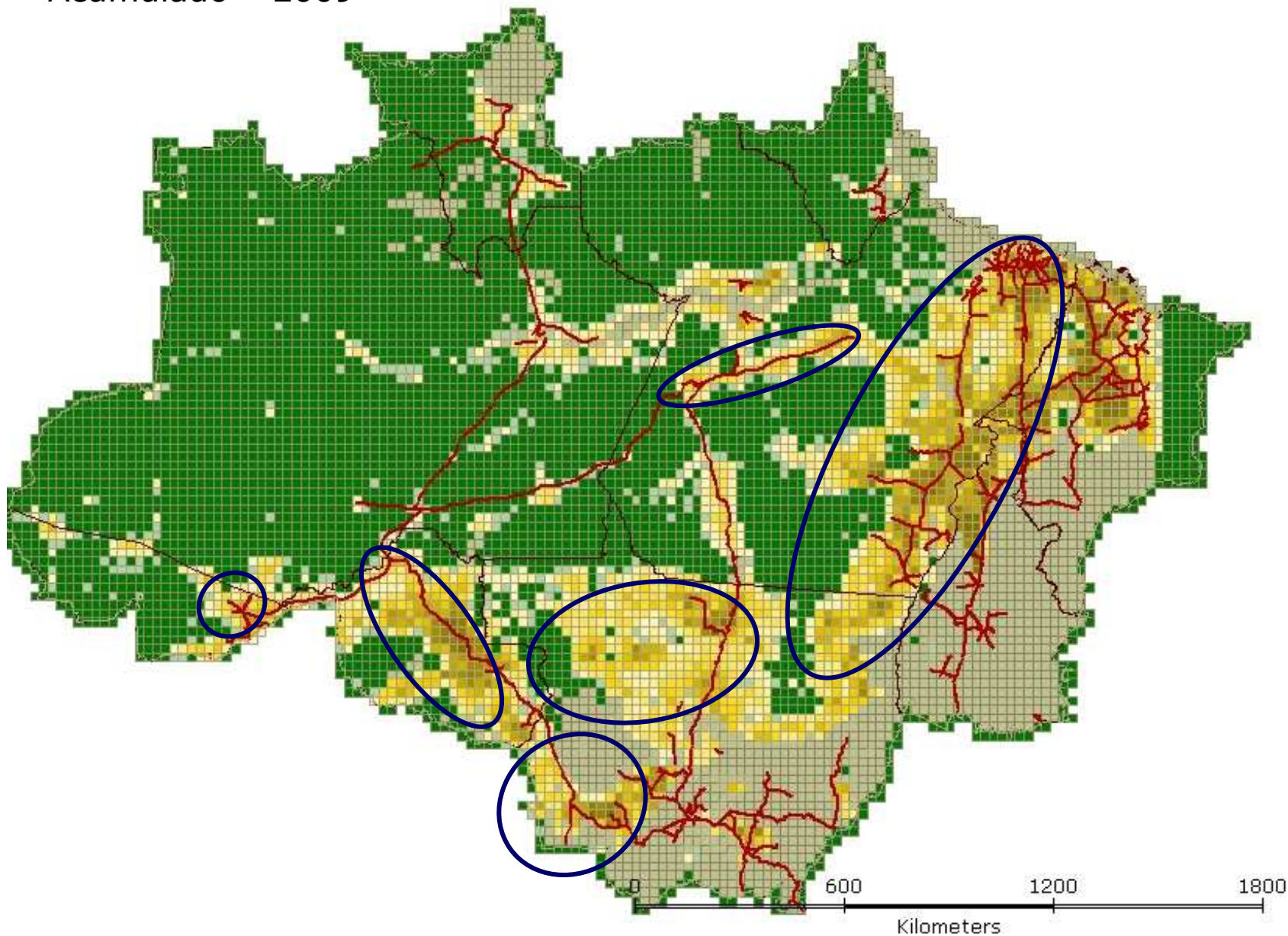
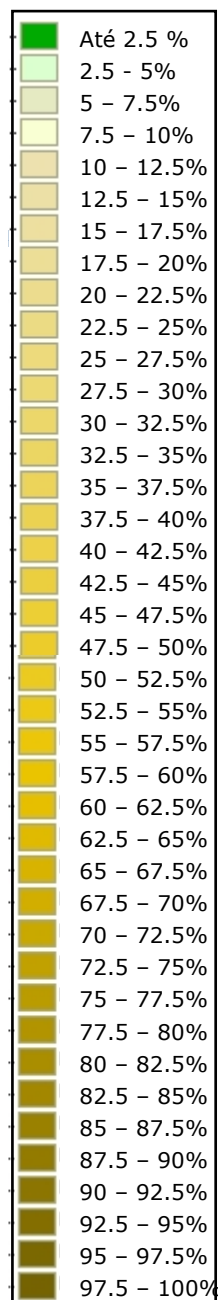


1. Lábrea/Boca do Acre
2. P. Velho/Buritis
3. Colniza/Aripuanã
4. Br 163 (PA)
5. S. F. Xingu/Alatamira
6. Novo Repartimento
7. Cumarú do Norte
8. Múcajaí/Cantá



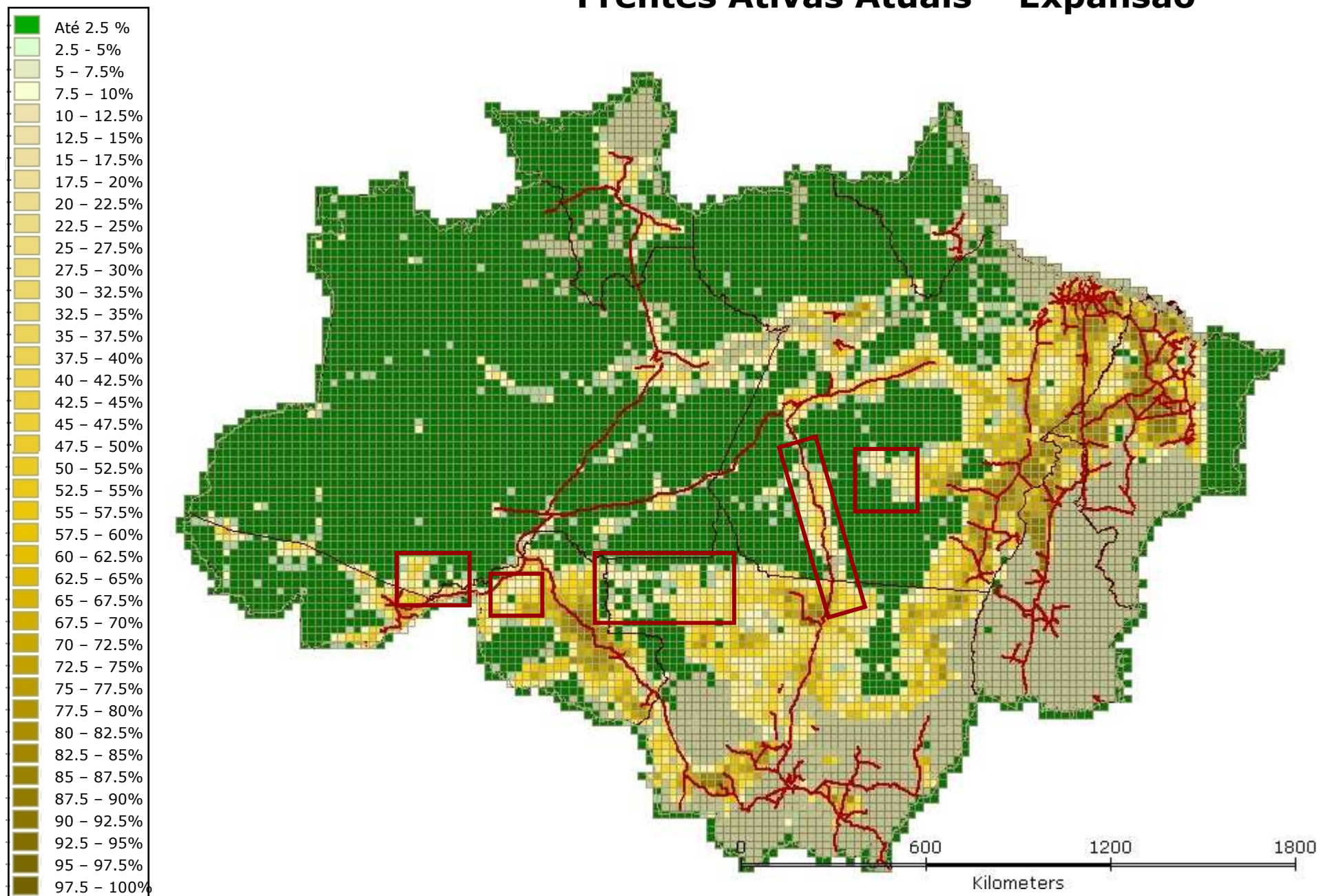
A Fronteira agrícola dos anos 60 - 80 Consolidação: intensificação do desmatamento e da ocupação

Desmatamento
Acumulado - 2009



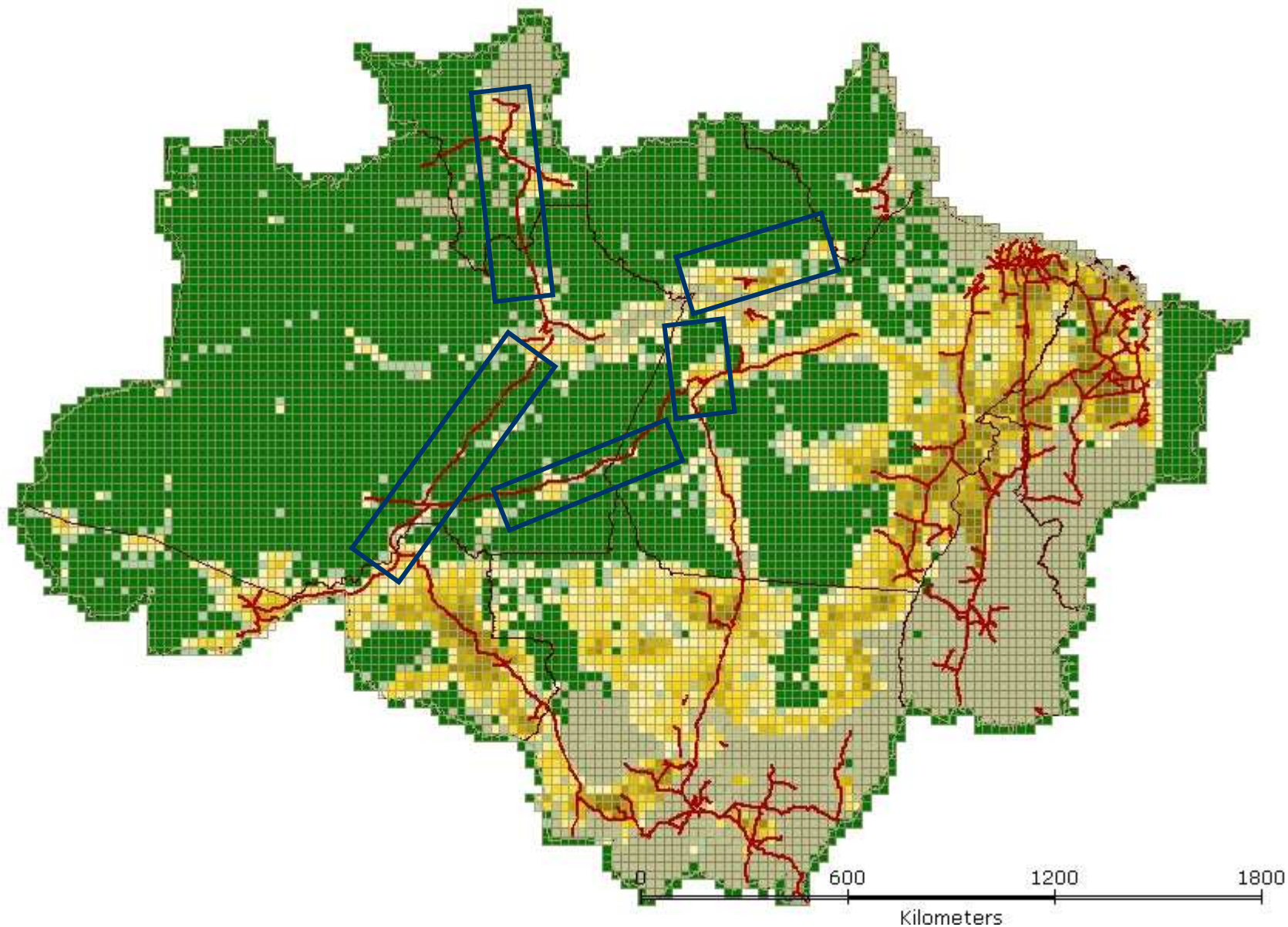
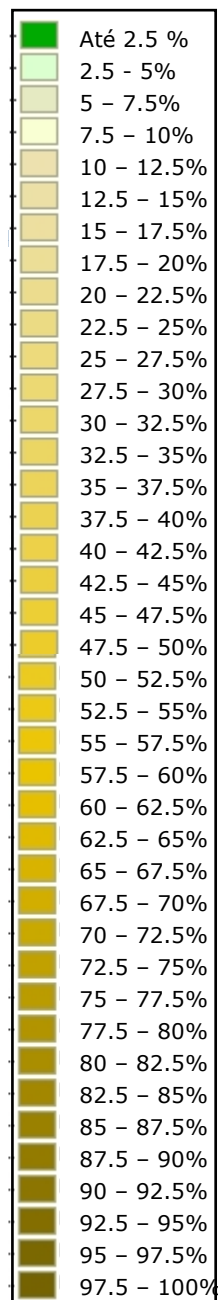


Desmatamento Acumulado 2009 – Frentes Ativas Atuais – Expansão





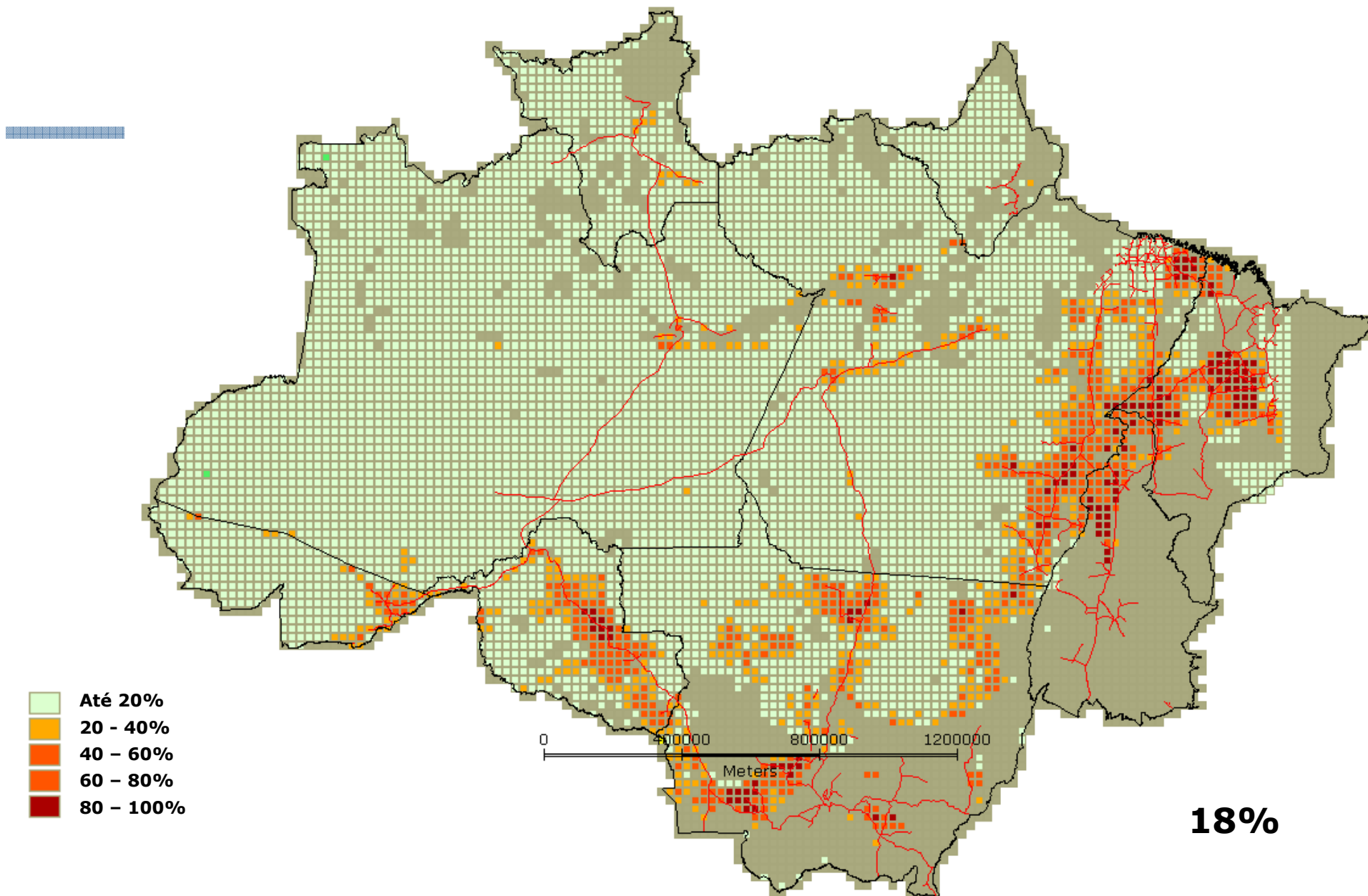
Desmatamento Acumulado 2006 – Frentes Potenciais





Reserva Legal- 1997

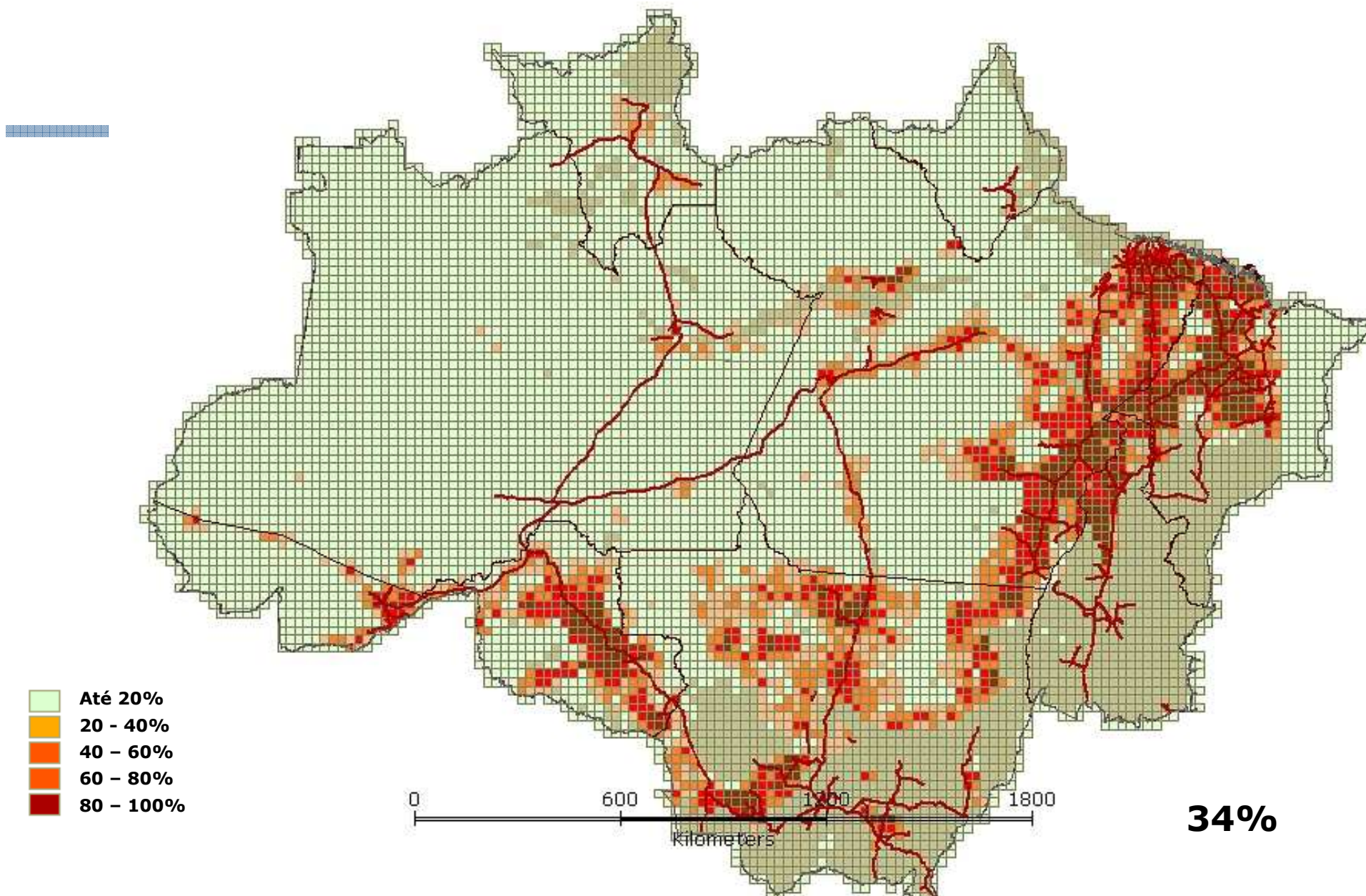
Medida Provisória nº 2.166-67, de 24 de agosto de 2001





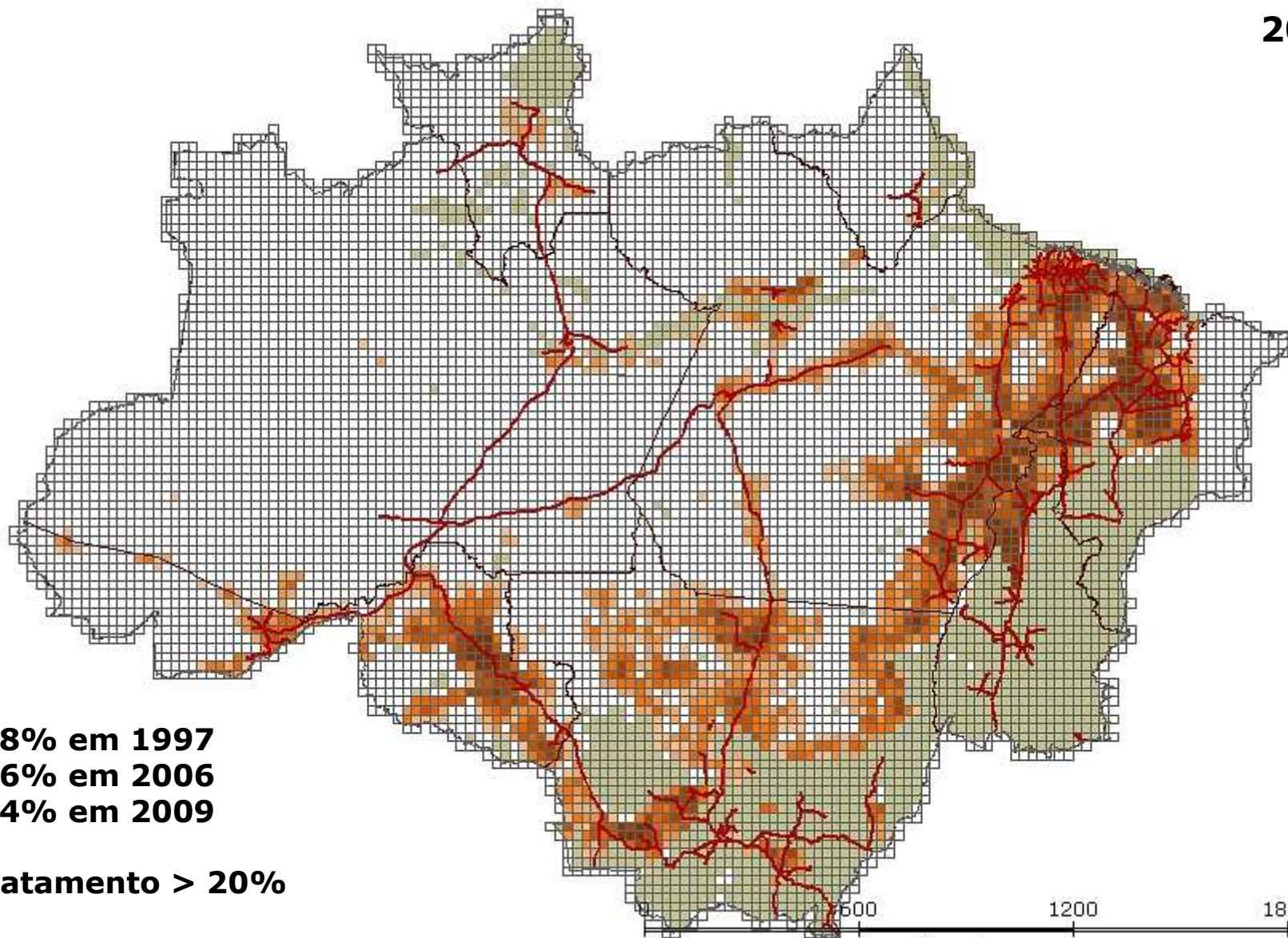
Reserva Legal - 2009

Medida Provisória nº 2.166-67, de 24 de agosto de 2001





2009



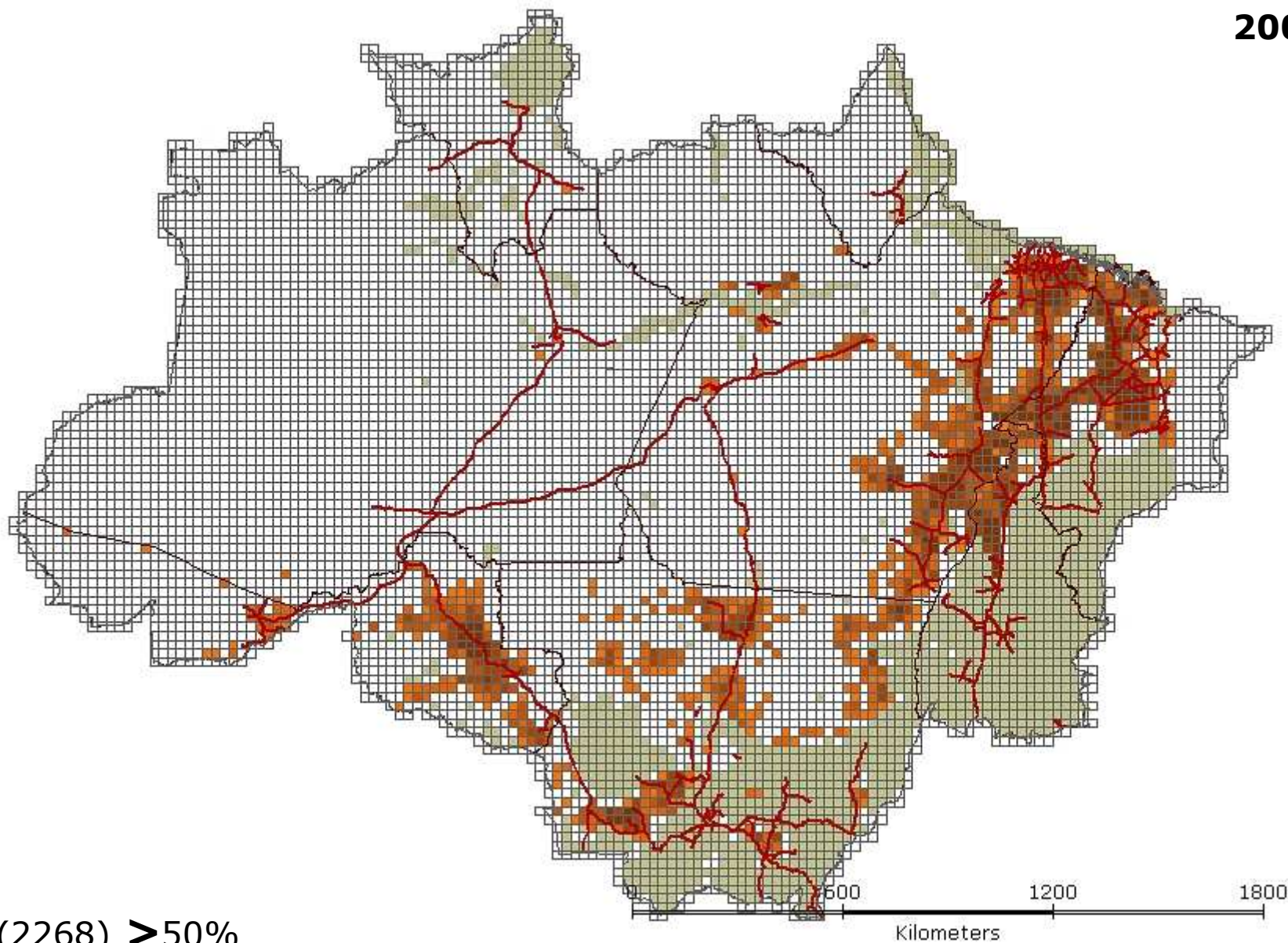
18% em 1997
26% em 2006
34% em 2009

Desmatamento > 20%

34% (2947) > 20%



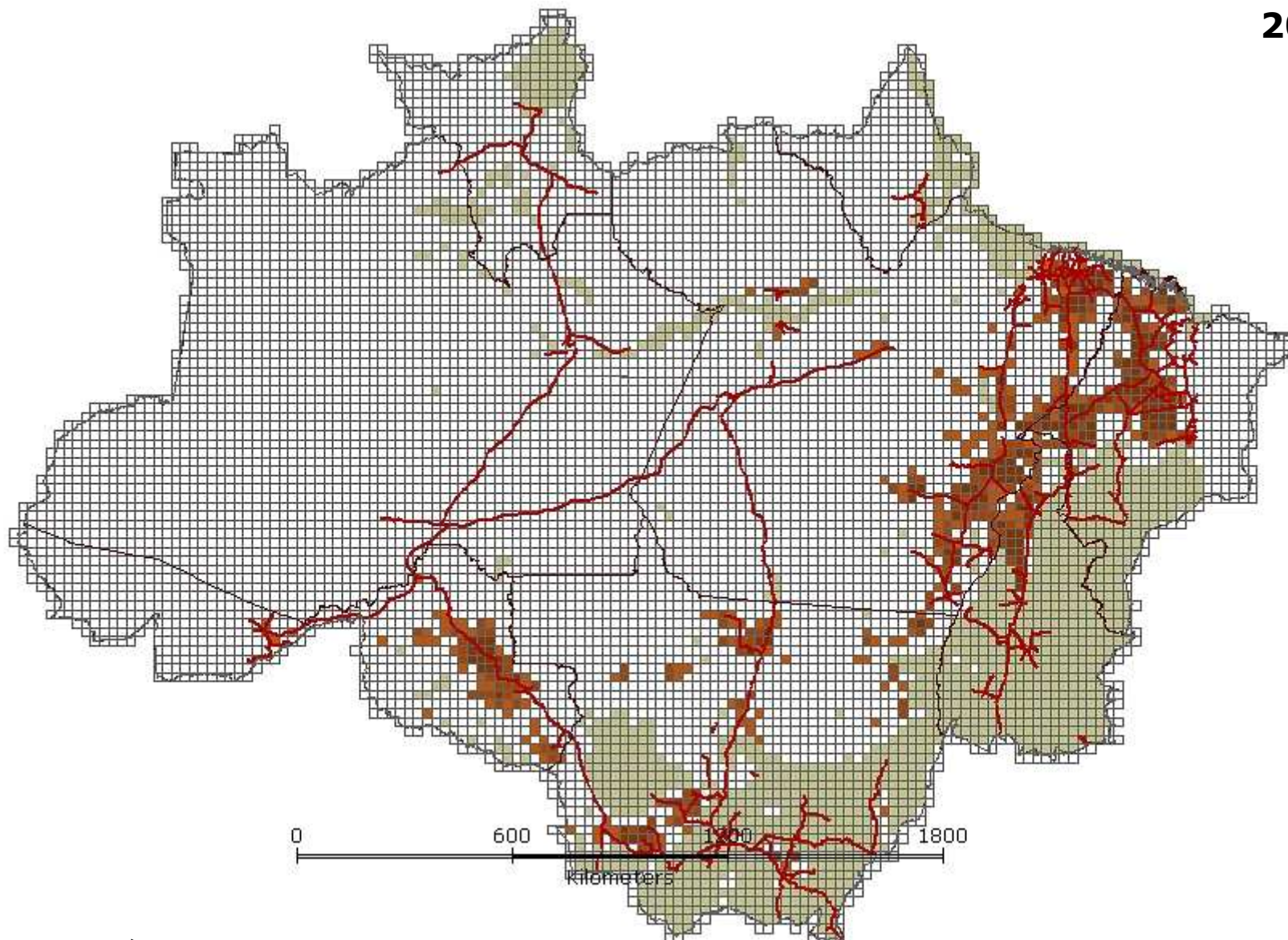
2009



26% (2268) > 50%



2009



16% (2268) >80%



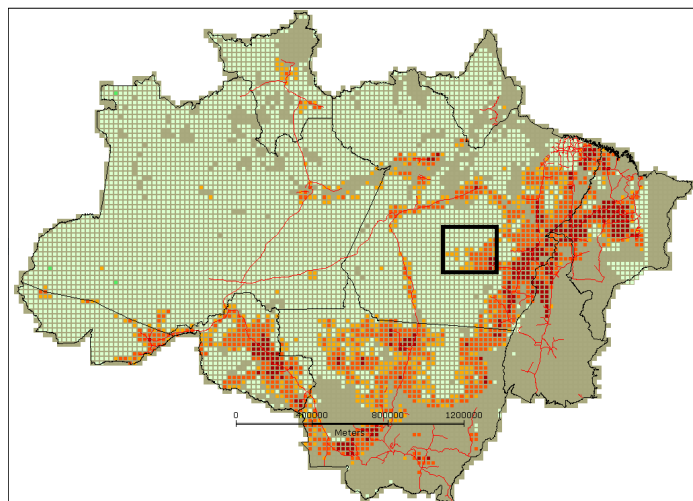
Considerações

- **Análises realizadas reforçam características descritas por Becker (2004, 2005) sobre as novas Fronteiras:**
 - Configuração - frentes localizadas;
 - Diferentes padrões espaço-temporais (diferentes estágios evolutivos, intensidade/consolidação, expansão).

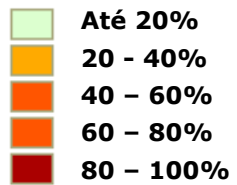


São Félix do Xingu / Terra do Meio

Área de Estudo



2006



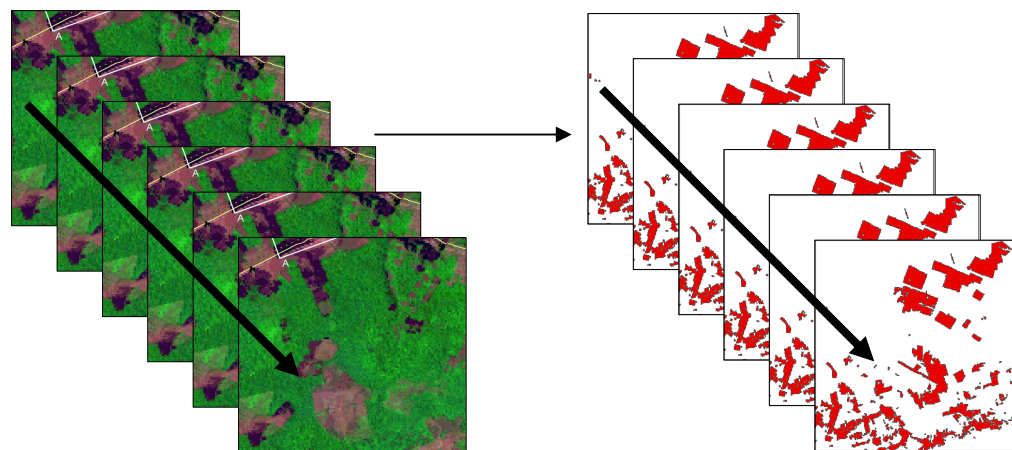
Resolução: 2.5 km





MINISTÉRIO DA CIÊNCIA E TECNOLOGIA
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Detecção e Caracterização de Padrões de Ocupação e suas trajetórias



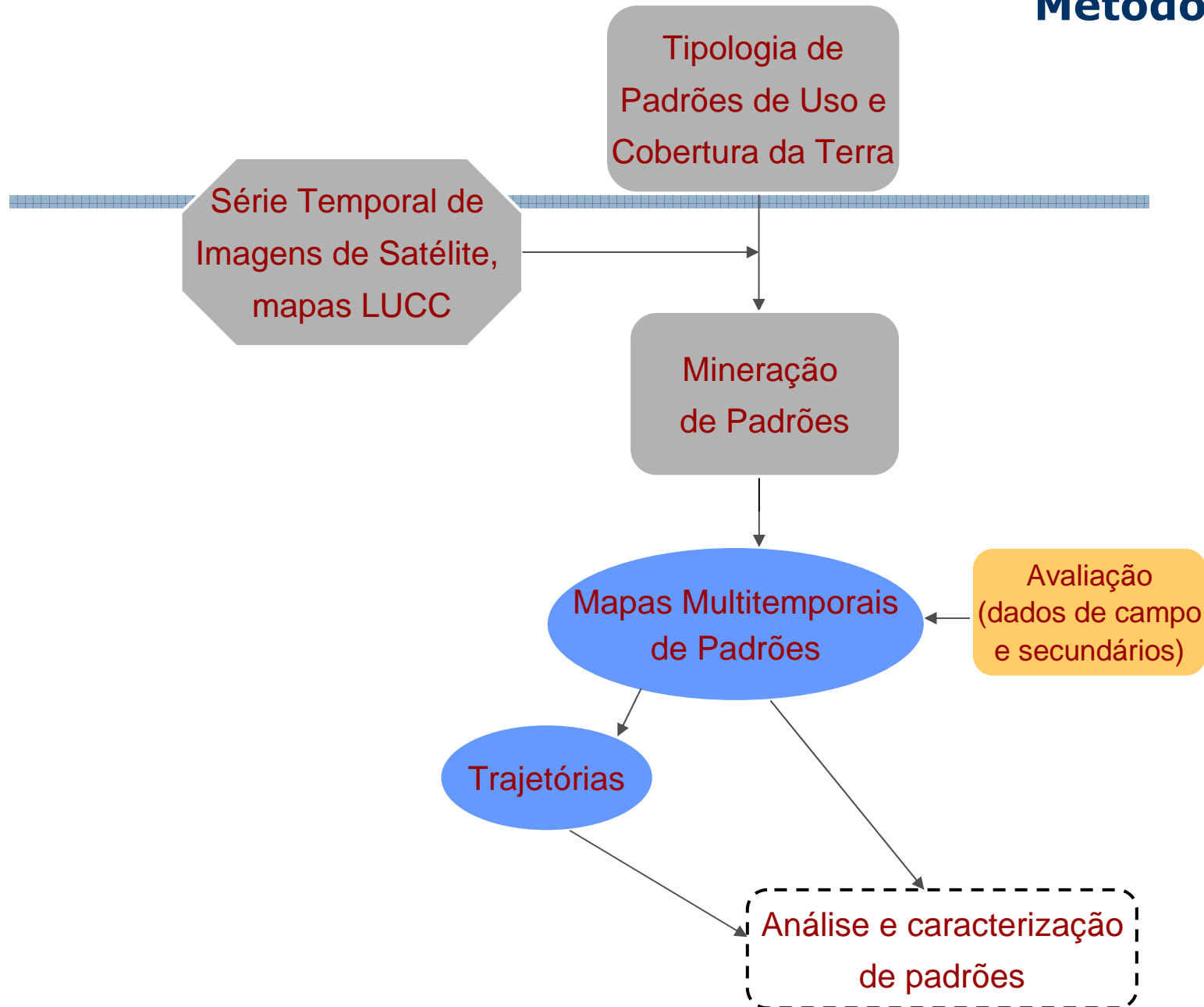


Objetivos específicos

- **Como associar diferentes atores sociais a padrões espaciais de imagens de sensoriamento remoto? Como detectar e caracterizar esses padrões?**
 - *Quais são os padrões de cobertura da terra predominantes para uma dada região?*
 - *Quando um certo padrão emerge?*
 - *Como os padrões mudam e evoluem no tempo?*



Metodologia

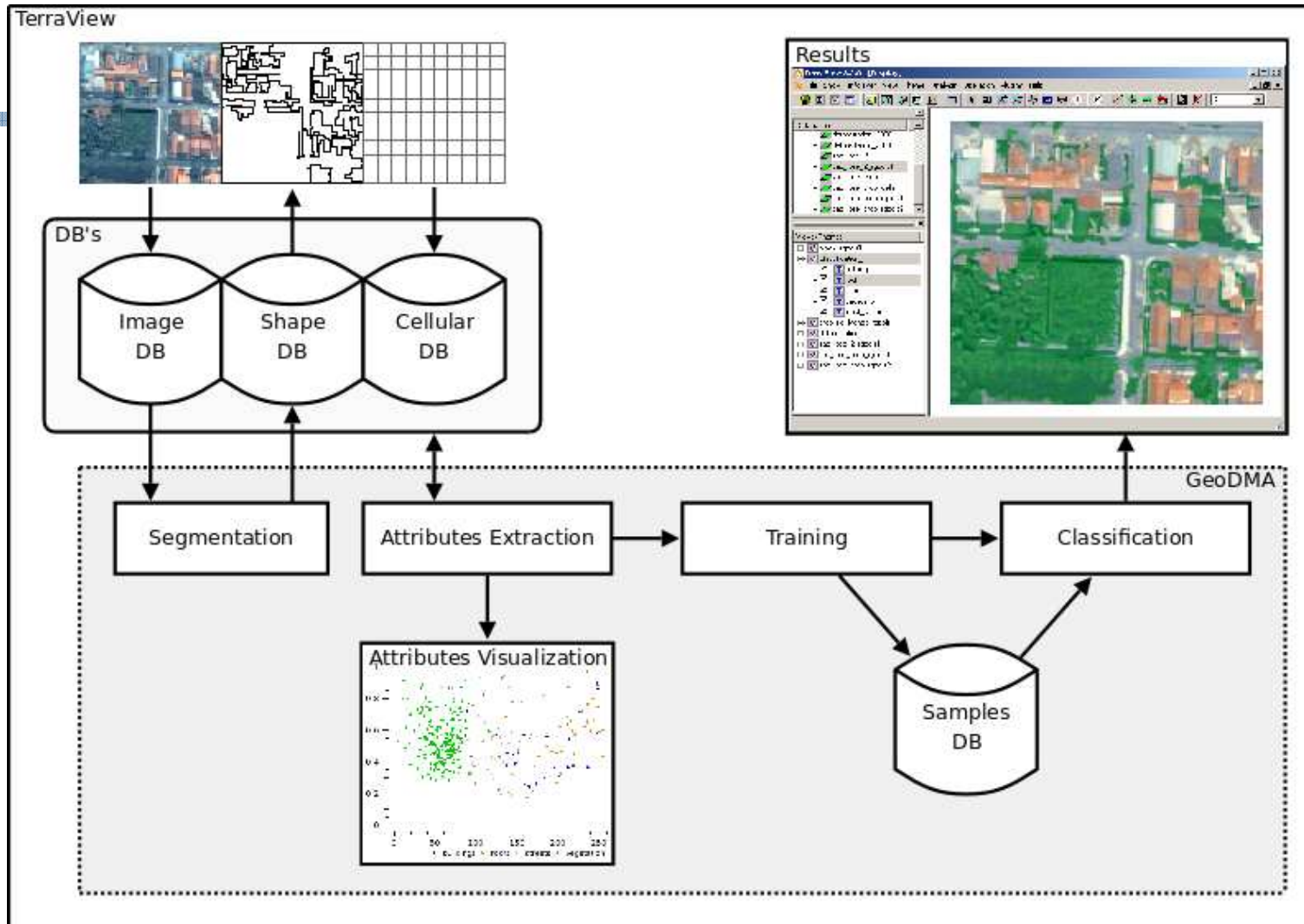


Tipologia de Padrões de Cobertura da Terra Terra do Meio

	Pattern	Pattern Description (1:100.000)	Semantic
	Diffuse	<ul style="list-style-type: none"> ▪ Small and isolated patches ▪ Low to medium density ▪ Uniform distribution 	<ul style="list-style-type: none"> ▪ Beginning or non intensive occupation process ▪ Non planned occupation ▪ Small farms or household family ▪ Occupations along rivers
	Linear	<ul style="list-style-type: none"> ▪ Linear patches like corridors ▪ Low density ▪ Unidirectional 	<ul style="list-style-type: none"> ▪ Beginning of the occupation process ▪ Non planned occupation ▪ Occupation along roads ▪ Small farmers
	Large Geometric	<ul style="list-style-type: none"> ▪ Large and medium isolated patches Geometric patches ▪ Low to medium density 	<ul style="list-style-type: none"> ▪ Beginning or intermediary stage of the occupation process ▪ Medium and large farms
	Multidirectional	<ul style="list-style-type: none"> ▪ Medium and Small patches ▪ Several shapes (irregular, geometric and linear) ▪ Medium to high density patches ▪ Multidirectional 	<ul style="list-style-type: none"> ▪ Occupation expansion. ▪ Non planned occupation ▪ Land concentration ▪ Medium and small farms
	Consolidated	<ul style="list-style-type: none"> ▪ Large compact and continuous deforestation patches. ▪ Small Forest remnants ▪ Low density of forest patches 	<ul style="list-style-type: none"> ▪ Advanced occupation stage ▪ Land Concentration ▪ Small, Medium and Large farms ▪ Fragmentation ▪ Consolidated Occupation



Geographical Data Mining Analyst GeoDMA



GeoDMA – Geographical Data Mining Analyst

Mineração de dados



Árvore de Decisão (J48)



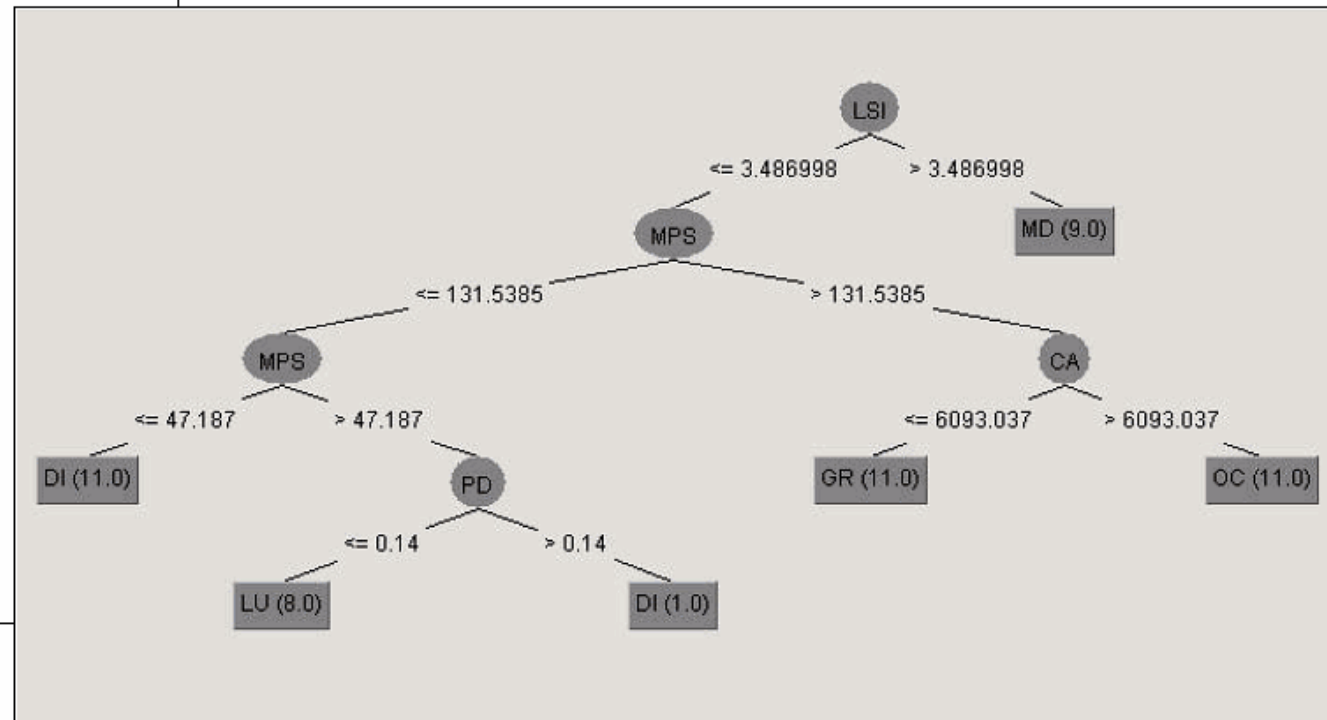
```
=== Classifier model (full training set) ===
```

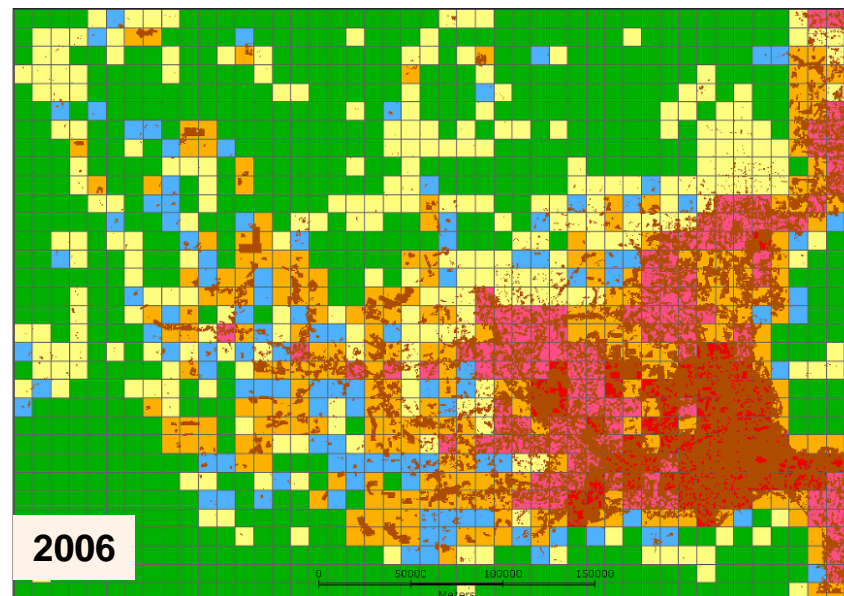
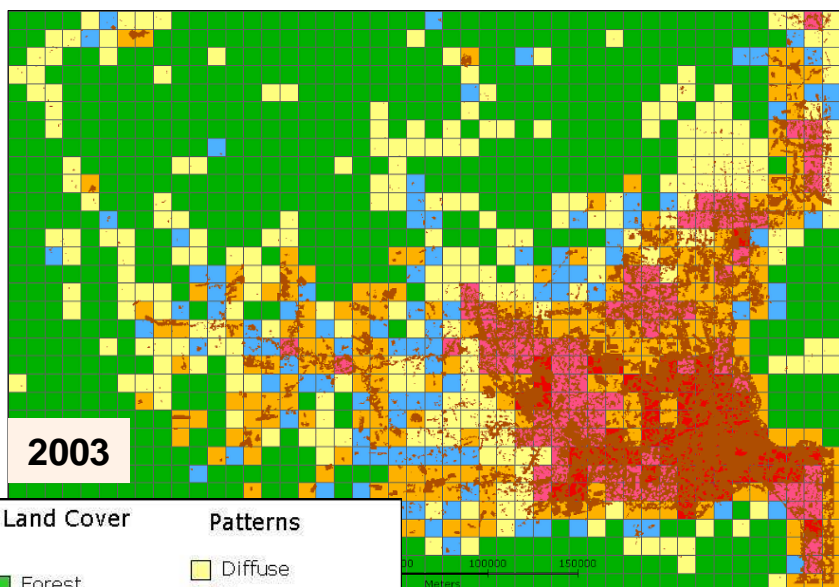
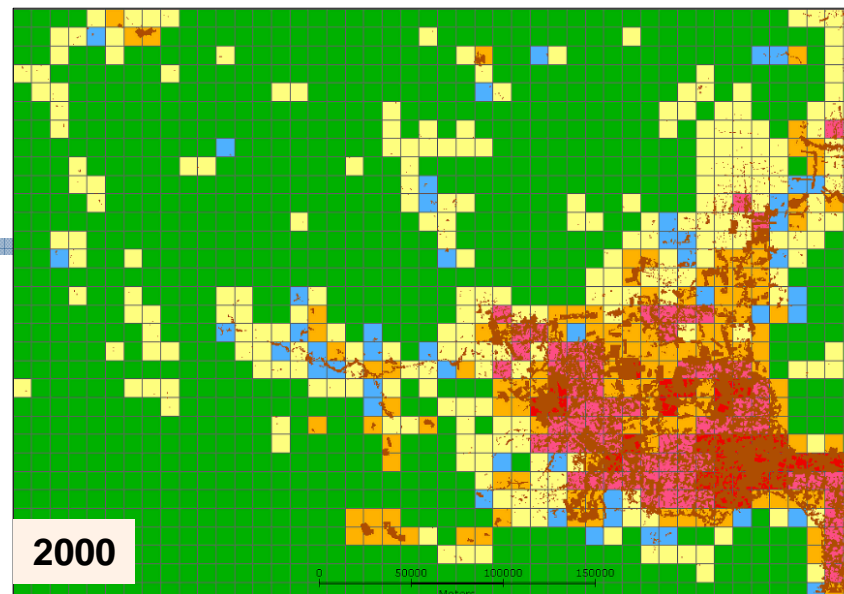
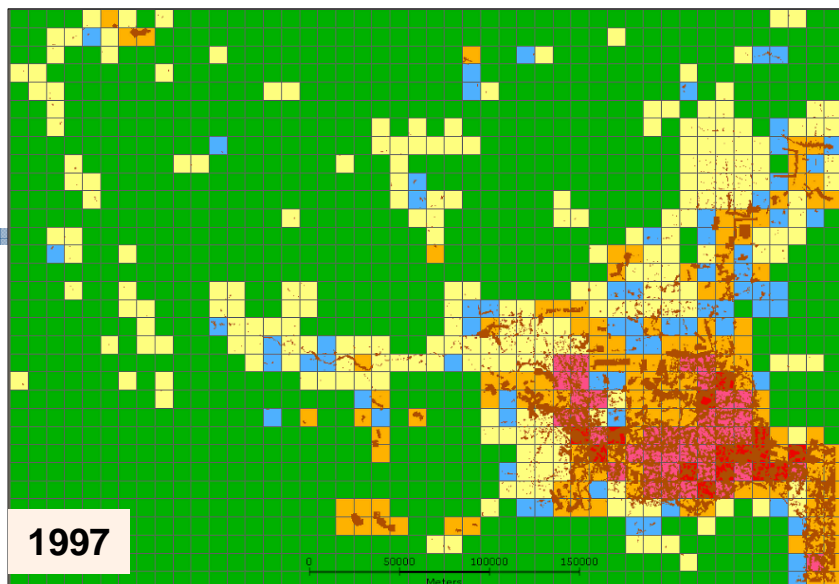
```
J48 pruned tree
```

```
-----  
LSI <= 3.486998  
| MPS <= 131.5385  
| | MPS <= 47.187: DI (11.0)  
| | MPS > 47.187  
| | | PD <= 0.14: LU (8.0)  
| | | PD > 0.14: DI (1.0)  
| | MPS > 131.5385  
| | CA <= 6093.037: GR (11.0)  
| | CA > 6093.037: OC (11.0)  
LSI > 3.486998: MD (9.0)
```

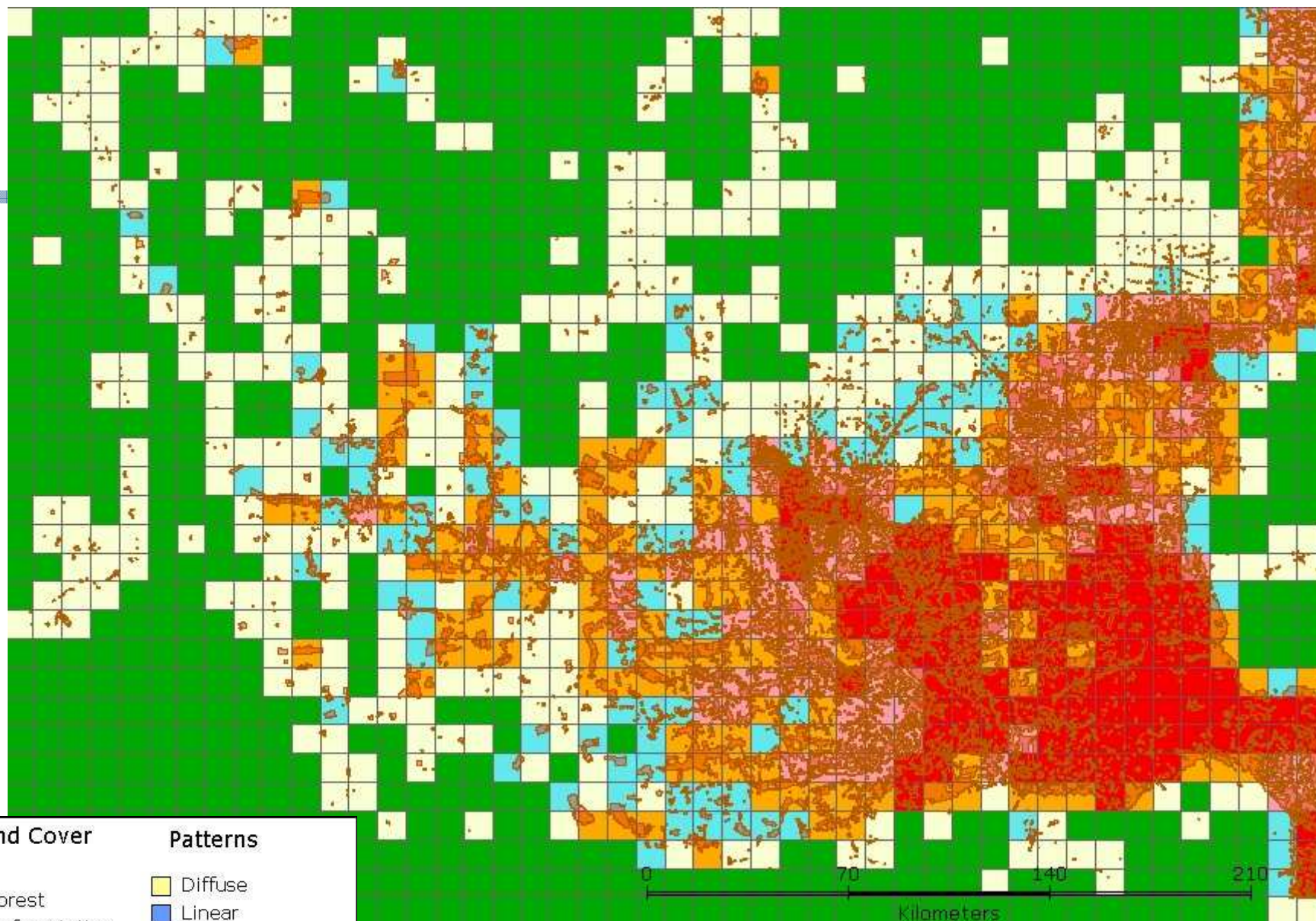
```
Number of Leaves : 6
```

```
Size of the tree : 11
```





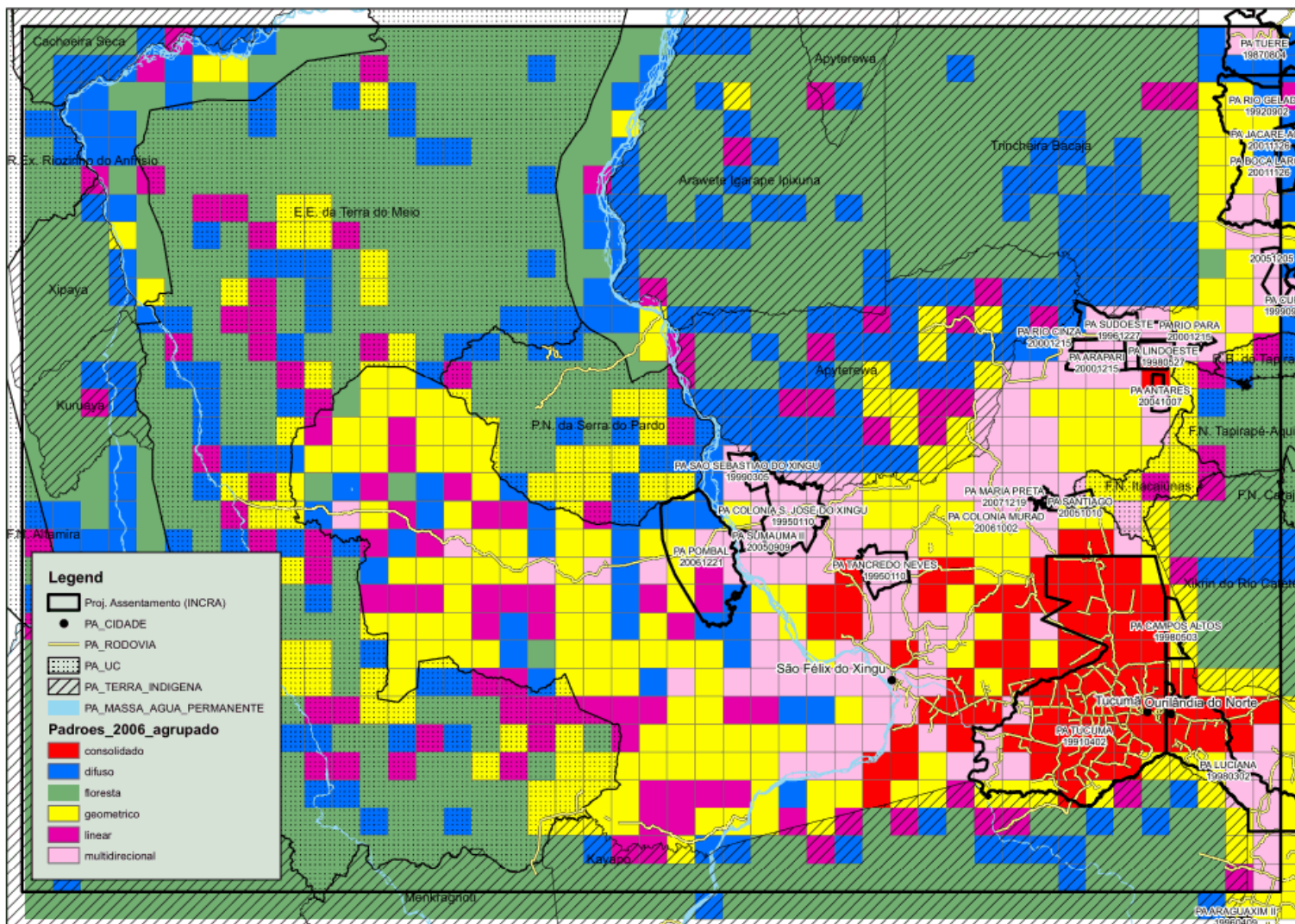
Land Cover	Patterns
Forest	Diffuse
Deforestation	Linear
	Geometric
	Multidirectional
	Consolidated

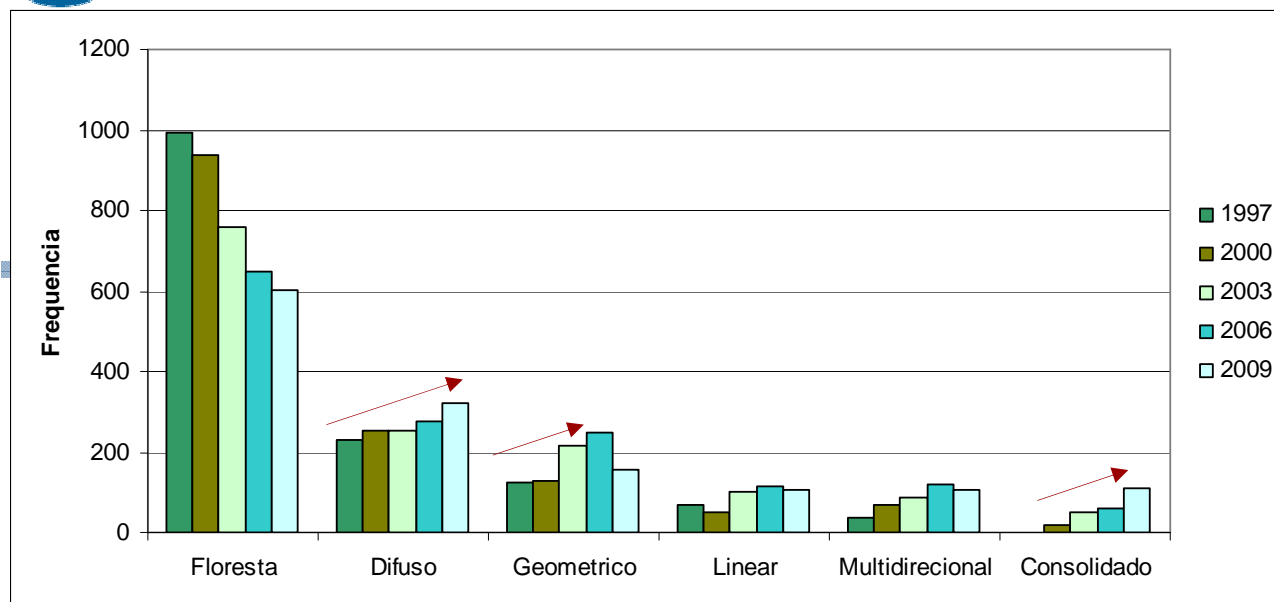


Land Cover	Patterns
Forest	Diffuse
Deforestation	Linear
	Geometric
	Multidirectional
	Consolidated



Avaliação: dados de campo e dados secundários





Trajетórias e Atores sociais

freq	1997	2000	2003	2006
103	Difuso	Difuso	Difuso	Difuso
69	Floresta	Floresta	Floresta	Difuso
61	Geometrico Regular	Geometrico Regular	Geometrico Regular	Geometrico Regular
57	Floresta	Floresta	Difuso	Difuso
51	Floresta	Floresta	Geometrico Regular	Geometrico Regular
23	Floresta	Floresta	Floresta	Linear Unidirecional
21	Linear Unidirecional	Geometrico Regular	Geometrico Regular	Geometrico Regular
20	Difuso	Multidirecional Desordenado	Multidirecional Desordenado	Multidirecional Desordenado
20	Floresta	Floresta	Floresta	Geometrico Regular
19	Difuso	Difuso	Multidirecional Desordenado	Multidirecional Desordenado
19	Floresta	Difuso	Difuso	Difuso
18	Floresta	Floresta	Difuso	Linear Unidirecional
18	Floresta	Floresta	Linear Unidirecional	Linear Unidirecional
15	Floresta	Floresta	Linear Unidirecional	Geometrico Regular
14	Difuso	Difuso	Difuso	Multidirecional Desordenado
14	Multidirecional Desordenado	Multidirecional Desordenado	Ocupacao Consolidada	Ocupacao Consolidada
12	Linear Unidirecional	Linear Unidirecional	Linear Unidirecional	Linear Unidirecional

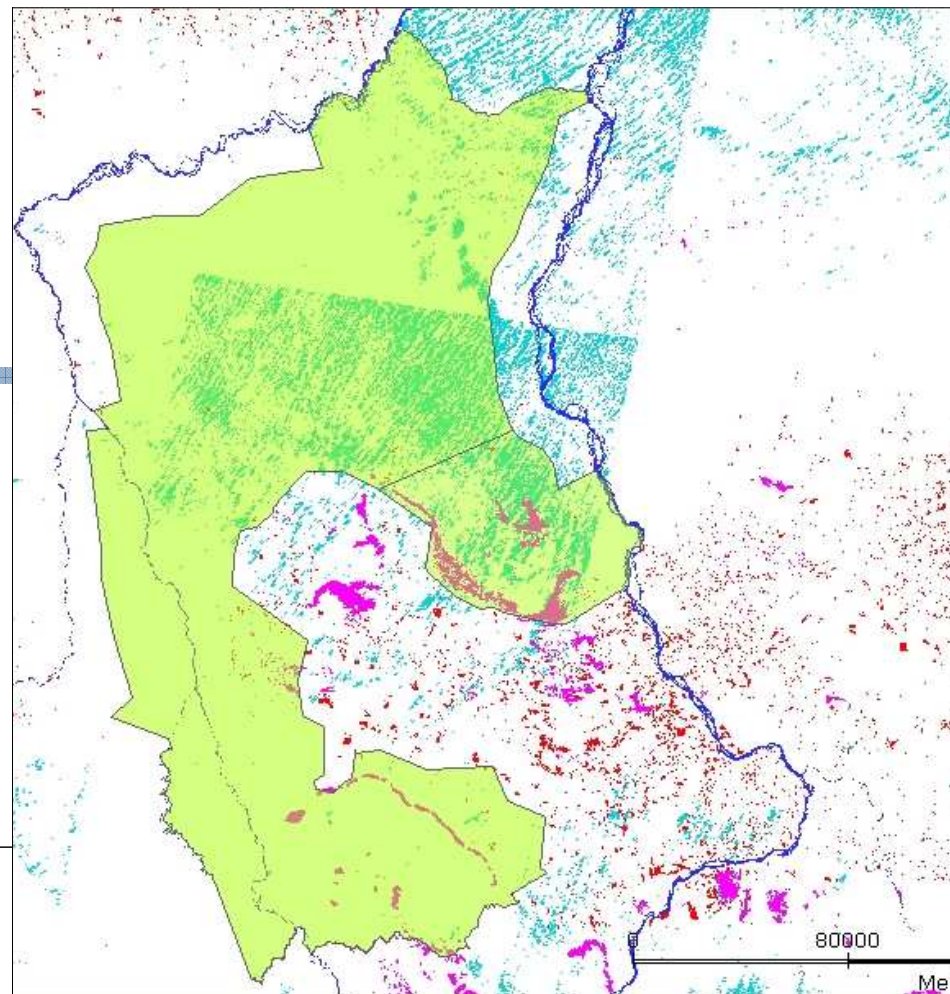
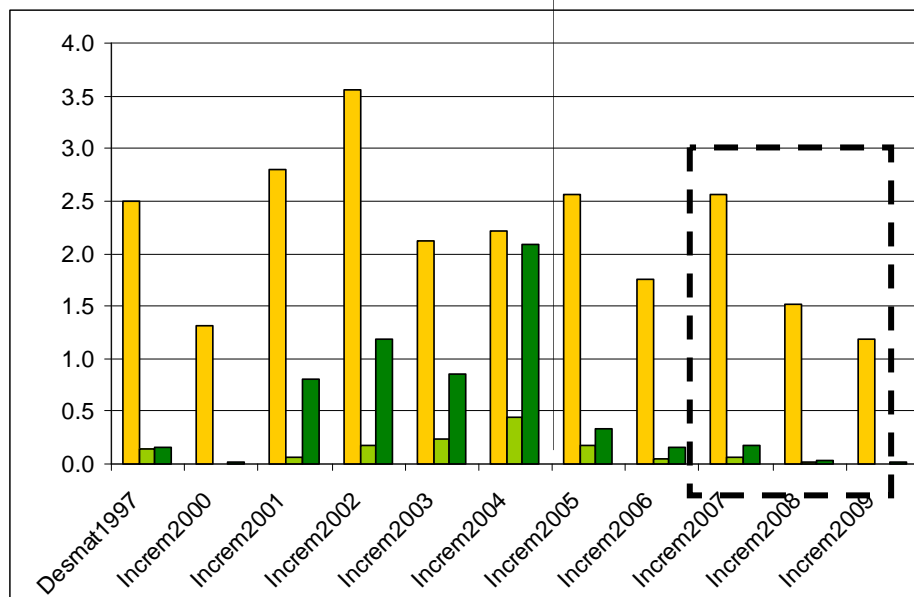
2006

- 54% Expansão
Floresta > Difuso
Floresta > Geométrico
Floresta > Linear
- 27% Sem mudança
- 19% Consolidação



Efeito das Unidades de Conservação no Desmatamento

Criação das UC
↑



- ÁREA DE PROTEÇÃO AMBIENTAL TRIUNFO DO XINGU
- ESTAÇÃO ECOLÓGICA DA TERRA DO MEIO
- PARQUE NACIONAL DA SERRA DO PARDO

- Desmatamento 2006 a 2009
- UC de Proteção Integral



Considerações finais

- **Mapeamento de regiões com diferentes dinâmicas, estágios evolutivos e atores sociais.**
 - Análise e caracterização da região
 - Subsídios para elaboração de políticas mais adequadas para cada região.
 - Subsídios para modelagem.
- **Recuperação do histórico de ocupação (análises de tendências, projeções).**

Obrigada!

