



# Spatial dynamic bayesian network to model deforestation in Brazilian Legal Amazon

*Silva, Alexsandro*  
*Fonseca, Leila*  
*Körting, Thales*



MINISTRY OF SCIENCE, TECHNOLOGY, INNOVATION AND COMMUNICATION  
**NATIONAL INSTITUTE FOR SPACE RESEARCH**



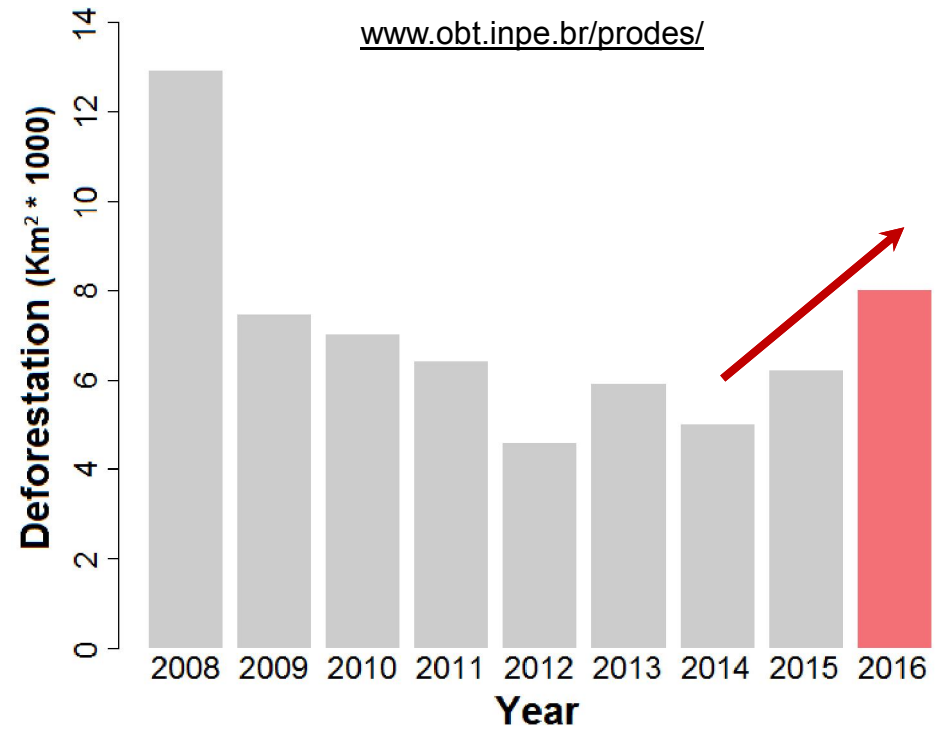
# Motivation



## PRODES

Deforestation monitoring system for Brazilian Amazon forest

[www.obt.inpe.br/prodes/](http://www.obt.inpe.br/prodes/)



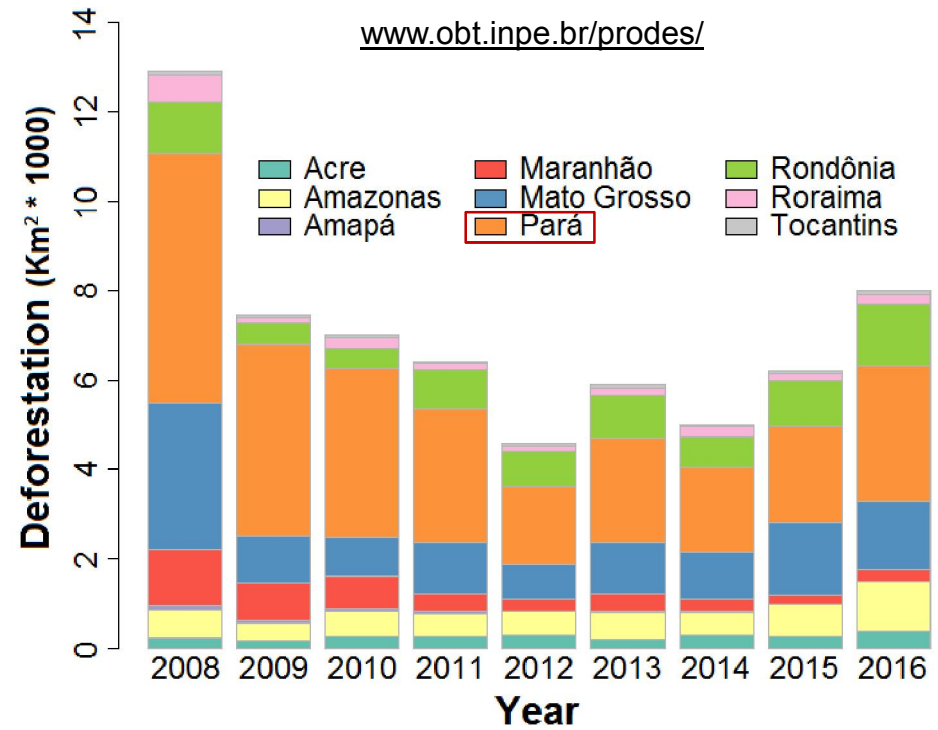
# Motivation



## PRODES

Deforestation monitoring system for Brazilian Amazon forest

[www.obt.inpe.br/prodes/](http://www.obt.inpe.br/prodes/)



## Objective

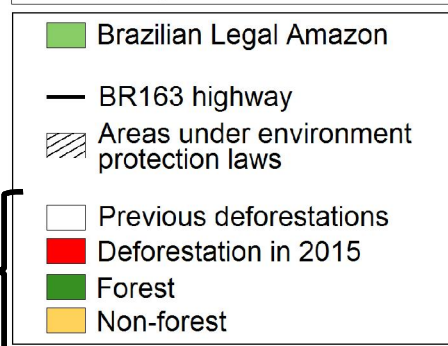


Identify the most susceptible areas to deforestation over the years using a probabilistic approach

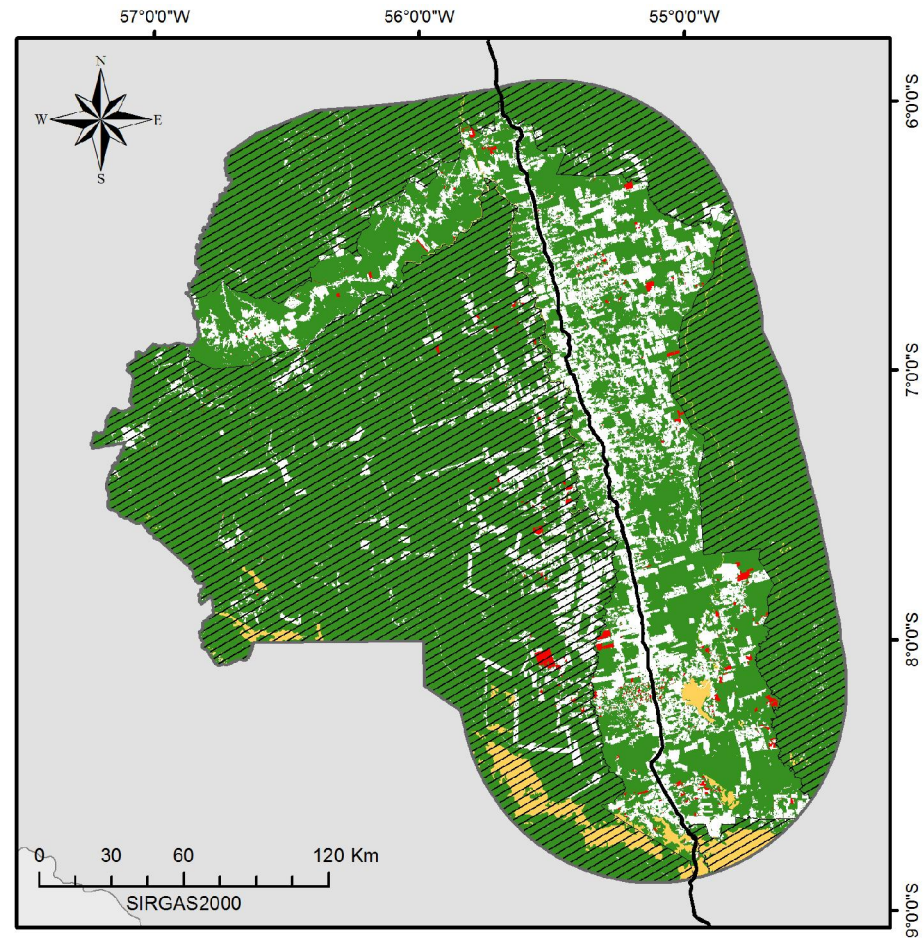




# Study Area

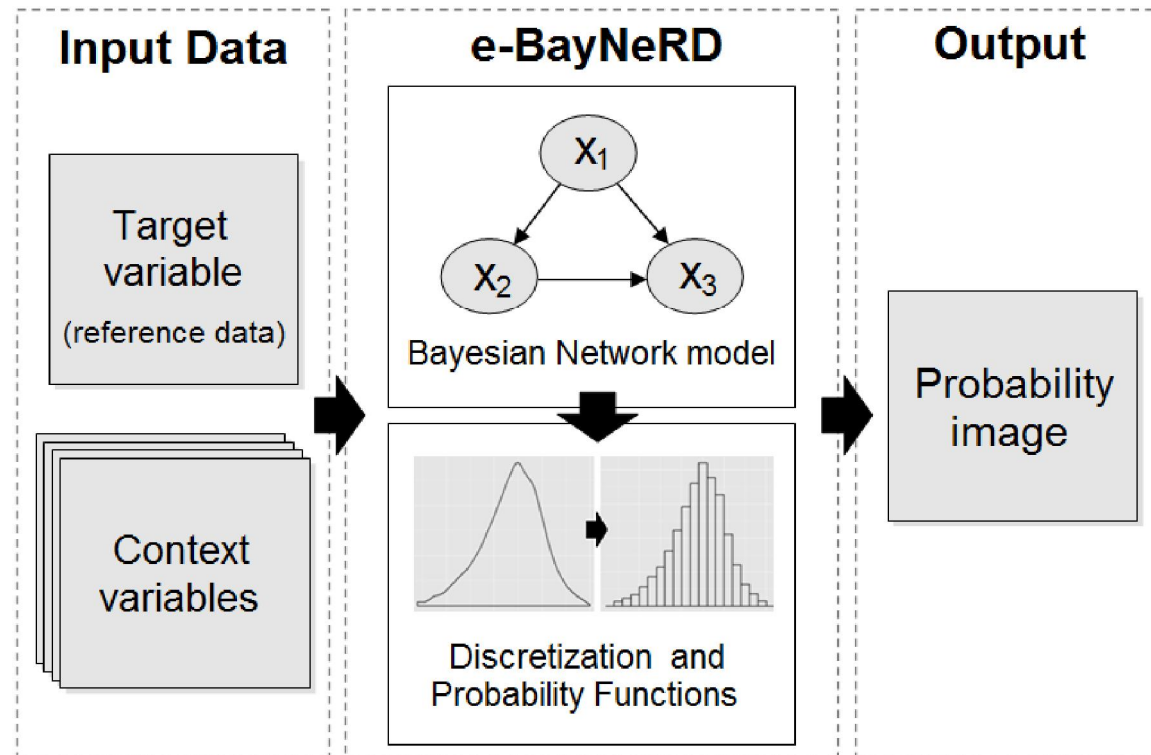


Data from PRODES Project



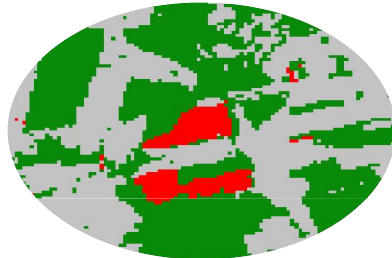
# e-BayNeRD algorithm

## Enhanced Bayesian Network for Raster Data



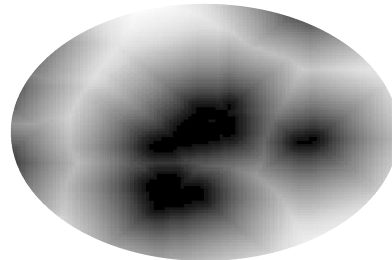
Silva et al. (2016) – Bayesian Network model to predict areas for sugarcane expansion in Brazilian Cerrado

# Selected variables

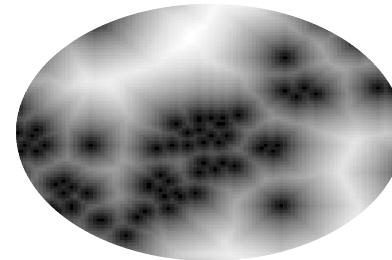


Deforestation in the current year

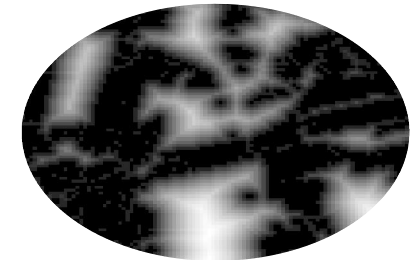
- Deforestation
- Forest
- Outside study area



Distance from degraded areas



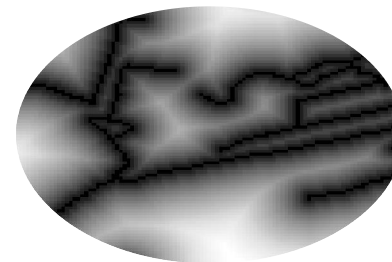
Distance from hot spots



Distance from pasture areas



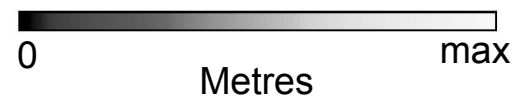
Proportion of deforested neighbours



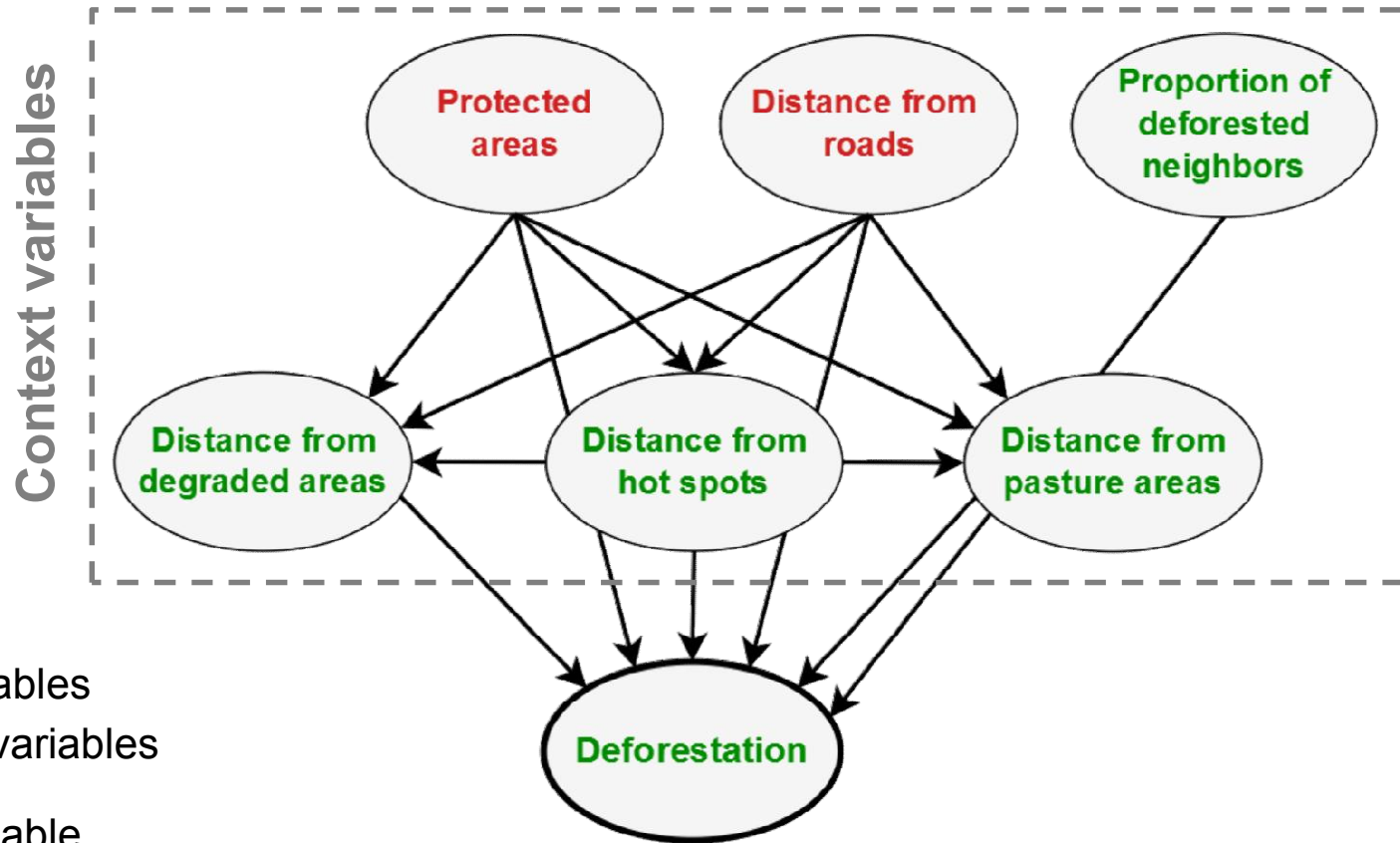
Distance from roads







Protected areas



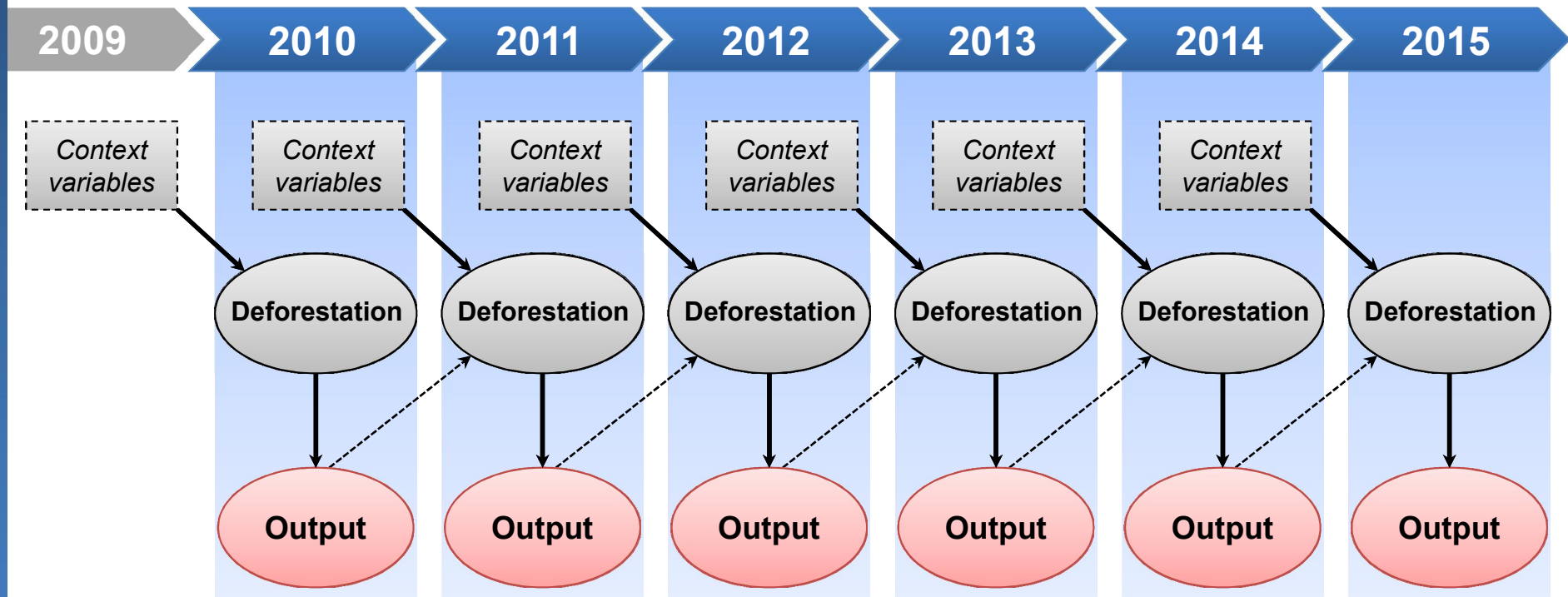
# Bayesian network graphical model



-  Static variables
-  Temporal variables
-  Target variable
-  Context variables



# Spatial dynamic bayesian network

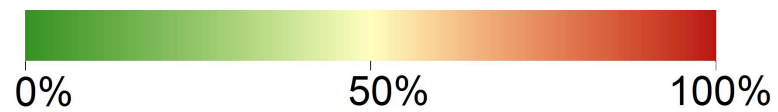


# Results

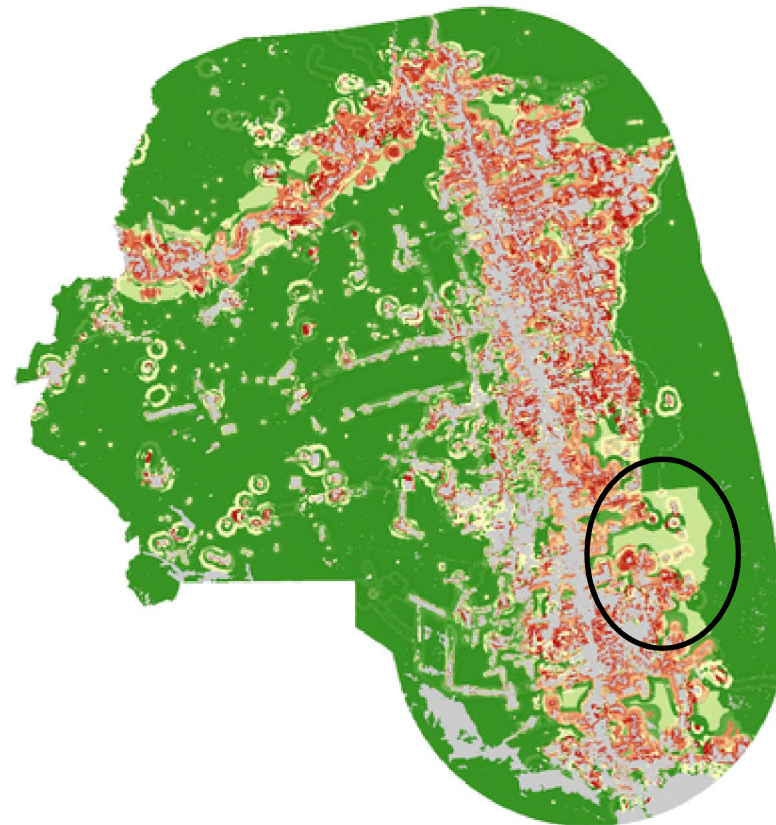
2010

Probability Images of each study year  
(2010 – 2015)

Deforestation susceptibility



 Non-forest

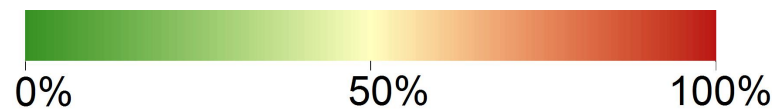


# Results

2010

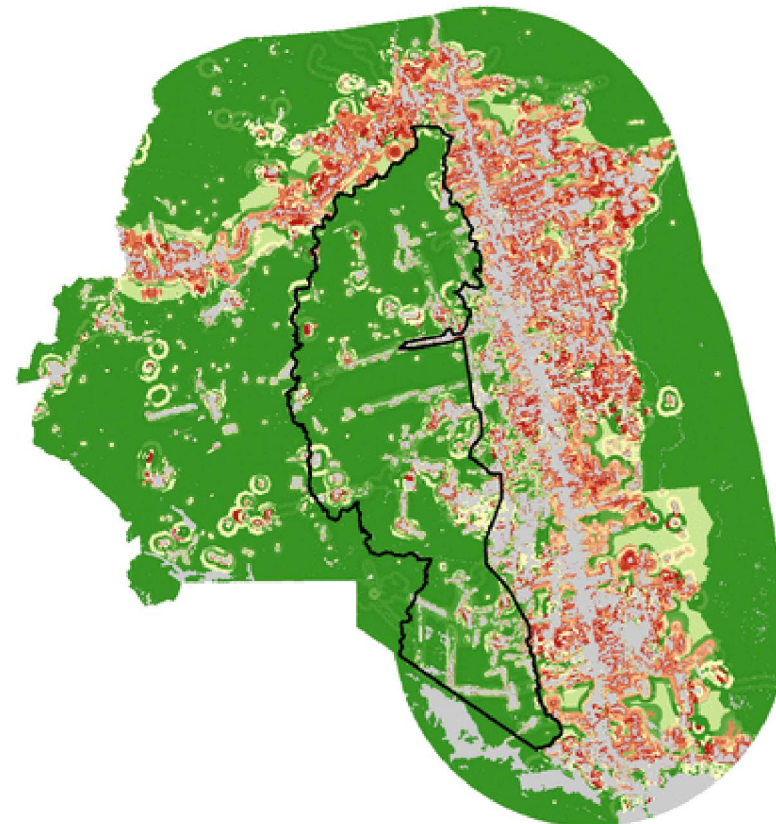
Probability Images of each study year  
(2010 – 2015)

Deforestation susceptibility



 Non-forest

 Jamanxim National Forest

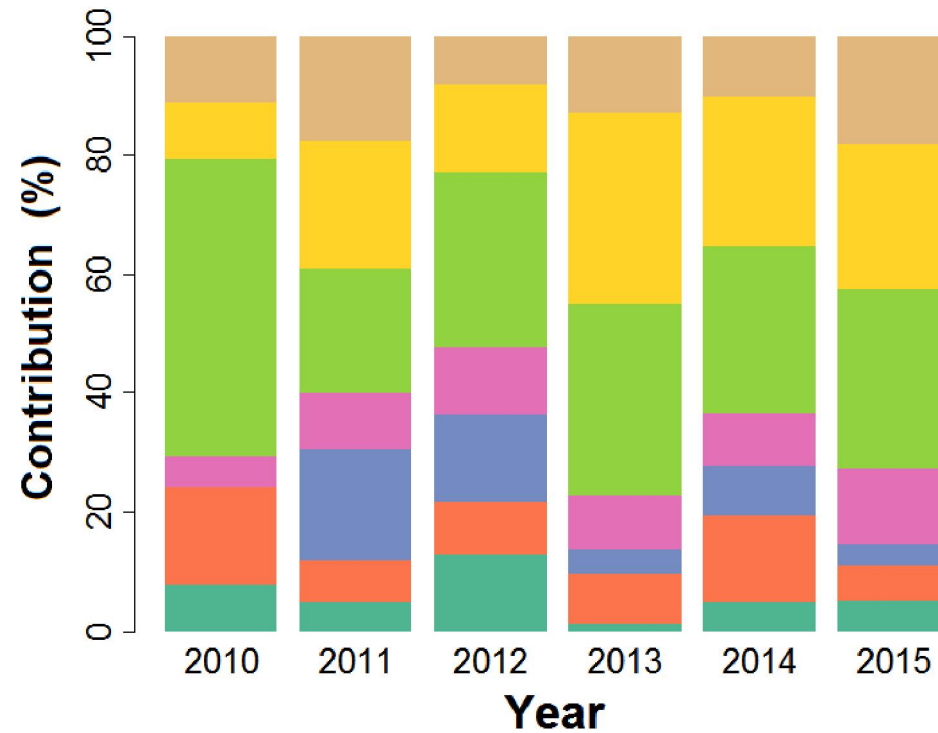


# Results



Influence of each context variable  
(Kullback-Leibler divergence)

- Distance from pasture areas
- Distance from degraded areas
- Distance from hot spots
- Distance from roads
- Previous year output
- Protected areas
- Proportion of deforested neighbors

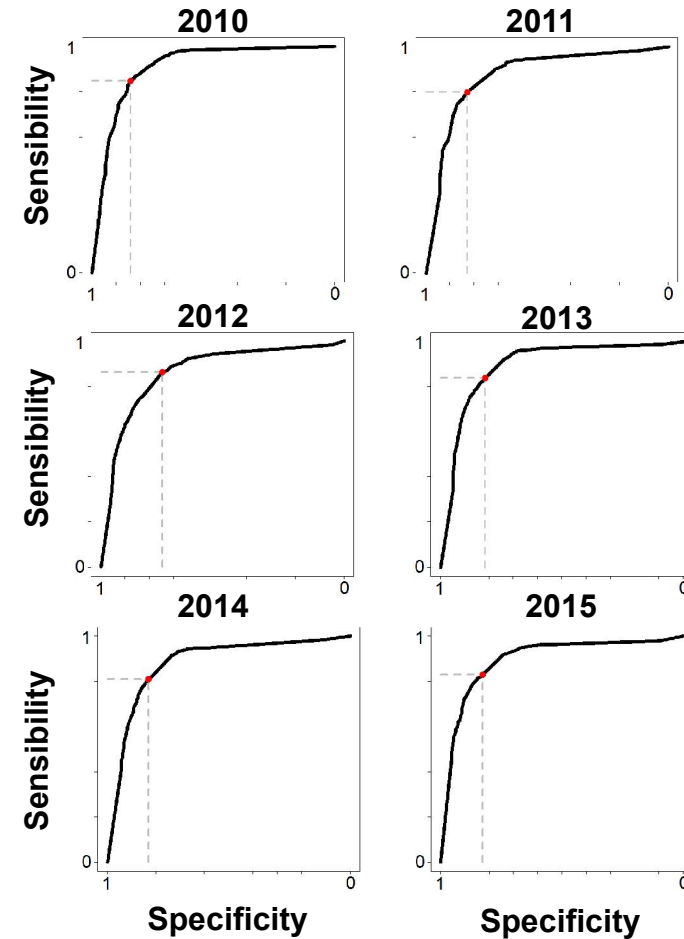


# Method assessment



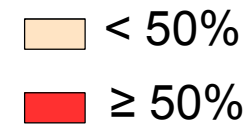
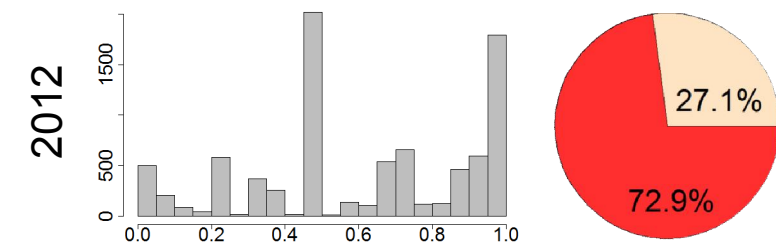
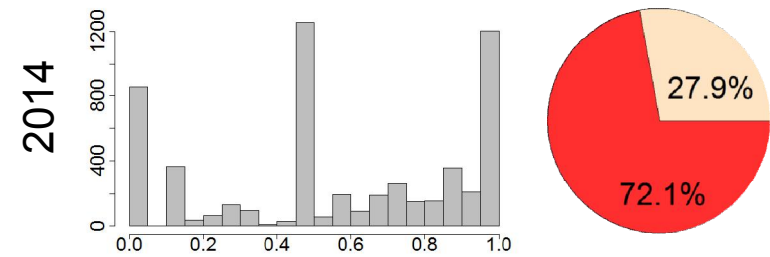
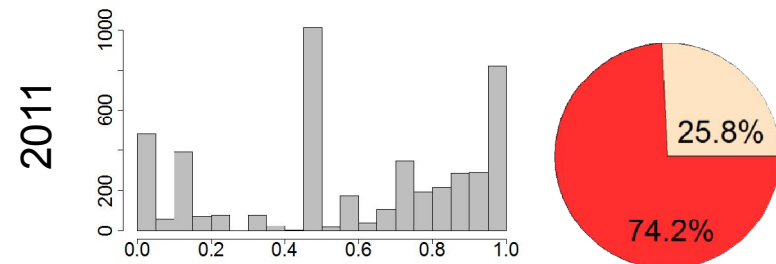
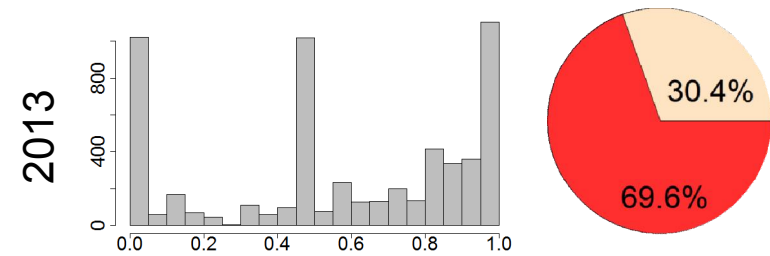
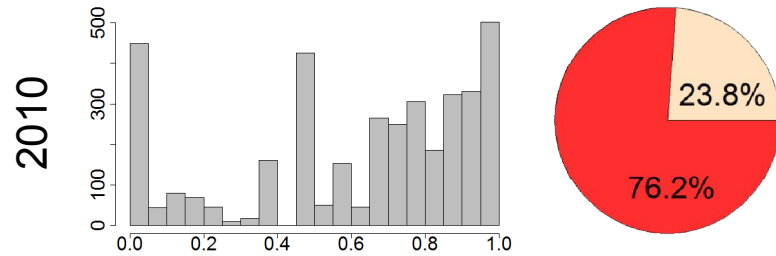
Receiver Operating Characteristic (ROC) curve

	Sensitivty	Specificity	Area under ROC curve
2010	0.84	0.84	90.5%
2011	0.80	0.83	87.3%
2012	0.86	0.75	86.3%
2013	0.84	0.82	89.3%
2014	0.80	0.83	87.9%
2015	0.83	0.82	89.3%





# Method assessment



## Final considerations



This study proposed a probabilistic method to identify susceptible areas to deforestation

Outputs can be used as indicators to the most critical areas to implement preventive action plans (Jamanxin National Forest)

*Distance from hot spots and distance from degraded areas* were the most important variables (selective logging)

Application of proposed method to other regions



# Thank you!

Silva, Alexandro ([alexandro.silva@inpe.br](mailto:alexandro.silva@inpe.br))

Fonseca, Leila

Körting, Thales

**FUNDO  
AMAZONIA**



MINISTRY OF SCIENCE, TECHNOLOGY, INNOVATION AND COMMUNICATION  
**NATIONAL INSTITUTE FOR SPACE RESEARCH**



MINISTÉRIO DO  
**PLANEJAMENTO,  
DESENVOLVIMENTO E GESTÃO**

MINISTÉRIO DO  
**MEIO AMBIENTE**

