

Introduction to deforestation modeling: spatialization and intensity

Camille Dezécache

Université des Antilles et de la Guyane - UMR Ecofog - CIRAD

camille.dezecache@ecofog.gf



May 3, 2015

Objectives of the presentation

- ▶ A review of existing spatial models of deforestation of interest for our study area
- ▶ Based on conclusions: choices concerning the on-going study on modelling deforestation in the Guiana Shield
- ▶ Main orientations: a radical distinction between factors influencing the location of deforestation and those influencing its intensity; and the necessity to consider absolute deforestation as the metric for characterizing this process

Introduction

- ▶ Deforestation is a complex and multidisciplinary object
- ▶ A review by Angelsen and Kaimowitz (1999) introduced different categories of economic models of deforestation based on the scale (household, sub-national or national) and on the methodology used (analytical or regression models)

Identifying the drivers of deforestation: Proximate causes and underlying drivers of deforestation

- ▶ Angelsen & Kaimowitz, 1999; Geist & Lambin, 2002: proximate (direct) and underlying (indirect) causes
- ▶ Proximate: Agriculture is a land consuming activity: in forested areas, its expansion directly provokes deforestation
- ▶ Underlying: Population growth may favour an increase in the demand for agricultural products which in turn increases deforestation rates
- ▶ More conclusive results are found using proximate instead of underlying factors (Kaimowitz et al., 1998), however underlying drivers could be more interesting for analysis
- ▶ But the distinction is somewhat artificial so choosing one or the other would not be relevant: agricultura subsidies = important driver of deforestation in French Guiana. Direct (provoque demand for land) or indirect (help existing demand for land)?

Identifying the drivers of deforestation: Defining universal factors of deforestation?

- ▶ Following Geist and Lambin (2002), no universal causal effect can be identified, most of the drivers of deforestation being region specific
- ▶ Mahapatra & Kant (2005) identified multiple drivers of deforestation, each having potential opposite effects on the dependant variable deforestation
- ▶ Examples:

- ▶ The percentage of forest cover is an indicator of the accessibility of a territory. For a same infrastructure network, the forest ecosystems of a country with low forest cover will face more pressure than in a country with a high remaining forest cover. However, with a high forest cover, a 'free common good attitude' can emerge and lead to less protection and more deforestation

- ▶ Population growth could create a Malthusian (increasing pressure on agricultural products create incentives to the expansion of agriculture) or Boserup (more people could enhance creativity and the development of new technologies to face the problem of deforestation) effect in different contexts;

- ▶ Economic growth could have negative effects on deforestation rates if the hypothesis of the environmental Kuznet's curve is true: poor people would destroy their environment in order to survive, while a growing economy would create off-farm employment and allow availability of capitals for forest protection. However, more investments in remote region could also favour deforestation, especially if the demand for agricultural and forest products is increasing because of the favourable economic situation;

Identifying the drivers of deforestation: The case of the Guiana Shield

- ▶ A review of local models of deforestation is impossible, as no study published focused on this particular region
- ▶ Soares-Filho et al. (2006): "systematic deforestation map series [were] not available for [...] subregions [outside Brazil] [...], deforestation rates and their annual variation were assigned by applying figures from subregions of Brazil that were considered similar in frontier type and age (see article's supplementary information)."
- ▶ Particular methodology due to some specificities: low deforestation, gold-mining

Statistical issues and tools: Choosing the appropriate dependent variable

Not a trivial choice

- ▶ remaining forest cover (percentage or absolute);
- ▶ deforestation as a percentage of a region's area;
- ▶ absolute deforestation (area of forest cover lost per year)

Brown and Pearce (1994), only absolute forest cover loss per year must be used in deforestation studies (but is almost never used)

Statistical issues and tools: which classifier to use?

- ▶ logistic regression = most frequently used method (predict a probability of deforestation)
- ▶ random forest = never used for deforestation studies, but very powerful classifier
- ▶ in both cases, how to make the link between a probability of deforestation calculated for each pixel and the absolute deforestation which should be the only metric used?
- ▶ Need to make a radical distinction between spatial and intensity processes

Distinguishing spatial factors from intensity factors

- ▶ Distinction somewhat artificial but often forgotten in deforestation modelling studies
- ▶ At local scale: remote areas will suffer low deforestation
- ▶ But at large scale: if demande exists (intensity), deforestation will focus on best areas (more accessible areas, etc.)
- ▶ Main hypothesis: localisation is driven only by geographic factors, whereas intensity is driven only by socio-economics factors which drive demand for land

How to take into account different deforestation processes?

- ▶ Different processes express in a different way (spatially and in term of intensity)
- ▶ Too many interactions driving spatial distribution of deforestation (but one major driver: spatial contagion)
- ▶ Deforestation trends can be really different between drivers

Conclusion: Main choices

- ▶ Using random forest classifier for computing spatial potential for deforestation. Only geographic factors. A unique model for all the area of interest
- ▶ Using linear modelling for predicting intensity of deforestation (absolute) per year. A model per area considered as homogeneous:
 - ▶ -Urban and agricultural areas;
 - ▶ -Gold-mining;
 - ▶ - Forestry.