MONITORING THE EXPANSION OF EUCALYPTUS PLANTATIONS IN BRAZIL

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Global Vegetation Monitoring and Modeling
International Conference
Avignon 3-7 February 2014

Introduction

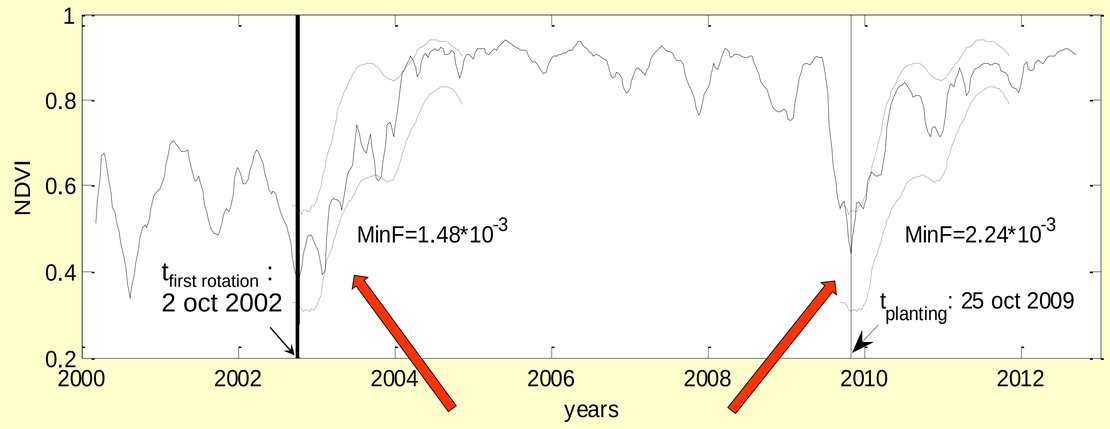
Classification of specific crops with MODIS or other coarse scale data is useful to assess regionally and annually the land use change

Area of *Eucalyptus* plantations in Brazil is continuously increasing: it was 3.5 MHa in 2006 and now reaches almost 5 Mha (ABRAF,2012).

A precise estimation of recent *Eucalyptus* expansion and associated land use change is a prerequisite to assess their environmental impact on regional carbon and water cycles, and later on climate.

Typical Eucalyptus plantation during harvest

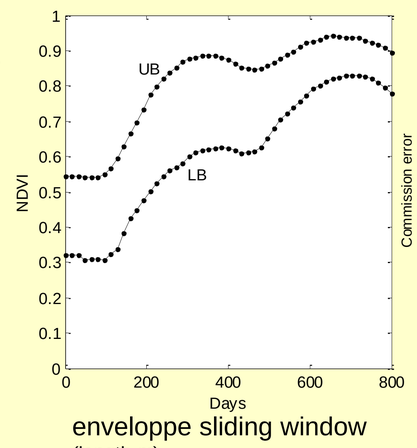
Binary classification method



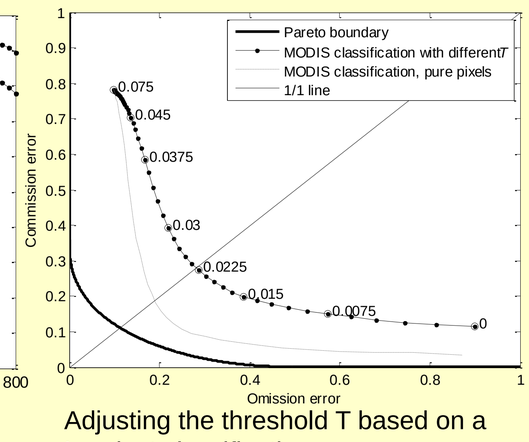
- MODIS 16-days 250m NDVI time series
- Matching function with a reference bounding envelope (UB and LB)
- Threshold coefficient adjusted using an equilibrate omission-comission criteria on a Landsat-based classification

$$F(t) = \sqrt{\frac{1}{m}\sum_{i=1}^{m}\begin{cases}(N_{t+i-1}-UB_i)^2, & if\ N_{t+i-1} > UB_i\\ (N_{t+i-1}-LB_i)^2, & if\ N_{t+i-1} < LB_i\\ 0, & otherwise\end{cases}}$$

If F(t) > T, Eucalyptus starting rotation in the window

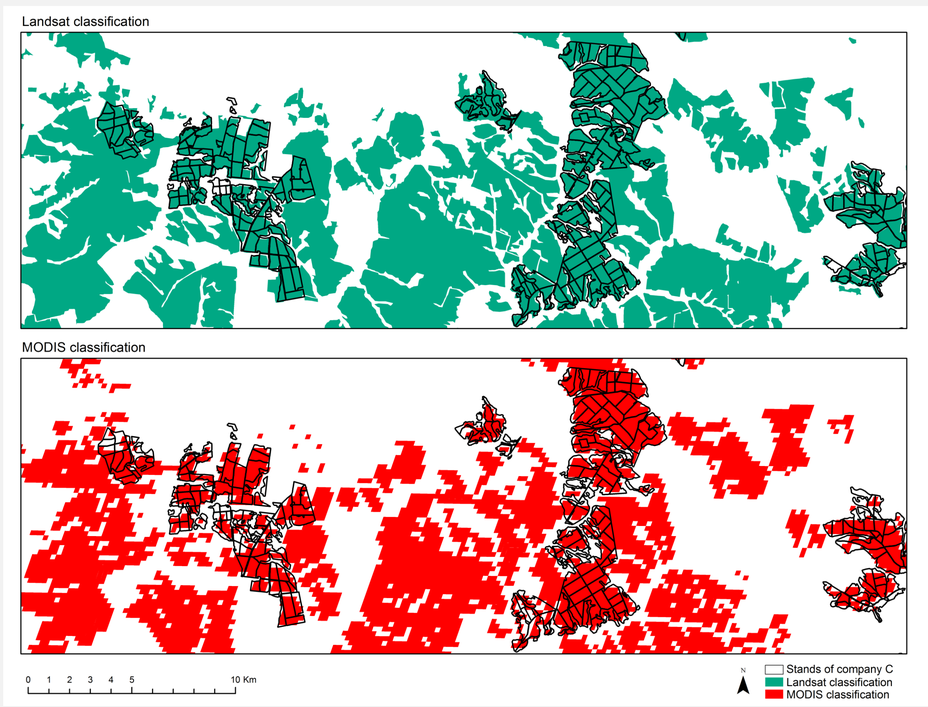


enveloppe sliding window (length *m*)

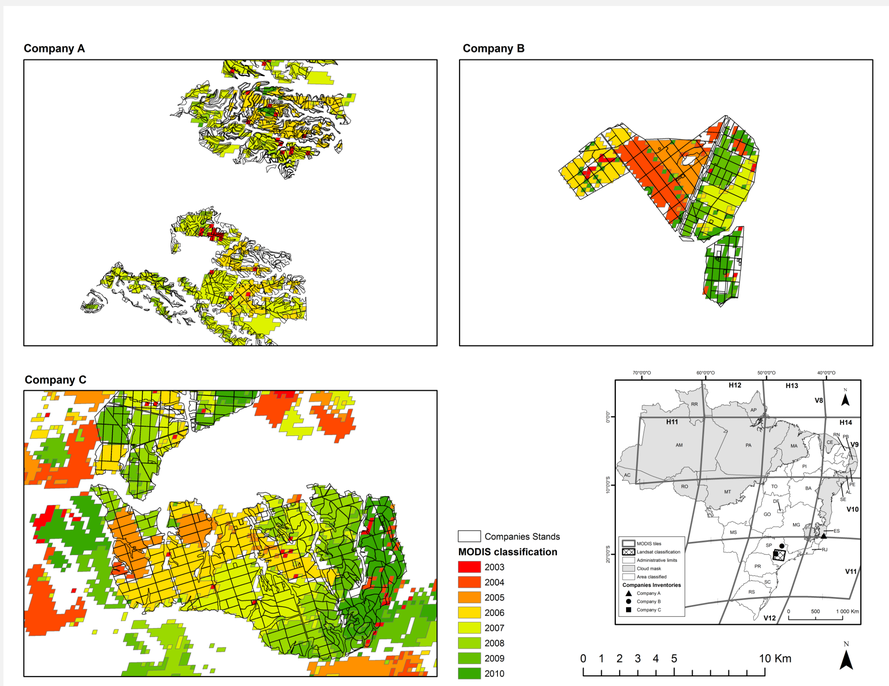


Adjusting the threshold T based on a Landsat classification

Validation on a Landsat classification



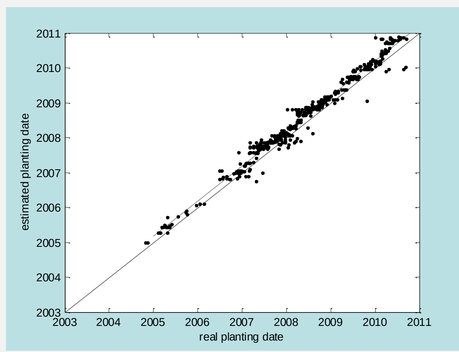
Validation on Forest Companies data



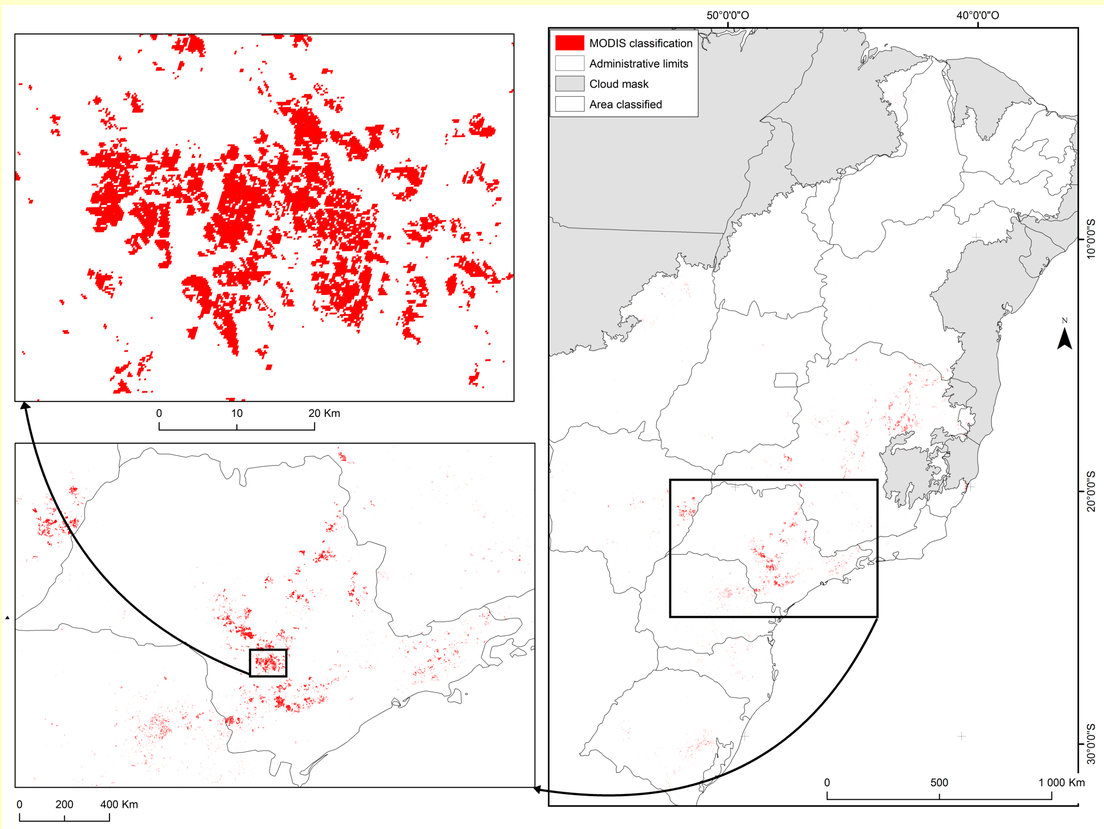
Validation on GoogleEarth

		Actual class (Google Earth photointerpretation)			User acc.
		Eucalyptus	Not eucalyptus	Total	%
Predicted class (from MODIS NDVI time-series)	Eucalyptus	**292**	81	373	78.3
	Not eucalyptus	22	**372**	394	94.4
	Total	314	453	767	
Prod. Acc	(%)	93.0	82.1		86.6

Validation of planting date



Short-rotation Eucalyptus plantations map



Short-rotation Eucalyptus plantations expansion

In the area covered by our analysis, area of short rotation Eucalyptus plantations has increased by 130% between 2002 and 2009.

Increase of 45% estimated from ABRAF data over Brazil between 2005 and 2009, similar to the 40% expansion estimated in this study. However there is a 30% underestimation

It is difficult to compare the results quantitatively with other census (IBGE 2006) or companies statistics in the same region (due to cloud mask) and for the same class (only fast-growing Eucalyptus), but work is in progress.

Conclusions and perspectives

- The statistics are correct for classification purposes assessed with 3 types of validation dataset, except in highly fragmented areas
- A global underestimation of *Eucalyptus* areas compared to large scales census was observed: effect of MODIS resolution, algorithm, and the fact that only short-rotation plantation are detected
- Some other time-series classification algorithm have been tested, but the procedure could be improved
- A transposition of the methodology using higher resolution images (e.g. Landsat) seems necessary to gain accuracy in area estimates
- Local calibration of UB, LB and T could enhance the classification results

ABRAF, 2012. Chapter 01, Planted forests in Brazil. Statistical yearbook 2012.
IBGE, 2006. Brazilian Institute of Geography and Statistics, Agrarian Census 2006, available at <http://www.sidra.ibge.gov.br/>.
Further readings…:
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ACKNOWLEDGEMENTS:
This study was conducted in the framework of the SIGMA European Collaborative Project (FP7-ENV-2013 SIGMA — Stimulating Innovation for Global Monitoring of Agriculture and its Impact on the Environment in support of GEOGLAM — project no. 603719). We thank the forest companies Duratex, International Paper of Brasil, and Fibria Celulose for providing the data. We thank NASA for sharing MODIS and Landsat data. We also thank Jean-Paul Laclau (CIRAD) and Jean-Pierre Bouillet (CIRAD) for their help in organizing the field work