2001-2006 Trends in Amazon Forest Conversion Fires

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Classifying Fire Type

• Conversion fire: any fire that burns woody material from initial forest cover, not just in the year of deforestation.
• Maintenance fire: pasture or cerrado
• How do we determine what is burning?
  – Difficult to interpret optical data, or even fire energy detected at the satellite (FRP).
• Fire Persistence or Repeated Burning may be better measures; only possible with MODIS geolocation accuracy.
• Critical component for emissions estimates, both total C loss and CO$_2$:CO ratio
Concept

• Multiple fire detections corresponding to same source for woody material. 1 km radius determined from gas flare study. Threshold for fire days from comparisons between deforestation and cerrado fires.
  – Terra only: $\geq 2$ fire days per 1 km radius
  – Terra and Aqua: $\geq 3$ fire days per 1 km radius
• Useful to determine spatial patterns of burning, total amount of area involved in woody (persistent) burning, and trends in the number of fire detections associated with high-density burning.
• Elvidge et al. 2001 Roraima fires with DMSP, Giglio et al. 2006 for GFED emissions model.
Conversion Fire Examples

2002 Deforestation
2,500 ha, 79 fire detections

2003
35 detections

2004
91 detections

2005
19 detections

Years of Woody Burning 2001-2005

0
1
2
3
4

Woody Burning
Intensity of Conversion Fire Activity by Transition Type

Max Fire Days

% of Polygons

Crop
Pasture
NIP
Seasonality of Fires by Conversion Type

- Forest-Crop
- Forest-Pasture
- Other Conversion (>2 Fire Days)
- Maintenance

Percent of 2004 MODIS Fire Detections

Seasonality: January-May, June, July, August, September, October, November-December.
2001-2005 Trend in MODIS/Terra Woody Burning

Legend:
- Red: Decrease
- Green: Increase
- Dark Green: Strong Increase
MODIS Terra/Aqua Fire Detections 2003-2006*

*2006 fire detections through 9-15-06
Low-frequency fires in new deforestation increase repeated burning fraction 2%
Conclusions

• Repeated burning accounts for half (48%) of MODIS fire detections in MT, PA, AC, AM, RO in 2003-2006.
• Comission/Omission: Automated approach is conservative.
  – Cool fires (5%, see Csiszar/Schroeder Poster)
• Seasonality and frequency of conversion fires is a function of subsequent land use.
  – Timing of emissions
  – Possibility of escaped fires
• Trends in conversion fire activity are similar to deforestation trends, but show evidence of “carry-over” of burning activity between years.
• Possible to apportion fire emissions by duration of conversion and post-clearing land use (DeFries, Friday).
Conclusions-2

• Important inter-annual variability exists in patterns of woody burning among Amazon states in terms of area contributing to repeated burning, % MODIS detections, and sum 01-05.
• Method has applications for real-time monitoring of forest clearing activities, fire types, and emissions estimates.
• What causes different patterns in repeated burning?
  – Climate
  – Type of deforestation/increased mechanization of clearing and management.
  – Repeated burning easier to detect with MODIS-type satellites.
  – Small properties contribute a small fraction of repeated burning detections.
  – Understory fires, cerrado and regrowth conversions
Questions
Number of MODIS 2004 Fire Detections

Distance from point source (m)

- Nigeria1
- Nigeria2
- Nigeria4
- Nigeria5
- Amazon1
Global Context

L. Giglio et al., 2006 JGR