2001-2006 Trends in Amazon Forest Conversion Fires

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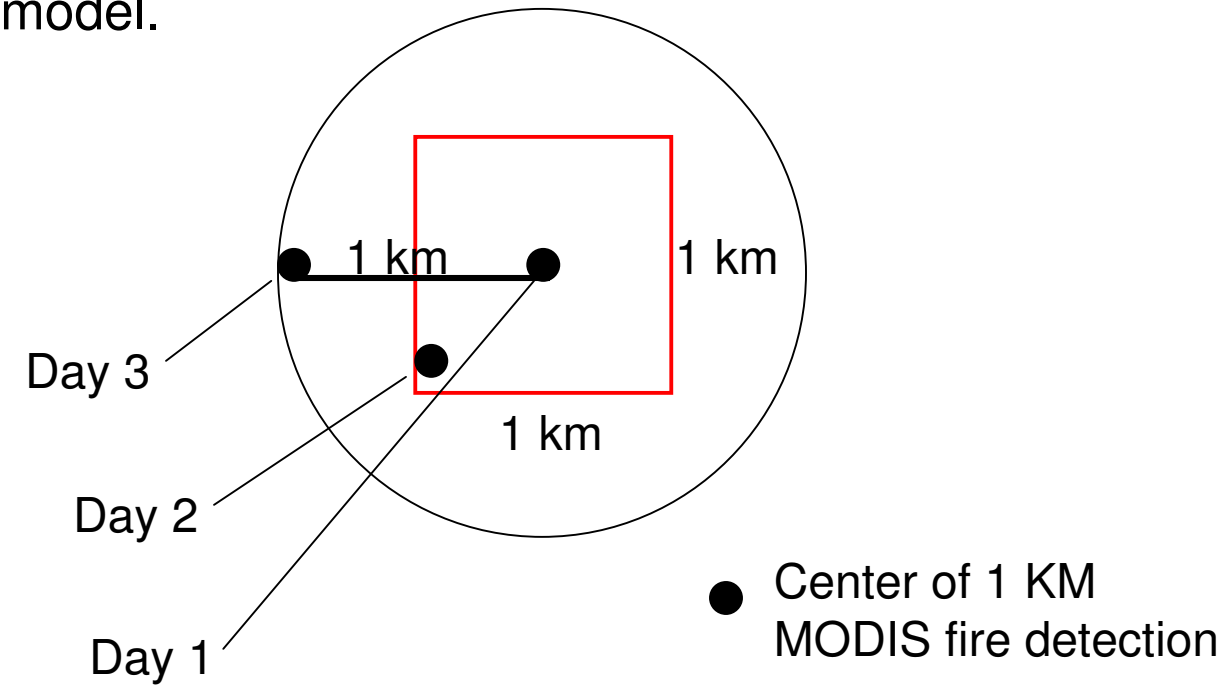
Classifying Fire Type

- 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

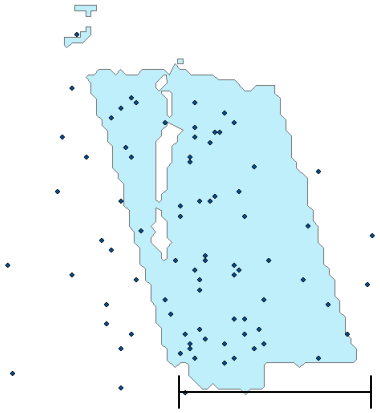
Concept

- 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: ≥2 fire days per 1 km radius
  - Terra and Aqua: ≥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.

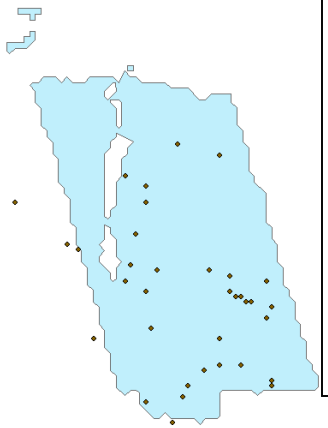


Conversion Fire Examples

2002 Deforestation
2,500 ha, 79 fire detections

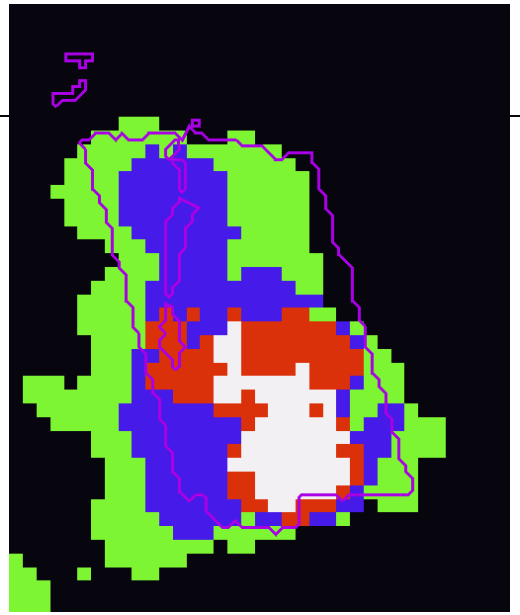


2003
35 detections

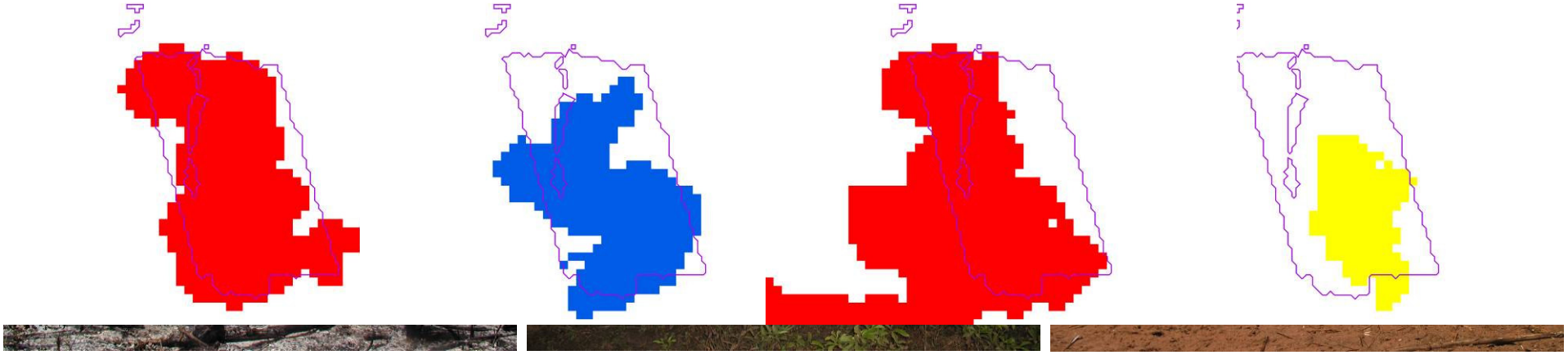


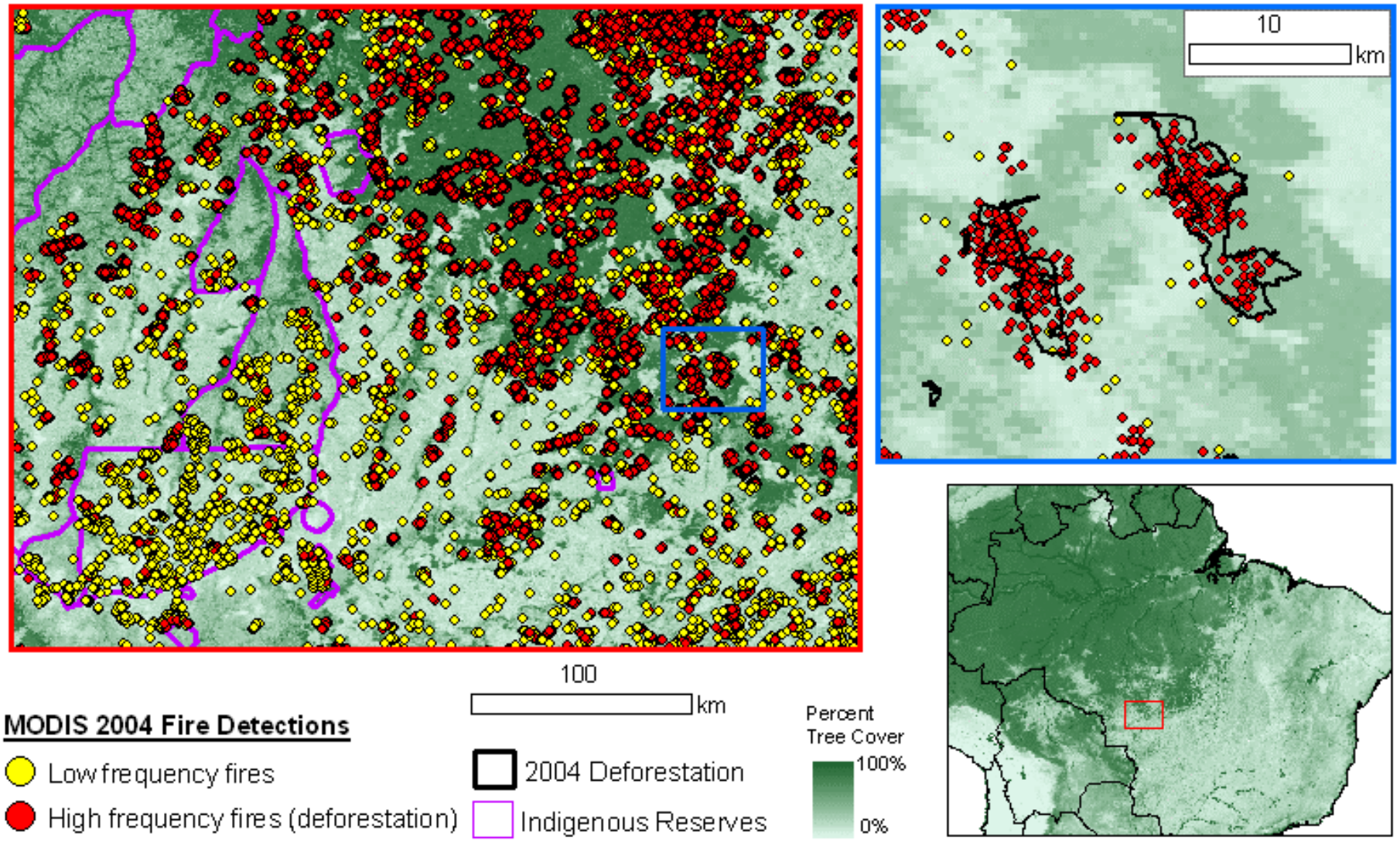
Years of Woody Burning 2001-2005

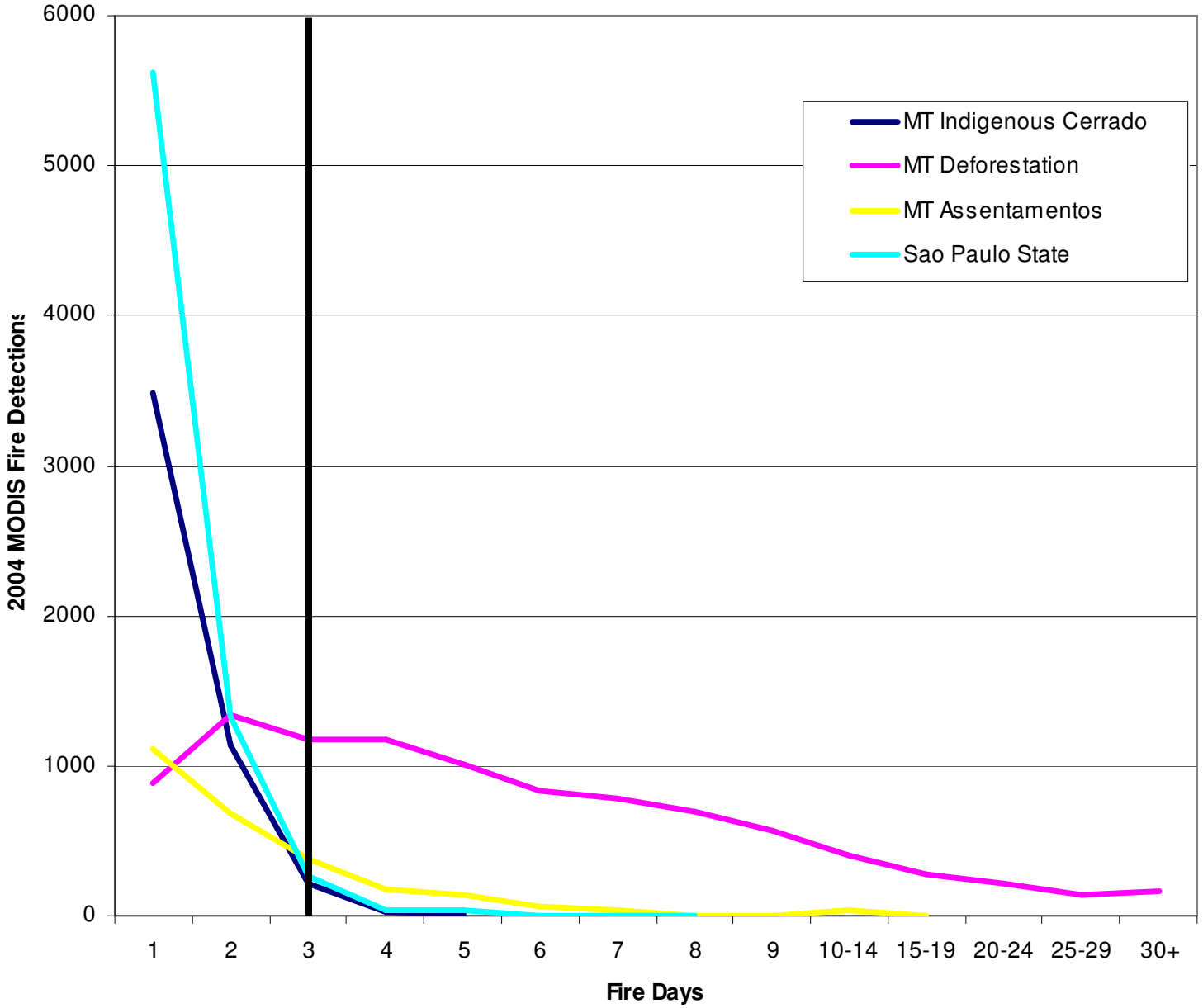
0
1
2
3
4

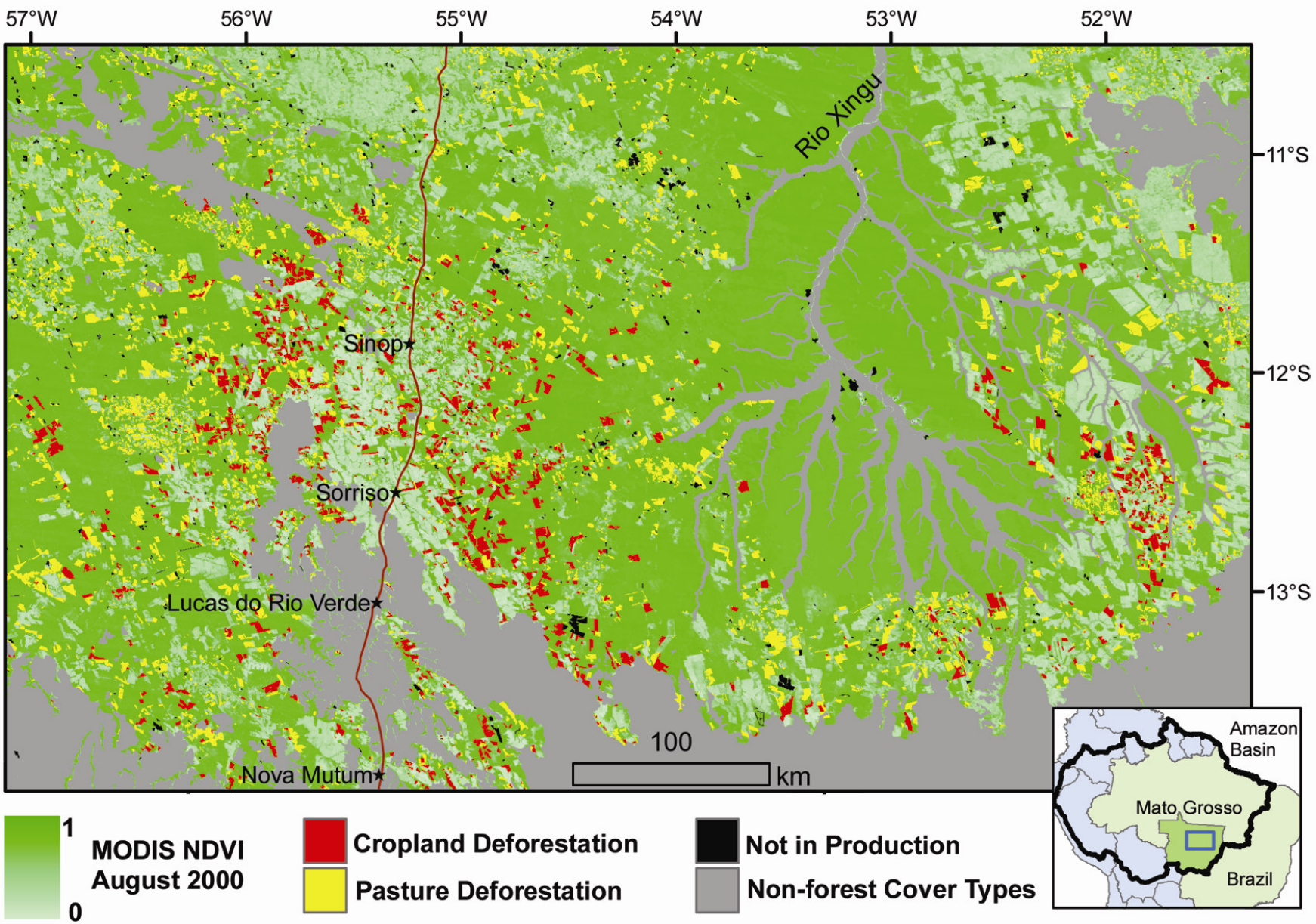


Woody Burning



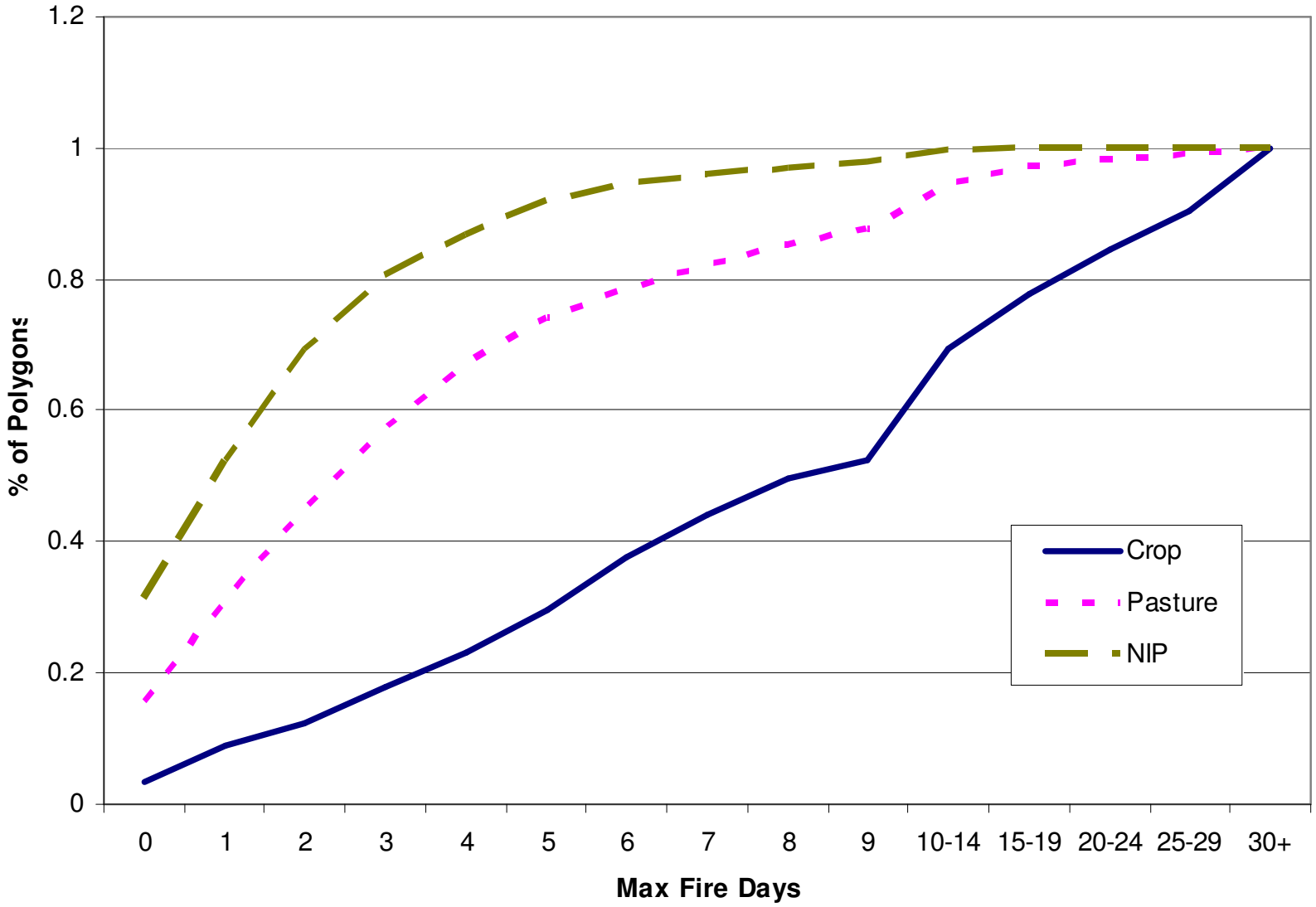

10
km
100
km
MODIS 2004 Fire Detections
Low frequency fires
High frequency fires (deforestation)
2004 Deforestation
Indigenous Reserves
Percent
Tree Cover
100%
0%


6000
5000
4000
3000
2000
1000
0
2004 MODIS Fire Detections
MT Indigenous Cerrado
MT Deforestation
MT Assentamentos
Sao Paulo State
1
2
3
4
5
6
7
8
9
10-14
15-19
20-24
25-29
30+
Fire Days

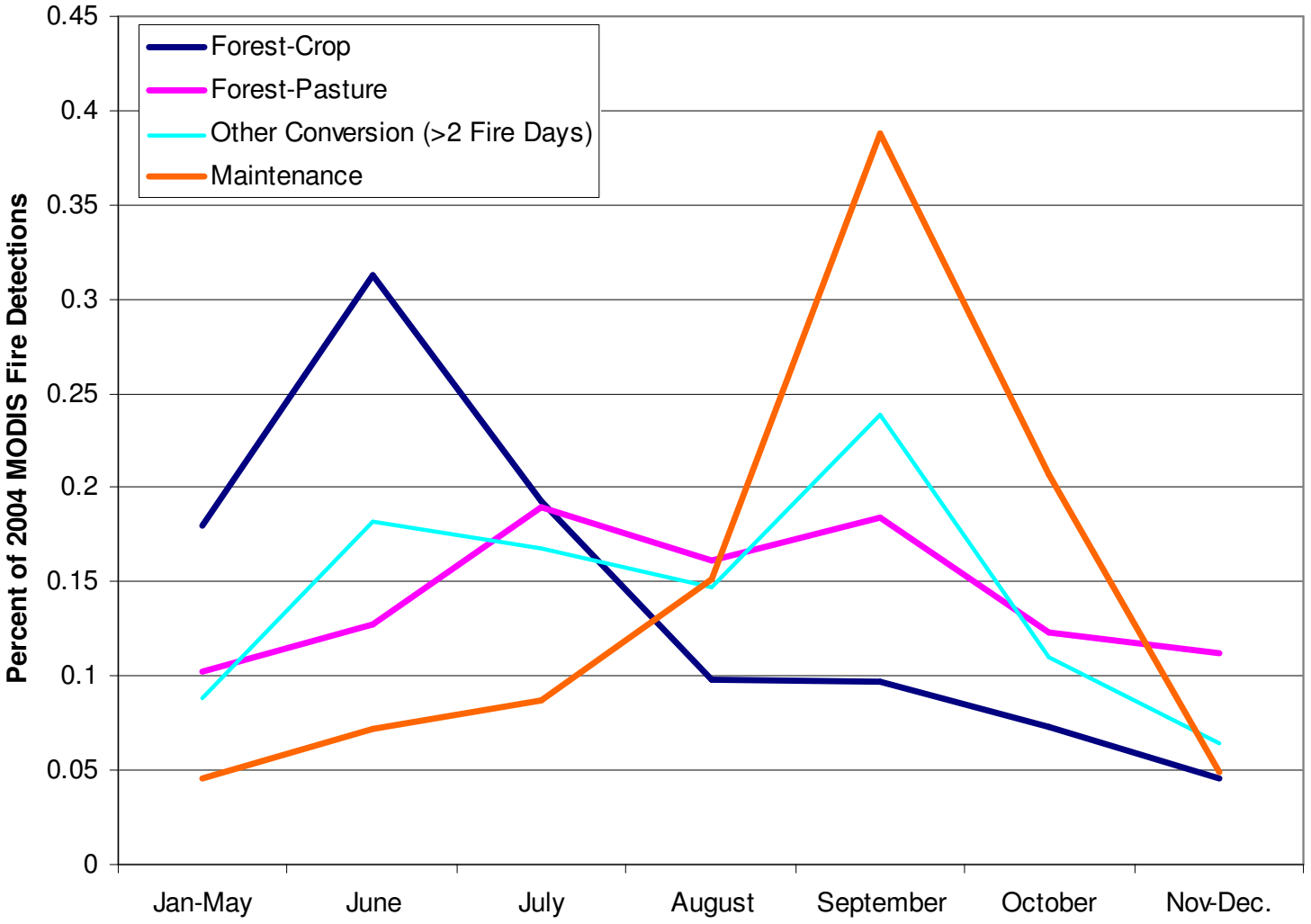


Morton et al., 2006 PNAS

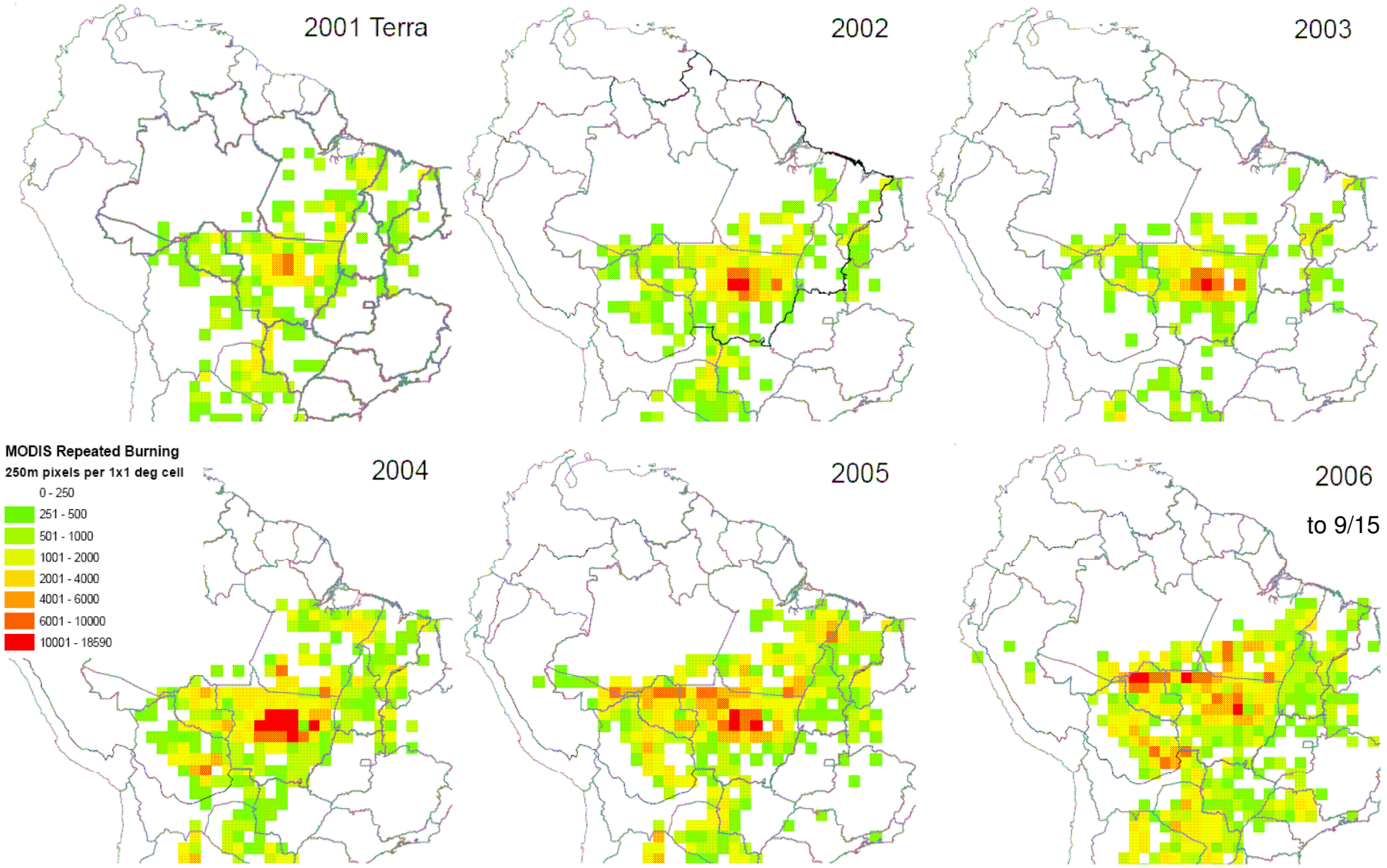
Intensity of Conversion Fire Activity by Transition Type



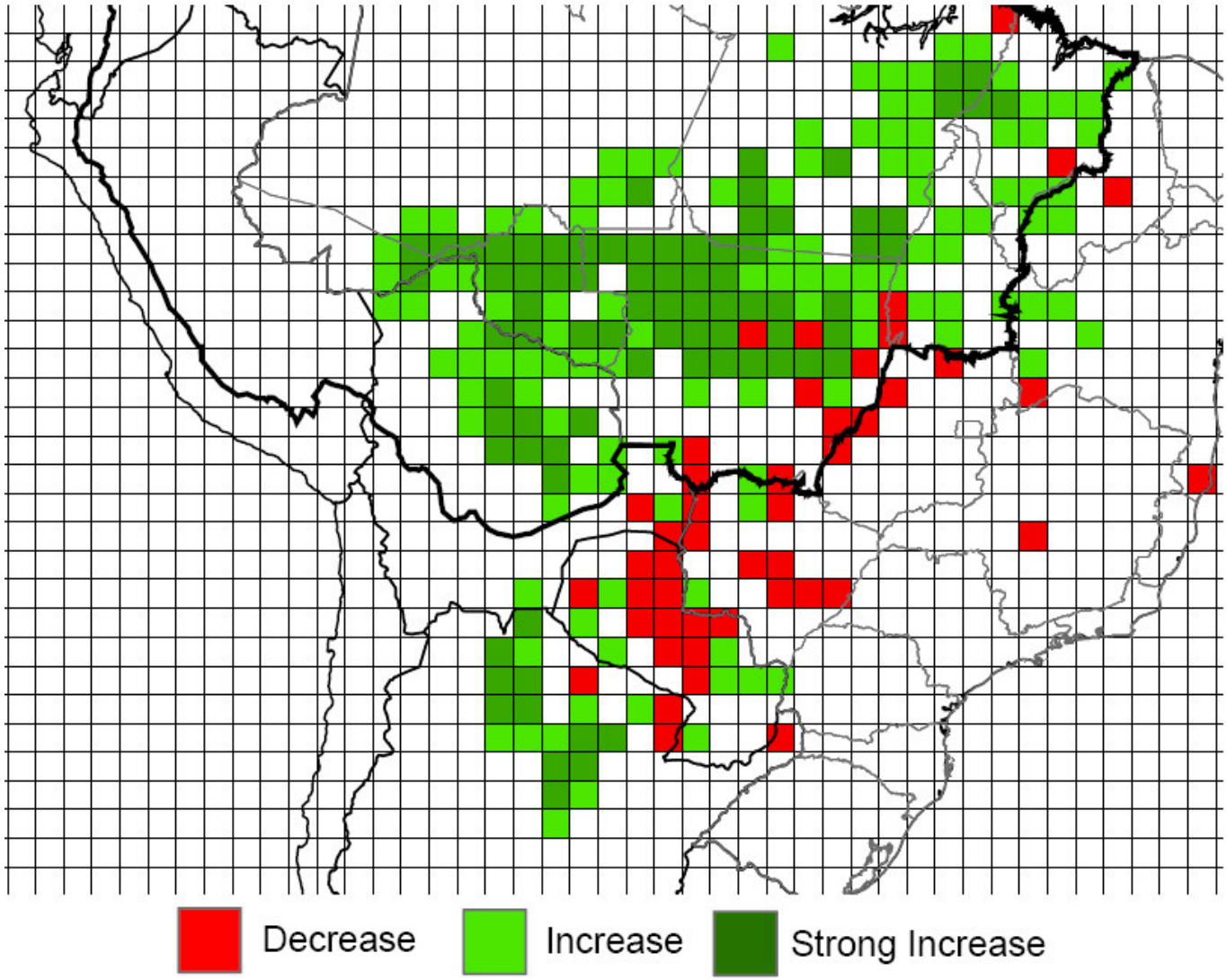
Seasonality of Fires by Conversion Type



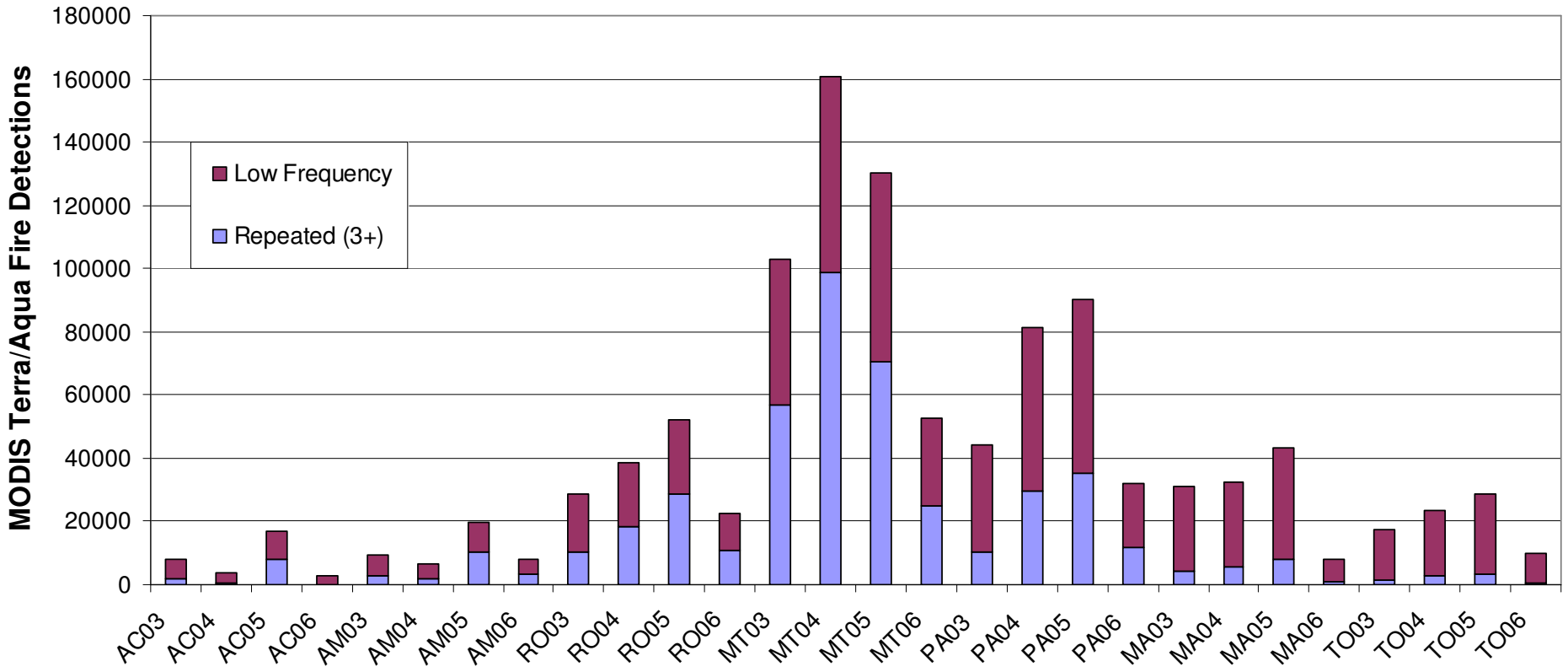
MODIS/Terra Repeated Burning Patterns 2001-2006 SHSA



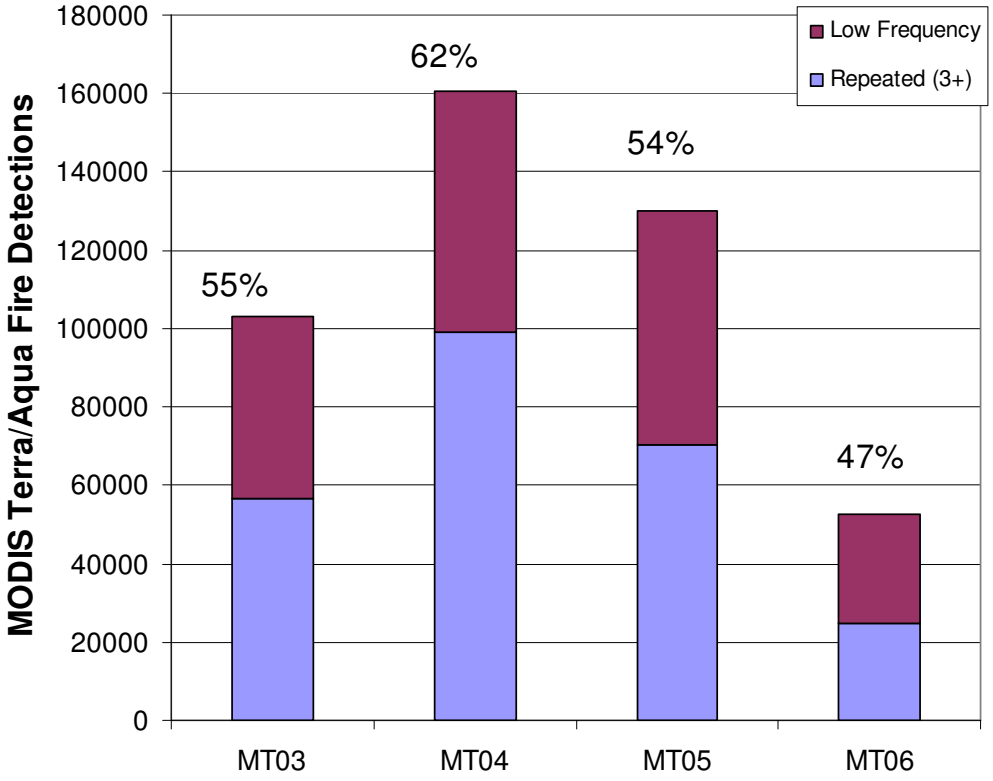
2001-2005 Trend in MODIS/Terra Woody Burning

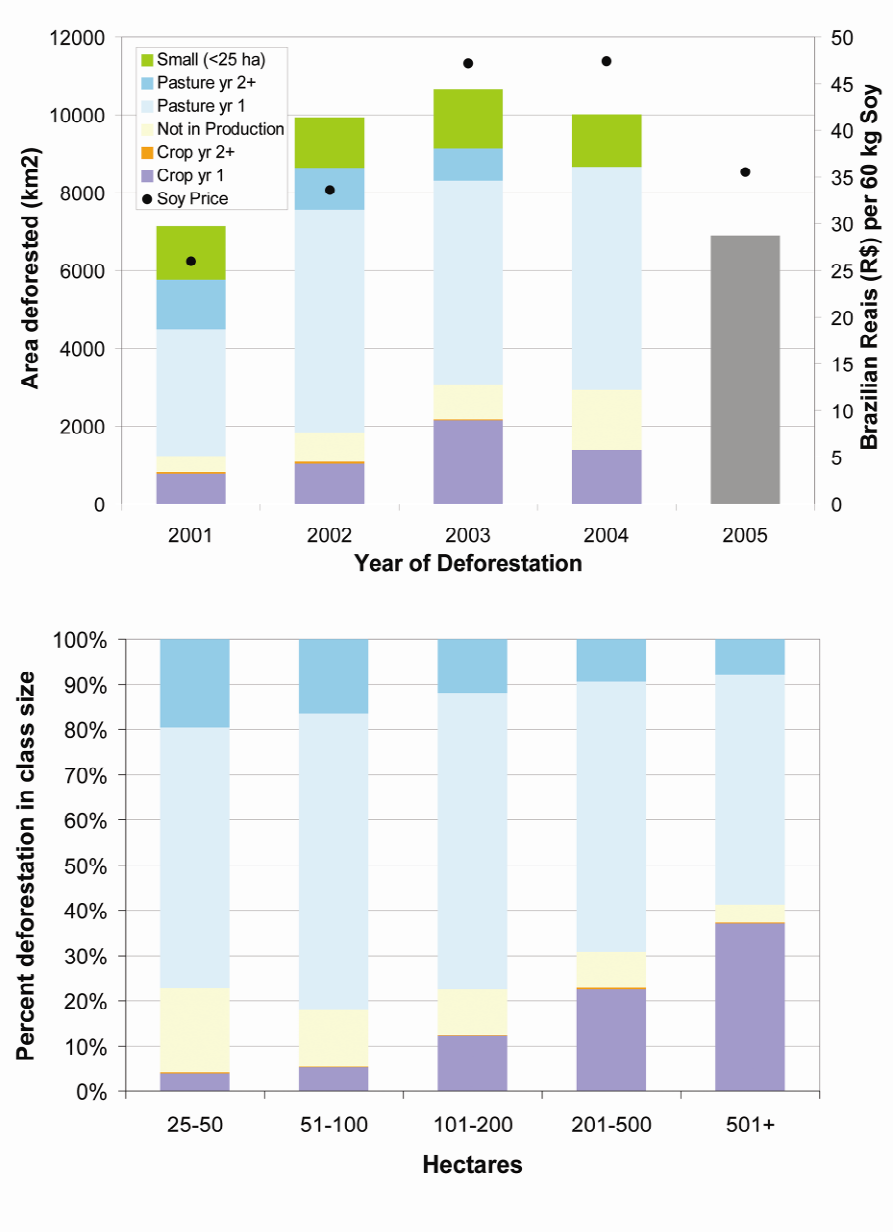


MODIS Terra/Aqua Fire Detections 2003-2006*



*2006 fire detections through 9-15-06





Low-frequency fires in new deforestation increase repeated burning fraction 2%

Morton et al., 2006 PNAS

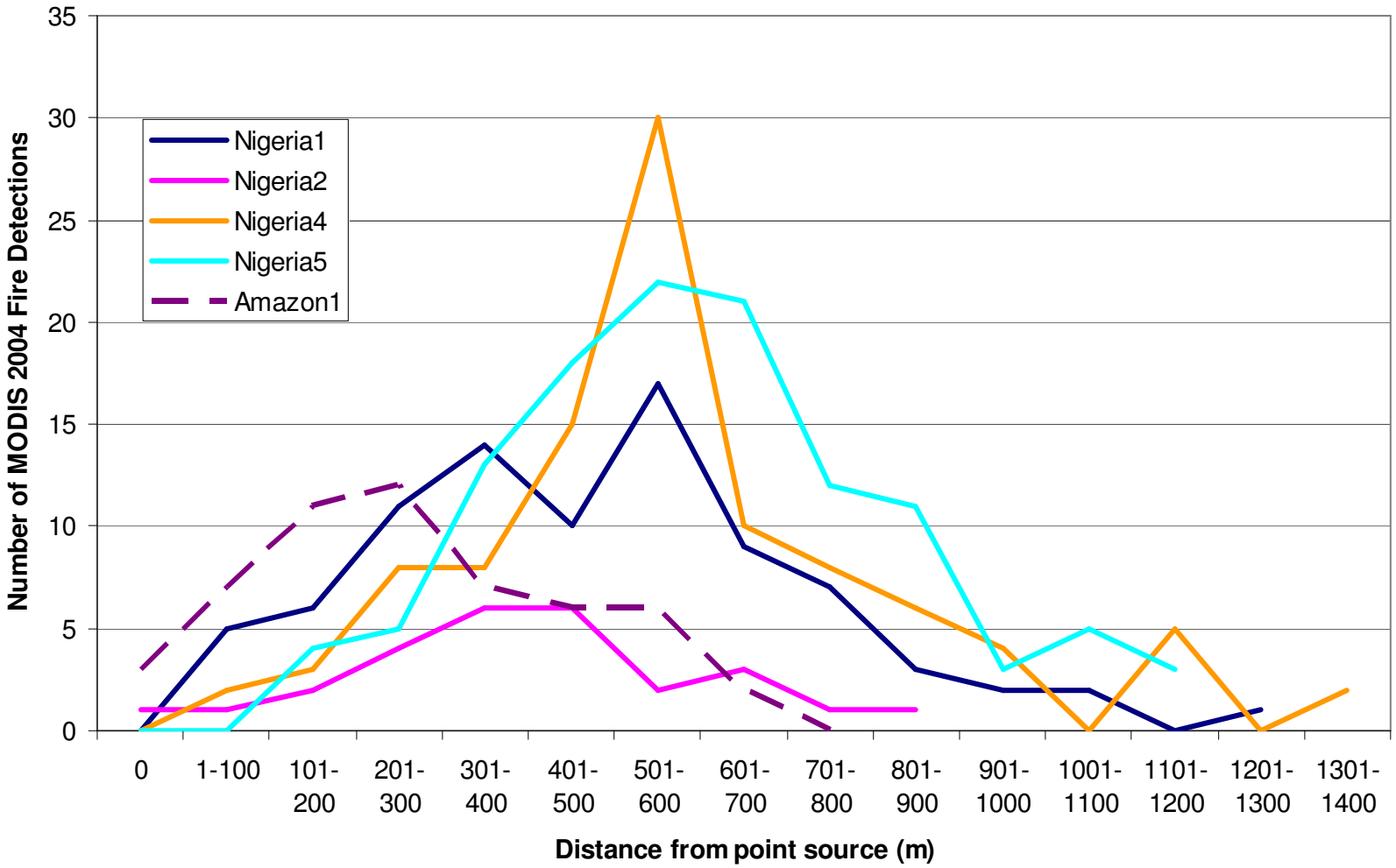
Conclusions

- 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).

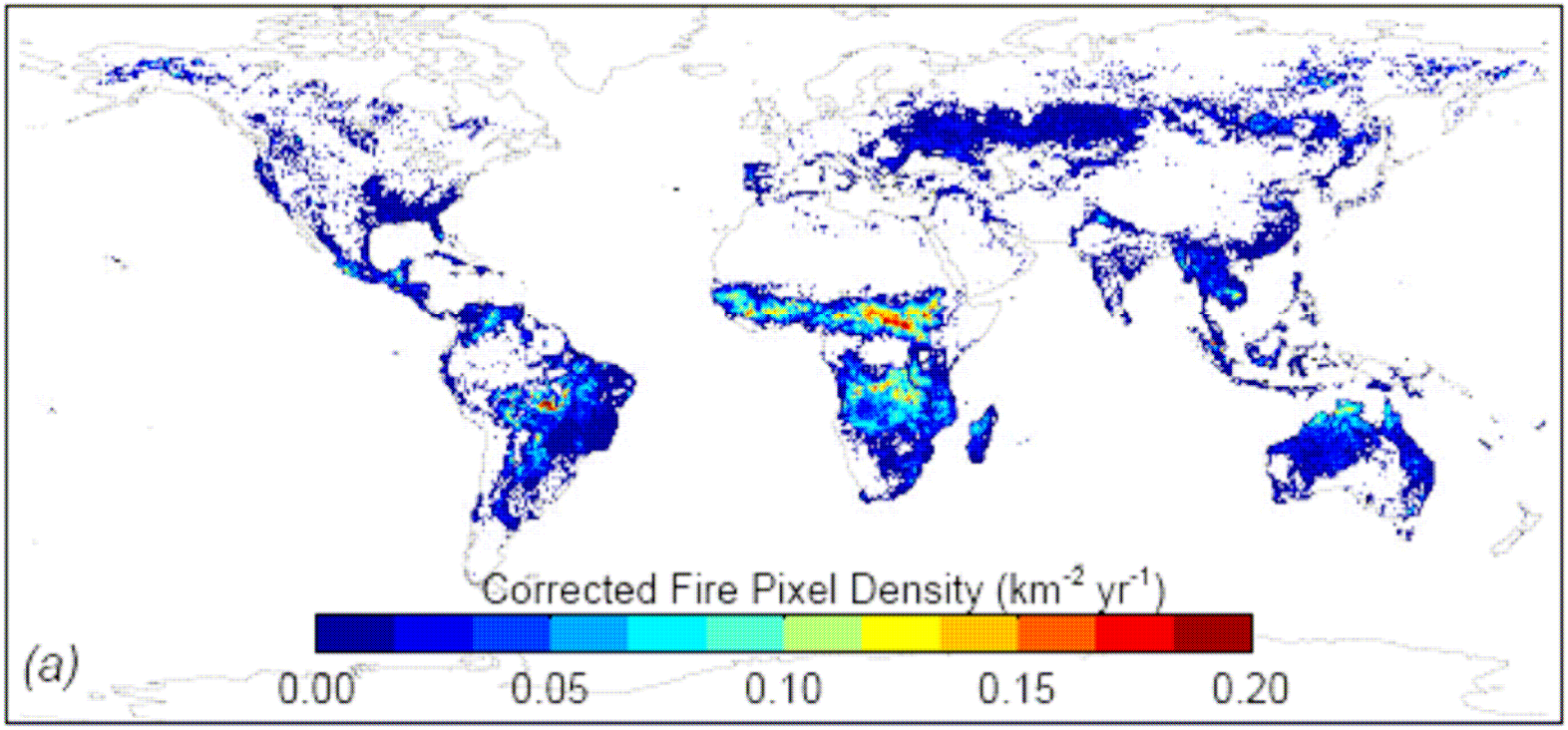
Conclusions-2

- 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.
  - Important increases in AC, AM, RO and decreases in MT 2004-2005.
- 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
35
30
25
20
15
10
5
0
Nigeria1
Nigeria2
Nigeria4
Nigeria5
Amazon1
0
1-100
101-200
201-300
301-400
401-500
501-600
601-700
701-800
801-900
901-1000
1001-1100
1101-1200
1201-1300
1301-1400
Distance from point source (m)

Global Context



L. Giglio et al., 2006 JGR