

Estimating Interannual Variability of Carbon Emissions from Land Use-Related Fires in the Southern Amazon

R. DeFries, University of Maryland College Park

Y. Shimabukuro, INPE

G. Van der Werf, Vrije Uiversiteit Amsterdam, The Netherlands

G.J. Collatz, NASA GSFC

D. Morton, University of Maryland College Park

J. Randerson, University of California Irvine

L. Giglio, SSAI

Estimates of carbon emissions from deforestation are highly uncertain

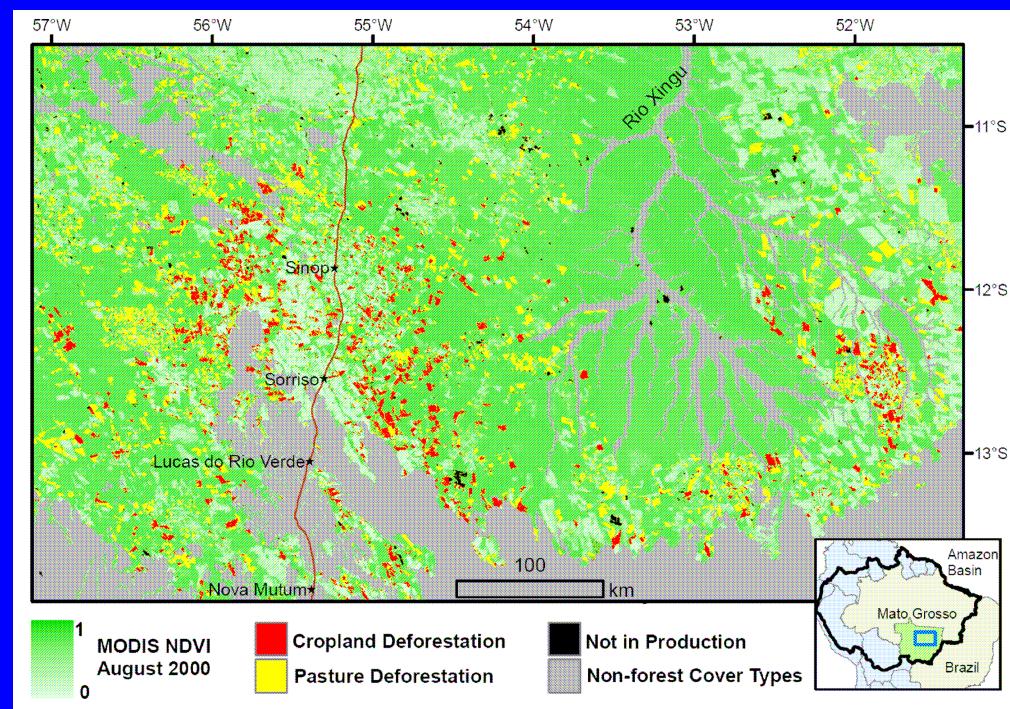
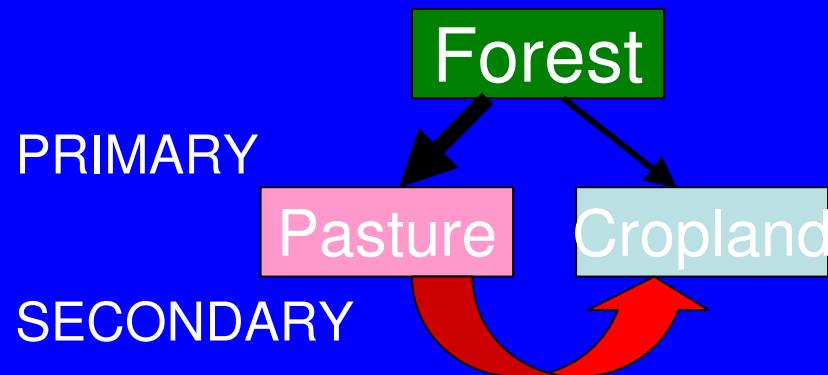
	1980's (PgC/yr)	1990's (PgC/yr)	Spatial coverage	Method for area	Method for carbon flux
Houghton (2003)	2.0	2.2	Global, 9 regions	FAO and inventories	Bookkeeping
Fearnside (2000)	2.4	-	Pan-tropic, 6 regions	FAO and inventories	Bookkeeping
McGuire et al (2001)	0.9-1.6	-	Global	Cropland change	Ecosystem models
DeFries et al (2002)	0.6 (0.3-0.8)	0.9 (0.5-1.4)	Pan-tropics	AVHRR	Bookkeeping
Achard et al (2004)	-	1.1 ± 0.3	Pan-tropics, sample	Landsat	Bookkeeping
Houghton et al (2000)	-	0.2	Amazon	Landsat-derived	Bookkeeping
Fearnside (1997)	-	0.261	Brazilian Amazon	Landsat-derived	Bookkeeping, committed flux
Potter et al (2001)	-	0.2-1.2	Legal Amazon	Satellite-derived fire	Fire emission and ecosystem model, gross flux
Van der Werf et al (2003)	-	2.6 fires + 1.2 decomposition (1998-2001)	Tropics and subtropics	Satellite-derived fire	Fire emission and ecosystem model, gross flux

Objectives

- Reduce uncertainties of interannual carbon emissions from deforestation
- Assess contributions of land management to emissions
- Incorporate satellite observations of fate of deforestation and active fire in emissions model
- Develop scalable approaches for whole basin
- Initial focus on Mato Grosso at 250m MODIS resolution



MULTIPLE LAND MANAGEMENT TRAJECTORIES



(from Morton et al, 2006)

FATE OF DEFORESTATION IN MATO GROSSO 2001-04

Cropland
Expansion

Deforestation

Forest→Not in Production
 $3,609 \text{ km}^2$

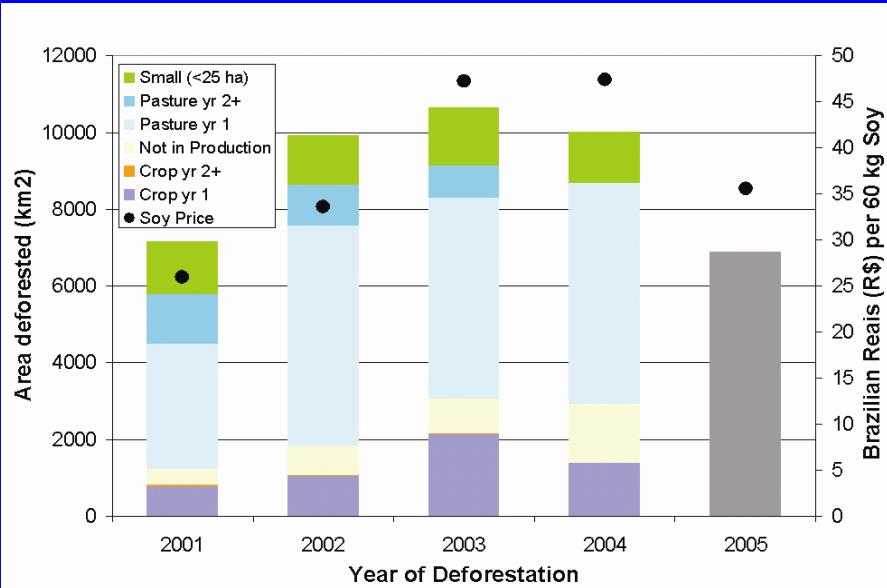
Cerrado→Crop
 $5,770 \text{ km}^2$

Forest→Crop
 $4,670-5,463 \text{ km}^2$

Pasture→Crop
 $5,930 \text{ km}^2$

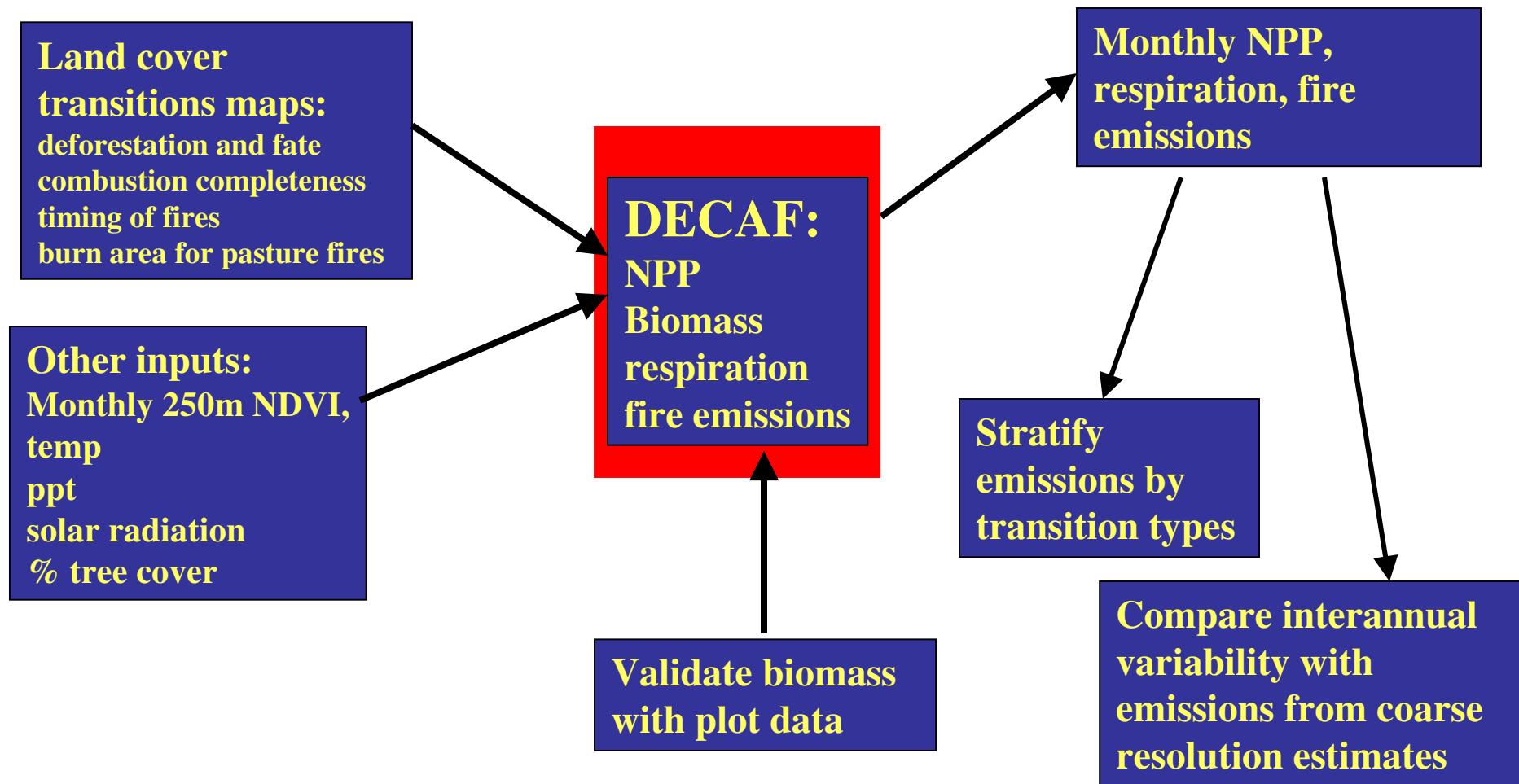
Forest→Pasture
 $23,463 \text{ km}^2$

Forest→Small (<25ha)
 $5,562 \text{ km}^2$



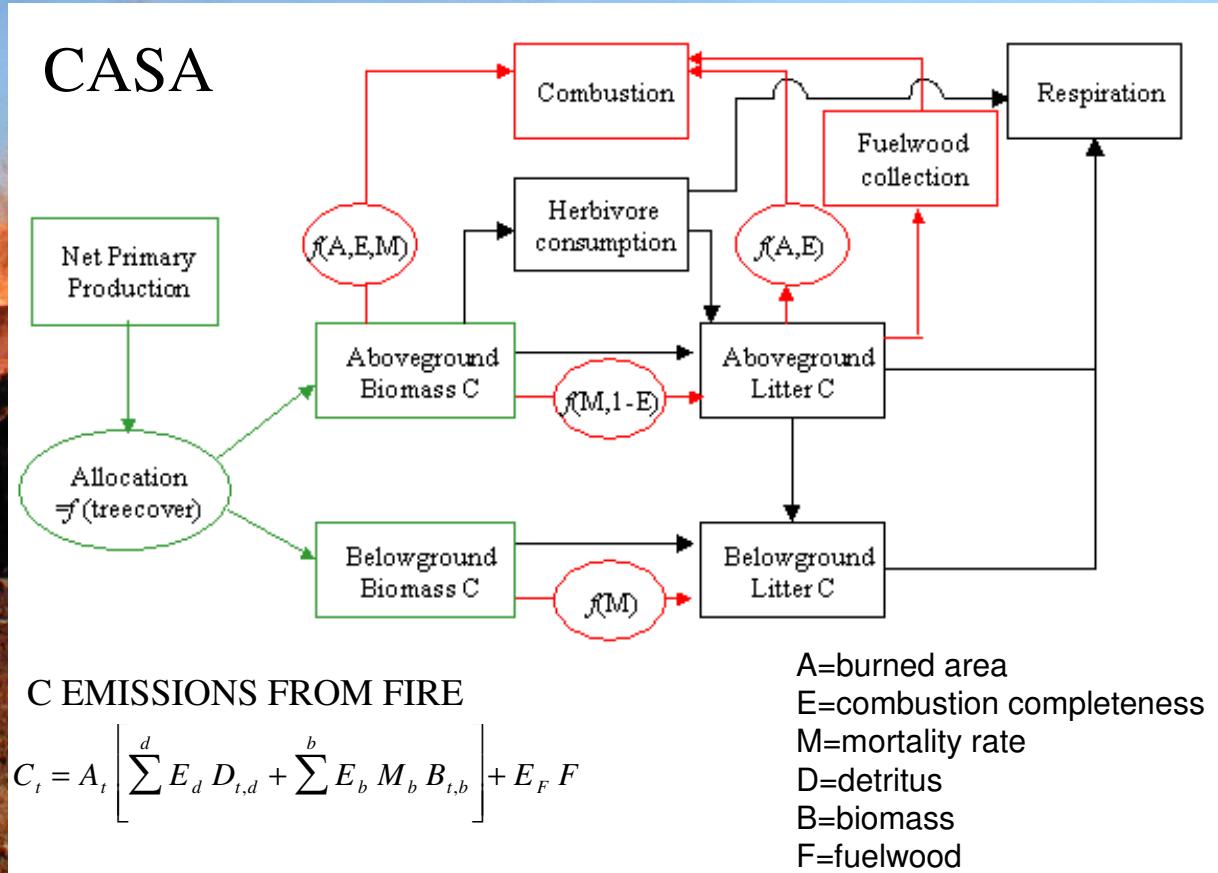
(Morton et al., PNAS, 2006)

MODEL APPROACH TO ESTIMATE CARBON EMISSIONS FROM DEFORESTATION



DECAF MODIFICATIONS FROM CASA

- runs on 250m MODIS monthly NDVI
- Includes timing of fires and combustion completeness as function of land management



Combustion completeness as function of land management

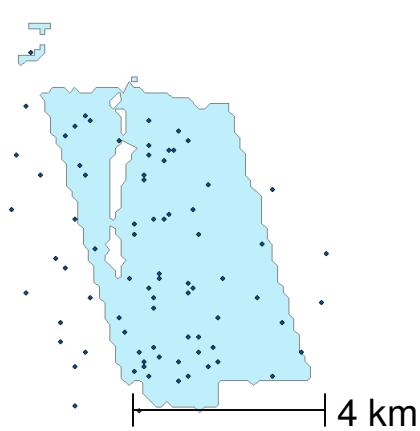
BURNING TRAJECTORIES IN DECAF:
Pasture management
Savanna to cropland
Forest to cropland
Forest to pasture
Forest to regrowth

Characteristic sequence of times of burning over multiple years for trajectories from MODIS active fire

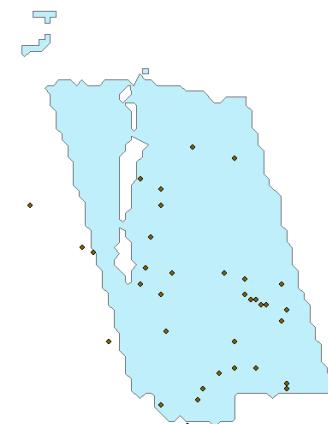


Conversion Fire Examples

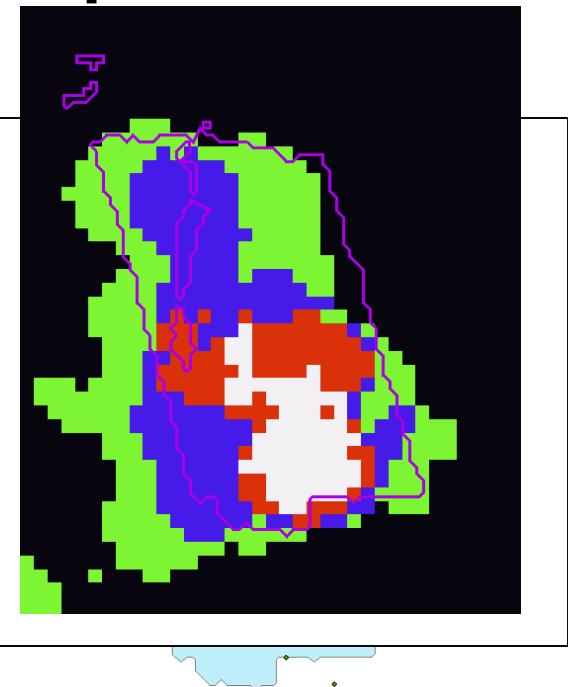
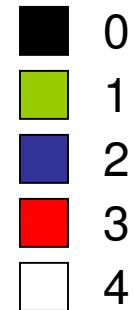
2002 Deforestation
2,500 ha, 79 fire
detections



2003
35 detections

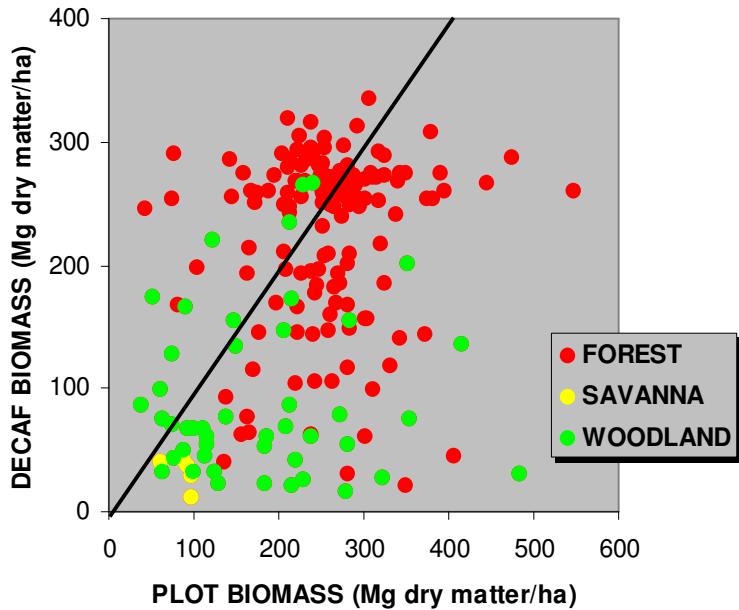


Years of Woody
Burning 2001-2005



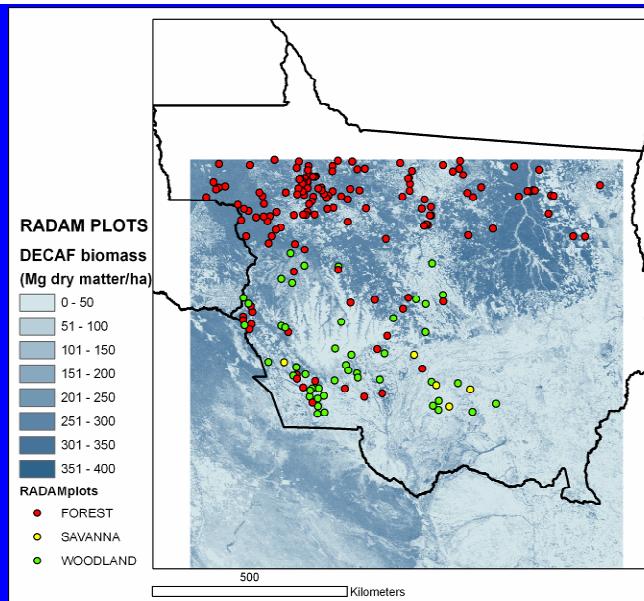
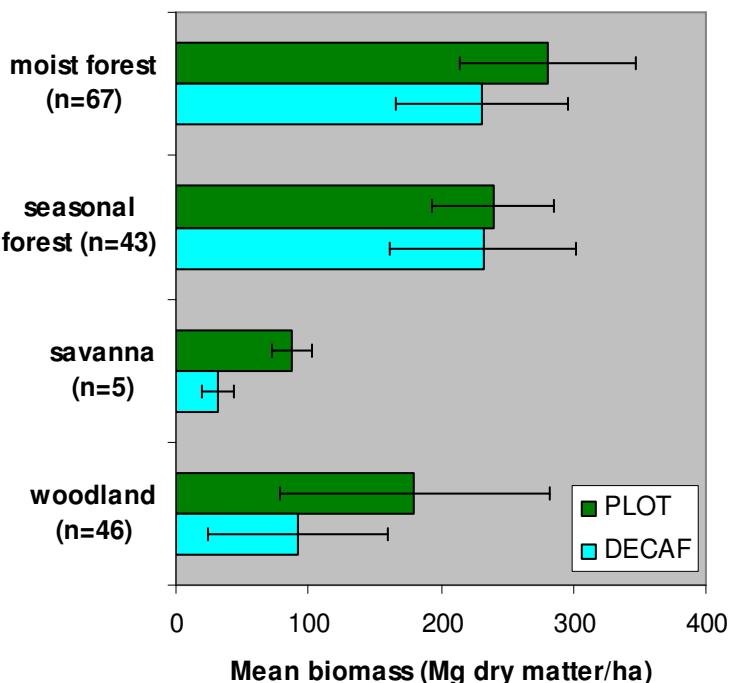
COMPARISON OF DECAF BIOMASS ESTIMATES WITH RADAM PLOT DATA

BIOMASS ESTIMATES FROM PLOT LOCATIONS AND DECAF

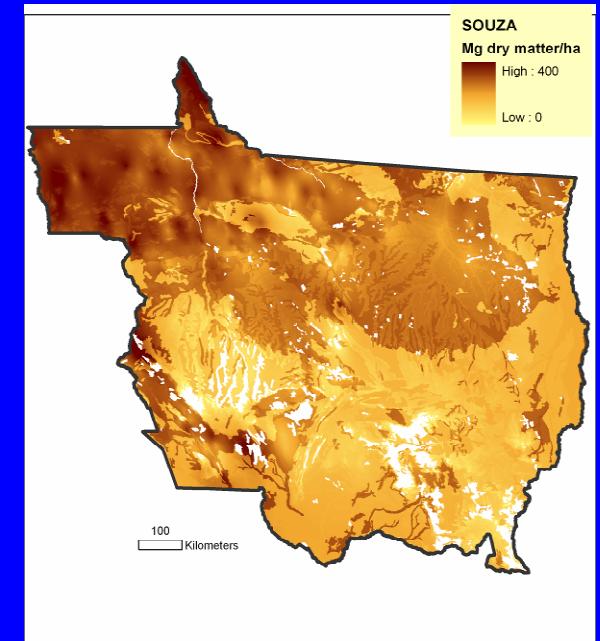
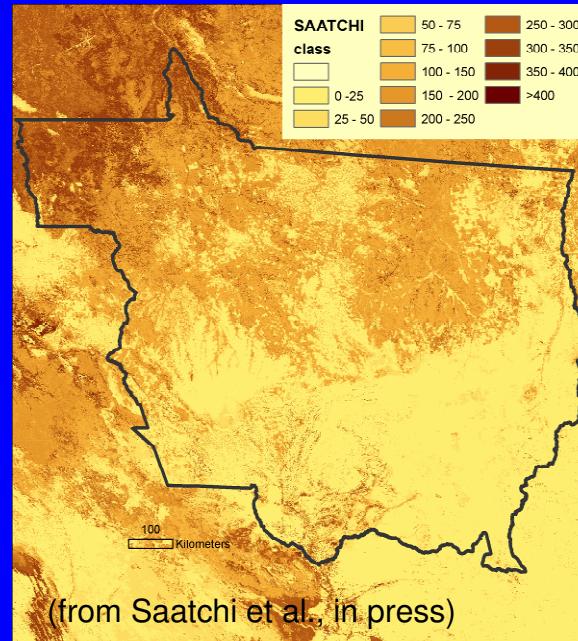
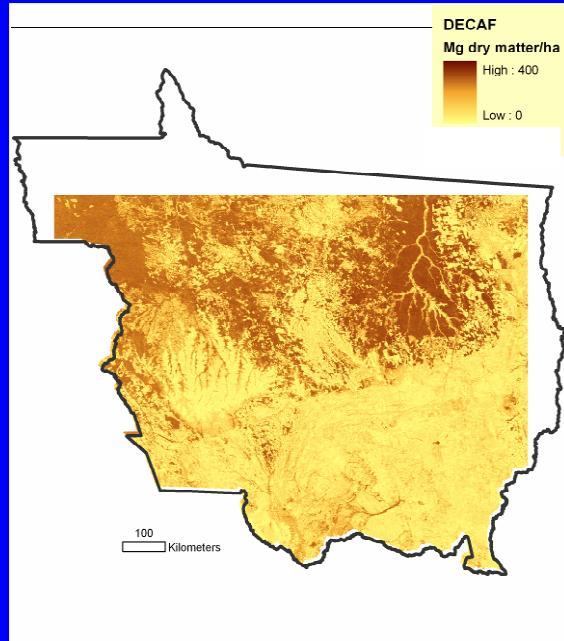


(thanks to Carlos Souza, Jr. for plot data)

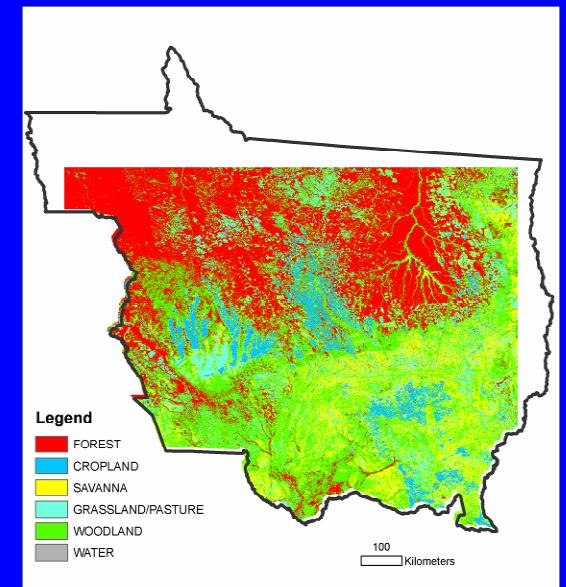
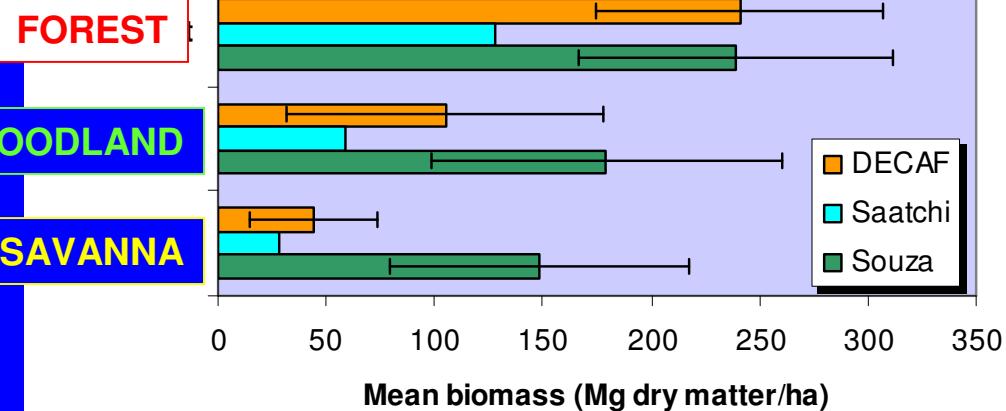
MEAN BIOMASS FROM PLOT LOCATIONS



COMPARISON WITH OTHER SPATIAL BIOMASS ESTIMATES

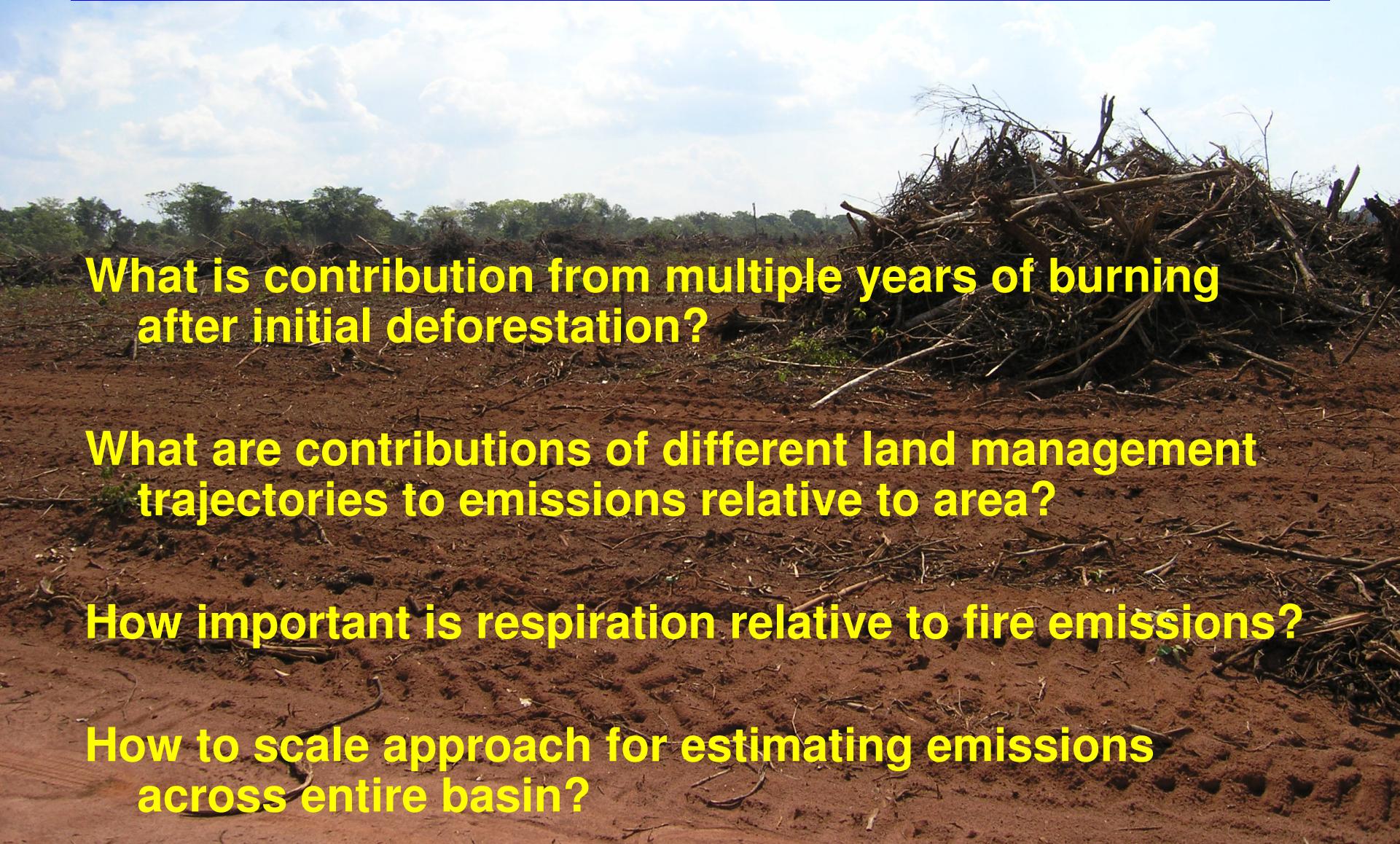


MEAN BIOMASS FOR LAND COVER CLASSES



(from Morton et al., in press)

Preliminary DECAF runs



What is contribution from multiple years of burning after initial deforestation?

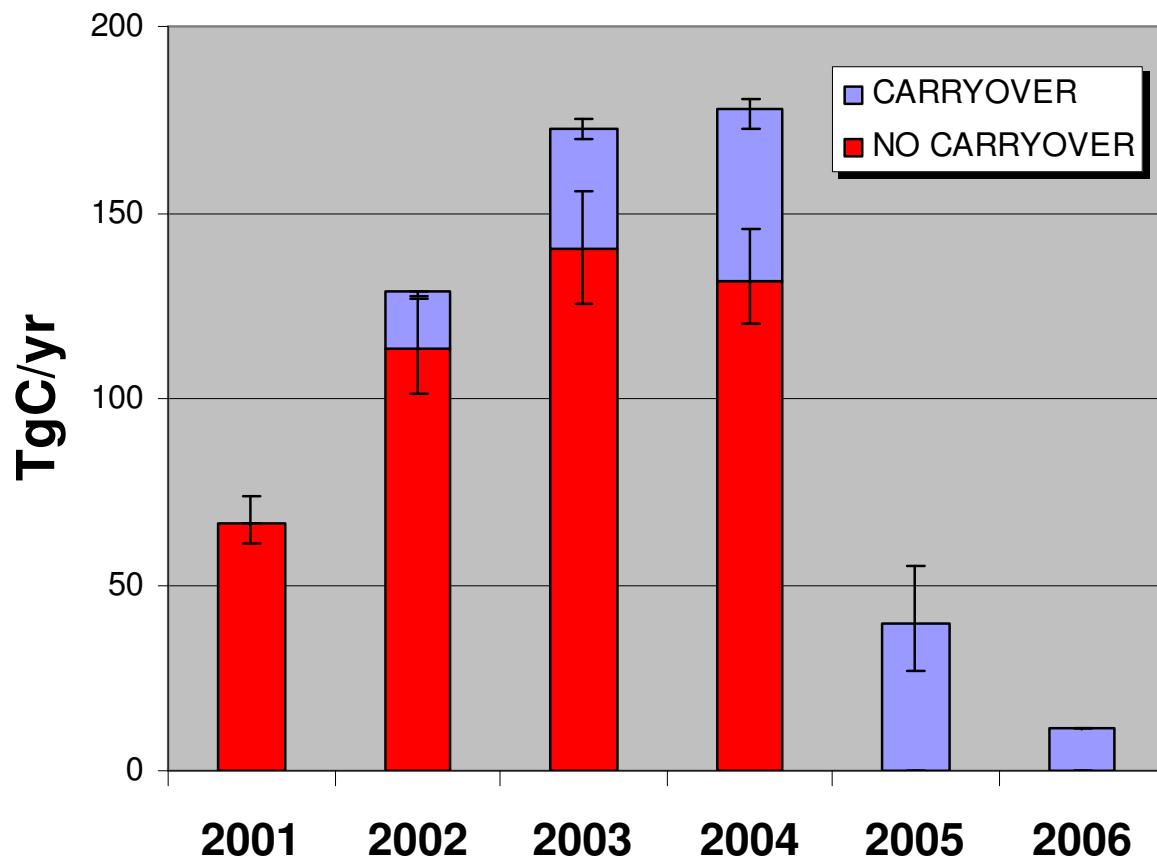
What are contributions of different land management trajectories to emissions relative to area?

How important is respiration relative to fire emissions?

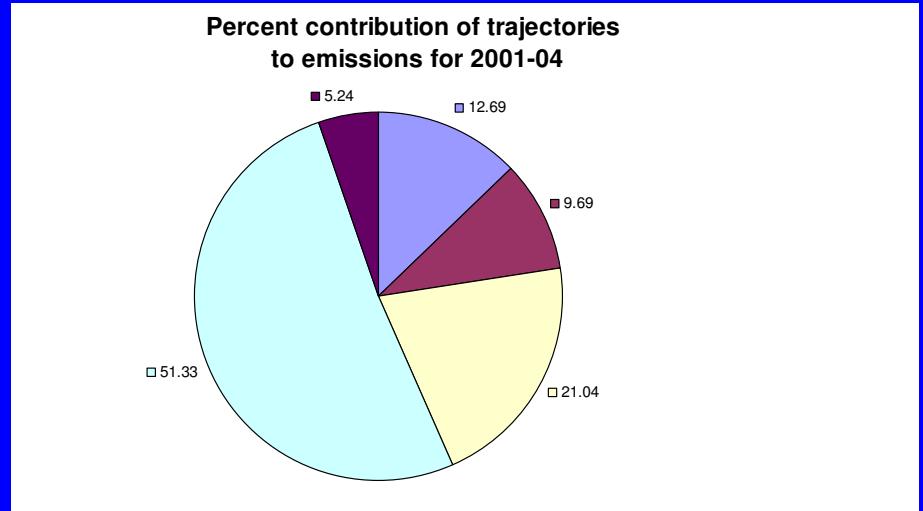
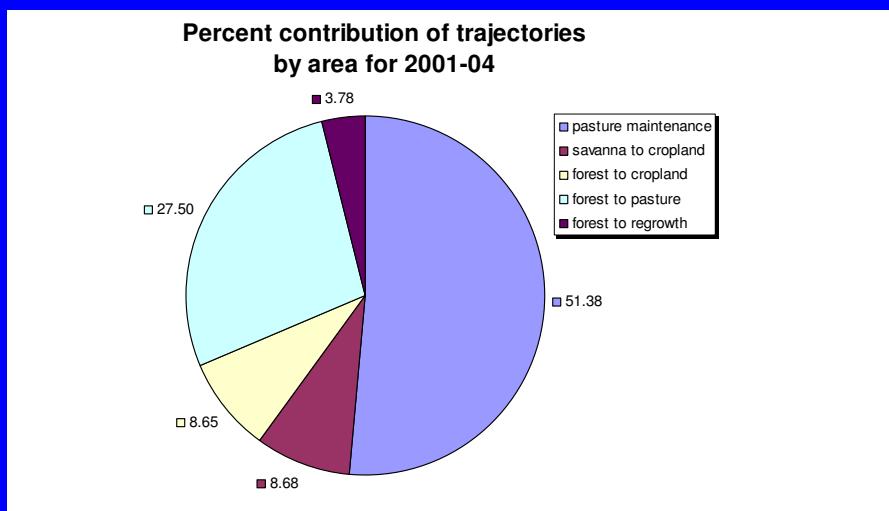
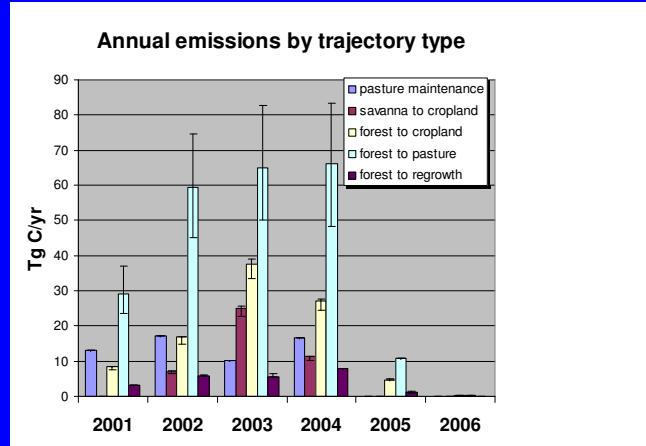
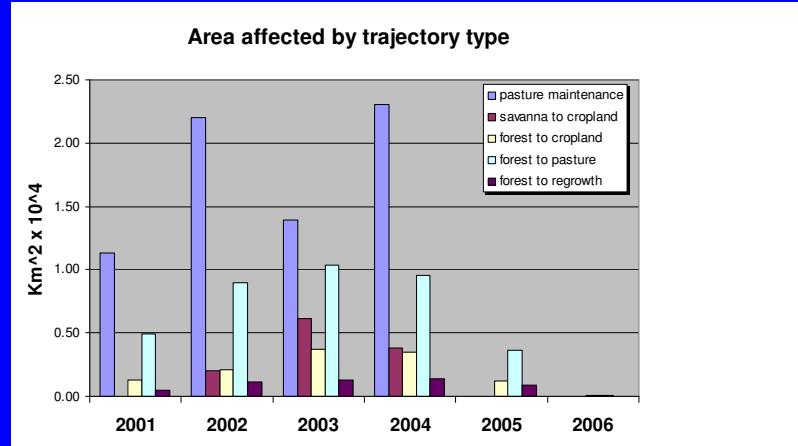
How to scale approach for estimating emissions across entire basin?

What is contribution from multiple years of burning after initial deforestation?

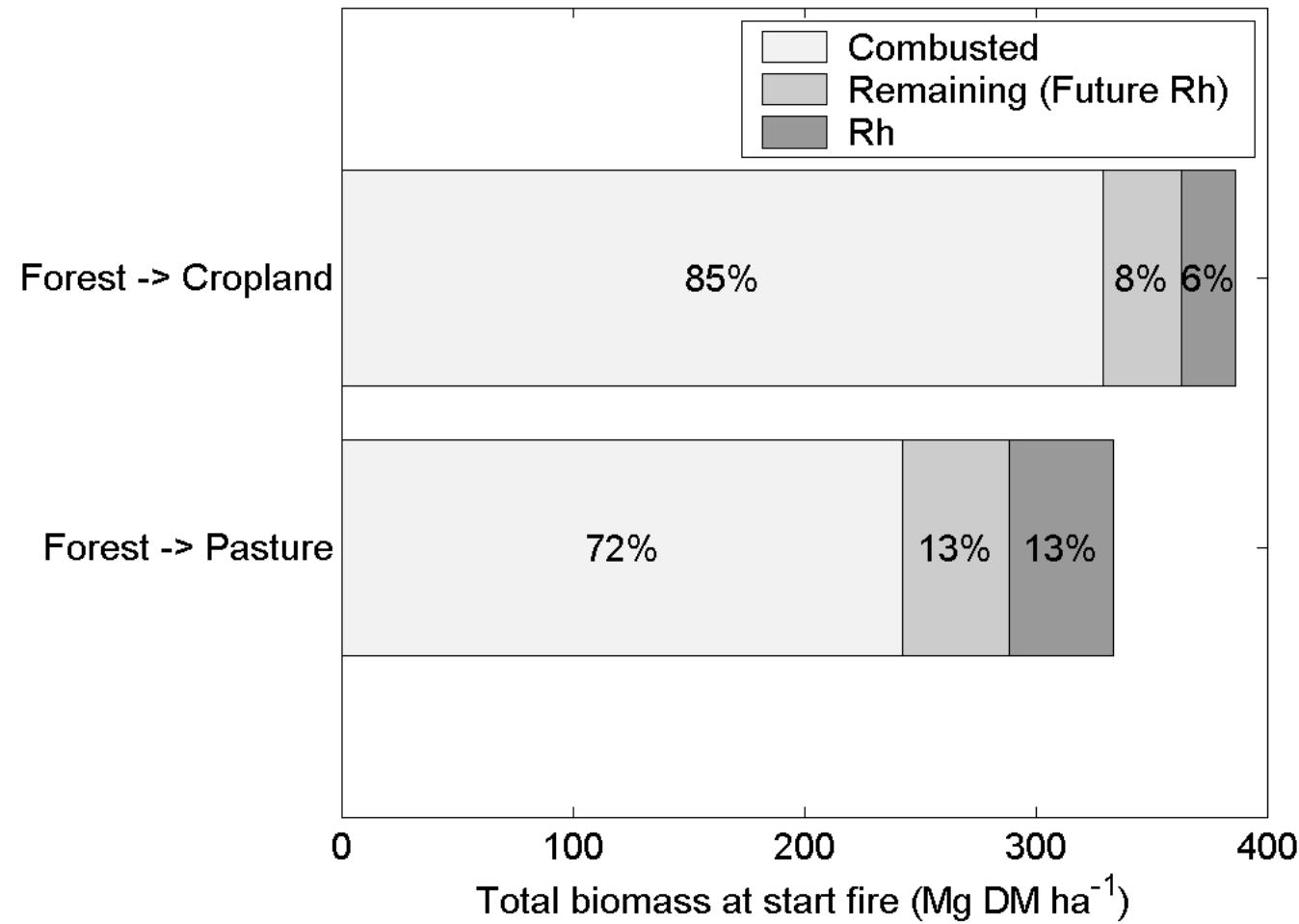
ANNUAL EMISSIONS FROM DEFORESTATION AND MAINTENANCE FIRES



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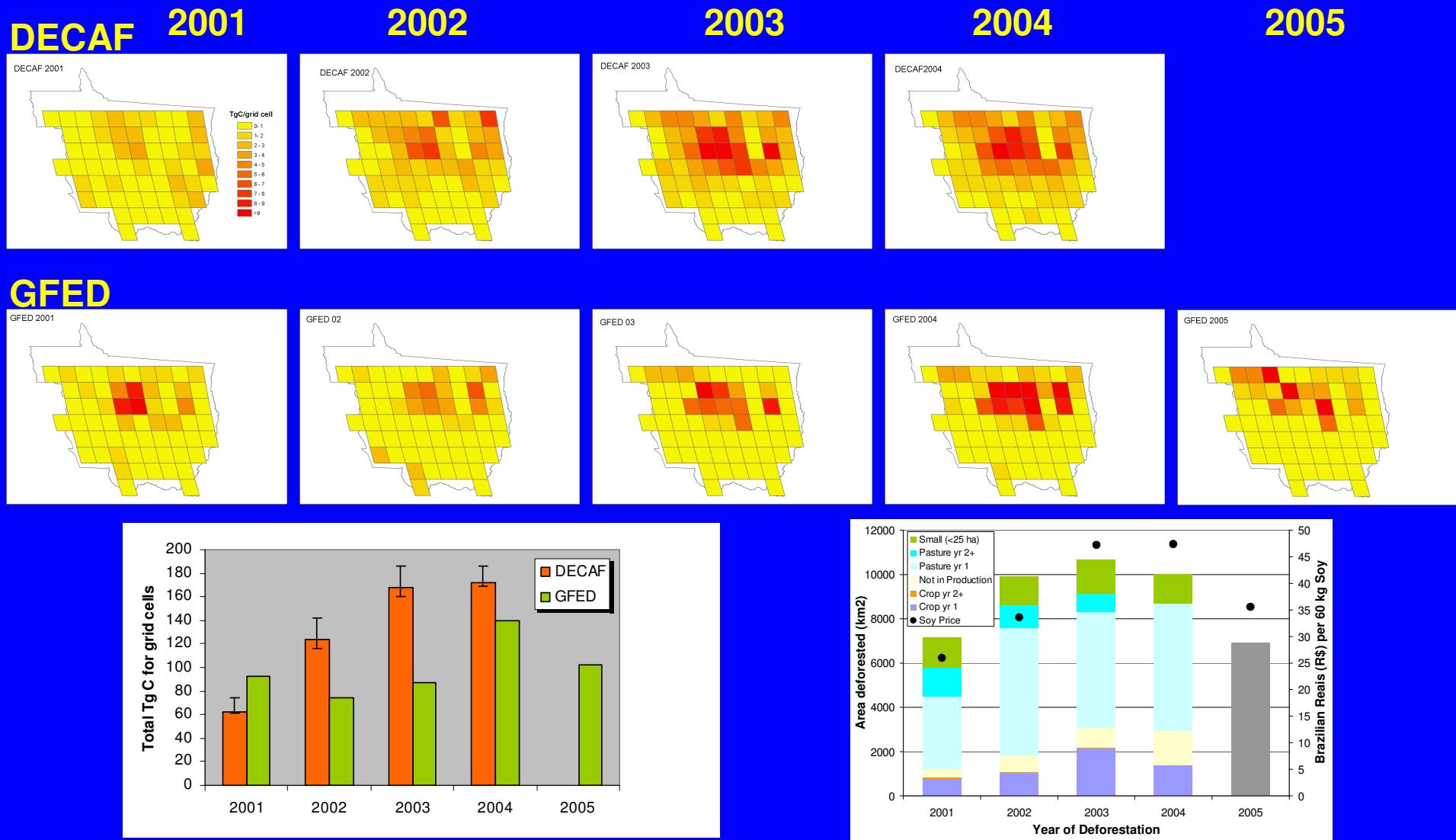


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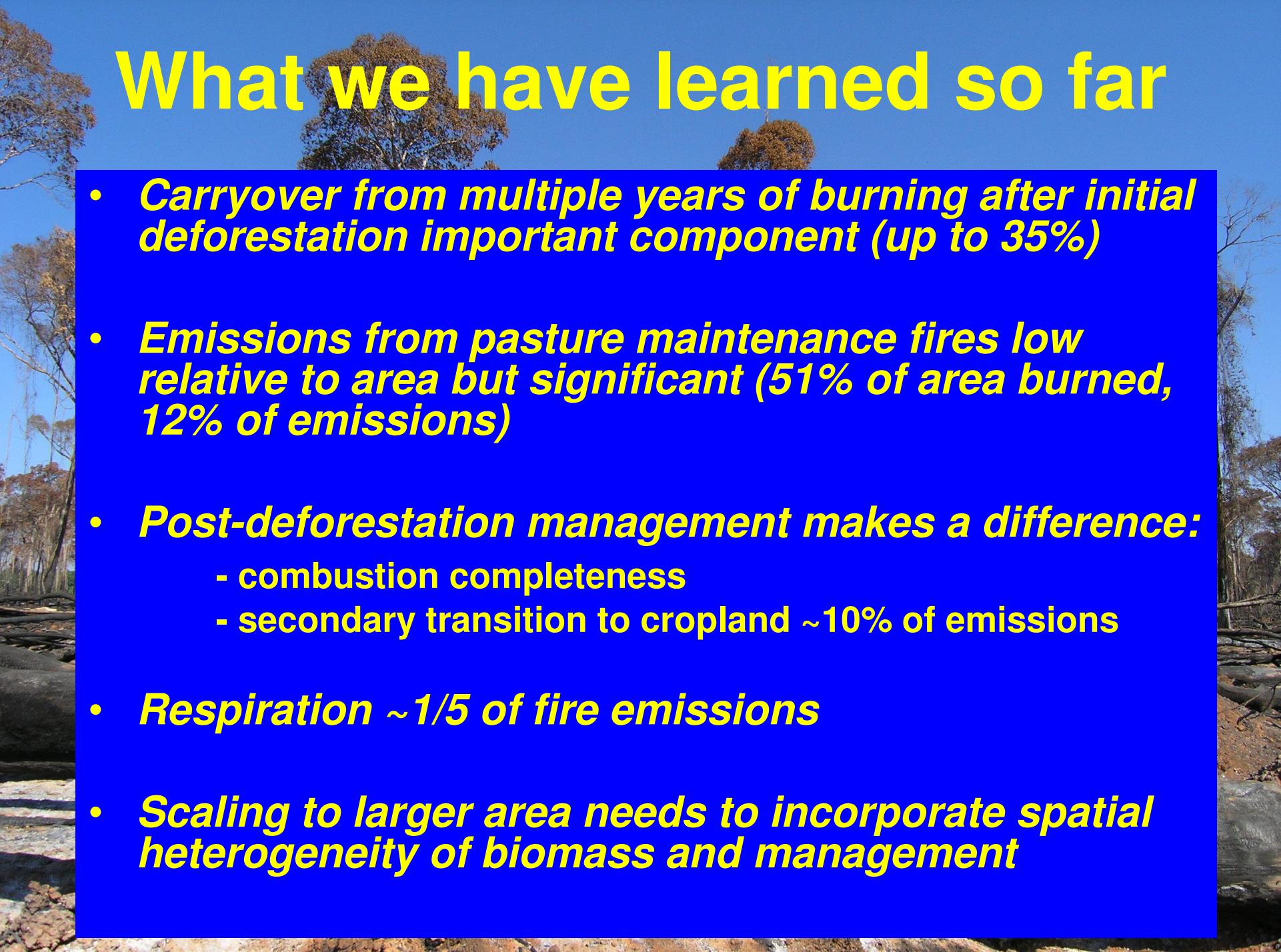
How to scale approach for estimating emissions across entire basin?

DECAF AGGREGATED TO ONE DEGREE AND GLOBAL FIRE EMISSIONS DATA (GFED) FOR MATO GROSSO



GFED from <http://www.ess.uci.edu/~jranders/> (for 2001-04) and J. Collatz (for 2005)

(Morton et al., 2006)



What we have learned so far

- *Carryover from multiple years of burning after initial deforestation important component (up to 35%)*
- *Emissions from pasture maintenance fires low relative to area but significant (51% of area burned, 12% of emissions)*
- *Post-deforestation management makes a difference:*
 - combustion completeness
 - secondary transition to cropland ~10% of emissions
- *Respiration ~1/5 of fire emissions*
- *Scaling to larger area needs to incorporate spatial heterogeneity of biomass and management*

