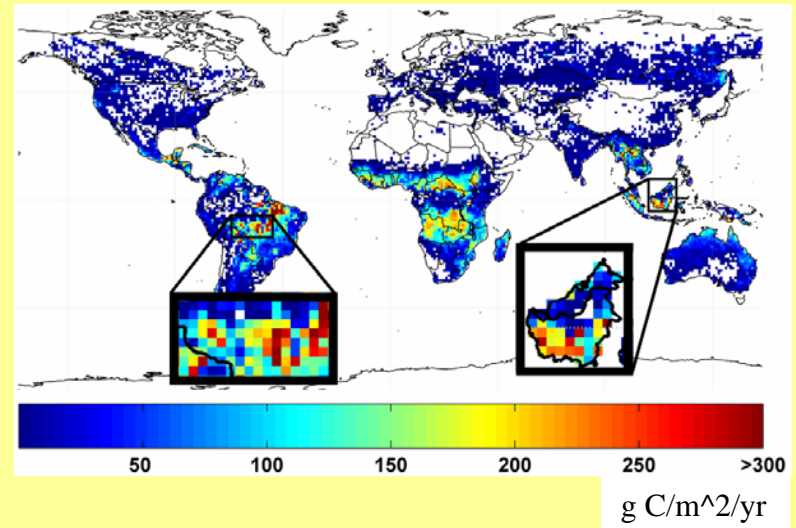
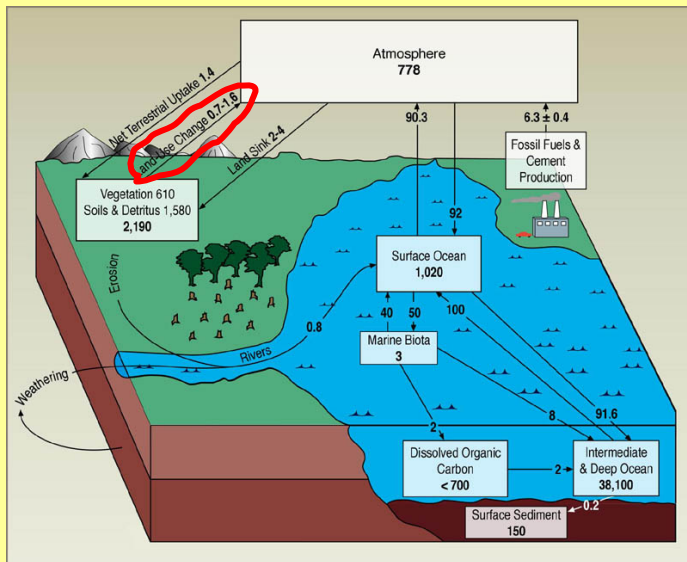


Reducing Uncertainties of Carbon Emissions from Land Use-Related Fires with MODIS Data: From Local to Global Scale

Investigators: R. DeFries, University of Maryland College Park; S. Trigg, University of Maryland College Park; G.J. Collatz, NASA GSFC; D. Morton, University of Maryland College Park

Collaborators: J. Randerson, University of California Irvine; G. Van der Werf; L. Giglio, SSAI, NASAGSFC; L. Curran, Yale University; P. Kasibhatla, Duke University

What are the carbon fluxes from deforestation?
A new approach to an old pesky question



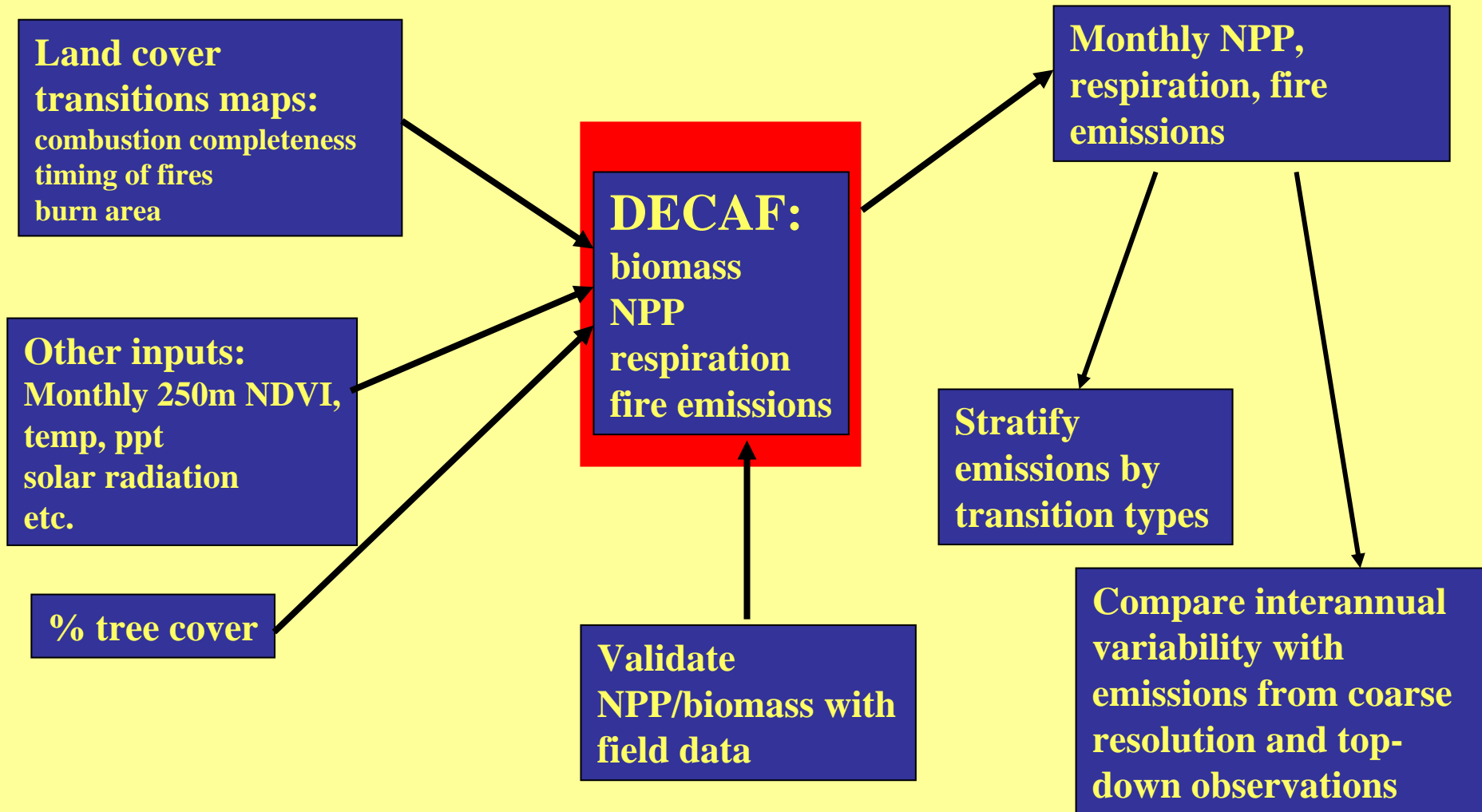
Combine deforestation carbon accounting and fire emissions approaches to estimate emissions from land-use related fires

Methodological - develop methods to incorporate the spatial heterogeneity of land cover, land management and associated fire in models of carbon emissions.

Science - advance understanding of the relationships between land use, land management, and carbon emissions from fire based on detailed analysis in the two test areas:

- quantify relative contributions of different land use types (e.g. pastures, mechanized agriculture, oil palm plantation, small-scale farming) to carbon emissions from fires
- characterize fire-related carbon emissions associated with different land use transitions (e.g. conversion of pasture to mechanized agriculture in the southern Amazon and conversion of forest to oil palm plantation in Kalimantan).
- quantify carbon emissions from new land clearing vs. land management fires to distinguish the relative contributions to interannual variability and long-term trends in the atmospheric CO₂ record.
- contribute to understanding of the potential for land management options to reduce carbon emissions

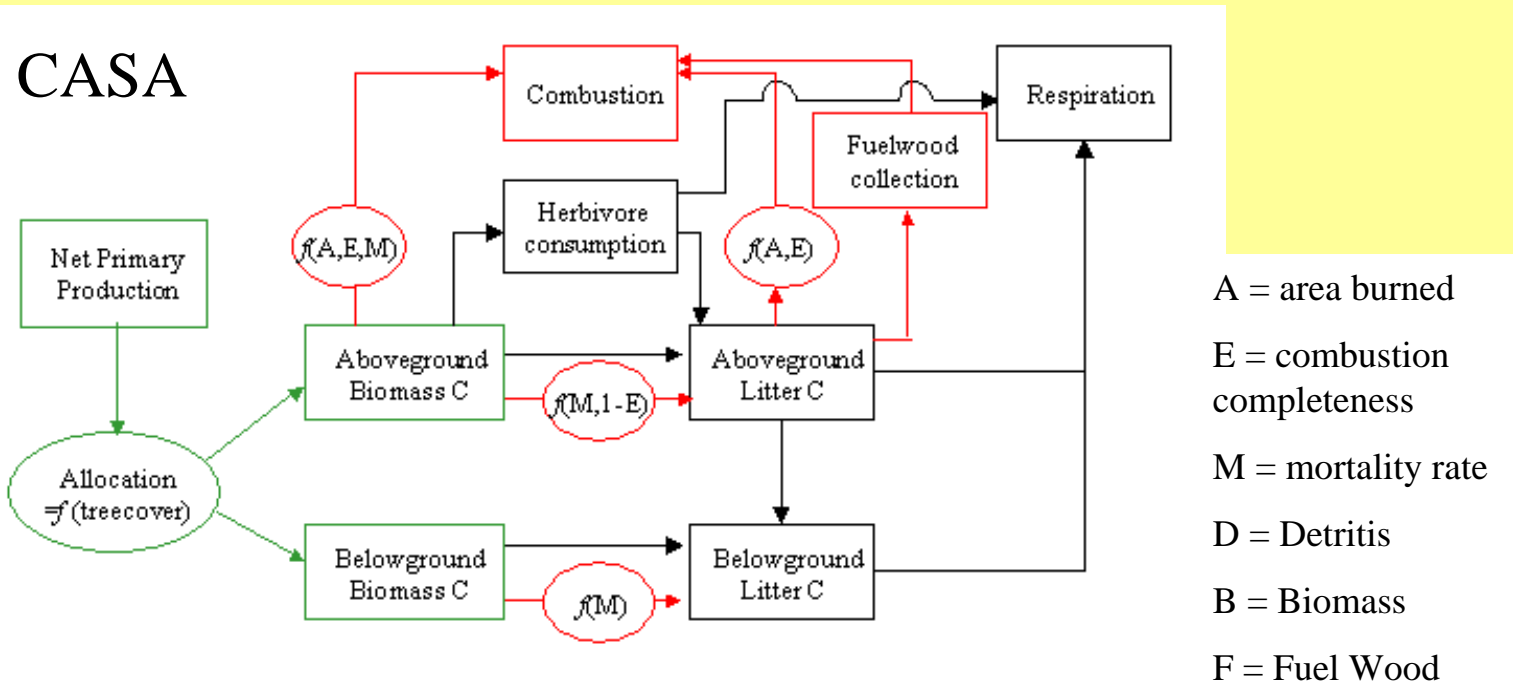
MODEL APPROACH



DECAF MODIFICATIONS FROM CASA:

-USE 250m MODIS MONTHLY NDVI

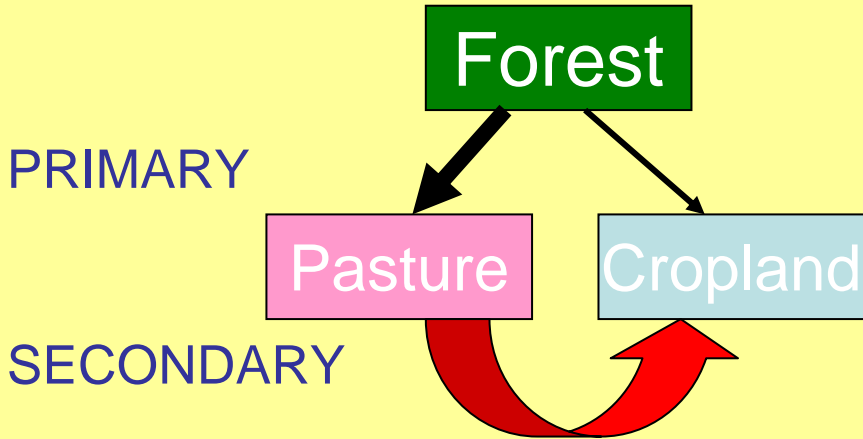
-INCLUDE BURNING TRAJECTORIES FROM MAINTENANCE AND CLEARING FIRES



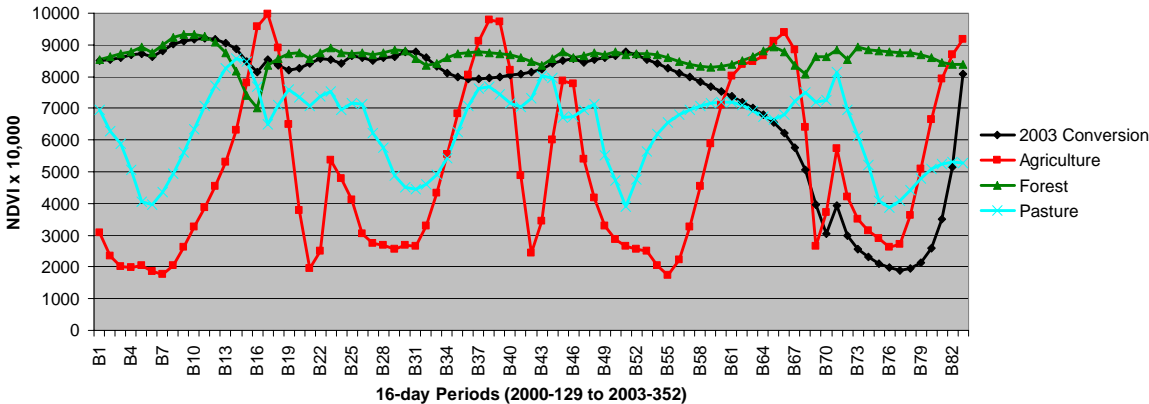
C EMISSIONS FROM FIRE

$$C_t = A_t \left[\sum_d E_d D_{t,d} + \sum_b E_b M_b B_{t,b} \right] + E_F F$$

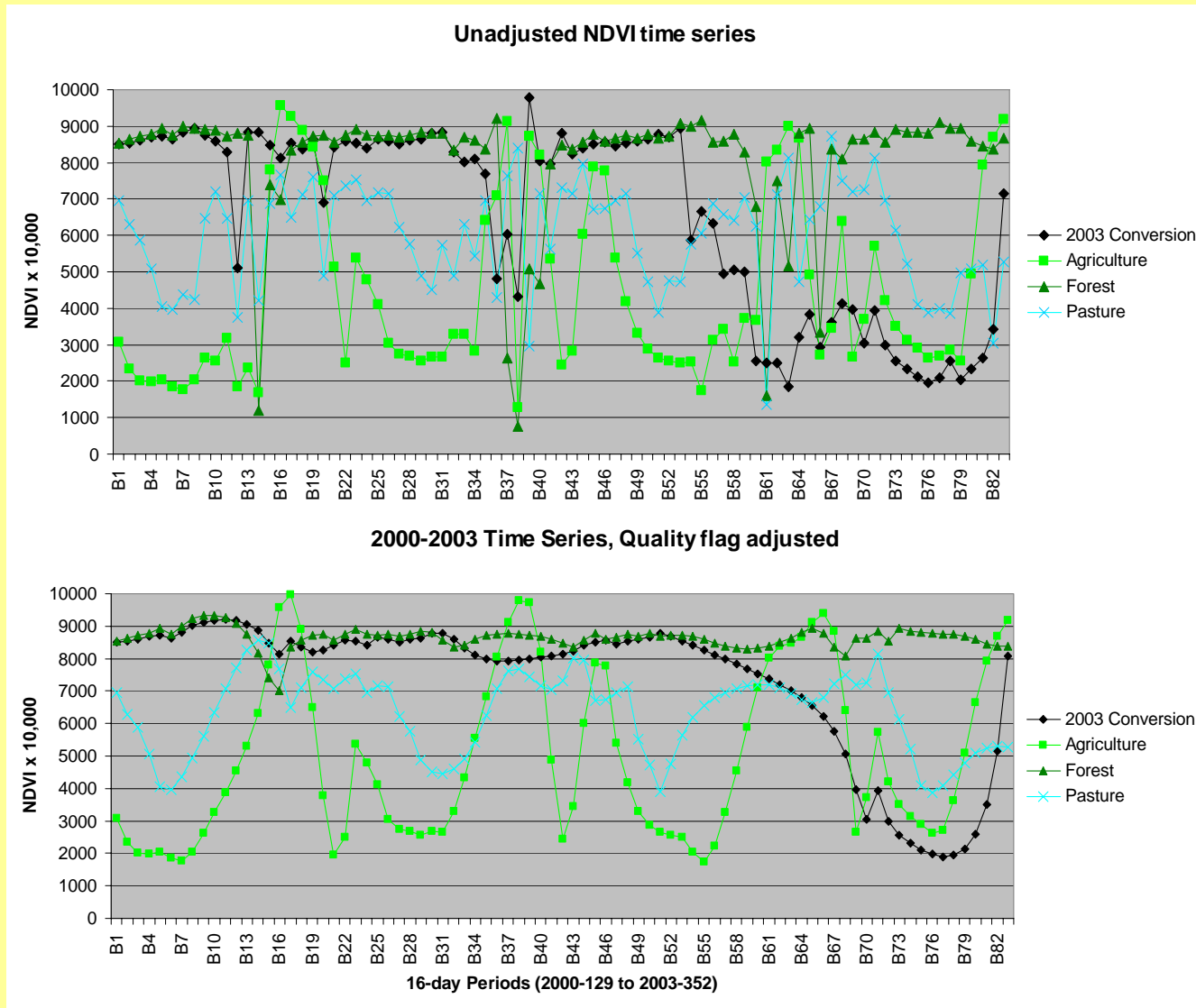
TRANSITION TYPE: DISTINGUISHING FATE OF DEFORESTATION WITH PHENOLOGY FROM MODIS 250m DATA



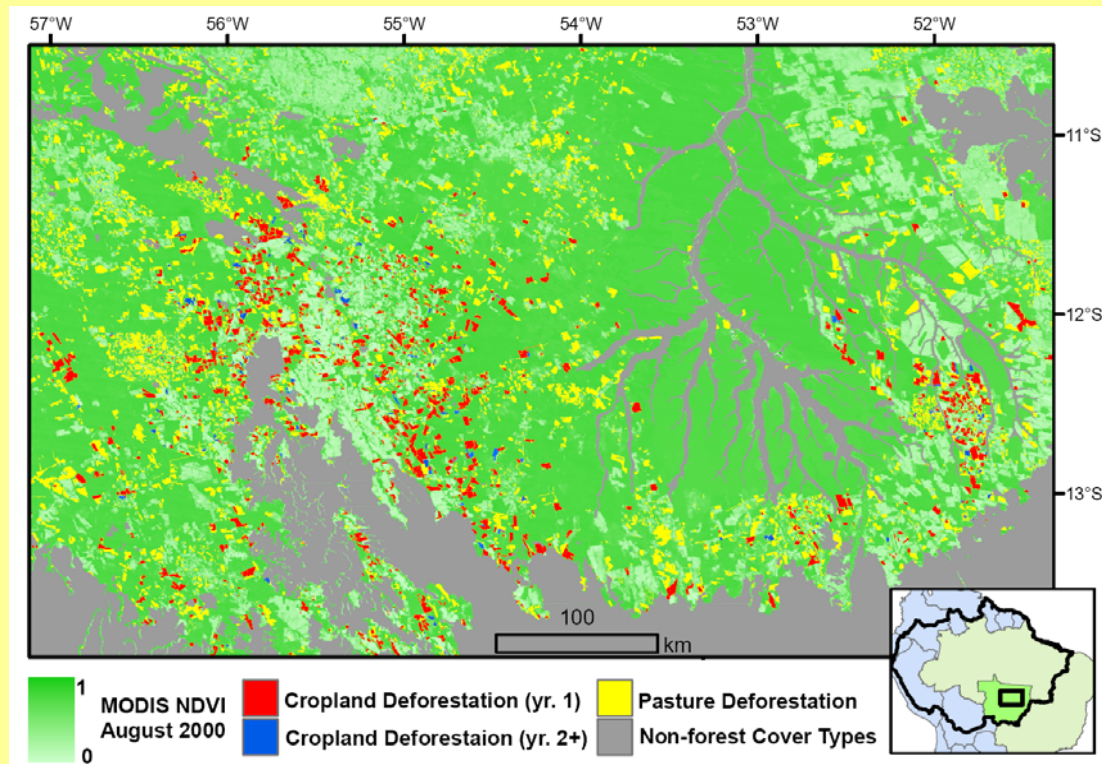
2000-2003 Time Series, Quality flag adjusted



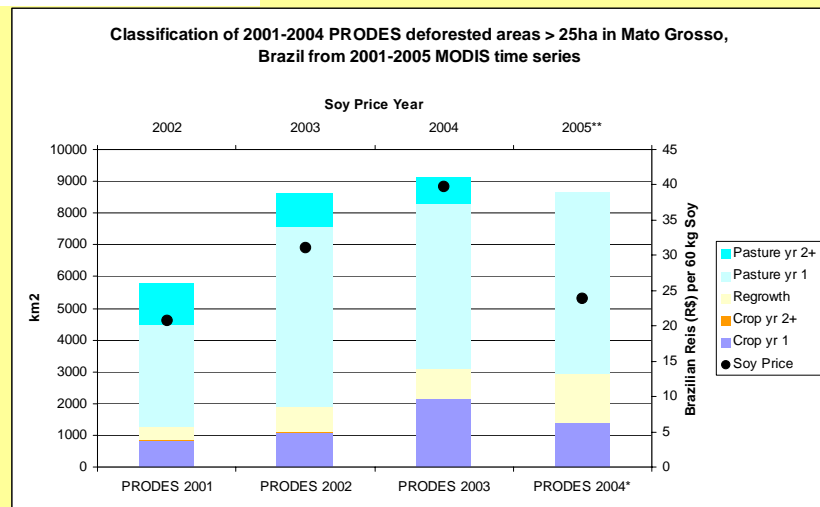
CLEANING UP THE 250m NDVI MODIS TIME SERIES



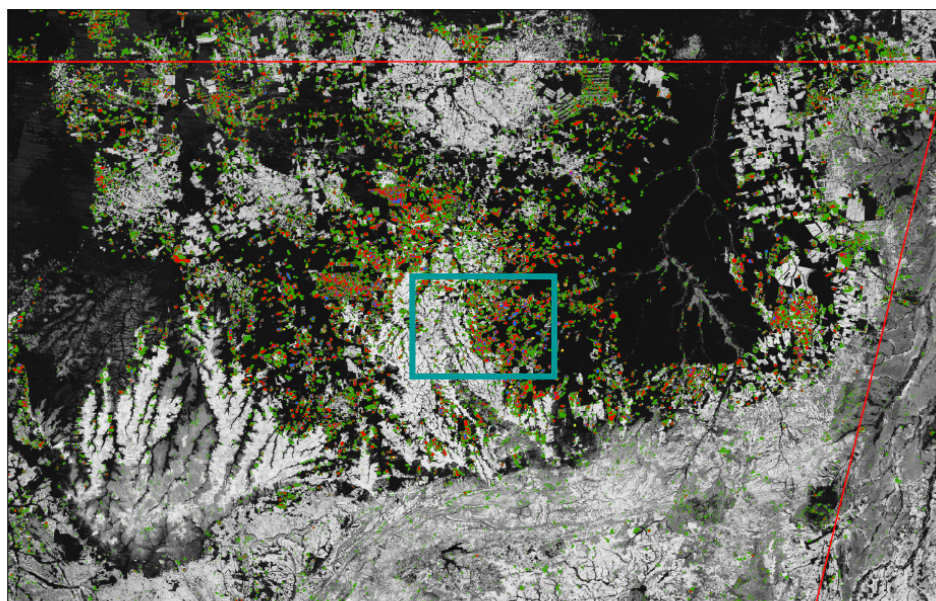
(thanks to J. Morisette and D. Morton)



~20% of deforestation in Mato Grosso is direct conversion of forest to cropland



BURNING SEQUENCE OF DEFORESTATION POLYGONS

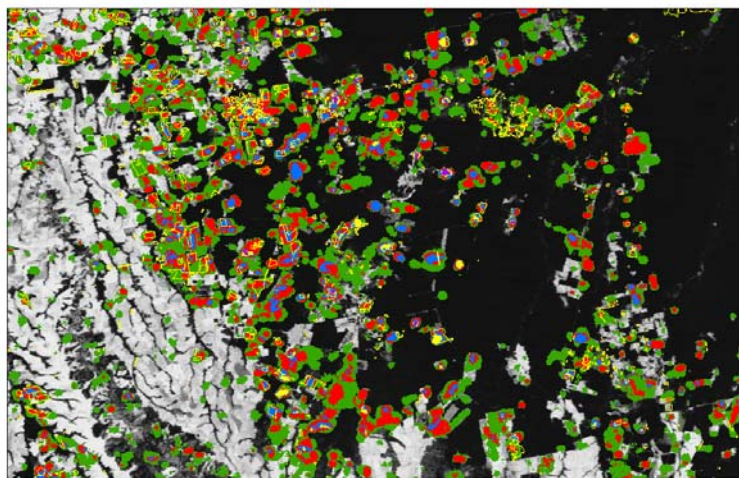


■ 1
■ 2
■ 3
■ 4
■ 5

Number of years with woody burning
2001-2005 (fire density > 1 per km² per year)

MODIS h12v10
 Tile Boundary

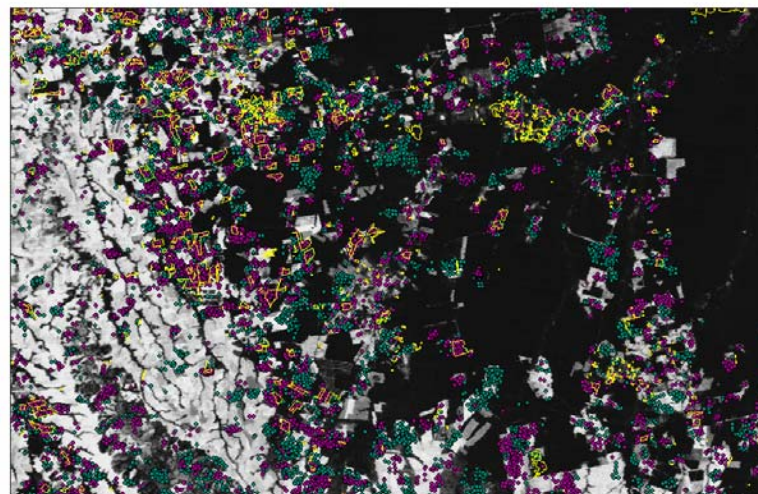
150
Kilometers



■ PRODES 2002 Deforestation
■ 0
■ 1 Years of woody burning
■ 2
■ 3 >1 fire per km² per year
■ 4 2000-2005
■ 5

Woody burning lasts for several years for most deforestation events.

30
Kilometers



• MODIS 2003 Fire Pixels
 PRODES 2002 Deforestation
• MODIS 2002 Fire Pixels

Woody burning dominates MODIS fire detections.

30
Kilometers

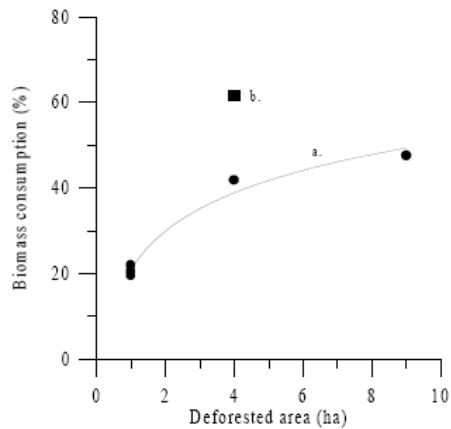
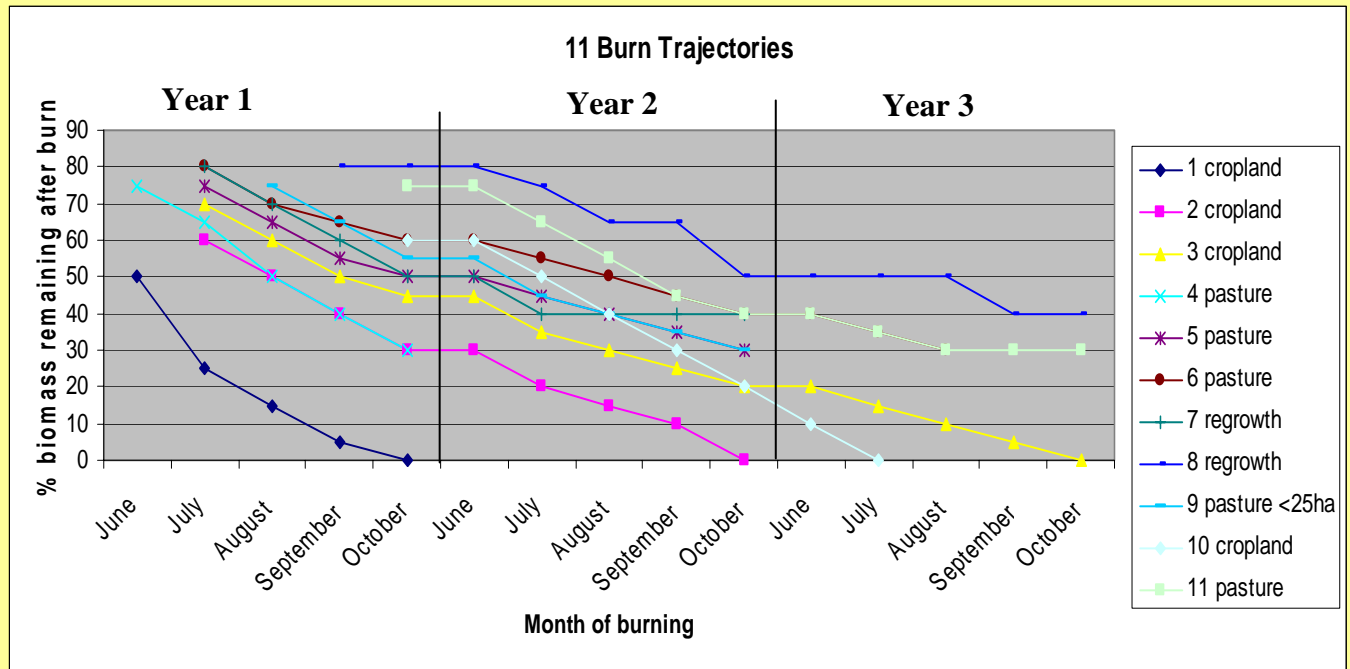
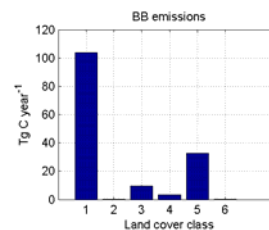
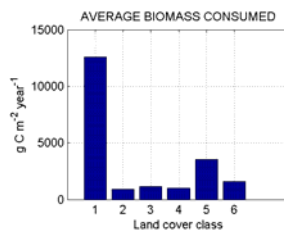
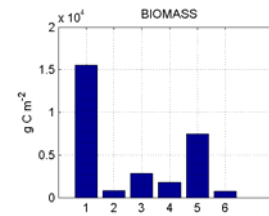
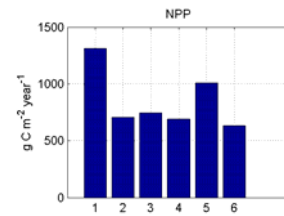
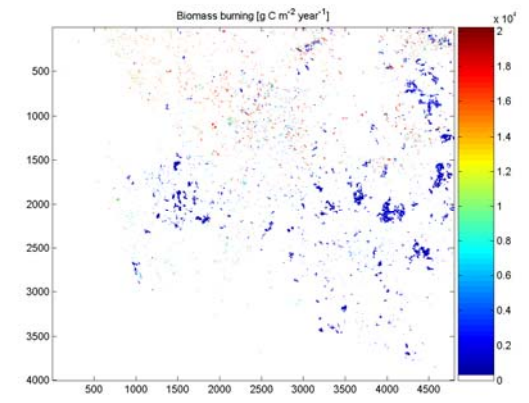
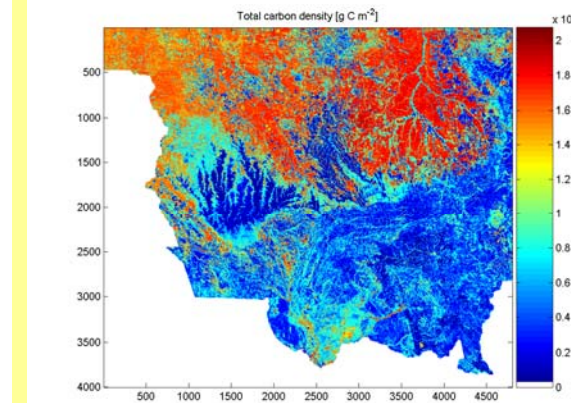
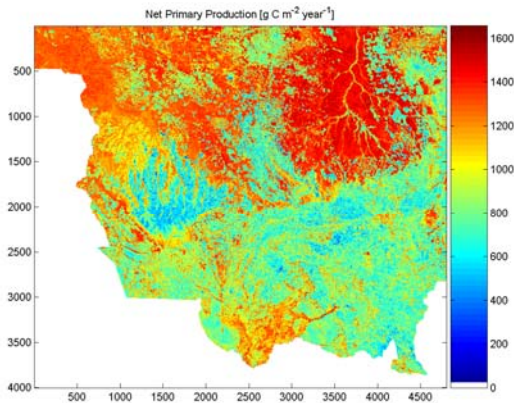
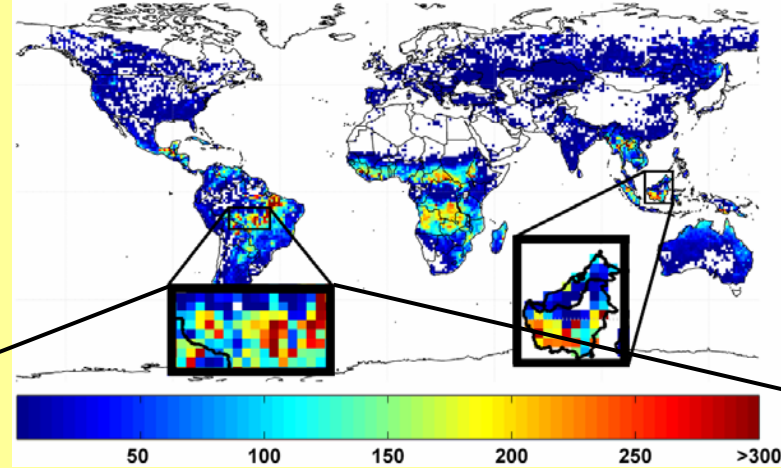


Figure 3. Biomass consumption in the central 1-ha plot as a function of the total deforested and burned area. The circles represent plots that were burned 3 months after they were cut; the square represents the plot that was burned 15 months after it was cut.

Biomass consumption higher for larger clearings and longer curing time

(Carvalho et al, 2001)

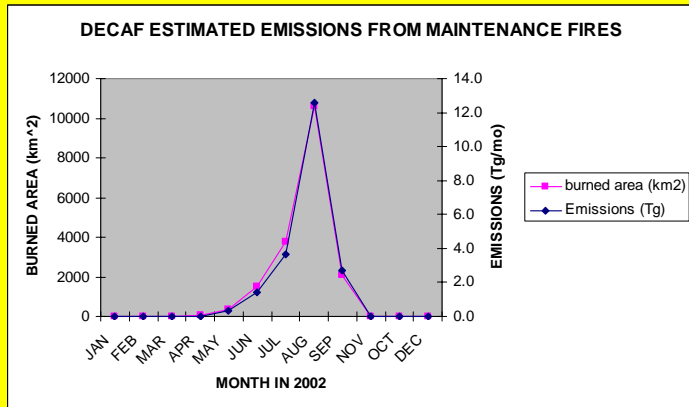
PRELIMINARY DECAF RESULTS FOR 2002



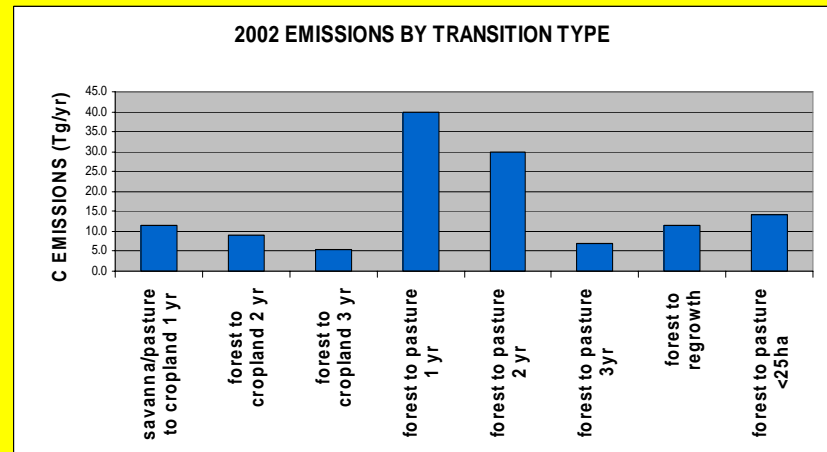
Land cover class 1 = forest, 2 = cropland, 3 = cerrado, 4 = grassland, 5 = woodland, 6 = water

GFED for same year (all of So Hem SA) = 264 Tg C, DECAF = 150 Tg C for only Mato Grosso

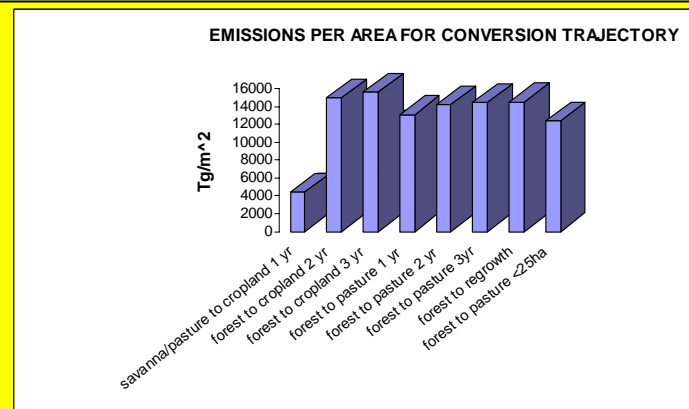
PRELIMINARY THOUGHTS FROM 2002 DECAF RESULTS FOR SOUTHERN AMAZON



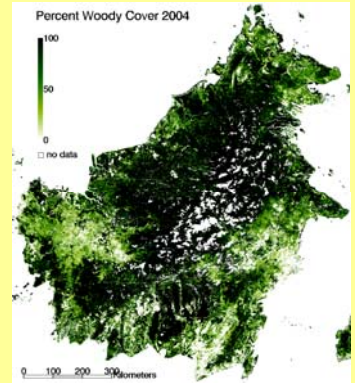
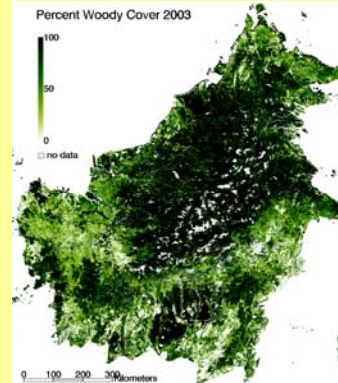
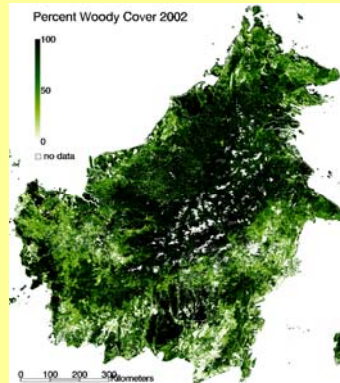
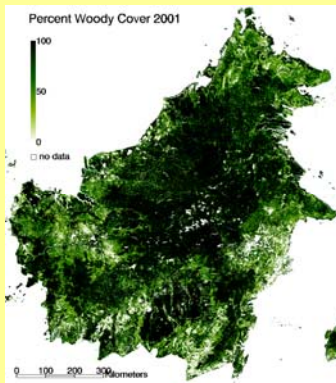
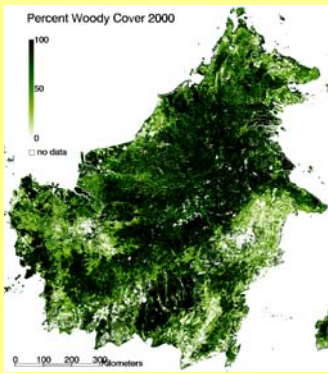
**MAINTENANCE FIRES ARE
62% of TOTAL BURNED
AREA AND 14% OF TOTAL
EMISSIONS**



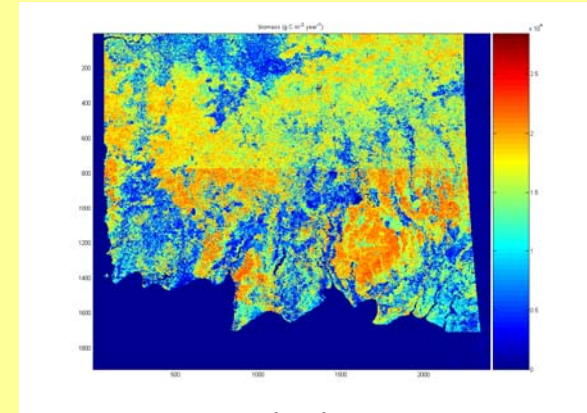
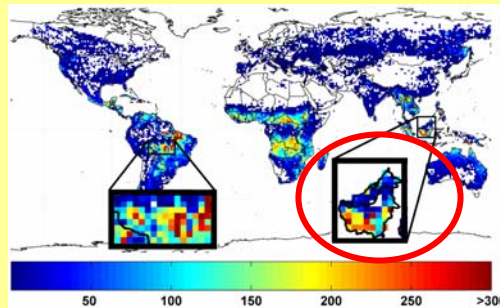
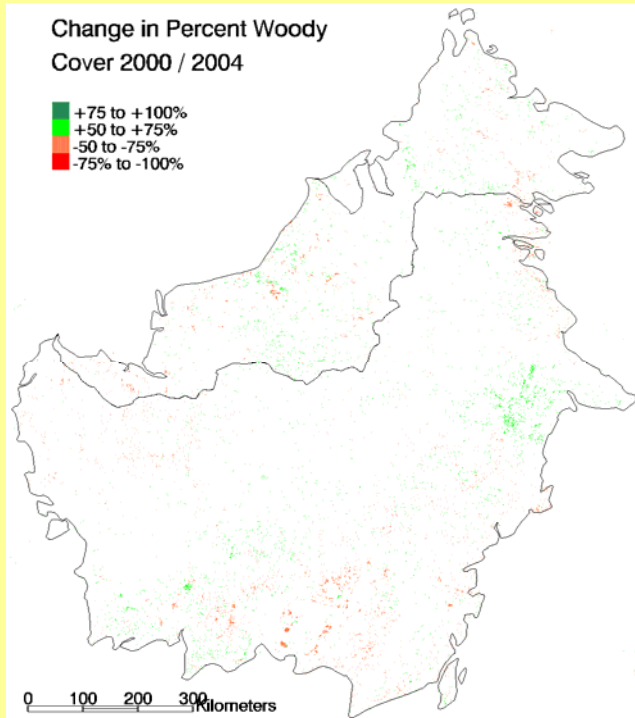
**CLEARING FOR PASTURE IS 78% OF ANNUAL
2002 EMISSIONS**



**CROPLAND CLEARING HIGHEST
EMISSIONS PER AREA**

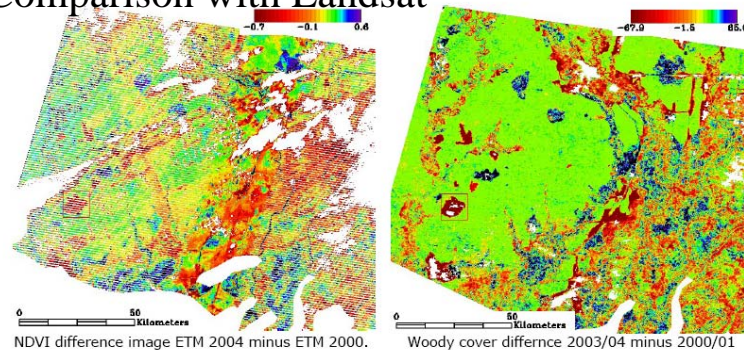


% woody cover derived from 250m MOD13



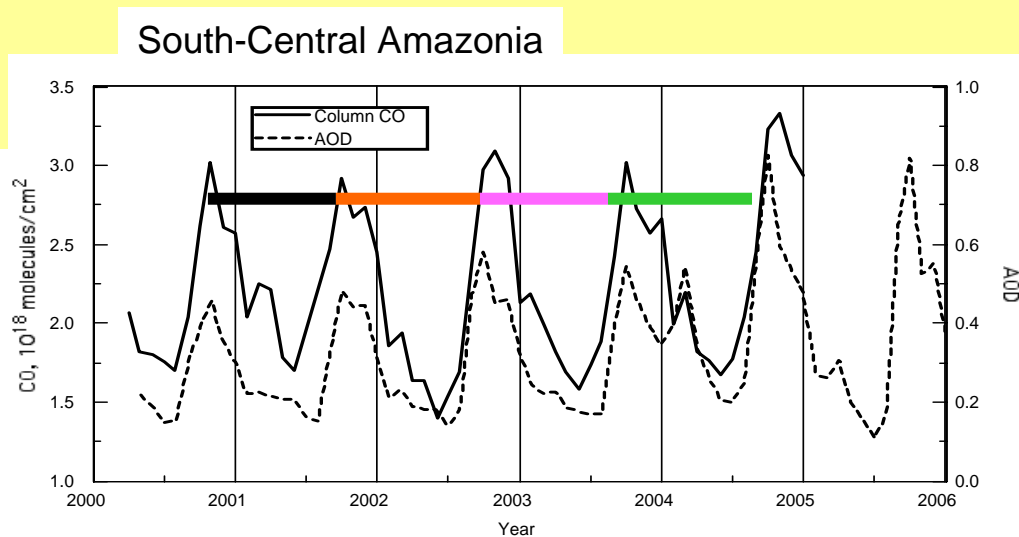
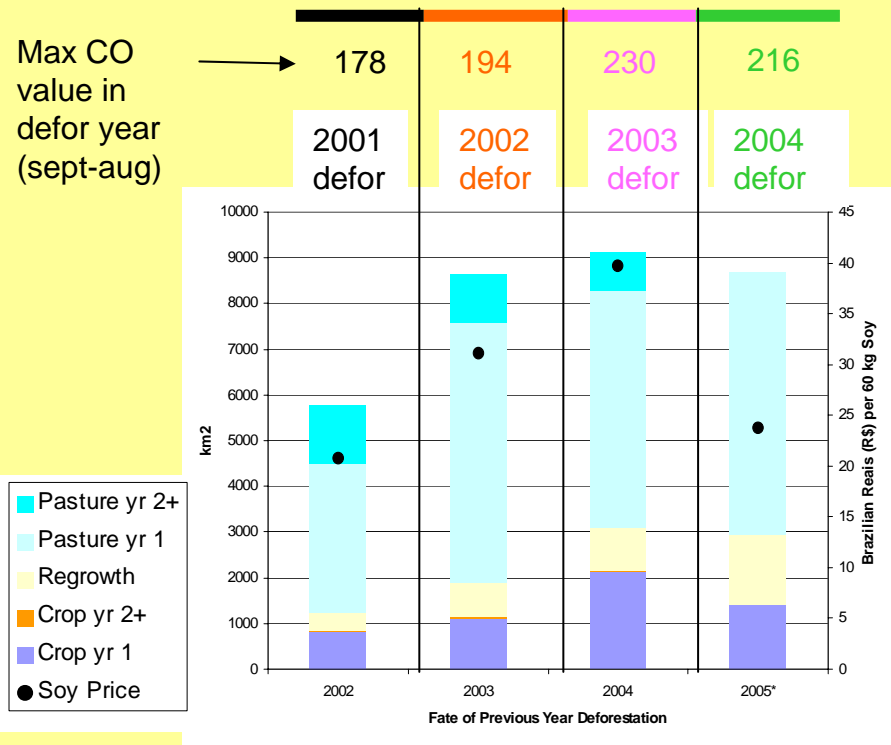
Very preliminary above ground carbon from DECAF for southwest

Comparison with Landsat



(thanks to J. Dempewolf, K. Murphy, S. Trigg)

COLLABORATION WITH GFED (Global Forest Emissions Database, Jim Randerson and colleagues) TO MESH BOTTOM UP WITH TOP DOWN APPROACHES



Progress and Plans

- **DECAF up and running with preliminary results for 2002 deforestation in Southern Amazon**
- **Quantified transition trajectories combining clearing fate and hot pixels from MODIS in Southern Amazon**
- **Preliminary data sets of forest cover change for Borneo**

- **Next year and beyond:**
 - **full time series 2000-2005**
 - **DECAF biomass validation**
 - **test sensitivities to assumptions**
 - **Borneo trajectories**
 - **comparison with MODIS atmospheric products**
 - **scaling approaches to compare with 1x1 degree estimates**



