

# REDUCING UNCERTAINTIES OF CARBON EMISSIONS FROM LAND-USE RELATED FIRES WITH MODIS DATA: FROM LOCAL TO GLOBAL SCALE

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## Abstract

The atmospheric and carbon modeling communities are increasingly aware of the importance of fire as a major source of carbon to the atmosphere, and as a key driver of interannual variability of net carbon fluxes from the biosphere. Previous estimates of carbon emissions from fire are based on coarse-resolution satellite data and do not account for varying fire regimes associated with different land uses or for variations in biomass within the model's grid cell. Several groups have estimated fire emissions on global scales using coarse resolution approaches, and the outcomes vary by more than a factor two. We are applying MODIS data and the CASA biogeochemical model at the MODIS 250m resolution in two test areas, each covering the extent of a MODIS tile (approximately 10 x 10 degrees). The test areas are the southern Amazon and Borneo, two regions of rapid land use change where fire is used extensively for land management. Detailed analyses of these two test areas will allow us to assess sources of uncertainties in the coarser scale estimates. It will also provide a means of partitioning carbon emissions from different land use types, i.e. initial forest clearing vs. maintenance of previously cleared pasture or oil palm plantations. This distinction is essential for assessing carbon emissions from fire because clearing represents a net carbon source, while emissions from pasture maintenance fires will be balanced by carbon uptake during subsequent growing seasons. Using the high-resolution model results, approaches will be developed to realistically scale up estimates of carbon emissions from land use-related fires to regional and global scales. The high-resolution model results will also provide a basis for assessing emissions from possible future land use trajectories in the rapidly-changing tropics.

## METHODOLOGICAL OBJECTIVE:

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

- assess the degree to which running the model at the MODIS resolution of 250m (~0.00225 degree) reduces uncertainties compared with previous model runs at 1 x 1 degree resolution for two test areas.

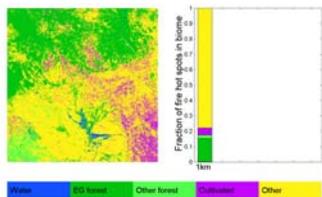
- develop approaches to scale-up spatial heterogeneity from the 250m MODIS resolution to a coarser resolution practicable at a global scale.

## SCIENCE OBJECTIVE:

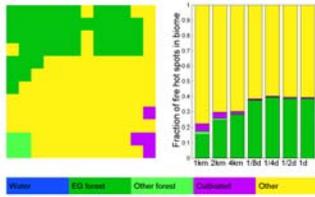
to advance understanding of the relationships between land use, land management, and carbon emissions from fire based on detailed analysis in two study areas

- quantify relative contributions of different land use types (e.g. pasture, mechanized agriculture, oil palm plantation, small-scale farming) to carbon emissions from fires in the test areas
- characterize fire-related carbon emissions associated with different land use transitions currently underway in the two test areas
- estimate 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 CO<sub>2</sub> record
- contribute to understanding of the potential for land management options to reduce carbon emissions

## Spatial resolution of land cover used in the fire emission model alters the fraction of fire hot spots in different land cover types

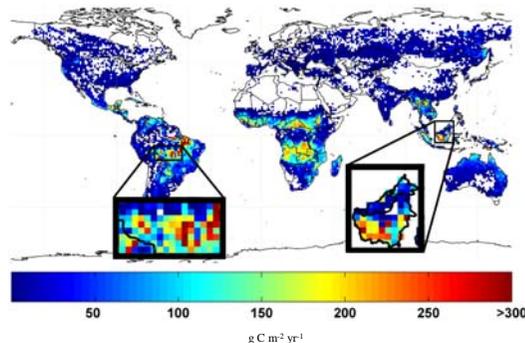


1km resolution



Aggregated to 1 degree resolution

## Global estimates of carbon from fire emissions for 1997-2001 at 1x1 degree (van der Werf et al., 2003)



This project will increase the spatial resolution by a factor of ~200,000 to better understand and quantify the fire and land use processes that operate at this high spatial scale. Model will be run for two test area with rapid land use change: Borneo and southern Amazon.

## LAND USE TYPES IN SOUTHERN AMAZON TILE



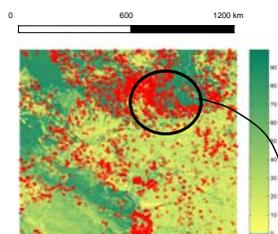
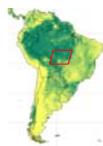
Pasture with periodic fire and low biomass



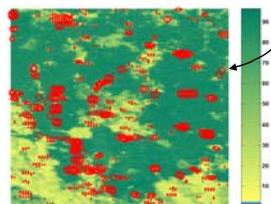
Mechanized agriculture with only initial clearing fires



Burn for initial clearing



MODIS 2001 Fractional tree cover (Hansen et al. 2004)  
MODIS 2001 Fire hot spots (Justice et al. 2004)

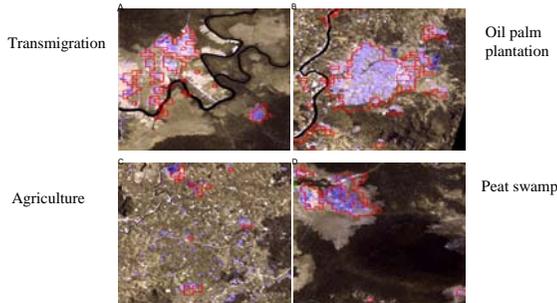


• = 1 Fire observation in 2003 (MODIS Terra: 10.30 and 22.30 overpass)

○ = More than 12 observations in 2003

NUMBER OF FIRES, INITIAL BIOMASS, AND COMBUSTION EFFICIENCY VARY WITH FRACTIONAL TREE COVER AND LAND USE

## LAND USE TYPES IN BORNEO TILE



Burns scars identified from MODIS 250m data (outlined in red) on Landsat TM data (burn scars in blue). Each area is ~90 km<sup>2</sup>.

## REFERENCES

- Hansen, M. C., R. S. DeFries, J. Townshend, M. Carroll, C. Dimiceli, and R. Sohlberg. 2003. Global percent tree cover at a spatial resolution of 500 meters: First results of the MODIS Vegetation Continuous Fields algorithm. *Earth Interactions* 7(10): 1-15.
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