Forest Disturbances in Mexico

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Themes

- Disturbances
  - Land-use change
  - Fires
  - Forest management

  } Human Induced

  - Pests and diseases
  - Hurricanes

  } Natural

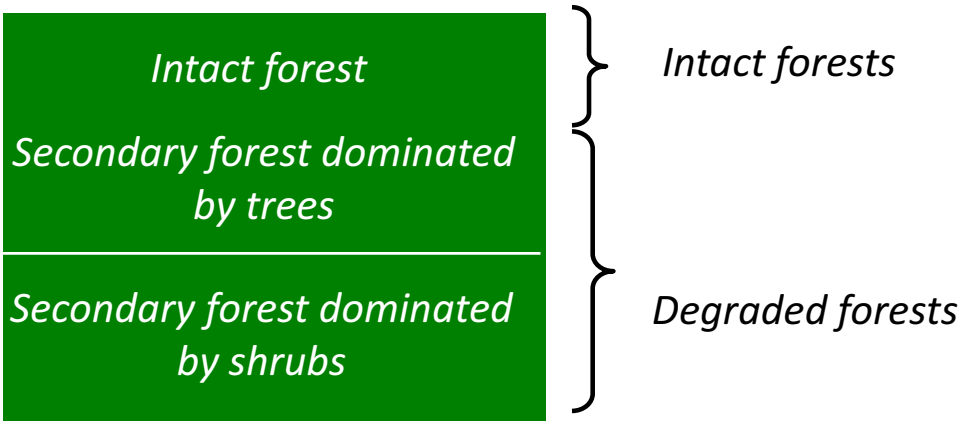
- Perspectives

Land-use change (1)

- Major disturbance.
- 4 LUC processes related to forests:
  - Deforestation
  - Degradation
  - Restoration (natural)
  - Reforestation (natural and planted)
- Land-cover maps produced by INEGI 1993, 2002, 2007

Land-Use maps (1993, 2002, 2007)

Disturbance classes

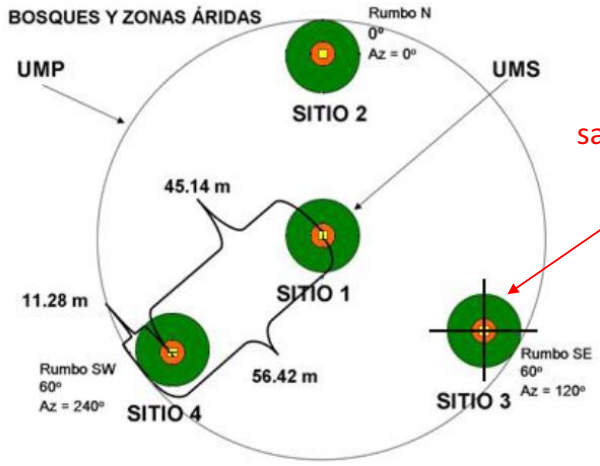


Impact of land-use change on emisions

- Data on loss and gain of biomass due to disturbances are available from 25,000 permanent inventory plots, set up in the National Forest Inventory 2004-2008
- Re-measurements from 2009 includes all carbon pools

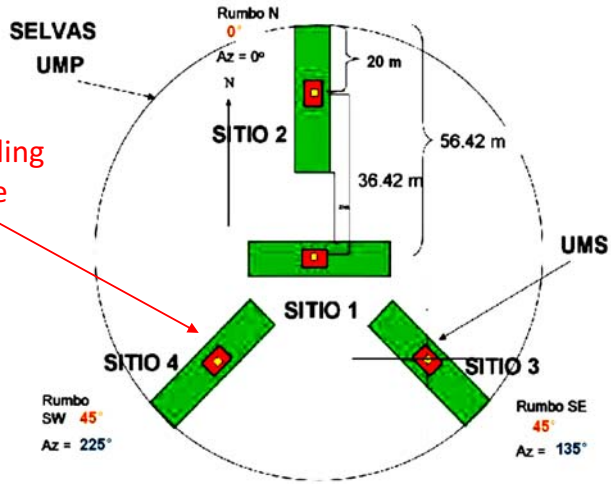
NFI: 2004-2008
SAMPLING DESIGN

Pine-Oak Forests and arid lands



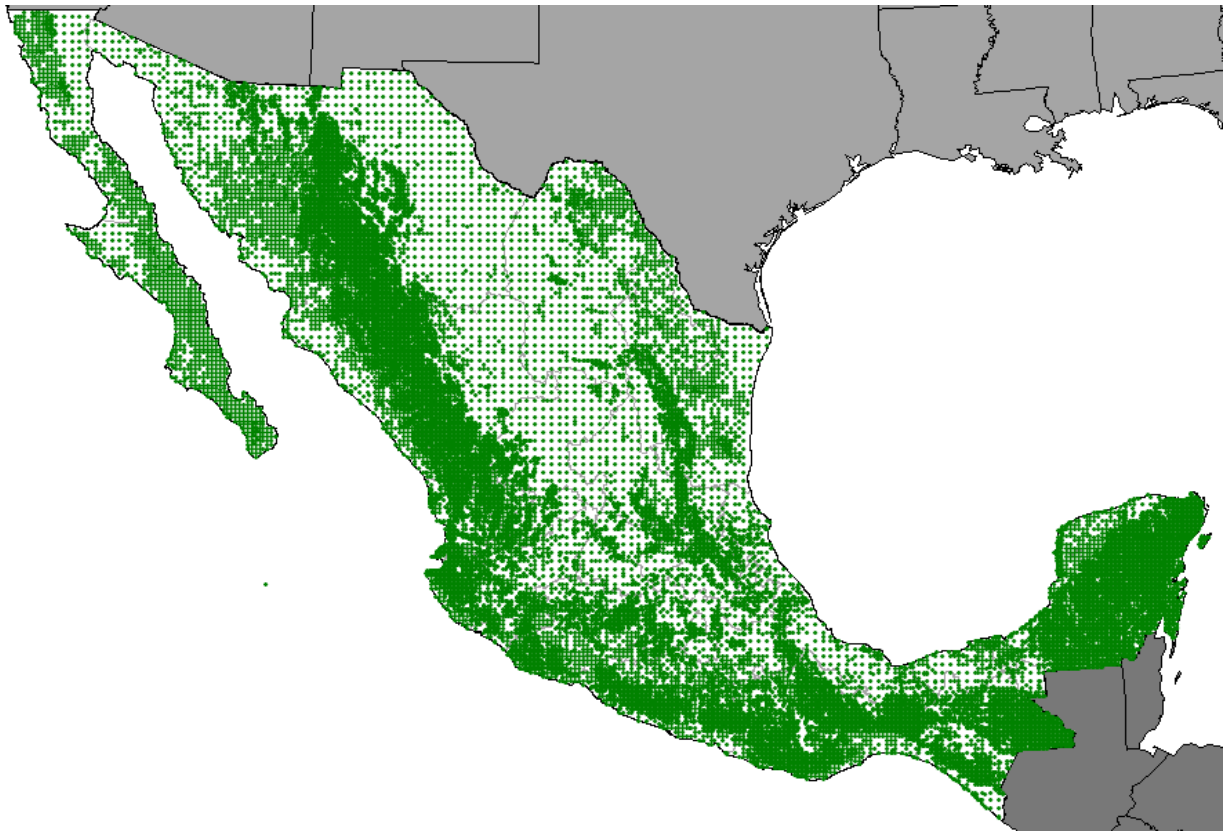
sampling site

"Tropical" broadleaved Forests

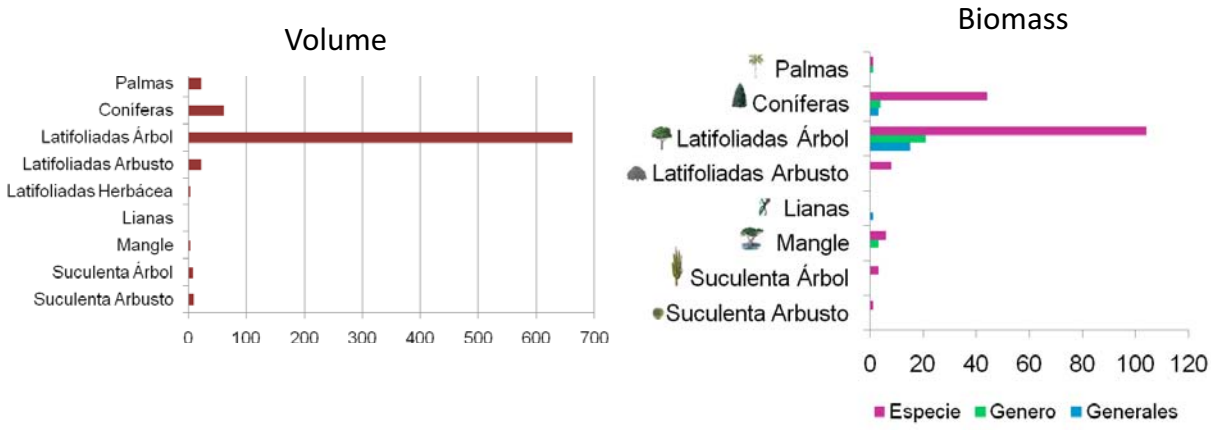


Sampling sites = 400 m^2

ABOUT 25,000 SAMPLING POINTS

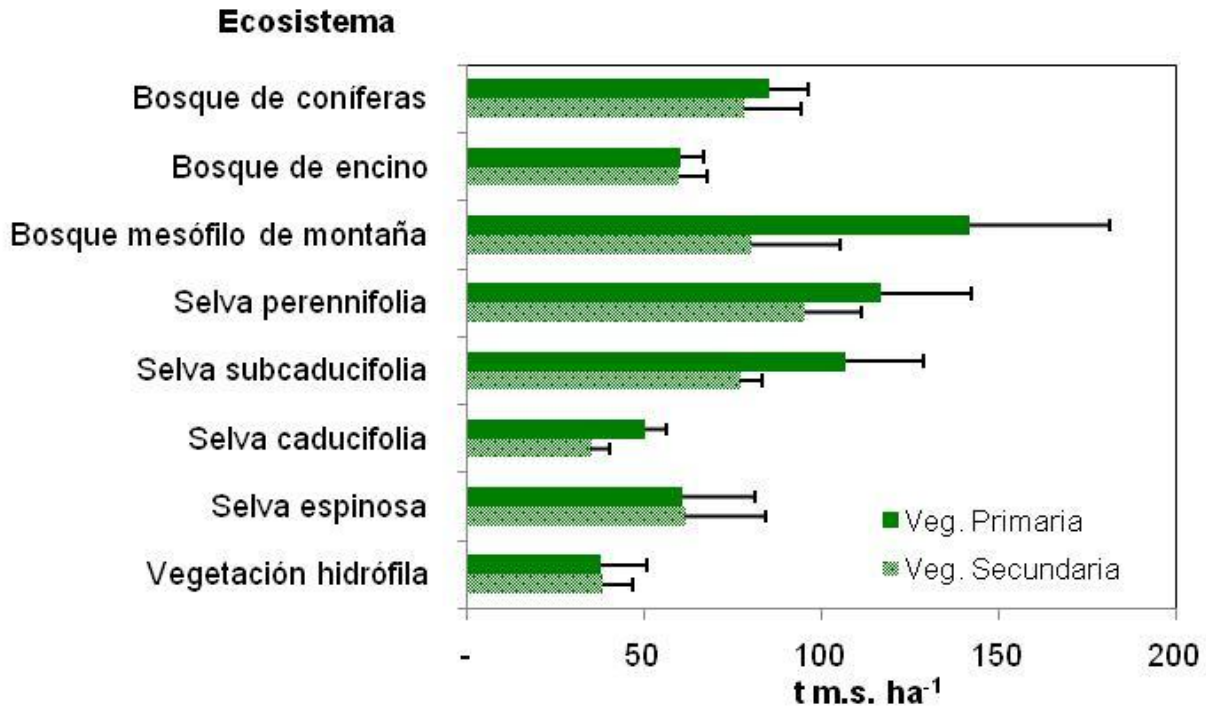


Number of allometric equations to convert inventory data to volume and biomass (representing > 50% of individuals)

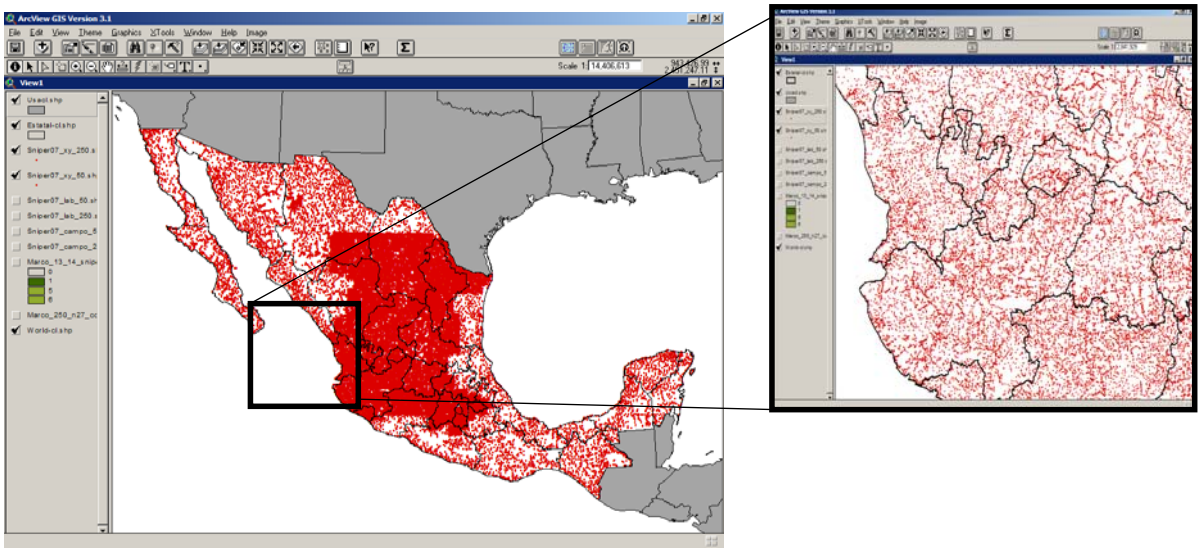


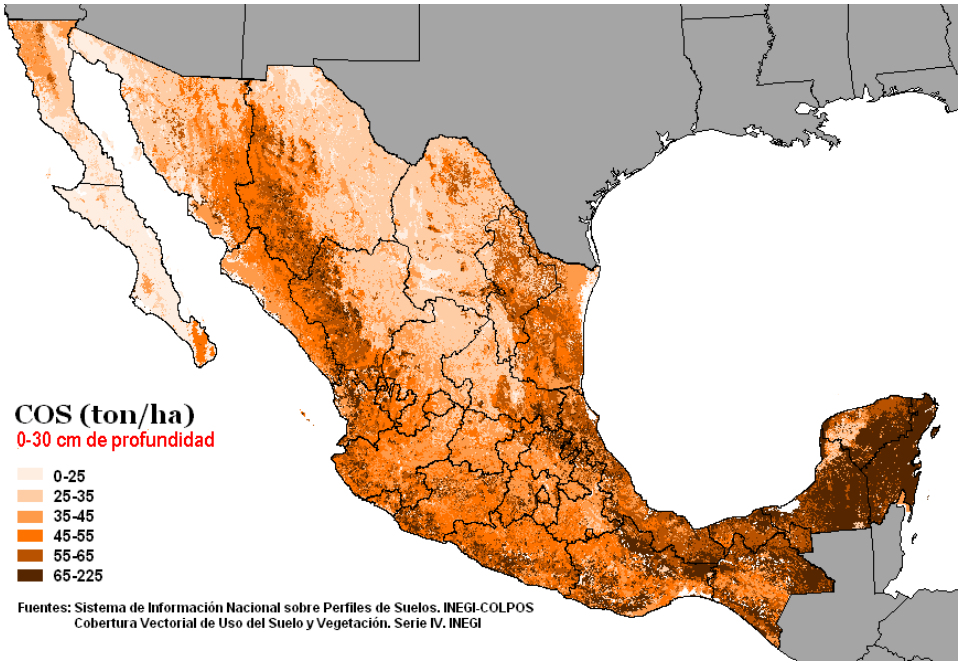
Combining the equations, we are generating expansion factors

Biomass densities in each vegetation type and disturbance class



Soil profile data



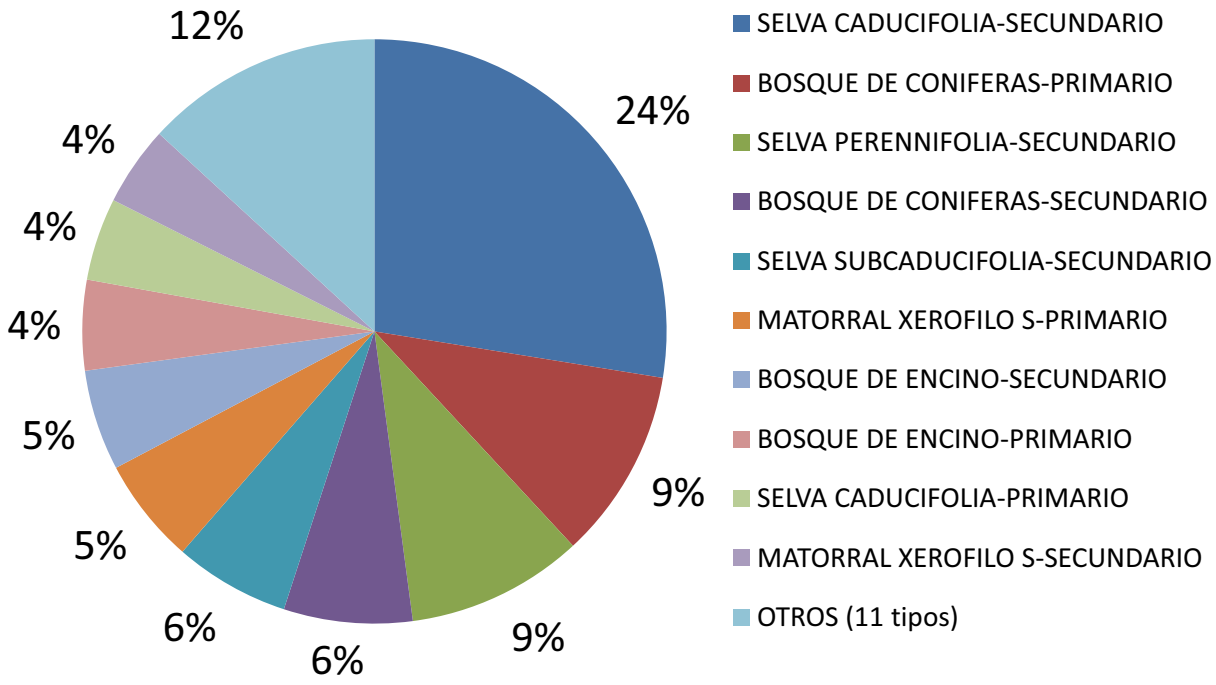


Land-use change

Without Change	1992-2002	2002-2007
Non-forest	101,129,041	104,524,178
Primary forest	50,380,796	49,857,146
Secondary Forest	27,620,940	32,230,003
Change	**ha/yr**	**ha/yr**
Deforestation	595,413	590,418
Degradation	633,018	415,803
Restoration	176,079	109,375
Reforestation	264,612	392,715
Rates	**1993-2002**	**2002-2007**
Deforestation rate	0.66%	0.69%
Degradation rate	1.13%	0.80%

Forest Land to Cropland

Annual change between 1993-2002: 184,009 ha



Forest Land remaining Forest Land

Forest Degradation: emissions based on Land-use Change Statistics and difference in carbon stocks in each forest type
Forest Restoration: Carbon removals based on increment data (see below)
Forest remaining in the same state: Emissions and removals based on harvesting and increment data

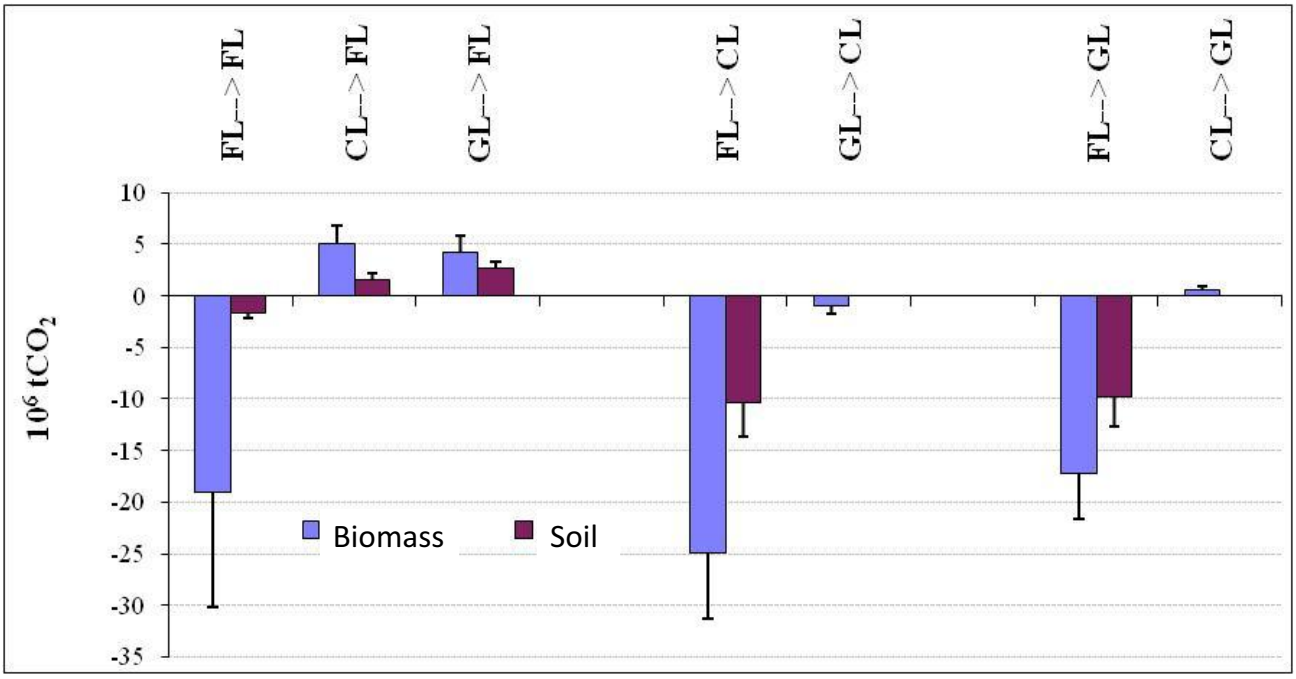
Harvesting:

- Legal harvesting statistics (state and species)
- Fuel wood consumption estimated with Wisdom (FAO): Georeferenced census data
- Irregular harvesting from national reports and reported stumps in forest inventory

Increment data:

- Derived from tree ring analysis ofnational forest inventory data
- Published articles
- Forest management plans

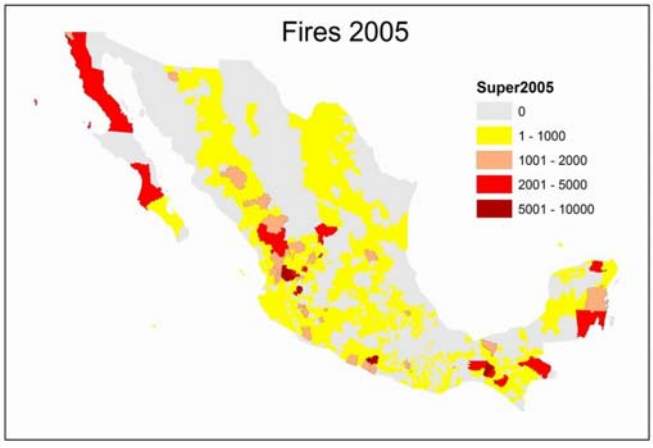
CO_2 Emissions from Land use and Land-use Change (2006)



Fires

- Three types of fires recorded daily (area, intensity, type, time burning):
  - Grassland
  - Scrubland
  - Forest (>99 superficial fires).

- Data are recorded at municipality level since 2005



228,006 ha

159,576 ha

106,114 ha

193,707 ha

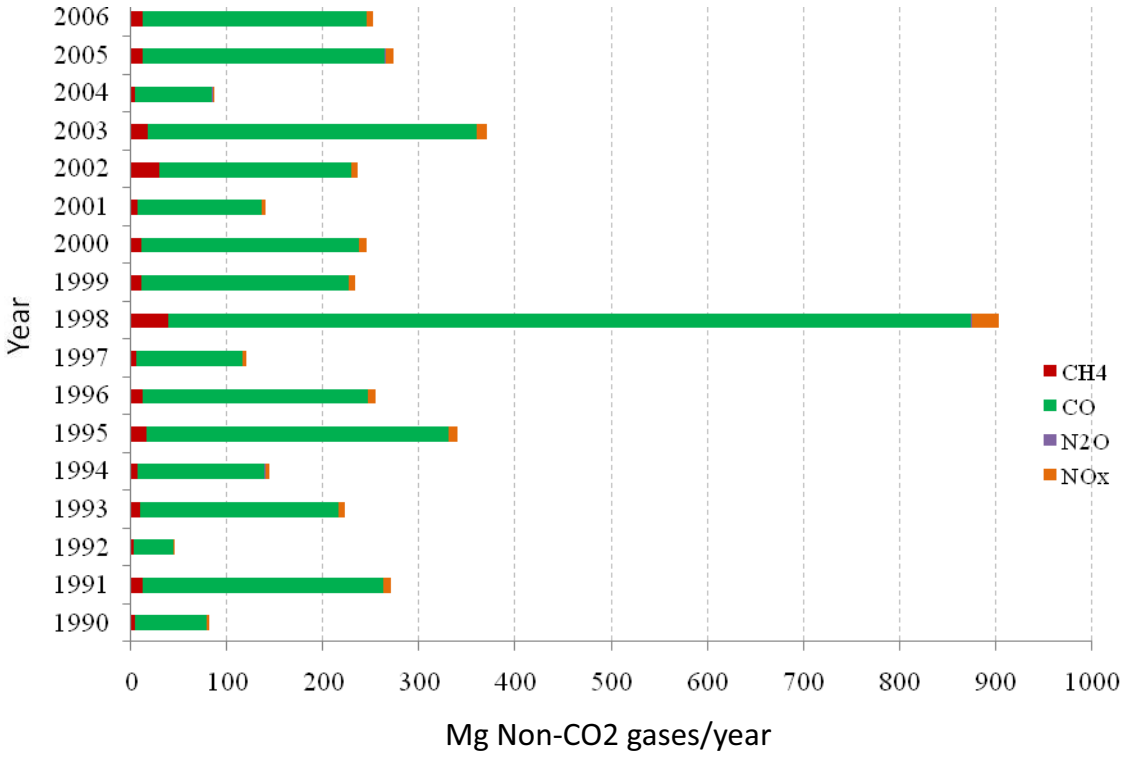
Emissions estimated, using Consume, version 3

Vegetation type	Consumption factors			
	Fermented litter	Leaves and dead wood <7.62 cm	Dead wood>7.62cm	Living material
Pine forest	0.60	0.93	0.55	0.91
Abies forest	0.47	0.93	0.55	0.91
Pine-Oak and Oak-Pine	0.56	0.93	0.55	0.91
Oak forest	0.45	0.93	0.55	0.91
Cloud forest	0.62	0.93	0.78[1]	0.91
Degraded coniferous forest	0.53	0.93	0.55	0.91
Degraded Pine-Oak forest	0.56	0.93	0.55	0.91
Degraded Oak forest	0.45	0.93	0.55	0.91

Emission factors (Andreae & Merlet 2001)

Vegetation type	CO_2	CH_4	CO	N_2O	NO_x
Pine and Oak forest	1569	4.7	107	0.26	3
Tropical dry and humid forests	1580	6.8	104	0.2	1.6
Scrub and pasture veg	1613	2.3	65	0.21	3.9

Applying the IPCC equations, we derived the following emission estimations of non-CO_2 emissions



Pests and hurricanes

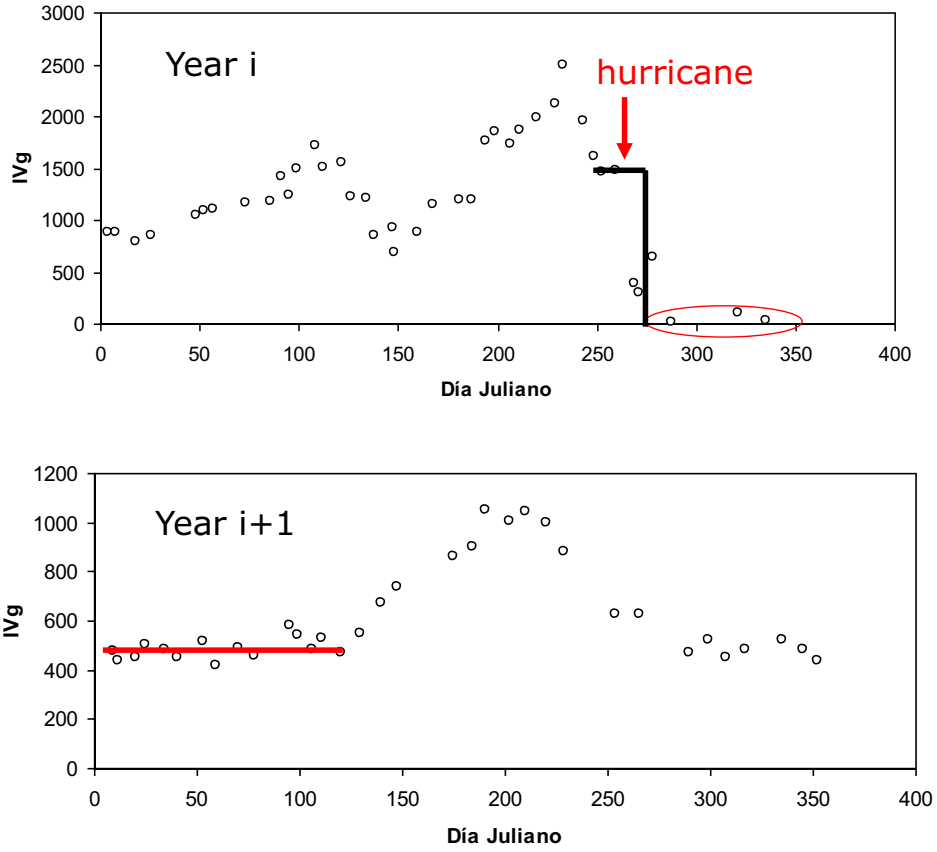
- Pest damage is detected and recorded by aircraft
- Is increasing, although no statistics are available, so the emissions are not included in the GHG inventory.

- Hurricanes affect forests particularly in the Yucatán peninsula. Damage of Hurricane Dean has been measured and regrowth monitored. Dead debris caused increase in forest fires in subsequent years.

Perspectives

- Modis derived anomalities in phenological behavior of vegetation is tested for certain rapid disturbance types, such as hurricanes and fires.

Impact of huracanes on phenological patterns



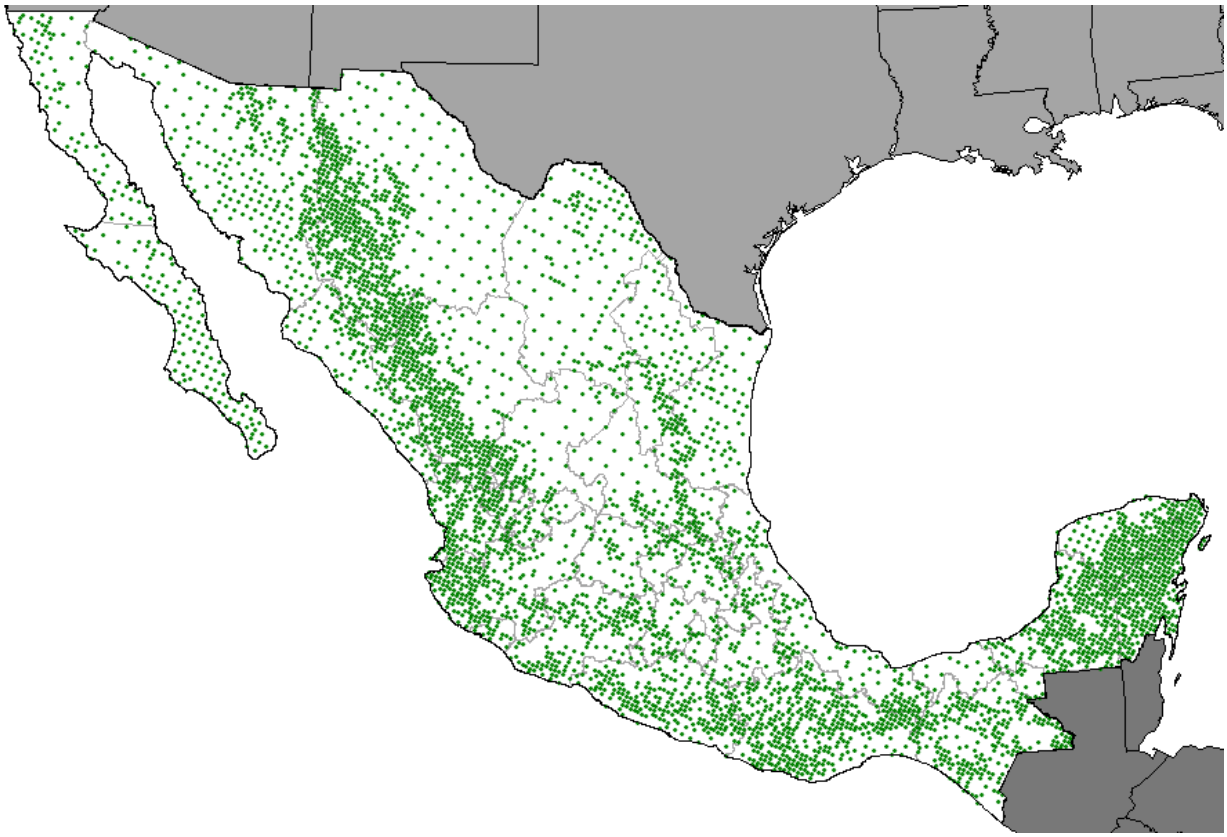
RESAMPLING (NFI 2004-2007)

- 2008: Initial resampling campaign, same methodology as sampling in 2004-2007
- 2009: Resampling reviewed and adjusted with complementary methodology for all C pools

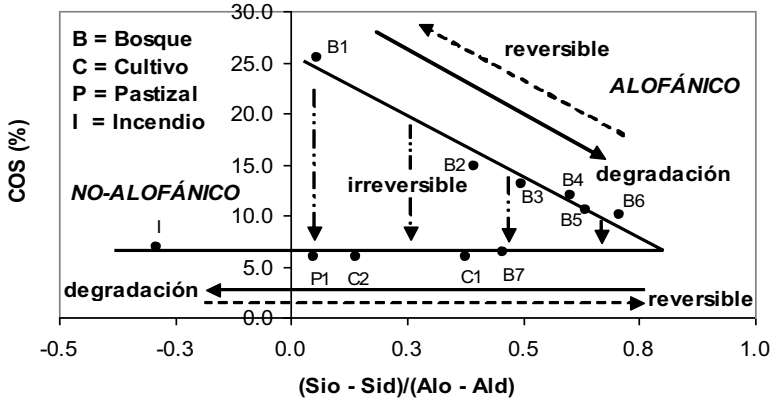
  - Each tree is marked (not marked initially)
  - Dead organic matter on surface measured in two transects
  - Samples of dead organic matter are collected for wood density and C content analysis
  - Soil sampled in two transects in one sampling site: 2 depths (0-30 and 30-60 cm), 9 samples spaced at 2 m, 1 sample for bulk density.
  - Litter (two layers sampled: humified and non-humified) sampled in same points as soils
  - Soil and litter sent to a central laboratory (COLPOS) for analysis

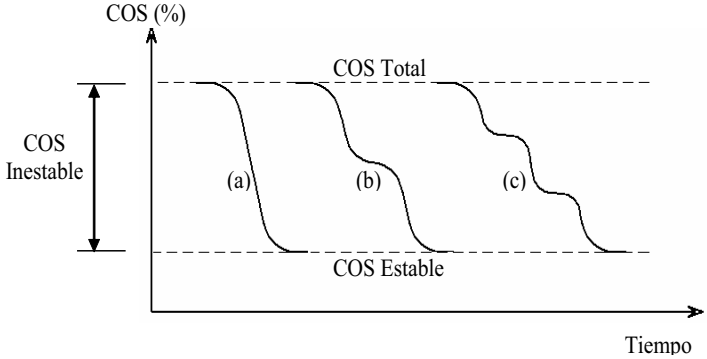
- From 2009 to 2013 the resampling will be completed

2009 resampling: aprox. 5,000 data points



Relation between Biomass and SOC





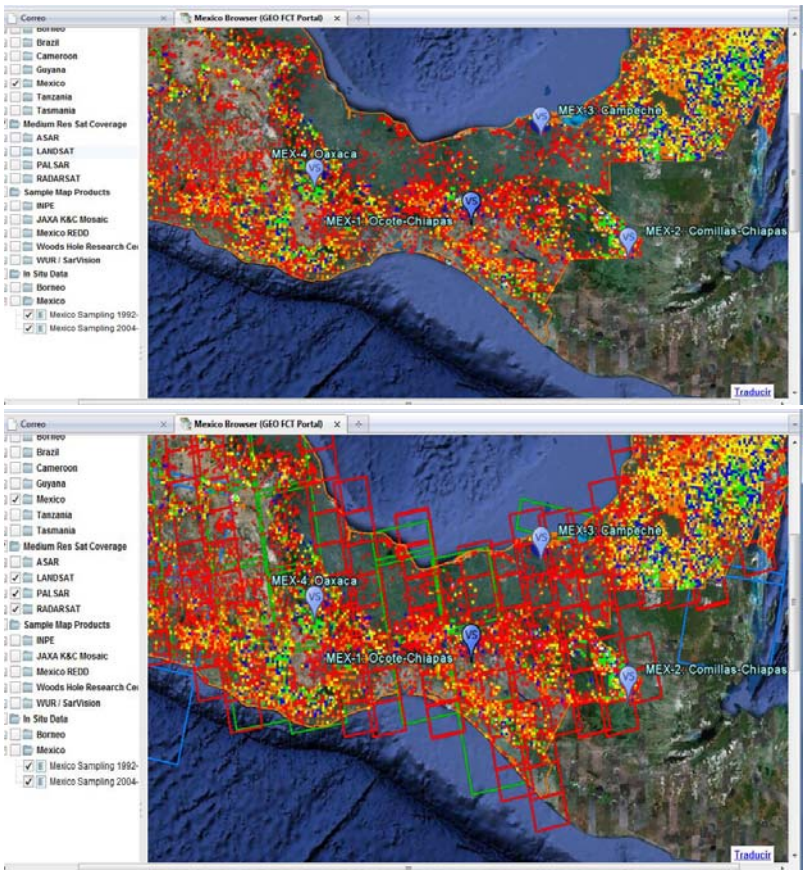
Additional information that will become available from the 2009 inventory data

- Combustion material in each forest type (Fires)
- Losses and gains in forest litter and DOM due to LU change, degradation and restoration.
- Changes in above-ground biomass due to disturbances

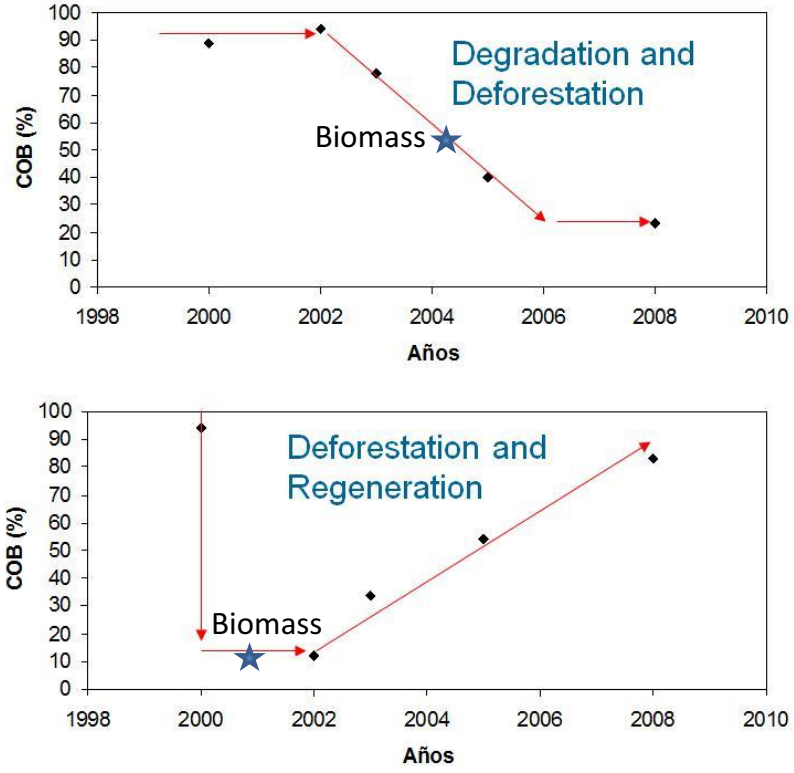
GEO-FCT
http://www.geo-fct.org/

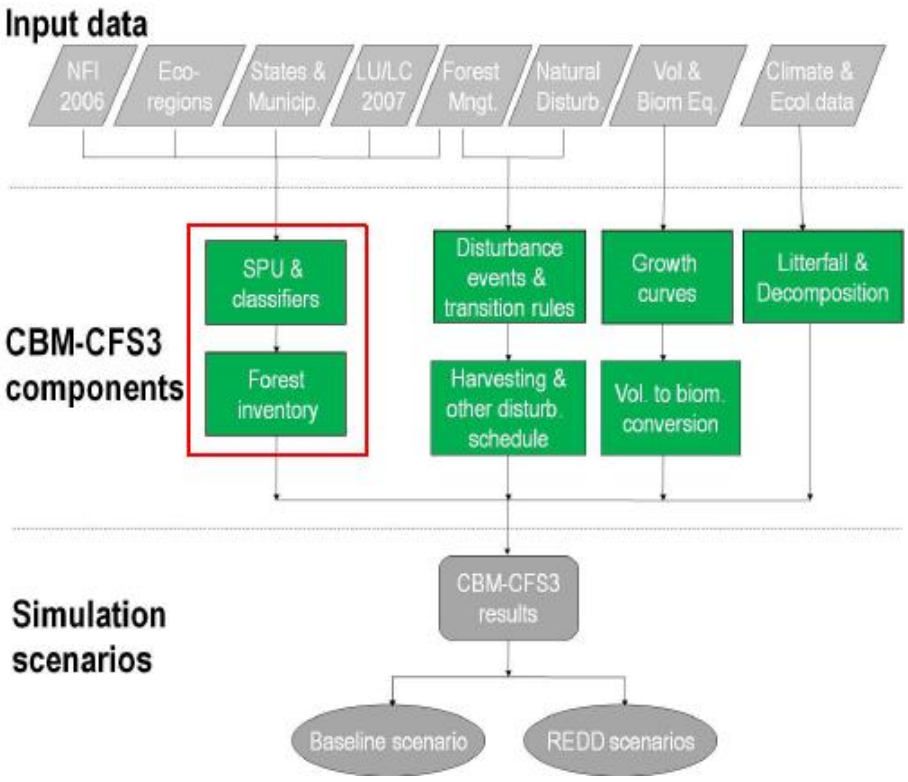
The Forest Carbon Tracking Task (GEO FCT) has been established to support countries wanting to establish national forest-change, carbon estimation and reporting systems. It will facilitate access to long-term satellite, airborne and in situ data, provide the associated analysis and prediction tools, and create the appropriate framework and technical standards for a global network of national forest carbon tracking systems.

Mexico is one of the 7 demonstrator countries



Detecting forest disturbance from stacking multi annual Landsat satellite information and validating these with biomass data from forest inventory (see also Powell et al 2010)





Thanks

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