Carbon in Mexican Forest Soils

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Historical soil C information in Mexico had high uncertainty

- The use of different methodologies and experimental designs that are not comparable generated uncertainty.

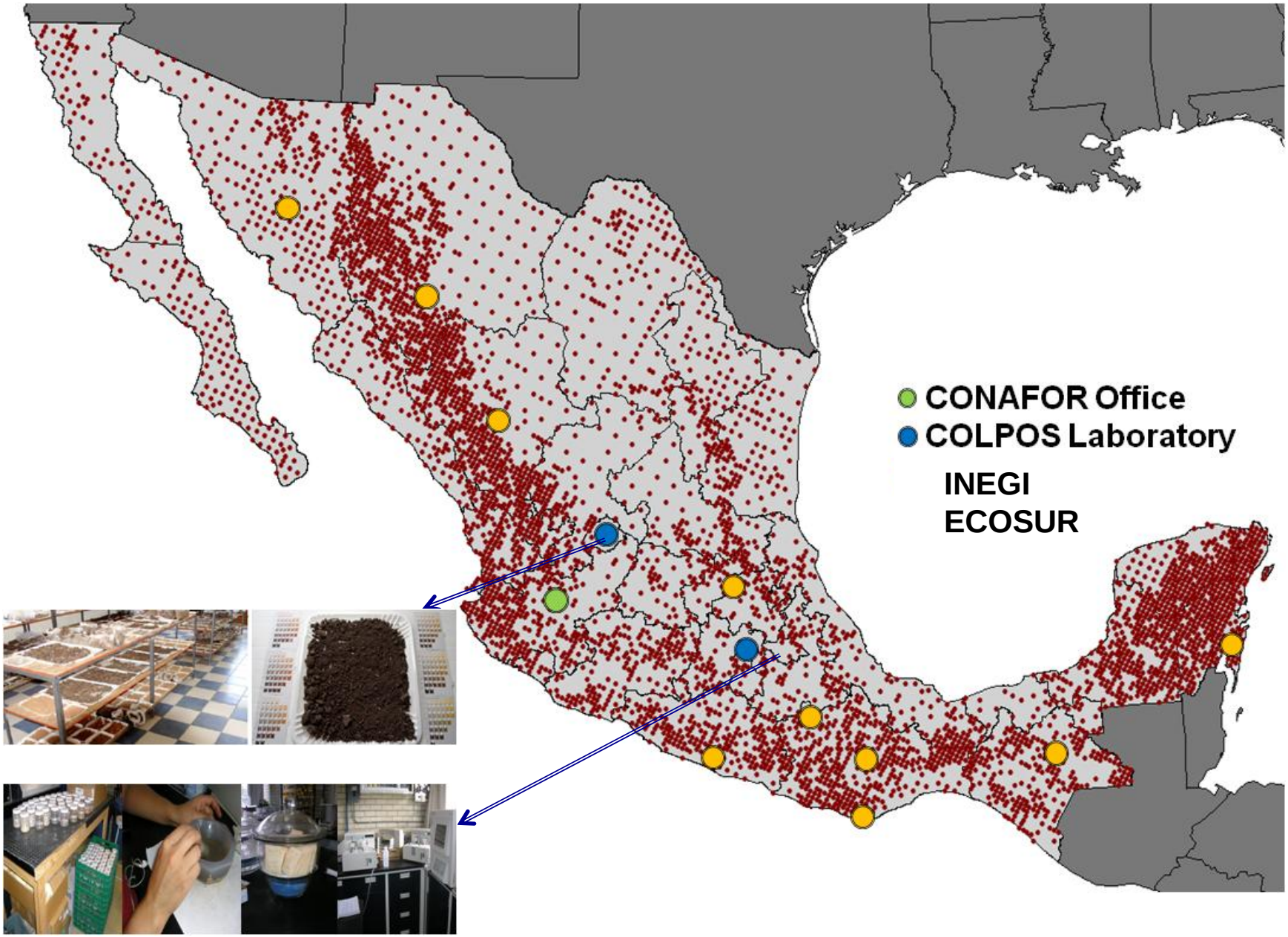
The Mexican Carbon Program

Was created as a mechanism for coordinating the national research effort related to the social and biogeochemical aspects of the global carbon cycle

Objectives

- To produce good quality data (lesser degree of uncertainty)
- To generate data based on sound science (knowing the data uncertainty) produced
- To continuously updated data to be delivered to decision makers
- To adapte and standarize methodologies and nomenclatures to those stablished by IPCC

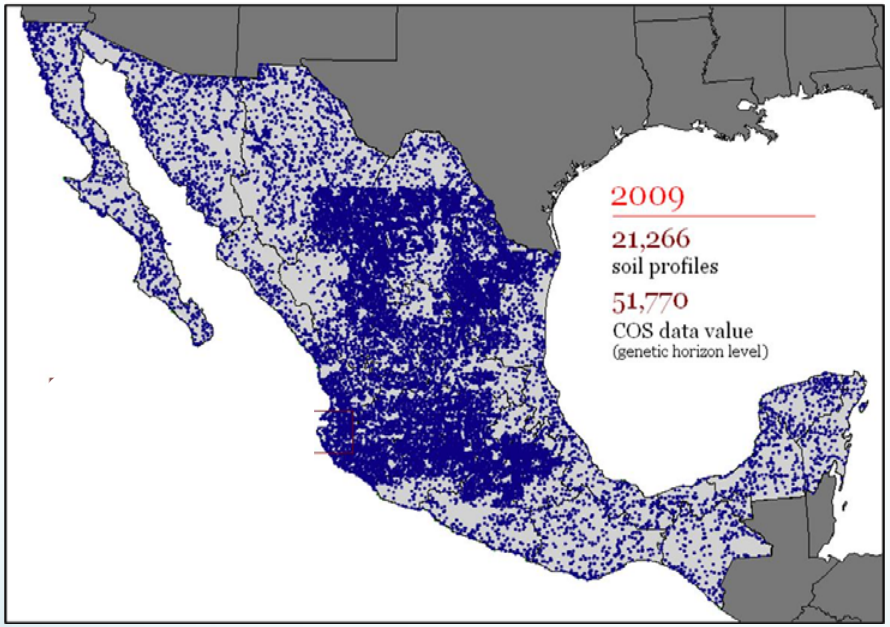
Strategic institutional colaboration



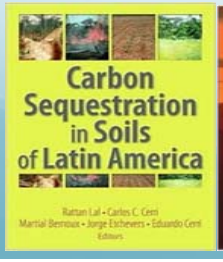
Two big databases

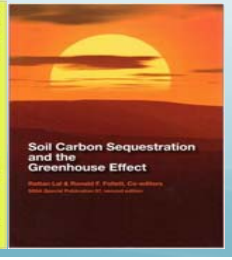
INEGI INSTITUTO NACIONAL DE ESTADÍSTICA Y GEOGRAFÍA

Sampling period 1968-2008



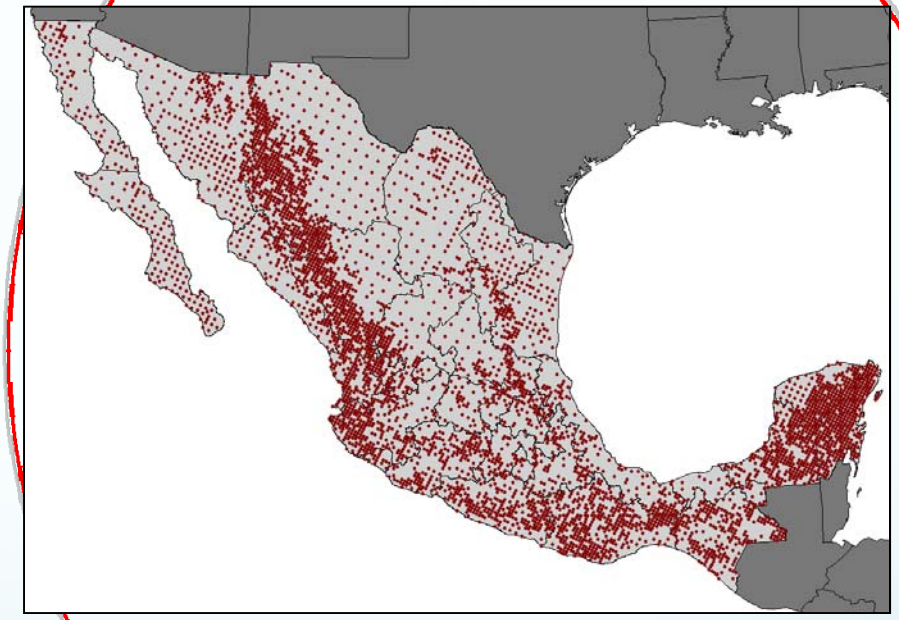
21,266 soil profiles; 51, 770 SOC data
Published papers based on these data.





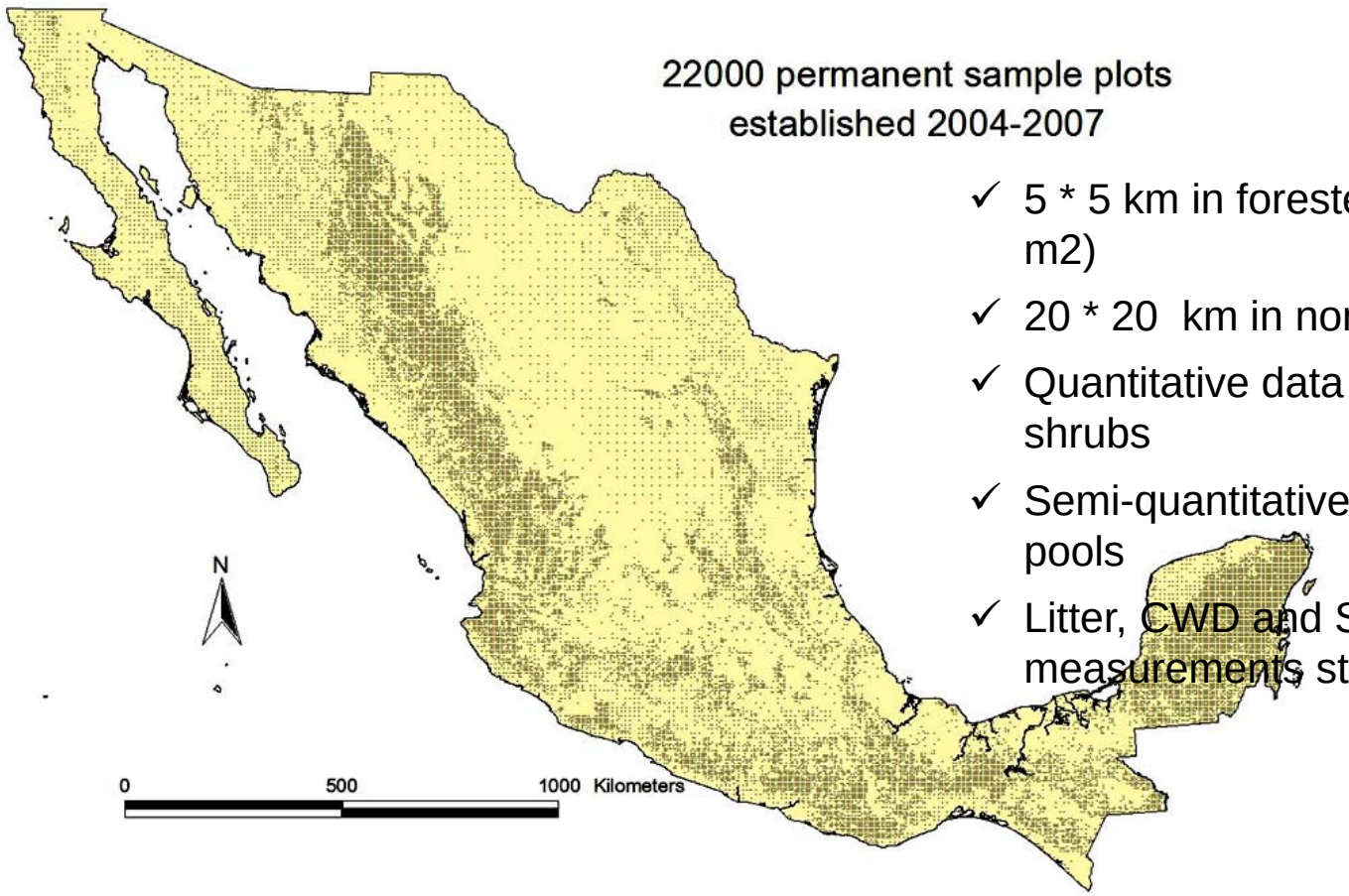
CONAFOR COMISIÓN NACIONAL FORESTAL

Sampling period 2009-2010



-In 2004, 22 000 permanent forest observation sites were established
-No soil samples were collected
-Sampling began 2009 (*ca*. 4000 yr^{-1})
-Re-sampling every 5 years
-Unpublished information

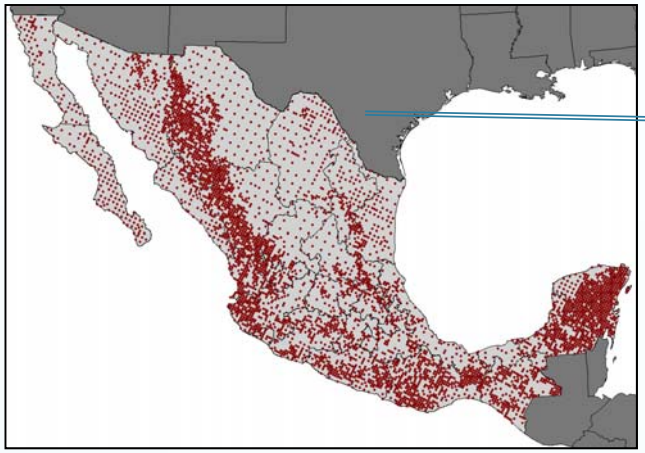
Sites established
2004-2008 National Forest and Soils Inventory

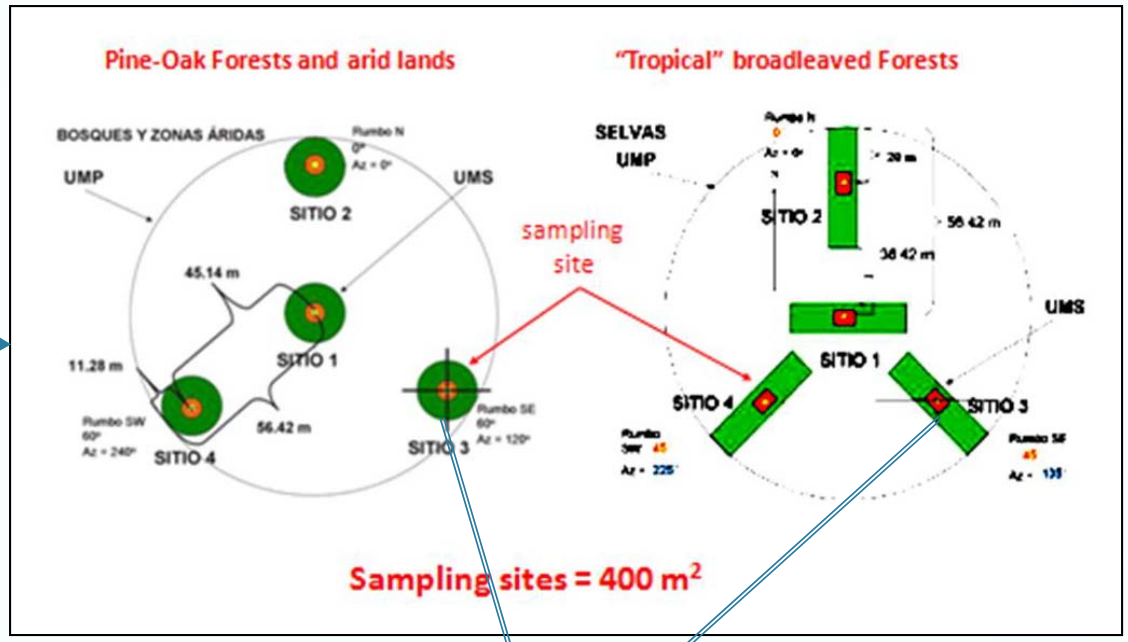


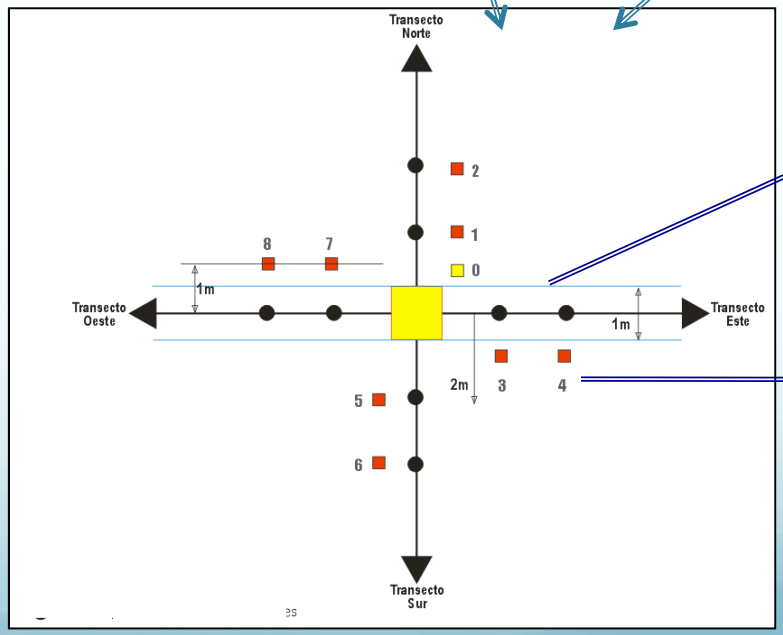
- ✓ 5 * 5 km in forested areas (1600 m2)
- ✓ 20 * 20 km in non-forested areas
- ✓ Quantitative data on trees and shrubs
- ✓ Semi-quantitative data on other pools
- ✓ Litter, CWD and Soil carbon measurements starting in 2009

*** Plots will be re-measured every 5 years and some will be permanently monitored**

At every sampling point
in 2009 and 2010







1m² sites
Register of herbs, mosses, lichens

Sampling point for BD
Sampling point for TOC analysis

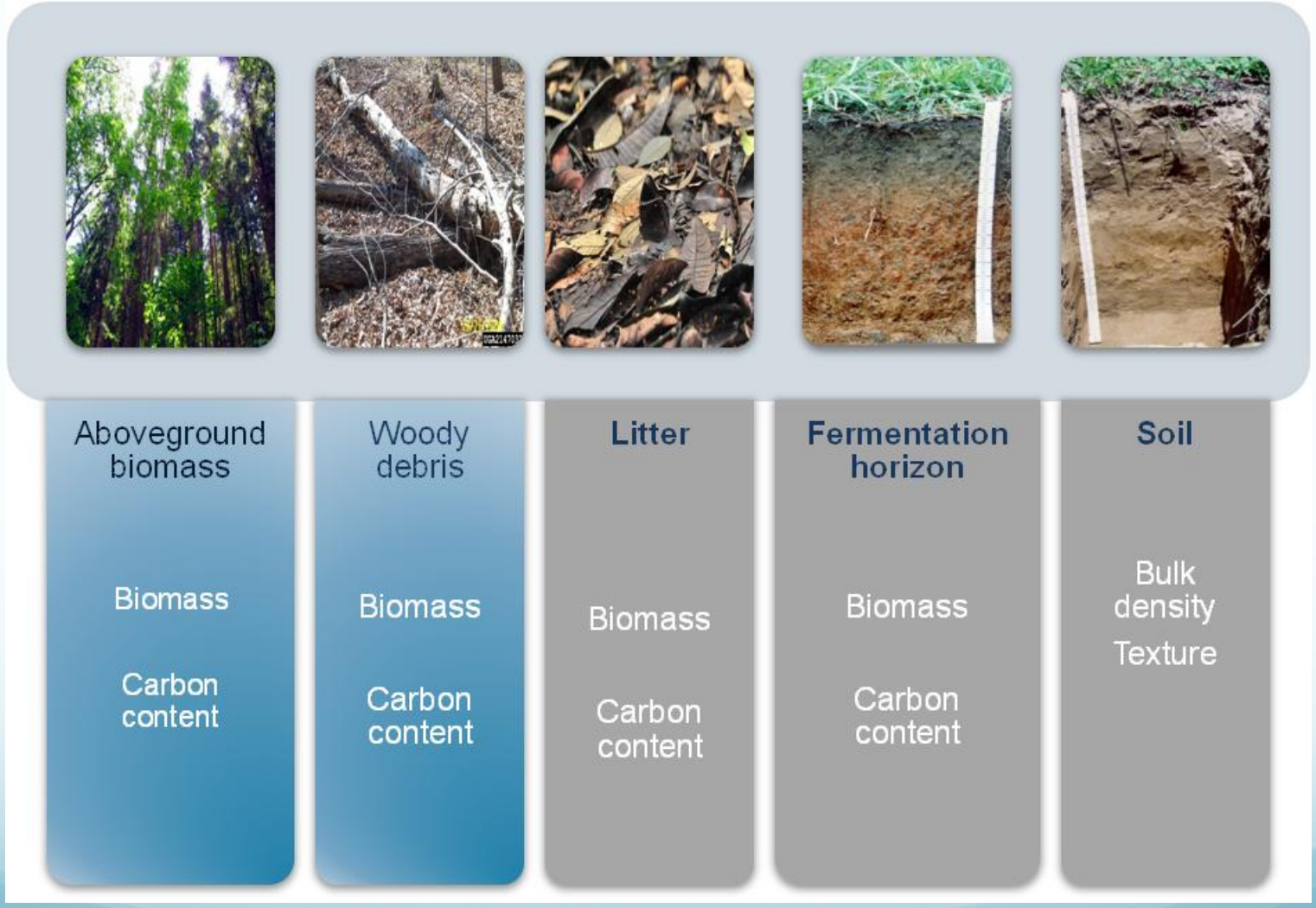
Sampling point for litter, fermentation horizon and soil

Sampling point for fuels

4200 soil samples were obtained and analized every year
(0-10, 10-30, 30-60 cm).

Near 35.000 samples are in the process of analysis by NIR to understand spatial variability of soil C.

Five carbon pools were measured and are being monitored



The methodology we used follows the approach proposed by IPCC

Methods

In order to measure C pools, to establish C cycle processes and C dynamics two analytical appproaches were used:

- Automated method
- TOC 5050 Shimadzu

Total Carbon Analizer

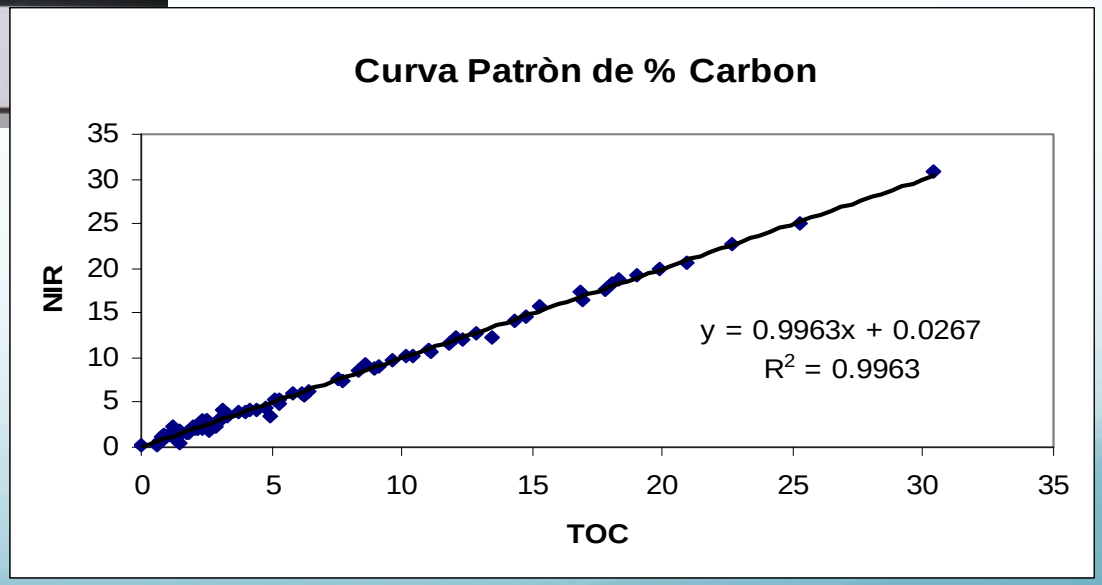
- NIR spectroscopy
- Calibration, validation, prediction

Chemometric methods

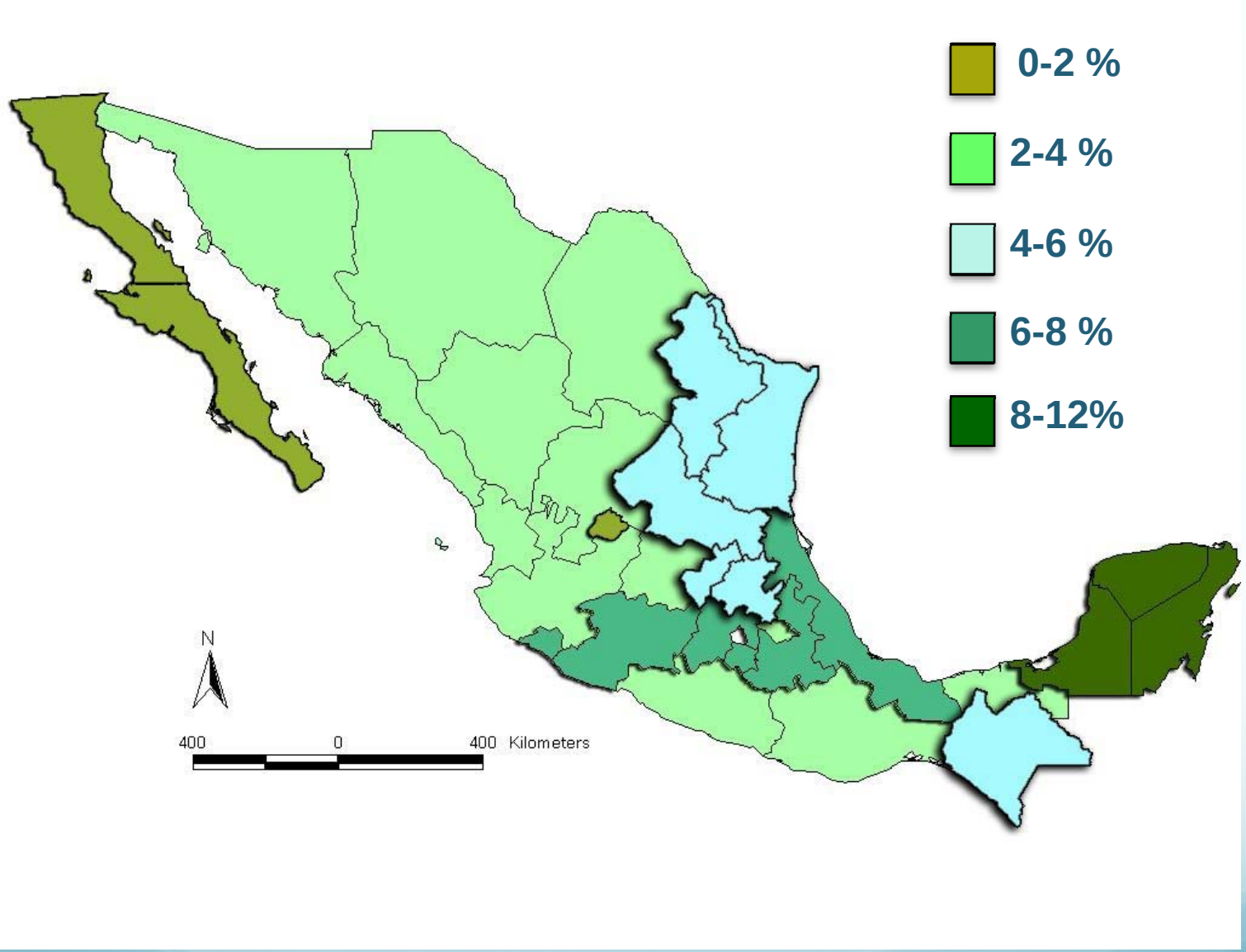
Results

- ≅ 38 000 soil samples are collected every year.
- 4 200 soil samples per year corrrespond to the Bd core samples site. Samples are analized for color, carbonates, bulk density,clay, silk and sand and for total organic carbon by dry combustion.
- ≅ 2000 soil samples are in the process of analysis.
- The remaining ≅34 000 samples from each year are being analized by NIR.

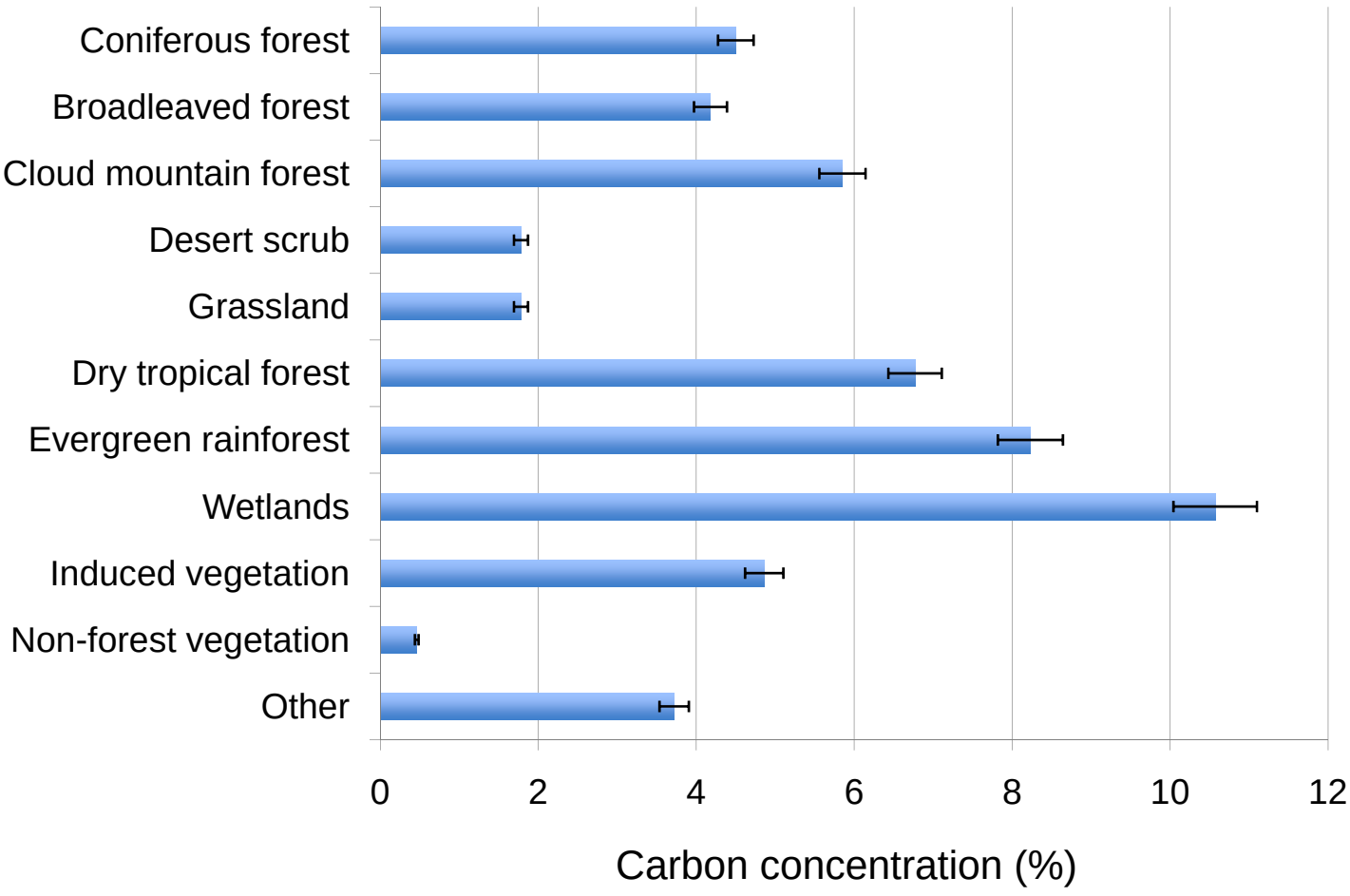
C determination with NIR



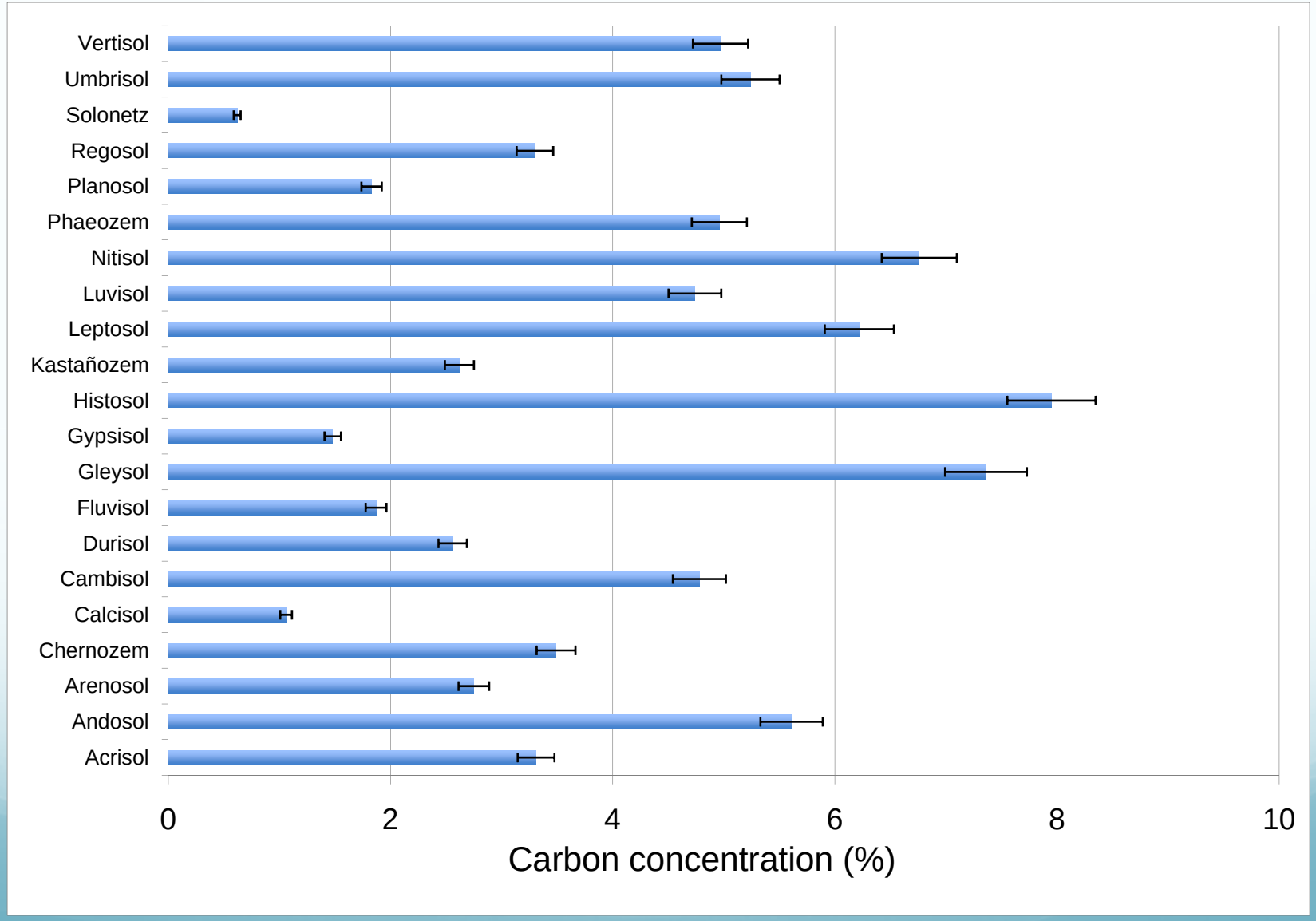
Soil carbon concentration by State (Mexico)



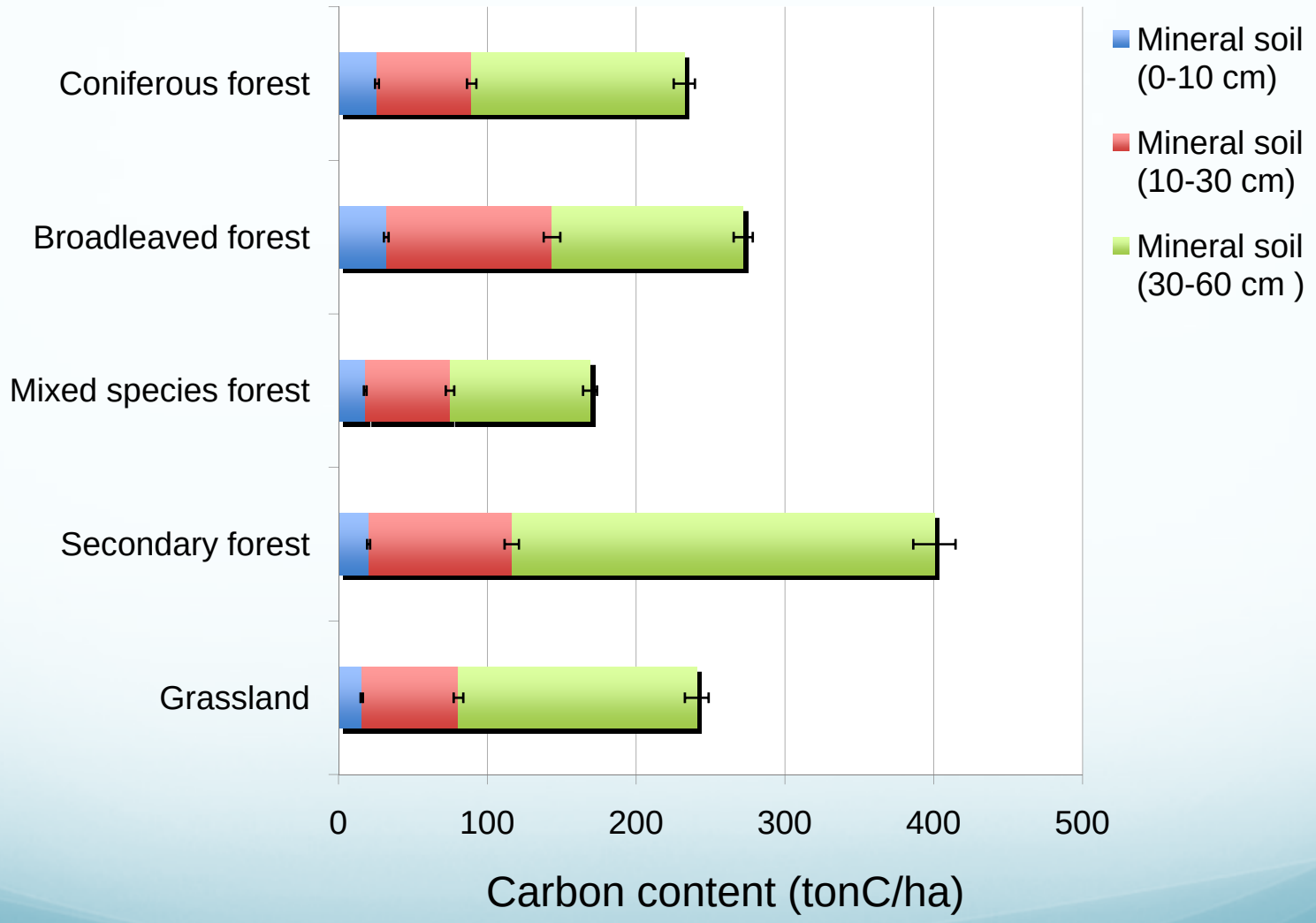
Soil Carbon concentration by biomes



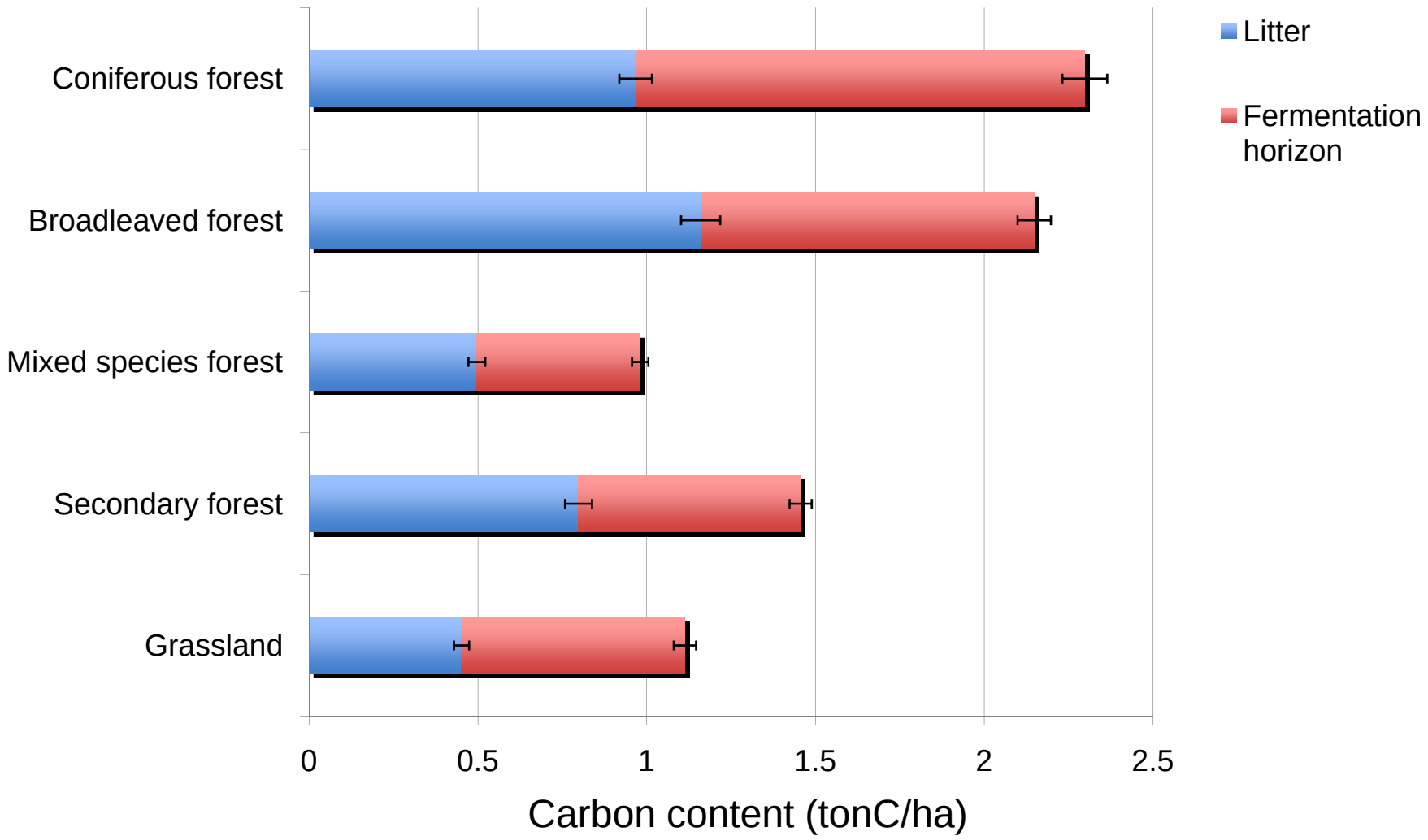
Soil carbon concentration by soil type



Carbon content in forest soils



Carbon content in litter and fermentation horizon (tonC/ha)



Ecosystem

High C concentration (6.3 – 10.7%)

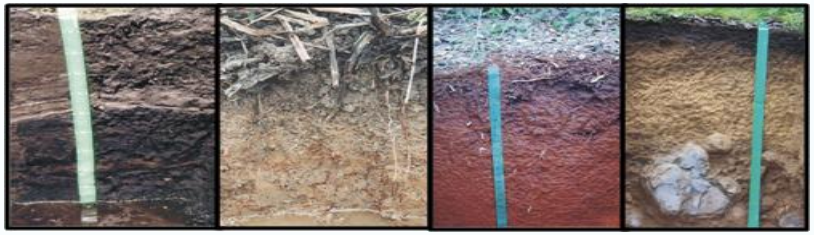
Wetlands | Evergreen rainforest | Dry tropical forest

Low C concentration (0.4 – 1.8%)

Desert scrub | Grassland | Non-forest vegetation

Soil type

High C concentration (5.6 - 8%)



Histosol | Gleysol | Nitisol | Andosol

Low C concentration (0.6 - 1.8%)

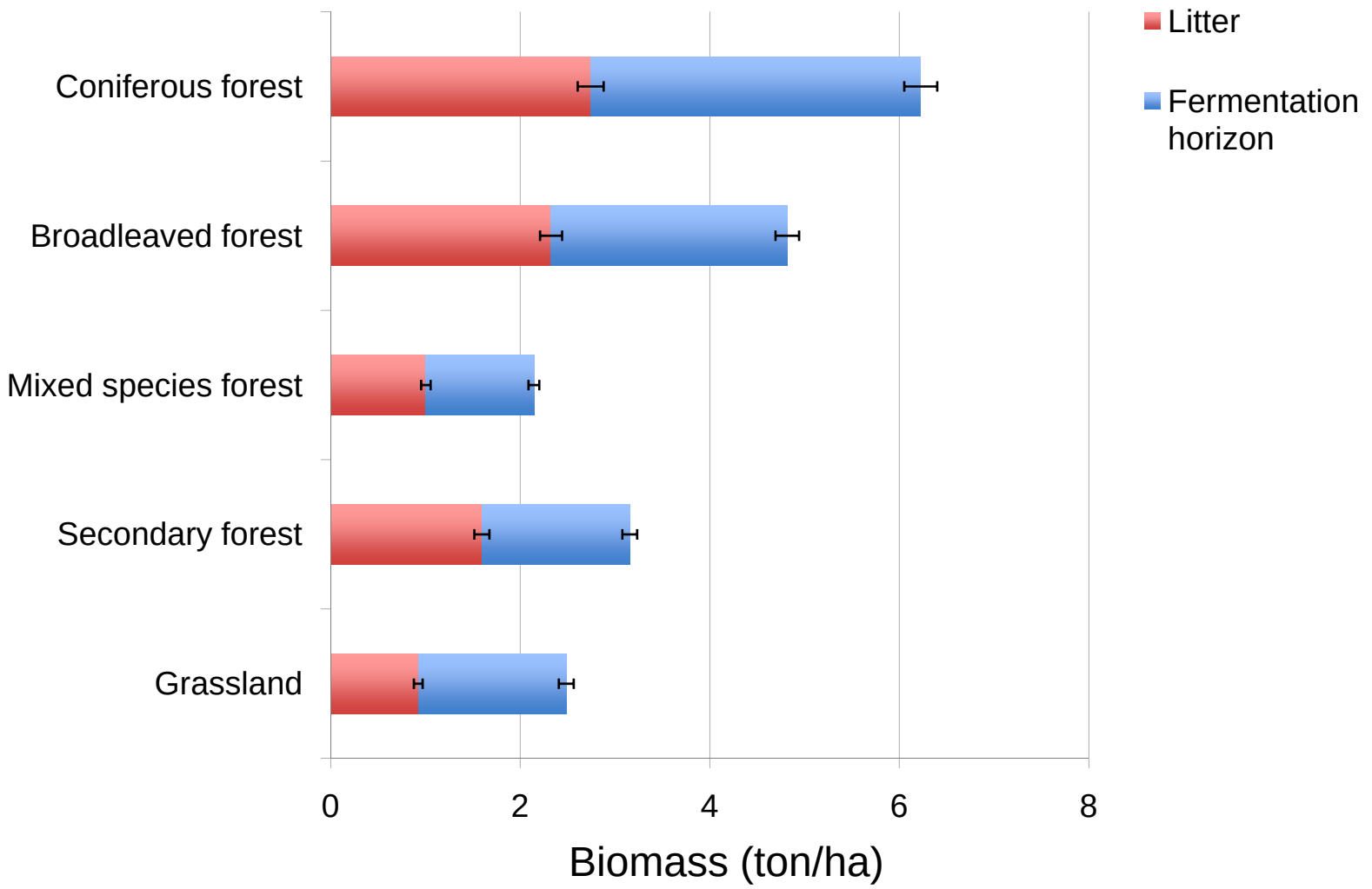
Solonetz | Calcisol | Gipsisol | Planosol

Conclusions

- By middle 2011 there will be near 8000 new soil C data with lower uncertainty that will be used to improve the previous data.
- Standarized methodologies (at field and lab level) have contributed to reduce the uncertainty levels of carbon inventories.
- Chemometric using NIR allows to determine 400 samples per day against 60 samples per day with traditional methods.
- We have now a closer preliminary outcome of how much C we have in five forest C pools in Mexican ecosystems.
- We are now focussing on exploring the dynamics of soil C processes.

Future Work

- To finish measuring the soils samples from each sampling site (2009 and 2010) to understand the real sparial variability of the soil.
- To relate soil C measurements with some remote sensing measurements and tower measurements.
- To continue the 2011-2014 round of samples
- Start plot resampling in 2015 to begin understanding the SOC dynamics
- To study the redistribution of C in forest C pools.
- To estimate the uncertainties in SOC

Experimental design

Litter and fermentation horizon biomass (ton/ha)