Breakout Session

Large stocks, larger uncertainties: The role of soils in North American carbon cycle

Network of Intensive Carbon Monitoring Sites in Mexico: Challenges for soil organic carbon estimation and modeling

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Local organizations

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Ejido Dos Lagunas Norte, Campeche
Ejido Felipe Carrillo Puerto, Quintana Roo
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Mexico-Goverment organizations

Comisión Nacional Forestal (CONAFOR)
Comisión Nacional de Áreas Protegidas (CONANP)
Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO)
Network of Intensive Monitoring Sites “Red Mex-SMIC”
¿What is a SMIC?

Site to intensive monitoring forest C stocks and C stock changes, from the integration multi-scale measurements:

- Ground plots
- Eddy covariance towers
- Remote sensing (diff. Spatial and temporal resolutions, e.g. LiDAR, Landsat, Rapid eye, etc.)
- C dynamics models (empirical, process)

From Birdsey et al. 2010
Idealized Sampling Scheme for a Landscape-scale Intensive Monitoring Site

- 3 x 3 km grid of inventory plots surrounding a meteorological tower or other installation at center
- Inventory plots follow standard FIA protocol
- Other measures (litterfall, respiration) take place at inventory plots
- Larger area for remote sensing; will include range of disturbance
# National FI and Intensive Sites

Approaches to monitoring changes in carbon stocks for REDD+

## Table 1. Variables collected at each scale of analysis.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intensive sites</th>
<th>Forest inventory</th>
<th>Remote sensing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land cover</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Leaf area index</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Disturbance impacts</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Aboveground biomass</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Live and dead aboveground biomass</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Forest structure</td>
<td>X</td>
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<tr>
<td>Species composition</td>
<td>X</td>
<td></td>
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<tr>
<td>Growth, removals, mortality</td>
<td>X</td>
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<tr>
<td>Forest health indicators</td>
<td>X</td>
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<tr>
<td>Litterfall</td>
<td>X</td>
<td></td>
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<tr>
<td>Belowground biomass</td>
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<tr>
<td>Root dynamics</td>
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<tr>
<td>Soil CO₂ flux</td>
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<tr>
<td>Runoff</td>
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<tr>
<td>Dissolved organic carbon</td>
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<tr>
<td>Net ecosystem exchange of CO₂</td>
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<td></td>
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<tr>
<td>Energy and water balance</td>
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</tr>
</tbody>
</table>

[Adapted from (41).]
Network of Intensive Carbon Monitoring Sites *Mex-SMIC*

Selection criteria:

a) Landscapes with great contribution to net carbon balance (LULUC forest sector)

b) Priority area for REDD+ activities

c) Potential multi-institutional collaboration to collect and access data in the long term
c) Ecological parameters, volume/biomass conversion

- **Mexican Network of Intensive C monitoring sites (Mex-SMIC)**

  Government, academics, NGOs group, providing long-term data from intensive measurements (ground plots, remote sensing, flux towers) for:

  - Better understanding of C dynamics in strategic landscapes (e.g. REDD+).
  - Model calibration (e.g. DOM decomposition rates), and evaluation (e.g. stand-level C stocks and landscape-level Tier 2 -Tier 3 comparisons).
Álamos, Sonora

Kaxil Kiuc, Yucatán

Atopixco, Hidalgo
Variables

Litter

Soil depth: total, real
Pit Volume
Rocks

Roots

Litter: Depth
Weight
%C

Roots: Weight
%C

Soils: pH
Texture
Water holding capacity
%C
%N
Quantitative Method

Mineral Soil Layer

12 mm sieve

Field Process

large roots
wet mass

rocks > 12 mm
wet mass

rocks and soil < 12 mm
wet mass

subsample

Lab Process

Refrigerated, sorted, washed, weighed

air-dry mass

Storage

2-12 mm rocks
air-dry mass

< 2 mm soil
air-dry mass

Subsampling, milling

Analytic Subsample
oven-dry mass (105°C)

C, N, Ca, Mg, P, etc. concentrations

Pennino et al. 2012
Vadeboncoeur et al. 2012
Plot layout - SMIC

CWD sampling

- Transectos de 4 m para biomasa de madera muerta sobre el piso con D≥ 0.5 a <2.5 cm
- Transectos de 8 m para biomasa de madera muerta sobre el piso con D≥ 2.5 a <7.5 cm
- Transectos de 15 m para biomasa de madera muerta sobre el piso con D≥ 7.5 cm

Litter and Soil sampling

Soil depth

Understory vegetation

Fuente: PMN, 2013
Procedimiento para el material leñoso caído (MLC) en los SMI

Soil sampling - SMIC

Atopixco
Litter and Soil sampling

Kaxil Kiuc

Soil depth

Felipe CP
Variability within depth increments indicates importance of accurate measurements of bulk density and rocks in rocky dry forest ecosystems.

General patterns with depth indicate differences between sites.

See Johnson et al poster, #112
LIDAR elevation data (background images) can be used with field data to develop high resolution maps of important soil properties.

Larger dots = Deeper Soils
Soil Carbon

Carbono (Mg/ha)

Stand age (years)

Depth

Ángeles et al. in prep.
Forest Floor Mass
Final remarks

- The intensive sampling methods presented uniquely represent landscape scale soil properties that are important to ecosystem functions.

- Soil chemical and physical data support the calibration and validation of process models for scaling to larger regions (e.g. CBM-CFS3, Forest-DNDC, Century, RothC, Yasso, InteC).

- Additional belowground data is being collected: litterfall production, litter and branch decomposition rates, soil respiration, belowground biomass, and fine root dynamics.
Acknowledgments

Atopixco, Hidalgo. 2014

Calakmul, Campeche. 2013

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