

# Mexican Forest Inventory Expands Continental Carbon Monitoring

The terrestrial ecosystems of the North American continent represent a large reservoir of carbon and a potential sink within the global carbon cycle. The recent State of the Carbon Cycle Report [U.S. Climate Change Science Program (CCSP), 2007] identified the critical role these systems may play in mitigating effects of greenhouse gases emitted from fossil fuel combustion. However, there are currently large uncertainties in continental carbon models, and the scientific community's understanding of relevant carbon sources and sinks has been much less complete in Mexico than in Canada and the United States [Birdsey et al., 2007]. One reason for this disparity has been a lack of systematic field data from throughout Mexico. Recently, though, new field and satellite inventory information has become available through two Mexican resource agencies, the Comisión Nacional Forestal (CONAFOR) and the Instituto Nacional de Estadística y Geografía (INEGI). This information has the potential to support new types of analysis within Mexico and to significantly augment efforts to characterize carbon dynamics at the continental scale. Moreover, because many of the forest types and land use issues present in Mexico can be found throughout Latin America, Mexico's support of carbon monitoring may provide a relevant example as other countries within the region develop their own inventories.

## Improved Identification of Land Use Change

Much of the previous work [e.g., De Jong et al., 2000; Masera et al., 1997; Ordóñez et al., 2006] done to quantify Mexican terrestrial carbon dynamics has focused on changes in carbon storage associated with land use change. National maps of land use produced by INEGI and other sources covering different time periods over the past two to three decades have been a primary source of information in these efforts. INEGI will continue to support land use change monitoring by releasing updated 1:250,000 maps of vegetation and land use in 2010. A recent addition to the process of updating these national maps is carried out by CONAFOR; consecutive satellite images are used to detect and map deforestation. A combination of imagery from the Moderate Resolution Imaging Spectroradiometer (MODIS), Landsat, and Satellite Pour l'Observation de la Terre (SPOT) platforms is used to identify hot spots of deforestation and digitize specific areas of change within these hot spots. Further satellite-based information about

land use and land cover change is becoming available via Mexico's collaboration with both the North American Carbon Program's North American Forest Dynamics project [Goward et al., 2008] and the North American Land Change Monitoring System conducted by the Commission for Environmental Cooperation (<http://www.cec.org>).

## New National Vegetation Inventory Information

In addition to INEGI's maps of vegetation and land use, extensive field inventory data are now available from throughout Mexico. The National Forest and Soil Inventory (Inventario Nacional Forestal y de Suelos, or INFyS), initiated by CONAFOR in 2002, represents the first nationally consistent sample of Mexico's many diverse vegetation communities. More than 24,000 standardized forest inventory plots have been surveyed in a network that provides substantially improved monitoring across all of the country's vegetation types (Figure 1). The distribution of plots (using a 5 × 5 kilometer systematic sampling grid for temperate and high tropical forests, a 10 × 10 kilometer grid for shrublands and low tropical forests, and a 20 × 20 kilometer grid for arid ecosystems) is determined using INEGI's national land use and vegetation maps. The fact that all vegetation types (not just forests) are surveyed should benefit efforts to understand changes in atmospheric carbon as air passes over the continent [e.g., Denning et al., 1999].

Mexican inventory plots are similar in design to national forest inventory plots used in the United States; four circular subplots are located within an area of approximately 1 hectare. There are plot-level variables for topography, species diversity, land use, soil depth, epiphyte presence, fire effects, and geographic location. Within each subplot, measurements taken on all trees (diameter ≥ 7.5 centimeters) include species, condition, diameter, height, height to canopy, vigor, and damage. Shrubs and saplings (<7.5 centimeters) are measured (frequency, height, damage) in a 12.56-square-meter area within each subplot, and herbaceous cover is likewise monitored in an even smaller 1-square-meter area within each subplot.

All plots within the national network were measured at least once by the end of 2007, and national-level analysis of this data has been published [CONAFOR, 2008]. The sample design underpinning this inventory will allow for the estimation of national live carbon stocks using methods common in

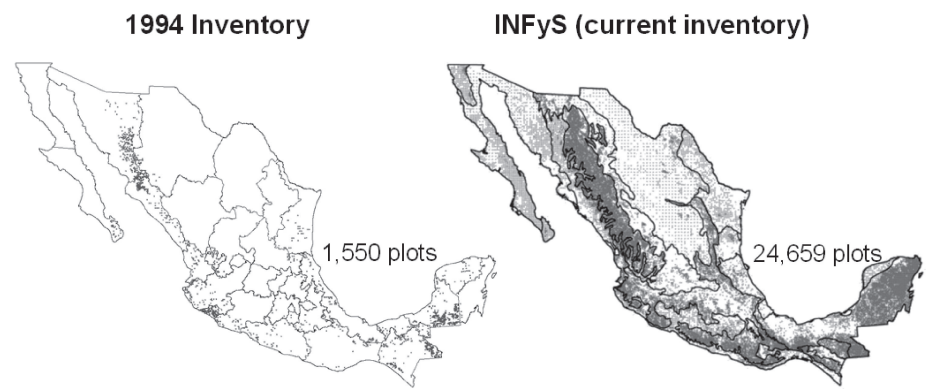


Fig. 1. Comparison of plot distributions supporting *Inventario Nacional Forestal y de Suelos* (INFyS) and the previous national forest inventory (1994 *Inventario Nacional Forestal Periódico*).

countries such as the United States [e.g., Woodbury et al., 2007]. Remeasurement will continue at a rate of 20% of the grid per year, as mandated by law, and may provide a system for monitoring potential impacts of climate change. Notably with respect to carbon studies, although timber volume is currently estimated via the inventory, no standardized equations for biomass (a more direct measure of carbon content) are currently available. However, the inventory provides basic information that pending additional allometric study, may support future estimates of Mexico's biomass.

Most of the resources discussed in this brief report, including the satellite-based change data and the plot- and tree-level inventory data, are available to the public through CONAFOR (<http://www.conafor.gob.mx> or <http://www.cnf.gob.mx/emapas>). It is anticipated that as baseline vegetation information in Mexico improves, the consistency and quality of national and continental carbon monitoring likewise will advance.

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