Project 3: Integrated Modeling and Assessment of M Change Mitigation Options	North American Forest Carbon Dynamics and Climate	Operating Year(s): 2013–2014		
Planned Budget for two years: \$410,000 Year 1: \$210,000 Year 2: \$200,000				
Strategic Priority/Objective: Climate Change–Low-Carbon Economy / Healthy Communities and Ecosystems				

# **Project Summary**

This project contributes to the development of science-based decision support models, data and tools that can quantify the impacts of alternative forest and land management options on the carbon balance of North American forests, and support policy and management decisions regarding climate change mitigation. It is part of the Climate Change–Air Quality group of projects that supports work on measuring emissions and quantifying carbon sinks, mapping ecosystem carbon and developing approaches to mitigate black carbon. Parts of these cross-disciplinary projects integrate forest and coastal/marine carbon cycle research to obtain an improved understanding of the current and future role of these ecosystem-based systems in North America's carbon cycle.

Forests are important contributors to the global carbon cycle with large differences in their functions as net sources or sinks of greenhouse gasses at regional and national scales and over time, following different land use, management and disturbance impacts. Understanding the responsible drivers and the distribution of greenhouse gas sources and sinks across diverse geographical regions and over time, as well as considering different landowner objectives, is required to sustainably manage forests to make a larger contribution to climate change mitigation targets. For example, degradation and conversion of forests to other land uses is the largest contributor to net carbon sources from forests in Mexico; natural disturbances cause large sources in some regions of the US and Canada; and actively growing young forests contribute carbon sinks in all of North America. The extent and type of change can be quantified by examining land cover together with additional information about causes of change. These "activity data" are important inputs for carbon models and help decision-makers understand the role of different natural disturbances (e.g., fire, hurricanes, insects) and human activities (land-use change, forest management) on carbon budgets.

The CEC supported the 2011–2012 project: *Ecosystem Carbon Sources and Storage: Information to Quantify and Manage for Greenhouse Gas Emissions Reductions* that focused on improving Mexico's ability to monitor and report on ecosystem carbon and worked in conjunction with several other large initiatives in Mexico to improve ecosystem carbon accounting and understand the role of different natural disturbances and human activities in carbon modeling. The three countries worked together to identify the potential role of models and their contribution to a monitoring, reporting and verification (MRV) system in Mexico, using methods that would be harmonized with those used in Canada and the United States, and take advantage of developed methodology. This project builds on the outcomes of the 2011–2012 work and expands the analysis to address forest sector mitigation options to meet national objectives of greenhouse gas emission reductions for selected landscapes in Mexico, the US and Canada. It will continue to support the generation of North American land cover data and maps by the North American Land Change Monitoring System group (NALCMS) at a spatial resolution of 250 m and the evaluation of land cover information at higher spatial resolution (30 m), which will help address information gaps in areas with high spatial variability and small-scale but frequent disturbances, which is important input for carbon models. It will also generate spatially

detailed (30 m) land cover information for test sites to populate carbon models locally over specific ecosystems. Lastly, it will examine the results of using different accounting approaches for estimating the effects of mitigation options and consider how data and tools developed for carbon assessment might be used in the context of all ecosystem services.

The forest sector is expected to play an important role in domestic greenhouse gas mitigation portfolios. This project contributes towards the generation of key input data and the harmonization of approaches and tools required for the assessment and reporting of greenhouse gas emissions in the North American forest sector. This project will also help identify the most effective approaches in each country to reduce forest loss and degradation, and improve sustainable management for maintaining or increasing carbon stocks. The methods used by the project will include assessments of carbon stock changes and the associated emissions and removals in both absolute terms and relative to a baseline (net-net accounting). All mitigation and REDD+ scenario options will be evaluated relative to a baseline. How the baseline will be determined, i.e., "business-as-usual," historic average rates of deforestation, or other methods is subject to ongoing research and will require consideration of national circumstances. Expected products of this project are maps, data and computer models that will lead to improved understanding of the role of land cover, land-cover change, and forestry in the carbon cycle across North America and the opportunities for improving land management. This understanding forms the basis for the desired outcome of improved design and assessment of climate change mitigation portfolios in the forest and land-cover change sector in North America.

## Short-term Outcomes (at halfway point)

- Developed and tested designs for databases of activity data and associated forest carbon stock changes.
- Developed and tested carbon budget models to improve analyses of forest sector GHG balance.
- Yearly land cover and land cover change maps (2005–2011) at 250 m to improve tracking of natural and human disturbance.

## Long-term Outcomes (by the end of the project)

- Application of carbon budget models for the analysis and projection of future GHG balance and climate change mitigation options in the forest sector in specific regions of high interest in North America.
- Spatial information about the impact of natural disturbances, land cover, and land-cover change on forest carbon in specific regions of high interest in North America to provide decision-makers and land managers with some of the data needed to make policy and management decisions.
- An evaluation of approaches for a North American methodology for standardized land cover mapping at 30 m resolution on a continental scale.
- A process for standardizing land cover maps at 30 m resolution for specific sites of high interest, to effectively target mitigation projects.

## Longer-term, environmental outcome (post project)

- Analyses of the rates of deforestation and forest degradation in North America and associated emissions will improve the understanding of the impact of natural and human disturbances and quantification of mitigation options on national carbon budgets.
- A monitoring, reporting and verification (MRV) system capable of assessing the magnitude of reductions in CO<sub>2</sub> emissions from forests, and increases in the removal of CO<sub>2</sub> from the atmosphere relative to the projected baseline.
- Improved management of forests leading to sustainable provision of services beyond climate mitigation, such as timber production, water supply, and biodiversity.

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### Tasks necessary to reach the environmental outcome:

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- 1. Develop and apply tools for carbon budget analysis and decision support for mitigation analyses
- 2. Develop input data for carbon budget analyses of North America

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3. Develop and apply multi-resolution land cover monitoring for describing "activity data" across the North American continent

Subtask	Project outputs	How does the subtask/output move the project towards the environmental outcome	Timing	Budget (activities)
1.1 Develop and test empirical models (e.g., CBM-CFS3) for data analysis, decision support and application in regional landscapes at 30 m resolution.	• Analysis of regional-scale carbon budgets for several pilot study areas over recent years and projections into the near future using empirical data (forest inventories, growth and yield, and activity data generated in Task 1).	These tools are the basis for the analysis of forest sector mitigation options that will be conducted in Task 1.3. They have to be developed and tested in different regions and ecosystem types.	Yr 1: Mexico Yr 2: Canada and the US	Year 1: \$50,000 Year 2: \$35,000
1.2 Develop and test process models (e.g., DNDC) for data analysis, decision support and application in regional landscapes, including managed forests and industrial wood plantations.	• Analysis of regional-scale carbon budgets over recent years and projections into the near future using process models and activity data generated in Task 1.	These tools are the basis for the analysis of forest sector mitigation options that will be conducted in Task 1.3. They have to be developed and tested in different regions and ecosystem types.	Yr 1: Mexico Yr 2: Canada and the US	Year 1: \$50,000 Year 2: \$35,000

1.3 Analysis of forest sector mitigation options in one or two selected landscapes of high interest, e.g., early action areas for REDD+ in Mexico, or Mountain Pine Beetle infested areas in the US and Canada, including the fate of carbon in harvested wood products.	The ultimate objective of this project is the analysis of forest-sector related mitigation options aimed at meeting national objectives of greenhouse gas emission reductions. All tasks are aimed at generating the input data and tools required to conduct the analyses of forest ecosystem and harvested wood product carbon stock changes and emissions that are the outcome of this project.	Model-based analyses of mitigation options in the forest sector (i.e., forest ecosystems and harvested wood products) will identify the options available and the resulting contributions to reducing greenhouse gas emissions. Scenario options will be defined in collaboration with national agencies, and applied in regions of high policy relevance. Results will be generated as figures, maps and tables and summarized in a project report.	Yr 1: planning and development of data and models Yr 2: conduct analyses and work with stakeholders	Year 1: \$30,000 Year 2: \$50,000
Task 2) Develop input data	for carbon budget analyses o	f North America		
Subtask	Project outputs	How does the subtask/output move the project towards the environmental outcome	Timing	Budget (activities)
2.1 Workshop and analysis of suitability of alternative data sources and methods for combining data sources for activity and ecosystem data as input to carbon models.	<ul> <li>Methods to combine data from multiple sources into databases on the extent and type of disturbances and other activities and associated data on changes in ecosystem carbon pools and carbon in harvested wood.</li> </ul>	This component will provide a working example of how data from multiple sources can be combined to develop spatially referenced and/or spatially-explicit activity data.	Yr 1: Development of methods and regional prototype Yr 2: Workshop on extension and application to additional regions	Year 1: \$30,000 Year 2: \$30,000

Subtask	Project outputs	How does the subtask/output move the project towards the environmental outcome	Timing	Budget (activities)
3.1 Workshops to continue the generation of 250 m land cover products for North America, exploration of potential for continental 30 m land cover mapping and generation of 30 m site- specific land cover and land cover change products.	<ul> <li>Completion of annual land cover time series 2005 to 2011</li> <li>Assessment of potential for spatially detailed (30 m) and new land cover product</li> </ul>	Key information for climate change community and carbon modelers at 250 m resolution. 30 m land cover products will overcome limitations in spatial resolution for describing activity data. Activity data are input to carbon models for up to 3 test sites.	Yr 1: Face-to-face workshop and development of baseline land cover map for test sites Yr 2: Face-to-face workshop, change detection and activity data for test sites	Year 1: \$50,000 Year 2: \$50,000

### Explain how this project meets the selection criteria adopted by Council in the Strategic Plan (See below)

The goal of all projects funded by the CEC will be to support the efforts of the Parties to conserve, protect and/or enhance the North American environment. The following criteria will guide the Secretariat, Working Groups, Committees, and other appropriate officials of the Parties in considering cooperative activities for Council approval under operational plans. These selection criteria do not apply for activities to be funded through the NAPECA grant program.

# • How does the project contribute to achieving Council's strategic objectives as described within the current Strategic Plan, or as related to other priorities subsequently confirmed by Council?

This project is part of the Climate Change–Air Quality group of projects that supports work on measuring emissions and quantifying carbon sinks, mapping ecosystem carbon and developing approaches to mitigate black carbon. Parts of these cross-disciplinary projects integrate forest and coastal/marine carbon cycle research to obtain an improved understanding of the current and future role of these terrestrial and aquatic systems in North America's carbon cycle. The results of the research will inform improved management of these systems by the public and private sectors including forest industry, to increase sinks and reduce sources to achieve climate change mitigation objectives. The project addresses the CEC's Climate Change–Low-carbon Economy priority and the Engagement of Experts and Strengthened Information Sharing in Climate Change and Low-Carbon Economy strategic objective. To a lesser extent, it also addresses the Healthy Communities and Ecosystems priority.

The project will help build capacity among the three countries for information sharing and data analyses of climate change mitigation options in the forest and land-use change sector. Specifically, the project focuses on:

- Generation of key input data and the harmonization of approaches and tools required for the assessment and reporting of greenhouse gas emissions and removals in the North American forest sector
- Collaboration with national experts and networks
- Improved data, information and tools for monitoring and reporting on GHG emission reductions
- Integration of data into monitoring and reporting schemes
- Consistent datasets on forest carbon, land cover, and land cover change
- Examples of reporting greenhouse gas emissions and reductions using different accounting approaches: "net-net" and "gross-net".
- Decision support tools with which to assess the climate change mitigation potential in the forest sector through reductions of emissions from deforestation and degradation and the sustainable management of forests.
- Strengthened information sharing to improve efforts to address climate change and the transition to a low-carbon economy
- Are the proposed objectives North American in scope? In other words, how are the proposed results relevant to
  protecting the environment in North America? (For example, what would Council members announce to the press at
  the successful completion of this project?)

Understanding the responsible drivers and the distribution of sources and sinks across diverse geographical regions and over time, as well as considering different landowner objectives, is required to sustainably manage forests to make a larger contribution to climate change mitigation targets. This understanding forms the basis for the desired outcome of improved design and assessment of climate change mitigation portfolios in the forest and land-cover change sector in North America.

The Parties recognize that the trilateral engagement of experts working on developing consistent data and information-sharing on forest carbon can bring added value as most of North America's ecoregions span across national boundaries and would benefit from consistent carbon reporting for respective efforts to address climate change and affect the transition to a low-carbon economy. The project will supply data, information and tools that can be used to monitor and report on the development and implementation of appropriate initiatives to reduce GHG emissions from land use and forest management. The project will also facilitate a broad and readily accessible mechanism for the sharing and dissemination of information among North American experts with a focus on scientific and technological best practices.

• What are the specific, clear and tangible results that will be achieved and how will progress toward each result be measured over time? Identify performance measures to be used to indicate success at reaching all outcomes and/or performance.

This project will generate improved understanding of the role of the North American Forest Sector in climate change mitigation, the possible pathways to reducing emissions and increasing carbon sinks and the magnitude and timing of these mitigation benefits. These results will be summarized in reports, including peer-reviewed publications, maps, presentations and documentation of the tools with which these analyses were conducted. The project will also develop improved estimates of greenhouse gas emissions for selected regions of high interest (thus

contribute to reporting obligations and the reduction of uncertainties of reported values), and estimates of carbon stocks in forests and to the extent practicable, harvested wood products. To enable these outcomes, intermediate products will be generated such as improved activity data (derived from time-series of land cover and land cover change products), data processing and modeling tools, and databases that contain the relevant information that is used as input to these analyses. Many of these intermediate products, such as land-cover information and the compilation of annual activity data (e.g., rates of disturbances and land-use change) will also be valuable to other user communities.

- Explain why the CEC is the most effective vehicle for the Parties to undertake the project, considering:
  - The value-added of doing it under the CEC cooperative program
  - Any other public, private or social organizations that work on such activities
  - Opportunities to cooperate and/or leverage resources with such organizations

The CEC is the ideal body to facilitate cooperation among governmental institutions for projects with a scope on the North American continent. The CEC has been supporting the North American Carbon Modeling Group since 2011 and the North American Land Change Monitoring System since 2007. The latter group being a leader in assisting with the establishment of continental land cover and land-cover change data at the appropriate scale (250 m) to support North American ecosystem carbon quantification and monitoring. Due to the trinational nature of the work, the project is well positioned to support the collaboration of the Parties' experts in exchanging knowledge on best practices for modeling and assessing North American forest carbon dynamics and climate change mitigation options

Other organization working on similar activities include:

- The North American Forestry Commission, Atmospheric Change and Forest Inventory Working Groups
- The North American Carbon Program (CarboNA), a trilateral research consortium coordinated by representatives of the 3 countries including participants in this project
- USAID/Mexico bilateral program on "Sustainable Landscapes" which is focused on several closely related tasks, including improving availability of field data, improving data management, disturbance mapping, and modeling of ecosystem response to disturbances and management
- Canada/Mexico bilateral collaboration which is focused on developing national- and regional-scale modeling approaches to support needs for MRV
- Mexico/Norway initiative, which is focused on developing the national MRV system for Mexico.

Opportunities to cooperate and/or leverage resources with such organizations include:

- The established collaboration among the various programs operating in the three countries and the sponsoring
  institutions, particularly the three forest services (CFS, USFS, Conafor) and three geographical institutions (NR-Can,
  USGS, INEGI), among others. This collaboration is highly effective at coordinating efforts, avoiding duplication of effort,
  and taking advantage of the synergistic opportunities.
- Some specific tasks of this proposal that benefit greatly from leveraging the resources of other programs include developing composite data about activities; mapping of stand age and disturbances; developing and testing empirical and process models; analyzing mitigation options; and generating land-cover products. Because of the reduced budget, the CEC project members will aggressively seek to leverage resources in order to achieve the desired outcomes.

• Does the project propose a clear timeline for implementation of the activities, including a target end date for CEC's involvement? Where applicable, describe how the work will continue after CEC involvement ends.

The tasks in this project will put in place strong continental networks and will provide data, maps and information for an online sharing platform on climate change. By project end, these activities should be integrated into the regular work programs of the trilateral land cover and carbon monitoring programs already well-established at USGS, USFS, Natural Resources Canada, Conafor, Conabio, and INEGI. Outputs will allow carbon accounting initiatives in North America to be monitored. In addition, the project will support the scientific collaboration of experts from each country in producing and sharing this information. The CEC funding will put in place a strong collaborative framework that will continue after the CEC involvement through the bi- and trilateral work of the forestry services and the North American Land Change Monitoring System.

The project proposes a clear and well-coordinated timeline: in year 1 the focus of the activities is on model development, testing and the acquisition of relevant input data both at the continental and regional scales (e.g., activity and land cover information). In year 2 the focus is on ongoing data processing and the application of the models and decision support tools to quantify the climate change mitigation potential of the North American forest and land-use change sector. The project will put into place improved monitoring capacity, and decision support tools with the required documentation to ensure that experts in all three countries will be able to continue the use of these tools for reporting and analyses after completion of the CEC-funded phase of the project.

- Where applicable, identify with reasonable specificity:
  - Linkages with other relevant CEC projects, past or present, in order to create synergies, capitalize on experience, or avoid duplication
  - The target audience, as well as its receptivity and capacity to use the information that may be produced as a result of the project
  - The beneficiaries of capacity building activities that the project may include
  - The relevant stakeholders, with particular attention to communities, academia, NGOs and industry, and their involvement and contribution to a successful outcome

This project builds on the 2011-2012 *Ecosystem Carbon Sources and Storage: Information to Quantify and Manage for Greenhouse Gas Emissions Reductions* project, which has supported several of expert groups (North American Carbon Modeling group, North American Land Change Monitoring group and the North American Atlas Coordination group). The products from this project are seen as building blocks for the anticipated deliverables from this project.

As part of the Climate Change – Air Quality group of projects, the project will work closely with the North America's Blue Carbon: Assessing the role of coastal habitats in the continent's carbon budget project, the black carbon project and would ensure that results and data were available on the North American Online, Interactive Informational Platform on Climate Change. Joint workshops with experts working on blue carbon will strengthen information and data sharing and lessons learned. Maps will also be hosted on the *North American Environmental Atlas*, maintained by the CEC. Other stakeholders and beneficiaries will include specifically: the private sector, including nonindustrial and industrial land owners, communities and *ejidos*, Canadian Forest Service NR-Can, US Forest Service, Conafor, Inegi, Conabio, CCRS NR-

Can, USGS - Core Science Systems, USGS - Climate and Land Use Change, North American Land Change Monitoring System Group, North American Carbon Storage Atlas Group, North American Forest Commission, Global Earth Observation System of Systems (GEOSS), and Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD).