Proposed

Forest Accounting, Assessment, and Greenhouse Gas Exchange.
July 24, 2009
Byron Sher Auditorium
CalEPA, Sacramento, CA

The AB32 Scoping Plan Sustainable Forest Target calls for no net loss of forest carbon or carbon sequestration capacity. This strategy relies on knowing (1) the current "carbon stock" and greenhouse gas (GHG) flux of California forests, (2) accurately projecting the 2020 stock and flux of California's forests, and (3) monitoring progress toward goals to reduce forest losses/emissions, and increase sequestration.

Broad categories of emissions and sequestration have been identified in the GHG inventory, including timber harvesting, wildfire, forest conversion, landfill wood-product emissions, and forest growth/sequestration. Furthermore, imports of wood products into the State contribute to emissions from the forest sector. Monitoring and inventory approaches for each of these categories should be designed, with the goal of creating finer scale, more tractable targets. Maintenance of the no net loss policy is greatly influenced by climate impacts on forests. Forest target projections should include realistic estimates of future forest conditions under climate scenarios.

Accurate quantification of forest carbon stocks and land-atmosphere GHG fluxes, as well as accurate projections of future stocks and fluxes are critical to developing and evaluating strategies to manage GHG emissions and sequestration. Efforts to integrate ongoing operational forest inventory programs, long-term ecological research, regional land/atmosphere CO2 flux monitoring, modeling, and remote sensing are being made in order to monitor sources and sinks of GHGs, and to attribute observations to human and natural causes.

Proposal: Initial symposium to focus on forest accounting issues. The purpose of the symposium is to consider capabilities of current ongoing forest inventory programs, other observational networks, and special studies, and identify opportunities for improved quantification of current and future California forest carbon stocks, carbon balance, and land-atmosphere GHG flux.

A second symposium is proposed to discuss forest monitoring approaches to determine progress to maintaining the no-net loss of forest carbon.

Session 1: The ARB forest sector GHG inventory: key categories and processes

Abstract. The ARB Forest Sector GHG inventory tracks the removal of CO2 from the atmosphere by forest and rangeland ecosystems and emissions of GHGs to the atmosphere by a number of processes occurring in the forest/range and forest products system in California. The key greenhouse gases of concern are CO2, N2O and CH4. CO2 fluxes between the atmosphere and ecosystems are controlled by uptake through plant photosynthesis and releases via respiration, decomposition and combustion of organic matter. N2O is primarily emitted from soil processes and from combustion of organic matter, while CH4 is emitted through methanogenesis under anaerobic conditions

in soils and during incomplete combustion of organic matter. The Forest Sector GHG inventory includes CO2 uptake, and GHG emissions from the decomposition and combustion of residues from harvest and conversion/development, wild and prescribed fire, and wood products decomposition.

Presentation by ARB staff

Session 2: Land inventories in CA: Fundamental to GHG inventory

Abstract. Forest type and management influence a variety of ecosystem processes that affect greenhouse gas fluxes, such as photosynthesis, respiration, decomposition, nitrification/denitrification, and combustion. These processes involve transformations of carbon and nitrogen that are driven by biological (activity of microorganisms, plants, and animals) and physical processes (combustion, leaching, and run-off). *Consistent survey, sampling, categorization, reporting, and mapping of land types and land cover over time, and detecting and attributing change (fire, conversion, harvest, etc.), are fundamental to estimating biomass, carbon stocks, stock changes, land-atmosphere CO2 exchange, and GHG emissions*.

Presentations:
Forest Inventory and Analysis Program (Robards- CalFire-FRAP)
National Resources Inventory (USDA)
California's Urban Forests (McPherson - USDA-FS PSW)
Land Cover Monitoring and Mapping Program (CalFIRE-FRAP)
Other change detection programs (NASA MODIS MCD12Q1)

Session 3: Ecosystem Stocks, CO2 Removal and GHG Emission Processes

Abstract. Greenhouse gas fluxes in the forest sector can be estimated as changes in carbon stocks (carbon pools or carbon reservoirs) over time and directly as gas flux rates to and from the atmosphere. Estimating ecosystem carbon stocks, stock changes and gas fluxes is essential to GHG inventory. Using C stock changes to estimate atmospheric CO2 removal and emissions is based on the fact that changes in ecosystem C stocks are predominantly through CO2 exchange between the land surface and the atmosphere (processes such as leaching are assumed to be negligible). Hence, increases in ecosystem total C stocks over time are equated with a net removal of CO2 from the atmosphere and decreases in total C stocks (while accounting for transfers to other pools such as harvested wood products) are equated with net emission of CO2. Non-CO2 emissions are largely due to soil processes and combustion of organic materials. *Emission and removal processes in forests are described for the major ecosystem stocks and processes, organized by ecosystem components: biomass, dead organic matter, and soils*:

Biomass. Large amounts of CO2 are transferred between the atmosphere and forest ecosystems through photosynthesis and respiration. The uptake of CO2 through photosynthesis is referred to as Gross Primary Production (GPP). About half of the GPP is respired by plants and returned to the atmosphere, with the remainder constituting Net Primary Production (NPP), which is the total production of *biomass* and *dead organic matter* in a year. NPP minus losses from heterotrophic respiration (decomposition of dead organic matter in litter, dead wood, and soils) *is equal to the net carbon stock change in*

an ecosystem and, in the absence of disturbance losses (fire, etc.), is referred to as Net Ecosystem Production (NEP).

Forest productivity is influenced by climate, nutrient and water availability, competition, natural disturbance, and by management through deforestation, forestation, thinning, prescribed fire, harvest, and species choice. For example, harvesting reduces biomass stocks on the land and generates GHG emissions from residues and soil disturbance on-site. Harvested wood requires additional consideration because some of the carbon may persist for long periods in wood products in use or in landfills. Thus, some of the carbon removed from a forest ecosystem is rapidly emitted to the atmosphere, while some carbon is transferred to other stocks in which the emissions are delayed. Land managers may use fire as a management tool or wild fires may burn through ecosystems, leading to significant releases of carbon to the atmosphere. Fires not only return CO2 to the atmosphere, but also emit the greenhouse gases CH4 and N2O, as well as other constituents such as VOCs, NOx, CO, and particulate matter. NEP minus additional carbon losses from disturbance (e.g. fire, harvesting and land clearing) is referred to as Net Biome Production (NBP).

Dead Organic Matter. A large portion of live plant material is eventually transferred to dead organic matter (DOM) pools (dead wood and litter). Some of the material decomposes quickly by heterotrophic respiration (the work of decomposer organisms) or is consumed by fire, returning some carbon to the atmosphere in the form of CO2, CH4, VOCs, CO, and particulate matter.

Soil Organic Matter. A portion of DOM may persist for long periods on the landscape until it is converted to Soil Organic Matter (SOM). Some of the soil carbon is released to the atmosphere by soil respiration (microbial activity) while other soil carbon may persist for long periods in the form of organic-mineral complexes. When anaerobic conditions are present, some of the released carbon is in the form of methane. “Black carbon” residues from fires can also persist for long periods in soils. When interred in landfills, approximately half of the carbon in wood products is converted to methane and CO2, with the remainder inert carbon persisting for many decades.

Presentations:
Overview of forest C cycle – biomass, Gross Primary Productivity, Net Primary Productivity, Net Ecosystem Production, disturbance processes. (UC Berkeley)

Forest Inventory and Analysis (FIA) Program (Robards –CalFIRE-FRAP) on how regional C stocks and C changes are estimated from scaled-up plot-level data

Carbon in Wood Products in Use (USDA-FS or U Montana) and in Landfills (CIWMB or ARB) in California

Remote Sensing Approaches to Forest Biomass Assessment (Gonzalez-UC Berkeley)

Direct Forest-Atmosphere GHG flux measurements (Baldocchi-UC Berkeley)

Regional Synthesis Activities – Measurements and Modeling to Track Forest Carbon:
North American Carbon Program – Oregon & California Project (Oregon State U)
NASA ECOCAST (Nemani)
NASA CASA
California Carbon Budget (UC Irvine)

Assessing Carbon Stocks and Flows in Regional Urban Forests (McPherson-USDA-FS PSW)
California Greenhouse Gas Emissions Project (Fischer-LBNL)

Session 4: Future Scenarios of Forest Condition

Abstract. Future forest carbon stocks, CO2 removal and GHG emissions are influenced through climate forcing, natural disturbance, competition, and a variety of anthropogenic actions such as forestation, conversion, harvest, and species choice. Accurate projections of future stocks and GHG fluxes are critical to understanding the forest carbon cycle and to developing and evaluating strategies to manage GHG emissions and sequestration.

Presentations:
Future forests of California (Shaw- CEC-PIER Scenarios Project)
Geospatial Vulnerability Assessment (CalFIRE-FRAP or TNC)

Session 5: Panel Discussion

Abstract. Considering the capabilities of current ongoing forest inventory programs, other observational networks, and special studies, discuss opportunities for improved quantification of current and future California forest carbon stocks, carbon balance, and land-atmosphere GHG flux.