D2.1 General equations for estimating C stock change in C pools and non-CO2 emissions

References

- Chapter 2 of vol.4 of the IPCC 2006 Guidelines : Generic Methodologies Applicable to Multiple Land-Use Categories

Inventory framework – overview of Carbon stock change estimation (1)

- **<u>ANNUAL</u> CARBON STOCK <u>CHANGES</u>** *for national territory*

- $\Delta C_{AFOLU} = \Delta C_{FL} + \Delta C_{CL} + \Delta C_{GL} + \Delta C_{WL} + \Delta C_{SL} + \Delta C_{OL}$, *where*
    ΔC = carbon stock change

- Indices denote the following land-use categories:
    - AFOLU = Agriculture, Forestry and Other Land Use
    - FL = Forest Land, CL = Cropland, GL = Grassland, WL = Wetlands, SL = Settlements, OL = Other Land

Inventory framework – overview of Carbon stock change estimation (2)

- **ANNUAL CARBON STOCK CHANGES for each land use (sub)category**

  - $\Delta C_{LU} = \sum \Delta C_{LUi}$

  - *Stratification on land use subcategories: area of "remaining"+ area "converted to"*

  - *Each subcategory is further on stratified on other criteria,* e.g. soil type, soil/land management

    - *Example of land use "remaining": CL remaining CL = arable, orchards, vineyards and conversion amongst them*

    - *Example of land use "converted to": CL to FL (arable, or vineyards, or orchard converted to forestland)*

Inventory framework – overview of Carbon stock change estimation in a pool (3)

- **ANNUAL CARBON STOCK CHANGES in each C pool of each land use (sub)category**

  - $\Delta C_{LUi} = \Delta C_{AB} + \Delta C_{BB} + \Delta C_{LT} + \Delta C_{DW} + \Delta C_{SOM} + \Delta C_{HWP},$ where

    ΔC_{LUi} = carbon stock changes for a stratum of a land-use category

- Subscripts denote the following carbon pools:
  - AB = above-ground biomass, BB = below-ground biomass, DW = deadwood, LI = litter, SO = soils, HWP = harvested wood products

Estimation of CARBON STOCK CHANGES in a pool: Tier 1 method

- Tier 1 methods include several simplifying assumptions:

  - default values are provided (as "large scale and time averaged" values);
  - no change in below-ground living biomass (i.e. roots);
  - dead wood and litter pools can be lumped together in 'dead organic matter';
  - no net stock change in DOM (LT+DW);
  - dead organic matter is assumed to be zero for non-forest land-use categories;
  - all post-disturbance emissions are estimated as part of the disturbance event, i.e., in the year of the disturbance (with exception of removal for harvested wood products)

Estimation of CARBON STOCK CHANGES in a pool: Tier 2 or Tier 3 methods

1st method: ***process-based approach***, which estimates the net balance of *additions to* and *removals from* a carbon stock, the ***Gain-Loss Method***

Gains = *growth* (of living biomass) and *transfer* of C from another pool (e.g., transfer to the dead organic matter)

Losses = *transfers* of C from that pool to another (e.g., slash on the ground from harvesting operation is a loss from the above-ground biomass pool), or *direct emissions to atmosphere* due to decay, burning, harvest (reporting convention), etc.

ANNUAL CARBON STOCK CHANGE IN A GIVEN POOL

$\Delta C = \Delta C_G - \Delta C_L,$ *w*here:

        ΔC = annual carbon stock change in the pool, tC yr-1

        ΔC_G = annual gain of carbon, **a positive (+) sign,** tC yr-1

        ΔC_L = annual loss of carbon, **a negative (-) sign,** tC yr-1

Tier takes into account transfers among C pools within the period

Estimation of CARBON STOCK CHANGES in a pool : Tier 2 or Tier 3 methods

2nd method: the **stock-based approach** which estimates the *difference in carbon stocks at two points in time,* the ***Stock-Difference Method***

$$\Delta C = \frac{(C_{t_2} - C_{t_1})}{(t_2 - t_1)}$$

where:

ΔC = annual carbon stock change in the pool, tC yr-1

C_{t1} = carbon stock in the pool at time t1, tC

C_{t2} = carbon stock in the pool at time t2, tC

Implicitly accounts for growth, emissions to atmosphere and transfers among pools

Beware to area involved in t1 and t2!

Question: Tier 1 or Tier 2 reporting?

Overview of estimation of non-CO2 emission from sources

A flux of emission from a source directly to the atmosphere, at **measurable rate** (by gas measurement)

$$Emission = A \bullet EF$$

Emission = non-CO2 emissions, t of the non-CO2 gas

A = activity data relating to the emission source (can be area or mass unit)

EF = emission factor for a specific gas and source category, t per unit of A

Guidance for non-CO2 emissions: **typically** estimated from national-level aggregate data (in Ch.2 for wildfires and Ch.11 of 2006 Guidelines for non-CO2 soil emissions from managed soils) or **sometimes only** associated with a specific land use (specific meth. then available in chapter dedicated to that category) or