



Specific methodologies and approaches applicable to land-use categories

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Land-use, land use change and forestry (LULUCF)

- Six sub categories (and land-use changes between these subcategories):
 - Forest land
 - Cropland
 - Grassland
 - Wetlands
 - Settlements
 - Other land
- Five pools (for UN-FCCC reporting compiled to three pools):
 - Biomass (aboveground, belowground)
 - Dead organic matter (Dead wood, Litter)
 - Soil (mineral, organic)

Monitoring, Reporting and Verification needs for LULUCF

1) Activity data:

■ Annual assessment of

- areas subject to the six land-use categories and associated (land-use change) subcategories
- Stratifications according to soil types, management differences, climate

2) Emission factors:

- Annual C stock changes of biomass, dead wood, litter, soil at the areas according to 1)

3) Verification on basis of defined QA/QC procedures

Typically, the GHG emissions/removals of LULUCF are estimated from a combination of input parameters based on

- Systematic randomized and representative assessments
- Models
- Input data from local studies
- Literature and default values from IPCC GL
- Expert judgements

Forest land (remaining)



Forest biomass

Gain-Loss Method

- Net change between differences in biomass increment and biomass loss (harvest and other drain)

Stock-Difference Method

- Differences between biomass stocks in two points of time

The Stock-Difference-Method for forest biomass

EQUATION 2.8

ANNUAL CHANGE IN CARBON STOCKS IN BIOMASS
IN LAND REMAINING IN THE SAME LAND-USE CATEGORY (STOCK-DIFFERENCE METHOD)

$$\Delta C_B = \frac{(C_{t_2} - C_{t_1})}{(t_2 - t_1)} \quad (a)$$

where

$$C = \sum_{i,j} \{A_{i,j} \bullet V_{i,j} \bullet BCEF_{S_{i,j}} \bullet (1 + R_{i,j}) \bullet CF_{i,j}\} \quad (b)$$

C stock change derived from the difference of C stocks
in two points of time

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The estimates of C stock for forests require input data for:

The Stock-Difference-Method for forest biomass

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The estimates of C stock require input data for:

Area: e.g. from remote sensing, ground based forest inventories, cadaster

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The estimates of C stock require input data for:

Volume of standing stemwood (in m³): e.g. from forest inventories, based on field measurements of tree diameters and height and volume models

The Stock-Difference-Method for forest biomass

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The estimates of C stock require input data for:

Conversion and expansion factors to convert stemwood volume to aboveground biomass: e.g. from ecosystem studies, models, wood density analyses, IPCC (2006) GL

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The estimates of C stock require input data for:

Root/shoot ratios to expand aboveground biomass to total biomass: e.g. from ecosystem studies, models, , IPCC (2006) GL

The Stock-Difference-Method for forest biomass

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The estimates of C stock require input data for:

C fraction to convert biomass to Carbon: e.g. C analyses, IPCC (2006) GL

The Gain-Loss-Method

Requires usually also expansion/conversion factors to estimate biomass C increment and drain from stemwood increment and losses

Tier 1 emission factors for forest biomass are only available for the Gain-Loss-Method (default values for biomass growth and loss)

Forest biomass

represents a significant pool of a key category in most reporting countries

- Higher tiers of reporting are needed

Frequently, forest inventories and/or forest management plans are available in the countries which provide country specific values for stemwood stocks and/or stemwood growth/harvest

- By that, higher Tier reporting is secured (even if default expansion/conversion factors are used)

Dead wood in forests

- Part of the dead organic matter pool
- Dead wood may origin from mortality, disturbances and harvest residues left on site
- Standing and lying dead wood
- Tier 1 assumes no C stock change in dead wood
- Usually assessed within forest inventories (higher tier methods)

Litter in forests

- Part of the dead organic matter pool
- Usually assessed together with soil assessment (soil inventories, models) – see next slide
- Tier 1 assumes no C stock change in Litter

Mineral soil in forests

- Tier 1 assumes no C stock change in soil
- For Tier 2, at least country-specific stock change factors for forest type (FI), management (FMG) and natural disturbance regime (FD) together with equation 2.25 of IPCC (2006) GL and default reference or country-specific soil C stocks are needed

Mineral soil in forests (2)

- Due to high C stock variability per site and destructive sampling, short time soil C stock changes cannot be assessed on basis of repeated soil inventories, but only after at least two decades in between the soil inventories or with an unrealistic high number of sample plots
- Therefore, higher tier methods usually assess the litter/soil C stock changes in forest land rem. forest land on basis of models
- Appropriateness of models for the country-specific conditions need to be verified/validated with national data (e.g. data from long-time soil monitoring plots)
- The running of models requires at least input data for litterfall/harvest residues (can be estimated on basis of forest inventory information) and climatic parameters

Organic soil in forests

- Likely not very relevant in ECRAN countries
- Equation 2.2.6 of IPCC GL requires area of drained organic soils as a minimum of country-specific information together with default or country specific emission factors

Forest fires

- IPCC (2006) GL provide emission factors
- Areas of forest fires need to be assessed in the countries

Harvested wood products

- IPCC (2006) GL not specific in methods (four methods are available)
- Decisions for second Commitment Period selected the “HWP production method from domestic harvest”
- It is recommended to use only this method for HWP C stock change reporting – for description see IPCC KP supplement (2013) combined with HWP chapter in IPCC (2006) GL
- The estimates can be carried out on basis of country-specific HWP data submitted to FAO:
 - production of sawnwood, panels, paper; ratio of domestic roundwood production from total roundwood vs. roundwood import and export

Cropland (remaining)



Biomass in cropland

- For annual cropland no biomass C stock change is assumed
- Changes in perennial cropland biomass need to be estimated
- Minimum information needed: change in area in perennial cropland (types) across time
- Default emission factors for perennial cropland available (growth rate, biomass at the end of rotation period, length of rotation period)
seem to be too high, should be substituted by country specific values (e.g. from agricultural research institutions, from questionnaires/surveys)

Dead wood, litter in cropland

- Not relevant

Mineral soil in cropland

C stock changes are frequently estimated on basis of:

- Country specific area information on changes in cropland management types (see Table 5.5 in IPCC (2006) GL); e.g. from statistics on agricultural management:
 - Land use type
 - Tillage type
 - Input type
- Default or country specific soil C stocks (from soil inventories)
- Default or country specific C stock change factors for the cropland management types (from experimental soil monitoring plots)
- Equation 2.25 of IPCC (2006) GL

Organic soil in cropland

- Likely not very significant in ECRAN countries
- Same approach as for organic soil in forests

Grassland (remaining)



Biomass in grassland

- Under Tier 1 no biomass C stock change is assumed
- Higher tier methods require country-specific information in biomass stocks in different points of time (e.g. perennial biomass in grassland) or growth/harvest rates together with area information

Dead wood, litter in grassland

- Very likely not relevant

Mineral soil in grassland

C stock changes are frequently estimated on basis of:

- Country specific area information on changes in grassland management types (see Table 6.2 in IPCC (2006) GL); e.g. from statistics on agricultural management:
 - Land use
 - Management type
 - Input type
- Default or country specific soil C stocks (from soil inventories)
- Default or country specific C stock change factors for the grassland management types (from experimental soil monitoring plots)
- Equation 2.25 of IPCC (2006) GL

Organic soil in grasslands

- Likely not very significant in ECRAN countries
- Same approach as for organic soil in forests

Wetlands



- In IPCC (2006) GL methods are only provided for peatlands with/converted for peat extraction (likely not relevant for ECRAN countries) and conversion to flooded land (see later for advice)
- IPCC (2013) Wetland Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories provides detailed methods on (incl. CO₂, CH₄, N₂O):
 - Drained inland organic soils
 - Rewetted organic soils
 - Coastal wetlands
 - Inland wetlands mineral soils
 - Constructed wetlands for wastewater treatment
- The methods are applied at these land-use/management types reported also in other land-use categories (e.g. drained organic soils in grasslands)

Settlements (remaining)



Biomass in settlements

- Under Tier 1 no biomass C stock change is assumed
- Higher Tier methods require area information on perennial crown cover or tree counts together with default or country specific growth rates per unit

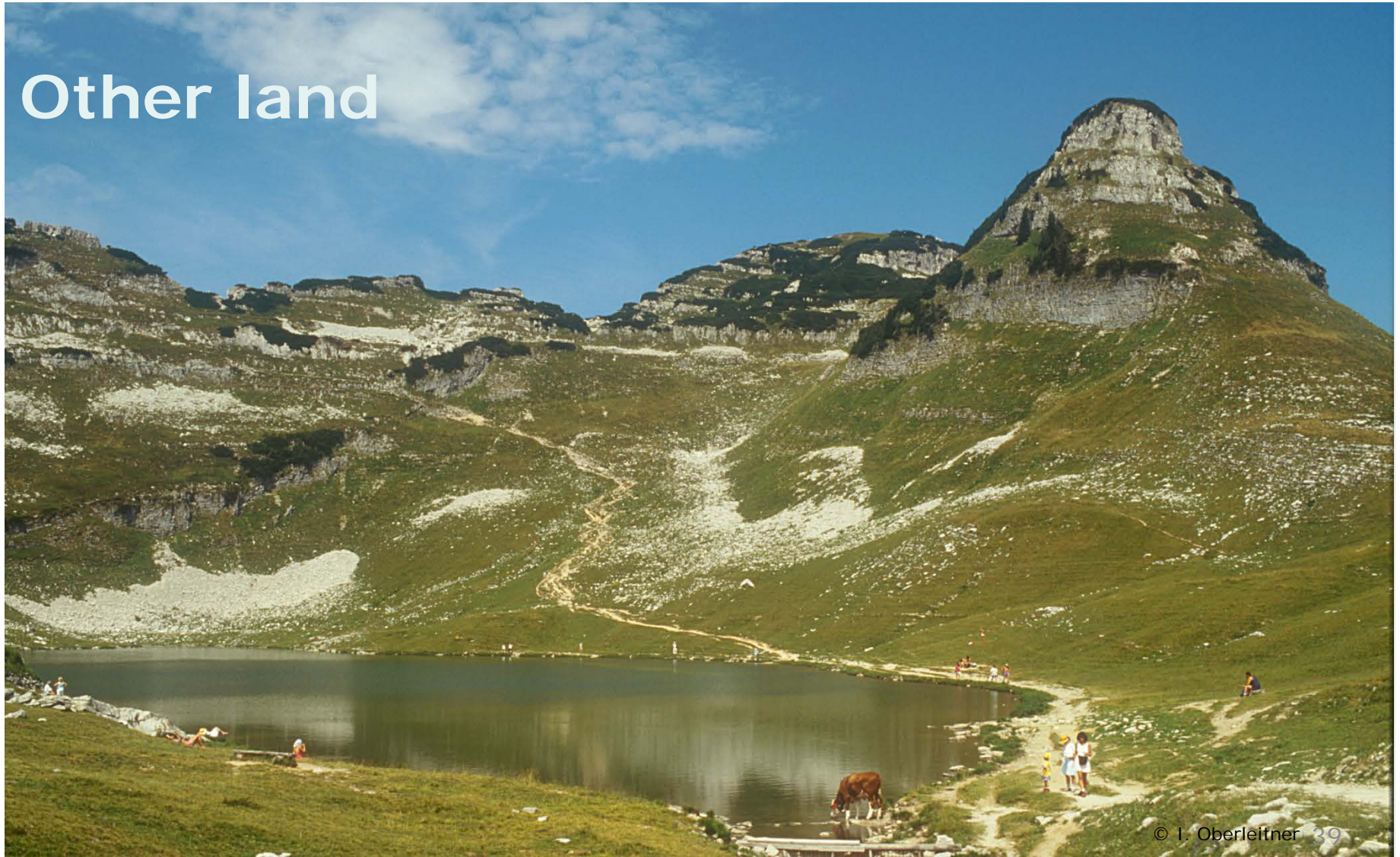
Dead wood, litter in settlements

- Only relevant in forest-like urban parks
- Tier 1 assumes no change
- Higher Tier methods require same input data as for forests

Mineral soil in settlements

- Tier 1 assumes no change
- Higher Tier methods require country-specific C stock change factors, because default C stock change factors (like for cropland and grassland) are not available

Other land



- Other land remaining other land often considered as being unmanaged – in that case, no emissions/removals need to be estimated
- Emissions/removals of land-use conversions to Other land need to be estimated

Land-use change subcategories



- Land Converted to Forest Land
 - Land Converted to Grassland
 - Land Converted to Cropland
 - Land Converted to Wetlands
 - Land Converted to Settlements
 - Land Converted to Other Land
 - Sub-sub-categories according to different previous land uses
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- After land-use change land stays the whole transition period (default 20 years) in the land-use change subcategory

Land-use change subcategories are frequently key categories

Biomass in land-use change subcategories

- Biomass of previous land-use is assumed to be lost in year of land-use change and
- Biomass of new land-use is assumed to start growing in the year of land-use change
 - Annual biomass within the first year of land-use change
 - Perennial biomass growth each year of the transition period
- Information on biomass stocks/growth rates of the land-use change categories is needed

Information on biomass stocks/growth rates of the land-use change categories

- Default values from IPCC (2006) GL or literature values
- Country specific values from the „remaining“ or LUC categories, for instance:
 - Forest biomass from forest inventories, forest management plans, monitoring plots, studies
 - Cropland biomass, grassland biomass from agricultural yield statistics (expansion of yield to total plant biomass), research plots, surveys
 - Wetland, settlement, other land biomass from studies in wetlands and other lands and from urban biomass surveys, tree cadasters

Dead wood, litter in land-use change subcategories

- Only relevant in LUC categories involving forests
- Dead wood C stock information may be taken from IPCC (2006) GL or from forest inventories and other assessments
- Litter C stock information may be taken from IPCC (2006) GL or from soil inventories
 - LUC from forests: Litter C stock is lost in the year of LUC
 - LUC to forests: Litter C stock is built up across the transition period

Soil in land-use change subcategories

- Mineral soil C stock changes in the LUC-subcategories are estimated for each year across the transition period of 20 years
- Data sources for soil C stocks before LUC and at the end of transition period:
 - IPCC (2006) GL
 - Soil inventory information in the country
- Organic soil C stock changes for LUC lands are estimated in the same way as for „remaining“ categories

Where to set priorities in planning improvements:

General basis:

the key category/tier concept together with the decision trees of the IPCC (2006) GL

- „Not estimated“ sub-categories or pools
- Significant pools (>25 to 30 %) of key categories
- Uncertain „not occurring“ emissions/removals
- Activity data and/or input parameters to emission factors with higher contribution to the total uncertainty of the emissions/removals of significant pools of key categories

Thank you for your attention

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