2019 IPCC Refinement

A walk-through

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Desired approach for Guidelines

La perfection est atteinte, non pas lorsqu'il n'y a plus rien à ajouter, mais lorsqu'il n'y a plus rien à retirer.

Perfection is achieved, not when there is nothing more to add, but when there is nothing left to take away.

Antoine de Saint-Exupéry

Outline

- Chapter 1 (general)
- Chapter 2 (generic methods, including IAV)
- Chapter 3 (land representation)
- Chapter 4 (Forest land)
- Chapter 5 (Cropland)
- Chapter 6 (Grassland)
- Chapter 7 (Wetlands)
- Chapter 8 (Settlements)
- Chapter 10 (livestock)
- Chapter 11 (managed soils)
- Chapter 12 (HWP)

Chapter 1 (I)

The AFOLU Sector has a unique characteristic: GHG E/R occur in nature, besides anthropogenic sources/sinks (direct and indirect), although these can be assumed to average out across time.

Natural factors, e.g. earthquake/wildfire, can trigger human activities reconstruction/forest restoration that causes emissions. Such "force-majeure-effect" is not unique of the AFOLU sector, and emissions are directly caused by the "remedial" activity, never by the natural factor, so fully anthropogenic.

Natural factors modify GHG fluxes from human activities, e.g. wildfires in cropland/plantation. Such indirect effects on human-related GHG fluxes, although almost unique of the AFOLU sector, are deemed anthropogenic since those emissions will not occur in the absence of the activity.

Natural factors, i.e. ***natural disturbances, directly causes GHG fluxes****, e.g. wildfires. Natural disturbances occur* ***also in absence of any human impact*** *and* ***are therefore unique of the AFOLU sector****. Nevertheless, when occurring on managed land such natural GHG fluxes are impacted by human activities.*

Chapter 2 (I)

Allometric models, including laser scanning techniques, to be used only if higher accuracy than IPCC defaults is demonstrated (through validation), and outcomes verified across time (good practice for models).

Biomass maps, not set as a good practice, which implies that their use is subject to validation (to show higher accuracy than defaults), and verification across time (since regarded as a modelled approach)

Revised defaults for **litter** C stocks, **new defaults** for **dead wood** C stocks in Forest land

Chapter 2 (II)

Revised defaults for **SOC**

Tier 2 method for **Biochar** amendment *(the absence of Tier 1 default factors imply that the EF is to be taken from measurements or as developed in literature under similar conditions; although the absence of a benchmark -i.e. a Tier 1 default- does not allow to establish whether or not the EFs reported are to be verified).*

Revised combustion factors for biomass burning

Revised combustion rates for biomass burning

Chapter 2 (III)

Additional guidance on **Tier 3**:

✓**Measurement-based**. It is good practice:

- To develop a methodology handbook
- To have a method to replace sample plots where not anymore available
- To ensure identification of plot centre and area when permanent plots are used
- To collect information also on environmental and management variables
- To avoid invasive/destructive sampling techniques in permanent plots, either to avoid resampling the identical point
- To document transparently: **i.** sampling design and measurement method/techniques as well as any change across time, **ii.** how GHG-inventory data are derived from measurements as well as the associated uncertainty, **iii.** describe impacts of periodicity in data collection on annual reporting as well as associated uncertainty, **iv.** integration with other methods for preparing GHG estimates

Chapter 2 (IV)

Additional guidance on **Tier 3**:

✓**Model-based**. It is good practice:

- To consider if the model: **i.** accurately represents the population to which is applied, **ii.** Allows uncertainties to be quantified, **iii.** Allows for higher accuracy than other methods, **iv**. Allows for its sustainable operationalisation, **iv**. Produces consistent time series of estimates and is coherent with other models/methods applied for preparing GHG estimates
- To document calibration method and results
- To evaluate and to ensure proper model behaviour within the boundaries (spatial, temporal, definitional) to which is applied
- To verify model'outputs

Chapter 3 (I)

Where multiple methods are applied for estimating changes in carbon stocks within and between land-uses it is good practice to describe how these models work consistently across land-uses.

If biomass maps are used then it is good practice to demonstrate how the maps are consistent with national land-use classification system, in particular how they are integrated with the land-use data chosen by the country.

Chapter 2 (V)

Interannual variability is caused by:

- Activities (*anthropogenic GHG fluxes*)

- Impacts of natural variables on activities (not separable, *anthropogenic GHG fluxes* since associated with the activity)

- Natural disturbances (occur also in absence of activities, *natural GHG fluxes*. That's why these can be identified in natural ecosystems –forest land, grassland, undrained peatlands- only)

Chapter 2 (VI)

Interannual variability from disturbances is impacted by the method applied to estimate GHG fluxes:

- When DOM is reported at Tier 1, all drivers of mortality (fires, windstorm, pest, drought) may cause **high interannual variability**
- When DOM is estimated at Tier 2, fires only may cause **high interannual variability** (*All other drivers may have a high impact on total GHG emission, although this occur across years so that interannual comparisons may not be affected by*)

*In practice, disturbances that cause instantaneous emissions may cause **high interannual variability** regardless of the reporting method applied, while others may or may not.*

Chapter 2 (VII)

It is ***good practice*** to estimate and report total E/R that occur on managed land, as captured by IPCC methods (MLP)

E/R associated with natural disturbances that cause **high interannual variability** may be disaggregated within the MLP estimate.

Chapter 2 (VIII)

Natural disturbances (ND) in the context of the AFOLU sector are **non-anthropogenic events or non-anthropogenic circumstances that cause significant emissions and are beyond the control of, and not materially influenced by a country**. These include wildfires, insect and disease infestations, extreme weather events and/or geological disturbances, beyond the control of, and not materially influenced by a country.

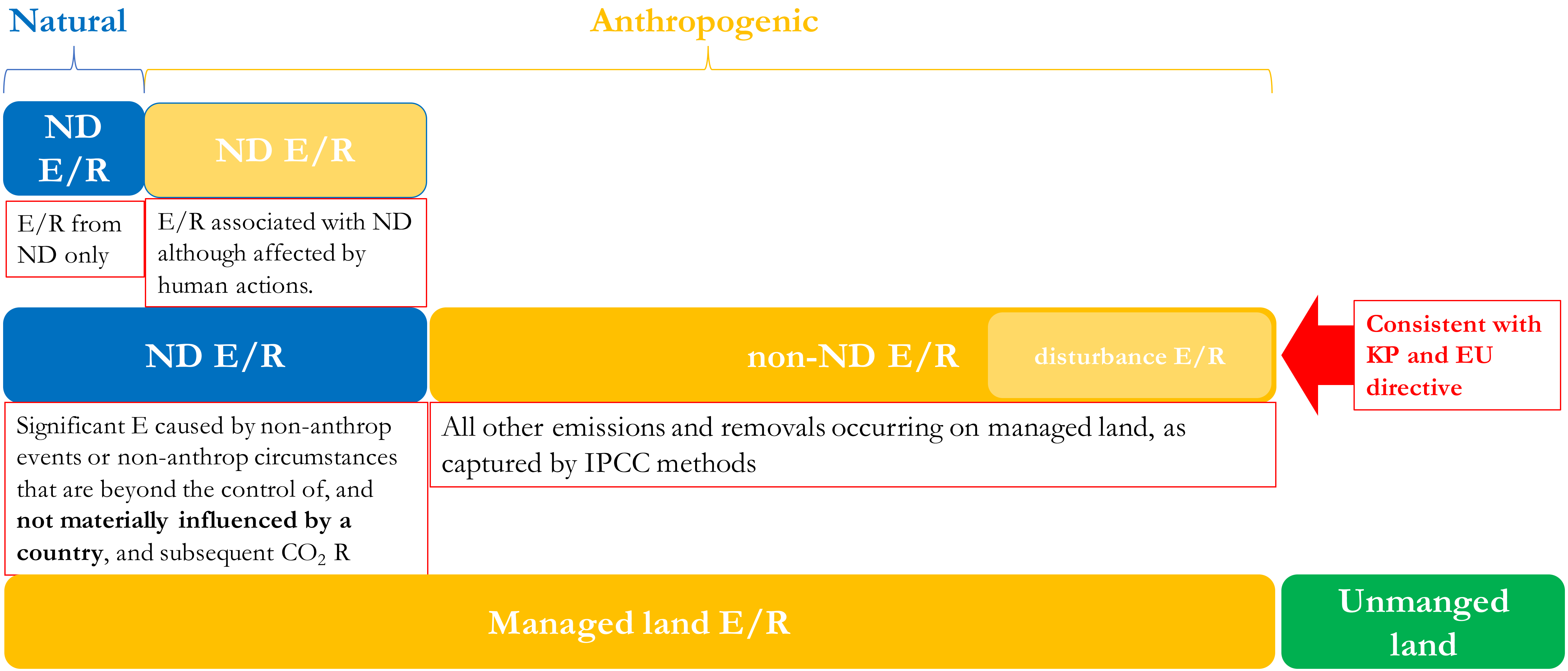
Natural disturbances exclude human activities, such as harvesting and fires associated with activities, such as prescribed burning and slash and burn.

Chapter 2 (IX)

Consistently with MLP, where E/R from natural background are expected to average out across time, E/R disaggregated as **ND** are expected to **balance to zero** across time. To do so:

- ✓ **Step 1** estimate E/R according to MLP
- ✓ **Step 2** report on the method applied to identify ND
- ✓ **Step 3** identify E/R associated with ND. It is *good practice* to:
  - ➢ **Avoid the inclusion of E/R that are materially affected by human actions**
  - ➢ **Exclude all E/R associated with any post-disturbance activities**
- ✓ **Step 4** disaggregate E/R associated with ND. It is *good practice* to:
  - ➢ **Disaggregate subsequent removals until CO_2 emissions are balanced**
  - ➢ **Disaggregate also subsequent removals on land disturbed before the time series starts**

Chapter 2 (X)


Natural
Anthropogenic
ND E/R
ND E/R
E/R from ND only
E/R associated with ND although affected by human actions.
ND E/R
non-ND E/R
disturbance E/R
Consistent with KP and EU directive
Significant E caused by non-anthrop events or non-anthrop circumstances that are beyond the control of, and **not materially influenced by a country**, and subsequent CO_2 R
All other emissions and removals occurring on managed land, as captured by IPCC methods
Managed land E/R
Unmanged land

Chapter 2 (XI)

If E/R associated with **ND** are disaggregated, it is *good practice* to **report** the following information on:

- ✓ Consistency of country approach to identify ND and ND definition
- ✓ Type of disturbances to which ND definition applies at country level
- ✓ How the approach applied to identify ND distinguishes *non-anthropogenic events or non-anthropogenic circumstances that causes significant emissions and are beyond the control of, and not materially influenced by a country* (i.e. ND), from all other disturbances
- ✓ How E/R that are materially influenced by human actions are excluded from the ND component
- ✓ How the approach applied to disaggregate E/R from ND is consistent with the expectation to balance disaggregated CO_2 E/R across time
- ✓ How land converted after disturbances are identified and excluded from ND disaggregation
- ✓ How E/R associated with any activities that occur after ND are excluded from ND disaggregation

Two AFOLU totals, with and without ND are to be reported

Chapter 3 (II)

Guidance restructured as:

- ✓ **Step 1** define land categories, subcategories and subdivisions
- ✓ **Step 2** select approach(es) for land representation
- ✓ **Step 3** stratify national territory according to defined categories and selected approach(es)
- ✓ **Steps 4&6** compile data for categories/subcategories/subdivisions, including any needed ancillary information
- ✓ **Step 5** develop rules to translate land cover information, as well as country-specific data (confusion matrix), in IPCC land use categories
- ✓ **Step 7** develop area estimates as per good practice
- ✓ **Step 8** *verify area estimates and* develop uncertainty estimates

Chapter 3 (III)

In developing IPCC land-use information, it is good practice to:

- ✓ Define the national land-use categories and develop rules to track them in the inventory, where needed;
- ✓ Describe how multiple data sources are combined to ensure consistent representation of lands;
- ✓ Demonstrate that the land-use categories definitions cover the entire variability of land-uses of the country territory, and do not overlap;
- ✓ Report an equivalence table between the categories used in the national land-use classification scheme and the IPCC land-use categories;
- ✓ Report land cover elements and classification rules used to identify land-use categories, including predominance among land uses.

Chapter 3 (IV)

It is good practice to clearly document the country-specific rules applied in the inventory to consistently derive land-use from land cover, both spatially and temporally, including predominance among land use categories. Following generic steps should be considered:

- ✓ translate remote sensing data to land cover types using decision rules and image classification;
- ✓ develop rules, and identify ancillary data needs, to translate land cover and cover change types to land-use and land-use change categories
- ✓ collect any required supplementary information and apply the developed rules

Chapter 3 (V)

it is *good practice* to report in the entire time series the country area of the last year of the inventory report.

If the country area is increased (e.g. land reclamation, better quality data) at any point of the time series, such additional area will be reported in the entire time series.

If the country area is decreased (e.g. sea level rise, better quality data) at any point of the time series, such lost area will be excluded from the entire time series.

Chapter 3 (VI)

When an unmanaged land is converted to managed land, it is *good practice* to describe the processes that lead to the re-categorization.

Managed land generally cannot become unmanaged as the legacy effects of past management can continue for extended periods, and such moves could result in anthropogenic emissions and removals being unreported.

Chapter 3 (VII)

So far as the methodology is not biased this is a random error that tend to cancel out.

This just implies to demonstrate that the land representation is not biased; which is an actual requirement in NGHGI reporting

This would imply that the land reporting should occur at a spatial unit smaller than the minimum area. How much smaller?

There is not limit to the infinite small; no guidance is provided, so the minimum mapping unit is the only requirement applicable, although countries may report at a finer resolution

Chapter 3 (VIII)

e.g. I do apply Approach 3 to forest land and Approach 1 to cropland; How do I calculate SOC changes?

I mean with approach 1, I do sum up all SOC, at equilibrium with current land use, across the entire country/region and then I compare it with the total SOC of 20 years before; however, with Approach 3 I calculate SOC changes at level of each single parcel of land by using actual SOC.

So, using different approaches for different land uses in the same country/region is NOT a good practice

Chapter 3 (IX)

Explain differences, if any, in the datasets used across time, as well ad how those are addressed when identifying area changes

Since E/R data will be based on area statistics instead of on each single map area unit; multiple changes are treated as de-linked processes (i.e. in parallel) **instead of as a single process (i.e. in series).**

e.g. a multiple change from forest to cropland to grassland is reported as both: a forest to cropland conversion, and a crop land to grassland conversion

✓ describe how areas with potential multiple changes in land-use through time are addressed in estimating E/R.

Chapter 3 (x)

When using Approach 3 wall-to-wall it is good practice to:

- ✓ Minimize the influence of images misalignment or artefacts in data *(e.g., cloud cover)*;
- ✓ Ensure the data **are** consistent with the methods for estimating E/R
- ✓ Ensure the time-series is dense enough to identify activities that drive E/R *(e.g., if the period between two points in time (i.e. the change detection period) is 5 years, but forest cover following clearing or harvesting recovers in 2 years, then management events affecting E/R may be missed, depending on the method applied)* **or ancillary data are used;**
- ✓ Demonstrate that, in cases where the time between maps differ *(e.g., a 5-year gap, followed by a 2-year gap)*, this does not bias results by changing detection rates;

Chapter 3 (XI)

When using Approach 3 wall-to-wall it is good practice to:

✓ use that the sensor data used in the maps does not cross over the

Ensure that chrono-sequences of composite images or maps do not contain data that cross over compositions

or the maps *(e.g., to remove cloud or sensor errors.* *cross over may occur* *when e.g., a 2005 map uses data from 2002-2008 and a 2010 map uses data from 2007-2013)*;

✓ demonstrate that the changes tracked through time are consistent and to report on any corrected biases and known uncertainties of the analysis;

✓ ensure that any improvements made to any single map in the time-series are consistently applied to the other maps in the time-series and the results are recalculated, in particular when new maps are added to the time-series;

✓ evaluate the final products to ensure consistent representation of land-use with no double counting or omission of lands

Chapter 3 (XII)

When using sampling it is good practice to ensure:

- ✓ A sufficient sample size used with repeat measurements over time to identify land-use and land-use changes with a desired level of uncertainty;
- ✓ Ancillary information is used to derive land use from land cover data;
- ✓ Samples are collected with sufficient temporal frequency to identify land-use changes and management events that drives E/R;
- ✓ Samples are collected with sufficient temporal consistency that detection rates of change do not alter;
- ✓ where sampling methods have changed through time, these changes do not lead to inconsistencies in the reporting of areas of land-use and land-use change;
- ✓ the sample assessment protocols are well documented.

Chapter 3 (XIII)

When using surveys it is good practice to:

- ✓ ensure that the area of the land units surveyed is consistent with the area of the entire land use category and other land uses, in particular where the land units do not cover all the land-use categories (*i.e., where a mix of Approaches are applied*);
- ✓ where possible, compare the area estimates obtained from other methods, such as sample-based methods.

Chapter 3 (XV)

When combining different data types and sources it is good practice to:

- ✓ Report the spatial and temporal scales of the data sources;
- ✓ Ensure consistency between different temporal or spatial scales in the data sources;
- ✓ Verify spatial datasets conform to national mapping standards *(e.g., appropriate equal area projections)* to ensure accurate area calculations, and that raster and/or vector layers align and are within official national boundaries;
- ✓ Ensure that land conversion areas are consistent with each other across the entire time-series. For example, losses in the area of Forest Land categories are consistent with gains in the areas of Forest Land converted to Cropland, Grassland, Settlements, Wetlands, and Other Land;

Chapter 3 (XVI)

When combining different data types and sources it is good practice to:

- ✓ Ensure that the land conversion period is applied consistently across all land-use categories *(i.e., that the same number of years is used before lands in a 'converted to' sub-category move to the 'remaining' sub-category)*;
- ✓ Establish a hierarchy among various data sources and proceed to their integration accordingly *(i.e., higher quality data prevail to other data when an inconsistency appears among them)*;
- ✓ Fill data gaps to derive consistent time-series *(See Section 5.3, Chapter 5 Volume 1)*;
- ✓ Report uncertainties.

Chapter 3 (XVII)

When using multiple spatial data layers it is good practice to:

- ✓ all data layers are registered to a common projection, and that the layers align as far as possible;
- ✓ reprojection of spatial data do not cause errors if applied correctly using appropriate type of projection for a given location;
- ✓ when combining data of different pixel sizes (e.g., climate data at 1km, with satellite land cover data at 25m) that the pixels align with ground coordinates;
- ✓ if pixels are resampled (e.g., resampling of Landsat pixels from nominal 30m to 25m) this is done prior to classification.

Chapter 3 (XVIII)

When using global data sets it is good practice to:

- ✓ assess the consistency of the global dataset with national definitions of land-use and suitability for reporting *(e.g., time-series consistency, spatial scales, update processes)*;
- ✓ assess the accuracy of the products and correct for bias by using reference data;
- ✓ ensure that the accuracy assessment processes represent not just the IPCC land-use categories, but also the strata *(e.g., by forest types, areas impacted by disturbances, soil classes)* used to estimate emissions and removals.

Chapter 3 (XIX)

When comparing national estimates to global products it is good practice to:

- ✓ ensure that apply to the same geographic extent and time period;
- ✓ ensure that land-use area and changes derived from the global data correspond as nearly as possible to the national definitions and legend;
- ✓ use reference observations consistent with the national definition. If the reference data are stratified, e.g. by accessibility or biomass quantity, strata should be applied consistently over time irrespective of whether national or global map products are being used;
- ✓ reduce common inconsistencies between global data and national definitions, e.g. minimum canopy cover, detailed consideration of land-use, the minimum area size, minimum tree height.

Chapter 3 (XX)

When gap-filling unavailable land use and land cover data, it is good practice to:

- ✓ Define, document and report the years where data are missing.
- ✓ Demonstrate that changes detected are not influenced by the change in frequency of observations;
- ✓ Justify the choice of the methods used to fill the data gap, and describe consistency with the guidance provided in Chapter 5, Volume 1.
- ✓ When extrapolating missing data based on trends and proxies, justify the length of the time-series used to develop the trend.

Chapter 3 (XXI)

When gap-filling unavailable land use and land cover data, it is good practice to:

- ✓ Whenever possible use functional proxies *(i.e. driver of changes)* for extrapolation or interpolation;
- ✓ Report the limitations and consequences of filling land cover data gaps with the chosen method.
- ✓ Whenever possible, estimate, document and report the uncertainty linked to the remote sensing annual data available and the uncertainty linked to the periods where this data is not available.

See Annex 3A.2.4 for examples

Chapter 3 (XXII)

For a consistent land-use stratification scheme, it is good practice to:

- ✓ assess the availability over time of reliable data to classify land-use categories into sub-divisions;
- ✓ ensure that strata can be sufficiently distinct to be identifiable and establish clear definitions;
- ✓ ensure that across the time series strata areas always cover the total land area of the category being stratified;
- ✓ ensure that the strata have the attributes required to develop estimates of emissions and removals *(e.g., emissions factors or model parameters)*;
- ✓ review the effect of the stratification to determine if further stratification would improve the estimates of E/R.

Chapter 3 (XXIII)

Approach 2 does not allow for the tracking of multiple changes (>2) in land use on a single land unit through time.

As such, when using Approach 2 methods it is good practice to stratify land into appropriate age or condition classes that can address these issues.

This doesn't mean that Approach 3 is to be always used.

This means that when Tier 1 methods requires a stratification per age or condition classes this is to be implemented also with Approach 2 (and 1).

E.g. Forest (younger older than 20 years), perennial crops, disturbed vs undisturbed forests

Chapter 3 (XXIV)

When using remote sensing data to generate estimates of land use and land use change, it is good practice to ensure that:

- ✓ U% are specific for the relevant land-use and land-use change categories, not for interim products;
- ✓ U% estimates include consideration of all sources of potential error;
- ✓ uncertainty assessment methods can be applied through the entire time-series, either as a single value or for set periods;
- ✓ evaluation and uncertainty estimation methods are relevant to the Approach;
- ✓ when using remote sensing data to assess accuracy, validation data of higher quality *(e.g., greater spatial resolution or spectral range)* are used;
- ✓ analysis should be consistent with Chapter 3, Volume 1: Uncertainties.

Chapter 3 (XXV)

It is good practice to ensure that validation data are:

- ✓ of at least the same quality as the calibration data;
- ✓ collected close to the time of the images used in the maps;
- ✓ of sufficient size and positional accuracy compared to the spatial resolution of the maps.

Chapter 3 (XXV)

To assess map accuracy it is good practice to collect and use validation data relevant to the estimation of E/R, noting that:

- ✓ the method and Tier adopted for generating E/R estimates may influence how and when bias in activity data is addressed;
- ✓ activity data accuracy needs to be assessed at the scale and for the strata used to develop the E/R estimates otherwise the resulting E/R estimates may still be biased.

For transparency purposes it is good practice to clearly document the sampling methods (including sample sizes), how the samples relate to the classification system, and the QA/QC processes applied in sampling.

Chapter 4 (I)

In extrapolating/interpolating by using functional relationships, it is good practice:

- ✓ To assume that the historical management practices continue during the period to be gap-filled;
- ✓ That the model used utilizes information on the methodological elements consistent with the rest of the time series
- ✓ To demonstrate that the model used for the extrapolation reproduces the existing time series, for a selected historical "calibration period".

Chapter 4 (II)

In extrapolating/interpolating by using functional relationships, it is good practice:

- ✓ To use same model parameter values for the entire time series, and to recalculate the entire time series if one or more parameters changed;
- ✓ to recalculate the entire time series if one or more GHG or C pool is/are added;
- ✓ to recalculate the entire time series if any historical data change

In extrapolating/interpolating by using functional relationships, it is not good practice to use model's results if for the calibration period the model's results do not fall within the reported range of uncertainty of the existing time series.

Chapter 5 (I)

Updated default coefficients for **maximum and mean** above-ground biomass, **biomass accumulation rate** and harvest/maturity cycles in agroforestry systems containing perennial species, and for monoculture.

Updated default coefficients for above- and below- ground biomass **accumulation rate** in agroforestry systems containing perennial species.

At Tier 1, given the large variation in cropping systems, incorporating trees or tree crops, it is *good practice* to seek national data on above-ground woody biomass growth rate.

Chapter 5 (II)

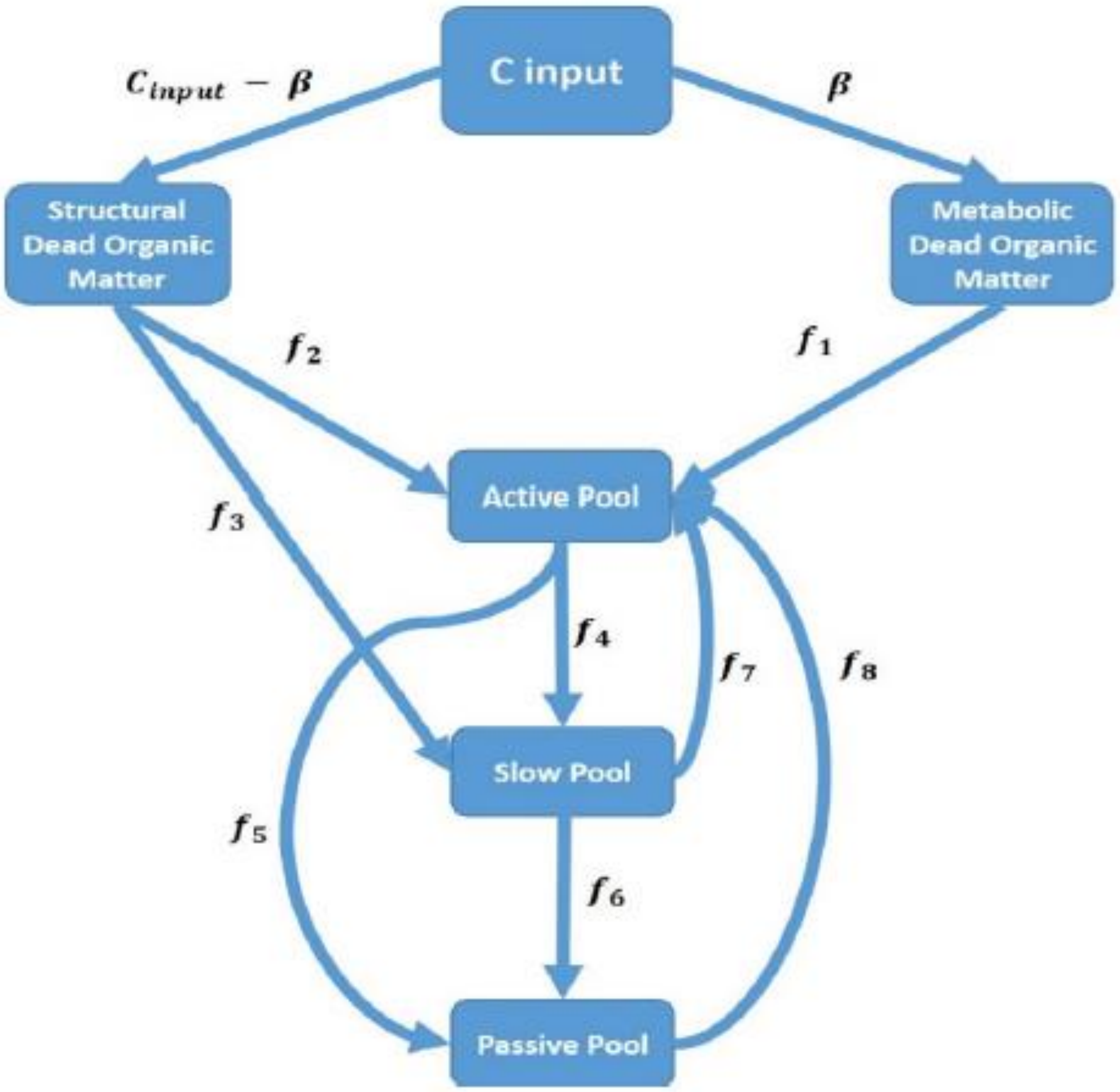
Default method for mineral soils, C stock change factors updated

Default method for mineral soils, it is good practice to;

- consider reduced and no-till only if applied continuously *(every year)*.
- where possible, to determine specific management practices for cropping systems *(e.g., rotations and tillage practice)* rather than only area by crop
- derive Tier 2 values for a higher resolution classification of management, climate and soil types if empirical analysis and/or well tested model show significant differences in the C stock change factors

Chapter 5 (III)

New Tier 2 method for SOC changes in mineral soils based on three sub-pool steady-state with fast *(Active sub-pool)*, intermediate *(Slow sub-pool)*, and long turnover times *(Passive sub-pool)*.



Chapter 5 (IV)

New Tier 2 method for SOC changes in mineral soils based on three sub-pool steady-state **variables**:

- C input
- C input lignin content, fraction
- Temperature
- Water
- Tillage
- Sand fraction
- Sub-pool-specific decay rates

and **parameters**:

- Sub-pool-specific decay rates under optimal conditions
- Fractions of C stocks transferred to and among SOC sub-pools
- Maximum, optimum and average monthly air temperatures
- Total monthly precipitation
- Total monthly potential evapotranspiration

Chapter 5 (V)

- Disturbance matrix for land conversions updated;
- It is good practice for countries to evaluate country specific values for conversion to cropland of disturbed forest under Tier 2.

Chapter 5 (VI)

Rice cultivation:

- CH_4 scaling factor for soil type and rice cultivar, $SF_{s,r}$, is split in two factors, one for soil type, SF_s, and another one for rice cultivar, SF_r;
- Updated Default CH_4 baseline EF, (and stratified by regions);
- Updated Default scaling factors for water regimes during cultivation;
- Updated Default scaling factors for water regimes before cultivation;
- Updated Default conversion factors for organic amendments;
- Added Default cultivation period, (and stratified by regions);
- Added good practice to develop Tier 2 CH_4 baseline EF
- Added an example on how to apply the Default method

Chapter 6 (I)

Default method for mineral soils, C stock change factors updated

Default method for mineral soils, it is good practice to;

- where possible, to determine specific management practices *(e.g., fertilization or grazing intensity)*
- derive Tier 2 values for a higher resolution classification of management, climate and soil types if empirical analysis ~~and/or well tested model~~ show significant differences in the C stock change factors

Chapter 7 (I)

Flooded land

i) waterbodies where human activities have changed the hydrology of existing natural waterbodies thereby altering water residence times and/or sedimentation rates, in turn causing changes to the natural GHG flux;

ii) waterbodies that have been created by excavation, such as canals, ditches and ponds

Seasonally flooded wetlands such as riparian floodplain wetlands are not considered; where these have been modified by human activity, E/R may be estimated using methods described in the 2013 Wetlands Supplement

Chapter 7 (II)

For those that choose to develop indicative estimates of the anthropogenic component of total GHG E/R, it is good practice to report the MLP E/R, as well as the indicative estimates of the anthropogenic component.

Emissions from Wastewater are estimated with methods provided in Waste sector

Chapter 7 (III)

WL_{FL}-WL_{FL}

- CO_2 and N_2O

No changes in guidance

- CH_4

MLP E/R estimated as Flooded Area x EF;

where EF is

- ✓ scaled by chlorophyll content, and
- ✓ fractioned in reservoir and downstream fluxes

Chapter 7 (IV)

L-WL_{FL}

- ➢ CO_2: Guidance revised:
- ✓ New Tier1 based on CO_2 fluxes instead of C stock changes and uses the generic equation: Flooded Area x EF
- ✓ New Tier2 based on SOC losses. Thus it applies to new flooded area only, as stratified by soil type. Anyhow, it uses the generic equation: Flooded Area x EF

- ➢ CH_4 emissions

as for WL_{FL}-WL_{FL}

- ➢ N_2O emissions

No changes in guidance

Chapter 7 (V)

In developing higher tier EF, it is good practice to undertake measurements at sufficient different locations and sufficient different times of year to capture both the spatial and temporal variability of CH_4 emissions from a reservoir.

Chapter 7 (VI)

Approach to provide indicative estimates of the anthropogenic component of total CO_2 and non-CO_2 emissions

This deviates from the MLP method in including in the estimates the area that **WAS NOT** previously *(before flooding)* unmanaged lakes, rivers/streams and unmanaged wetlands **only**, on the basis that emissions already occurring from these unmanaged lands are not reported in NGHGIs.

Chapter 8 (I)

Tier 2:

- crown-cover-area annual growth rates **Updated**
- Biomass accumulation average annual growth **Updated**

Chapter 10 (I)

- Livestock categories **Updated**
- If a population lies in multiple climate zones, it is good practice, if possible, to disaggregate it by climate zone.

- Manure management systems **Updated**

Energy balance expanded to goats *(i.e. sheep-related methods apply to goat too)*

- Representative feed digestibility (DE%) **Updated**
- Coefficients for net energy for maintenance (NE_M) **Updated**
- Activity coefficients for feeding situation (C_a) **Updated**
- Constants for net energy for growth (NE_G) for goats **Added**

Chapter 10 (II)

- DMI equations for cattle:
  - ✓ constants **Updated**
  - ✓ Digestibility (DE) variable **Removed**
  - ✓ Fat corrected milk production **Added**

- DMI defaults for non-dairy cattle **Added**

- Net energy concentration of feed (NE_{mf}) **Updated**

Chapter 10 (III)

An advanced Tier 1 method (Tier 1a) for enteric fermentation is added, where low and high productivity systems coexist.

- Decision tree for CH4 from Enteric fermentation **Tier 1a Added**
- Default CH_4 EF for enteric fermentation **Updated**
- Default methane conversion factors (Y_m) **Updated**
- New equation to derive the CH_4 EF from DMI **Added**

Chapter 10 (IV)

Enteric fermentation higher tiers, it is good practice that NGHGI:

- reflect only those technologies or genotypes developed through selection conform to QA/QC principles and have attracted a wide degree of international acceptance such as through peer-reviewed articles that include a description of the technology, its efficacy and validation under field conditions.

- be accompanied by evidence of the uptake of the technology in agricultural practice, and apply it only to emissions by those livestock where uptake can be validated.

Chapter 10 (IV)

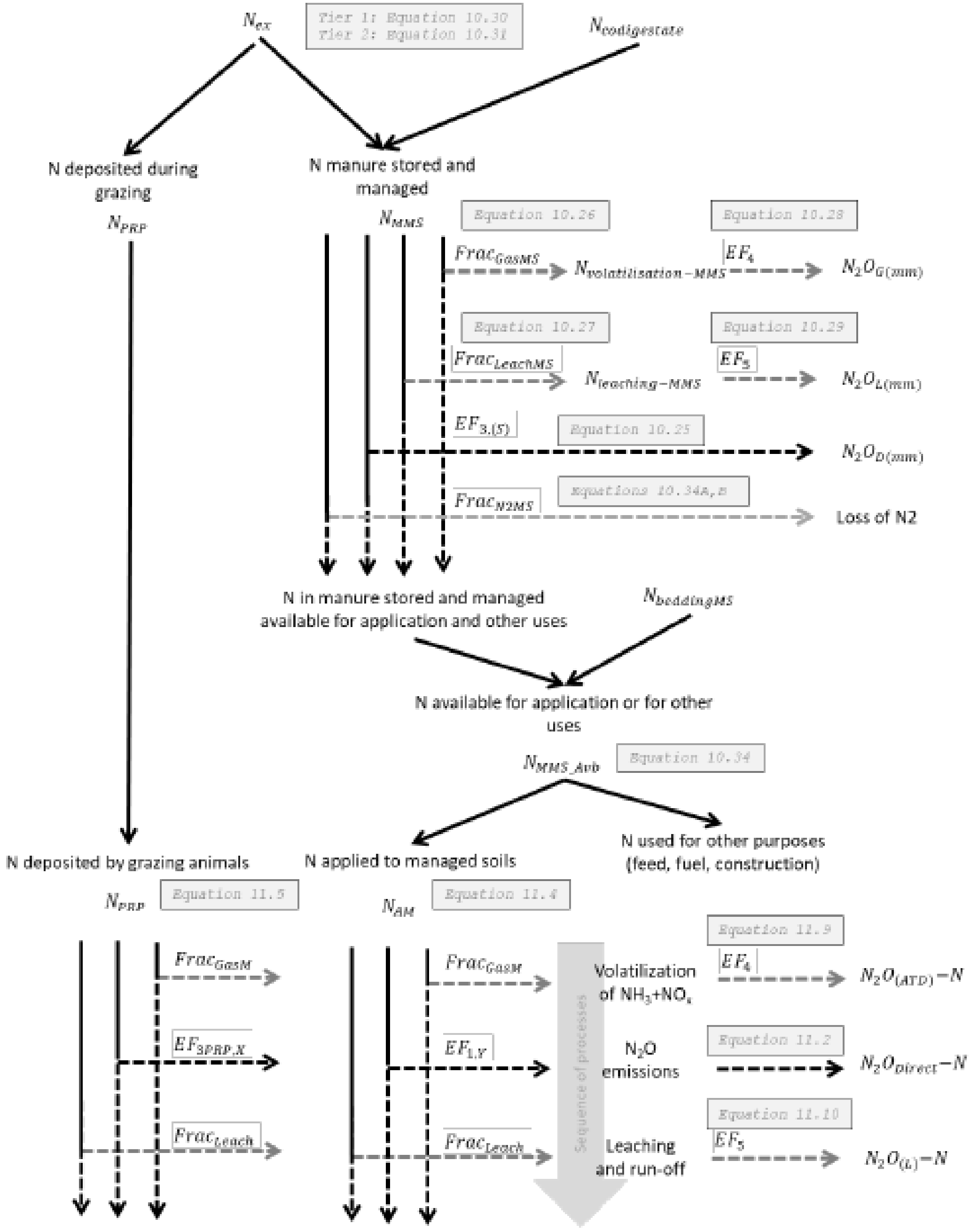
An advanced Tier 1 method (Tier 1a) for manure management is added, where low and high productivity systems coexist.

- Decision tree for CH_4 from manure management **Tier 1a Added**
- Tier 1 equation **modified** by adding the following variables:
  - ✓ Manure management system (MMS)
  - ✓ Volatile solid excretion rate (VS)
- Animal mass-dependant Tier 1 equation to calculate VS **Added**
- New table for VS *(by region and productivity)* at Tier 1 **Added**

Chapter 10 (v)

- CH_4 EF *(by animal, MMS and climate)* **Updated**
- Maximum methane producing capacity (B_0) **Updated**
- Methane conversion factors (MCF) **Updated**
- If information is available on manure spreading practices *(number of times that manure storages are emptied per year)* and on monthly temperature profiles, it is good practice to customize MCF based on residence time and temperatures
- If manure is managed in multiple systems, it is good practice to report the respective CH_4 emissions from each system

Figure 10. 5 **Processes leading to the emission of gaseous N species from manure (*New Figure)***



Chapter 10 (VI)

N_2O from manure management:

- Leaching added at Tier 1
- Tier 1 equations *(for direct and indirect)* **modified** by adding the variable:
  - ✓ annual nitrogen input via co-digestate (N_{cdg})
- Decision tree for N_2O from manure management **Tier 1a Added**
- N excretion rates **Updated**
- EF for direct N_2O from MMS **Updated**
- Defaults *(by MMS)* for $Frac_{GAS}$ and $Frac_{LEACH}$ **Updated**

Chapter 10 (VII)

N_2O from manure management:

- Leaching added at Tier 1
- Tier 1 equations *(for direct and indirect)* **modified** by adding the variable:
  - ✓ annual nitrogen input via co-digestate (N_{cdg})
- Decision tree for N_2O from manure management **Tier 1a Added**
- N excretion rates **Updated**
- EF for direct N_2O from MMS **Updated**

Chapter 10 (VIII)

Manure N available to be applied to soils:

- Equation to calculate $Frac_{LOSS}$ **Added**, with the following variables:
  - ✓ $Frac_{GAS}$
  - ✓ $Frac_{LEACH}$
  - ✓ $Frac_{N}$, amount of manure lost as N_2 (calculated as ratio to N_2O emissions)

Chapter 11 (I)

Managed soils:

- N_2O direct EFs **Updated**
- Ratios of belowground residues to harvested yield recalculated as belowground biomass to aboveground biomass
- Defaults for N from crop residues and forage/pasture renewal **Added**
- Alternative method to estimate aboveground residues **Updated**
- Indirect N_2O EFs Updated

Chapter 12 (I)

Consistent with treatment of other sectors: emissions counted where and when they occur

- HWP categories (sawnwood, wood-based panels … erboard), first order decay function, initialization of C po… KP method

- Atmospheric flow approach,
  - ✓ stock change for HWP in use *(including imported HWP)* + balance between exported and imported fuelwood, industrial roundwood and wood pulp *(i.e. wood export is a "sink" while import is a "source")*
- Stock change approach,
  - ✓ stock change for HWP in use *(including imported HWP); (i.e. HWP export is a "source" while import is a temporary "sink")*
- Production approach,
  - ✓ stock change for HWP produced with domestic wood *(excluding imported HWP and HWP produced with imported industrial roundwood and wood pulp)*

Chapter 12 (II)

<table>
<tr><th colspan="5">TABLE 12.5
REPORTING OF CO_2 EMISSIONS FROM WOOD BIOMASS BURNT BY PRODUCING AND CONSUMING COUNTRIES UNDER DIFFERENT HWP APPROACHES</th></tr>
<tr><th>Element of wood biomass</th><th>Assumption of ‘a steady-state HWP pool’</th><th>‘Stock-change’ approach</th><th>‘Production’ approach*</th><th>‘Atmospheric-flow’ approach</th></tr>
<tr><td>Unutilized wood harvest residues</td><td rowspan="5">Producing country</td><td rowspan="3">Producing country</td><td rowspan="5">Producing country</td><td>Producing country</td></tr>
<tr><td>Harvested wood biomass used directly as energy feedstocks</td><td rowspan="4">Consuming country</td></tr>
<tr><td>Industrial residues from manufacturing semi-finished wood products</td></tr>
<tr><td>Industrial residues from manufacturing finished wood products in use**</td><td rowspan="2">Consuming country</td></tr>
<tr><td>Wood biomass collected and burnt as post-consumer waste</td></tr>
</table>

Chapter 12 (III)

Decision 4/CMA, Annex II:

"…"If the harvested wood products are accounted provide information on the IPCC approach used"

Which means that the approaches to be used in accounting for NDC are those three only.

Note that the Simple-decay approach is to be implemented with the same equations of the production approach (which means that it does not bear any difference in the accounting quantities)

Questions/Comments

Thanks