Review Comments by Experts on Second Order Draft of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (General comments)

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
4880	General				The following comments concern only aspects of estimating changes in soil organic carbon for cropland and grassland.	Roland Hiederer	Noted	
4882	General				1. Assumption that higher tier methods lead (automatically) to more accurate estimates of changes in SOC stocks. This is cannot be substantiated by the results of using various SOC models in the scientific literature. The models depend very much on the set-up, calibration and data. Models also show differences in estimated SOC stocks in the region of the error given in Table 5.5 for FLU (11% - 17%). Even using different run-up periods can introduce such uncertainties in the SOC C model output. It is therefore, questionable, how the assumption that the use of higher tiers would lead to more accurate data unless the input data and the model parameters can be more accurately specified. At the very least the wording should reflect that an improvement in the accuracy of estimates from with a higher tier method depends on the availability of suitable and accurate data.	Roland Hiederer	Accepted	Agreed. The accuracy of higher Tier methods will depend on a number of factors. With poor input data and calibration, inaccurate predictions would be produced by higher Tier methods. However, it is important to note that the Tier 1 method ,as currently presented, has signficant uncertainty associated with the reference stocks (78-210% of the mean values - Table 2.3) and the stock change factors (5-50% of the mean values for croplands and grasslands - Tables 5.5 and 6.2). In addition uncertainty would exist in the spatial allocation of activity data. With adequate input data and calibration to the conditions over which a model is applied, the potential to derive more accurate and representative data are possible. General explanation of tiers should be included in the Overview Chapter.
4884	General				The introduction of a three-pool steady-state C model for Tier 2	Roland Hiederer	Noted	The new Tier 2 method is proposed as an option that compilers may consider, but there is also another option using the default equations.

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4886	General				The introduction of this model is not a refinement of the existing Tier 2 method, but a fairly radical deviation from the reasoning behind 2006 IPCC Guidelines. It raises several questions and concerns: a) The Refinement text states that the 3-pool steady-state C model as a Tier 2 does not represent a Tier 3 model. One may argue and disagree with this statement. The steps and calculations are a cut-down version of the Century model, which is a Tier 3 method.	Roland Hiederer	Noted	Note that the Tier 2 model in the 2006 guidelines is still provided in the refinement, and therefore the new method is not refining the previous method. It is an update providing a second option. The proposed Tier 2 method is of intermediate complexity between Tier 1 and 3 methods. It allows a country to estimate C stock changes in a more disaggregated way compared to Tier 1, but lacks the complexity of a fully dynamic Tier 3 model. The equations provided can be used to derive national C stock change factors that integrate C input and management effects analagous to the default factors in the Tier 1 method. However, the Tier 2 equations allow the compiler to derive stock change factors that are more specific to their national circumstances given the management, climate and soil conditions in the country. This approach is analogous to the Tier 2 method in Volume 4, Chapter 10 for enteric fermentation, in addition to the stock difference method for biomass that requires more detailed calculations to estimate biomass C stock changes. The model differs from typical Tier 3 methods for this source category in that the results represent steady state conditions and thus does not yield a fully dynamic time series by simulating water dynamics, temperature regimes, nitrogen dynamics, plant production, and other processes that produce daily or monthly estimates of the soil C stock changes. Also, it has been decided to only provide this alternative Tier 2 method for Cropland Remaining Cropland based on another comment.

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4888	General				b) Going all the way to find the data for the various aspects of the proposed model one may well just use Century. Going all the way to find the data for the various aspects of the proposed model one may well just use Century. It is then superfluous to have this option as a Tier 2.It is then superfluous to have this option as a Tier 2.	Roland Hiederer	Rejected	The proposed Tier 2 method has been structured to minimise data requirements. Generic global model parameters values have been developed through application of a Bayesian calibration process (see Annex 2A.3) and are provided for the compiler in Table 2.3C. The data required by the user to run the model is much reduced from that required by Century and other dynamic soil carbon cycling models (e.g. RothC). Specifically, the steady state model requires spatial data for climate, annual carbon inputs based on national yield data or forage production (for which equations are provided) and organic amendments, tillage practices, irrigation management and sand content. If a country does not have access to these data, much of this data can be obtained from global datasets, which are referenced to the location of these data sources is provided in the text. It is noteworthy that the Tier 1 method also requires more activity data on management than the Tier 2 steady state method. A Tier 3 model, such as Century, requires some of the same data, such as climate soil types, irrigation, organic amendments and tillage practices, but information must be scheduled in the simulation on a monthly basis (or sometimes daily basis) as well as the need for monthly data on mineral fertilizer additions, planting and harvesting dates, fires, organic amendments, crop types and sequences, harvesting practices, among other practices. Moreover, the Tier 2 model has approximately 30 parameters, and the values are provided in the guidance. Century or similar models have 100s to 1000s of parameters that influence processes from the amount of maximum plant production, to leaching rates of carbon and nitrogen, overland flow of water, temperature regimes in the soil, uptake of nutrients by plants, etc. The additonal complexity in parameterizing a typical Tier 3 model is many orders of magnitude more difficult than the Tier 2 model provided in this guidance. Of course, successfully calibrating a Tier 3 model is likely to generate results with less uncertainty. This is another reason why the steady-state model proposed here at the Tier 2 level is not considered a Tier 3 model, which we would expect to provide results with less uncertainty. Also, it has been decided to only provide this alternative Tier 2 method for Cropland Remaining Cropland based on another comment.

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4890	General				c) With the introduction of the model in the Guidelines may be seen as endorsing the Century ecosystem model as the preferred model for estimating SOC stocks and changes. A more balanced view of the merits and limitations of various SOC models would have been more appropriate. This is addressed, but under Tier 3 (Box 2.2E). Giving these examples for a Tier 3 m3ethod is better option than tacitly proposing the method used by Century as a Tier 2. For Tier 2 the choice of model should be left to the party reporting the data and not be biased by the Guidelines.	Roland Hiederer	Rejected	The Tier 3 section does not endorse any specific process-based model. Ultimately, the compiler must parameterize and evaluate a Tier 3 model for their national circumstances. The Tier 2 method with global default parameters is a much simpler representation with intermediate complexity than typical Tier 3 models. This model was proposed because the steady-state solution was peer-reviewed and published in the scientific literature. In addition, the Century model has been used because of its extensive testing across a range of land uses, land use changes and management practices being considered within inventory analyses. Providing this Tier 2 option will allow compilers to improve their inventory without all of the complexity, time and resources needed to develop a Tier 3 approach. However, it is likely that a compiler can develop a Tier 3 method and improve their inventory, and this guidance does not endorse any specific model for Tier 3, which may even be a measurement-based approach.
4892	General				d) Introducing the model deflects from the need of all models for measured data. Assuming that the use of a model would increase the accuracy of estimates of changes in SOC stocks is flawed. It depends very much on the quality input data and setting appropriate model parameters. One would have wished for a proposal for national soil inventories and support to long-term experimental sites, i.e. expanding Section 2.5.1.	Roland Hiederer	Accepted with modification	We accept that measurements are an important source of information for an inventory. The proposed approach uses spatially explicit climate data and inputs of carbon to soil along with a set of calibrated global parameters. Applying this method with the global parameter set will provide more specificity in the C stock change factors, compared to the default equations that provided a limited number of bins for estimating changes in C stocks (e.g., high, low and medium input). This approach could be part of path for compilers to improve their inventory in the short term before developing a more complicated Tier 3 method, which depends on adequate measurements. We agree that quality of input data and parameters are critical for reducing uncertainty, and there are limits to reductions in uncertainty given that compilers will be using global parameters with this Tier 2 option. However, the guidance encourages Tier 3 methods if data are available for developing these methods; see Figure 2.4 in Chapter 2 of Volume IV. If data are available, compilers can optimize parameters and test any model that they select, potentially further reducing uncertainty in their estimates of soil C stock changes with a tier 3 method. The development of a soil monitoring program would be desirable going forward to develop Tier 3 methods with less uncertainty. Including this Tier 2 method in the guidance does not limit a compilers ability to develop the Tier 3 method, which is encouraged by the guidance and will require collection of soil C measurements.

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4894	General				One may be forgiven to fail to see the introduction of the 3-pool steady-state c model as a refinement or improvement over the 2006 IPCC Guidelines. It puts the virtualization of environmental conditions at the same level as measuring these conditions. This may be applicable in cases where conditions cannot be measured, in particular when modelling scenarios as a what-if condition. However, the IPCC Guidelines concern past developments and reporting on those developments, for which a modelling approach should take second place to measurements.	Roland Hiederer	Noted	In principal it is agreed that where possible measurement should be the primary focus of government resources for improving their soil C inventory. However, few countries are implementing a measurment campaign to derive national soil carbon inventories. The proposed approach uses spatially explicit actual past climate data, inputs of carbon to soil based on national yield statistics, and mapped soil data to estimate C stock changes. Using these data allows the Tier 2 method to approximate soil C stock changes based on past history. Regardless, the method is only of intermediate complexity and there is certainly improvements that can be made with a Tier 3 method, which will require soil C measurements.
4896	General				In this respect the 2006 IPCC Guidelines had a mopre balanced and measured approach. One could have understood a re-definition of the tiers into: Tier 1: default values and static steady-state models. Tier 2: dynamic models Tier 3: inventories May be a future amendmend to the Guidelines will rectify the direction taken for reporting emissions and removals.	Roland Hiederer	Noted	This is an interesting suggestion and could be proposed in the next refinement of the guidelines. In particular, differentiating process-based modeling and measurement based inventories (which are now in the Tier 3 method) may lead to more specificity around these two very different approaches to an inventory.
8348	General				I find it a very dubious procedure that comments are not possible on the text that is not subject to refinement. I certainly found one or two mistakes there in looking at the FOD. This is not providing the rigorous review expected of an IPCC report.	Pauline Midgley	Noted	In accordance with the decision by the IPCC (Decision IPCC XLIV-5), this report is not to fully revise the 2006 Guidelines. The authors are not allowed to change the text where "no refinement" is expected in the approved outline, unless changes are necessary to ensure consistency with refinements made in the other parts.
1190	General				Accuracy. As long as it is understood that "accuracy" of NGHGI means both low bias and high precision (low uncertainty), then attention should be given throughout the GLs that this term is used consistently. As an example, section 1.3.2 Of Col 4 Ch 1 (not revised), states that "In general, moving to higher tiers improves the accuracy of the inventory and reduces the uncertainty." According to the GLoassary definitions, it should actually simply say " ... improves the accuracy of the inventory." In fact, exactly because this IPCC definition of accuracy (whihc coincides with the current ISO definition) is not generally aligned with common use, one could atually write "... improves the accuracy of the inventory, that is, reduces bias (improves truness--to use a ISO term) and increases precision.	francesco nicola tubiello	Accepted	

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1206	General				Use of Tier 2/3. This is of course what good practice is, however, as indicated by every single figure in these GLs, the use of tier 2/3 is subject to the actual availability of data--hence it depends on a country capability. I think this shoul dbe conveyed as a message throughout teh GLs, becasue the result of this language ofte has been that countries produce no inventory at all rather than starting with Tier 1--since they understand it is not good practice.	francesco nicola tubiello	Noted	Also, the 2006 GL are already very clear (see Overview chapter page 8) that use of Tier 1 can be considered good practice depending on the circumstances, and Volume 1 Chapters 1 and 8 show that completeness of coverage is a key part of good practice
1252	General				AFOLU. In which sense does the "Agriculture, Forestry and Other Land Use" terminology fits within the six IPCC land use classes that are the focus of ""AFOLU"? On the one hand, the AFOLU terms seems to imply that "agriculture" and "forestry" are land use classes, i.e. alongside "other" land uses. And yet, "agriculture" and "forestry" are clearly not IPCC land use classes. Note nonetheless that "agriculture" and "forestry" are in fact land use classes in the existing statistical classification followed by both FAO and UNSD as concerned. See for instance, the land use classification in the annex of SEEA AFF, http://www.fao.org/fileadmin/templates/ess/ess_test_folder/Publications/Agrienvironmental/SEEA_AFF_White_Cover.pdf; or the FAO land use classification, endorsed by the UN Statistical Commission, for international reporting by countries to FAO on land use, irrigation and agricultural practices: http://www.fao.org/economic/ess/ess-home/questionnaires/en/.	francesco nicola tubiello	Noted	The Sector title "AFOLU" was adopted and accepted by the IPCC in 2006. This report is not to fully revise the 2006 Guidelines, and should ensure consistency with the 2006 Guidelines. It is our understanding that the authors of the 2006 guidelines developed a name that would cover agricultural cropland and grasslands, forest land and other land uses (settlements, wetland and other lands). The intent was to unify the previous agriculture and LULUCF sector, which subdivided sources on land that often have interdepedencies through biogeochemical processes influencing GHG emissions.
1254	General				AFOLU (part II). Clearly there are internal definitional inconsistencies in these guidelines that should be addressed. In the Glossary, "land use" is defined as an activity that uses land. This is overall consistent with the definitions used by the international statistical community, so that every single economic activity (as economic sectors) are associated to a land use class, including "agriculture" and "forestry". Indeed, the most recent land use questionnaire by FAO talks of Agriculture, Forestry and Other Land Use. However, the six land use categories are not a one-to-one map to economic activities. Here at a minimum, the GLs should strive to at least indicate where "agriculture" (cropland and grassland?) and "forestry"'(forest land?) map onto.	francesco nicola tubiello	Noted	The terminology was adopted and accepted by the IPCC in 2006. This report is not to fully revise the 2006 Guidelines, and should ensure consistency with the 2006 Guidelines. It should be recognized that this is not an economic-based classification, but rather a grouping anthropogenic activities in order to estimate their influence on GHG emissions.

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1256	General				AFOLU (part III). It is understood that the AFOLU "sector" is not a sector in the socio-econoic statistical sense, but only a part of the NGHGI as defined in the 2006 IPCC GLs. It is also understood that "land use" emissions are only those that are associated to changes in carbon stocks in biomass and soils as well as associated changes in other GHG fluxes. A first recommendatoin is to change the term "sector" to something more specific, such as "inventory sector". This would avoid endless misunderstandings in discussoins at UNFCCC about the "land use" sector in relation to mitigation via economic activities, where in fact tehre is no such thing in the economy as a "land" sector."	francesco nicola tubiello	Noted	The terminology and source/sink categorization was adopted and accepted by the IPCC in 2006. This report is not to fully revise the 2006 Guidelines, and should ensure consistency with the 2006 Guidelines. We agree that that this is not a socioeconomic term, but rather a classification to differentiate groups of activities in a country for an efficient compilation of a GHG inventory.
1258	General				AFOLU (part IV). If the more narrow definition of the AFOLU "sector" in these guidelines is accepted, then how can emissions from "livestock," especially enteric fermentation, be a part of AFOLU? In this sense, it was better to keep "agriculture" as a separate "sector" from FOLU. If the tentative answer is that the methane bulched by cows comes from grass in the field, then one could observe that many manufacturing activities generate emissoins linked to land and thus should also be accounted for under AFOLU --which is obvioulsy not possible.	francesco nicola tubiello	Noted	The terminology and source/sink categorization was adopted and accepted by the IPCC in 2006. This report is not to fully revise the 2006 Guidelines, and should ensure consistency with the 2006 Guidelines. Including livestock in this sector is important because the linkages between livestock production and dependence on land for forage as well as impact on land with urine and manure return to soils. These linkages are important for estimating GHG emissions from both the land and livestock.
1260	General				AFOLU (final). The only part that makes sense in putting AFOLU together is the recognitoin that a significant component of FOLU emissions is caused by "agriculture" as an economic sector. This allows then for increased consistency, i.e., to account within a unified place for non-CO2 and CO2 emissions coming from one single activity (e.g., drainange of peatlands). Yet all of the inconsistencies mentioned above are not resolved by this useful purpose.	francesco nicola tubiello	Noted	The terminology and source/sink categorization was adopted and accepted by the IPCC in 2006. This report is not to fully revise the 2006 Guidelines, and should ensure consistency with the 2006 Guidelines. Grouping activiities into sectors is useful for conducting a GHG inventory. It may be possible to improve the classification in the future but it is beyond the mandate for this report.
2574	General	General			Please go through all chapters and correct all notations. At least I have found four: " yr-1" versus "year-1" " °C " versus "degrees C" "fraction" versus "proportion" denominations are some places provided in brackets "[ ]" or "( )" Shall references be "Volume (roman letters)" or "Volume (arabic digits)"? "unitless" versus "dimensionless"	Steen Gyldenkærne	Accepted	This kind of consistency throughout the report was ensured to the extent possible. However, some inconsistenies might still remain. Those will be rectified by TFI TSU before the final publication of this report, in accordance with the IPCC procedures. However, it seems very difficult to achieve perfect consistency because some inconsistencies already existed here and there in the 2006 Guidelines.

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928	General	General			Considering that FAOSTAT statistics are mentioned as an alternative source of activity data whenever national information is missing, it may perhaps help to insert a Table summarizing all the available FAOSTAT data sources, at the outset of this chapter or even at the outset of this volume (or as an appendix to it). To this end, kindly consider consulting as well as inserting a reference to the IPCC (2015) report 'Emerging activities to combat climate change– use of FAO data and IPCC GHG Inventory Guidelines for Agriculture and Land Use' (https://www.ipcc-nggip.iges.or.jp/public/mtdocs/pdfiles/1411_FAO-IPCC-IFAD_Rome_AFOLU.pdf).	francesco nicola tubiello	Accepted with modification	The Author's view is that FAO start is one of the alternative sources for activity data amongst a large portfolio of international, regional and national sources. Approaching the chapter in this way will mean equal treatment for other data sources. In response to the comment, the Authors have enhanced the text on the use of FAO data chapters 2 and 6 of Vol.1 and included key references.
1140	General	General	7	8	Temperate, cold. This comment applies to the definitions of climatic zones in this glossary. Are they consisten with how the same terms are used in other IPCC Assessment Reports and more in general in the scientific literature? If so, why can’t a link to where this definitoin comes from be given?	francesco nicola tubiello	Noted	The climate classification in this guidance is used to derive emission and stock change factors in the AFOLU volume. It is not feasible to make changes in the classification at this point in the review process because developing the new default factors requires a synthesis of the literature that has taken 6-12 months for many of the author teams. The proposed change may be possible in the next refinement if harmonization of climate classifications is brought to the attention of the IPCC experts during the scoping process before preparation of the report begins.