PEER REVIEW RESPONSE DOCUMENT

April 2017

A methodology for **Wetland Implementation and Rice Cultivation in the Sacramento-San Joaquin Delta, San Francisco Estuary and the Coast of California – Methodology for Quantifying Greenhouse Gas Emissions Reductions** was developed by the Sacramento-San Joaquin Delta Conservancy, HydroFocus, Tierra Resources, the University of California (UC) Berkeley and the Nature Conservancy, with support from the Sacramento Municipal Utility District, Metropolitan Water District and the California Department of Water Resources. The methodology builds upon ACR's approved methodology, **Restoration of Degraded Deltaic Wetlands of the Mississippi Delta** by integrating California data and region-specific restoration techniques. The methodology was submitted to ACR for approval through the public consultation and scientific peer review process.

The methodology was formally submitted to ACR on June 10, 2015. ACR conducted its standard internal methodology screening and the authors submitted a revised draft on November 30, 2015. The methodology was then posted for public comment from January 12, 2016 – February 12, 2016. Public comments and responses by the authors were finalized on June 19, 2016, and have been provided to peer reviewers. Reviewer comments and responses by the authors are given below.

This document is organized by modules of the methodology. The far-left column of the table presented here contains the document section name where the comment was made. Page numbers as referenced by the scientific peer review panel in the following table refer to the document versions as provided for peer review. Final document versions and versions as posted for public comment are also available on ACR's website under Process Documentation.

FRAMEWORK MODULE (WR-MF)

FRAMEWORK MODULE (WR-MF)		
Section	**Comment Type**	**Comment / Response**
(WR-MF) Background	Initial Comment	**Awkward or unclear meaning** "The objective of this methodology is to describe quantification procedures for the reduction of greenhouse gas (GHG) emissions through conversion of land to wetlands and rice cultivation in the Sacramento-San Joaquin Delta" This is rather awkward and unclear what is being converted? What "land" is converted to wetland or rice cult? Or is it the conversion of wetlands to rice or vice versa?
	Author Response	To add clarity, the sentence has been changed to read as follows. The objective of this methodology is to describe quantification procedures for the reduction of greenhouse gas (GHG) emissions through conversion of land currently used for agriculture or managed seasonal wetlands or land covered with open water to wetlands and rice cultivation in the Sacramento-San Joaquin Delta, San Francisco Estuary and in coastal areas of California.
(WR-MF) Background	Initial Comment	"This methodology achieves GHG emission reductions.....'. This methodology allows for quantification of GHG emission reductions.....'
	Author Response	Changed.
(WR-MF)	Initial Comment	The applicability of this meth. is not limited to the areas mentioned in the first sentence as far as I understood. Better mention that directly in the preface

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Section	**Comment Type**	**Comment / Response**
Background	Author Response	Preface, title and legend of table 1 were changed to more clearly state the applicability of the methods in California
(WR-MF) Background Baseline Conditions	Initial Comment	For international compliancy (IPCC, UNFCCC, all research on EF's), wouldn't it be better to use hectares instead of acres throughout the documents?
	Author Response	We agree that from an international perspective, hectares are more appropriate. However, the geographic applicability of this methodology is primarily limited to California where producers will be working in acres. We have therefore opted to leave as acres . A sentence has been included to reflect this and provide the conversion factor for acres to hectares.
	Reviewer Reply	Wouldn't this also depend upon the market you will be trading in? Most I have seen are based on $/metric ton? It's going to be really cumbersome to have to convert all fluxes into English units. Most people working in carbon are likely to already be working strictly in metric units. I know this is the USA, but metric is really more realistic for carbon trading.
(WR-MF) Background	Some general comments: (1) There needs to be some more consequent use of the terms GHG sources and sinks (emissions and uptake) and Carbon losses and - sequestration. (2) the term ' subsided land' or ' subsided agricultural land' does not always automatically imply that these subsided soils are 'dry' and ' drained' right? Subsided soils can we wet soils as well (e.g. paldudiculture/wet agriculture). I would prefer to use the term ' drained (organic or peat) soils' which is a broader applicable term. (3) the quantification of emission shall be ' conservative', all project emissions shall be considered (including CH_4 and N_2O) not overestimating emission reductions, baseline emission emissions as close as possible to reality, but not overestimating (see also comment table 1) (4) The framework doc. would improve if a table is added outlining per area (Delta, Bay and Marsh) which EF's are used for the	

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Section	**Comment Type**	**Comment / Response**
	baselines for CO_2, CH_4 and N_2O + site characteristics such as % soil C, Subsidence rates, annual average water table, Salinity etc.	
	Comment noted	
(WR-MF) Background Table 1	Initial Comment	The column Primary GHG Impact could be improved by a brief explanation per each GHG (CO_2, CH_4, N_2O): what is the result of the project on each of the GHG's, in additions to the ' overall' GHG impacts.
	Author Response	Additional language providing more information about GHGs added to table to address reviewer's comment.
	Reviewer Reply	This is improved. But the primary GHG impact for wetlands is still awkward. You should state CO_2 is the primary emission with also significant N_2O emissions. I would review the lit. On the GHG equivalence, N_2O can really be significant for N demanding crops.
	Author Response	We changed table 1 and added possible N_2O emissions in seasonal and tidal wetlands. The agriculture already included the N_2O.
(WR-MF) Background Figure 1	Initial Comment	**Figure needs revision** In the figure the CO_2 is not part of Anaerobic decay as CH_4 is. I would add an arrow of CO_2 sequestration. and perhaps other pathways such as DOC
	Author Response	Figured was modified and replaced.
(WR-MF) Background Figure 1	Initial Comment	In Fig 1. compaction seems a large factor in the process of soil subsidence. Please make sure that the fig is not misleading and provides a good understanding of the contribution of oxidation/compaction and consolidation in the process of subsidence.

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	Author Response	Additional explanatory language and reference added to figure caption.
(WR-MF) Agricultural Lands in the Sacramento - San Joaquin Delta	Initial Comment	Is fertilizer used only? or also manure? or does this include manure?
	Author Response	Fertilizer is the primary source of added plant nutrients in Delta organic soils.
(WR-MF) Agricultural Lands in the Sacramento - San Joaquin Delta	Initial Comment	Oxidation does not lead to ' relatively small amounts of CH_4 '. CH_4 forms under anaerobic conditions. Some of the CH_4 can become CO_2 if oxidized. please correct
	Author Response	Revised as follows The primary baseline emission and carbon stock change for this target area is due to oxidation of organic matter in farmed and grazed organic and highly-organic mineral soils. This oxidation results in primarily in the emission of CO_2. Relatively small amounts of CH_4 are emitted due to anaerobic decomposition of organic matter below the water table.
(WR-MF) Seasonal Wetlands in the San Francisco Estuary	Initial Comment	**Use of the term 'Seasonal Wetland'** I recommend changing this to 'managed seasonal wetland' instead of 'seasonal wetland' since the examples given are all managed. Without that qualifier, the reader gets the assumption that all seasonal wetlands in the Bay area are GHG sources and I don't believe that this is the case. Are vernal pools, which are naturally occurring seasonal wetlands, considered in this category?
	Author Response	Seasonal wetlands are indeed managed in much of the Estuary for duck hunting. However, there are non-managed seasonal wetlands which are areas that are

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		too wet to farm (see Deverel et al. 2015). Text has been added to clarify this. Deverel, Steven J.; Lucero, Christina E.; & Bachand, Sandra. (2015). Evolution of Arability and Land Use, Sacramento-San Joaquin Delta, California. San Francisco Estuary and Watershed Science, 13(2). jmie_sfews_27914. Retrieved from: http://escholarship.org/uc/item/5nv2698k
(WR-MF) Project Conditions Managed, Permanently Flooded, Non-Tidal Wetlands on Subsided Agricultural Lands	Initial Comment	The literature used for reference is quite old. Is there more recent information, especially because the LU has changed since the late 80-s, e.g. the creation of managed wetlands on subsided islands in the Sacramento-San Joaquin Delta?
	Author Response	This is a confusing comment. What is LU? There is more recent information on managed wetlands on subsided islands in the Sacramento-San Joaquin Delta some of which is presented in the Methods Module. Language has been added here.
	Reviewer Reply	I assume LU is land use? If true, what has been the evolution of land use since the 80s as it would affect GHG emissions?
	Author Response	Need clarification from reviewer. Recent information about GHG emissions or LU?
	ACR Response	More information on land use change since the 80s was provided in Appendix B.
(WR-MF) Tidal Wetlands in San Francisco Estuary, San	Initial Comment	**Callaway misspelled** Please change 'Calloway' to 'Callaway'.
	Author Response	Thank you. Changed in text.

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Francisco Bay and the California Coast		
(WR-MF) Tidal Wetlands in San Francisco Estuary, San Francisco Bay and the California Coast	Initial Comment	**Clarification - with large N inputs N_2O can be emitted from tidal wetlands (eg., sewage outflows)** N_2O is emitted in very low concentrations in most tidal wetlands
	Author Response	References for this statement would be helpful: "N_2O is emitted in very low concentrations in most tidal wetlands". We cannot find data to support this statement. It is not anticipated that tidal wetlands projects will receive sewage effluent and the projects module states that the methodology is not applicable where application of fertilizer or manure occurs.
	Reviewer Reply	I would do a lit search of N_2O emissions in tidal wetland ecosystems. At least in mangroves there is usually detectable amounts and this increases when there are land uses or other sources of N such as you would find int the delta. I only know the lit with mangroves and salt marshes. But N_2O emissions are pretty common in the few studies of tidal wetlands.
	Author Response	After the initial response with “no N_2O when no N sources”, we decided to add the possibility to have N_2O emissions in tidal wetlands. N_2O was added as possible emission to text and tables. The comment refers to the paragraph describing baseline seasonal wetland conditions (1.1.2.2). We assume N_2O fluxes would not be determined in baseline conditions because excluding them would be conservative and thus underestimate the baseline emissions.

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		We would like to add the following review of wetland N_2O emissions literature demonstrating that N_2O emissions are generally low and even negative in un-enriched fresh and costal marshes. Specifically: Moseman-Valtierra, SM. (2012) Reconsidering the climatic roles of salt marshes: Are they sinks or sources of GHGs? In: Marshes: Ecology, Management, and Conservation, D. C. Abreu and S. L. de Borbón (eds.), NOVA Science Publishers. p. 1-48. ISBN 978-1-61942-715- 0. "In un-enriched fresh and costal marshes, N_2O emissions are generally low, and even negative, while significant positive N_2O fluxes are found in N enriched marshes." Badiou, P., McDougal, R., Pennock, D. and Clark, B., 2011. Greenhouse gas emissions and carbon sequestration potential in restored wetlands of the Canadian prairie pothole region. Wetlands Ecology and Management, 19(3), pp.237-256. "The study examined change in soil organic carbon density as well as emissions of methane and nitrous oxide in newly restored, long-term restored, and reference wetlands across the Canadian prairies to determine the net GHG mitigation potential associated with wetland restoration. Our results indicate that methane emissions from seasonal, semi-permanent, and permanent prairie pothole wetlands are quite high while nitrous oxide emissions from these sites are fairly low."

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		Wang, H., et al., Dissolved nitrous oxide and emission relating to denitrification across the Poyang Lake aquatic continuum, J. Environ. Sci. (2016), http://dx.doi.org/10.1016/j.jes.2016.03.021 reports relatively low N_2O concentration (0.10–0.40 µg N/L) and N_2O emission (−9.37–24.4 µg N/m^2/hr) in wetlands. "The Poyang Lake wetlands may be the sink for N_2O or may reduce the transfer of N_2O emission to the atmosphere." Yu, J., Liu, J., Wang, J., Sun, W., Patrick Jr, W.H. and Meixner, F.X., 2007. Nitrous oxide emission from Deyeuxia angustifolia freshwater marsh in northeast China. Environmental management, 40(4), pp.613-622: "The annual average N_2O emissions showed that NW marsh, which had no standing water, were N_2O source (4.45–6.85 lg m^{-2} h^{-1}) and SW marsh, in which standing water depth ranges of 0–10 cm, were N_2O sink." Liikanen, A., Sivennoinen, H., Karvo, A., Rantakokko, P. and Martikainen, P.J., 2009. Methane and nitrous oxide fluxes in two coastal wetlands in the northeastern Gulf of Bothnia, Baltic Sea. boreal environment research, 14(3). In this study fluxes of CH_4 and N_2O were measured in wetlands in the Baltic Sea. "On average, the wetland close to the Temmesjoki was a small source of N_2O (mean flux of 131 µg m^{-2} d^{-1}), whereas the wetland close to the Lumijoki was a small sink for N_2O (mean flux of -53 µg $m^{-2}d^{-1}$). The higher availability of nitrogen in the wetland near the Temmesjoki obviously induced the higher N_2O fluxes.

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		Estuarine wetlands seem to be important sources of atmospheric CH_4 but do not represent an important source of N_2O." Chauhan, R., Ramanathan, A.L. and Adhya, T.K., 2008. Assessment of methane and nitrous oxide flux from mangroves along Eastern coast of India. Geofluids, 8(4), pp.321-332. "Mangroves are considered to be a minor source of greenhouse gases (CH_4 and N_2O) in pristine environmental condition. However, estimates of efflux suggest that anthropogenic activities have led to a pronounced increase in greenhouse gas emission." Moseman-Valtierra S, et al. (2011). Short-term nitrogen additions can shift a coastal wetland from a sink to a source of N_2O. Atmospheric Environment 45: 4390–4397. "To better assess the climatic roles of salt marshes, greenhouse gas emissions need to be studied in the context of chronic nitrogen loads that impact many coastal ecosystems. Notably, all of the control plots were either nonsignificant sources or small to large sinks of N_2O in a salt marsh at Rowley, Massachusetts. In contrast, among all of the nitrate-amended plots, there were some substantial sources and no sinks."
(WR-MF) Rice Cultivation on Subsided Agricultural Lands	Initial Comment	**Clarification** conversion of what to rice? Another ag crop or a pristine wetland?
	Author Response	Organic soils where field crops such as corn are grown have been converted to rice.

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in the Sacramento-San Joaquin Delta		
(WR-MF) Geographic Applicability	Initial Comment	'..it maybe used without modification for areas throughout California....': it would be good to add a table which characteristics need to be/are required to be similar to those in the described areas (Delta, Marsh and tidal wetland). is it salinity? percentage C in soil? soil type? Is this meth. applicable to California only? or with justification also for areas in the same climate zone and similar soil characteristics?
	Author Response	The methodology has been written for areas where the available data demonstrate that there is the potential for a net GHG emissions reductions. These include tidal wetlands and managed non-tidal wetlands and rice where there are baseline GHG emissions due to the oxidation of organic soils and where salinity inhibits methane emissions in tidal areas.
(WR-MF) Modules and Tools	Initial Comment	**Awkward and unclear** by the time you get to table three it is really hard to follow all of the acronyms. I can't really even follow table 3. For example, I can't find WR-MF.... if you want this to be user friendly you are going to have to clarify acronyms and terms... perhaps spell them out in these tables....
	Author Response	We attempted to update and make the table clearer. Except for WR-MF, all modules are clearly explained in the Table 2. We replace WR-MF with the word framework.
(WR-MF)	Initial Comment	**Figure organization** This would be more intuitive if the locations of Baseline and Project Activity are

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Eligible Project and Baseline Modules Figure 3		switched so that it flows from left to right. Also, why are the arrows bi-directional?
	Author Response	New Figure 3 added
(WR-MF) Applicability Conditions Table 3	Initial Comment	**Grammar** Please change 'effecting' to 'affecting' in last scenario bullet.
	Author Response	Thanks. This has been corrected.
(WR-MF) Applicability Conditions Table 4	Initial Comment	**Ecological justification** In table 4.I largely agree except there are cases where fire could be ecologically beneficial mimicking nature in restored freshwater and tidal wetlands ... I would make this burning ag vegetation.
	Author Response	Where there are wetlands adjacent to agricultural peat lands, burning could be problematic in that peat fires are difficult to extinguish. We removed the burning from the applicability general criteria in table 4 and for rice in paragraph 3.3.1.2
(WR-MF) Applicability Conditions Table 5	Initial Comment	**Inclusion of eelgrass restoration under tidal wetland project condition** In Scenario 2 - Tidal Wetland project condition: This is the first time that eelgrass restoration is mentioned in the text. To me, the model processes for marsh restoration are not the same as for eelgrass, and that a different module would have to be developed that takes into consideration metrics related to subtidal habitat (water quality measures, tidal flow and patterns, etc). Please include reasoning as to why these two habitat types are grouped into one module. I

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		absolutely agree that eelgrass should be included in this assessment, but don't agree with lumping them into a tidal marsh module.
	Author Response	The rationale was based on similar baselines for the both eelgrass and tidal wetlands in San Francisco Estuary. We will further consider how best to incorporate eel grass within the context of the project modules. After due consideration and in light of the geography and likely implementation of eel grass, we have opted to leave eel grass as part of the tidal wetlands module.
	Reviewer Reply	I am not quite sure what you mean in your second comment regarding geography and likely implementation of eel grass - please clarify. Does this mean that you don't think it is likely that eel grass beds will be restored or that this methodology will be used in eel grass beds? What makes the geography of SF Bay different than other regions, which would affect eelgrass GHG measurements? I do think that it should be noted in the Methods Module that different methodologies need to be implemented when measuring GHG fluxes under inundated conditions (notably for eelgrass, see Bahlmann et al. 2015 *Biogeosciences*) and that it's not a 'one size fits all' approach to using static chambers (which I think most projects would use due to the high cost of flux towers). Based on their results, collecting GHG fluxes only during low tides would underestimate emissions by nearly 3 fold.
	Author Response	Geographically eelgrass beds only cover approximately 1% of submerged land in the San Francisco bay (Merkel and Associates 2004). 98.8% of all mapped eelgrass in the bay was found between -1.77 and 0.4 m. 9,490 ha of potential

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		habitat may be suitable for eelgrass within the bay, about an order of magnitude more than currently exists (KE. Boyer and S. Wyllie-Echeverria, Eelgrass Conservation and Restoration in San Francisco Bay: Opportunities and Constraints). Thus eelgrass areas can be restored, but eelgrass doesn't represent a very important contribution to wetland restoration in the Bay-Delta region. Eelgrass are included and described in paragraph 3.2.2.2. describing Tidal wetland Projects. Paragraph 3.2.2.4 on Tidal wetland Project Carbon Stock Changes and GHG Emissions contains "That is, chamber or eddy covariance measurements shall be conducted at times and places in which CH_4 emissions are expected to be the highest based on expert judgment, datasets or literature". We added a sentence about temporal sampling in eelgrass. The same concept is expressed in the methods module, when describing chamber measurements. Paragraph 4.1.4.2.1 says: "Measurements should ensure that temporal variations are accounted for, or be measured during the time of greatest anticipated flux in order to conservatively estimate net GHG emission reductions/removal enhancements".
(WR-MF) Applicability Conditions	Initial Comment	**Soil criteria** Why does soil carbon have to be >3%? where does this criterion come from and why?
	Author Response	The available data indicate that oxidation and subsidence occurs and soil carbon values over 3% (see for example Deverel and Leighton, 2010). Deverel, Steven J; & Leighton, David A. (2010). Historic, Recent, and Future Subsidence, Sacramento-San Joaquin Delta, California, USA. *San Francisco*

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		Estuary and Watershed Science, 8(2). jmie_sfews_11016. Retrieved from: http://escholarship.org/uc/item/7xd4x0xw
	Reviewer Reply	This is an unclear reply. What are you saying? Oxidation occurs in soils with values <3%. And I have measured subsidence in tropical forests where soil c was much less than 3%. Similar observations of collapse (subsidence) has been made in mangroves following disturbance (hurricanes). I recommend some revision recognizing that subsidence and emissions (heterotrophic respiration) does exist when soils are <3%.
	Author Response	Of course, heterotrophic soil respiration occurs in soils with lower carbon contents. However, this protocol is aimed to areas where soil CO_2 emissions and subsidence are highest because in these areas conversion to wetland/rice most certainly significantly reduces carbon emission. The protocol does not specify that soil respiration doesn't occur in soil with organic content <3%. For clarity, we removed the 3% criteria.
(WR-MF) Assessment of Net GHG Emission Reduction	Initial Comment	(1) Add permanence assessment? (2) definition of project boundaries, and strata within the project boundary, (including buffer zones?) (3) where is leakage assessment included? (4) for 5&6: estimation of carbon stocks, carbon stock changes (or carbon losses and carbon sequestrations), GHG emissions and uptake (or GHG sources and sinks)
	Author Response	Most of these issues are addresses in subsequent sections. We do not see a need for a permanence assessment. The leakage assessment is included in an appendix which will be provided to reviewers.

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	Reviewer Reply	I assume that the project needs to assure a certain permanence?
	Reviewer (2) Comment	Why don't you need a permanence assessment? Wouldn't this be required for participation in many C trading schemes?
	Author Response	Permanence is included in the risk assessment. See paragraph 1.3.9 that states: "Project activities have the potential for GHG emission reductions to be unintentionally reversed, such as when a Project is subject to flooding, damage from wildlife, erosion; or intentional reversals or termination, such as landowners choosing to discontinue Project Activities before the Project minimum term has ended". A buffer pool is established to protect from a possible lack of permanence. We don't believe additional assessment of permanence is needed.
(WR-MF) Step 2 - definition of project boundaries	Initial Comment	**Carbon pools described or defined for the user?** I assume that the carbon pools have been defined? There must be some sort of conformity or standardization?
	Author Response	See section 1.3.2.3 for description of carbon pools and sources
	Reviewer Reply	OK Ill assume they are defined in this section
(WR-MF) Step 2. Definition of project boundaries	Initial Comment	buffer zones? GHG sources & sinks? Strata boundaries?
	Author Response	GHG sources and sinks are described subsequently. A project proponent can elect to include buffer zones and strata boundaries but the methodology does not need to provide guidance for this.
(WR-MF)	Initial Comment	Perhaps add information on re-assessment of the baseline. the baseline shall be re-assessed around every 10 years e.g. based on reference region data.

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Temporal Boundaries	Author Response	The paragraph was changed to synthetize and clarify temporal intervals relative to baseline and project conditions.
(WR-MF) Carbon Pools and Sources	Initial Comment	**Unclear terminology** What do you mean by "conservatively excluded in tables below? It seems this could be significant emissions and this term in rather unclear.
	Author Response	For baseline, because the primary project benefit is due to the stopping or greatly reducing baseline emissions, the project proponent can conservatively exclude for example N_2O emissions. Please see revised table for project language.
	Reviewer Reply	It is still a really vague term. What do you mean by "conservatively omitted"? Is this different than simply omitted? It really seems somewhat qualitative here.
(WR-MF) Carbon Pools and Sources	Initial Comment	**Point of clarification** Just for a point of clarification - are there any livestock in the project area - beef or dairy? If so how are they treated in terms of enteric fermentation and N_2O emissions?
	Author Response	There will be no livestock in the project area for the project scenario. Livestock can be present in the agricultural baseline scenario.
(WR-MF) Carbon Pools and Sources	Initial Comment	It is important to make very clear that IF soil-C is being considered as a pool (change) in the baseline-project scen. comparison, soil CO_2 emissions due to oxidation/uptake due to photosynthesis cannot be considered anymore in the baseline/project comparison.

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	Author Response	This comment appears inconsistent with our understanding which I attempt to explain here. As an example, for the agricultural baseline, the soil carbon pool is being depleted due to oxidation. Crop production results in CO_2 uptake but the net result is carbon loss due to oxidation of the soil organic carbon pool resultant from exposure to oxygen. Implementation of the project, managed, non-tidal wetlands through hydrologic modification, (i.e. shallow permanent flooding), stops or greatly reduces the oxidation and depletion of the soil carbon pool. Moreover, under the project scenario, wetland photosynthesis contributes to the soil carbon pool through plant productivity and methane emissions. The methodology relies on accounting for the emissions reductions and carbon sequestration associated with this change. This seems to us wholly consistent with standard carbon accounting.
	Reviewer Reply	Sorry for my confusing comment, even when I read it back I don't know what I meant. What I wanted to say (I will explain with an example): In the baseline of a certain agricultural area a project proponent decides to take the soil carbon pool in his carbon calculations: upon agricultural management the soil carbon pool will decrease with x t C per h per year, this includes soil CO_2 release and soil CH_4 release + fluvial losses - carbon sequestration/carbon inputs in soils) It has to be clear form the methodology that in the project scenario it is required to be conservative/not over estimating. So, if e.g. in the project scenario carbon

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		sequestration is being considered, then in the baseline should be done the same. If carbon is being used as pool change, then make sure that this not mixes with the GHG sources and sinks. BTW: note that if a project proponent is going to take soil subsidence as a proxy for the soil carbon stock change (e.g t C ha^{-1} yr^{-1}), then it should be clear that this can not directly by transformed into CO_2 emissions since CH_4 is also part of this process. Part of the carbon will be released as CO_2, part of it will be released as CH_4. Just make sure that both (the conservative issue and the double counting issue) are captured.
	Author Response	The text repeatedly and clearly warns to avoid double counting. We agree methodologies to quantify GHG emission reduction should be conservative. We don't believe baseline and project GHG fluxes should always be measured in the same way. New and old ecosystems could be characterized by very different carbon dynamics, different components can have different and new importance and it could be more appropriate to assess them in a different way compared to how they were quantified in baseline conditions. The comment refers to an equation describing baseline emissions when the cumulative net baseline GHG emissions (ΔGHGBSLin t CO_2e) for the Project area due to the oxidation of organic soils can be estimated by changes in the soil carbon pools using the depth of subsidence". We agree this method doesn't distinguish between CO_2 and CH_4. However, only considering CO_2 emission would underestimate baseline emissions and thus be conservative.

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(WR-MF) Carbon Pools and Sources Table 12	Initial Comment	Table 12: GHG sources and sinks Emission from fossil fuel combustion: included in each scenario? or optional?
	Author Response	Optional where demonstrated to be insignificant. (See revised table).
(WR-MF) Carbon Pools and Sources Table 12	Initial Comment	Table 12, Project: - first/second/third row: only optional if the significance tool has shown that these emissions are negligible in the project scenario, otherwise they shall be included. - Is it so that in the ' tidal wetlands restoration' and ' permanently flooded managed non-tidal wetlands' do not produce any CO_2 or N_2O if the baseline was agriculture or seasonal wetland?
	Author Response	Language added to reflect the first comment. Yes the data demonstrate that there is no production of CO_2 or N_2O.
(WR-MF) Carbon Pools and Sources Table 12	Initial Comment	Table 12. Project. Emissions from fossil fuel shall only be excluded from consideration in the project scenario if they are negligible and shown to be in-significant. Not if they are a ' minor source'.
	Author Response	Thank you. Changed in table.
(WR-MF) Stratification	Initial Comment	Not only stratification for ' accuracy and precisions of carbon stock estimates'. Different stratifications may be required for the baseline and project scenarios to achieve optimal accuracy of the estimates of net GHG emissions or removals. The procedures that should be described: 1. Stratification of aboveground biomass 2. Differentiation of different soil types 3. Stratification of the area into discrete units of relatively homogenous emission characteristics 4. in the case of

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		peatland, stratification of area based on peat thickness 5. Establishment of a buffer zone in the case of peatland (off-site impacts)??
	Author Response	Please see baseline and project modules for more specific detail on stratification.
(WR-MF) Practice Based Performance Standard	Initial Comment	**Science of emissions from rice vs other crops** I sure would closely examine the science of how much additionality you actually obtain when converting corn or field crops to rice. What is the temporal scale?
	Author Response	I am unclear about the science of additionality as mentioned here. If the project is additional, it is beyond the business is usual. This is demonstrated here through the small area under rice cultivation presently relative to the potential. The temporal scale for this additionality assessment is 10 years. The science of emissions reductions and removals in rice has been documented. See for example Hatala JA, Detto M, Sonnentag O, Deverel SJ, Verfaillie J, Baldocchi DD (2012) Greenhouse gas (CO_2, CH_4, H2O) fluxes from drained and flooded agricultural peatlands in the Sacramento-San Joaquin Delta. Agriculture, Ecosystems and Environment 150: 1-18.
	Reviewer Reply	But how much more carbon is actually sequestered when you change crops? Is it a meaningful reduction in GHG emissions? What could one expect in terms of additionality from such a conversion?
	Author Response	Knox et al. (2015) measured GHG emission from pasture, corn and rice in adjacent areas. Corn and pastures GHG emissions were 16 -20 t CO_2eq ha^{-1} yr^{-1},

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Section	**Comment Type**	**Comment / Response**
		compared to 4 t CO_2eq ha^{-1} yr^{-1} from rice. Thus, rice meaningfully reduces GHG emission. Rice is currently cultivated in less than 3% of the Delta, so it can not be included in the business as usual scenario.
(WR-MF) Step 4. Development of a Monitoring Plan	Initial Comment	Monitoring plan 3. description of data collection and/or sampling procedures, including a sampling design for the entire area Add: justification of any default values used from literature
	Author Response	Thank you for the comment. The suggested language has been added.
(WR-MF) Step 5. Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions	Initial Comment	Please explain what ' sufficiently similar agricultural practices' are.
	Author Response	Language has been added to help explain. For example, field crop cultural practices that result similar drainage conditions and depth of the unsaturated zone qualify as sufficiently similar agricultural practices relative to a project site where field crops (e.g. corn, alfalfa) are grown.

BASELINE MODULES

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
(BS) Preface	Initial Comment	See earlier comment on the term ' subsided land' and the expression of tons CO_2 on an acre base instead of on hectare base.
	Author Response	Please see previous responses.
	Reviewer Reply	But still consider how this document can be cross-referenced to other carbon emissions sampling documents. You want this to be relevant.
(BS) Preface	Initial Comment	**Clarity** I still think that the statement "conversion of land to wetlands and rice cultivation..." is quite vague. What is it that you are converting to? In other words, be more specific than the work land.
	Author Response	We added language to improve clarity.
	Reviewer Reply	OK
	ACR Response	Sentence was removed during editing.
(BS-AG) Applicability	Initial Comment	**Editorial and technical point** This section helps to understand that the project sites must be on current ag lands... can you better define them - what crops? pasture lands are included? Will the emissions from livestock be included in the baseline? I know that I am getting ahead of myself but this is really important.
	Author Response	Language has been added to address the comment.
	Reviewer Reply	Improved
(BS-AG) Parameters	Initial Comment	**Technical use of units of measure** you really need to be consistent with the units of measure. Sometimes you speak in English units and sometimes it is in metric. Globally, you ought to

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
		report everything metric. It you wish you could put English units in parentheses. But the world and most markets are metric?
	Author Response	All tons of CO_2-e are metric. Acres have been left in for reasons stated previously.
	Reviewer Reply	So this is a mix of English and metric units? That seems quite unusual. You probably ought to add a section that clearly states what units you are using - metric for mass but English for area?
	Author Response	The measurement system for area used in the protocol is specified in the framework paragraph. Units are in acres and hectares. Mass measurements are metric.
(BS-AG) Parameters	Initial Comment	**Acronyms defined or described** will you need to spell out the acronyms for each section? Probably a good idea
	Author Response	Language added to address comment
	Reviewer Reply	So did you spell out the acronyms? make this document user friendly.
(BS-AG) Step 2. Establishment and Documentation of the GHG Boundary	Initial Comment	In agricultural land on organic soil, are drainage ditches also emission hotspots/sources which could be accounted for?
	Author Response	Yes. They can be hot spots and included via stratification. They would come under the description in Line 2 in Table 13.
(BS-AG) Step 2. Establishment and	Initial Comment	**Emissions from livestock?** You are really missing a really significant source of ag emissions if you do not include emissions from livestock in this table. This would include enteric fermentation from livestock and N_2O emissions from manure. You need to

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
Documentation of the GHG Boundary		review the IPCC default values for these numbers. IPCC default values for enteric fermentation –53 kg CH_4/head/year for US beef cattle N_2O emissions from manure per cow on the range 1.4 kg N_2O /year •GWP of methane is 34 and of nitrous oxide is 298 (IPCC 2013) •The CO_2e per cow is 1904 kg CO_2e for methane and 417 kg for N_2O which equals 2,321 kg CO_2e/head/year As you can see this is a large source of GHGs from agriculture...
	Author Response	Thank you. These GHG sources have been added to the table.
	Reviewer Reply	Good
(BS-AG) Step 3. Baseline Stratification	Initial Comment	be consequent in which terms are used: GHG emissions/removals or GHG sources/sinks, biomass carbon stocks/biomass stocks/carbon stocks.
	Author Response	Language has been changed to increase consistency. Thank you.
(BS-AG) Step 3. Baseline Stratification	Initial Comment	Complete Table 14. e.g. ' for baseline properties' is not a description of ' chemical properties', empty cell.
	Author Response	Thank you. This cell has been filled in.
(BS-AG) Step 3. Baseline Stratification	Initial Comment	Make sure that Table 14 and Table 13 are in line. E.g. Depth of water (in open water) is mentioned as a factor for stratification. Meaning that depth of the water might influence emissions from open water. IN Table 13 there is no mention of emissions from ' open water' as a source.
	Author Response	Table 13 refers only to baseline emissions. Table 14 refers to stratification that would occur for baseline emissions estimates based on baseline and project conditions. For example, stratification for ex-ante baseline emissions estimates

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
		could be based on soil conditions under baseline and the spatial variability in wetland conditions for the project scenario.
(BS-AG) Step 3. Baseline Stratification	Initial Comment	**Open water stratification factor** Under the third listing of 'wetland vegetation' in Table 14, open water is used as the description. I don't intuitively associate open water areas with wetland vegetation. I think that the stratification factor should be 'open water' and not 'wetland vegetation', or that the Description should be changed to 'variation in vegetation cover'.
	Author Response	Language has been changed to address this comment. Thank you.
(BS-AG) Step 3. Baseline Stratification	Initial Comment	**Soil texture** You may want to include soil texture in this table. We have found strong correlations with carbon storage and texture in tidal wetlands... This would greatly affect storage capacity yet not included
	Author Response	Soil texture has been added.
(BS-AG) Step 4. Baseline Emissions and Carbon Stock Changes	Initial Comment	In general, but here specific: Be consequent in the description of parameters. In paragraph 2.1.1.3 the description for deltaCBSLAg/W/RC is: cumulative total of carbon stock changes and greenhouse gas emissions for the baseline agricultural scenario when the project activity will include managed wetlands or rice, while here it is: the cumulative total of GHG emissions due to oxidation of organic soils as shown in the Methods Module (MM-W/R) and determined using eddy covariance, subsidence measurements or biogeochemical models (tCO_2-e).
	Author Response	Thanks for this comment. We have improved consistency throughout the methodology.

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
(BS-AG) Step 4. Baseline Emissions and Carbon Stock Changes	Initial Comment	When is see Tables 13 and 14, the cumulative total of baseline emission is not limited to emissions from oxidation and combustion like is suggested in equation (4). Please check equation (4). The first parameter in equation is equal to the actual factor.
	Author Response	The description of equation 4 has been changed to include additional emissions sources. Thank you.
(BS-AG) Step 4. Baseline Emissions and Carbon Stock Changes	Initial Comment	**Additional feasible methods of carbon gain/emissions** Soil emissions and removals can also be measured via chamber techniques which would be more feasible than eddy flux towers on a site? depending upon the time scale would a stock-change be feasible?
	Author Response	Chambers are not recommended for measurement of baseline CO_2 emissions because of the need to separate the estimated emissions from soil oxidation and plant root respiration.
	Reviewer Reply	This is easily accomplished via methods to separate heterotrophic from autotrophic respiration via trenched plots. we have done this in many wetlands throughout the world. This would be a more direct measure than the modeled calculation from eddy towers. Chambers are likely cheaper and more specific to a small area. I would not put all of the emphasis on towers
	Author Response	Carbon stock change measurements would be feasible. This is the basis for the use of subsidence measurements described in the methodology module.
	Reviewer Reply	But the subsidence method would not include all of the carbon stocks... just soils and that is only an elevation change... you would also need to sample bulk density and C concentration changes. I am also speaking of measurements of the IPCC carbon pools that comprise the ecosystem C stock.

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
	Author Response	We changed paragraph 2.1.2.4 to express the fact that ecosystem carbon pools only sometimes correspond to the soil pool. We changed the text to "When the soil carbon pool includes all components of the ecosystem carbon dynamic, the above equation is reduced to the soil carbon pool change and the fossil fuel emissions."
(BS-AG) Parameters originating in other modules	Initial Comment	**Quantification of stocks** Again a combination of subsidence (stock change) and measures of emissions via portable IRGAs and measures of N_2O is likely more feasible than eddy towers?
	Author Response	Chambers do not lend themselves well to measuring CO_2 emissions for baseline conditions because of the need to account for plant respiration. They can be used for N_2O emissions as is mentioned in the methods module.
	Reviewer Reply	You can easily calculate NPP without a tower in herb meadows (measurements of standing crop and litterfall). Then from soil respiration data you can determine NEP. Are you referring to root respiration or total plant respiration?
	Author Response	The parameter table in 2.1.3 references the method module and doesn't give indication of the specific technique to use. The Proponent is free the select the most appropriate method.
(BS-AG) Parameters originating in other modules	Initial Comment	Please complete with ' parameter/data'.
	Author Response	Parameters added in table. Thanks.
(BS-SW)	Initial Comment	A comment from an ecosystem perspective, disconnection from carbon-accounting: how liable is it to turn an (untouched) natural seasonal wetland

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
Estimation of baseline greenhouse gas emissions and carbon stock changes for seasonal wetlands - Scope		used by birds for breeding into a rice field. Perhaps clarify more clear what is meant, because I cannot image that this is what you want with this methodology, even though emissions are reduced.
	Author Response	The seasonal wetlands being considered are not untouched. See Table 15 for examples. They are typically hunting clubs or areas too wet to farm. Language has been added to clarify. Thanks for the comment.
(BS-SW) Applicability	Initial Comment	The conclusion 'These areas likely continue to subside and emit carbon dioxide although there are no measurements' is not enough for developing a robust baseline. It must be sure, defended by literature or measured, what exactly the baseline is. Otherwise people can make up their own baselines, who's responsible then for checking validity. Very tricky.
	Author Response	Thanks for the comment. There is actually some data for similar systems in the Delta. References have been cited.
(BS-SW) Step 1. Identification of the Baseline Scenario and Performance Standard Evaluation	Initial Comment	See for the steps 1-5 the comments in paragraph 2.1
	Author Response	There are no comments in paragraph 2.1

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
(BS-SW) Step 2. Establishment and Documentation of the GHG Boundary	Initial Comment	**Completeness of baseline emissions?** Again if the land use is cattle/dairy pasture then you are missing huge sources of GHGs; most likely higher than the emissions due to fertilizer application…
	Author Response	Seasonal wetlands are not used for pasture or grazing.
	Reviewer Reply	Are you sure of this? In many places as soon as the water table declines and soils dry, they are grazed.
	Author Response	We changed the text to explicitly mention animal GHG emissions.
(BS-SW) Step 3. Baseline Stratification	Initial Comment	**Soil texture** Soil texture is also an important parameter
	Author Response	Thank you. This parameter has been included.
	Reviewer Reply	You are under-emphasizing soil texture (if variable in this area). we are finding this is a major determinant of the capacity for a wetland to sequester and store carbon. In African wetlands we found that fine textured soils mangroves store twice the C as coarse textured soils with all other variables held constant.
	Author Response	We changed each stratification table and now all soil factors have the same importance.
(BS-SW) Parameters originating in other modules	Initial Comment	**Realism of eddy covariance in projects?** Has any operational project ever used eddy covariance for carbon stock changes? This is really more of a research tool? Is it realistic to expect his would be used for a project area? And the footprint of the tower may be larger than the project area,
	Author Response	Eddy covariance is being used in managed non-tidal wetland projects constructed since 2013. It is a primarily a research tool but is being used for multiple projects on state-owned islands. A key motive is for calibration and

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
		validation of biogeochemical models. The recently constructed wetlands are 700 to 1000 acres. The eddy covariance footprint is about 8 acres.
	Reviewer Reply	What are the total project costs of using a tower? It seems that it could exceed the value of the carbon being sequestered? How are they being used?
	Author Response	Currently there is no mention to specific methods in the parameter tables. The cost of the tower can't be compared easily to the income generated by the sequestered C. It depends on the size of the project area. It could be shared by more than one project within an aggregate. The high initial cost of purchasing the equipment is followed by a low workload and low general cost of long term monitoring GHG fluxes compared to chamber measurements and soil/biomass sampling. We believe the Proponents should be free to choose the appropriate methods to measure C stocks changes and GHG fluxes. Moreover, wetland projects in the Delta are currently using EC and therefore this method is included in the methodology.
(BS-OW) Scope	Initial Comment	Please identify clearly and consequent: is this baseline for ' open water' only? or also for ' tidal wetlands' as is suggested later in this paragraph?
	Author Response	The open water is a baseline for tidal wetlands. Candidate open water areas are primarily former salt ponds located in the San Francisco Estuary. These areas can be potentially converted to tidal wetlands.
(BS-OW)	Initial Comment	**Methane in saline/brackish environs?** What are the ranges in salinity? Methane may not be very relevant in the tidal brackish and saline areas?

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
Step 2. Establishment and Documentation of the GHG Boundary	Author Response	Salinity ranges from less than 2,000 ppm to sea water. A discussion of salinity relevant to methane emissions for tidal wetlands is presented in the projects module.
	Reviewer Reply	Not a very clear answer? The porewater salinity of the wetlands is important in terms of CH_4 emissions. At 2ppt we would expect CH_4 emissions... but at higher salinities...
	Author Response	The paragraph was changed. A paragraph explaining the effect of salinity on CH_4 fluxes was added.
(BS-OW) Step 2. Establishment and Documentation of the GHG Boundary	Initial Comment	**Allochthonous carbon** How are you going to realistically separate allochthonous from autochthonous carbon in a project scenario? As it is captured for the long term what is the justification for not including it? How variable is this as a source of carbon? The science in not really clear here and the separation is not strongly justifiable
	Author Response	The methodology for estimating allochthonous carbon is described in the project module for tidal wetlands. Where allochthonous soil organic carbon accumulates on the project site in the project scenario as indicated by aqueous or particulate organic carbon entering the project area, a compensation factor calculation is proposed based on the estimated percentage allochthonous soil carbon entering the system from measurement of aqueous or particulate organic carbon fluxes. For the baseline, the compensation factor can conservatively be set to zero.
	Reviewer Reply	If you are using a mass balance wouldn't you also have to measure the amount of C also leaving the project area? If the C is being sequestered by the wetland it should be counted. I remain really skeptical it can be measured, and we

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
		should credit all C being sequestered. I do agree the factor should be set to zero
	Author Response	Aqueous Carbon Loads are described in details in paragraph 4.1.4.4. If they are an important dynamic in the current/project landscape, they should be assessed. Eddy covariance and chambers only quantify vertical fluxes, and are not able to assess lateral movement of carbon in water.
	ACR Response	In the Project Scenario, net accumulation of allochthonous carbon must be subtracted from the net carbon balance of a wetland unless the Project Proponent can document that no other entity may claim its GHG emission reductions or removals (i.e., that no other entity may make an ownership claim to the emission reductions or removals for which credits are sought) and if its storage in the tidal wetland decreases the rate of its decomposition compared to what it would be in the absence of the Project (i.e., the case the tidal wetland was not implemented). In the Baseline Scenario, net accumulation of allochthonous carbon must be accounted for and subtracted from the Baseline, or can be conservatively set to zero as its exclusion from the balance between GHG losses and gains would underestimate total GHG emissions.
(BS-OW) Step 2. Establishment and	Initial Comment	' The project GHG boundary describes the carbon pools that will be included or excluded from GHG accounting': not only carbon pools (since this excluded N_2O and the warming potential of CH_4), but also GHG sources and sinks. Thereby avoiding any overlap between the carbon pools and CO_2 and CH_4 emissions.

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
Documentation of the GHG Boundary	Author Response	The language has been change to address this comment.
(BS-OW) Step 3. Baseline Stratification	Initial Comment	If there is no literature on the influence of elevation of open water on the emissions, then this factor could perhaps better not be mentioned here. If 'tidal wetlands' are included in the base line, then other factors then 'depth of water' and ' water quality' could be mentioned for potential stratifications.
	Author Response	There is some evidence that depth of water influences methane emissions. See for example, Ding et al., 2002, Atmospheric Environment, 36, 5149 - 5157
	Reviewer Reply	Yes, I know that depth of water may influence height of emissions, but my comment is about the ' elevation', where I assumed that you talk about elevation relative to sea level.
	Author Response	Sorry for our mistake, for water elevation we meant water depth. We changed the text.
(BS-OW) Step 4. Baseline Carbon Stock Changes and Emissions	Initial Comment	The net carbon stock changes in the baseline are equal to the soil organic carbon stock minus the baseline greenhouse gas emissions including the combustion of fossil fuels if determined to be significant'. Please be specific: (1) carbon stock: soil (SC) and water (DC) (2) loss of carbon stock in baseline: natural oxidation to CO_2, natural anaerobic processes to CH_4, on top of that: combustion of fuel to CO_2 and CH_4, extra emissions because of dredging, construction and other activities (CO_2 and CH_4).
	Author Response	Language has been added to clarify the definition of the parameters in equations 6 and 7.
	Initial Comment	In equations 6 and 7 the assumption is that each year NBE is the same. From the text I understand that the during 1 year of the baseline the open water area

BASELINE MODULES (BS)		
Section	**Comment Type**	**Comment/Response**
(BS-OW) Step 4. Baseline Carbon Stock Changes and Emissions		is construction into a tidal wetland which causes specifically in that year very high emissions. It might be better to re-write the formulae in such a way that for each year the baseline can be calculated separately (t = 1-x). Please in equations 6 and 7 describe CBSL_OW W/RC
	Author Response	Language has been added to allow for inclusion of multiple years for the baseline calculations.
(BS-OW) Step 4. Baseline Carbon Stock Changes and Emissions	Initial Comment	**Question on the units in equations** Should there be an area added to the emissions and stocks variables? It seems knowing the emissions on an areal basis is needed. How are you explaining this?
	Author Response	Language has been added to state that the carbon stock changes and emissions are for the project area or stratum.
	Reviewer Reply	OK
(BS-OW) Parameters originating in other modules	Initial Comment	**Difficulty following acronyms when no descriptions are provided** Unless you are sure your readers will know your acronyms you really need more description and definition here. I find it hard to follow all of the abbreviations on first reading.
	Author Response	Language added to improve the descriptions
	Reviewer Reply	OK

PROJECT MODULES

PROJECT MODULES (PS)		
Section	**Comment Type**	**Comment/ Response**
(PS) Preface	Initial Comment	**Writing style** Awkward writing. the methodology does not achieve GHG emissions...
	Author Response	Thank you for the comment. We have revised the language to address the concern. The subject sentence has been changed to read as follows. This methodology provides guidance for estimating GHG emissions, emissions reductions and GHG sink enhancements by 1) halting or greatly reducing soil organic carbon oxidation on agricultural land and 2) increasing soil organic storage by restoring wetlands (tidal and non-tidal).
	Reviewer Reply	OK
(PS) Preface	Initial Comment	Somewhere there shall be a clausal that projects in which e.g. drainage continues or is maintained and where baseline practices continue etc are not eligible. Accidents (eg, breaching of a dam) or unplanned ' negative' activities must be reversed and remediation must be monitored together with justifications that the effect has been temporal and insignificant.
	Author Response	We have added language to reflect this concern. Thank you. The following has been added: “If, within the project area, drainage and baseline practices occur or other unplanned and prohibited activities (e.g. flooding) occur, the situation shall be reversed. Subsequent documentation shall quantify the effects on GHG emissions, emissions reductions or GHG sink enhancements”.

PROJECT MODULES (PS)		
Section	**Comment Type**	**Comment/ Response**
(PS-MW) Applicability	Initial Comment	**Applicability?** Can you give an example of paludiculture in the SF bay and delta?
	Author Response	There are no examples currently of paludiculture in the SF bay in Delta. The following bullet has been added. Baseline emissions can also the result from fertilization and enteric fermentation. I do not understand the last question.
(PS-MW) Step 1. Project Boundaries	Initial Comment	**Data on SLR** Should you provide some reference on where parties may obtain data on SLR... models and predications are quite variable and continually changing. What range(s) will be acceptable? A lot of thought and details will be needed for this
	Author Response	Swanson et al. [45] (already referenced) summarized the relevant literature and range of sea level rise. The following sentence has been added. " For the establishment of boundaries, project proponents shall be conservative, i.e. use the upper range of values from the most recent literature". Swanson, Kathleen M.; Drexler, Judith Z.; Fuller, Christopher C.; & Schoellhamer, David H.(2015). Modeling Tidal Freshwater Marsh Sustainability in the Sacramento-San Joaquin Delta Under a Broad Suite of Potential Future Scenarios. San Francisco Estuary and Watershed Science, 13(1). jmie_sfews_26000. Retrieved from: http://escholarship.org/uc/item/9h8197n
(PS-MW) Step 1. Project Boundaries	Initial Comment	In Chapter 2 (baseline) this paragraph contained a table with baseline emissions sources and sinks. This table is missing here, please add.
	Author Response	We have not included a table due to small number of emissions sources. The following text has been added. Sources and Sinks Methane is the primary

PROJECT MODULES (PS)		
Section	**Comment Type**	**Comment/ Response**
		emission from managed non-tidal wetlands due to decomposition of organic matter. There are also fossil fuel emissions resultant from wetland construction activities. Managed non-tidal wetlands are sinks for CO_2.
(PS-MW) Stratification	Initial Comment	Is it an idea to delineate the area (stratum) that is expected to be influenced by sea level rise in the 40 years' project time? Depending on soil subsidence, this stratum may be exactly the same in the baseline, however, emissions from this stratum may differ between project and baseline.
	Author Response	Yes, the intention is for sea level rise to be considered during the 40 year time frame. Language has been added to reflect this time frame. We agree with the second sentence.
(PS-MW) Stratification	Initial Comment	See the comments for the same table in chapter 2.
	Author Response	The Table has been modified as per comments in Chapter 2.
(PS-MW) Stratification	Initial Comment	Project activity includes hydrologic management, infrastructural modification, and plantings or natural plant regeneration. Depending on what exactly 'hydrological management' is (is that water table depth management only?) it would be good to also mention other factors for stratification such as 'delineation of areas where new infrastructure is being developed', or ' areas with dredging and/or earth movements'. These activities will result in emissions.
	Author Response	A definition of hydrologic management has been added as follows. Hydrologic management includes alteration of water management practices and water delivery and drainage structures such that drained conditions prevalent for agricultural are eliminated and the land is flooded for

PROJECT MODULES (PS)		
Section	**Comment Type**	**Comment/ Response**
		wetlands. Language has been added to the table to enable adding areas of varying infrastructural modification.
(PS-MW) Stratification	Initial Comment	**Again, soil texture** I would include soil physical properties esp. texture
	Author Response	A line for soil classification and chemical composition which includes texture has been included in the table.
(PS-MW) Step 3. Monitoring Project Implementation	Initial Comment	See comments in Framework Module
	Author Response	Unclear which comments are being referred to.
(PS-MW) Step 3. Monitoring Project Implementation	Initial Comment	Shouldn't there be any guidance on 6 ' the monitoring plan, together with a record of implemented practices and monitoring during the project'? There will be a procedure for validation and verification after submission, but guidance e.g. for strategic sampling, spacing etc would help to speed up processes and unnecessary extra work.
	Author Response	Guidance is available in the form of published data. We added the following. Information and data for spacing and sampling and associated uncertainty for managed wetlands can be obtained from a review of the available literature for managed wetlands in the Sacramento-San Joaquin Delta. For example, Miller et al. (2008) provide data that points to the spatial variability of sedimentation erosion table and coring measurements that can help guide plot and instrumentation placement.

PROJECT MODULES (PS)		
Section	**Comment Type**	**Comment/ Response**
(PS-MW) Step 4. Project GHG Emissions	Initial Comment	Please make very clear somewhere in the Framework Module that the ' emission from soil (CO_2, CH_4)' and ' changes in soil carbon stock' are overlapping almost 100% (except for DOC losses from soil). Users have to consider one or the other. IF soil carbon stock changes (loss of CO_2, CH_4 and DOC) are considered, and transformed into warming potentials (e.g. considering that DOC is completely transformed into CO_2 from ditches, rivers, lakes etc) then users should not ALSO consider CO_2 from oxidation and CH_4 from anaerobic decomposition. Perhaps it is better to consider carbon stock and stock changes for above ground only. And GHG fluxes for ' belowground' (soil and water). For consideration.
	Author Response	We generally agree with your statement about emissions and carbon stock changes. We don't feel that the Framework is the correct location for this. We suggest that the methods modules and the equations make this abundantly clear.
(PS-TW) Step 2. Stratification	Initial Comment	Potential strata of high emissions might also be (1) areas of levee breaching (2) areas of construction of e.g. infrastructure (3) areas where earth moving will be an activity
	Author Response	A seventh stratification criterion has been added to address this comment Thank you.
(PS-TW) Step 2. Stratification	Initial Comment	**Technical advice** You probably ought to mention that you would expect the different soil and plant communities to sequester different quantities of Carbon at different rates. You can't assume the entire project area will have similar c dynamics... another reason eddy correlation may not be the best approach...

PROJECT MODULES (PS)		
Section	**Comment Type**	**Comment/ Response**
		good discussion on CH_4 and interactions with sulfates. This also needs to be in the section 2.
	Author Response	Soil and plant species are included in the list of stratification factors. Language has been added to make the point made in the comment. We realize that the entire project will not have the same carbon dynamics. Eddy covariance measurements are being made in areas of varying carbon dynamics. EC data will be used to calibrate models that can be used by producers to estimate spatially variable effects. The methane discussion has been added to Chapter 2.
	Reviewer Reply	not exactly clear what you are saying.... but Ok
(PS-TW) Step 4. Project GHG Emissions	Initial Comment	' If project activities include moving sediments, fossil fuel combustion emissions must be quantified during project activities using methods described in module E-FFC if determined to be significant using module T-SIG. An Ex-Ante estimate shall be made of fuel consumption based on projected fuel usage'. GHG emissions from Project activities that include levee breaching, dredging, earth moving, constructions etc shall also be determined. Please give guidance on how this should be done.
	Author Response	The following language has been added. GHG emissions from Project activities that include earth moving, construction, etc. shall also be determined using machinery fuel use determined during project implementation and conversion of gasoline and diesel fuel consumption to CO_2-e emissions (e.g. http://www.eia.gov/tools/faqs/faq.cfm?id=307&t=11).
(PS-TW)	Initial Comment	**First mention of chamber methods**

PROJECT MODULES (PS)		
Section	**Comment Type**	**Comment/ Response**
Step 4. Project GHG Emissions		Chamber methods should be mentioned earlier along with eddy covariance methods....
	Author Response	Thank you for pointing this out. We added language about chamber measurements in section 3.1.
	Reviewer Reply	Ok
(PS-TW) Step 4. Project GHG Emissions	Initial Comment	**Measuring emissions** You probably ought to mention or give an example of the proxy methods of estimating emissions...
	Author Response	Thank you for pointing this out. We added language in section 3.1.
	Reviewer Reply	OK
(PS-TW) Step 4. Project GHG Emissions	Initial Comment	**Proxy for porewater** I have found that floodwater is a real poor proxy for the salinity in porewater. It is almost always lower in floodwater than porewater
	Author Response	It would seem therefore that measuring floodwater would be conservative relative to the use of default CH_4 flux. If it is low relative to porewater and below 18 ppt, it would behoove the project proponent to measure pore water. Can you provide a reference please?
	Reviewer Reply	I am sure there must be temperate references but see Admane et al (Plos1) for a mangrove example... Also Alongi's book on mangrove energetics...higher porewater salinity is pretty universal given losses due to evap and plant respiration...Using floodwater salinity as a proxy would overestimate CH_4 emissions in many cases... strive to get porewater measures.

PROJECT MODULES (PS)		
Section	**Comment Type**	**Comment/ Response**
	Author Response	The text has been changed to require sampling of pore water for salinity and sulfate.
(PS-RC W/RC) Applicability	Initial Comment	**Burning** Just a quick question, what is the carbon basis for not allowing burning? Is there any evidence this results in increased emissions? What is the alternative? more chemicals? less production? Is there a scientific basis for this condition? Will it result in net removals?
	Author Response	For air quality reasons, burning has been substantially curtailed and regulated in rice fields in California. There is also the danger of starting a peat fire if the straw is burned. The alternative is to chop and incorporate the straw for contribution to the soil organic carbon pool or harvest the straw for commercial use. Emissions due to burning have not been measured.
	Reviewer Reply	So there really is no scientific rationale in terms of carbon dynamics to not allow burning? Then why include? I am not a proponent of burning but could it be a carbon neutral or even less GHG emissions than other approaches? Does this reflect some bias without a science basis?
	Author Response	We removed the burning from the applicability general criteria in table 4 and for rice in paragraph 3.3.1.2
(PS-RC W/RC) Step 1. Project Boundaries	Initial Comment	**Sea-level rise effect on rice fields** Since rice fields aren't tidal, I'm curious why sea-level rise is a consideration here. I understand that SLR affects the stability of the levees surrounding rice fields (especially in the Delta), and could increase the amount of water

PROJECT MODULES (PS)		
Section	**Comment Type**	**Comment/ Response**
		infiltration to the fields, but I don't see as direct of an effect as with tidal wetlands. In the pdf version that I was reading, rice and wetlands were grouped into the same module, but they aren't here. Which is the most up-to-date version?
	Author Response	I agree that the SLR is not needed and has been deleted.
(PS-RC W/RC) Step 4. Project GHG Emissions	Initial Comment	**Data availability?** These are really interesting tables - the correlation of c and N_2O emissions. Are these published?
	Author Response	We are not aware of the publication of this data

METHODS MODULES

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
(MM)	Initial Comment	A general comment for Chapter 4: please make use of existing methodologies that describe procedures for monitoring and measuring. E.g. VM0007, module VMD0046 (M-PEAT) for all monitoring and measurements related to organic soils and peat. Here we say ' dont' discover the wheel again' (-: and copy-paste those things unless they are not applicable.
	Author Response	Thank you for the recommendation. We did indeed review the VCS methodology during the writing of this methodology and incorporated relevant information and methods. such as the use of subsidence to estimate carbon loss in peats.
(MM) Applicability	Initial Comment	**Models only** It seems that the sole use of biogeochemical models is sufficient for participation? Is this correct? There is no requirement for field verification/inventories or monitoring on the ground? You need to be more conclusive than models and eddy covariance. These are not even likely to be the best (most accurate) approaches to the quantification of carbon sequestration.
	Author Response	There are many requirements listed for models. Please see the requirements for the use of biogeochemical models in the Model Module. Models must be: -Be documented in the peer-reviewed literature;

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
		-Be validated in the Project Area or similar sites using peer-reviewed or other quality controlled data for baseline and project conditions; -Be parameterized using peer-reviewed or other quality-controlled data appropriate to each identified strata; -Be able to effectively simulate GHG emissions and removals and carbon stock changes for baseline and project conditions. The bullet in red obligates the project proponent to validate the model with data.
	Reviewer Reply	Yes but... there still is no field verification requirement of the model outcomes? As you know there is always variability and uncertainty in the outcomes of models when applied to the real world. One would think there should be some verification that carbon is actually being sequestered via ground-based measurements of a temporal or spatial sub-sample
	Author Response	The model module includes the requisite "Be validated in the project area or similar sites for baseline and project conditions". It means verification of the model outcome comparing model result with field data and for each different conditions.
(MM-W/R) Parameters and Estimation Methods	Initial Comment	Table 22. Row 1: note: EC does not capture DOC leakages, subsidence measurements do not distinguish between CO_2 and CH_4 and do not include DOC, Chamber measurements could be added since they can do the same as EC (capturing CO_2 and CH_4, but on a smaller scale) Table 23 ROW 1/2. note: soil subsidence can not distinguish between CO_2 and CH_4 Is use of TIER 1 defaults not allowed?

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
	Author Response	Response to individual comments follow. Row 1: note: EC does not capture DOC leakages, Agreed. aqueous flux measurements have been added to the table to account for DOC leakages. subsidence measurements do not distinguish between CO_2 and CH_4 and do not include DOC, Agreed. It does provide an estimate of the CO_2-e emissions for baseline conditions. Chamber measurements could be added since they can do the same as EC (capturing CO_2 and CH_4, but on a smaller scale) Chamber measurements are included in the emissions table. Chambers are not useful for estimating carbon stock changes in the baseline because of inability to account for plant respiration. ROW 1/2. note: soil subsidence can not distinguish between CO_2 and CH_4 Agreed. Please see above comment. Is use of TIER 1 defaults not allowed? I am unclear what Tier 1 defaults are.
(MM-W/R) Parameters and Estimation Methods	Initial Comment	How to determine other project emissions such as from dredging/earth movements/levee breaching/constructions? Please advise the users
	Author Response	Guidance has been provided in the Project module.
(MM-W/R) Parameters and Estimation Methods	Initial Comment	How to determine fluvial losses in the case that no eddy covariance can be used? e.g. if the footprint of the system is to large or if the instrument is too costly. Chemical analyses of dissolved organic carbon? chamber measurements on ditches?
	Author Response	I find this to be a confusing comment. Fluvial carbon losses or gains are measured by determining flow rates and carbon concentrations using methods

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
		described in this module. Ditches can be a stratum where chamber measurements can be made.
	Reviewer Reply	IF EC is used, then fluxes from ditches within the footprint are included in the analyses. IF NO EC is used, then fluxes should either be determined by (1) determining the carbon leaving the system boundaries by rivers and streams or (2) determining the fluxes by floating chambers. This should be clear in the methodology to avoid double counting or no-accounting.
	Author Response	The section 4.1.4.4 describes in details how to quantify aqueous carbon exchanges. It includes carbon entering and exiting the Project area for all scenarios excluding the tidal wetland, where carbon sequestered in external areas could greatly contribute to the net carbon budget of the Project area. In this case, the Project would passively benefit from a process that is independent from the Project implementation.
(MM-W/R) Parameters and Estimation Methods	Initial Comment	**Field methods of quantifying carbon stock changes are poorly defined and described** Probably also need to add chamber methods to Table 22 as it in table 23. I am not quite sure what you mean by "subsidence methods" as this should be defined. I assume you are meaning changes in surface elevation via RSET and marker methods as well as periodic measures of changes in soil properties (C conc, bulk density, etc). And these approaches have not even been mentioned to this point in the ms.

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
	Author Response	Chamber measurements are not helpful for estimating carbon stock changes for baseline or project conditions due to inability to account emissions due plant respiration. Subsidence measurements are described and an example is provided in this module. We added the description of whole ecosystem chambers and a more general and inclusive description of chamber methods. Methods are briefly introduced in table 22 and 23, and described in details in subsequent paragraphs.
(MM-W/R) Parameters and Estimation Methods	Initial Comment	**Emissions** Are you assuming the eddy covariance and models will quantify changes in N_2O and CH_4 emissions? In the baseline are you including livestock (ruminants) which are such a large source of GHGs?
	Author Response	Chambers are included under emissions for determination of baseline emissions. Please see Table 3.
(MM-W/R) Eddy Covariance	Initial Comment	I would consider referring to literature and not go into details. E.g. The project proponent may carry out direct measurements of GHG fluxes to assess emissions also in relation to chosen proxies. Direct measurements of GHG fluxes may include closed chamber measurements, eddy covariance measurements and (for measuring C loss in drained sites only) subsidence measurements. Applied techniques must follow international standards of application as laid out in pertinent scientific literature (eg, Pattey et al. 2006, Alm et al. 2007, Evans et al. 2011, xx, xx).
	Author Response	We have chosen to include details based on review by the public and local practitioners. The results of those reviews indicated the need for more details

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
		on the methodology. However, text was added expressing the importance of following international standards as laid out in pertinent scientific literature as suggested by the reviewer.
(MM-W/R) Eddy Covariance Introduction	Initial Comment	**Eddy covariance** Has this approach ever been used outside of research? I am unaware that given the expense and difficulty of its PROPER use it would be appropriate for operational use. Most scientists who really work with EC towers are pretty adamant for also taking field measures of c stocks to verify tower data....
	Author Response	It is currently being used in several projects in the Sacramento-San Joaquin Delta and will be used in conjunction with feldspar markers, soil coring and SET measurements to estimate carbon credits and inform and calibrate models.
	Reviewer Reply	Good discussion. I would love to discuss further. Are these research projects or actual C market-related projects? Agree about the Net GHG exchange in eddy towers. But what is really needed is the net sequestration or emissions from the site. And, verification of the tower data using ground measurements and chambers is pretty important to insure accuracy... I'm sure you know this.
	Author Response	Eddy covariance is the only method that measures directly net GHG exchange on a large spatial scale. It has errors and limitation as the other methodologies, and errors and uncertainty will be part of the carbon stock change quantification. Eddy covariance can and should be combined and/or be validated with other techniques and models.

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
	Reviewer Reply	Ask Dave Hollinger about the comments above... I think the cite is incorrect initials?
	Author Response	Again, the Proponent should be free to use the methods most appropriate for his/her need. We included and described eddy covariance as one technique able to measure net ecosystem exchanges of GHG. If all assumptions and quality insurance indicated in this protocol are met, eddy covariance is applicable and is the only technique that gives a direct quantification of GHG fluxes over large areas. Uncertainties must be quantified. There are 2 different Hollinger in the eddy covariance field, Dave Hollinger and Steven Hollinger.
(MM-W/R) Eddy Covariance Quality Assurance and Quality Control	Initial Comment	**A few other cites that you may be interested in terms of error terms** Hollinger, D.Y.; Richardson, A.D.; Richardson, A.D. 2005. Uncertainty In Eddy Covariance Measurements And Its Application To Physiological Models. Hagen, S.C.; Braswell, B.H.; Linder, E.; Frolking, S.; Richardson, A.D.; Hollinger. D.Y, David; Hollinger. D.Y, . 2006. Statistical Uncertainty Of Eddy Flux-Based Estimates Of Gross Ecosystem Carbon Exchange At Howland Forest, Maine. Richardson, Andrew D.; Hollinger, David Y.; Burba, George G.; Davis, Kenneth J.; Flanagan, Lawrence B.; Katul, Gabriel G.; Munger, J. William; Ricciuto, Daniel M.; Stoy, Paul C.; Suyker, Andrew E.; Verma, Shashi B.; Wofsy, Steven C.; Wofsy, Steven C. 2006. A Multi-Site Analysis Of Random Error In Tower-Based Measurements Of Carbon And Energy Fluxes.

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
	Author Response	The uncertainties of eddy covariance fluxes are described in the UNC module. A sentence introducing the uncertainties of eddy covariance fluxes with a link to the UND module was added to the text.
(MM-W/R) Chamber Measurements	Initial Comment	Similar comments: do not go into details but instead refer to literature.
	Author Response	We have chosen to include detail based on review by the public and local practitioners. The results of those reviews indicated the need for more detail in the methodology.
(MM-W/R) Chamber Measurements Introduction	Initial Comment	**Use of boardwalks with chamber measurements** It is equally important to highlight the use boardwalks (temporary or permanent) when conducting chamber measurements since any sort of pressure on the soil surface, especially in wetlands, can lead to ebullition and greatly exaggerated CH_4 fluxes.
	Author Response	Agreed. Language has been added to reflect the use of boardwalks. Thank you.
	Reviewer Reply	Thank you for adding that text, but please state that boardwalks also are used to reduce ebullition at the sampling site.
	Reviewer (2) Comment	very good point... not to mention the simple compaction due to frequent visits to the experimental site.
	Author Response	Ebullition and compaction were added to the paragraph 4.1.4.2.1
(MM-W/R) Chamber Measurements Introduction	Initial Comment	**Methods could be updated** I am surprised there is no mention of portable IRGAs for measurement of CO_2 (and now CH_4 -eg. the Los Gatos portable devices). This section could really be updated to current tech standards. Your cites are really out of date.

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
	Author Response	We have added language that provides for the use of more advanced methods for estimating GHG fluxes such as the Picarro instrumentation.
	Reviewer Reply	Good
(MM-W/R) Chamber Measurements Equations	Initial Comment	**Incomplete sentence** There is either a word or a comma missing in the sentence selected below.
	Author Response	Thank you. We have corrected the problem.
(MM-W/R) Chamber Measurements Equations	Initial Comment	It seems quite confusing: in the baseline chapter 2 all fluxes are expresses as Carbon (unit CO_2-eq) and the type of notation of equations is different from chapters two and three. Also inconsistent in terminology: e.g. here ' cumulative net GHG emissions' is used, while in chapter 2 ' cumulative total baseline emissions' is used. Consistency needed between the equations (4), (5), (6) and the equations used in chapter 4. This comment is also valid for the equations related to the project emissions.
	Author Response	For equations 4 and 5 in the baseline module, it is stated that that cumulative total of carbon stock change for the baseline seasonal wetlands scenario when the project activity will include managed wetlands or rice is equal to the cumulative net emissions due to oxidation of organic soils and emissions from manure, due to fertilizer application and enteric fermentation from livestock. Equation 17 shows that, when using chambers, the cumulative GHG emissions are equal to the rate of GHG emissions times the period of time which corresponds to the pre-project reporting period which results in cumulative tons CO_2-e. Language has been added to help clarify this.

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Section	**Comment Type**	**Comment/Response**
		Variables names and acronyms were modified and are now kept unchanged through the different sections.
(MM-W/R) Chamber Measurements Equations	Initial Comment	I don't understand equation 18: where is CO_2?
	Author Response	For baseline CO_2 emission measurements, chamber methods are not recommended because of the impracticality of estimating CO_2 emissions that are due to oxidation of organic soils and organic matter and plant respiration. We have therefore left CO_2 out of the equation. Whole ecosystem chambers were added to the method description and the text was changed to reflect this addition. CO_2 has been included in the measurement of GHG fluxes using chambers.
(MM-W/R) Harvested Grain and Biomass Introduction	Initial Comment	Please make sure that also in the baseline corresponding to this type of project activities the carbon sequestration (NPP) is considered at the same detail.
	Author Response	The grain and biomass removal is considered for baseline agricultural conditions and project conditions when rice is the project scenario. Moreover, it is primarily up to project proponent as determined in the ex-ante calculations as to the level of accounting and measurement detail based on costs and net GHG emissions reductions.
	Reviewer Reply	What I try to say is that WHEN carbon sequestration is being done in de baseline, then it should be clear that this calculation would be done at the same details is being done in the project scenario to keep things ' conservative' or ' not overestimated'.

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Section	**Comment Type**	**Comment/Response**
	Author Response	Paragraph 4.1.4.3.1 states that "The carbon in harvested grain and biomass represents an essential part of the carbon stock changes for Baseline agricultural and rice Project conditions ", clearly indicating this component needs to be quantified in both baseline and project conditions. This assessment is important for crops, because they are used to produce biomass that is exported from the site and consumed (producing GHG emission) in the short term. This section lists and describes in details every method used to determine C stock changes and emissions in all Baseline and Project Scenarios. It doesn't indicate what and when to use each method. Baseline and Project Modules suggest specific carbon components that Proponents should quantify. We don't believe the same component should always be measured in the same way and in the same details in baseline and project conditions. If crop land is converted to a wetland, the harvested grain will be measured in baseline conditions, but it should not be also quantified in project conditions, because it will not be a component of the carbon budget of the new land use. It is the importance of each component of the carbon cycle of a scenario that determines the need to assess it, and not the fact that it is assessed in the previous/following scenarios.
(MM-W/R) Harvested Grain and Biomass Introduction	Initial Comment	**How big of a deal is the grain?** Is this amount of grain produced even within the error of carbon fluxes? Is it more than 5% of the carbon stock? Is this both for baseline and converted areas? if so, why aren't you including GHGs from livestock as part of the baseline? this is far greater than grain losses.

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Section	**Comment Type**	**Comment/Response**
	Author Response	The removal of grain can be substantial when using eddy covariance techniques. For example, Knox et al. (2015) demonstrated that corn grain accounted for about 50% of the CO_2 removed in the annual GHG budget. The methodology has been changed to account for GHG emissions from livestock. Knox SH, Sturtevant C, Matthes JH, Koteen L, Verfaillie J, Baldocchi D, 2015, Agricultural peatland restoration: effects of land-use change on greenhouse gas (CO_2 and CH_4) fluxes in the Sacramento-San Joaquin Delta, Global change biology 21.2 (2015): 750-765., The grain is not a deal in terms of carbon stocks, but it is important in terms of carbon stock changes, or NEE. It can be a significant loss of the carbon previously fixed by a crop on an annual scale, and need to be included in the annual carbon budget.
	Reviewer Reply	Really interesting. I am left to wonder how much of the total plant productivity is grain vs roots, and aboveground vegetation. what proportion of the vegetation and roots are decomposed (CO_2) annually? If grain was 50% of the CO_2e lost I am really curious of the fate of the rest of the C sequestered by the annual crop? this seems really high. Did this study balance the carbon budget? Good to include the livestock emissions. but need to worry about additionality?
	Author Response	The study found that grain was 50% of sequestered carbon, not emitted carbon. We included the additionality of livestock emission. In the baseline

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Section	**Comment Type**	**Comment/Response**
		emission modules, we stated that animal GHG can be included if a leakage assessment can prove the animal were not just moved outside the project area.
(MM-W/R) Aqueous Carbon Loads Introduction	Initial Comment	**Aqueous fluxes** If you are only concerned about c sequestration (gain or loss) do you really need to know the fluxes or can you simply measure gain or loss? This c fluxes are not part of the eddy covariance as mentioned below?
	Author Response	The aqueous carbon is a leakage from the system due to dissolution of organic matter. Therefore, movement of aqueous TOC and POC from the project is a loss or gain of carbon not accounted for by eddy covariance or chambers.
	Reviewer Reply	This is true. But my point is what we really need to know is the fate of carbon storage on the site. How much carbon is being sequestered on the site under a new land use scenario. If funding is focused on just carbon gain, and differences in emissions then we really don't need to know about DOC... its arguably irrelevant in carbon accounting (not in the science of carbon budgets). This was just a big discussion at a recent international blue c science working group meeting. In other words, if you know the C stocks and emissions of the baseline and new land use you don't really need to know GPP... just the differences in NEP.
	Author Response	Eddy covariance only quantifies vertical fluxes of gas. Lateral movement occurring under the sensor height are not included in the measurements. This is why advection is a problem for eddy covariance measurements. Chambers also will quantify exchanges from the surface of the area they include, they can not see horizontal fluxes occurring below that surface. Thus the need to add

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Section	**Comment Type**	**Comment/Response**
		the horizontal fluxes to eddy derived NEE, it is quite different from partitioning the measured fluxes.
(MM-W/R) Subsidence Measurements	Initial Comment	Similar comment as for EC and Chamber: refer to literature and leave it to the project proponent to choose a method + justification.
	Author Response	We received input during public and practitioner review that more information was better thus we prefer to leave the detail as is.
	Reviewer Reply	There is a difference between (1) say exactly what must be done and (2) suggest what could be done + give room for other options. In the first case you exclude other options and I believe this is not scientifically sound. What you could do is adding text on this ' freedom'.
	Author Response	We changed the text to express how described methods are only one example of how subsidence can be measured.
(MM-W/R) Subsidence Measurements Introduction	Initial Comment	**Generalizations** I would caution on the 50% C in SOM. this can vary where you would be off by many Mg/ha
	Author Response	We have added language advising caution and recommending quantification of uncertainty when using the relationships cited.
	Reviewer Reply	OK
(MM-W/R) Subsidence Measurements Applicability	Initial Comment	**Marker horizons?** If peat layers are shallow enough or if you have a marker horizon you can very effectively measure carbon loss though time (see Kauffman et al 2014 Ecological applications)

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Section	**Comment Type**	**Comment/Response**
	Author Response	Kaufman et al. (2014) measured the depth and carbon density of the peat and estimated emissions from changes in C stocks from land conversion as the difference of carbon stocks in mangroves and the carbon stocks of abandoned shrimp ponds. This approach provides an estimate of total emissions since conversion, which the authors admit is substantially uncertain. We opine that the determination of the rate of carbon loss due to subsidence provides greater certainty at specific locations and for documented time frames. Determination of carbon stocks in organic soils in the area of geographic interest, i.e. coring the entire peat column, provides no information about the rate of emissions during the 40-year project period necessary for the counterfactual scenario that provides a forecast of the likely stream of emissions to occur if the Project Proponent does not implement the project. Kaufman et al., 2014, Carbon stocks of intact mangroves and carbon emissions arising from their conversion in the Dominican Republic, Ecological Applications, 24(3), 2014, pp. 518–527
	Reviewer Reply	We are talking apples and oranges here. A stock change approach can be used to estimate cumulative emissions (or gains) through time (albeit with a great deal of uncertainty). It can not be used to examine annual losses or gains which is the value of towers and chambers. But it is important to know how much C has been lost from project areas for determination of baselines and cumulative emissions. This can't be done by EC unless you are on site for the entire land use sequence....

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
	Author Response	Comment noted
	ACR Response	The baseline scenario is the counterfactual scenario that should be estimated with validated models or measured at reference site.
(MM-W/R) Subsidence Measurements Equations	Initial Comment	Note that organic soil is not per se defined as peat. Peat is always organic soils but not the opposite.
	Author Response	Agreed. Thank you. We changed "peat" to "organic soil".
(MM-W/R) Soil Coring	Initial Comment	I think reference to other methodologies is sufficient.
	Author Response	Reviews by the public and local practitioners indicated the need for the presented information.
(MM-W/R) Soil Coring Introduction	Initial Comment	**Don't recommend LOI and the use of RSETs really should be included** Highly recommend not using the LOI as it is not that accurate unless you have a relationship with induction furnace results. I would really include the use of RSETs to measure increases of decreases in surface elevation. These are not quite common and are being used throughout the world. This seems to be really lacking in completeness. You can also quantify complete soil ecosystem carbon stocks by measuring c pools to mineral soils (or bedrock), We do this throughout the world and even in Peat forests with 12 deep peats. You really need to read the methods manuals and studies who have examined soil carbon stock changes... See Kauffman et al for ideas. also you really should be citing Fourqueren et al 2014.. Fourqurean, J., B. Johnson, J. B. Kauffman, and 26 others. 2014. Coastal Blue Carbon: Methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrasses. Howard, J.,

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Section	**Comment Type**	**Comment/Response**
		Hoyt, S., Isensee, K., Telszewski, M., Pidgeon, E. (eds.) Conservation International, Intergovernmental Oceanographic Commission of UNESCO, International Union for Conservation of Nature. Arlington, Virginia, USA Kauffman, JB and DC Donato. 2012. Protocols for the Measurement, Monitoring, & Reporting of Structure, Biomass and Carbon Stocks in Mangrove Forests. Working Paper 86. Center for International Forest Research. 40p.
	Author Response	LOI has been documented as accurate in Drexler et al. (2009) and Callaway et al. (2011) for the area of geographic applicability. Language has been added to ensure accuracy and validation by project proponents. Language has been added to provide guidance and reference for the use of SETs and RSETs. We have included Hoyt et al. (2014) as a reference. Howard, J., Hoyt, S., Isensee, K., Telszewski, M., Pidgeon, E. (eds.) (2014). Coastal Blue Carbon: Methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrasses. Conservation International, Intergovernmental Oceanographic Commission of UNESCO, International Union for Conservation of Nature. Arlington, Virginia, USA. Thank you for this. It has useful information for tidal wetlands and sea grasses. We did not find Kauffman, and Donato (2012) applicable as it is directed towards mangroves. We do not have this kind of vegetation in our tidal wetlands.
		In response to the following comment "You can also quantify complete soil ecosystem carbon stocks by measuring c

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Section	**Comment Type**	**Comment/Response**
		pools to mineral soils (or bedrock), We do this throughout the world and even in Peat forests with 12 deep peats." we offer the following We understand that c pools can be quantified to the underlying bedrock or mineral layers. Indeed, we have done this as documented in Drexler et al. (2009). The key issue for the purposes of this protocol, is to quantify the carbon stock changes. Therefore, we have focused the writing in this and other sections on this determination. Drexler JZ, de Fontaine CS, Deverel SJ, . 2009, The legacy of wetland drainage on the remaining peat in the Sacramento-San Joaquin Delta, California, USA, Wetlands, 29, 372 - 386 Callaway, John C., Borgnis, Evyan L. Turner, R. Eugene & Milan, Charles S., 2012, Carbon Sequestration and Sediment Accretion in San Francisco Bay Tidal Wetlands, Estuaries and Coasts, (2012) 35:1163–1181.
	Reviewer Reply	Good discussion...I really have problems with LOI/carbon concentration relationships as there is so much variation where it is most important - sites with high LOI and carbon. Yes, we get great correlations of LOI and Carbon but the scatter is really high for the high end of the spectrum. This means a lot of uncertainty where it is most important.

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		The Drexler et al paper is really a great study! The data there is tighter than what I have found. But you do see a wider scatter at the high carbon concentration points which is what we commonly see.
	Author Response	Regression uncertainty will increase total uncertainty and reduce the emission reduction tons. Project proponents are free to decide the balance between reduction in costs versus reductions in the GHG emission reduction estimate. A sentence was added to reflect this.
(MM-W/R) Soil Coring Introduction	Initial Comment	**Aggregation of soils?** You don't want to aggregate as then you have no idea of variation.
	Author Response	The intention is to allow aggregation of samples at the same sampling location where there is a documented basis for this practice. We changed step 2 to read as follows. Multiple samples collected at the same plot may be aggregated provided that the uncertainty and guidance for estimating the appropriate number of samples is appropriately documented.
	Reviewer Reply	My point is that aggregation is not a very good sampling approach. it would be better to take an adequate sample size to obtain a mean and SE of the samples rather than aggregate samples in the field for one measurement.... kind of old school agronomic sampling approach. I would recommend multiple samples collected in the field and analyzed separately...
	Author Response	Aggregation will affect the uncertainty and thus the calculation of emissions reduction tons. The paragraph states " uncertainty and guidance for estimating

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		the appropriate number of samples shall be appropriately documented". See response at comment 144.
(MM-W/R) Soil Coring Introduction	Initial Comment	**Use of sediment pins** I would highly recommend adding a disclaimer about the applicability of using sediment pins. They work best when a large elevation change is elevation is anticipated (at least 20 cm), and they are prone to scouring around the pin.
	Author Response	The authors are unaware of these kinds of problems in wetlands within the geographic applicability area. Can the reviewer please provide a reference and possible ways to deal with this uncertainty?
	Reviewer Reply	Please disregard the previous response. Communication with John Callaway at USF confirms the reviewer's concern. Language has been added to reflect the uncertainty associated with the use of sediment pins.
(MM-W/R) Estimating Above- and Below Ground Biomass Using Allometric and Destructive Methods	Initial Comment	**Incorporation of woody species biomass measurement** Even though they aren't as extensive as herbaceous species, woody species such as Salix and Poplar are the high marsh dominants in Delta wetlands. Please include methodology for measuring woody species.
	Author Response	Agreed. Methodology reference added.
(MM-W/R)	Initial Comment	**Remote sensing** Is this biomass or just current year's growth... You also need to account for the extensive amount of litter which can greatly exceed that of live veg

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Estimating Above- and Below Ground Biomass Using Remote Sensing Methods	Author Response	Remote sensing is used for estimating biomass accumulation in the current year's growth. Litter is accounted for implicitly in the determination of accumulation of organic carbon in the soil carbon pool as determined using methods described previously.
	Reviewer Reply	What is implicit accounting?
	Author Response	The implicit accounting means that in wetlands the biomass is mostly herbaceous, annual. It becomes soil. So Δsoil includes the Δ of the dead plant biomass. For this reason, there is the risk of double counting.
(MM-W/R) Litter Decomposition	Initial Comment	**Why?** Why are you doing this? If you are measuring respiration, then you are double counting. I would recommend measuring litter for carbon stock and gas measurements for decomp since you really need to know carbon fluxes.
	Author Response	Text has been added to clarify that determination of litter decomposition rates is for input to biogeochemical models and to caution against double counting. We recognize that determination of respiration reflects litter decomposition. However, for estimating these rates in biogeochemical models, field measured litter decomposition rates are useful. Thus, guidance is provided here.
	Reviewer Reply	Ok, good explanation
(MM-W/R) Litter Decomposition	Initial Comment	**Incorporating standing dead plant material** One aspect of CA freshwater marshes not mentioned here is the very dense and tall (up to 1.5 m) layer of standing dead plant material that persists over

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		multiple years, especially in non-tidal marshes where no tidal flushing of material occurs. My colleagues and I have also observed that live shoot density decreases in areas with dense thatch (especially so in managed non-tidal wetlands). I know that there hasn't been much research on the persistence of this standing dead material or how much carbon is stored in this unique stock, but I do think it's worth mentioning in the text since it is so prevalent and can influence remotely-sensed estimates of LAI and biomass. It is quite remarkable how much dead material persists across years, and I haven't seen it to this degree in any other temperate US wetland.
	Author Response	Good point. We have added language reflect this concept. We added the following to section 4.1.5.2 Project proponents should be aware that standing dead material can persist in non-tidal marshes for multiple years which can influence remotely sensed estimates of leaf-area indices and biomass as live shoot density decreases in areas with dense thatch.
(Model –W/R) Wetland Restoration and Rice Methodological Module-Biogeochemical Model Module	Initial Comment	**Use of W/RC vs W/R** This is minor, but please choose a consistent naming convention for the wetland/rice model. Sometimes W/RC is used and sometimes W/R is used.
	Author Response	Thanks for this comment. We will make consistent.

METHODS MODULES (MM)		
Section	**Comment Type**	**Comment/Response**
(Model –W/R)	Initial Comment	Currently the only model explained is the PEPRMT model. Are users of this module limited to the use of this model? and if not, can there be reference to other models, or a sentence on that ' any model that is proven to be applicable for the specific situation' etc be added? There are more models available for similar climate zones/processes. Perhaps some guidance on what is acceptable and what not.
	Author Response	As discussed in the Framework Module, other biogeochemical models can be used. The Framework model provides criteria for acceptable models. Please see section 1.3.7.7 Use of models. Sorry. Second sentence in previous comment should read "The Framework Module provides criteria for acceptable models. Please see section 1.3.7.7 Use of models. "
(Model –W/R) Scope	Initial Comment	**Applicability of PEPRMT to tidal wetlands and brackish/saline** Since PEPRMT was calibrated and validated at a managed non-tidal freshwater wetland that stays constantly flooded (Twitchell Island), I have questions about how applicable it is to tidal wetlands that vary in salinity. I am concerned about its application to tidal wetlands where there is significant lateral flow, tidal changes (exposing soil; affecting Eh), salinity (affecting salt accumulation via evapotranspiration; flushing of sulfides that affects productivity), introduction of suspended sediment, among other abiotic factors. Can this model be used when an eddy flux tower is not available? All of the information that I have read below suggests that it the model requires a lot of time series data, and I don't believe that many of the projects using this

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Section	**Comment Type**	**Comment/Response**
		methodology will have access to/funding for a flux tower or have the staff time for processing the data. Has the efficacy of the model been tested using only the minimum inputs?
	Author Response	These are valid points. The next section provides guidance for the use of the PEPRMT model. It is not applicable for tidal conditions. Refinements of the model are ongoing for varying wetland conditions in the Delta. Model validation discussed in section 4.2.3.1 illustrates the ability of the model to effectively simulate a period with only the required input for the Twitchell pilot wetland.
	Reviewer Reply	Reference to PEPRMT in Figure 4 under Tidal Wetlands should be removed.
	Author Response	We removed the reference to PPRMT and other specific models to tidal wetland in tidal wetlands. See response to comment #25
(Model –W/R) Applicability Conditions and Methodological Requirements	Initial Comment	**PEPRMT not appropriate for tidal wetlands or eelgrass beds** I brought this concern up in my last comment, but I see that it's specifically stated in condition 5 that this model is not appropriate for tidal wetlands. No alternative biogeochemical models are listed for tidal wetlands. What about WARMER from USGS or Marsh Equilibrium Model from Jim Morris? How does this apply to eelgrass beds where you can't readily measure many of the required parameters? As currently framed, this methodology appears to only be applicable to non-tidal herbaceous freshwater wetlands.

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Section	**Comment Type**	**Comment/Response**
	Author Response	These models could be used for these situations if they meet the criteria specified in the Framework Module. Please see section 1.3.7.1 Use of models
	Reviewer Reply	I still would bring attention to examples of models that could be used in section 1.3.7.1, and refer to this specific section where applicable. (Oops - I hit 'publish' too quickly...) Particularly in light of how much attention is paid to PEPRMT in future sections (and that it hasn't officially been published in a peer-reviewed journal), equal attention should be made towards other published and tested biogeochemical models.
	Reviewer Reply	I think the MEM model is only for tidal marshes and not for eelgrass.
	Author Response	Special attention was paid to SUBCALC and PEPRMT models because they are specifically developed for the Delta region. Also, PEPRMT is the only model developed for managed wetlands. We agree that Proponents should be able to use other models, if they meet the specific requirements listed in the model module. We decided to give less importance to any specific model, such as PEPRMT, and thus we removed direct reference to PPRMT and SUBCALC from the general modules sections and moved the description to the Appendix. We added mention of the WARMER and MEM models.
(Model –W/R) Model Calibration and Validation	Initial Comment	**Realistic** Is this degree of calibration feasible in a carbon market? Does this mean it would require 2 years of calibration before the project began? Is this more realistic for research rather than application?

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Section	**Comment Type**	**Comment/Response**
	Author Response	This model calibration would likely be more in the purview of research. However, the model can be calibrated after the project begins with project monitoring data. If less than semi-continuous data are collected and used for calibration, model uncertainty will likely be greater and quantified as per guidance in the Uncertainty Module. Language has been added to reflect convey this.
	Reviewer Reply	Would this approach pass verification standards?
	Author Response	Project proponents are free to decide the balance between reduction in costs versus reductions in the GHG emission reduction estimate.
(Model –W/R) Project Model description: The Peatland Ecosystem Photosynthesis, Respiration, and Methane Transport model (PEPRMT)	Initial Comment	**Incorporation of salinity into model** In a previous module, the effect of salinity on CH_4 production was discussed at length but I don't see how it's incorporated into the model below. Please explain how the model can be adjusted to work in brackish wetlands.
	Author Response	The model has not been modified to account for varying effects of salinity on methane emissions as these effects are not important in the freshwater non-tidal wetlands for which it was calibrated. We envision that the model will be modified in the future using a function that modifies methane emissions based on salinity levels somewhat similar to the water table modification shown in equation 33.
(Model –W/R) Data and	Initial Comment	**Use of SSURGO data for initial soil organic carbon** Recent work using SSURGO soil organic carbon data has shown that it is not accurate for tidal wetland soils. It is not difficult to measure soil organic carbon

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Section	**Comment Type**	**Comment/Response**
Parameters Monitored		(CN analyzer or Callaway et al. published a LOI v %OC relationship for San Francisco Bay) and should be a basic requirement.
	Author Response	Thank you for the comment. We changed the language to recommend sampling instead of using SSURGO data.
(EFFC –W/R) Wetland Restoration and Rice Methodological Module- Estimation of Emissions from Fossil Fuel Combustion	Initial Comment	Given the scope, and as mentioned earlier: large project emissions will be expected if activities such as earth movements, (infrastructure) constructions take place, but also ' event fluxes' if e.g. during rice harvesting. Perhaps some knowledge can be taken from the research that is done on fluxes from rice in the tropics. Project emissions should never be underestimated.
	Author Response	Agreed. The following sentence has been added. The fossil fuel methods module shall be used to estimate all project emissions that include but are not limited to earth moving, construction and agricultural operations such as cultivation, planting and harvesting.
(X-UNC) Methodological Module Tool for estimation of uncertainty	Initial Comment	Please also see VCS VM0007, VMD0017 X-UNC
	Author Response	We have reviewed the Uncertainty Module associated with the REDD methodology as suggested by the reviewer. We do not find it substantially different from the Uncertainty Module presented here, in theory. However, we are reluctant to reference it here because this Uncertainty Module has been developed specifically for this methodology and includes uncertainty calculations for eddy covariance measurements and biogeochemical models not included in the REDD UNC module. We opine that to reference it would create confusion for a project proponent.

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Section	**Comment Type**	**Comment/Response**
Overall Comment	Reviewer Comment	This has been a very interesting project. This version is much improved. I great enjoyed and appreciated the comment replies. One thing for certain, is that this is not an easy task. Such manuals are monumental efforts and you all are to be commended for such a professional approach!