Voluntary Emission Reductions in Rice Management Systems v1.0 and Regional Calibration Modules

Errata & Clarification

September 2016

This is a supplemental document to the ACR Methodology *Voluntary Emission Reductions in Rice Management Systems*, v1.0 and its Regional Calibration Modules. The ACR Methodology *Voluntary Emission Reductions in Rice Management Systems* v1.0, and all subsequent versions of this methodology, is considered the “Parent Methodology” for both the Midsouth and California modules.

It is intended that topics in this document will be incorporated into the updated ACR Methodology *Voluntary Emission Reductions in Rice Management Systems* v2.0 and its updated Modules. As supplemental information or clarifications are needed on future versions of this methodology, updates may be found in this document.

1 Voluntary Emission Reductions in Rice Management Systems v1.0

Uncertainty Deduction

In addition to the Parent Methodology, a Project Proponent must use the most current uncertainty deductions for the Rice Growing Region where the project is located, found in the 'DNDC structural uncertainty deduction factors' addendum published on ACR’s website. The addendum will be a dynamic home to future updates of any other Rice Growing Region module uncertainty deduction factors. Project Proponents are required to use the most updated uncertainty deductions as published in the addendum for the GHG Project Plan at validation.

Solar radiation is not required as an input parameter for the process-based model, though it may be provided as a climate input option. Requiring solar radiation limits the availability of daily weather data, as most weather stations have gaps in solar radiation data.

In the original ACR Rice Methodology, the model was assumed to be unbiased with normal residuals (see Section 14.1.3). The variance of the residuals does not depend on whether the situation being modeled is a baseline or project scenario. Thus,

$$\mathrm{PE}_{\mathrm{model}} = \mathrm{PE}_{\mathrm{meas}}\varepsilon_1, \varepsilon_1, \sim \mathrm{N}\ (0, \sigma^2\ )$$

$$\mathrm{BE}_{\mathrm{model}} = \mathrm{PE}_{\mathrm{meas}}\varepsilon_2, \varepsilon_2, \sim \mathrm{N}\ (0, \sigma^2\ )$$

Unfortunately, it will sometimes be the case that the model cannot be demonstrated to be unbiased using a two one-sided test (TOST) equivalence testing approach (ACR Rice Methodology, Section 14.1.2). Thus, it is necessary to introduce a slope and/or intercept to describe the relationship between modeled and measured emissions. In the event of a model that is biased (insofar as it does not pass the TOST test), structural uncertainty factors can be derived as long as the modeled result can be shown to be conservative. Specifically,

$$\mathrm{PE}_{\mathrm{model}} = \beta_0 + \beta_1\mathrm{PE}_{\mathrm{meas}} + \varepsilon_1, \varepsilon_1, \sim \mathrm{N}\ (0, \sigma^2\ )$$

$$\mathrm{PE}_{\mathrm{model}} = \beta_0 + \beta_1 \mathrm{BE}_{\mathrm{meas}} + \varepsilon_2, \varepsilon_2, \sim \mathrm{N}\ (0, \sigma_a^2)$$

Where β_0 andβ_1 are parameters to be estimated from the data. Equivalently, we can write

$$\mathrm{PE}_{\mathrm{meas}} = \gamma_0 + \gamma_1\ \mathrm{PE}_{\mathrm{model}} + \varepsilon_1, \varepsilon_1, \sim \mathrm{N}\ (0, \sigma^2\ )$$

$$\mathrm{BE}_{\mathrm{meas}} = \gamma_0 + \gamma_1\ \mathrm{BE}_{\mathrm{model}} + \varepsilon_2, \varepsilon_2, \sim \mathrm{N}\ (0, \sigma^2\ )$$

where $\gamma_0 = -\beta_0/\beta_1$, $\gamma_1 = -1/\beta_1$, and $\sigma^2\ =\ \sigma_a^2/\beta_1^2$. It is the latter form that we will actually use to estimate the structural uncertainty deduction. As before, our interest is in the quantity

$\mathrm{DER}_{\mathrm{model}} - \mathrm{DER}_{\mathrm{measure}}$, i.e.

$$(\mathrm{BE}_{\mathrm{model}} - \mathrm{PE}_{\mathrm{model}}) - (\mathrm{BE}_{\mathrm{measure}} - \mathrm{PE}_{\mathrm{measure}})$$

$$= (\mathrm{BE}_{\mathrm{model}} - \mathrm{PE}_{\mathrm{model}}) - [(\gamma_0 + \gamma_1\ \mathrm{BE}_{\mathrm{model}} = \varepsilon_2)\text{-}(\ (\gamma_0 + \gamma_1\ \mathrm{PE} + \varepsilon_1)]$$

$$=(1 - \gamma_1)(\mathrm{BE}_{\mathrm{model}} - \mathrm{PE}_{\mathrm{model}})\ +\varepsilon$$

with $\varepsilon \sim N(0{,}2\sigma^2\ (1 - \rho))$. We can estimate σ^2 as the variance of the residuals measured on modeled values for the field sites, and ρ as the correlation of the residuals between project-baseline pairs. Where the model is estimated based on k pairs of modeled and measured values, and n hectares of fields are included in the project, then following the rationale of the parent methodology, constructing an approximate one-sided, 90% confidence limit for $\mathrm{DER}_{\mathrm{model}} - \mathrm{DER}_{\mathrm{measure}}$, i.e. yields an uncertainty deduction of

$$u_{struct} = n(1 - \gamma_1)(E[\mathrm{BE}_{\mathrm{model}} - \mathrm{PE}_{\mathrm{model}}]) =\ \mathrm{s}\sqrt{2\mathrm{n}(1 - \rho)}t_{inv}\ (0.90, k - 2)\ ,$$

where the expectation in the left-hand term indicates the average modeled net emissions reduction on a per-hectare basis, and s is the empirical standard deviation of the regression residuals. The degrees of freedom in the inverse of the cumulative t distribution is $k - 2$, because there are two estimated parameters in the regression (compared with zero in the original derivation, where the slope was assumed to be one and the intercept was assumed to be zero). The left-hand term in the equation adjusts the original modeled net emissions reduction for the systematic departure of the model from a 1:1 line. This term will be positive when the model tends to over-predict measured emissions, and can be negative if the model tends to under-predict measured emissions on average. The second term, which is always positive, provides the adjustment for the variability in predictions around the typical model performance. The better the model is at predicting measured emissions, following adjustment by a linear calibration, the smaller the second term will be.

Baseline Adoption Rate

In the parent methodology, “Baseline adoption rate” refers to the baseline adoption rate of the project activities. When a Project Activity is implemented on less than 50% of the acres in the Rice Growing Region, it is considered a practice that is not commonly used, and is therefore eligible for a Common Practice Baseline after year ten. The flow chart is provided to better explain the different baselines allowed. Adoption rates of a specific practice are assessed on an annual basis. At validation of an initial Crediting Period, one annual adoption rate in the past five years suffices to set the baseline adoption rate. However, upon renewal of a project’s Crediting Period the baseline adoption rate must be set as the average of at least two adoption rates in the five years preceding the Crediting Period. Often little data is available for a given practice initially at project start, but the practice is adopted more readily over time.

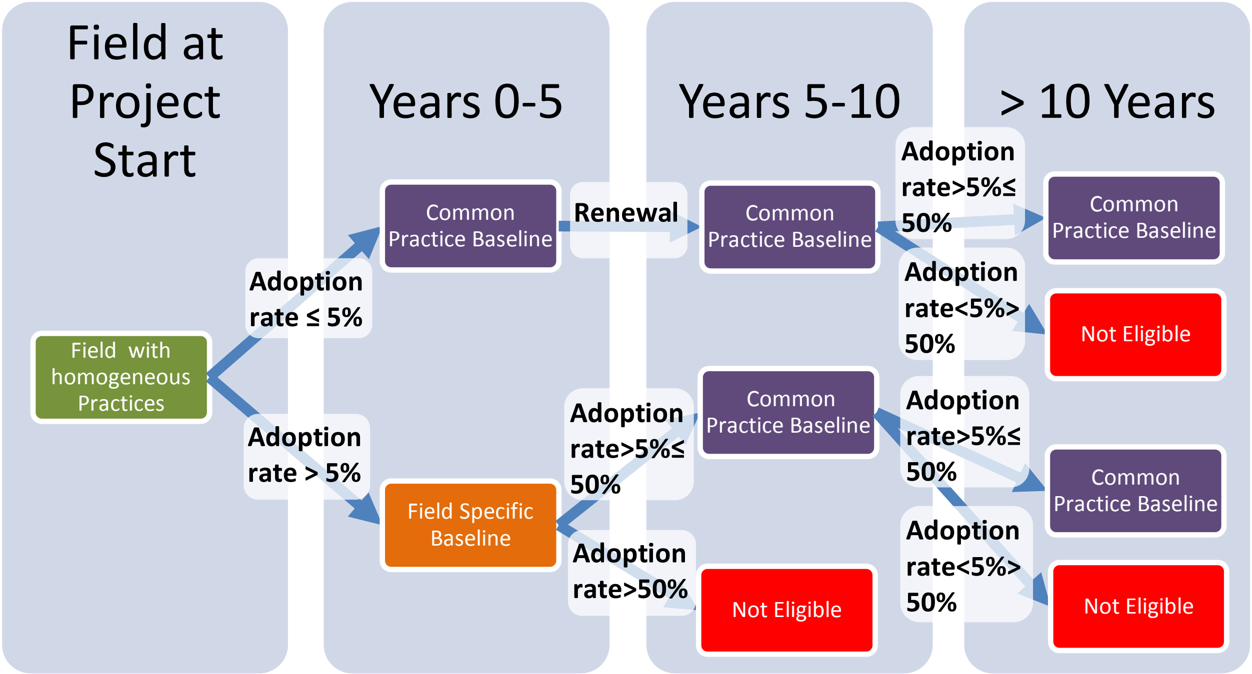

Figure 1. Flow chart of Crediting Period, Project Renewal and Baseline Update.

Greenhouse gas boundary

The intention of the methodology is to credit only methane emission reductions associated with the approved practice changes – project developers are not able to claim credits for increases in soil organic carbon (SOC), or reductions in nitrous oxide emissions that occur during the reporting period using this methodology alone. Furthermore, the GHG quantification must account for any increases in emissions associated with the project's practices changes, meaning any increases in CO_2 and/or N_2O must be deducted from the modeled decreases in CH_4.

Regarding SOC, it is not realistic to secure the permanence of any short term increases in SOC that result from cropping year to cropping year field management. Also, given that the methodology only debits losses of SOC and does not credit SOC sequestration, and that the project year is defined based on cropping years, project proponents may exclude the litter and humad pools, which tend to demonstrate high variability across cropping years, from the soil carbon debit calculations. Therefore, only losses of SOC attributed to the humus pool will be included in the GHG quantification.

Regarding nitrous oxide, the version of the DNDC model approved for use with this methodology to estimate methane emissions reductions is not validated for estimating nitrous oxide emissions. The DNDC model can be a valuable tool for estimating GHG emissions from changes in land use practices when it has been properly calibrated and independently validated. However, analysis conducted by DNDC-ART using the ACR-approved version that has been fully calibrated for estimating methane emissions but not N_2O in US rice growing regions shows that it is not able to consistently estimate changes in N_2O emissions. Therefore, any modeled outputs for N_2O cannot be used in the quantification of overall project emissions reductions. Until there is a version of the model that has been fully calibrated and validated for US rice growing regions for both CH_4 and N_2O, project developers must instead estimate changes in N_2O emissions using the methods described in Chapter 3 of the USDA published Methods for Entity-Scale Inventory[1]. Specifically, direct N_2O emissions shall be calculated using equation 3-21: Direct Soil N_2O Emissions from flooded Rice in Section 3.5.6.2, using the appropriate emission factor and scaling factor according to the water management scheme as referenced in the paragraph below equation 3-21 (based on research by Akiyama et al, 2005). The defaults in Table 3-B-2 can be used to determine the N content of rice residue inputs.

Indirect N_2O emissions shall be calculated using the method outlined in Section 3.5.4.2, by applying Equation 3-13: Total Indirect Soil N_2O Emissions from Mineral Soils; Equation 3-14: Indirect Soil N_2O Emissions from Mineral Soils —Volatilization; and Equation 3-15: Indirect Soil N_2O Emissions from Mineral Soils —Leaching and Runoff.

As stated in the methodology, Project Proponents are allowed to use this methodology in combination with a separate methodology that credits reduced N_2O emissions from optimized fertilizer management. When the DNDC model is used for quantification in the fertilizer reduction methodology, only one simulation run for Baseline and project conditions shall be used that is used for both the fertilizer reduction methodology and this methodology. This of course will require the DNDC model to also be validated and calibrated for N_2O for rice in the applicable growing region.

Clarifications have also been made to the text of Table 1 summarizing the GHG sources.

Table 1. Overview of included greenhouse gas sources.

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[1] Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory. USDA Technical Bulletin 1939. July 2014. http://www.usda.gov/oce/climate_change/estimation.htm

	Source	Gas	Included?	Justification/Explanation
Baseline Scenario	Soil microorganisms metabolizing soil C, root exudates, and soil mineral N	CO_2	Yes	Significant changes in CO_2 emissions due to crop residue management.
		CH_4	Yes	Significant Baseline emission source if Rice Fields are flooded.
		N_2O	Yes	Significant Baseline emission source if fertilizer is applied.
	Emissions from burning straw	CO_2	Yes/No	Significant emission if straw residues are burned. May be excluded in cases where emissions resulting from burning in both the baseline and project scenario are expected to be the same; or when conservative to exclude in scenarios where burned residue in the baseline is baled in the project scenario.
		CH_4	Yes/No	Significant emission if straw residues are burned. May be excluded in cases where emissions resulting from burning in both the baseline and project scenario are expected to be the same; or when conservative to exclude in scenarios where burned residue in the baseline is baled in the project scenario.
		N_2O	No	N_2O emissions from burning residue are insignificant due to low N content of rice straw.
Project Scenario	Soil microorganisms metabolizing soil C, root exudates, and soil mineral N	CO_2	Yes	Significant changes in CO_2 emissions due if there are changes to crop residue management.
		CH_4	Yes	Significant emission source affected by Project Activities if flooding duration and periods are changed. Emissions from ruminants are potentially significant if feed is replaced by low-nitrogen rice straw.
		N_2O	Yes	Significant emission source affected by Project Activities if fertilizer amounts and dates are changed or seeding practices are altered[2]
	Emissions from burning straw	CO_2	Yes/No	Significant emission if straw residues are burned. May be excluded in cases where emissions resulting from burning in both the baseline and project scenario are expected to be the same; or when conservative to exclude in scenarios where burned residue in the baseline is baled in the project scenario.
		CH_4	Yes/No	Significant emission if straw residues are burned. May be excluded in cases where emissions resulting from burning in both the baseline and project scenario are expected to be the same; or when conservative to exclude in scenarios where burned residue in the baseline is baled in the project scenario.
		N_2O	No	N_2O emissions from burning residue are insignificant due to low N content of rice straw
	Emissions from alternative uses of straw	CO_2	Yes	CO_2 emissions from decomposition of rice straw management are insignificant. However, fuel used to collect straw is potentially significant
		CH_4	Yes	Significant if rice straw decomposes anaerobically
		N_2O	No	Due to the low N content of rice straw, N_2O emissions during decomposition of rice straw are assumed insignificant.

	Increases in emissions related to production and transportation of N, P, and K fertilizer due to project activities	CO_2	Yes	Increases in emissions are only to be included if fertilization increases to replenish soil nutrients after straw removal (baling), and shall be omitted when no baling is done as a project activity.
		CH_4	Yes	Increases in emissions are only to be included if fertilization increases to replenish soil nutrients after straw removal (baling), and shall be omitted when no baling is done as a project activity.
		N_2O	Yes	Increases in emissions are only to be included if fertilization increases to replenish soil nutrients after straw removal (baling), and shall be omitted when no baling is done as a project activity.

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[2] *Dry-seeding*, as defined in Section 6 may increase N_2O emissions in the period right after seeding and before flooding, when the soil is kept moist and inorganic N from fertilizer is readily available.

Field-specific Model Calibration

Step 2 of the process outlined in this section indicates maximum biomass as the "maximum biomass" as the parameter should be tuned so that DNDC predicts the recorded yields. Please note that adjusting the TDD (the accumulative temperature parameter in DNDC) is also acceptable and potentially a required step in the initial parameter adjustments made in order to successfully calibrate the field.

Quantification of Baseline and Project Emissions

The following text replaces Section 7.5 of the Parent Methodology:

7.5 Quantification of Baseline Emissions

Separate model simulations of the Baseline Scenario must be conducted for each of the individual Rice Fields. The Project Proponent shall determine the flux rates from the DNDC output files (not the "Greenhouse gas" page of the DNDC results).

NOTE: The following equation for deriving the $N2O_{B,y,i\text{-}CO2e}$ term can only be used with an ACR-approved version of DNDC that has also been calibrated and validated for N_2O emissions in US rice growing regions. For ACR-approved model versions only calibrated for CH_4, the methods outlined in Section 3.5.6 of the USDA published Methods for Entity-Scale Inventory[3] must be used to derive $N2O_{B,y,i\text{-}CO2e}$. Please be aware that it will be necessary to keep the result derived using this method in kg CO_2-eq ha^{-1} yr^{-1}, as it will be in provided in total metric tons CO_2-eq yr^{-1}.

$$CO2_{B,y,i-CO2e} = \frac{44}{12} \cdot [CO2 - C]_{baseline,y,i} \quad \text{[EQ 1]}$$

$$N2O_{B,y,i-CO2e} = GWP_{N2O} \cdot \frac{44}{28} \cdot [N2O - N]_{baseline,y,i}$$

$$CH4_{B,y,i-CO2e} = GWP_{CH4} \cdot \frac{16}{12} \cdot [CH4 - C]_{baseline,y,i}$$

Where:

$CO2_{B,y,i-CO2e}$	=	Baseline carbon dioxide emissions in year y for individual Rice Field i [kg CO_2-eq ha^{-1} yr^{-1}]
$[CO2 - C]_{baseline,y,i}$	=	Baseline carbon dioxide flux rate from changes in SOC content, using only the humus pool (excluding litter and humad pools), in year y for individual Rice Field i as reported by DNDC [kg C ha^{-1}]
$\frac{44}{12}$	=	Unit conversion of C to CO_2

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[3] http://www.usda.gov/oce/climate_change/Quantifying_GHG/Chapter3S.pdf

$N2O_{B,y,i-CO2e}$ = Baseline nitrous oxide emissions in year y for individual Rice Field i [kg CO_2-eq ha^{-1} yr^{-1}]

$[N2O-N]_{baseline,y,i}$ = Baseline nitrous oxide flux rate in year y for individual Rice Field i as reported by DNDC [kg N ha^{-1}]

GWP_{N2O} = The global warming potential for N_2O

$\frac{44}{28}$ = Unit conversion of N_2O-N_2 to N_2O

$CH4_{B,y,i-CO2e}$ = Baseline methane emissions in year y for individual Rice Field i [kg CO_2-eq ha^{-1} yr^{-1}]

$[CH4-C]_{baseline,y,i}$ = Baseline CH_4 flux rate in year y for individual Rice Field i as reported by DNDC [kg C ha^{-1}]

GWP_{CH4} = The global warming potential for CH_4

$\frac{16}{12}$ = Unit conversion of C to CH_4

The values for the Global Warming Potentials for methane and nitrous oxide must be in accordance with the requirements published in the current *ACR Standard*.

The following text replaces Section 8.3.1 of the Parent Methodology:

8.3.1 Gross Project Emissions

Similarly to the Baseline simulations, the DNDC model must be run separately for each of the individual Rice Fields. The Project Proponent shall determine the flux rates from the DNDC output files (not the "Greenhouse gas" page of the DNDC results).

NOTE: The following equation for deriving the $N2O_{P,y,i\text{-}CO2e}$ term can only be used with an ACR-approved version of DNDC that has also been calibrated and validated for N_2O emissions in US rice growing regions. For ACR-approved model versions only calibrated for CH_4, the methods outlined in Section 3.5.6 of the USDA published Methods for Entity-Scale Inventory[4] must be used to derive $N2O_{P,y,i\text{-}CO2e}$. Please be aware that it will be necessary to keep the result derived using this method in kg CO_2-eq ha^{-1} yr^{-1}, as it will be in provided in total metric tons CO_2-eq yr^{-1}.

$$CO2_{P,y,i-CO2e} = \frac{44}{12} \cdot [CO2-C]_{project,y,i} \qquad \text{[EQ 4]}$$

$$N2O_{P,y,i-CO2e} = GWP_{N2O} \cdot \frac{44}{28} \cdot [N2O-N]_{project,y,i}$$

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[4] http://www.usda.gov/oce/climate_change/Quantifying_GHG/Chapter3S.pdf

$$CH4_{P,y,i-CO2e} = GWP_{CH4} \cdot \frac{16}{12} \cdot [CH4 - C]_{project,y,i}$$

Where:

$CO2_{P,y,i-CO2e}$	=	Project carbon dioxide emissions in year y for individual Rice Field i [kg CO_2-eq ha^{-1} yr^{-1}]
$[CO2 - C]_{project,y,i}$	=	Project carbon dioxide flux rate from changes in SOC content using only the humus pool (excluding litter and humad pools) in year y for individual Rice Field i as reported by DNDC [kg C ha^{-1}]
$\frac{44}{12}$	=	Unit conversion of C to CO_2
$N2O_{P,y,i-CO2e}$	=	Project nitrous oxide emissions in year y for individual Rice Field i [kg CO_2-eq ha^{-1} yr^{-1}]
$[N2O - N]_{project,y,i}$	=	Project nitrous oxide flux rate in year y for individual Rice Field i as reported by DNDC [kg N ha^{-1}]
GWP_{N2O}	=	The global warming potential for N_2O
$\frac{44}{28}$	=	Unit conversion of N_2O-N_2 to N_2O
$CH4_{P,y,i-CO2e}$	=	Project methane emissions in year y for individual Rice Field i [kg CO_2-eq ha^{-1} yr^{-1}]
$[CH4 - C]_{project,y,i}$	=	Project CH_4 flux rate in year y for individual Rice Field i as reported by DNDC [kg C ha^{-1}]
GWP_{CH4}	=	The global warming potential for CH_4
$\frac{16}{12}$	=	Unit conversion of C to CH_4

The values for the Global Warming Potentials for methane and nitrous oxide must be in accordance with the requirements published in the current *ACR Standard*.

Clarification of Section 10.1.1

Section 10.1.1 *Uncertainty in the Input Parameters*, currently says that “Uncertainty due to variability in the input parameters can be captured using a Monte-Carlo analysis, and can be calculated using the built-in tools in the DNDC model.” Please note that the “built-in” tools in the DNDC model should NOT be used for the input uncertainty analysis, and instead should be set up manually.

Further, project developers may exclude the N_2O outputs from the 1000 baseline and project emission calculations when completing the Monte simulation.

Clarification of Section 10.1.3 and Correction to Equation 7

Equation 7 does not appropriately account for the difference in emissions between the Project and Baseline scenarios. Rather than subtracting the Baseline emissions from the Project emissions it should subtract the Project emissions from the Baseline emissions. Additionally, the original Project emissions and Baseline emissions terms do not correctly capture the intent of the methodology to account for any increases in N_2O and CO_2 emissions, and not credit for any decreases.

Therefore, Equation 7 should read:

$$u_i = \frac{u_{struct}}{\sum_{i=1}^{nrFields} A_i\left(FER_{y,i}\right)} + u_{input,i} \qquad \text{[EQ 7]}$$

Where:

$FER_{y,i}$ = Field Emissions Reductions in year y for individual Rice Field i [$kgCO_2$-eq yr^{-1}], calculated as:

$$FER_{y,i} = MIN\left[\left(N2O_{B,y,i-CO2e} - N2O_{P,y,i-CO2e}\right), 0\right] + \left(CH4_{B,y,i-CO2e} - CH4_{P,y,i-CO2e}\right) - MAX\left[\left(CO2_{B,y,i-CO2e} - CO2_{P,y,i-CO2e}\right), 0\right]$$

Please note however, that at the time of publication of this version of Errata and Clarifications, it is recommended that rather than combining the two sources of uncertainty as outlined in EQ 7, they be applied in sequence. Specifically, $u_{input,i}$ should be applied to each individual Rice Field *i* as a percentage deduction. Then u_{struct} (as determined by the currently published Structural Uncertainty Deduction Factors Addendum) should be applied to the resulting field level values as an absolute per ha deduction.

Calculation of Emission Reductions

The following text replaces Section 10.2 of the Parent Methodology:

10.2 Calculation of Emission Reductions

The GHG emission reductions for year y (ER_y) are calculated as:

$$ER_y = \sum_{i=1}^{nrFields} A_i \left[u_i(FER_{y,i}) - CRH_{y,i}\left(\frac{OFEF_{y,i} + IFEF}{1000}\right)\right] - E_{leakage,i} \qquad \text{[EQ 2]}$$

Where:

ER_y = GHG emissions reductions and/or removals in year y [tCO$_2$-eq yr^{-1}]

$nrFields$ = Number of individual Rice Fields included in the Project area

A_i = Size of individual Rice Field i [ha].

u_i = Uncertainty Deduction factor for individual Rice Field i

$FER_{y,i}$ = Field Emissions Reductions in year y for individual Rice Field i [kgCO$_2$-eq yr^{-1}]

$CRH_{y,i}$ = Crop Residue harvested in year y for individual Rice Field i defined in Section 8.3.2 [t dry straw ha^{-1}]

$OFEF_{y,i}$ = Off-Field Emission Factor in year y for individual Rice Field i [kg CO$_2$-eq t^{-1} dry straw]

$IFEF$ = Increased Fertilizer Emission Factor [kg CO$_2$-eq t^{-1} dry straw]

Optional Use of Common Practice Baseline

The Parent Methodology indicates two possible baseline choices, a common practice baseline and a field-specific baseline. Version 1.0 of the methodology states that a common practice baseline “must” be used for the project activities that are adopted on less than or equal to 5% of the rice acres within a particular Rice Growing Region. However, the intension of the methodology is not to preclude project proponents from using field-specific baselines for any or all project activities if they are able to provide the required historical data. Any instances where the terms “must use”, “must be used”, or “must be set” are stated in reference to the application of a common practice baseline should be considered to read “may use”, “may be used”, or “may be set” respectively.

DNDC Model Simulation Historical Period

Section 7.1 Duration and Structure of Model Simulations (pg. 23) of the Parent methodology states: “The duration of a DNDC model simulation must be at least 20 years before the start of the Crediting Period so that the model can attain equilibrium in certain critical variables for which empirical data is lacking, such as the sizes and the quality of the different carbon pools, and the inorganic nitrogen contents of soil pore water. This period is referred to as the Historical Period. In case a Field Specific Baseline is used, the Model Parameters for the 20-year Historical Period must be set by repeating the frequency of historical occurrence of Project Activities during the last five years before the start of the Crediting Period four times, while using the management parameters of at least three out of five years before the start of the Crediting Period unless otherwise noted. However, if rice was grown only two out of the past five years, two years of historical data are sufficient to parameterize the DNDC model.”

There are no specific instructions for a common practice baseline. Upon consulting with Bill Salas from Applied Geo-Solutions, it was clarified that this same method for developing the 20-year Historical Period stated above for the Field Specific Baseline can be used for the practices of Dry Seeding and Intermittent Flooding. In the case of Baling, if the practice was applied on field before the start of the crediting period, using the field specific agronomic data in the historical period will affect the modeled soil parameters, thereby impacting the resulting emissions reported for the baseline and project period.

Instead, if the common practice baseline developed for that field is used and repeated three times to create a 15-year Historical Period before the practice start date and the real field historic data is used for the 5 years before the crediting period start then the model will more accurately represent real field conditions. Please see the table below for details.

Table 2 Schematic of the modelling period for baling if practice is adopted before crediting period

Year -20 to -15	Year -15 to -10	Year -10 to -5	Year -5 to 0	Year 0 to 5	Year 5 to 10
Historical Period using the common practice data			Use of actual field data	Crediting Period	
Model Equilibrium			Crop Yield Calibration	Period 1	Period 2

2 California Regional Calibration Module v1.0

The formula for structural uncertainty in line 77 of the California Module displays u_{struct} in the units of kg CO_2-eq. The equation, however, does not include the appropriate term to convert from kg C to kg CO_2-eq. The correct formula should read:

$$u_{struct} = s\sqrt{2n(1-\rho)} \cdot t_{inv}(0.90, k) \cdot \frac{44}{12}$$

Additionally, as in the Midsouth Module, all updates to model calibration/validation and the associated uncertainty equations will be published in ACR's 'DNDC structural uncertainty deduction factors' addendum. The most updated uncertainty deduction factors for the California Rice Growing Region, as published in this addendum, are required to be used at the time of GHG Project Plan validation.