METHODOLOGY ASSESSMENT REPORT FOR THE TOOL FOR CALCULATING DEFORESTATION RATES USING INCOMPLETE REMOTE SENSING IMAGES

Document Prepared By Francis Eaton and Ryan Anderson

Methodology Title	TOOL FOR CALCULATING DEFORESTATION RATES USING INCOMPLETE REMOTE SENSING IMAGES	
Version	8-0	
Methodology Category	Methodology	
	Methodology Revision	
	Module	
	Tool	X
Sectoral Scope(s)	14. AFOLU-REDD	

Report Title	METHODOLOGY ASSESSMENT REPORT FOR THE TOOL FOR CALCULATING DEFORESTATION RATES USING INCOMPLETE REMOTE SENSING IMAGES
Report Version	1-0

Client	Terra Global Capitol
Pages	29
Date of Issue	17 November 2015 (originally submitted on13-May-2014)
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Work Carried Out By	Lead assessor: Francis Eaton Assessor: Ryan Anderson Technical reviewer: Larry Wilson

Summary:

This report describes the first assessment of the Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Image. The purpose of the assessment is to assess the conformance of the methodology elements to the VCS rules and current best practices for assessing remotely sensed imagery. The assessment was performed through a desk review of the methodology elements and other relevant documents. The scope and criteria are described in Section 2.1 below. The verification team raised 20 findings throughout the course of the assessment. At this time, all findings have been adequately responded to, and it is the opinion of SCS that the tool complies with all of the assessment criteria, and the assessment team has no restrictions or uncertainties with respect to the compliance of the methodology element with the assessment criteria.

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1 INTRODUCTION

1.1 Objective

The purpose of the audit activity was to conduct a first assessment of the "Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images" in accordance with the guidance documents listed in Section 2.1 of this report. Within this report, the "Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images" will be referred to as "the Tool"

1.2 Summary Description of the Methodology

The methodology element provides criteria and procedures for the calculation of deforestation rates using incomplete remote sensing images attributable to project activities that reduce emissions from mosaic deforestation and degradation. The reader is directed to Section 2 of the methodology element for a more thorough summary.

2 ASSESSMENT APPROACH

2.1 Method and Criteria

In accordance with the Methodology Approval Process, the scope of the assessment included the following:

- Applicability conditions: Assessment of whether the proposed methodology's applicability conditions are appropriate, adequate and in compliance with the VCS rules.
- Data and parameters: Assessment of whether the specification for monitored and not monitored data and parameters is appropriate, adequate and in compliance with the VCS rules.
- Adherence to the project principles of the VCS Program: Assessment of whether the methodology adheres to the VCS Program principles set out in the VCS Standard.
- Relationship to approved or pending methodologies: Assessment of whether any existing methodology could reasonably be revised to serve the same purpose as the proposed methodology.

The Tool was assessed for conformance against the VCS Version 3, including the following documents: VCS Standard, Version 3.4 Agriculture, Forestry and Other Land Use Projects (AFOLU) Requirements, Version 3.4 Methodology Approval Process, Version 3.5 Program Definitions, Version 3.5

- The primary method used for this assessment was document review, as described in Section 2.2 below.

2.2 Document Review

The assessment activity included a detailed review of the methodology elements against the criteria of the guidance documents listed in Section 2.1 of this report. In addition, the methodology elements were assessed for logical coherence, internal consistency, completeness, and consistency with current best practices for assessing remote sensing imagery. The specific documents reviewed were as follows:

- Tool - Module Deforestation rate from multiple images v8-0
- Tool Demonstration v6-0
- IPCC GPG-LULCF, 2003
- Lillesand et al. (2008) - Remote Sensing and Image Interpretation, 6th Edition
- GOFC-GOLD Sourcebook

2.3 Interviews

No interviews were conducted during the course of the assessment.

2.4 Assessment Team

Lead Assessor: Francis Eaton

Mr. Eaton holds a Masters of Forest Science from the Yale School of Forestry and Environmental Studies and received his B.S. in Forestry from Northern Arizona University. Mr. Eaton currently works as a Verification Forester for SCS and has completed forest carbon projects under the Verified Carbon Standard (VCS), the Climate Action Reserve (CAR), and the Climate, Community, and Biodiversity Alliance (CCBA). Moreover, Mr. Eaton is accredited by the California Air Resources Board as Lead Offset Verifier and is also certified by the Board in the US Forest Project and Urban Forest Protocols. He is also certified as Lead Verifier under the Climate Action Reserve.

Assessor: Ryan Anderson

Mr. Anderson served as a technical consultant in the review of this tool. Mr. Anderson holds a BS in Environmental Science from the University of Denver and an MS in Natural Resource Science and Management from the University of Minnesota, with an emphasis in remote sensing. He has served as a verifier or consultant on a number of carbon projects under the VCS, CCB, and CAR standards, and has contributed to the development of two approved VCS methodologies.

2.5 Resolution of Findings

Potential material discrepancies identified during the assessment process were resolved through the issuance of findings. The types of findings issued by SCS were characterized as follows:

Non-Conformity Reports (NCRs) were issued in response to material discrepancies in one or more methodology elements. A material discrepancy could be defined as one of the following:

- An instance of non-conformance to the guidance documents listed in Section 2.1 of this report;
- An instance where the language of the methodology element required clarification in order to avoid ambiguity;
- An instance where the proposed methodology lacked internal consistency; or
- An instance where formulae in the proposed revision were not consistent with mathematical convention.

An adequate response for each issued NCR, including evidence of corrective action, was required before an assessment opinion could be reached.

New Information Requests (NIRs) were issued to the client when more information was needed to determine whether a material discrepancy existed. Issuance of an NIR did not necessarily signify the presence of a material discrepancy. However, an adequate response to all issued NIRs was required before an assessment opinion could be reached.

Opportunities for Improvement (OFIs) were issued to the client when an opportunity for improvement in the proposed revision was identified. Such opportunities for improvement did not constitute material discrepancies. OFIs were considered resolved on issuance, and therefore a response to issued OFIs was not required before an assessment opinion could be reached.

All issued findings are described in Appendix A below.

3 ASSESSMENT FINDINGS

3.1 Relationship to Approved or Pending Methodologies

The Tool is a standalone document and while it may lend itself to the use of certain methodologies, it does not meet the criteria of a methodology. Thus, this section is not applicable to the Tool.

3.2 Stakeholder Comments

The Tool developers received two comments during the public comment period. The comments, along with the developer response were as follows:

A comment from Kyle Holland was received on 3 April 2012 claiming Approach C may not result in robust estimated transition matrix. The developer has since removed approach C from the Tool and therefore this comment is no longer valid.

A second set of comments from Florian Remier was received claiming that minimum age of the most recent image “0-1 years” is too rigid. The developer has changed the most recent image requirement 0-2 years. Other comments were made within this submission, however, it is the opinion of the verification team that these comments do not apply to the Tool, but rather to methodologies that may employ the Tool and is therefore not applicable to the Tool.

The assessment team confirmed that the comments have been adequately addressed by the developer and no outstanding issues exist with respect to the stakeholder comments.

3.3 Structure and Clarity of Methodology

The assessment team assessed whether the developer has followed the instructions in the methodology template and ensured that the methodology’s various criteria and procedures are documented in the appropriate sections of the template. It was found that the tool is structured according to the guidelines provided in the VCS Module Template that was current at the time of the tool’s original development and has since been updated to the most recent version of the VCS module template.

The assessment team considered whether the terminology used in the methodology is consistent with that used in the VCS Program, and GHG accounting generally and found that terminology used is

appropriate and consistent with both the VCS program and general practice in greenhouse gas accounting.

The use of the key words *must*, *should* and *may* was assessed in the tool. It was found that *must* was consistently used to denote firm requirements, *should* was used for non-mandatory recommendations, and *may* for permissible or allowable options.

The assessment team considered the overall clarity and structure of the tool during the assessment process to determine whether the tool is written in a clear, logical, concise, and precise manner, as well as considering whether the criteria and procedures are written in a manner that can be understood and applied readily and consistently by project proponents and whether the criteria and procedures are written in a manner that allows projects to be unambiguously audited against them. A number of findings were issued to seek additional information about the intent of the tool and to improve its clarity, and consistency. The complete text of these findings can be found in Appendix A with the proponent's response to each and a written evaluation by the audit team. A brief summary of the findings relevant to the structure and clarity of the tool follows below:

OFI2012.3, which asked the proponents to provide examples of the tool's use. The proponents responded by provided appropriate examples.

NIR2012.4, which asked for clarification regarding an unclear approach allowed by the tool. The proponents responded by removing the unclear approach from the tool altogether.

NIR2012.5, which noted an inconsistency in an equation used in the tool. The inconsistency was corrected.

NIR2012.6, which sought to reduce subjectivity arising from the use of jargon and procedures referenced without detailed explanations. The proponents responded by provided appropriate references.

NIR2012.7, which sought more clarification of language used in an applicability condition. The proponents responded by appropriately clarifying the language used.

NIR2012.8, which sought additional details about the steps required to demonstrate appropriate co-registration. The proponents responded by arguing that co-registration was outside the scope of the tool, and that the tool assumes images have been adequately spatially registered as appropriate to their acquisition source prior to use in the tool's procedures.

NIR2012.9, which sought to clarify that all images used by the tool must be resampled to a common coordinate system and pixel resolution. The proponents adequately clarified the language used.

NIR2012.12, which sought to clarify a discrepancy in time periods provided in an example. The proponents corrected the discrepancy.

NIR2012.15, which sought to clarify a discrepancy in a quantity applied in the example provided of the tool's use. The proponents corrected an error in the spreadsheet provided.

NIR2012.16, which sought clarification on the use of calculations related to various time periods for which calculations are made in the tool. The proponents clarified that it is methodologies that use the tool that must provide guidance for using the results of each of the calculation.

NIR2012.17, which sought additional guidance regarding the calculation of weights, used in calculating transition rates. The proponent responded by adding additional equations and explanation to the tool to clarify the use of weights.

NIR2012.18, which sought references for quantitative techniques, employed by the tool that project proponents may not be familiar with. The proponents responded by including appropriate references and additional descriptions of the techniques in the tool.

Overall, after these findings were adequately addressed, the assessment team found the tool to be appropriately structured and adequately clear.

3.4 Definitions

The assessment team considered whether all key terms are defined clearly and appropriately. The team found that the term "orthorectified" was not defined in the Tool and that its definition was important for accurate interpretation of the tool. NIR2012.11 was issued, seeking the addition of this definition. The proponents responded by adding an appropriate definition to the tool. After this change was made, the assessment team found that key terms were clearly and appropriately defined. The terms in the definitions section are listed in alphabetical order, and terms already defined under the VCS were not redefined in the tool.

3.5 Applicability Conditions

The tool is contains six applicability conditions:

1. There is at least one Incomplete Remote Sensing Image in the Area of Interest due to reasons beyond the control of the proponent. Reasons beyond the control of the proponent comprise either (a) atmospheric conditions such as cloud and shadow cover, dust or smoke, (b) sensor related errors such as anomalous speckles, data saturation, spatial offsets or corrupt data, or (c) seasonal effects such as phenology, fire, water saturation, snow.

This condition is necessary for use of the tool, as the entirety of the tool is dedicated to estimating historical deforestation rates from incomplete images in areas where complete images are not available. Because the condition limits use of the tool to circumstances in which missing data is outside of the control of the project proponent and falls into the natural or technical reasons listed, there is no reason to expect that the environmental integrity of the project activity will be compromised under this scenario of incomplete data.

The condition is clear, as the important terms "Area of Interest" and "Incomplete Remote Sensing Image" are clearly defined in section 3 of the tool. Conformance with the condition can be demonstrated at the time of project validation by enumerating all available images and demonstrating that they meet the definition of Incomplete provided in section 3 of the tool.

2. During the time period during which Incomplete Remote Sensing Images are used, no other complete remote sensing images exist in a Remote Sensing Data Archive that is practically available to the proponents at the time the classification work is conducted.

This condition is important because if complete images are available, they will provide a more accurate estimate of deforestation rates in the Area of Interest than incomplete images. The condition therefore serves to protect the principles of accuracy and conservativeness. The condition is clear and precise, and conformance with the condition can be demonstrated at the time of project validation by enumerating all available images and demonstrating that they meet the definition of Incomplete provided in section 3 of the tool.

3. All source imagery must be orthorectified to remove the effects of image perspective (tilt) and relief (terrain) effects for the purpose of creating a planimetrically correct image. The resultant orthorectified image has a constant scale wherein features are represented in their 'true' positions. It is recommended that the maximum off-nadir angle of source imagery is less than or equal to 30°.

This condition was added in response to concerns raised by the assessment team in NCR2012.1 and is necessary because the tool uses a pixel count as a proxy for area. Inherent in the method is the assumption that all pixels represent the same area. This condition ensures that this assumption is valid. It is clearly stated (the term Orth0rectified is clearly defined in section 3 of the tool). It can be demonstrated at validation by documentation of the process by which the images in use of been pre-processed.

Conditions 4 and 5 are considered together:

4. All source imagery must be co-registered into a common coordinate system to a RMSE of less than or equal to one pixel. The co-registration is the process of matching the location of an object across multiple images taken at different time[1].
5. All the classified remote sensing images must be re-sampled to a common pixel resolution matching the highest resolution (i.e. smallest pixel size) of the images used. For example, if data sources are used when one image has a resolution of 30 m and another has a resolution of 15 m. The images must be resampled into a common spatial resolution of 15 m. It must also be ensured that all the classified remote sensing images have same common origin.

In reviewing the tool, the assessment team determined that high quality spatial registration is an extremely important assumption underlying the tool's quantitative estimates of deforestation rate. If image registration is not of high quality, the transition rates calculated by compositing images could result from spatial mismatch of pixels, rather than from actual change in land cover or land use in the Area of Interest. These conditions seek to verify that the assumption of high quality spatial registration is valid. The assessment team issued a number of findings aimed at clarifying these conditions. Concerns were raised about the methods used for co-registration and the interpretation of the maximum allowable error of one pixel. The proponent clarified that the pixel size refers to the resolution of the highest resolution image in use, and that all images were to be resampled to a common pixel size and coordinate system prior to use within the methodology. Additionally, the proponent argued that the specific methods used to register the images are outside the scope of the

tool, that registration is often carried out by a party other than the project proponent (such as an image vendor), and that the tool is only applicable when it can be demonstrated that all source imagery is co-registered with a spatial error of less than one pixel, regardless of the methods used. The assessment team accepted this separation of scope. However, we note that, at project validation, the spatial registration of source images should be carefully assessed according to whatever methods are most appropriate to the image registration techniques employed for the project's data to ensure that the one pixel requirement is met and that the estimate of registration error is robust and unbiased. The consequence of poor registration is likely an overestimate of the number of changed pixels in the area of interest, which may lead to estimates of baseline deforestation that are not conservative. Nonetheless, if the co-registration requirements specified in this applicability condition are met, any such error should be minimized. Thus, the applicability conditions are appropriate to the tool and when the condition is met, the tool should provide appropriate accuracy.

6. Available images that do not meet overall quality criteria are not to be included in this procedure. Quality criteria include seasonality effects (phenology, water saturation, and snow), overall cloud cover, and atmospheric distortion from haze and thin clouds such that remaining non-missing pixels are too few or too compromised to be useful in the analysis.

This condition ensures that the tool is only used when high quality remote sensing data is available. The assessment team concluded that the condition is appropriate for identifying relevant imagery and helps to ensure accuracy of resulting estimates of deforestation rates. Conformance to the applicability condition can be met at the time of project validation by reviewing the images used subjectively and assessing them against the listed criteria.

As whole, the assessment team found that the applicability conditions are appropriate to ensure that the tool is only used with high quality data and that the underlying assumptions of the methods described are valid.

3.6 Project Boundary

Assessment of project boundary is not applicable to the tool. The tool is not used to determine any physical boundaries or the inclusion or exclusion of any GHG sources, sinks, or reservoirs.

3.7 Baseline Scenario

The tool is only applicable to VCS-approved methodology that requires the use of remote sensing images to calculate historical deforestation rates and land-transition matrices for determining the baseline scenario. However, the tool itself is only used for calculating those historical deforestation rates required by a VCS approved methodology, and does not in itself determine baseline scenarios. Assessment of the criteria and procedures for determining baseline scenarios is therefore not applicable to the tool.

3.8 Additionality

The tool does not contain any content relevant to assessing additionality, and is only to be used with an approved VCS methodology. Assessment of additionality is not applicable for this tool.

3.9 Quantification of GHG Emission Reductions and Removals

3.9.1 Baseline Emissions

The tool is used for estimating historical deforestation rates which are used by an approved VCS methodology for estimating baseline emissions. Consequently, the tool itself is not used to estimate baseline emissions, but it provides parameter values that contribute to the baseline emissions estimates produces by other methodologies. As such, the technical approach used is described here.

The general approach of the tool is to use multiple incomplete images as a substitute for a single complete image when calculating deforestation rates. This can be accomplished by using one of two approaches.

In approach (A), composite land use/land cover maps are produced by combining non-missing data from several images that contain missing data. These composite maps are then used to produce composite change maps from which change rates are calculated.

Approach (B) is quantitatively similar, but uses many pairs of images at different points in time to estimate the deforestation rate instead of compositing images.

Both approaches were quantitatively reviewed using excel spreadsheets with dummy data, including both data provided by the proponent and data generated by the assessment team. The algorithms, equations, and formulas used were deemed appropriate. The tool contains appropriate guidelines for estimating the uncertainty of the resulting deforestation rate estimates.

3.9.2 Project Emissions

The tool is used only for estimating deforestation rates from historical images, and is not used for project monitoring. It contains no procedures for calculating project emissions and removals. An assessment of project emissions calculations is not applicable to the tool.

3.9.3 Leakage

The tool is not used for calculating leakage. Assessment of leakage estimation procedures is not applicable to the tool.

3.9.4 Net GHG Emission Reductions and Removals

The tool is used only for estimating deforestation rates from historical images, and is not used directly for calculating net GHG emissions reductions and removals. An assessment of the procedures for calculating net GHG emission reductions and removals is not applicable to the tool.

3.10 Monitoring

The tool is used only for estimating deforestation rates from historical images, and is not used for project monitoring. Assessment of data, parameters and procedures for monitoring is not applicable to the tool.

4 ASSESSMENT CONCLUSION

The assessment team concludes that the Tool for Calculation Deforestation Rates Using Incomplete Remote Sensing Images v 8-0 is in full conformance with the assessment criteria. It is the recommendation of the assessment team that the VCSA approve the methodology element

5 REPORT RECONCILIATION

The assessment team has reviewed and assessed the updates to the Tool and the Second assessment report performed by Det Norske Veritas (U.S.A.) Inc. and confirms that the changes made to the Tool do not change the original opinion of SCS. For a complete list of changes see below:

- The assessment team confirmed that changes to the improper use of key words “can” and “shall” are appropriate requests by the second assessment team. The assessment team confirmed that the use of the words “should” and “must” have been appropriately applied as per the requirements of the template
- The assessment team confirmed that the Tool now conforms to the use of 10 point Arial font throughout the document
- The assessment team confirmed that version 2.0 has been changed to version 2.1 of the VCS VM0006 methodology, as it had been updated during the approval process of the Tool
- The assessment team confirmed that the improper wording in the definition of Incomplete Remote sensing Image has been corrected and a definition of Complete Remote Sensing Image has been added. The assessment team also confirmed that the definitions now use the correct formatting and are in alphabetical order
- The assessment team reviewed the rationale for implementing Step 8 of the Tool and confirmed that the revised definition of V to V(p1->p2) allows for the correct calculation of the transition rate
- The assessment team confirmed that the inclusion of the definition of “practically available” and the additional language as to what is meant by “Quality Criteria” is appropriate
- The assessment team reviewed the clarification requests from the second assessor and concludes that the changes in response to the clarification requests do not change the opinion of the assessment team
- The assessment team agrees that the updated title of the Tool is more appropriate as it provides a more holistic description for the use of the Tool.

6 EVIDENCE OF FULFILMENT OF VVB ELIGIBILITY REQUIREMENTS

The following evidence of fulfilment of SCS’ eligibility requirements is presented in accordance with Section 4.2 of the Methodology Approval Process.

SCS has completed ten project validations under sectoral scope 14 (AFOLU). A summary of the first ten project validations performed by SCS is as follows:

Project and Project ID	**Date validation report issued**	**Date project registered**	**Name of GHG program under which project registered**
INFAPRO Rehabilitation of logged-over dipterocarp forest in Sabah, Malaysia (672)	31-Aug-2011	2-Sep-2011	Verified Carbon Standard
Natural High Forest Rehabilitation Project on degraded land of Kibale National Park (673)	6-Sep-2011	6-Sep-2011	Verified Carbon Standard
Protection of a Tasmanian Native Forest (Project 3: Peter Downie) (587)	18-Mar-2011	7-Apr-2011	Verified Carbon Standard
Redd Forests Grouped Project: Protection of Tasmanian Native Forest (641)	13-May-2011	1-Jul-2011	Verified Carbon Standard
Protection of a Tasmanian native forest – Project 1 – REDD Forests Pilot (605)	18-Mar-2011	3-May-2011	Verified Carbon Standard
Boden Creek Ecological Preserve Forest Carbon Project (647)	24-Jun-2011	18-Jul-2011	Verified Carbon Standard
Peri-urban bamboo planting around South African townships (Project ID confidential)	8-Aug-2011	8-Dec-2011	Verified Carbon Standard
Tree planting in South African townships (Project ID confidential)	2-Sep-2011	8-Dec-2011	Verified Carbon Standard
Rimba Raya Biodiversity Reserve Project (674)	31-Aug-2011	7-Sep-2011	Verified Carbon Standard
Reforestation Across the Lower Mississippi Valley (774)	20-Apr-2011	14-Feb-2012	Verified Carbon Standard

7 SIGNATURE

Signed for and on behalf of:

Name of entity: _____*SCS Global Services (SCS)*_____

Signature: __  _____

Name of signatory: _____*Christie Pollet-Young*_____

Date: _____*13 May 2014*_____

APPENDIX A: FINDINGS ISSUED DURING THE ASSESSMENT PROCESS

NCR 2 dated 02/07/2012

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images, Approach A

Finding: The validator attempted to calculate a deforestation rate using the method of approach A using toy data. Please see the attached excel file for an explanation of this attempt (filename: ApproachA_ToyData_Demonstration.xlsx). These experiments resulted in deforestation rates that were not accurate or conservative. This indicates that either (a) the intended procedures were not described with sufficient clarity to be implemented by the validator as the tool's developers intended or (b) the approach provided overestimates the deforestation rate in the circumstances shown. Please review the examples provided, assess the cause of the demonstrated overestimations, and correct the tool by clarifying the approach intended or modifying the algorithm to ensure accuracy and conservativeness.

Client Response: Procedures have been completely reworked and documented in the revised version to ensure clarity and proper execution.

Auditor Response: The verification team assessed the revised tool and agrees with the client response and confirmed that the calculation of deforestation using approach A in the example now results in accurate and conservative estimates, therefore this NCR is now closed.

Closing Remarks: The Proponent's response adequately addresses the finding.

OFI 3 dated 02/07/2012

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images, Approach A

Finding: An example figure would clarify the intent of the locations that are to be masked in each change map as described in approach A step 4. The validator had to parse the language provided very carefully to fully understand the intended portions of each image that should be masked, and believes a figure would help ensure users of the tool apply it correctly.

Client Response: An example Excel workbook, "Tool Demonstration.xlsx", has been added to provide visual instruction and to clarify the procedures.

Auditor Response: The client has provided a workbook, replete with figures providing a stepwise approach to the procedures employed in "Approach A" of the Tool. In addition, the tool no longer requires the user to mask areas of missing data. The audit team considers this issue resolved; however, in reviewing the workbook "Tool Demonstration v5-0" the audit team encountered additional issues with the equation 2 in the workbook have led to the issuance of NIR 5.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 4 dated 02/07/2012

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images, Approach C

Finding: Approach C is described in an insufficient level of detail. Additionally, it is not clear how it differs from Approach A, as both apply an area weighted average of deforestation rates calculated from portions of imagery that are cloud free, relying on multiple sets of images to achieve representative coverage of the areas under assessment. Please provide a more detailed description of approach C for review, explaining how it differs from approach A and giving detailed procedures for estimating the deforestation

rate in each set of images and combining the separately estimated rates to obtain a project-level rate.

Client Response: Approach C has been removed.

Auditor Response: As stated in the client response, Approach C has been deleted from the tool. The removal of Approach C from the Tool sufficiently addresses this issue.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 5 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images, Approach A; Tool Demonstration v5-0

Finding: In response to OFI 3, the client has provided a workbook, replete with figures providing a stepwise approach to the procedures employed in "Approach A" of the Tool. In addition, the tool no longer requires the user to mask areas of missing data. In reviewing the workbook "Tool Demonstration v5-0" the audit team encountered an incongruity with equation 2, as it is used in the workbook and how it is explained in the tool.

In the spreadsheet example, Cells O118, 119, and 120 utilize valid pixel count for variable V in equation 2; however the text description in the tool for variable V reads "V = Fraction of valid pixels (to normalize for remaining cloud/shadow cover)."

Please provide the rationale for the lack of agreement between the two work products and amend the appropriate document if applicable.

Client Response: The use of word 'fraction' was changed. Here 'V' represents total number of valid pixels used in developing the composite maps. This is used to weigh the transition rate based on the number of pixel. In the demonstration tool, the valid pixels were incorrectly applied. The valid pixels are sum of all the pixels that were used in assessing the transitions across the time periods.

"Total number of pixels that were used in preparing the composite land-use change maps (to normalize for remaining cloud/shadow cover)."

Auditor Response: The revisions to the tool have resulted in the equation referenced in the finding now referring to the total number of pixels rather than a fraction, therefore resolving this issue.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 6 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: Throughout the Tool, the text uses verbiage that is obviously intended for users who are well versed in both remote sensing techniques and standard practices. Examples include section 5.2 (step 1) “reasonable quality criteria” and section 5.2 (step 2) "Conduct classification." Presumably, the methodology that is to be used alongside this tool provides more complete guidance; however this is not made clear in the tool. It is the opinion of the audit team that the users of the Tool would benefit from the text being more explicit about the steps or measurables required to demonstrate that requirements are met.

Client Response: We realize that the phrase ‘reasonable quality criteria’ is not explicit. After all, the image is of quality if the primary information – the land cover/land use – can be identified. The applicability criteria and steps 2 and 3 ensure the quality sought form the image. Thus, we removed the phrase ‘reasonable quality criteria’ from the text.

To explicitly describe the image classification for non-technical audience, we modified step 2 for both approach A and B as below:

"Conduct classification on all acquired images according to the appropriate land use and land-cover (LULC) class; classify areas with missing data according to the reason, e.g., cloud, smoke, scan line correction problem, etc. The image classification must result in appropriate land use/ land cover (LULC) categories using established procedures. The land cover class used during classification of the Remote Sensing images shall be compatible with the definitions from the Intergovernmental Panel on Climate Change’s Good Practice Guidance for Land Use, Land-Use Change and Forestry 2003 report (IPCC GPG-LULCF, 2003) for forest, cropland, grassland, settlement, wetland and other land."

Auditor Response: The verification team reviewed the revised tool and confirmed that the added language provides basic guidance to enable the user to determine the steps or measurables necessary to determine if the requirements of the tool have been met. The information provided in the revised tool is sufficient for closing this information request.

Closing Remarks: The Proponent’s response adequately addresses the finding.

NIR 7 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: The first applicabilicability condition is quite lengthy and appears to contain two unique

conditions. It is the professional judgment of the audit team that the user of the Tool would benefit from the second sentence being a separate, standalone applicability condition.

Client Response: The applicability criteria is lengthy but these two issues are related. However, we split the applicability criteria into two. as below:

• There is at least one Incomplete Remote Sensing Image in the Area of Interest due to reasons beyond the control of the proponent. Reasons beyond the control of the proponent comprise either (a) atmospheric conditions such as cloud and shadow cover, dust or smoke, (b) sensor related errors such as anomalous speckles, data saturation, spatial offsets or corrupt data, or (c) seasonal effects such as phenology, fire, water saturation, snow.

• During the time period during which Incomplete Remote Sensing Images are used, no other complete remote sensing images exist in a Remote Sensing Data Archive that is practically available to the proponents at the time the classification work is conducted.

Following footnote was also added for additional clarity:

"Most imagery from image vendors come co-registered. If the images are not co-registered, these images must be registered to a common coordinate system using appropriate image pre-processing techniques and using known sets of ground control points. "

Auditor Response: As stated in the client response, the applicability conditions have been re-written to provide more clarity. The revisions to the applicability conditions of the tool are sufficient for closing this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 8 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: Applicability condition three requires that the user co-register all sources of imagery; however, the requirement is not clear as to what is involved in this process. For example, the condition does not express how many control points are necessary is assessing RMSE or how the control points should be distributed. Additionally, the tool is not clear as to what images are being registered. For example, the audit team can conceive of a scenario in which in which image 1 and 2 differ by 1/2 pixel and image 2 and 3 differ by 3/4 pixel. Given this scenario, image 1 and 3 may differ by > 1 pixel. Finally, it is unclear as to the meaning of RMSE in instances where pixel sizes differ.

Please provide additional guidance as to the process for co-registration with respect to control points. In

addition, please provide additional guidance as to how all source imagery is being co-registered. Finally, please provide additional guidance as to the meaning of RMSE in cases where pixel sizes differ.

Client Response: Co-registration is simply a process of aligning images. The spatial accuracy of orthorectified imagery is completely unrelated to spatial resolution. The size of a pixel has no physical bearing on the accuracy of its location in the ground coordinate system. Spatial accuracy depends only on the quality of the georeferencing, either as applied from ground control with aerotriangulation or provided by direct georeferencing. Thus, the differing pixel sizes would bring no issues with regards to RMSE.

There is not 'ideal approach' or 'simple algorithm' to select number of ground control points (GCP) and their distribution. This is really dependent on the 'quality of control' points, 'distortion' on image and mathematical equations being used to apply the correction (dependent on order of polynomial equations). For example, first order polynomial requires at least 3 GCPs and fourth third order polynomial requires at least 10 GCPs. The only thing that can be objectively verified is the amount of error in the resultant image.

This error is known as RMSE and as a rule of thumb the RMSE value of less than one pixel is considered good.

The co-registration is an applicability criteria and the tool is applicable when a set of co-registered images are available. Both registration and georectificaiton are 'pre-processing' steps and the tool assumes that such steps have already been completed and are outside of the scope of this tool. We added some guidance around the registration as below:

• All source imagery must be co-registered into a common coordinate system to a RMSE of less than or equal to one pixel. The co-registration is the process of matching the location of an object across multiple images taken at different time .

Auditor Response: Based on the response provided by the client, along with additional discussions between the developer and the verification team, the auditors agree the argument that the additional guidance requested constitute pre-processing steps and can be considered outside the scope of this assessment. The information provided is sufficient for closing this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 9 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: The fifth applicability condition requires that "All the classified remote sensing images must be re-sampled to a common pixel resolution."

It is the professional judgment of the audit team that these images must also be re-sampled to a common origin (i.e. the same coordinate system). Whereas, this may be assumed by anyone familiar with the techniques being describing, this should be explicitly stated in the Tool.

Please amend the Tool to include additional guidance on re-sampling of the classified remote sensing images.

Client Response: When the images are co-registered, images will have a common origin. Given the fact that the images used are orthorectified and co-registered to a common map unit, it would always be the case that the images being resampled to a common pixel size have same origin. Again, the resampling of image to a common cell size is pre-requisite to implementation of this tool. We have attempted to incorporate suggestion from the validator to provide additional guidance on resampling. But the important thing to understand is that the tool is indeed a specialized tool and this entire tool is about using the already proven technology of remote sensing in assessing the rate of change in land use/land cover and we believe that some of the complexity coming from technical terminology is and will remain an integral part of this tool.

• All the classified remote sensing images must be re-sampled to a common pixel resolution matching the highest resolution (smallest pixel) of the images used. For example, if data sources are used when one image has a resolution of 30 m and another has a resolution of 15 m. The images must be resampled into a common spatial resolution of 15 m. It must also be ensured that all the classified remote sensing images have same common origin.

Auditor Response: As stated in the client response, additional guidance has been provided in the tool with respect a common pixel resolution and coordinate system. The revised tool now provides adequate guidance on resampling and therefore is sufficient for closing this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 10 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing

Images

Finding: The fourth applicability condition states that "The maximum off-nadir angle of source imagery is less than or equal to 30°."

The audit team is not sure how the developer has decided on this limit or as to its significance.

Please provide supportive literature or other rationale for the less than or equal to 30° limit reported in the tool.

Client Response: It is rarely the case in commercially available satellite remote sensing product where the nadir is off by over 30 degrees. The possibility of wider nadir does exist if aerial photographs are used. It was the professional experience of the developer that it takes a lot of time to correct the images when the nadir is over by 30 degrees. Technically, any image can be corrected, but the quality seems to degrade as we use the images that are off by large nadir angle. However, we have combined this applicability criterion to 'orthorectification' applicability criteria.

Auditor Response: The revisions to the applicability conditions provide greater clarity as to the rationale for the maximum off nadir of 3o degrees. The revision to the Tool is sufficient for closing tis finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 11 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: Applicability condition two states that "All source imagery must be orthorectified."

It is the professional judgment of the audit team that the term "orthorectified" is a "key term" and integral to the proper use of the Tool.

Please update the Tool to include a definition of "orthorectified."

Client Response: We added the following definition for Orthorectification.

• Orthorectification. Orthorectification is a process of removing sensor, satellite/aircraft motion and terrain-related geometric distortions from raw imagery and converting these raw images into planimetric maps. Orthorectified data sets are required for thematic image analysis, for data fusion and analysis of data from different sources or seasons, when overlaying images with existing data sets and maps, or using them for

evaluations like change detection and map updating.

Auditor Response: As stated in the client response a definition for 'orthorectication' has been added to the Tool and therefore sufficiently addresses the issue raised in this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NCR 12 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: Section 5.2 of the Tool defines the three remote sensing time periods as follows:

(1) period 1 - from 5 until 15 years before the start of the crediting period;

(2) period 2 - from two years until 5 years before the start of the crediting period, and;

(3) period 3 - start of the crediting period until 2 years before the start of the crediting period.

Additionally, footnote 3 states that "Years are to be counted as calendar years. For example, if the starting date is March 11, 2013, the three periods are (1) March 12 2011 – March 11, 2013, (2) March 12 2008 – March 11 2011, and (3) March 12 1998 – March 11 2008."

Based on the above text there appears to be a disagreement in the nomenclature between these two sections of the Tool.

Please update the Tool to correct the disagreement between these statements.

Client Response: Changed the 'calendar year' in foot note to 'Common Year'. The footnotes was also modified to correct the error related to which time period corresponds to which years. The edited footnote is shown below:

"Years are to be counted as common years. For example, if the starting date is March 11, 2013, the three periods namely 1, 2 and 3 are respectively (Period 1) March 12 1998 – March 11 2008, (Period 2) March 12 2008 – March 11 2011, and (Period 3) March 12 2011 – March 11, 2013."

Auditor Response: As stated in the client response, footnote 6 in the revised Tool has been amended and is now in agreement with other sections of the Tool. The revision to the Tool is sufficient for closing this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 13 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: The specification of the time periods in which historical imagery can originate appears to speak specifically to the VCS Methodology VM0006; however, it is not clear as to how the Tool addresses other methodologies in which the historical time periods differ from those listed in the Tool.

Please provide evidence as to how the Tool will address instances in which methodologies that employ different time periods are used in concert with this Tool.

Client Response: This is a good point. However, the tool cannot address the requirements of current and future methodologies. Also, it is not tool which determines if this tool can be used by a methodology. If a methodology allow use of the tool, the methodology must take necessary precaution or changes so that the tool can be used within that methodology.

We have revised the tool to make the procedure more flexible. The historical remote sensing image analysis and deforestation trend analysis requires that at least two sets of images from which rate is derived. Various methodologies use two or more LULC maps to detect the change and assess deforestation. The three time point approach was used in VM0006 and while other methodologies may require only two or more than three. We have revised the language in the tool such that images from two or more periods can be used.

For approach (B), the time period requirement is relatively straightforward. We also revised step 3 to address the issues related to time period in Approach B.

At the very beginning of the tool, we were advised by the VCS that the tool must not specifically refer to existing or future methodology regarding the applicability of the tool and that the tool must be devised such that it can be applied as a standalone entity. The reason that the procedures in this tool seem to be guided by the provisions in VM006 is due to the fact that the developers of this tool and VM006 are same, but there is no requirements whatsoever for this tool to be used in conjugation with VM006 or other (existing or future) methodologies. For example, if the VM006 (or any other applicable methodology) intends to make use of this tool, such methodologies must explicitly provide procedure or options to using this tool (for estimating the rate of historical deforestation rate from incomplete imageries) and ensure that provisions in such methodologies satisfy the applicability criteria of this tool. It is up to the developer of

the methodology who wish to make use of this tool to provide procedures so as to allow this tool if desired. Therefore, the tool therefore does not have to ensure compliance with existing methodologies.

Auditor Response: As stated in the client response, the language in the Tool was revised to provide greater flexibility, as well as providing justification as to why this Tool is not relagated to the use of VM0006 exclusively. The information provide is sufficient for closing this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NCR 14 dated 12/15/2013

Standard Reference: The VCS Standard Section 4.1.4

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: The VCS Standard states that "Methodology elements shall be guided by the principles set out in Section 2.4.1." Section 5.2 (Step 3) of the Tool states that "3. Verify that 80% of all pixels within the Area of Interest have an identified LULC class…"

Additionally," If for one of the three periods, more than 20% of all pixels within the Area of Interest are classified as missing data within all images of that time period, approach A is not eligible or additional remote sensing imagery must be obtained for that time period or project areas must be reduced by excluding areas classified as missing data."

It is the professional understanding of the audit team that in many cases, high elevation areas (more difficult to access for deforestation) tend to have an unequitable distribution missing data due to clouds. In such situations it is possible that the majority of missing data across areas of high topographical diversity will include high elevation areas. If such situations were to occur it is likely that landuse change over time would overestimate historical deforestation rates and therefore not provide conservative estimates.

Please provide evidence that the requirements in section 5.2 (Step 3) of the Tool will result in conservative estimates of historical deforestation rates.

Client Response: Our original response prior to the retraction of NCR was:

While is it required that 80% of the area of interest must have valid LULC at each time period, the actual rate of deforestation is only estimated from non-missing data. The tool is used only in combining multiple imagery that would otherwise not qualify under certain methodologies.

The possibility exclusion of areas that happen to fall in 'missing data' region that are pristine or have lower deforestation may also be present even when there is data available. For example, project proponents can select only the areas for the project that are at the verge of deforestation and systematically exclude areas that do not experience higher rate of deforestation. Thus, even when we have enough data (say 100% coverage), the project proponent may simply exclude those 'high elevation' areas because such areas are not the areas where a REDD project can fit and function. The idea of REDD project is to target areas that are experiencing high rate of deforestation and therefore, it is natural and acceptable form of management to target only the areas that have higher rate of deforestation. In addition, if clear shots of satellite images are not available, these areas will be excluded any way.

Auditor Response: The verification team received justification of this process that led to further discussions between the project developer and the verification team. Upon the completion of these discussions, the verification team agrees with the justification of the developer that the issues raised in this finding are applicable to project implementation and not to the functionality of the Tool. Based on this realization, the verification team has decided to retract this finding, as it is not applicable to the Tool being assessed.

Closing Remarks: The Proponent's response adequately addresses the finding.

NCR 15 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool Demonstration v5-0

Finding: The example provided in the Tool Demonstration v5-0 fails to provide a clear demonstration of the instructions defined in section 5.2 (Step 7) of the Tool. The Tool states that "Only when no data is available for period 2 for a specific pixel, shall that pixel be represented in the land-use change map from period 1 to 3." It appears; however, that the example calculates the transition rate for period 1-3 using all pixels.

Please provide evidence that the example is following the requirements of the Tool, or otherwise clarify the intended behavior of the calculation.

Client Response: That was error. Yes, the pixels for which deforestation rates have already been assessed in previous periods, do not need to be assessed during periods 1-3. We have changed the demonstration excel file. Specifically, we have added, "not assessed" category for the change map representing transition between first and last periods.

Auditor Response: As stated in the client response, the excel file containing the tool demonstration now includes a category for periods 'not assessed' which corrects the error referred to in this finding. The changes to the excel file adequately address the issue raised in this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 16 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images; Tool Demonstration v5-0

Finding: It is unclear to the audit team how the three time periods are to be used at the end of Approach A. Whereas, this may be explained within the methodology being used in concert with this Tool, as it stands alone, the aggregation of the three time periods may result in double counting.

Please amend the Tool to provide greater clarity on how and when to use each of the following or greater clarity on how they should be aggregated to avoid double counting:

tr_(LULC1→LULC2) (p1→p2), tr_(LULC1→LULC2) (p2→p3), tr_(LULC1→LULC2) (p1→p3).

Client Response: We have added some guidance with a graph in the tool at end of the step 8 in section 5.2. The graph was produced using the demonstration data in the excel file.

Auditor Response: As stated in the client response, guidance has been added to the Tool to ensure that double counting does not occur. The guidance provided adequately addresses the issue raised in this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NIR 17 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: Section 5.3 (Step 4) of the Tool states that "However, the number of points used in the calculation of the relative transition rate may vary as a function of the amount of data that is non-missing. Therefore, subsequent calculations must be based on statistics that are using n1+n2 as weights when compiling different values of the relative transition rates into an aggregated rate."

Please supplement the requirement above with guidance (e.g. a formula) prescribing how the weighted statistics are to be calculated.

Client Response: Section 5.3 (Step 3.a) was elaborated to address the concern. The revision provides guidance and formula to calculate the weighted statistics based on n1+n2.

Auditor Response: As stated in the client response, the Tool was revised to include guidance to

calculate the weighted statistics based on n1+n2. The revised Tool sufficiently addresses the issue raised in this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

NCR 18 dated 12/15/2013

Standard Reference: NA

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: It is the professional judgment of the audit team that both the bootstrap technique referred to in section 5.3(4)(a) and the loess regression technique discussed in 4(b) are not adequately explained in the text.

Please amend the Tool to provide more guidance or appropriate references for applying and assessing these techniques.

Client Response: Given the scope of the tool, we are in the opinion that the tool must limit itself from illustrating most basic scientific functions. With this view, we provided an elaborated description of both bootstrapping and loess regression.

Auditor Response: The verification team reviewed the revised Tool and confirmed that the additional language regarding bootstrapping and the loess regression is adequate for applying and assessing these techniques and therefore is sufficient for closing this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.

OFI 19 dated 12/15/2013

Standard Reference: VCS Standard section 4.1.4

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: The VCS Standard states that "Methodology elements shall be guided by the principles set out in Section 2.4.1. They shall clearly state the assumptions, parameters and procedures that have significant uncertainty, and describe how such uncertainty shall be addressed. Where applicable, methodology elements shall provide a means to estimate a 90 or 95 percent confidence interval. Where a methodology applies a 90 percent confidence interval and the width of the confidence interval exceeds 20 percent of the estimated value or where a methodology applies a 95 percent confidence interval and the width of the confidence interval exceeds 30 percent of the estimated value, an appropriate confidence

deduction shall be applied"

Additionally, the section 5.3 (Step 4) states that "Only transition rates with a confidence interval width less than 15% of the mean may be used in any subsequent calculations."

Whereas, the procedures for calculating uncertainty in the Tool seem appropriate, there is no guarantee that uncertainty from many parameters will not propagate to a larger uncertainty. Given that methodologies, particularly VM0006, referenced in the Tool, provide procedures for handling uncertainty, it is the professional judgment of the audit team that it should be sufficient to just provide the means to calculate each value and its associated uncertainty and let the methodology handle the propagation analysis.

Client Response: This is a valid point. We have removed the clause related to require CI.

Auditor Response:

Closing Remarks: The Proponent's response adequately addresses the finding.

NCR 20 dated 04/10/2014

Standard Reference: VCS Methodology Approval Process Section 3.2.2

Document Reference: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images

Finding: The VCS rules require that "Methodologies and methodology revisions shall be prepared using the VCS Methodology Template and modules and tools shall be prepared using the VCS Module Template. All instructions in the templates must be followed. The methodology element documentation shall state clearly the date on which it was issued and its version number."

A new version of the VCS Module Template (V3.3) was released on 8 October 2013 and is effective immediately. Whereas, methodological elements already under development at the time of this update, may be allowed a grace period for use of the new version until 8 April 2014, that date has passed. Therefore, use of the out-of-date template constitutes non-conformity with respect to the VCS rules. Please update the tool to use the current version of the VCS Module template (v3.3).

Client Response: We transformed the tool document into most recent template V3.3. from VCS. In addition, we also added some acronyms used in the tool under Definition section and corrected minor typographical error that were identified during the revision.

Auditor Response: The revised Tool now uses the latest version of the VCS Module Template and is now in conformance with the Rules of the VCS with respect to this finding.

Closing Remarks: The Proponent's response adequately addresses the finding.