DNV·GL

31 August 15

VERIFICATION REPORT: "2ND ASSESSMENT - TOOL FOR CALCULATING LULC TRANSITIONS AND DEFORESTATION RATES USING INCOMPLETE

REPORT № 2013-9201

REVISION NO. 01

Methodology Element Title	Tool for Calculating LULC Transitions and Deforestation Rates Using Incomplete Remote Sensing Images	
Version	Version 9-3 Dated 17 August 2015	
Methodology Element Category	Methodology	
	Methodology Revision	
	Module	
	Tool	**X**
Sectoral Scope(s)	Sectoral Scope 14 - AFOLU	

Report Title	2nd Assessment - Tool for Calculating LULC Transitions and Deforestation Rates Using Incomplete Remote Sensing Images
Report Version	Version 01
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Pages	16
Date of Issue	31 August 2015
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Reviewed By	Edwin Aalders
Work Carried Out By	Andres Espejo (Lead Assessor); Alfredo Fernández (RS Expert)

Summary:

Det Norske Veritas (U.S.A.), Inc. (DNV GL) has performed a second assessment of the "Tool for Calculating LULC Transitions and Deforestation Rates Using Incomplete Remote Sensing Images" to confirm that the methodology design, as documented, is sound and reasonable and meets the identified criteria. The validation was performed on the basis of VCSA requirements for VCS methodologies, as well as criteria given to provide for consistent project operations, monitoring and reporting. The validation was conducted by means of document review, follow-up interviews, and the resolution of outstanding issues. The review of the methodology documentation and the subsequent follow-up interviews has provided DNV GL with sufficient evidence to determine the fulfilment of stated criteria.

The proposed MED provides a specific method for determining Land Use Land Cover (LULC) transition rates when available remote sensing imagery is incomplete beyond the control of the project proponent, e.g. (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.

The assessment identified 4 CARs, 9 CLs and 1 OBSs. The CARs and CLs were satisfactorily addressed by the project participants by among other revising the MED

In summary it is DNV GL's opinion that the MED "Tool for Calculating LULC Transitions and Deforestation Rates Using Incomplete Remote Sensing Images", Version 9-3 as described therein, is in compliance with the methodological requirements set in AFOLU requirements: VCS Version 3.4 and VCS Version 3.5. Hence, DNV GL recommends the approval of the proposed tool.

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1 INTRODUCTION

1.1 Objective

The purpose of a second methodology element assessment is to have an independent third party assess the Methodology Element Documentation's (MED) conformance with the requirements and principles set out in the *VCS Standard* as well as whether the methodology conforms with scientific and other best practices.

1.2 Summary Description of the Methodology Element

The proposed MED provides a specific method for determining Land Use Land Cover (LULC) transition rates when available remote sensing imagery is incomplete beyond the control of the project proponent, e.g. (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.

2 ASSESSMENT APPROACH

2.1 Method and Criteria

2.1.1 *Method*

The assessment was based on the recommendations of the VCS Validation and Verification Manual /6/ as required by VCS standard Version 3 /1/.
The validation consisted of the following five phases:

I a desk review of the MED
II follow-up interviews with project stakeholders
III the resolution of outstanding issues
IV Internal quality control
V Issuance of the final assessment report

2.1.2 *Criteria*

The MED is reviewed against the criteria stated in the VCS standard Version 3 Requirements Document:

Ref.	Document
/1/	VCSA: VCS standard: VCS Version 3.5, 25 March 2015
/2/	VCSA: AFOLU requirements: VCS Version 3.4, 8 October 2013
/3/	VCSA: Program Definitions: VCS Version 3.5, 8 October 2013
/4/	VCSA: JNR Requirements: VCS Version 3.2, 30 October 2014
/5/	VCSA: AFOLU Non-Permanence Risk tool: VCS Version 3.2, 4 October 2012
/6/	VCSA: Validation and Verification Manual, Version 3.0, 4 October 2012
/7/	VCSA: VCS Module/Tool Template, Version 3.3, 8 October 2013
/8/	IPCC (2006): 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the

Ref.	Document
	National Greenhouse Gas Inventories Programme. Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds).Published: IGES, Japan
/9/	IPCC, 2003: Good Practice Guidance for Land Use, Land-Use Change and Forestry, prepared by the National Greenhouse Gas Inventories Programme, Jim Penman, Michael Gytarsky, Taka Hiraishi, Thelma Krug, Dina Kruger, Riitta Pipatti, Leandro Buendia, Kyoko Miwa, Todd Ngara (eds). Published: IGES, Japan. URL: http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html
/10/	GOFC-GOLD, 2014, A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation. GOFC-GOLD Report COP20 version 1, (GOFC-GOLD project office, Natural Resources Canada, Alberta Canada).

2.2 Document Review

The following tables list the documentation that was reviewed during the assessment

Ref.	Document
/11/	Terra Global Capital LLC: Methodology Element Document "Tool for Calculating LULC Transitions and Deforestation Rates Using Incomplete Remote Sensing Images" including excel spreadsheet "Tool Demonstration v6-0" -First version DRAFT 8.0 dated 14 April 2014 -Final version 9-3 dated 17 August 2015
/12/	Terra Global Capital LLC: Methodology Element Document Approved VCS Methodology VM0006, Version 2.1.

2.3 Interviews

DNV held various interviews with the methodology proponents.

Date	Name	Organization	Topic
4 September 2014	Benktesh Sharma (Principal)	Terra Global Capital	- Kick-off meeting
27 November 2014	Benktesh Sharma (Principal)	Terra Global Capital	- Discussion on findings
26 December 2014	Benktesh Sharma (Principal)	Terra Global Capital	- Discussion on findings

2.4 Assessment Team

The validation team is in accordance with the requirements of the VCS Version 3.5.

Role	*Last Name*	*First Name*	*Country*	*Type of involvement*

				Project management	Desk review	Interviews	Reporting	Supervision of work	Technical review	TA 14.1 competence	VCS AFOLU expert
Project Manager	Silon	Kyle	USA	✓							
Team leader (Assessor)	Espejo	Andres	Spain		✓	✓	✓	✓		✓	✓
Expert	Fernández	Alfredo	Spain		✓		✓			✓	
Technical reviewer	Aalders	Edwin	Norway						✓	✓	✓

Team Leader: Andrés Espejo.

Mr. Espejo is a Natural Resource and Forestry Engineer, with strong technical expertise in quantification and modelling of biomass and carbon in the Agriculture, Forestry, and Other Land Use (AFOLU) sector, and also with extensive experience in monitoring, reporting and verification (MRV) of AFOLU carbon offset projects, programs and initiatives under the main standards, i.e. Afforestation /Reforestation under CDM, REDD under VCS, MRVs of REDD national initiatives, JNR requirements, etc. Additionally he has expertise in forest inventory, cruising, forest management and operations, forest certification, and financial analysis of various types of projects. He has validated/verified more than 30 AFOLU projects under the VCS or the CDM standard, and he has participated in the assessment of 3 VCS methodologies. He is qualified VCS AFOLU expert for REDD and IFM categories and he is qualified VCS JNR Expert.

Technical reviewer: Edwin Aalders.

Mr Aalders has 20 years of experience as an assessor in Environmental Auditing and Policy and Management. Mr Aalders started his career in SGS in 1992 were he quickly became involved in the development of new environmental certification & control services. In 2004 he became the Director of the International Emission Trading Association (IETA) which he held till 2009. In addition to his role as Director in IETA he was the first CEO for the Verified Carbon Standard Association (VCSa) between November 2007 and October 2008. After leaving IETA Mr Aalders became a Partner with IDEAcarbon before joining DNV GL as at their Climate Change and Sustainable Development Department in 2011.

Throughout his career Mr Aalders lived and worked in the various developing and developed countries, particularly Latin America, Africa and Australasia, involved in developing new environmental markets services. At SGS his work covered the development of environmental programmes such as SGS' Services in for Climate Change, Marine Stewardship Council (MSC), Organic, GLOBALGAP and Forest Stewardship Council (FSC). Whilst within IETA he had the operational responsibility of IETAs overall

activities and in particularly those related to the UNFCCC process (CDM & JI) as well as the voluntary market which ultimately led to the setting up of the VCSa.

Mr Aalders is and has been an elected member of roster of experts for the Methodology & Accreditation Panel Expert of the CDM & JI, member of the JI Accreditation Panel, and the Pacific Carbon Trust Advisory Board and is currently member of the VCSa AFOLU Steering Committee.

2.5 Resolution of Findings

The objective of this phase of the MED assessment is to resolve any outstanding issues which need be clarified prior to DNV GL's positive conclusion on the project design. All the findings are listed in Appendix A of this report and the findings are expressed as follows:
A corrective action request (CAR) is raised if one of the following occurs:

(a) An element of the MED is not in compliance with a specific requirement of the VCS Standard;
(b) An element of the MED contains typos, mistakes, errors or lack of internal consistency;
(c) An element of the MED is not in compliance with VCS main principles as set in Section 2.4 of VCS Version 3.5;
(d) An element of the MED is not in line with scientific and other best practice;
(e) An element of the MED needs more clarity;

A clarification request (CL) is raised if the Assessor requires some clarification from the MED proponent on an element of the MED;

An Observation (OBS) is raised when areas of improvement are identified. The MED proponent is not required to address these observations and may consider them voluntarily for the improvement of the MED.
A total of 4 CARs, 9 CLs and 1 OBSs were raised during the assessment. These were solved satisfactorily by the MED proponent by revising the MED and providing clarifications. A summary of these may be found in Appendix A of this assessment report.
The assessment report underwent a technical review before DNV GL approved the MED. The technical review was performed by a qualified technical reviewer in accordance with DNV GL's qualification scheme.

3 ASSESSMENT FINDINGS

3.1 Relationship to Approved or Pending Methodologies

The MED is a tool that has to be used within the framework of applicable VCS approved methodologies or tools. DNV GL checked the VCS website and confirmed that there are no tools or modules that enable to estimate AFLB averages with the same methods as the proposed in the MED.

3.2 Stakeholder Comments

In the period from 24 April 2014 until 24 May 2014, the MED was published in the VCS website for the 30-day stakeholder consultation period and received comments from six stakeholders (http://www.v-c-s.org/methodologies/tool-remote-sensing-biomass-measurement).
DNV GL received these comments after the issuance of the first list of findings from the customer, so some of these issues were not taken into account in the first version of the list of findings yet they were already addressed by the project proponent in the first revision of the MED.
DNV GL is able to confirm that all issues raised have been addressed by the project proponent or are no longer applicable.

Comment by: Kyle Holland; ecoPartners; United States

Comment:

Overall, this is an essential tool to estimate deforestation rates from imagery in cloudy regions. We have one suggestion for improvement regarding Approach C:

The approach specifies that images may contain cloud cover and cloudy portions of images are masked. The transition matrix is estimated using the cloud-free portion of three images in a time series. If the area of the cloud mask for each image comprises 20% of the reference region, then the composite cloud mask from all three images could be 60% of the reference region, leaving only 40% to estimate the transition matrix. This effect could be worse if images contain more than 20% cloud cover in the reference region.

Intuitively, in this situation, it seems that the estimated transition matrix may not be robust. Consider specifying some maximum level of composite cloud cover relative to the size of the reference region to ensure that the estimated transition matrix is reasonably robust.

For instance, VM0009 handles this situation by requiring 90% “double-coverage” of imagery in the reference region. This requirement attempts to minimize the uncertainty associated with partial observations of land use change in any particular image, the partial observations perhaps caused by clouds or some other visual obstruction.

***Response MED proponent**:*

No response from the MED proponent.

DNV GL:

DNV GL confirmed that none of the listed comments require any action by the MED proponent as Approach C is no longer in the assessed version of the MED.

Comment by: Florian Reimer, Yougha von laer; South Pole Carbon Asset Management; Mexico; y.vonlaer@southpolecarbon.com

Comment:

South Pole Carbon Forestry is pleased to see efforts of standardization of remote sensing requirements on VCS REDD+ methodologies and generally agrees with the notion and requirements of the Tool on replacing, improving incomplete imagery or incorporating this incompleteness in the deforestation rate calculations.

Still, we see some inconsistencies with other VCS REDD+ methodologies and would like to add to following comments to the discussion:

The minimum age of the most recent image "0-1 years" i n the Tool is inconsistent with requirements of VM0015: "(+/-2 years from the project start date)" 0-1 years is a too rigid requirement considering the facts that:

- Project start is normally a year after the year PDD is created
- Simple cloud cover in the year of PDD creation (1 year prior to project start) can already violate the requirement
- Landsat 5 TM has a sensor failure sensor and does not deliver data for 2012 – eleminating the single error-free, free-of-cost source for medium resolution imagery until 2013 Landsat 8 is scheduled to be launched.

Recommendations:

The VM0015 requirement 0-2 years to project start should be accepted generally. VM0006 still requires 4 images in the reference period to be analyzed (VM0006 v1.0 page 29ff, while VM0015 and the proposed Tool (see Approach C) only require 3. This inconsistency should be streamlined by revision of VM0006 to be requiring also only 3 images minimum from reference period.

Generally a lot of standardization seems necessary on VCS REDD+ remote sensing requirements. An expert group should be formed and draft general recommendations and standards. South Pole Carbon Forestry would be happy to participate.

For example we would like to include more guidance on new classification algorithms (Support Vector Machine) and inclusion of texture filters which have been repeatingly shown to increase classification algorithm enormously compared to older approaches of Maximum Likelihood and pure spectral pixel-based classification. (See papers attached)

comments VM0009 remote sensing section: "The minimum spatial resolution of the imagery must be 30 m. Where possible, multi-spectral imagery should be enhanced using a Tasseled-Cap transformation, Principal Components Analysis (PCA) or other similar transformation to facilitate the differentiation of forest vegetation from other land covers." To reduce inconsistencies with other VCS REDD+ methodologies, resolution of up to 100 x 100 m pixel should be permitted (e.g. VM0015). Transformations of Tasseled Cap or PCA can also erode seperatebility of forest vegetation. For example newly burned area get a high wetness & low brightness value in Tasseled Cap, effectively making them look like forest in a Tasseled Cap RGB. We state that the vast volume of visualizations possible for a multispectral imagery (several RGB combinations, filter stretches, transformations) hardly represent a clear guidance for image interpretation. For the most recent image wall-to-wall classification has to be done anyway. The reduction in work effort or simplification of image interpretation due to the point grid sampling is not fully given. VM0009 should also allow for complete wall-to-wall classification of all historic imagery applying accuracy requirements established in other VCS REDD+ methodologies like VM0006 and VM0015. This would reduce inconsistencies greatly.

***Response MED proponent**:*

No response.

DNV GL:

DNV GL raised a number of CARs and CLs (e.g.CL4, CL3) indicating the lack of consistency between the methods proposed in the MED and VCS REDD methodologies such as VM0006 and VM0007. DNV GL confirmed that these findings were addressed by revising the MED and that the comment raised by the stakeholder has been addressed by the MED proponent.

3.3 Structure and Clarity of Methodology

DNV GL is able to confirm that the MED is written in a clear, logical, concise and precise manner. Moreover, DNV GL confirms that the structure of the methodology allows the reader to follow exactly the procedures to be applied for the estimation of each emission source and sink. Moreover it is able to confirm that:

- The MED proponent has followed the instructions in the tool/module template and ensured that the tools' various criteria and procedures are documented in the appropriate sections of the template;
- The terminology used in the tool is consistent with that used in the VCS Program, and GHG accounting generally;
- Key words must, should and may have been used appropriately and consistently to denote firm requirements, recommendations and permissible or allowable options, respectively;
- Criteria and procedures are written in a manner that can be understood and applied readily and consistently by project proponents;
- Criteria and procedures are written in a manner that allows projects to be unambiguously audited against them.

3.4 Definitions

The audit team confirmed that terms listed in the MED are in alphabetical order, and terms already defined under the VCS have not been repeated. Moreover, the audit team confirmed that the Definitions section includes a list of the key acronyms used in the tool.

The audit team assessed the reasonableness of the definitions through criteria such as the GOFC-GOLD REDD Sourcebook /10/ which is sets the best practices in the remote sensing sector.

3.5 Applicability Conditions

An assessment of how the applicability conditions are appropriate, adequate and in compliance with the VCS rules follows. Below are assessed the conditions where the MED is applicable:

Applicability Condition	Assessor comments
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	This appplicability condition serves to define the scope of application of this tool, i.e. application where there is at least one incomplete remote sensing image in the area of interest.

Applicability Condition	Assessor comments
speckles, data saturation, spatial offsets or corrupt data, or (c) seasonal effects such as phenology, fire, water saturation, snow.	
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.	The applicability condition serves to ensure that there is not really any complete remote sensing images. This is to avoid "cherry-picking" when it comes to use the methods provided in the tool or not.
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 serves to ensure that all source images have the same specifications and that no inconsistencies exist, which could be source of bias. This is critical when different sources are used for the same location, as using inconsistent data may lead to serious local biases and would allow the application of the two approaches described in the MED.
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.	This serves to ensure that all source images have the same specifications and that no inconsistencies exist, which could be source of bias. This is critical when different sources are used for the same location, as using inconsistent data may lead to serious local biases and would allow the application of the two approaches described in the MED.
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.	This serves to ensure that all source images have the same specifications and that no inconsistencies exist, which could be source of bias. This is critical when different sources are used for the same location, as using inconsistent data may lead to serious local biases and would allow the application of the two approaches described in the MED.
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	This serves to ensure that all source images have the same specifications and that no inconsistencies exist, which could be source of bias. This is critical when different sources are used for the same location, as

Applicability Condition	Assessor comments
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. Metrics for quality assessment are sometimes made available by the image producer. Other metrics can be contextual. For example, it is always preferred to use images from same season if seasonal effects on land cover assessment is significant. Therefore the project proponents must describe the quality criteria applied, and the scientific basis used to include or exclude the images especially when inclusion or exclusion were based on seasonality effects.	using inconsistent data may lead to serious local biases and would allow the application of the two approaches described in the MED. Inconsistencies due to quality aspects such as seasonanility could cause serious biases in the methods proposed in the MED.

In view of the above, the applicability conditions include conditions regarding the where the methods proposed in the MED would not be applicable, so the scope of application is sufficiently clear. These conditions are written in a sufficiently clear and precise manner, such that it can be determined whether a project activity meets with the condition. Furthermore, conformance with the applicability conditions can be demonstrated at the time of project validation or at the time of application of the MED.

In summary, the applicability conditions are appropriate, adequate and in compliance with the VCS requirements.

3.6 Project Boundary

Not applicable.

3.7 Baseline Scenario

Not applicable.

3.8 Additionality

Not applicable.

3.9 Quantification of GHG Emission Reductions and Removals

Not applicable.

3.9.1 Baseline Emissions

Not applicable.

3.9.2 Project Emissions

Not applicable.

3.9.3 Leakage

Not applicable.

3.9.4 Net GHG Emission Reductions and Removals

Not applicable.

3.10 Monitoring

As explained in the MED, it may be applied to obtain rates of incomplete sets of remote sensing imagery for validation or for ex-post estimates. Therefore, it may be used by project proponents at the time of validation or at a time of verification, so each parameter may appear in Section 4.1 or Section 4.2 of the PD. Hence, all parameters have been reported in Section 6.1 of the MED.

Moreover, the MED may be applied under different circumstances and different overarching methodologies, which require different parameters. In order to avoid overlapping with the requirements of overarching methodology or being to specific, the MED does not list those parameters.

The only parameters that are reported, are those related to the cross-validation results and the final estimates per stratum. They are described hereunder:

- $t(p)$ - Representative time point for a specific composited LULC map p. The unit is year;
- $\mathrm{tr}_{LULC1 \rightarrow LULC2}(p1 \rightarrow p2)$ - LULC change rate for transition from LULC class 1 to LULC class 2. The units are ha year^{-1}.;
- $\overline{tr_{LULC1 \rightarrow LULC2}(P)}$- Mean LULC rate for transition from LULC class 1 to LULC class 2 in time period P [-]

DNV GL deems that the list of parameters is complete.

4 ASSESSMENT CONCLUSION

Det Norske Veritas (U.S.A.), Inc (DNV GL) has performed a validation of the "2nd Assessment - Tool for Calculating LULC Transitions and Deforestation Rates Using Incomplete Remote Sensing Images". The validation was performed on the basis of VCSA criteria for methodologies as well as criteria given to provide for consistent project operations, monitoring and reporting.

The review of the MED and the subsequent follow-up interviews have provided DNV with sufficient evidence to determine the fulfillment of stated criteria.

It is DNV GL's opinion that the MED "Tool for Calculating LULC Transitions and Deforestation Rates Using Incomplete Remote Sensing Images", Version 9-3 as described therein, complies with the methodological requirements set in AFOLU requirements: VCS Version 3.4 and VCS Version 3.5. Hence, DNV recommends the approval of the proposed MED.

5 REPORT RECONCILIATION

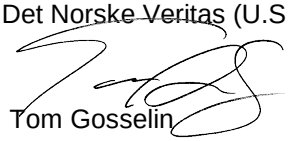
No report reconciliation has been done yet so this is not applicable.

6 EVIDENCE OF FULFILMENT OF VVB ELIGIBILITY REQUIREMENTS

Det Norske Veritas (U.S.A.), Inc holds accreditation to perform validation for projects under sectorial scopes 3 (agriculture, forestry, other land use) under the American National Standards Institute (ANSI). DNV GL, therefore, is eligible under the VCS Program to perform assessments for the MED, which falls under the sectorial scope 3.

7 SIGNATURE

Signed for and on behalf of:

Name of entity:	Det Norske Veritas (U.S.A.), Inc
Signature:	
Name of signatory:	Tom Gosselin
Date:	31 August 2015

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APPENDIX A

RESOLUTION OF CORRECTIVE ACTION AND CLARIFICATION REQUESTS, AND OBSERVATIONS

Corrective action requests

CAR ID	Corrective action request	Response by project proponents	DNV's assessment of response by project proponents
CAR1	**Element of MED** General **Requirement** §4.1.3 VCS Version 3.5 referring to VCS Module/Tool template **Evidence** MED Version 8 **Corrective Action Request** According to the applicable criteria, the MED has to be completed following the VCS template and considering any guidance provided in the same. The assessment team identified the following issues: a) According to the template, "The module must use key words must, should and may appropriately. Consistent with best practice, must is to be used to indicate a firm requirement, should is to be used to indicate a (non-mandatory) recommendation and may is to be used to indicate a permissible or allowable option. The term shall is reserved for VCS program documents and is generally not appropriate for modules". However, the tool uses in a number of places "can" or "shall" which are not appropriate. b) The template requires to use as font Arial 10 pt. However, the font of some tables of the tool are not in the required format.	**Response #1** (MED Version Draft 8.2) a) Changed 'can' and 'shall' to must at multiple places. b) Changed font **Response #2** (MED Version Draft 9.0) **Response #3** (MED Version Draft 9.22)	**Assessment #1** (MED Version Draft 8.2) a) The audit team checked the revised version and confirmed that "can" or "shall" have been replaced by "must" or "may" were applicable. Therefore, this finding has been resolved and may be closed. b) The audit team checked the revised version of the MED and confirmed that the font has been changed to Arial 10 throughout. Therefore, this finding has been resolved and may be closed. **CAR is closed.**
CAR2	**Element of MED** 2. Sources **Requirement** §4.1.3 VCS Version 3.5 referring to VCS Module/Tool template **Evidence** MED Version 8 **Corrective Action Request** According to the applicable criteria, the MED has to be completed following the VCS template and considering any guidance provided in the same. The assessment team identified the following issues: a) According to the template in Section 2 the MED proponent shall "Indicate key modules,	**Response #1** (MED Version Draft 8.2) a. Changed the version number to 2.1	**Assessment #1** (MED Version Draft 8.2) The audit team checked the revised MED and confirmed that it has been updated and makes reference to the latest version of VM0006, i.e. Version 2.1. Therefore, the finding has been resolved and may be closed. **CAR is closed.**

CAR ID	Corrective action request	Response by project proponents	DNV's assessment of response by project proponents
	tools, methodologies, documents and/or projects upon which the proposed module is based. Identify any modules or tools used by this module". The project proponent has listed VM0006 Version 2.0, yet this version is no longer valid and it has been replaced by 2.1.		
CAR3	**Element of MED** 3. Definitions **Requirement** §4.1.3 VCS Version 3.5 referring to VCS Module/Tool template **Evidence** MED Version 8.1 **Corrective Action Request** According to Section 3 of the template, using the format provided, "*provide, in alphabetical order, definitions of key terms and acronyms that are used in the module. Ensure all defined terms are used, and consistently applied, in the module*". The assessment team identified the following issues: a) In the definition of Incomplete Remote Sensing Image it is stated "Remote sensing images in which not more than 20% of the data are missing. This seems to be incorrect as VM0006 allows to use images with 20% of cloud cover. b) The list is not in the required format; c) The list is not in alphabetical order;	**Response #1** (MED Version Draft 8.2) a. It was an oversight. Adding definition for complete and incomplete remote sensing images. b. Corrected the formatting errors c. Changed the order	**Assessment #1** (MED Version Draft 8.2) a) The word "not" has been deleted so the definition is now correct. Therefore this finding has been resolved and may be closed. b) The format has been revised and now is in accordance to the Module/Tool template. Therefore, this finding has been resolved and may be closed. c) The list is now in alphabetical order. Therefore, this finding has been resolved and may be closed. **CAR is closed.**
CAR4	**Element of MED** 5.2. Approach A – Step 5 **Requirement** Section §4.1.4 VCS Version 3.4 sets that methodologies shall be guided by the principles set out in §2.4.1 of VCS Version 3.4. Which includes the principle of accuracy and conservativeness. **Evidence** MED Version 8.1 **Corrective Action Request** a) Step 8 provides an equation for estimating the transition rates for each transition and each period. In order to normalize the value, it divides by V which is the total number of pixels that	**Response #1** (MED Version Draft 8.2) a) I think you are correct. If V is used in Eq.2 as fraction than, we need to multiply this rather than divide by. b) The x-axis is incorrect. You are right in flagging this error. I am looking at it. The period length needs to be divided by two and sorted. I am looking at your graph and I do not think we need to offset the mid-point value. **Response #2** (MED Version Draft 9.0) a) I agree with the result. But V is total number of pixel used/Total number of pixel in composite image. So if we have 14 pixel that were valid, and we have 16 pixels in all, then the fraction is 14/16 or 0.87. Thus for each pixel that was found to be deforested will have just a weight of .87. On the other hand if valid pixel is just 1,	**Assessment #1** (MED Version Draft 8.2) a) Please kindly note that we think it should be divided by the proportion of valid pixels in order to normalize it. 2 pixels where 80% of the pixels were valid, is not the same as 2 pixels where 95% of the pixels were valid. In the latter there is more information so the rate should be 2*0.95, while in the former the rate should be lower 2*0.8. b) The audit team deems that period 1-3 should be in the mid-point of the two dates which is not the case in the current version of the tool. **Assessment #2** (MED Version Draft 9.0) a) The audit team checked the revised MED and confirmed that the parameter V appears no as multiplier rather than a division, and it is specific to each period. This will ensure the correct application of the weighting (weighted by the

CAR ID	Corrective action request	Response by project proponents	DNV's assessment of response by project proponents
	were used in preparing the composite land-use change maps. In order to understand what is meant by this, the assessment team checked the provided spreadsheet and found that this has been estimated as the total number of pixels for all periods. However, transitions should be for each period, and in order to normalize the values to the total area V should be the ratio between classified pixels and total pixels. Please refer to the attached excel. b) Moreover, the assessment team checked the excel spreadsheet in order to understand how the equation would be applied to the change between period 1 and 3, but it is not clear why in this case only data from one pixel that did not have data in the period 2 has been applied. c) The assessment team checked the excel spreadsheet provided as example and it seems that the mid points for each of the periods have not been correctly calculated. Please refer to the excel spreadsheet.	then the fraction is 1/16 or 0.0625 and the weight for each pixel is just that. Also redefined the variable V. b) Yes. The period 1-3 in most cases fall I between period 1-2 and 2-3. However. Given the fact that we are using time weighted average, for really skewed data this could alter. Let's discuss.	proportion of valid pixels) in the determination of the average historical deforestation rate. Therefore, this finding has been resolved and may be closed. b) The audit team checked the revised excel spreadsheet and confirmed that it has not been calculated correctly. Therefore, this finding has been resolved and may be closed. **CAR is closed**

Clarification requests

CL ID	Clarification request	Response by project proponents	DNV's assessment of response by project proponents
CL1	**Element of MED** 4. Applicability conditions **Requirement** §4.1.3 VCS Version 3.5 referring to VCS Module/Tool template **Evidence** MED Version 8.1 **Clarification request** According to §4 of the template, it should be firstly described, "•*Applicability conditions must be* a) The second applicability criterion of the MED states "•During the time period during which Incom meant by "practically available". This could be subject to interpretation. b) The sixth applicability criterion of the MED states "•Available images that do not meet overall analysis." It is not clear what is meant by quality criteria as the provided definition is too open. An image with only 5% of good pixels should not be	**Response #1** (MED Version Draft 8.2) a) Definition added. Practically available can be defined in many ways. However, within the context of this tool, the availability of image depends on existence of image and ability of procure an image. For example, an image may not exit for a location. Second, the image exists, but the use of image is costly and is not generally used. An image may be available for an area, but that image cost is too high or the project proponent do not have resources to process such images as 'radar' images, very high resolution images, or 'lidar images'. We have now added a requirement such that project proponents must ensure a complete search of at least one image archive. Suggested archives are Landsat or ASTER. Here the idea is not about discarding the good pixel, but discarding the image based on certain quality criteria. As long as that pixel is covered it would not matter which image is used. It is important that the used images must meet the quality and this quality is assessed at pixel level. b) The selection of images is always at the discretion of the project proponents. The idea of asking project proponent to include the quality criteria is for transparency which would help auditors in validating the use of this tool. The cloud cover over pixels, atmospheric distortions, and presence of thin clouds on image are objective.	**Assessment #1** (MED Version Draft 8.2) a) The audit team checked the revised MED and confirmed that the definition of "Complete remote sensing images" was added to Section 3.1 of the MED. According to the definition "Remote sensing images in which not more than 20% of the data are missing. Data that are unavailable due to the rotation of a scene during orthorectification must not be used in the calculation of this ratio". This is the complement of the definition of "Incomplete remote sensing images", so it is correct and consistent with other definitions and aspects of the MED. Moreover, the team confirmed that the MED now includes a clarification of what "practically available" implies that "the project proponent should at least demonstrate that the complete remote sensing images were not available for the project area from Landsat image archive". This ensures that a project proponent has to at least consider all images in the Landsat image archive, which will ensure the avoidance of "cherry-piccking" or biases caused by the interpretation of whether an image is "practically available". Therefore, this finding has been resolved and may be closed. b) The audit team would like to note that the reasons have to be justified technically, and that these decisions are not source of bias (no cherry picking). Therefore, the MED is still not clear with this regard.

CL ID	Clarification request	Response by project proponents	DNV's assessment of response by project proponents
	discarded as it provides good data for those 5% pixels.	The phenology, water saturation and snow are subjective in the sense that when the land is covered with snow, the pixels have 100% information for that land, but the snow cover will not help classify the land. In the case like this, it is going to be subjective. Another area where subjective knowledge is helpful is quality of information in individual bands. For example, if we are looking at just distinguishing the vegetation from bare soil (only for deforestation), the quality of image in visible band is not that important as we can rely on infrared portion of the images. But same image may not provide good information for 'degradation estimation'. However, we have added one line of text indicating that any criteria used must be described. **Response #2** (MED Version Draft 9.0) Additional information has been added around that.	**Assessment #2** (MED Version Draft 9.0) b) The audit team checked the revised MED and found that it now includes additional text clarifying what is meant by Quality criteria. This narrows the definition of quality criteria and it ensures that there is no intentional bias with this regard. Therefore, the MED is now in compliance with the VCS rules and this finding may be closed. **CL is closed.**
CL2	**Element of MED** 5.2 Approach A – Step 2 **Requirement** Section §4.1.4 VCS Version 3.4 sets that methodologies shall be guided by the principles set out in §2.4.1 of VCS Version 3.4. Which includes the principle of accuracy and conservativeness. **Evidence** MED Version 8.1 **Clarification request** a) In Step 2 of Approach A of the proposed MED it is stated that "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". However, methodology VM0015 accepts to use only forest and non-forest class which are not compatible with the IPCC LU categories. Clarification is sought on what would be the procedure in this case or whether the	**Response #1** (MED Version Draft 8.2) a) Compatible implies that the cover classes must one of the six recognized classes of IPCC. While this tool cannot speak for specific methodologies (such as for VM0015), it is our assumption that the non-forest class of the VM0015 can be regarded as other than forest class of IPCC classes. Our assumption is also based on the definition non-forest class of VM0015. See their definition below: *"Non-Forest Land" may be further stratified in strata representing different non-forest classes. IPCC classes used for national GHG inventories may be used to define such classes (Crop Land, Grass Land, Wetlands, Settlements, and Other Land). See IPCC* *2006 GL AFOLU Chapter 3, Section 3.2, p. 3.5 for a description of these classes. However, where appropriate to increase the accuracy of carbon stock estimates, additional or different sub-classes may be defined.*	**Assessment #1** (MED Version Draft 8.2) a) The audit team agrees with the statement made by the MED developer. According to the IPCC class definition, non-forest land could be included in the definition of "Other Land", so there would not be any issue in the application of this tool under VM0015. Therefore, this finding has been resolved and may be closed. **CL is closed.**

CL ID	Clarification request	Response by project proponents	DNV's assessment of response by project proponents
	requirements of the overarching methodology prevails.		
CL3	**Element of MED** 5.2 Approach A – Step 3 **Requirement** Section §4.1.4 VCS Version 3.4 sets that methodologies shall be guided by the principles set out in §2.4.1 of VCS Version 3.4. Which includes the principle of accuracy and conservativeness. **Evidence** MED Version 8.1 **Clarification request** a) In Step 3 of Approach A of the proposed MED it is stated "Verify that 80% of all pixels within the Area of Interest have an identified LULC class in at least one image within time periods required by the applicable methodology". This statement is not clear as theoretically with the composite all periods should be complete (i.e. less than 20% of cloud cover). b) In Step 3 of Approach A of the proposed MED it is stated that "*if the applicable methodology requires that the deforestation rates must be assessed from three different time periods representing up to 15 years prior to the project start date, then images must be present from each of the following three periods:* *(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,* *(3) Period 3 - start of the crediting period until 2 years before the start of the crediting period*". It is not clear why these periods are different to the periods required by VM0006. c) In Step 3 of Approach A of the proposed MED it is stated that *"If the applicable methodology only requires that deforestation analysis be based just on a pair of images, or be based on more than 4 images from a set of given time periods, the images must be selected according to the specification of the applicable*	**Response #1** (MED Version Draft 8.2) a) The idea here is that 80% of the area must have coverage. The 100% coverage is possible, but it is not a requirement. b) It has come to our attention that assessing deforestation from images that are over 10 years old (from the project start date) may not be result in a reliable indicator to estimate future deforestation. Also, old images that can be used are sometimes hard to find therefore it is conservative to allow use of oldest image that is over 10 years old from the project start date as annual rate of deforestation is going to be low. The tool is designed to assess deforestation from most current time (i.e. within 2 years from project start date), 2-5 and 5-15 years' time period. The tool is not functionally tied to any methodology. In other words, the tool's approach is to improve the process of estimation without breaking the assumptions in VM006 and any other methodology. "It suggests that to follow the 'binning the years' as per the specification of the methodology. If however, the methodology does not specify number of periods, then time periods can be set as proponents like it. This would be considered in compliance with the methodology to which this tool will be applied ". c) The deforestation can be estimated based on 1 pair of images. The non-linear regression based estimate of future deforestation would benefit from more than one pair of images. Since this tool allows use of one pair or two pairs or more pairs of images, it does not affect the estimate. **Response #2** (MED Version Draft 9.0) a) Yes and No. No because at this step, we have not created the composite image and therefore we cannot refer to composite image. Yes – because – one composite should have 80% coverage and this 80% coverage results from one or more of the individual images that goes into forming composite. c) Clarified the language.	**Assessment #1** (MED Version Draft 8.2) a) Please kindly note that if there is "at least one image within time periods" with 80% of all pixels with a LULC class, then it is a complete image and this tool would not make sense to be applied. Please clarify whether you are referring to the composite or on an image. This finding remains unresolved. b) The audit team checked the revised MED and confirmed that the added phrase (i.e. ""It suggests that to follow the 'binning the years' as per the specification of the methodology. If however, the methodology does not specify number of periods, then time periods can be set as proponents like it. This would be considered in compliance with the methodology to which this tool will be applied ") is enough in order to clarify how the periods stated in the MED woudl apply under the framework of this tool. Therefore this finding has been resolved and may be closed. c) Please kindly note that if the methodology requires to use a pair of images or 4 images, it refers to a pair of images, not a pair of composite images. I think that the issue is that we are not being clear of how to translate "image" in a methodology, to "images" for a composite" in this tool. If the methodology requires a pair of images, between 0.2 years and 15 years, means that it needs two points in the period, which under the framework of the tool it may mean 4, 6, 8 images that are used for producing a composite. **Assessment #1** (MED Version Draft 9.0) a) The audit team checked the revised MED and confirmed that it has been revised. The MED developer has now clarified that "the verification applies to one or more images/composites" indicating clearly that 80% of the pixels as a whole must have a LULC class assigned. Therefore, this finding has been resolved and has been closed. c) The audit team checked the revised and MED and confirmed that the addition of the phrase "Note that a composite image applicable under this tool is considered equivalent to a single image representing one time point referred in methodology that do not use composite image" ensures that it is understood on how to apply the concept of "composite" images to "single" images as referred to the overarching methodologies. Therefore, this finding has been resolved and may be closed. **CL is closed.**

CL ID	Clarification request	Response by project proponents	DNV's assessment of response by project proponents
	methodology" .It is not clear why images must be selected according to the specification of the methodology, or whether it refers to the specifications for grouping images.		
CL4	**Element of MED** 5.2 Approach A – Step 4 **Requirement** Section §4.1.4 VCS Version 3.4 sets that methodologies shall be guided by the principles set out in §2.4.1 of VCS Version 3.4. Which includes the principle of accuracy and conservativeness. **Evidence** MED Version 8.1 **Clarification request** a) *Step4* provides procedures for compositing LULC maps, yet these are not applicable to already composited products. Already composited products have different criteria for compositing to those provided in the Step 4. Clarification is sought on how these different procedures could have an impact in the final estimates of transition rates. *b)* Step 4 provides the following procedure for compositing the intermediate period: "b. For intermediate (i.e., period 2), the image that is closest to the 7.5 years before the start of the project (i.e., the midpoint of the period boundary) shall be selected". It is not clear why the criteria is the image that is closes to the 7.5 years if according to Step 3 the intermediate period is formed by images "from two years until 5 years before the start of the crediting period". c) Step 4 states that "if there are more than three periods, then multiple intermediate periods can must be added". It is not clear what would be the procedures in this case regarding the prioritization of the pixels, hence pixels could be prioritized in a subjective basis.	**Response #1** (MED Version Draft 8.2) a) Already composite products include information about the source date of pixel. These composite image may pixels sourced from different dates. In Step 1, we have stated, "If composite imagery is used the source date of all pixels is required to calculate the representative time point." Implication is that the pre-processed composite image is still a raw image which may include pixel information sources from multiple dates. During the processing of time periods, this information is used to assign pixel into a time period. b) This was an oversight. The year should mid-point of the oldest and the latest period must be selected. c) Revised the text to add rule in the previous section by adding revising the text. If the applicable methodology does not specify the time periods, but only specifies the number of images, the time periods must be set such that the images in recent time period are not older than 2 years from the project start date, images from oldest time period (i.e. Period 1 in three time periods) are not older than 15 years and intermediate periods that fall between oldest and latest periods must be established such that the length of periods are equal.	**Assessment #1** (MED Version Draft 8.2) a) The audit team checked the revised MED and confirmed that it has been revised. Now it is clearly indicated that the procedure indicated is not applicable to composite images. Therefore, this finding has been resolved and may be closed. b) The audit team confirmed that the MED has been revised. The mid-points of each period is no longer mentioned so this finding has been resolved and may be closed. c) The audit team confirmed that the MED has been revised indicating clearly the procedure where the applicable methodology requires more periods. The MED now indicates that a similar procedure must be followed for the oldest and most recent periods, while for intermediate periods pixels closest to the mid-point must be used. Therefore, the MED is now clear and this finding may be closed. **CL is closed.**
CL5	**Element of MED** 5.2 Approach A – Step 6 **Requirement** Section §4.1.4 VCS Version 3.4 sets that	**Response #1** (MED Version Draft 8.2) a) It was again error. It should be between 5 – 15. Here we want to use images from 5 – 15 years for oldest image. This step is just a check to ensure that calculations are correct.	**Assessment #1** (MED Version Draft 8.2) a) The audit team checked the revised MED and confirmed that it has now been corrected. The oldest period has been changed from 10-15 years to 5-15 years in accordance with the previous steps. Therefore, this finding has

CL ID	Clarification request	Response by project proponents	DNV's assessment of response by project proponents
	methodologies shall be guided by the principles set out in §2.4.1 of VCS Version 3.4. Which includes the principle of accuracy and conservativeness. **Evidence** MED Version 8.1 **Clarification request** a) Step 6 requires to "Verify that representative time point of period 1 is between 10-15 years prior to the start of the crediting period". However, this seems to be applicable to one of the cases listed in Step 3. It is not clear where the applicable methodology have different requirements regarding the number of epochs and the maximum length of the historical period as acknowledged in Step 3.		been resolved and may be closed. **CL is closed.**
CL6	**Element of MED** 5.2 Approach A – Step 7 **Requirement** Section §4.1.4 VCS Version 3.4 sets that methodologies shall be guided by the principles set out in §2.4.1 of VCS Version 3.4. Which includes the principle of accuracy and conservativeness. **Evidence** MED Version 8.1 **Clarification request** a) Step 7 states "Only when no data is available for intermediate period (such as for period 2) for a specific pixel, shall that pixel be represented in the land-use change map from first and last period (i.e., from period 1 to 3)". It is not clear the meaning of this and how this would be considered in the calculations.	**Response #1** (MED Version Draft 8.2) a) The calculation based on image in time point 1 and time point 3 is allowed only when there is no visible pixel at time point 2. If one pixel has values for time point 1, 2 and 3, then such pixels must not have calculation based on 1 and 3, but only for 1 and 2 and 2 and 3 time points to avoid double counting.	**Assessment #1** (MED Version Draft 8.2) a) The MED proponent has provided an excel with an example of the calculation and it is now clear how the data from the intermediate period would be used. The calculation based on period 1 and 3 would only be valid where there is no data for 2. Therefore, no additional clarifications are required in the MED and this finding may be closed. **CL is closed.**
CL7	**Element of MED** 5.3 Approach B – Step 1 **Requirement** Section §4.1.4 VCS Version 3.4 sets that methodologies shall be guided by the principles set out in §2.4.1 of VCS Version 3.4. Which includes the principle of accuracy and conservativeness. **Evidence**	**Response #1** (MED Version Draft 8.2) a) These days, the composite images are commercially available in which portion of images may be from different time point. For example, google images have tiles which may represent different time points as these images are patched. As long as we have recorded time point for each pixel, it would not cause any difference in outcome. **Response #2** (MED Version Draft 9.0) b) Got it. I have added a guidance to separate images based on time representation.	**Assessment #1** (MED Version Draft 8.2) a) Please note that then P in approach b may be a composited map which is contradictory with what is written above. I am not pointing out that it cannot be done, but that the first paragraph of the section might not be accurate. This finding has not been resolved. **Assessment #2** (MED Version Draft 9.0) a) The audit team checked the revised MED and confirmed that it has been revised. The MED provides now guidance on the procedure to apply when

CL ID	Clarification request	Response by project proponents	DNV's assessment of response by project proponents
	MED Version 8.1 **Clarification request** a) Step 1 of Approach B states that image composites may be used in order to apply this Approach. However, this is contradictory with what it is stated previously, i.e. "The description of Approach B uses the same symbology as Approach A, with the exception that p in Approach B signifies a non-composited LULC map, whereas p in Approach A signifies a composited LULC map". Moreover, using composites would not make much sense in this case as what it is of interest in Approach B is to use as many pixels as possible. Clarification is sought on how a composite could be used in Approach B.		using already composited images, i.e. "Images may be acquired as separate complete scenes or as a single composited image [1] using pixel quality algorithms for pixel inclusion prioritization. If composite imagery is used, then pixels representing different time points must be isolated as individual images such that each image represent one time point". Therefore, this finding has been resolved and may be closed. **CL is closed.**
CL8	**Element of MED** 5.3 Approach B – Step 3 **Requirement** Section §4.1.4 VCS Version 3.4 sets that methodologies shall be guided by the principles set out in §2.4.1 of VCS Version 3.4. Which includes the principle of accuracy and conservativeness. **Evidence** MED Version 8.1 **Clarification request** a) Step 3 of Approach B requires to estimate transition rates for each LULC class transition and for each image pair. Hence, we will have for each period a number of sample transitions which will depend on the number of image pairs. Areas that tend to have a high cloud coverage will be less represented than areas that tend to have a low cloud coverage, meaning that the probability of identifying a certain transition in some pixels might be different to other pixels. This is relevant for instance in some areas of the tropics where very cloudy areas are in intact forested areas were little change occurs,	**Response #1** (MED Version Draft 8.2) a) Yes, it is allowed that some pixels might have more observation than others. The maximum number of observation is 15 and some pixels may have values for all 15 years, while others may not have values for full 15 years. That was the reason the estimated deforestation rate is weighted by the number of pixels used. But if one pixel has transition from period 1 and 2, and period 2 and 3, then that pixel will not have transition from 1 and 3. Under the current framework, pixels are allowed to have multiple observation. This way we get more points to observe in that particular time point. The localized regression functions normally in such cases. More the observation, better it is for local regression. Here n1 and n2 are number of pixels respectively in 'from' transition and 'to' transition. **Response #2** (MED Version Draft 9.0) a) Here the equation is only estimating the rate of transitions. Lets say we have 6 pixels in first image belonging to class1. In second image that is one year newer than first image, we noticed 2 pixels transitioned to class2 and 4 pixels retained the same class. Thus the rate of transition is 2/(2 + 4) per year. If the second image is 10 years apart, then same rate will be 2/6*1/10. Why do we	**Assessment #1** (MED Version Draft 8.2) a) Please note that the audit team is not understanding the weighting applied. The issue we point out is that a pixel that has been observed 15 times should have a lower weight than a pixel observed 2 times. Moreover, it is not the same if one year we have 5000 pixels than if we have 50 pixels of that LC1; in the latter one single pixel may have more weight on the total proportion. Therefore, each pixel should be corrected by multiplying in each pair by 1/ (number of observations of that pixel * number of pixels observed). **Assessment #2** (MED Version Draft 9.0) a) The audit team now understands the weighting applied. The weighting applied is reasonable. Therefore, this finding may be closed. **CL is closed.**

[1] For example, pixel quality prioritization was employed for the cloud free Landsat composites used to produce the Global Forest Change time-series analysis. Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. "High-Resolution Global Maps of 21st-Century Forest Cover Change." Science 342 (15 November): 850–53..

CL ID	Clarification request	Response by project proponents	DNV's assessment of response by project proponents
	whereas in less cloudy areas, it is more likely to identify LULC transitions. In the former there would be less number of pixels while in the latter there would be a higher number of pixels. Clarification is sought on how the different probability of each pixel based on number of observations per pixel would be accounted in the model.	need to correct the rate by observation? Also, when we are getting an average for a period, we are correcting this rate by number time points representation. Finally, we are using these rates to make a local regression.	
CL9	**Element of MED** 5.3 Approach B – Step 4 **Requirement** Section §4.1.4 VCS Version 3.4 sets that methodologies shall be guided by the principles set out in §2.4.1 of VCS Version 3.4. Which includes the principle of accuracy and conservativeness. **Evidence** MED Version 8.1 **Clarification request** a) Step 4 of Approach B – a) provides equation 3 for estimating the Mean LULC change rate for transition from LULC class 1 to LULC class 2 in time period P. According to the proposed MED, this is the weighted average of values of $\frac{n1}{n1+n2}$ from the transition dataset created in step 3, using $n1+n2$ as weights. However, it is not clear that the notation of equation 3 is correct. b) Step 4 of Approach B – a) states that data must be bootstrapped in order to define 90 or 95 confidence intervals. Although it has been stated the number of repetitions required, it has not been defined the minimum number of samples. According to Bickel & Krieger, (1989), sample sizes of 10 to 20 give good results, while Chernick, (1999) states that sample sizes below 5 are not adequate. Clarification is sought on what would be the minimum sample size.	**Response #1** (MED Version Draft 8.2) a) The number of image pairs (or time points) has been used to provide weight. In Step 3 (table 2), transition rate is estimated as N1/(n1+n2). In this step, we are getting an average for all transition. This is same as n1/n1+n2 * n1+n2/sum_i(n1il + n2,i). Here the plain n1+n2 will cancel out and leaving us with the equations. Thus, weighting is achieved by mutilpying n1+n2 /sum of all n1+n2. b) My idea is that we keep increasing the sample size until we get a convergence. For any sample size n the distribution for samples chosen at random *is* the sampling distribution assumed in bootstrapping. The bootstrap principle says that choosing a random sample of size n from the population can be mimicked by choosing a bootstrap sample of size n from the original sample. Whether or not the bootstrap principle holds does not depend on any individual sample. **Response #2** (MED Version Draft 9.0) a) The equation has been changed to; $$\frac{1}{\sum_{i=1}^{imagePair(P)}\big((n1,i)+(n2,i)\big)}\times\sum_{i=1}^{imagePair(P)}\frac{n1,i}{\big(t(p2,i)-t(p1,i)\big)}$$ b) Got it. . When you attempt to run bootstrap, you look at the data and see if the	**Assessment #1** (MED Version Draft 8.2) a) Please kindly note that it seems that the notation of the equation seems not correct. We think it should be $$\overline{tr_{LULC1\to LULC2}(P)}=\sum_{i=1}^{imagePair(P)}weight_i\times\frac{n1,i}{\big((n1,i)+(n2,i)\big)\times\big(t(p2,i)-t(p1,i)\big)}$$ $$=\sum_{i=1}^{imagePair(P)}\frac{\cancel{\big((n1,i)+(n2,i)\big)}}{\sum_{i=1}^{imagePair(P)}\big((n1,i)+(n2,i)\big)}\times\frac{n1,i}{\cancel{\big((n1,i)+(n2,i)\big)}\times\big(t(p2,i)-t(p1,i)\big)}=$$ $$\sum_{i=1}^{imagePair(P)}\frac{n1,i}{\big(\sum_{i=1}^{imagePair(P)}((n1,i)+(n2,i))\big)\times(t(p2,i)-t(p1,i))}$$ b) It seems we have not been clear. Please kindly note that we were not talking about the bootstrap samples but the original sample. Please note that even in non-parametric bootstrap if the sample size is too small (e.g. 3-7) the possible bootstrap samples is not Rich" or large enough in order to reach any conclusion on the original population **Assessment #2** (MED Version Draft 9.0) a) The audit team checked the revised MED and confirmed that it was updated and it is now correct. Therefore, this finding has been resolved and may be closed. **CL is closed.**

CL ID	Clarification request	Response by project proponents	DNV's assessment of response by project proponents
		results make sense and increase the sample size. So there cannot be priori on this. Also note that we are using bootstrap for estimating confidence interval and not using this technique for estimating a mean. Presumably I expect there will be small number of transition rate. The aspect of transparency is critical on a tool like this. From practical stand point, it would be good to provide users with a starting value. On that front I do not disagree with you to have a minimum sample size. After discussion with on this idea, I have now added a minimum sample size requirement to be of at least 30 randomly selected transition rates to get started with the bootstrapping process unless total number of transition rates per period are less than 30 (at that time 90% of the available rates must be used). The sample size may be incrementally added to cover 100% of the transition rates.	

Observations

OBS ID	Observation	Response by project proponents	DNV's assessment of response by project proponents
OBS1	**Element of MED** Title **Requirement** - **Evidence** MED Version 8.1 **Observation** The title of the tool is "Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images". Since the tool includes procedures for estimating LULC class transitions which include additional transitions to deforestation, the assessment team would like to point out that probably the name of the tool is not very accurate and may be deceiving.	**Response #1** (MED Version Draft 8.2) Title is revised to «Tool for Calculating LULC Transitions and Deforestation Rates Using Incomplete Remote Sensing Images»	**Assessment #1** (MED Version Draft 8.2) The audit team checked the revised MED and confirmed that the name was revised to «Tool for Calculating LULC Transitions and Deforestation Rates Using Incomplete Remote Sensing Images» which addresses the observation made by the audit team. Therefore, this finding may be closed. **OBS is closed.**