Summary and Response to Public Comments

A draft of the *Framework for Remotely Sensed Quantification of Forest Carbon* was developed by ACR.

The Framework was posted for public comment May 21, 2025 – June 20, 2025. Comments and responses are documented here.

#	ORGANIZATION / COMMENTER	COMMENT	AUTHOR RESPONSE
1	Weyerhaeuser	Document structure and flow may be improved by reorganizing the sections a bit. Perhaps it could be structured like scientific papers such that the data requirements come first, then model requirements, and finally model validation/evaluation requirements.	Thank you for the suggestion. The document progression is intended to chronologically detail the process for model development, reporting and approval. There have been updates and improvements throughout following public comment that follow a similar structure that has been outlined. The flow includes the following sections in this order: • Intro • Predictive Models • Assessing Model Eligibility • Validation Plot Remeasurement • Calculation and Reporting of Carbon Stocks • Reporting and Verification. ACR also improved Figure 1 and added a new Figure 2 to help

			describe the process and flow of the Framework.
2	Weyerhaeuser	Adding ability for developers to use "off the shelf" carbon layers such those from Chloris, Kanop, or Planet could help make use of remote sensing more affordable and accessible. As the methodology currently stands, this will be quite an expensive and time-consuming endeavor as the current methodology seems to require each developer to create their own remote sensing model for each individual carbon project. A more efficient process could involve using one model for a larger area, such as those "off the shelf" options.	ACR clarified that the use of "off the shelf" products are permitted to use this Framework, within Sections 1.1. and 2. It was not our intention to exclude such products and have added the following language to clarify: Section 1.1: ""Off the shelf" commercially available data products may also be used as a Predictive Model." and Section 2: A new model may be developed specifically for this application, or a previously existing ("off the shelf") geospatial data product may be applied."
3	Weyerhaeuser	Page 13 of the methodology states that "The Project Proponent must develop a Predictive Model for each Stratum (i.e., one Predictive Model per Stratum);". We suggest opening this up to allow the use of either one or multiple models and allow the developer to decide what works best. We believe typically only one model should be required but want to leave it open.	ACR removed this sentence from the Framework in conjunction with clarifying that separate Predictive Models for each forest inventory strata are not required. To avoid confusion, ACR added and defined the term

			Area of Interest (AOI) (Section 1.4). It is possible to validate a Predictive Model for an AOI (separate from strata) that estimates carbon stocks for the entire project area. Alternately, more than one AOI (each with their own approved Predictive Model) can be defined within a project area.
4	Weyerhaeuser	Guidelines for raster data resampling would be a good addition to this methodology. As a general best practice, the output model raster data should be the same resolution as the lowest resolution data used to train the model. As an example, if a developer is using 10 m sentinel data and 1 m LiDAR data to train the model, the output will generally be 10 m resolution at the lowest. This is a concern primarily due to the possibility of resampling data to reduce error/variability and increase likelihood of passing audit – for example if the example scenario resampled their model output to 100 m resolution.	ACR appreciates this input. While providing best practices may be beneficial for some users, it is preferred to keep the Framework as simple as possible and avoid non-required guidelines. Ultimately, we want to provide flexibility regarding the relationship between input data sources and the Predictive Model output.
5	Weyerhaeuser	We really like the process described on page 15 wherein the VVB is provided the centroids of all the pixels within each strata and then selects a minimum of 30 pixels per strata that the PP must measure in order to further validate the model. We have a few suggestions for improvement that may strengthen this part of the protocol. First, we notice that this process is strata-based and may be intended for projects with only a few strata. Weyerhaeuser projects we may have 15+	A. In regard to VVB remeasurement of pixels per strata, ACR clarified in Section 1.3 that: "This Framework provides a **project-level** Framework for

		strata, which would mean an additional 450 plots to measure on top of the model training/Validation Plots. We have two potential suggestions for alternatives: a. Perhaps instead of a set number per strata, this process could require ¼ of the number of training and Validation Plots and distribute those across all strata. b. Alternatively, the VVB could focus on the strata that performed worst in the model validation process and distribute a set number of plots in those (i.e. PP must install 10 plots per strata in the 5 lowest per-forming strata) Second, we want to ensure that there is no spatial autocorrelation that impacts the results of this process. We suggest that a buffer be put around each model training plot such that those pixel centroids that are within a set distance (i.e. 60 m – or two Landsat pixels) of the model training plots outer boundary are excluded from the random selection. This ensures that those pixels that are near the training plots and thus were used for model training are not influencing this additional check.	assessing model eligibility and approval. It is also possible to apply this Framework to provide carbon estimates for specific Area of Interest(s) (AOI), which may or may not constitute the whole GHG Project or collectively make up a whole GHG Project. The project area may consist of a single of multiple AOI or multiple AOI's. An AOI, must be assessed at the scale in which it is applied (i.e. whether one project level AOI or geographically defined sub-project AOI's)." If a project-level Predictive Model and associated AOI is developed, the minimum number of Validation Plots required by the VVB to sample is 30. If Predictive Models are created for two or more AOI's, that number will increase by a minimum of 30 per AOI. To mitigate spatial autocorrelation, the Framework requires that Calibration Plot

			areas cannot overlap with Validation Plot areas. We have also added text requiring that a buffer the length of the diameter of the plot be maintained between Validation Plots and Calibration Plots (Sections 3.2).
6	Weyerhaeuser	The methodology states the model outputs for estimating carbon can be categorical or continuous (page 12). We like the flexibility that this offers developers and appreciate this inclusion. With this said, it should be noted that RMSE is not suitable for categorical models. We propose instead requiring the use of RMSE for continuous models and F-score for categorical models.	ACR altered Section 2.1 to specify that model outputs must be continuous. This eliminates the need for an F-score.
7	Weyerhaeuser	On page 12, the document states that each stratum must be fully covered by remote sensing pixels, but there is no guidance for handling partial coverage or missing data in challenging conditions (e.g., persistent cloud cover, steep terrain, or sensor limitations). Opening this requirement to allow for gap-fill techniques (i.e. interpolation, imputation, or other modeling approaches) would be beneficial, as almost all remote sensing data will have some gaps due to clouds, water, or other sensor-specific issues.	ACR updated Section 2.1 to state that "Interpolation, modeling, or other systematic and verifiable approaches may be used to assign carbon density to Pixels with missing data (e.g., due to persistent cloud cover, sensor limitations). If these Pixels overlap with a randomly allocated Validation Plot area (Section 3.3), they must be treated as any other Pixel and included in Validation Plot measurements."

8	Weyerhaeuser	We believe equation 1 is calculating the per pixel stratum-level carbon estimate. With this, the definition of CPM,p,i should be modified to say, "Carbon stock (in metric tons CO2e/unit area) for **all** Remote Sensing Pixel**s** p within Stratum i, as derived from the Predictive Model (PM)."	Thank you for this observation. Equation 1 has been updated and now clearly calculates the mean carbon density (in metric tons CO2e/unit area) for the AOI.
9	Chloris Geospatial	Comment 1: Refers to Section 2.1 Predictive Model Requirements, second bullet point The section requires that "Timestamps must be provided for all Remote Sensing measurements;". While AGB datasets such as those provided by Chloris provide clarity on the annual timestamps for the data, we propose removing this requirement for input images used. Some approaches utilize a high number of input satellite images as input to the computation of annual stock and change estimates. It would neither be practical nor meaningful to provide all those dates for every single image.	This has been altered to read "Details regarding the timing of data collection (i.e., temporal resolution) and any steps taken to compile data collected over a period of time" (Section 6.1).
10	Chloris Geospatial	Comment 2: Refers to Section 3.2 Assessing Predictive Model Eligibility In this section, the Framework proposes a plot to pixel validation ("Each Validation Plot is paired with the Remote Sensing Pixel inside of which it is located. The carbon estimate derived from the Validation Plot measurements is treated as the observed point and compared with the Predictive Model output for that Remote Sensing Pixel. The differences between these two values (i.e., the errors) are used to calculate the Predictive Model's Root Mean Squared Error (RMSE) (Equation 2) as well as the Standard Error (Equation 3)." We propose to perform the validation at both, the project level, and the plot level. To ensure a valid and robust data comparison, comparing data at the project scale is appropriate. Field plots are used to derive average	The Framework relies on a minimum of 30 plots (if the entire project area consists of one AOI) that are randomly sampled across the AOI. This minimum number of Validation Plots may be increased if desired by the project developer (Section 3.1). ACR views the collection of these plots to be representative of the model's performance at the AOI-level,

		biomass stock estimates by strata at the project level, that is the number that the user needs. Remotely-sensed biomass estimates provide wall-to-wall, spatially explicit (pixel-based) biomass estimates for the entire project area, with quantified uncertainty at the pixel level.	based on a series of plot-level accuracy assessments. Since crediting is performed at the AOI/project level, it only makes sense to validate at this scale too, using a conglomerate of plot-level comparisons that represent the Predictive Model's performance across the AOI to inform validation.
11	Chloris Geospatial	Comment 3: Refers to Section 3.1 Validation Plot Installation and Measurement This part of the Framework does not specify any specific size requirements for Validation Plots ("Validation Plots may be designed as either circular or square plots, or they may match the size and shape of the Remote Sensing Pixel. While Validation Plots are not subject to any specific size requirements, they must be located completely within a single Remote Sensing Pixel and therefore may not exceed the size of the Remote Sensing Pixel.") To ensure robust validation results and mitigate the risk of unreliable validation results due to geospatial errors included in field data, we strongly suggest introducing some minimum plot size to the Framework. A minimum plot size of 40x40m or 30m radius would allow to generate more robust validation results.	ACR removed the quoted requirement that Validation Plots be smaller than Pixel size. Equation 2 has been introduced to allow Validation Plots to compare against a weighted average carbon densities from multiple overlapping Pixels, which addresses how to compare the field measurements of Validation Plots to various pixel sizes.
12	Chloris Geospatial	Comment 4: Does not refer to a specific section of the Framework Rather than making it a requirement for the use of remote-sensing data, we suggest calibration as a proposed step, and required if the validation	The approach proposed aligns with the intent of the Framework as written. The first sentence of

		assessment indicates a lack of correlation or presence of any systemic under- or over-estimation biases in the remote sensed data that should be corrected for.	Section 2.3 clarifies that calibration plots are optional. Predictive Models may incorporate calibration plots, or not. If any sequence of Validation Plots does not yield statistical agreement, a Project Proponent has the option to additionally calibrate the Predictive Model with calibration plots before re-evaluating statistical agreement with a new sequence of Validation Plots.
13	ERIA Consultants, LLC	Qualified Professionals The existing ACR and CARB forest carbon protocols indicate that a SAF Certified Forester is needed for verification guidance on forest projects. In that same vein, a Certified Mapping Scientist (CMS) from the American Society for Photogrammetry and Remote Sensing (ASPRS) (https://www.asprs.org/certification) would be a suggestion for projects that involve Remote Sensing. ASPRS has been at the fore front of Remote Sensing technology for over 80-years. Furthermore, ASPRS publishes the scientific monthly journal Photogrammetric Engineering & Remote Sensing. ASPRS has set the positional and attribute accuracy standards for optical, SAR, and LiDAR data globally. Using an ASPRS Certified Mapping Scientist ensures that projects utilizing Remote Sensing will be developed and verified at the highest professional and industry standards.	This is an interesting suggestion. However, ACR does not want to create barriers to entry that may be presented by a requirement to contract with this type of third-party.

14	ERIA Consultants, LLC	General Computations Remotely Sensed data are subject to spatial autocorrelation (Cliff and Ord 1973). Data that are spatially autocorrelated present problems when parametric statistics (e.g., mean, confidence intervals, standard deviations, etc.) are applied. Parametric statistics rely on the data being analyzed to be independent and identically distributed (iid). That is, iid data relies on the foundation of the Central Limit Theorem. Autocorrelated data are not independent; thus, potentially leading to Type I errors. A Type I error indicates that there is a difference in the statistics being analyzed when in fact there is no difference. Or in statistical terms "Rejecting the null hypothesis when in reality we should fail to reject the null hypothesis." I believe that using the methods for computing equation 1 (Page 13) will produce incorrect results. One straight forward approach would be to just multiply the number of pixels (picture elements) by the units they represent by stratum. See Example 1 below: Stratum = 1 Stratum area = 500-hectares 500 total pixels in stratum 1 1-pixel = 1-hectare Two types of pixels were derived from the forest inventory plots a) 200 pixels = an average of 50/MTCO2e/hectare (above and below live) b)	Thank you for this comment. Equation 1 has been rewritten and now only focuses on AOI level carbon density, and we have also specified that classification models (as used to stratify in your example) are not allowable. To mitigate spatial autocorrelation, the Framework maintains that Calibration Plot areas cannot overlap with Validation Plot areas and buffer space must be maintained between them (Sections 3.2). This is a robust solution that is also practical.

		300 pixels = an average of 75/MTCO2e/hectare (above and below live) (50 * 200) + (300 * 75) = 32,500 MTCO2e for stratum 1 c) Three things I would like to highlight at this point. First, inventory plots sizes should be as close as possible to the pixel area. Second, fixed radius plots should only be implemented (no variable radius plots). Finally, some limits need to be mentioned on how many different pixel types can be encompass a single stratum. That is, in Example 1 there are two types of pixels (50/MTCO2e/hectare and 75/MTCO2e/hectare). If too many pixel types are contained in a single stratum; then, this indicates a great degree of variability within and perhaps a new stratum should be developed.	
15	ERIA Consultants, LLC	Accuracy Assessment For over 30-years a standard method for assessing the accuracy for remotely sensed data has been in place. A total of 50-forest carbon plots were installed in stratum 1. That is, 20-plots for the 50/MTCO2e/hectare pixels and 30-plots for the 75/MTCO2e/hectare pixels. Holding out 20% of the forested plots for accuracy assessment (see bullet #5 in the Predictive Model section for an explanation). There will be 4-plots in the 50/MTCO2e/hectare pixels abd 6-plots in the 75/MTCO2e/hectare pixels The confusion matrix (Story and Congalton 1986) (Congalton, Green et al. 1993) (Tuffly 1995) is the standard non-parametric process for addressing the accuracy of remotely sensed data. The Confusion Matrix (Example 2) is derived from example 1. Note, the vertical column (blue color) are the remote sensed data and the horizonal row (grey color) are the plot data (observed). The bold number	ACR agrees with the general approach proposed as it relates to classification models. However, the RMSE approach in this Framework is a better fit for models with a continuous output per pixel. In consideration of this comment, ACR has disallowed classification models (see new definition of Predictive Model and Section 2.1).

		(orthogonal) are the correctly classified pixels and the other values are incorrectly classified pixels. **Remote Sensed Data** / Plot Data: 50/MTCO2e, 75/MTCO2e / **Total** / **Accuracy (%)** 50/MTCO2e: **3**, 1, 4, 75.00 75/MTCO2e: 1, **5**, 6, 83.33 **Total**: 4, 6, 10, **80.00** The overall accuracy of 80.00% could be used as an uncertainty value by pixel type. However, I would suggest using the accuracy by class (e.g., 75.00% for the 50/MTCO2e and 83.33% for the 75/MTCO2e).	
16	ERIA Consultants, LLC	Predictive Models Many Predictive Models that use field sample data to estimate values in other areas which were not field sampled often contain an accuracy value by default. This accuracy value is very important when evaluating Predictive Model usefulness. A commonly used scientific method for developing a model is illustrated in the sequences of events listed below: 1. Collect field plot data by stratum and compute MTCO2e by plot. 2. Group Plots, by stratum, into logical categorial increment (e.g., 25-50 MTCO2e, 51-75 MTCO2e, etc).	This comment assumes the use of classification models, which are now not eligible for use with the Framework, per response to comment #15.

		3. Run the Predictive Model of choice on the remote sensed data using the plot data partitioned into logical categorial increment by stratum; however, leave out a randomly selected number of plots (i.e., 20%) by stratum and class. 4. Evaluate the initial model accuracy from the accuracy values output by the model (many Predictive Models provide default accuracy values). 5. Once default model accuracy values are deemed acceptable take the 20% randomly selected plots not used in model development, by stratum, and create a confusion matrix (example 2).	
17	ERIA Consultants, LLC	Pixel Area When pixel area differs from the reporting area units, erroneous results may occur. Case in point, if using LandSat-9 multispectral bands which have a ground sample distance (GSD) of 30 meters by 30 meters (1-pixel = 900 m2) and the MTCO2e are reported in hectares there can be a problem. That is, it makes little sense that each 900 m2 pixel represents some MTCO2e amount per hectare. Some kind of mathematical conversion will need to be conducted on the pixel of the reporting units. Each pixel must be resized to meet the following criteria: 1) the area of the pixel times the number of pixels equals the area of the stratum, 2) the reporting units directly corresponds to both the pixel area and the MTCO2e/reporting units. There are options to address this topic; however, they can be difficult to articulate in this document format.	Reporting carbon density "per acre" or "per hectare" is common practice in GHG projects, even when reporting at scales less than an acre/hectare where conversions are required. As this Framework applies to jurisdictions that apply both imperial and metric systems, "per unit area" is used for all equations, but the expectation remains that carbon density (even at the sub-acre/hectare Pixel level) is reported "per acre" or "per hectare".
18	ERIA Consultants, LLC	Summary -Field plots should be as close as possible in size as to the remotely sensed pixels.	Thank you for your comments and this summary. While the Framework is currently going in

		-Pixels should be the same size as the reporting units or some mathematical conversion will be required. -Fixed radius plots should be implemented no variable radius plots should be installed. -The definition of precision is repeatability and the definition of accuracy is the closest to the truth. There could be situations where the remote sensed data are precise but inaccurate. Furthermore, there also could be conditions where the remote sensed data are accurate and not precise. Concluding, that we want the information to be both accurate and precise. -Using parametric statistics such as means, confidence intervals, standard deviations, etc. should mostly be avoided when working with remotely sensed data due to autocorrelation. -It is suggested to convert plot data from continuous MTCO2e/unit area to logical categories.	a different direction than suggested, classification models in future versions may be incorporated in the future.
19	Forest Carbon Works	2.2: Predictive Model Design The Framework states that, "Calibration Plots do not need to adhere to the field inventory SOP document (Seciton 3.1) and may be designed, allocated, and measured using any methods at the PP's discretion." This leaves a large amount of interpretation to the project developer. The Framework should be clear on whether requirements laid out in the associated methodology (e.g. ACR IFM 2.1) must be used to quantify carbon on Calibration Plots.	Section 2.3 now states: “The calculation of carbon stocks derived from Validation Plot measurements do not need to adhere to the biomass estimation techniques prescribed by the applied Methodology.” Calibration Plots are optional and Predictive Models are tested against independent Validation Plots. Statistical agreement between the Predictive Model and

			Validation Plots is the metric for assessing model approval, and therefore such specificity in Calibration Plots was deemed overly prescriptive for the application.
20	Forest Carbon Works	2.2: Predictive Model Design The Framework states that, "It is permissible to use this Framework for certain Strata and to use field inventories per the requirements of the applied Methodology for the remaining Strata." For the sake of consistency, it seems that requiring a consistent approach to carbon estimation (field-based approach or remote sensing approach) would be beneficial. It is unclear why a project developer would use this Framework for one strata but not another, and could present opportunities to pick one or the other based on which would yield the higher overall project carbon.	There could be many reasons to use a Predictive Model(s) for some parts of a project area and a plot-based inventory for other parts (e.g., accessibility, difficulty capturing a certain forest type's heterogeneity with modeling, etc.). While we appreciate the question, both remote sensing meeting the requirements of this Framework and plot-based inventories with requirements such as statistically sound sampling, and resampling by a VVB, ensure that the carbon stocks estimated using either approach, or a mixed approach to quantification, will provide a statistically valid estimate of carbon.

21	Green Assets	Section 1.3 Framework states "Project utilizing methodologies that do not rely on growth models for baseline development (i.e., Active Conservation and Sustainable Management on U.S. Forestlands) or projects where the baseline carbon stocks are negligible at the project Start Date (i.e., Afforestation and Reforestation of Degraded Land) may utilize Remote Sensing to derive with-project stock measurements at any point in the project following use of this Framework." Note that the Active Conservation and Sustainable Management on U.S. Forestlands V1.0 requires the use of a growth model for estimation of baseline harvested wood products. I.e., page 44 of the Methodology states ""Baseline harvested wood quantities and species are derived from modeling a baseline harvesting scenario using an approved growth model."	Thank you for this observation. Section 1.3 now states: “The following Methodologies require ground-based (e.g., tree-level or stand-level) inventories to apply growth models to develop baselines and calculate harvested wood products at project Validation: *Active Conservation and Sustainable Management on U.S. Forestlands* *Improved Forest Management (IFM) on Canadian Forestlands* *Improved Forest Management (IFM) on Non-Federal U.S. Forestlands* Projects applying these Methodologies may not apply this Framework to derive initial carbon stocks. These projects may apply this Framework to estimate with-project carbon stocks at any point thereafter.
22	Green Assets	Section 1.3	Thank you for this comment.

		The Stratum-level Framework allows for balancing of remotely sensed estimates and traditional ground-based estimates where necessary across strata to meet inventory design goals and Methodology and ACR requirements.	
23	Green Assets	Section 2.1 The Framework requires that the entire area of interest must be covered by Remote Sensing Pixels. There are acceptable methods for handling missing data in remote sensing based Predictive Modeling. The requirement for the model to pass validation seems adequate enough to allow for some missing data from the model inputs.	Section 2.1 now states: "Interpolation, modeling, or other systematic and verifiable approaches may be used to assign carbon density to Pixels with missing data (e.g., due to persistent cloud cover, sensor limitations). If these Pixels overlap with a randomly allocated Validation Plot area (Section 3.3), they must be treated as any other Pixel and included in Validation Plot measurements."
24	Green Assets	Section 2.2 Framework requires a separate model for each distinct stratum. This requirement can lead to restrictions on using the latest and most current state of the art Predictive Modeling techniques which are capable of defining and predicting stocking for multiple strata in a single run. This also separates out the ability to develop a model that helps stratify an area of interest with insight from predictive stocking and other layers.	Section 1.4 now clarifies the use of AOIs (previously referred to as strata) within the project area. Please note that AOIs are distinct from traditional forest inventory strata. Please also note that classification models are no longer allowed by this Framework (see comment #15).

25	Green Assets	Section 3 Framework requires that Validation Plots be placed as centroids of pixels but in Section 2.2 the Predictive Model design requirements allow the model to predict at the pixel, aggregated pixel, or segment level. It is unclear how to determine Validation Plot location if the model predicts at an aggregated pixel or segment level.	Thank you for this observation. Previous language referring to the "group of Remote Sensing Pixels or segment" has been removed. The requirement for Validation Plots to be located at Pixel centroids has also been removed. Please see Section 3.1 and 3.2 detail for more detail. Equation 2 has been added to allow a single Validation Plot to compare with an area-weighted average carbon density from all overlapping Pixels.
26	Green Assets	Section 3.1 Framework states ""Any Validation Plots that cannot be relocated by the VVB shall be assigned an estimate of zero carbon for the purposes of the VVB's remeasurements or a new Validation Plot location must be randomly generated by the VVB for Project Proponent plot installation."" What purpose does the zero-carbon estimate have? This would significantly skew the validation data in a high stocked stratum. It seems more appropriate to simply require a new Validation Plot location.	ACR agrees the zero-carbon estimate would inappropriately affect the statistical test and have removed it. Section 4 now says: "If a Validation Plot cannot be relocated, the VVB may skip it and remeasure another Validation Plot. If many Validation Plots cannot be relocated, the VVB may conduct a risk-based assessment to determine whether the pattern is indicative of a failed implementation of the Validation Plot measurement

			SOPs, in which case the VVB may conclude the Student's t-test has failed."
27	NativState	**I. Use of Commercial Remote Sensing Products** 1. Will ACR allow the use of pre-trained, third-party remote sensing-based carbon models from commercial vendors as the basis for Predictive Modeling, provided those models are subsequently calibrated and validated using project-specific field plots as outlined in the Framework? 2. Can Validation/Verification Bodies (VVBs) independently validate the outputs of commercial carbon data products using a standard Validation Plot protocol and statistical testing, even if the original models were trained using external or global datasets? 3. Would ACR consider adjusting the required number or distribution of Validation Plots in cases where commercial data products already provide pixel-level uncertainty metrics with statistically calibrated confidence intervals across extensive geographic test data (e.g., derived from LiDAR or GEDI)? 4. Can Calibration and Validation Plots be designed to align with the spatial resolution and pixel geometry of commercial data products (e.g., 10–30m pixels), even if this differs from traditional forest inventory plot designs? 5. Can strata used in Predictive Model development be derived from commercial datasets such as canopy height, canopy cover, or carbon density layers provided by third-party vendors, assuming proper documentation and validation?	1. Yes, this ACR Framework allows for pre-trained, third-party RS carbon models from commercial vendors or "off the shelf" data products to be used. Please see response to comment 2 and associated clarifying edits to Sections 1.1 and 2. 2. Yes, this is possible under the requirement of the Framework. We have added that "Once a project has developed **or selected a commercially available** Predictive Model, they may assess its eligibility…". If a commercially available model is being utilized, the validation process would begin with step 3 in Figure 1. 3. No, the ACR Framework relies on a minimum of 30 Validation Plots, for assessing the accuracy and precision of the various RS estimate sources that may be used.

		6. Can commercial remote sensing data products be used to fulfill interim monitoring or stratification updates between full verification events, particularly where ground access is limited or cost-prohibitive? 7. Are there provisions for using high-frequency or high-resolution commercial remote sensing layers (e.g., canopy loss alerts, change detection, wildfire or deforestation layers) as part of early warning systems or targeted remeasurement campaigns within verified projects? 8. How will ACR assess the transparency and replicability of Predictive Models developed using proprietary commercial algorithms? What minimum level of documentation or disclosure is required to demonstrate methodological integrity? 9. Given limited FIA-style plot networks outside the U.S. and Canada, will ACR support the use of commercial data products as a way to initiate or enhance quantification efforts in geographies where field plot infrastructure is lacking.	4. Yes, the Framework provides some flexibility in the allowable types and sizes when establishing Validation Plots (see Section 3.2). However, per Section 3.2, “If the GHG project has previously used a Ground Plot-based inventory to derive carbon stocks (e.g., at time 0), the same steps and biomass estimation techniques should be applied to derive Validation Plot-level carbon stocks”. 5. Yes, canopy height, canopy cover, or carbon density layers from third-party vendors may be used as inputs in the stratification and/or biomass/carbon estimation processes. Per Section 2.2, “Any type of Predictive Model may be approved for use if it successfully achieves statistical agreement with Validation Plots (Section 3) and if the Validation Plots statistically agree with the VVB’s remeasurements (Section 4), as outlined in this Framework”.

			6. Commercial products may only be used in MRV, subject to eligibility requirements and validation process outlined in the Framework. Section 1.1 states the temporal approval period for Predictive Models: "Use of this Framework must coincide with a GHG project's Validation and/or full Verification. Once approved for use, a Predictive Model is valid for 5 years of reporting, at which point the same or an updated Predictive Model must be submitted for approval for use." 7. There are not provisions for this. However, all ACR reversal notification and compensation requirements apply. 8. Section 1.8 of the Framework outlines the reporting requirements of the Predictive Models employed to measure and quantify forest carbon stocks. 9. Commercial data products that exist or are developed meeting the criteria undergoing

			the ACR Framework will be accepted for use in ACR projects. We re-iterate that the approach uses independently installed and Project Proponent measured Calibration and Validation Plots. As such, the presence or absence of FIA-style plot networks are not a limitation in this context.
28	NativState	**II. Implementation of the Framework – Operational Clarifications** **Validation Plot Requirements** 10. Can existing, evenly spaced fixed-radius inventory plots be used as Calibration or Validation Plots if they are monumented and meet measurement SOP standards, or must all Validation Plots be generated randomly by the VVB regardless of existing infrastructure? 11. Is there a pathway for designating a subset of existing grid plots as Calibration Plots and then deploying new Validation Plots over time to reduce redundancy and fieldwork burden? 12. Is it acceptable for Calibration and Validation Plots to be aligned with the resolution and geometry of the remote sensing pixel grid (e.g., 30x30m squares), instead of traditional circular plots? 13. **Growth and Yield Model Integration** 14. For Improved Forest Management (IFM) projects, can field plots used for baseline modeling (e.g., using FVS) also serve as Calibration Plots for remote sensing-based carbon estimation under the Framework?	10. Existing plot networks in projects may be used as Calibration Plots in model development. Validation Plots are randomly generated to ensure model performance and lack of bias in the validation process. 11. Yes, existing grid plots can be used in calibrating Predictive Models. This Framework provides intentional flexibility in model development across a range of geographies, projects and project types. 12. Sections 2.3 and 3.2 of the Framework provide specifications that Calibration

		15. How should outputs from traditional growth and yield models (e.g., tree lists, projected volume) be reconciled with the continuous pixel-based outputs from Predictive Models under the Framework? 16. Does ACR provide specific guidance or a preferred format for delivering growth and yield models alongside remote sensing-derived carbon layers? Are simulation outputs from FVS or similar models acceptable as part of the Remote Sensing SOP package?	Plots and Validation Plots, respectively, must adhere to. Yes, this is technically possible if plots can be established, measured, and incorporated in an unbiased and accurate manner. 13. No comment. 14. Yes. 15. For IFM projects, growth models are still required to create baseline scenarios, and hence an initial field inventory (and its tree list) is required to derive initial carbon stocks. Any time after project start (i.e., time 0), the with-project scenario carbon stocks may then be estimated using the Framework. There is no reconciliation process as any source of carbon estimation (field inventory, remote sensing) must be deemed as statistically sound. 16. Not outside of existing methodological requirements as well as the requirements outlined in Section 1.5 of the Framework.

29	NativState	**File Formats and Deliverables** 17. Are there preferred or required data formats for submitting Predictive Model outputs (e.g., GeoTIFF), plot data (e.g., shapefile + CSV), or model scripts (e.g., R, Python)? 18. What level of version control or code documentation is required for Predictive Models used in the Framework? Would a Jupyter Notebook or R Markdown file be sufficient to demonstrate reproducibility? 19. Should all SOPs (Stratification, Calibration, Validation, QA/QC) be submitted as standalone PDF files, or can they be consolidated into a single document for each reporting cycle?	17. The Framework does not require a specific data format. However, model output is subject to VVB and ACR review, so common and open source formats will functionally help these review processes to go smoothly. 18. Reproducibility is required for verification purposes. R Markdown (or similar program [like Jupyter]) would likely be sufficient. Different developers are likely to have different methods and tools, which align with the intended flexibility of this Framework. 19. SOP documents should be submitted as an appendix to the GHG Project Plan. If they are being submitted later in a project term they should be submitted as an appendix to the Monitoring Report. They can be submitted into a single PDF if desired. They must contain all relevant and required information.

30	NativState	**Implementation and Resourcing** 20. Does ACR assume a certain baseline level of staff (e.g., biometricians, field foresters, GIS analysts) to implement the Framework effectively? Are there any published benchmarks for resource or time requirements per 100,000 acres? 21. Can any components of the Predictive Model development or plot installation (e.g., stratification, plot layout, biomass estimation) be contracted to third parties while still maintaining project compliance? 22. For project developers transitioning from traditional inventory approaches, will ACR consider a grace period or phased adoption schedule for full Framework compliance, especially for projects already under management or in mid-cycle reporting?	20. ACR does not assume a certain level of staff to implement the Framework in the same manner that it does not assume a certain level of staff to implement a methodology. The intention of this Framework is to create efficiencies and please keep in mind that use of this Framework is also optional. 21. Yes. The requirements of the Framework can be contracted out by the Project Proponent, so long as there is no conflict of interest or violation of ACR rules and requirements. 22. Utilization of this Framework is optional. If utilized, the Framework shall be implemented over the course of a Reporting Period and verified (which developers have some flexibility of reporting period duration). Projects could rely on existing traditional inventory approaches while developing a Predictive Model to be used for future verifications, if desired. Upon first use of the Framework,

			a Predictive Model must adhere and be validated/verified against all Framework requirements.
31	NativState	**III. Comments and Recommendations from Technical Review** **General Framework Concern: Integration with Growth Models (e.g., FVS)** 23. We would like to express concern that the Framework, as currently written, may limit alignment with established forest carbon modeling approaches required by existing forest carbon methodologies—particularly those relying on individual tree-level data structures such as tree-lists used in growth models like FVS. Since the Framework's outputs are derived from area-based predictions (e.g., aboveground biomass at the pixel level), they do not inherently provide tree-level input data necessary for stand projection modeling. While established workarounds exist—such as tree-list imputation techniques or k-nearest-neighbor (kNN) matching to library plots—these are post-processing steps that translate pixel-level inventory predictions into tree-list inputs. These techniques are increasingly accepted in forest modeling workflows and represent a viable pathway for integrating remote sensing outputs into IFM modeling requirements. We request that the Framework explicitly allow such approaches and clarify the permissibility of using off-project data sources (e.g., state-level FIA plot libraries) to support imputation or matching. Doing so would maintain modeling integrity while enabling broader use of remote sensing within the structure of IFM methodologies.	23. As written, the type of model imputation being described in this comment is beyond the scope of integration of remote sensing measurements into ACR forest carbon projects. Current ACR IFM growth models will utilize an initial inventory of field measured plots as inputs for tree-level growth and yield modeling (FVS) for baseline development.
32	NativState	**Lack of Clarity: One Predictive Model per Stratum vs. Mixed Approaches**	Section 1.4 has been edited and added to provide clarity that the

		24. We also seek clarification on the apparent inconsistency between Sections 1.3 and 2.2 of the Framework. Section 2.2 states that a separate Predictive Model must be developed for each Stratum ("one Predictive Model per stratum"), whereas Section 1.3 and the latter portion of Section 2.2 suggest that the Framework may be applied selectively to certain Strata within a GHG Project, with others relying on conventional field-based inventory methods. In practice, there are legitimate scenarios where a Project Proponent may wish to apply remote sensing models to some Strata and retain field-based methods in others—due to data availability, forest type variability, or management context. The current language creates confusion as to whether this hybrid modeling approach is permissible, and whether models must be built independently per stratum or if a single, stratum-agnostic model may be used across multiple zones. We recommend ACR clarify whether the "one model per stratum" rule is a strict requirement or if more flexible model architectures and mixed-method approaches are acceptable under the Framework.	spatial extent of a Predictive Model is termed and defined as an "area of interest" and "Any parts of the GHG project area that are not included in a Predictive Model's AOI must use another Methodology-approved inventory (e.g., a Ground Plot-based forest inventory) to estimate that area's carbon stocks". Throughout the Framework it is clarified that mixed-method approaches are eligible.
33	NativState	**Uncertainty in Plot Measurements** 25. The Framework does not explicitly address the uncertainty associated with field plot measurements, which can be non-negligible and may affect model eligibility analysis. *Recommendation: Incorporate field plot measurement uncertainty into the total uncertainty budget to improve the accuracy and fairness of model eligibility criteria.*	Uncertainty is incorporated into the project accounting structure (Sections 1.3 and 5). In regard to this Framework, we can elicit through use of VVB Validation Plot remeasurements that the field measurements represent an accurate estimate of carbon stocks (with known uncertainty) that aligns with current

			uncertainty estimates employed by the ACR Forestry program. ACR agrees with the caution in treating field measurements as a source of truth for comparing the accuracy of RS estimates. However, field measurements are standard practice in carbon accounting and the Framework will ensure that remotely sensed carbon estimates align with currently employed measurement approaches.
34	NativState	**Coverage Requirements and Temporal Gaps** 26. Section 2.1, bullet 1, appears to require full coverage of input features across the area of interest. Given the potential for gaps due to cloud cover or data noise, this may inadvertently restrict valid model applications. *Recommendation: Allow statistically valid gap-filling and noise reduction methods and clarify how temporal gaps should be addressed in the input features.*	Please see related comments and responses to comments 7 and 23, regarding allowable interpolation when there is missing pixel data.
35	NativState	**Bias and Uncertainty Handling** 27. The Framework emphasizes cross-validation to understand uncertainty but does not require models to produce pixel-level uncertainty estimates. This could obscure bias or residual errors in specific situations.	The Framework does require calculation of Pixel-level uncertainty, which is used as an input for uncertainty (RMSE based) in Equation 3 and Equation 4. ACR understands

		Recommendation: Require models to produce both predictions and uncertainty estimates per pixel to explicitly quantify bias and uncertainty.	that uncertainty at the plot level will fall within a range. However, the ACR Framework is concerned with AOI-level uncertainty for the purpose of Predictive Model approval, or not. Since crediting is performed at the project level, it is appropriate to deduct for uncertainty at the project level as well.
36	NativState	**One Model per Stratum** 28. Restricting one Predictive Model per stratum may limit data availability and model flexibility. It also prevents the use of more generalizable models that can learn across strata. *Recommendation: Permit the use of stata-agnostic models that accept statum as an input feature and make predictions across multiple strata.*	Please see ACR response to comment 3 regarding Predictive Models being associated with an AOI. The definition of Predictive Model can encompass algorithms with multiple inputs, which addresses this concern. Please see ACR responses to comments 5, 21, 24, and 32 addressing confusion regarding the definition of Strata (now referred to as AOI) and use of a Predictive Model across varied ecological conditions within a single project.

37	NativState	**Simple Averaging in Estimation** 29. Equation 1 appears to use a simple average to estimate carbon stock, without incorporating model uncertainty. This may lead to biased or unreliable estimates. *Recommendation: Encourage uncertainty propagation techniques for models that generate per-pixel uncertainty estimates to improve robustness.*	Section 5.4 now details how uncertainty is incorporated.
38	SCS Global Services	**Overall** This is a promising Framework that is well thought out and meets the demands of project developers invested in remotely sensed data approaches. In the broader context of model development and performance testing, the terms calibration, validation, test, and training datasets (etc.) are used with variable interpretations. To ensure consistent understanding and application of the Framework, it would be beneficial to acknowledge this and refer to the explicit definitions and intended meaning of 'calibration' and 'validation' data/plots within the context of the Framework. Below we have included other comments, VVB concerns, and potential points of confusion remaining in the Framework presented by section	ACR appreciates the general feedback. We point the commentor to the definitions section at the end of the Framework, where both Calibration Plot and Validation Plot are specifically defined in context of this Framework.
39	SCS Global Services	**Section 1.1 Summary** “The approach is designed to decrease the required field sampling intensity necessary to derive forest carbon estimates within ACR uncertainty thresholds and to facilitate efficient long-term monitoring, reporting, and verification. The Framework leverages field sampling for Predictive Model calibration and validation of remotely sensed forest carbon estimates.” Underlining added for emphasis.	Please refer to comments 5, 21, 24, 32, and 36 regarding the definition of AOI and the use of Predictive Models across multiple ecological conditions. ACR expects many projects to use a single Predictive Model and thus may require as few as

		It is unclear whether this is supported by the Framework. The RMSE metric in section 3.2 is highly sensitive to outliers. We could see a scenario where one Validation Plot with a lot of saplings (that satellites do not necessarily detect well) could fail a model for a stratum. However, we understand that this is an optional Framework that project developers may choose to use at their own risk.	30 Validation Plots. While outliers could be problematic, it is expected that this Framework still reduces field work overall.
40	SCS Global Services	**Section 1.3 Utilization in GHG Projects** (a) "Project utilizing methodologies that do not rely on growth models for baseline development…" Typo: Project should be plural (i.e., Projects). (b) "It is therefore possible to apply this Framework to provide carbon estimates for specific Strata, which may or may not constitute the whole GHG Project. The project area may consist of a single or multiple strata. Each Methodology provides details regarding stratification that shall be followed." The treatment of 'strata' may not be clear enough for projects that are applying this Framework during verification and have been previously validated with strata unrelated to the application of this Framework and Predictive Models. Are project developers allowed to adjust stratification post-validation to better accommodate remote sensing models? Such adjustments to strata made post-validation would conflict with critical modeling procedures tied to the baseline scenario and quantification. See also comment (a) for Section 2.2 related to this, below.	(a) This section has been removed for other reasons. (b) ACR altered the use of strata throughout the Framework. Area of Interest is now used to avoid confusion in this regard. This should clarify confusion with stratification for baseline purposes.
41	SCS Global Services	**Section 1.5 Reporting** "The Remote Sensing SOP document must be validated by an ACR-approved VVB and contain the following information:"	No, a validation report would not be required when this Framework is first applied at a verification event. The use of this

		Would a validation report be required when this Framework is first applied at a verification event, or an edit/extra section to the verification report regarding validation? This is important for proposals, scoping, and the applicable ISO requirements (i.e., validation = prospective, verification = retrospective).	Framework does not necessarily require a GHG project validation as defined by the *ACR Standard.* Use of this Framework is subject to verification. The implementation of this Framework would only be subject to GHG project validation if it was applied to derive initial carbon stocks. In all other cases, a verification would suffice. Section 6.2 now makes this clearer.
42	SCS Global Services	**Section 1.6 Validation and Verification** "This process must be described in the relevant Validation and/or Verification Report, including the following information: · A description of the process of generating a sequence of points for Validation Plot installation and measurement, including the points generated and how they were utilized" VVB Risk: Recognizing that there is a little more guidance in section 3.1, there is still not a lot of guidance. A VVB concern would be that the VVB selection is not reviewed by ACR until after significant fieldwork has been conducted mid-audit (i.e., Validation Plot establishment and measurement by the Project Developer). If the VVB selection is deemed inadequate by ACR (or a modeling issue is not caught until after Validation Plot fieldwork commences), the VVB could be viewed as at-fault for considerable field costs.	The Framework has been updated to change the way that Validation Plots are randomly generated. This process is now completed using an ACR hosted R script for an individual AOI. This should eliminate any risk on behalf of the VVB for selecting Validation Plots. This process is outlined further in Section 3.1.

43	SCS Global Services	**Figure 1** Step 5 “framwork” Typo: e is missing from Framework	This has been corrected.
44	SCS Global Services	**Section 2 Predictive Model Development** “All projects utilizing this Framework must develop a Predictive Model to estimate carbon stocks according to the specifications outlined in this section. All projects utilizing this Framework must also use the prescribed methods to estimate uncertainty and to discount carbon stock estimates for uncertainty. Predictive Models must be developed prior to engaging in the Validation Plot process with a VVB (Section 3).” It may be helpful to be prepared for the question: Why do project developers have to develop one model, a priori? It could be just as independent if a list of models were developed prior to sampling Validation Plots and given to the VVB with corresponding calibration accuracy. The one that performs best with Validation Plots could be selected (given no unreasonable differences from the calibration dataset RMSE which would indicate overfitting). Evaluating a suite of models against unseen validation data is a valid approach to identify the most robust and predictive solution. However, it is arguable that a dataset used to select models is truly 'unseen' statistically, as the selection process implicitly incorporates information from it.	The multi-model approach described would be allowed by the Framework as written. Such an approach could add expense and complexity to project development and verification, but it could be a valid application.
45	SCS Global Services	**Section 2.1 Predictive Model Requirements** “If using Object Based Image Analysis (OBIA), objects or segments must cover the entire stratum or area of interest” The application of OBIA to pixels is not treated further in this Framework but involves several important challenges and choices that can impact	The reference to OBIA has been removed from this Framework all together and is no longer an option. This should remove concern about lack of

		the final data quality and interpretation, especially near boundaries. As the Predictive Model details are left to the project developer, leaving out these details in the Framework may be fine and as ACR intended. However, the 'grain' of predictions needs to be clearly stated up front and carried through the procedures, noting that subsequent calculations provided in this Framework are pixel-based. If OBIA are resampled to pixels, a concern here is that projects could resample an object and then claim the new pixels are independent samples in uncertainty equations (inflating n and decreasing RMSE). Generally, counting multiple Validation Plots within a single OBIA object as independent observations (as in a RMSE calculation) violates the assumption of independent samples that could underestimate your RMSE and overestimate your model's accuracy. See related comment (d) for Section 2.2.	independence in the RMSE calculation.
46	SCS Global Services	**Section 2.2 Predictive Model Design** (a) "Stratification may be used to improve the accuracy of the Predictive Model's Inference and precision of carbon stock estimates." For projects that have been validated without this approach applied, but the Project Proponent chooses to utilize these methods, how do existing strata apply here? Do the Framework strata supersede any existing stratification in the GHG Plan or would there be two strata systems applied? It seems that the existing strata design should not be altered except where "the number and boundaries of strata may change during the Crediting Period (ex-post) as baseline and with-project scenario management practices diverge" as per Section 3 of IFM v2.1. This is because the initial inventory sampling was guided by stratification and	(a) See the above response to SCS's comment on Section 1.3 (comment 40). Stratification for baseline purposes is different and separate from testing a Predictive Model's carbon density estimates within an AOI. The Framework is intended to 'proof' estimates of with-project stocks (not baseline stocks). (b) See Comment #45 above. The reference to OBIA has

		baseline model procedures/assumptions are tied to the original strata design. See also comment (b) for Section 1.3 related to this. (b) “All Predictive Models are subject to the following requirements: Predictive Models must estimate the aboveground live tree and standing dead carbon pools for each Remote Sensing Pixel or object;” Underlining added for emphasis. We are assuming 'object' here refers to OBIA. This complicates the application of Validation Plots and pixel-based equations presented herein. Other issues also arise with the use of objects: Can there be multiple Validation Plots within 1 object in this Framework? How are these accounted in uncertainty calculations given the statistical assumption of independent samples for RMSE calculation? How big can objects get? Could objects become another type of strata if they are large? See related comments for Section 2.1. (c) “Remote Sensing Pixels located on a boundary which include area found outside the Stratum must pro-rate that Remote Sensing Pixel’s carbon estimate by the percentage of area found within the Stratum.” Issues may arise surrounding alignment between the walk-through method (if applied in Validation Plots, especially if they are square) and the application of pro-rating pixels. Overall, if a project decides to sample the 'whole pixel', then partial pixels will complicate things. (d) Equation 1, variable Ni “Total number of Remote Sensing Pixels (n) within Stratum i.” Here is where a clarification about how to deal with 'N' for the OBIA approach could be useful. See related comments for Section 2.1.	been removed from this Framework and is no longer an option (c) ACR added the following language to Section 3.2: “If any Validation Plots are located on a boundary which includes area outside of the AOI, the boundary must be mapped within the plot area and trees outside of the boundary are excluded from the plot.” (d) See response to comment #45 above.

47	SCS Global Services	**Section 3.1 Validation Plot Installation and Measurement** (a) "After contracting with a VVB for a given Reporting Period (or for a stand-alone validation), the VVB must generate a randomly allocated sequence of points that are located as centroids to Remote Sensing Pixels within the Stratum…" Underlining added for emphasis. This language does not align with language elsewhere surrounding 'pixel or object' for Predictive Model estimates. See related comments for Section 2.1 and 2.2 (d). The Validation Plots are paired with pixels for validation. This requires mapping-grade or even survey-grade GPS units depending on the remote sensing data used (GSD), and the impacts of topography and canopy cover on GPS signal quality. Should the VVB trust the client installed these correctly, as it is in their best interest to do so (therefore we could use our current consumer-grade GPS to reach a reasonable level of assurance on location), or would we need this higher-accuracy, expensive GPS equipment? Different VVBs may assess the risk here differently without explicit guidance. (b) "Each Stratum must have a unique sequence of points located therein." Is it 'each stratum' or 5 stratum/90% stocks, as indicated below Equation 5? (c) "Validation Plots may be designed as either circular or square plots, or they may match the size and shape of the Remote Sensing Pixel." VVB Risk: Details on the plot design would be needed to scope a project. Even so, a VVB will have a limited ability to accurately approximate the time needed given new plot sampling techniques introduced for this	(a) The Framework now requires a process where an ACR hosted R script generates GPS plot locations that the Project Proponent will establish in the field. Essentially, this sequence of points will be established from a randomly located selection of plots. The VVB should confirm plot location accuracy and lack of bias, similar to how they would assess plot location establishment in a typical ACR IFM inventory. (b) It is each AOI (previously called Stratum). The language below Equation 5 has been clarified. (c) Project Proponent choice of unconventional plot types may spur increased verification costs, similar to if unconventional field plots were employed in a conventional forest inventory. The practicality of FIA-style circular plots should limit the number of

		Framework (i.e., size, shape, sub-plot sapling approach, edge approach/walkthrough, etc…). (d) "The field inventory SOP document must include the following: - Sample size;" I assume 'sample size' refers to the number of Validation Plots. While it is indicated that the minimum is 30 Validation Plots per strata herein, it is also stated that, "The Project Proponent may continue to install and measure Validation Plots following the predetermined sequence until all conditions for statistical agreement (Sections 3.2) are reached." Therefore, the sample size cannot be determined ahead of time in an SOP. Some clarity may be required here.	unconventional sampling protocols, as we seen with plot-based inventories. Language has been added suggesting the adaptation of existing SOPs in Section 3.2. (d) Section 6.1 now requires the Validation Plot SOP to include "Number of Validation Plots installed", as a clarification of "sample size". ACR expect the final number of plots installed to be recorded here. It is unnecessary for this number to be determined ahead of time and may be recorded prior to submission to the VVB.
48	SCS Global Services	**Section 4 Validation Plot Field Remeasurement** "If the project contains multiple Strata (and hence Predictive Models), remeasured Validation Plots may be located within the lesser of either 1) five (5) strata selected by the verifier based on a strategic assessment of risk, or 2) fewer than five (5) strata comprising ≥90% of the proportional project carbon stocks." It appears as though this approach (in combination with the deduction applied in Equation 6) allows a project developer to skip a confidence	Thank you for this observation. However, this is a misunderstanding regarding remeasurement plots in the site visit. This is similar to the way we do things already for VVBs and site visits. With multiple AOIs (previously called Strata) and thus models, 30 Validation Plots per

		deduction for stocks in strata not measured. In diverse systems (e.g., species, topography, land use history) a large number of strata may be justifiable, but not necessarily warranted, resulting in 15+ strata where deductions are taken on a smaller percentage of stocks (only 5 strata). Some justification of strata pertaining to model calibration may be needed to answer: Are this number of strata really needed to create accurate models? See also related comment for Section 5, directly below.	strata/model are required for model validation. However, only the square root of the number of Validation Plots for the project need to be replicated to confirm the Project Proponent's proper measurement of Validation Plots. The provision allowing remeasurements on less than all of the AOIs has been removed. We have clarified the expectation that all AOIs receive Validation Plots, subject to VVB remeasurement and uncertainty calculations (Section 3 and 4).
49	SCS Global Services	**Section 5 Model Limitations and Approval** "If the project contains multiple Strata, the models of each Stratum must individually be assessed for uncertainty percentage." Above, it is mentioned that only 5 strata (or enough to meet 90% of stocks) may be measured in some projects. It appears as though uncertainty is not applied to strata without Validation Plots. See also related comment for Section 4, directly above.	Please note that all AOIs (previously called Strata) are subject to Validation Plots and hence uncertainty calculations. This has been clarified in the Framework (Section 3).
50	SCS Global Services	**Definition Section** Stratum "Entire or part of a project area which has similar properties, for example topography, forest types, density classes, volume, age classes,	This language has been incorporated in Section 2.2, which discusses the process for defining AOIs for projects with

		management regime, site index, or other properties indicative of carbon stocks." Underlining added for emphasis. Consider rewording to, 'similar properties **indicative of carbon stocks**, for example...' We have had issues with strata being identified based on non-carbon stock criteria. In the case of this Framework and the definition quoted above, strata could be defined related to any 'similar properties' not explicitly excluding non-carbon related data.	more than one Predictive Model. However, we did not include the suggested language. We do not think it is appropriate to define AOIs (i.e., the spatial scope of a Predictive Model) based on properties indicative of carbon stocks. For example, a Predictive Model may perform well within a certain broadleaf forest type but poorly in a neighboring coniferous forest type. Assume these two forest types have similar carbon density. In this case, forest type is not indicative of carbon stocks, but it is reasonable that an AOI would be defined using this forest type boundary. The Framework provides needed flexibility for the various types of Predictive Models that may be used, while still being robust in requiring successful statistical agreement with ground based samples..
51	The Conservation Fund	The current requirement of 30 Validation Plots per stratum, while statistically sound, discourages the inclusion of smaller strata. To improve stratification flexibility, we suggest implementing a minimum number of plots per stratum acre, capping at a maximum of 30 Validation	The Framework has been clarified to specify that stratification in this context only applies when multiple Predictive

		Plots. This would allow for the practical inclusion of smaller, but potentially significant strata.	Models are utilized (see Section 1.4). In practice, many projects may only require one Predictive Model and thus only 30 Validation Plots total.
52	The Conservation Fund	TCF suggests considering extending the applicability of the validated remote sensing model beyond the 5-year threshold.	ACR has retained the 5 year period, which aligns with ACR's full verification interval.
53	GreenTrees and Coolant	*In summary, this set of comments (provided as a 3-page write-up) proposes a specific framework for verifying the output of a Predictive Model without the need for VVB remeasurement (Section 4) during a 5-year period following initial approval. Specific reporting and VVB data checks are suggested.*	We appreciate this detailed and thoughtful proposal. The Framework has incorporated several elements you suggested, including clearer guidelines regarding the use of the Predictive Model during its 5-year approval period (Section 1.5) and specific details regarding the scope of verification (Section 6.2).
54	Rayonier	**Error-in-variable problem in the model** Any model built to satisfy the inversion of a remotely sensed forest will have a bias towards the mean. We think the methodology should include how bias would be corrected. There are many methods to tackle the error-invariable problem. We have attached a paper by Kinane 2021 that tackles this problem using Simex in this email, which highlights one method of doing it.	Thank you for this suggestion. Kinane (2021) explains well the issues arising from building prediction models without correcting for remote sensing measurement error. However, rather than prescribe a single method to correct for this bias, it

			is appropriate for the Project Proponent to implement a method appropriate for the specific situation. This would take place during Predictive Model design and calibration. This Framework focuses more on the use of Validation Plots to demonstrate accuracy; at this stage, the comparison to plot measurements would reveal whether or not sufficient bias correction has been implemented.
55	Rayonier	**Multiple strata considerations (Section 3.2):** • ACR should clearly state that overall project-level RMSE and CI will be calculated as area-weighted averages of stratum-level values, with appropriate statistical methods for combining uncertainties. • If one stratum (in case of multiple strata) fails to meet its individual criteria, the Framework should outline consequences.	Section 1.3.2 has been added to elaborate on the specific outputs from use of this tool. Additionally, Equations 3 through Equation 6 are outlined very specifically to this point. Section 5.4 outlines specific details regarding project level uncertainty calculation and is updated from the original draft. Section 4.1 now focuses on Model approval and describes the process to optionally follow

			if a Predictive Model does not initially meet required criteria.
56	Rayonier	**Assessing Model Eligibility with Validation Plots (Section 4)** • Discontinuation of Validation Plots and Recalibration: The Framework states that if statistical agreement is not reached, a Project Proponent may discontinue a sequence of Validation Plots, recalibrate their model using the discontinued plots, and then request a new sequence of Validation Plots. • Question: This process seems to allow for iterative recalibration and re-testing with new validation datasets. How many times can this cycle be repeated? Are there any limitations or increased scrutiny after multiple attempts to reach eligibility? • Thought: While flexibility for model improvement is good, clear boundaries or a process for handling repeated failures might be needed.	Thank you for this suggestion. We anticipate that the expense of installing and measuring Validation Plots will be a self-regulating mechanism on this process. However, if a model does fail with Validation Plots, it is reasonable and still robust to allow a pathway for their use in calibration. It is recognized that this can be an iterative process, and ACR therefore did not place a limit on number of times this cycle can be repeated. Also, the process of requesting a seed number from ACR (Section 3.1) prevents Project Proponents from repeatedly generating point sequences until a favorable sequence of points is generated. However, Section 6.1 requires reporting on whether any sequences were discontinued and why. This transparency will

			enable further review by the VVBs when needed.
57	Rayonier	**Validation Plot Field Remeasurement by VVB (Section 4)** • "Efficiently Relocated" and Zero Carbon Assignment: If Validation Plots cannot be efficiently relocated by the VVB, they shall be assigned an estimate of zero carbon for remeasurement, and the t-test, or a new plot can be generated. • Question: "Efficiently relocated" seems subjective. What defines "efficiently"? Will ACR provide clearer guidelines or metrics for what constitutes a non-relocatable plot? Assigning zero carbon could severely penalize projects, even for minor relocation difficulties. Could there be alternative approaches, like allowing for a reasonable margin of error in plot relocation, or another approach rather than a default to zero? • Thought: Clarity on the definition would be helpful to avoid misinterpretation	The assignment of zero-carbon to plots that cannot be relocated has been removed. While Project Proponents are still required to install Validation Plots "such that they can be relocated by the VVB" (Section 3.2), Section 4 now says: "If a Validation Plot **cannot be relocated** [emphasis added], the VVB may skip it and remeasure another Validation Plot. **If many Validation Plots cannot be relocated**, the VVB may conduct a risk-based assessment to determine whether the pattern is indicative of a failed implementation of the Validation Plot measurement SOPs, in which case the VVB may decide that the Student's t-test has failed."
58	Rayonier	**Other general questions** • What kind of quality assurance and quality control documentation is required for the remote sensing data used?	Reporting of quality assurance and quality control methods is

		• While sharing model-related documents with the VVB, is there an expectation for the model code or specific algorithms to be shared with the VVB for review?	now required in Section 6.1. Thank you for this suggestion. The Framework now specifies that a Predictive Model's algorithm is not subject to VVB review, although the VVB does need to ensure the model has not been modified when used during its 5-year approval period (Section 2.2).
59	PotlatchDeltic	Suggesting a Framework is a great way to improve protocol efficiency (time and effort) and expedite integration of forest inventory methods for evaluation under the ACR protocols, without having to evaluate new possibly unsuitable forest inventory protocols every time a project proponent / developer submits a new project. Defining a protocol in this way should make all of our lives easier. One thing of note is that it may be worth broadening the scope slightly. It is a good idea to reference it as remote sensing Framework, but it is worth mentioning that it is applicable to all sources of auxiliary information. This could include soils layers, slope, aspect, elevation, forest type maps (remote sensing based or otherwise), burn perimeters, GPS tracks around drought or pathogen impacts, etc. While remote sensing represents the most prominent technological opportunity, there are many sources of auxiliary information which can improve estimates of carbon.	Thank you for this suggestion. The following has been included in Section 2.1 of the Framework to incorporate this suggestion: "The input data sources may include Remote Sensing measurements, Calibration Plot measurements, and other auxiliary data (e.g., soil or topographic data)."

60	Anew	We would like to stress the importance of implementing a rigorous, area-based validation Framework. Specifically, the remote- sensing model's mean CO2/acre must be compared to the mean CO2/acre from the Validation Plots. This approach ensures the modeling outputs are grounded in proven methods and provides a transparent metric for assessing model accuracy against on-the-ground measurements. We welcome the opportunity to discuss this in more detail.	Thank you. We developed this framework with input from numerous remote sensing experts who confirmed that the approach in the Framework (which leverages a minimum of 30 Validation Plots across the entire AOI) to evaluate a Predictive Model's accuracy is appropriate and robust.
61	Anew	If the overall goal is to ease barriers to entry into the program by making it more cost effective, it is unclear how the cost savings will be achieved. Can you offer more details of how and where you see the lower barriers (both financial and human capital) of entry into the program?	We suspect this comment may stem from a misunderstanding that has been addressed across multiple comments above: 3, 5, 21, 24, 32, 36 and 39. In most cases, a single Predictive Model may be sufficient for an entire project area, rendering the practical possibility that as few as 30 field plots will be needed to conduct a project inventory. This has the potential to reduce costs compared to current inventory practices.
62	Anew	Doesn't seem 2.1 would apply given the tree level periodic baseline assessment. Can you confirm and/or clarify?	Section 1.3.1 has been added to clarify distinctions between project level carbon stock

			estimation and requirements for baseline setting across project types and at specific points in time of a carbon project.
63	Anew	Are there any citations and peer reviewed literature that demonstrate this pixel level approach has been done? High uncertainty of pixel level models. What about gaps in canopy? Meadows? An area below the Minimum Mapping Unit (MMU) could easily be selected with higher uncertainty.	There are many examples of pixel-level regression models for estimating biomass in the scientific literature. See the following for a few examples: Matasci et al. (2018); Maselli et al. (2016); Baccini et al. (2012).
64	Anew	How would this apply to Canada? If Canada uses stand level modeling with RS approach to strata, it wouldn't require tree-level data so may not be applicable?	The reference to tree-level has been replaced with the term ground-based to provide clarity. The Canada IFM methodology is applicable.
65	Anew	Can plots be chosen to balance quality and cost? For example, can the developer measure the maximum number of plots that meet a specific budget? From there remote sensing could be leveraged to estimate stocking on more remote plots.	This can be done, in concept, by installing a measured, cost-effective number of Calibration Plots to adequately calibrate the Predictive Model. When approving a Predictive Model for use, ACR's primary concern is the validity of the resulting carbon stock estimates. We recognize that it is possible this Framework will not

			be financially feasible in all instances (such as, if the number of Calibration Plots needed to calibrate the model becomes cost prohibitive).
66	Anew	Can FIA plots be used for validation (not just the methodology) and can ACR help coordinate access to this already restricted data? This would present many efficiencies for all involved and avoid the creation of bespoke methodologies that take time to review and approve.	Given ACR's understanding of the confidentiality of FIA plot locations we would not be able to coordinate access. More information can be found at the following link: Spatial Data Services | US Forest Service Research and Development.
67	Anew	Can this Framework be used to abandon the need to revisit plots once projects enter the non-crediting phase? Either at Year 20 OR if the proponent elects to no longer issue credits from the project?	This Framework was developed to facilitate cost effective monitoring, reporting, and verification, both during a reporting period and after. It is correct that it may be especially useful in post-crediting period monitoring. The current Framework requires a reduced number of plots (minimum 30) but does not completely negate the need for measuring a number of plots.

68	Anew	Can the proponent just use RS to report on monitoring in the out-years, as opposed to needing to ground truth at all if they're not planning on crediting?	Validation/verification of the RS estimates are still required, which includes a potentially reduced number of field plots compared to conventional field inventories. Site visits are and still will be required, per the methodology and ACR Standard, at stated intervals.
69	Anew	The current requirement for pixel-to-plot validation is arguably scientifically ideal but not feasible for project-level applications, given current limitations in remote sensing and field measurement technologies. Specifically, GPS inaccuracies, small plot sizes, and sub-pixel variability in forest structure make one-to-one pixel-to-plot comparisons unreliable. We recommend adopting a more practical and scientifically sound alternative for project-scale implementation that accounts for spatial uncertainty and heterogeneity while aligning with methods commonly used in area-based forest inventory calibration. Here are some alternatives: ○ Comparing aggregated biomass values from remote sensing within a larger buffer (e.g., 60 m radius around each plot center, or another value depending on pixel size), ○ Averaging across fixed-area grid cells (e.g., 2 acres, 5 acres, etc.) that contain one or more plots, ○ Stand-level or management zone averaging, when project boundaries are operationally defined,	Given some of these concerns, the requirement for Validation Plots to be within a single Pixel has been removed. Validation Plots now create a weighted average of all Pixels they overlap (Section 3.3).

		○ Stratified aggregation, where plots and pixels are grouped by forest condition or structure class and compared at the group level. These area-based methods are more appropriate for project-scale biomass estimation and validation than strict pixel-to-plot matching. They provide more stable and interpretable accuracy assessments and are more realistic to implement with the tools and data available today.	
70	Anew	1.1 Summary Clarification needed: The Framework references "known and accepted statistical thresholds" but does not specify which thresholds these are or their sources. Are these values defined in a separate ACR document or established guidance? Do you mean 10%? Or will there be acceptance of even higher rates of uncertainty given that the uncertainty of these RS/pixel models is likely higher. Providing explicit references or examples of these thresholds would improve clarity and ensure consistent application. If these thresholds are not drawn from existing ACR standards, it would be helpful to cite relevant scientific literature or widely accepted protocols to support their use.	The "known and accepted" language has been removed to alleviate ambiguity. All required thresholds are found in Section 3.4.
71	Anew	1.3 Utilization in GHG Projects Is there any proof of concept developed to demonstrate the feasibility of combining remote sensing derived data with allometric equation estimates?	This Framework is the first of its kind for the ACR program. We expect that ACR stakeholders will learn and innovate through this process, demonstrating feasibility in projects and locations that are suitable. Additionally, ACR has tested this Framework with remotely

			sensed biomass estimates on live aboveground forest carbon stocks with mixed results on a limited number of projects. These results demonstrate proof of concept while also suggesting that using remote sensing might not be appropriate or financially feasible to all geographies and forest conditions (such as those where remote sensing predictions do not align well with field-collected data, or where the number of Calibration and Validation Plots necessary to do so is prohibitively high).
72	Anew	1.3 Utilization in GHG Projects Does the Framework permit the development and use of new remote sensing models within the five-year reporting period, or must projects adhere strictly to the initial model for the entire duration? Allowing updated models for each Reporting Period could improve accuracy by incorporating newer data and methods. We recommend that the language permits model updates annually or periodic to reflect advancements and maintain robust biomass estimation.	This Framework permits Predictive Models to be updated, coincident with a 5 year (or sooner at the Project Proponent's discretion) approval interval. To renew Predictive Model approval, the same Predictive Model, or an updated Predicted Model, must be verified with a site visit. Section 1.5 of the Framework states the following:

			"After a Predictive Model is approved for use, there is no obligation to use it in subsequent reporting during its 5-year period. This Framework may be used again (to approve a different Predictive Model) before a previously approved Predictive Model's 5-year period expires, and other Methodology-approved approaches (e.g., a Ground Plot-based forest inventory) may be applied to derive carbon stocks at any time, including during the 5-year period."
73	Anew	1.3 Utilization in GHG Projects Can you clarify if the intention is to use the remote sensed data for interim desk reviews or can it be used for baselines assessed after post initial validation?	Predictive Models that are approved under this Framework are allowed to quantify with-project carbon stocks during interim desk reviews (see Section 1.5). For IFM projects, Predictive Models cannot be used to estimate baseline carbon stocks (see Sections 1.3.1 and 1.5.1).
74	Anew	1.3 Utilization in GHG Projects	Each project using this Framework must receive its own

		How would you address projects near each other and nearly identical that may use different Frameworks with materially different results between ground data and remote sensed data?	approval for using a Predictive Model to estimate carbon stocks. There is currently no option to approve a single Predictive Model for use in multiple projects, even if geographically close and ecologically similar. The statistical tests within this Framework ensure that despite the two differing approaches to carbon inventory, the results of such approaches are statistically the same.
75	Anew	1.3 Utilization in GHG Projects According to the document "This Framework provides a Stratum-level Framework for assessing model eligibility and approval." The stratum level approach described here contradicts the pixel level approach in other parts of the document.	Predictive Models are assessed for use within their defined AOI through the use of Validation Plots (Section 3). There is plot to (weighted) pixel sampling at an intensity that is representative of the entire AOI. This language has been clarified in the Framework design (Section 3.3).
76	Anew	1.3 Utilization in GHG Projects "Eligible approaches leverage remotely sensed carbon estimates and field Calibration Plots to achieve required accuracy and uncertainty thresholds, inclusive of discounts for uncertainty."	This language has been removed from the Framework. Please see Section 1.3.2 and Section 5.4 for details regarding uncertainty discounting, which are now

		Can you clarify how this model is meant to meet or exceed uncertainty, but discounting is also allowed?	reliant on existing methodology applications.
77	Anew	1.3 Utilization in GHG Projects "This Framework provides a Stratum-level Framework for assessing model eligibility and approval. It is therefore possible to apply this Framework to provide carbon estimates for specific Strata, which may or may not constitute the whole GHG Project." Can you clarify if the RS approach could be used for a single stratum within a multi-strata project?	This Framework allows for approval of a Predictive Model whose AOI (previously called a stratum) does or does not encompass the entire project area. Section 1.4 of the Framework has been added to provide clarity on this subject.
78	Anew	1.5 Reporting Can you clarify if Validation Plots must be assessed for each RP this Framework is utilized? What about for desk verifications?	Section 1.5 has clarified that testing a Predictive Model with validation Plots is only required once every 5 years of reporting (coincident with full verification). In interim years between full verification, an approved Predictive Model can be used for estimating carbon during either desk or full verifications.
79	Anew	1.7 Process- Regarding validation, this version of the Framework indicates that VVBs should select plots after the RP has been contracted. Doing so could raise concerns about conflicts of interest and would be highly inefficient.	Updates to the Framework now require the Project Proponent to generate random Validation Plot locations via an ACR Script for Validation Plot Location

		If a third-party is required, it would be more logical for ACR to select them before the RP concludes. This would allow sufficient time to gather data points and contract crews accordingly. It is far more effective and defensible to use an existing dataset and select those points for validation, rather than relying on randomly chosen pixel points. The latter approach would not be cost-effective and would be difficult to justify. Additionally, live inventory should not occur during the verification process.	Generation. This script will is made available on ACR's website. Details regarding generating validation plot locations are contained in Section 3.1 of the Framework, including processes that ensure reproducibility and lack of conflicts of interest. Regarding data collection, the Project Proponent installs Validation Plots prior to engaging with the VVB (Section 4).
80	Anew	1.7 Process In Figure 1, it reads as if a site visit is needed each time this is used. Can you clarify?	Yes, the process described by Figure 1 must coincide with a site visit. However, as stated in Comment #78, approved Predictive Models may be used without a site visit during a 5-year approval period.
81	Anew	2.2 Predictive Model Design The definition of "group of Remote Sensing Pixels or segment" is not clear. Is there a minimum or maximum number of pixels that can be grouped together? Can developers develop models that are segment-based instead of pixel-based? If yes, how should we proceed with validation? For Equation 2, pixel values (predicted vs Validation Plot values) are the input, but if developers use segments, should they input	This language has been removed. Segment-based models are currently not allowed by this Framework (Section 2.2).

		the average of pixels inside segments instead of the value of single pixels?	
82	Anew	2.2 Predictive Model Design We recommend using continuous output only, instead of allowing for categorical use. The output is estimating biomass, and this is a continuous variable by nature.	Section 2.1 has been edited to specify that Predictive Model outputs must be continuous.
83	Anew	2.2 Predictive Model Design The document does not mention the use of private or publicly available data as supporting data to develop models. Only Calibration Plots are mentioned. Are developers allowed to use other data sources to train their models if they pass the validation tests?	Clarifying text has been added in Section 2.1. Predictive Models may utilize a variety of inputs (including public or private data) for estimating carbon stocks.
84	Anew	2.2 Predictive Model Design The document says, "strata should be defined based on properties indicative of carbon stocks" (page 13). Should we re-stratify projects based on carbon stocks if we decide to use this Framework? Do we need two strata per project then (one based on forest type, as we usually do, and another based on carbon stocks)?	No, you do not need to re-stratify based on carbon stocking to use this Framework. Clarifying language has been added regarding stratification versus delineating an AOI in conjunction with this and other comments (see responses to comments 24 and 50). The quoted language has been altered to clarify that AOIs do not need to be defined on the basis of carbon stocking. However, AOIs are subject to remeasurement of Validation

			Plots and statistical testing on the basis of carbon density.
85	Anew	2.2 Predictive Model Design "However, standardization of the measurement protocols for Calibration Plots and Validation Plots is likely to better facilitate validation and verification of the remotely sensed carbon estimates. " How can calibration and Validation Plots be measured in different ways? That would create a model based on one method of collection and tested using another method. Can you clarify the rationale for this approach?	Calibration Plots provide data inputs to the Predictive Model, but we are ultimately concerned with the Predictive Model outputs and their statistical alignment with Validation Plots. Validation Plots are independent of Calibration Plots and must have standardized and replicable procedures. Validation Plots are ultimately the unit tested by this Framework. The identified statement makes clear that it is advisable to standardize, but since Calibration Plots are not tested during the approval process, they may be measured differently than Calibration Plots, if desired.
86	Anew	2.2 Predictive Model Design On the second bullet point, for consistency, explicitly say that the project proponent must develop a Predictive Model for each stratum "in case there is more than one stratum."	Section 1.4 now specifies the relevant details related to this comment. Strata language has been omitted and now refers to an AOI in the scope of this

			validation Framework. This section states the following: "Therefore, a GHG project area may include one or more Areas of Interest. If a GHG project area includes multiple Areas of Interest, the Project Proponent must seek approval for each AOI's Predictive Model independently."
87	Anew	2.2 Predictive Model Design Should the document add a maximum spatial resolution? Perhaps be consistent with the dynamic baseline language and set it to up to 30m?	This Framework does not prescribe a minimum or maximum spatial resolution. Predictive Models of any resolution may be used if they meet the statistical thresholds. Please note the independence between this Framework and baseline setting added in Section 1.3.1.
88	Anew	2.2 Predictive Model Design "…Strata should be defined based on properties indicative of carbon stocks." "It is permissible to use this Framework for certain Strata and to use field inventories per the requirements of the applied Methodology for the remaining Strata."	Language in Section 2.2 has been clarified and "indicative of carbon stocks" has been removed. AOIs may be defined on the basis of various site properties (with examples provided in Section 2.2), not

		Framework indicates “strata should be defined based on properties indicative of carbon stocks.” Does that mean they must be defined on such properties, or may the strata be based on access, management regimes, etc., or other properties not necessarily indicative of carbon stocks, but are spatially explicit?	necessarily just those that are indicative of carbon stocks.
89	Anew	2.2 Predictive Model Design Equation 1 needs explanation for Pi	ACR has updated the equations in this document. Please see Equation 1.
90	Anew	2.2 Predictive Model Design How do we pro-rate the pixel's carbon estimate by the percentage of area found within the Stratum when the value is per area? Doesn't it make more sense to calculate the overall carbon stock (metric tons CO2e) for the entire stratum area (with pro-rated values for the pixels around boundary) and divide it by the stratum area to get the stratum-level carbon estimate (Equation 1), rather than just dividing it by the number of pixels (also since pixel size can vary slightly)?	The language has been updated to clarify that the Pixel-level output is carbon density (per unit area), and the following sentence has been added to Section 2.4: “Once all Pixels for a particular Predictive Model have been assigned a carbon density, these values are averaged to calculate an AOI-level carbon density (Equation 1). If any Pixels within the AOI are located on a boundary which includes area outside the AOI, this average should be weighted by Pixel area inside the AOI.” Pixel-level output as carbon density has been retained to maintain consistency with other Equations. This addresses the

			issue raised, albeit differently than suggested.
91	Anew	2.2 Predictive Model Design Ni is the total number of pixels in each stratum, but it ignores the partial pixels.	As explained in response to Comment #90, in the instance of partial Pixels, this is a weighted average.
92	Anew	2.2 Predictive Model Design Can developers create models for the full project area and validate them for each stratum? This would allow them to use all Calibration Plots to develop their models, which would benefit from more diverse training data.	ACR has added clarity on this subject. Section 1.4: Spatial Scope (Area of Interest) has been added and specifies the following: "When applying this Framework, the Project Proponent must define that Predictive Model's spatial scope (i.e., its Area of Interest or AOI). An AOI may contain either the entire GHG project area or only a part of it. Therefore, a GHG project area may include one or more Areas of Interest. If a GHG project area includes multiple AOIs, the Project Proponent must seek approval for each AOI's Predictive Model independently."

93	Anew	2.2 Predictive Model Design "Once all Remote Sensing Pixels or objects for a particular Predictive Model have been assigned a carbon estimate, these values are averaged to calculate a Stratum-level estimate of carbon (Equation 1) per unit area." This appears to be tailored strictly to estimating carbon. How does this tie in with baseline operations? In other words, how would this tie into baseline harvests and acceptable RX's. Would you have to go pixel by pixel to establish appropriate RXs? Related, how would baseline harvests work using a pixel approach?	A new section has been added (1.3.1) addressing how this Framework can be used for estimating baseline carbon stocks (where relevant) across the various eligible project types.
94	Anew	3.1 Validation Plot Installation and Measurement Can you clarify the justification for a minimum of 30 Validation Plots per stratum?	The central limit theorem states that sample distribution will approach a normal population's distribution as sample size increases. A common rule of thumb is that a sample size of 30 is sufficient to ensure normality. This is supported by the literature (see Footnote 2 in the Framework). In the context of GHG projects, a plot count of 30 is generally far less than most projects install using traditional sampling inventories, so we interpreted 30 as both a practical and statistically supported minimum plot count.

95	Anew	3.1 Validation Plot Installation and Measurement The VVB picks plot locations for the proponent to measure, and then the verifier measures those at the site visit. It seems like this would create a conflict of interest. Can you clarify this approach?	This process has been changed with the creation of the ACR Script for Validation Plot Location Generation. Now, the Project Proponent, with ACR's assistance, generates a sequence of random points to be used as plot centers. The Project Proponent then measures Validation Plots until reaching statistical agreement (Section 3.4), and lastly a subset of Validation Plots are remeasured by the VVB to confirm data integrity and proper measurement.
96	Anew	3.1 Validation Plot Installation and Measurement "When the eligibility assessment is restarted with a new sequence of Validation Plots, allowing the previously installed and measured Validation Plots to be used as Calibration Plots." This appears to conflict with the current rules. Currently, developers are not allowed to use data collected by verifiers. Can you clarify?	This appears to be a misunderstanding. Validation Plots are collected by the Project Proponent, and a subset are remeasured by the VVB. In the event that a sequence needs to be restarted, the previously measured Validation Plots will not be used for reaching the statistical thresholds and may therefore be used as Calibration Plots if desired.

97	Anew	3.1 Validation Plot Installation and Measurement What is plot relocation by the WB?	This is VVB (as in Validation/Verification Body), not WB, and is included in the Acronym list.
98	Anew	3.1 Validation Plot Installation and Measurement "Plots that cannot be relocated by the VVB shall be assigned an estimate of zero carbon for the purposes of the VVB's remeasurements or a new Validation Plot location must be randomly generated by the VVB for Project Proponent plot installation." If you cannot find a plot center, a new plot is established at site visit, what is the protocol for this? Taking a zero does not make sense just because the plot is not located. We suggest a more formal approach in the event that a plot(s) is not located during a site visit.	Thank you for this observation. This language has been largely revised and now states (in Section 4): "If a Validation Plot cannot be relocated in the field, the VVB may skip it and remeasure another Validation Plot. If many Validation Plots cannot be relocated, the VVB may perform assessment to determine whether the pattern is indicative of a failed implementation of the Validation Plot measurement SOPs, in which case the VVB may conclude that the Student's t-test has failed"
99	Treefera	Key Observations on the Current Draft Framework 1. Pixel-constrained plot rule – §3.1 states that every Validation Plot "must be located completely within a single Remote-Sensing Pixel and therefore may not exceed the size of the Remote-Sensing Pixel."	Thank you for this observation. The requirement that Validation Plots are smaller than Pixel size has been removed. Validation Plots are no longer forced to a Pixel centroid. The carbon

		2. Pairing at pixel support – The same section pairs each plot one-to-one with the pixel it sits in to compute residuals for RMSE and confidence intervals. 3. Strict eligibility thresholds – A model passes only if RMSE < 20 % and the 90 % CI ≤ 10 % of mean stratum carbon 4. Typical forest-inventory plots are larger (0.04–0.1 ha) than a 10m Sentinel pixel (~0.01 ha), so most plots naturally cover several pixels. 5. Hand-held GNSS under canopy may provide 2-6m accuracy [1], meaning the true centre of a plot often drifts across pixel boundaries. Remote sensing sources themselves will have an uncertainty, as an example, Sentinel-2 L1C products are specified with <12m absolution geolocation error (95% confidence), but typically around 6m [2]. These factors together risk inflating residuals for high-resolution (10–20 m) models and could bias the Framework toward coarser imagery.	densities from all Pixels overlapping the Validation Plot area must be averaged to derive the Predictive Model's area-weighted average carbon density for each Validation Plot area (Section 3.3). These changes mitigate the incentive towards coarser resolution Predictive Models.
100	Treefera	Proposed alternative text (Section 3.1) "Where Validation Plots exceed the footprint of a single Remote-Sensing Pixel, the Project Proponent may instead assign to the plot the area-weighted mean of all pixels whose centroids fall inside the plot boundary. In this case the plot diameter must be reported, the list of intersecting pixel IDs archived, and the same aggregation procedure applied to both model predictions and field-based carbon estimates." Why? 1. 1. Aligns spatial 'support' of observations and predictions.	Thank you for this suggestion. It has been implemented in Equation 2.

The current requirement that each Validation Plot "… must be located completely within a single Remote-Sensing Pixel" forces field data to be collected on a pixel support (≈ 0.01 ha for 10 m pixels). Forest inventory guidelines, however, favour plot sizes of 0.04–0.1 ha for biomass estimation to reduce tree-count variance. Allowing the plot to span multiple pixels then averaging the corresponding model outputs eliminates the

scale mismatch. And reduces uncertainty related to satellite imagery co-registration variations/uncertainties

2. Mitigates GPS error without inflating model RMSE.

With uncertainty in both the horizontal GNSS and remote-sensing geolocation, the true plot centre can drift across pixel boundaries. An area-weighted mean of all overlapping pixels is less sensitive to such sub-pixel shifts, whereas the single-pixel method can mis-assign a plot to the wrong spectral class, artificially elevating RMSE and failing the ≤ 20 % threshold in §3.2.

3. Captures inta-Plot Heterogeneity that small pixels resolve

High-resolution imagery intentionally resolves canopy gaps, species mixtures, and disturbance signatures. Aggregating predictions over the full plot ensures that these fine-scale variations contribute proportionally to the validation statistic, rather than being discarded because the plot is forced to mimic a single pixel. This would reduce the impact of mismatch between location or edge effects - where tall forest meets a recent harvest or road.

Adopting an "area-weighted pixel mean" option would allow detailed Carbon quantifications of (10 -20m) to showcase their finer detail, while keeping the validation method faithful to the real, heterogeneous forest that the field plots measure.

		References [1] Michael G. Wing, 2011. Consumer-Grade GPS Receiver Measurement Accuracy in Varying Forest Conditions. Research Journal of Forestry, 5: 78-88. [2] Copernicus Sentinel-2 (processed by ESA), 2021, MSI Level-1C TOA Reflectance Product. Collection 1. European Space Agency, https://doi.org/10.5270/S2_-742ikth	
101	TerraCarbon	2.1 Predictive Model Requirements Predictive Models have many components and requirements based on the draft methodology. In reviewing the Predictive Model requirements, our team has the following comments, itemized by the proposed methodological requirements. (1)Time stamps are stated as being required for any remote sensing images. This poses a problem for composited images (which is common practice remote sensing for arriving at a cloud free image. Guidance should be provided for how composite remote sensing images are supposed to be reported. There are many methods for compositing, each with different implications for the final time stamp. Including: (i) Day of Year (DOY) "best" pixel (ii)Mean / Median pixel value of a date range (iii) Empirically estimated pixel value (2)Georeferenced coordinate information must be provided for all remote sensing measurements. It is not clear if this refers to image extents, pixel locations, or something entirely separate. This should be clarified. Further, there is no discussion about an appropriate projection	1) Section 2.1 has been revised to state "Details regarding the timing of data…", also in conjunction w/ comment 9 (above). 2) This language has been removed. However, your point regarding projection is still relevant. The following language has been added to Section 2.1: "To preserve the accuracy of a Predictive Model's area-based outputs, an equal-area projection that minimizes local distortion should be used." 3) The Framework allows for any Pixel size. Previously, Validation Plots had to be equal to or smaller than Pixel size, but that

		for the output AGB values. Given that we are interested in area estimates, an equal area projection with minimal local distortion would be critical. This will of course then be reflected by the georeference coordinate information. (3)A requirement not discussed is the minimum mapping unit and pixel sizes appropriate for use in this methodology. There should be guidance for appropriate pixel and object sizes for the application of this methodology.	requirement has been removed, which enables smaller Pixel sizes. A minimum mapping unit is not necessary, as carbon densities from all Pixels overlapping the Validation Plot area must be averaged to derive the Predictive Model's area-weighted average carbon density for each Validation Plot area (Section 3.3).
102	TerraCarbon	2.2 Predictive Model Design 1. It is stated that in the project design there are several requirements. Requirements include that the project proponent must develop a Predictive Model for each stratum (one Predictive Model per stratum). It is unclear if a single ensemble model can be developed using forest stratum as indicator variables to embed different variable weights within a single model which is sensitive to forest strata. A single model per stratum may constrain the total sample size in model development. 2. Further, it is required that Predictive Models must estimate the carbon for all remote sensing pixels or objects within the stratum. Remote sensing pixels located on a boundary which include area found outside the stratum must pro-rate that remote sensing pixels carbon estimate by the percentage of area found within the stratum. Once again, currently there is no guidance on the spatial resolution for input data and output prediction data. As such, pixels, especially large heterogenous ones, will be ill conformed to project boundaries. While it is common to assume a pro-rated area - this assumes homogenous subpixel stock configuration.	1. We have clarified that Predictive Models are not related to traditional strata used with plot-based inventories. Rather, they are related to an AOI (Section 1.4). The described ensemble model would seemingly be allowed. This comment is largely not applicable following other changes made to the Framework. Most notably, we have clarified that object-based classification is not allowed, and all Pixels must be uniformly sized. We agree there is a risk in the

		This homogeneity of a pixel is intrinsically tied to the pixel size. In instances where pixels are not much larger than landscape features of interest, partial pixel effects might be minimized. However, with pixels significantly larger than the landscape features of interest, the error introduced due to heterogeneity will act to artificially alter biomass estimates within the given stratum. We strongly recommend defining a minimum AGB prediction mapping unit to minimize the impact of heterogenous pixels.	treatment of boundary Pixels and have made revisions (see response to question #3 of Comment #101) to allow for smaller Pixel sizes, which sufficiently mitigates this risk.
103	TerraCarbon	Assessing Model Eligibility 3.1 We note that the VVB will generate a randomly allocated sequence of points, located at remote sensing pixel centroids which are then measured by the project proponent as Validation Plots. These are distinct from Calibration Plots (which are used in training a Predictive Model). A minimum of 30 plots are to be used in validation per stratum. See note below about considering accessibility in the generation of these plot locations. In addition, some stratum could be smaller than others. Consider options for required sampling intensity not setting a minimum number of points. Current requirements will be very time intensive and could be cost prohibitive. Further, it is stated that a Predictive Model is eligible if the Predictive Model root mean square error (RMSE) is below 20% of the stratum level Predictive Models average carbon estimate and the confidence interval (CI) is equal to or less than 10% of the stratum level Predictive Models average carbon estimate. While RMSE is a commonly applied statistic for evaluating model performance, it is usually applied without consideration of whether or not it is appropriate as an estimator of a particular model's performance. In order for an error metric to be useful	Regarding plot accessibility, please see the response to Comment #104 below. The Framework now specifies that 30 Validation Plots is the minimum number of Validation Plots for each AOI, and we expect many projects to delineate a single AOI. Projects may measure more Validation Plots per AOI if they cannot reach statistical agreement with 30. Still, where remote sensing is well suited, this approach has the potential to result in substantially less field work than traditional plot-based inventories. After evaluation and testing of the RMSE metric, ACR has elected

		and grounded, consideration should be given to a model error residual analysis to determine if there is a more appropriate metric based on the distribution of model errors (such as the median absolute deviation (MAD)). RMSE is best suited for uniformly distributed errors and may over-represent outlying errors. In the instance where we are concerned with the general performance of the model, an error estimator robust to outliers may be more appropriate.	to continue to use it as one of the conditional validation metrics to approve Predictive Models (Section 3.3). RMSE is well suited to evaluate model performance of estimating carbon stocks for a specified geography and AOI.
104	TerraCarbon	Validation Plot Field Remeasurement Validation Plots may be designed as either circular or square plots, or they may match the size and shape of the Remote Sensing Pixel.1 While Validation Plots are not subject to any specific size requirements, they must be located completely within a single Remote Sensing Pixel and therefore may not exceed the size of the Remote Sensing Pixel. Validation Plots must be installed by the Project Proponent and monumented such that they can be efficiently relocated by the VVB. This, while useful, could potentially represent an enormous amount of effort. In some instances we have project plots that can take 3 days to access. We suggest that provisions be made in the event of extremely remote and/or inaccessible plot locations to ensure that the level of effort required is reasonable. There could be bounds of reasonable accessibility applied here in the stratification process.	While ACR recognizes the burden of accessing certain plot locations, the purpose of this Framework is to reduce the amount of boots-on-the-ground field work required to inventory project forest carbon stocks. With fewer plots than traditional plot-based inventories, there is a lesser probability of needing to measure difficult to access plots, although it is still a non-zero probability. Land enrolled in either an Improved Forest Management or Active Conservation project must be accessible for timber harvest or land conversion. Existing Methodology requirements do not contain provisions to exclude difficult to access areas from sampling and the Framework

			follows a similar approach, where any area in a carbon project has an equal probability of sampling.