SEQANA

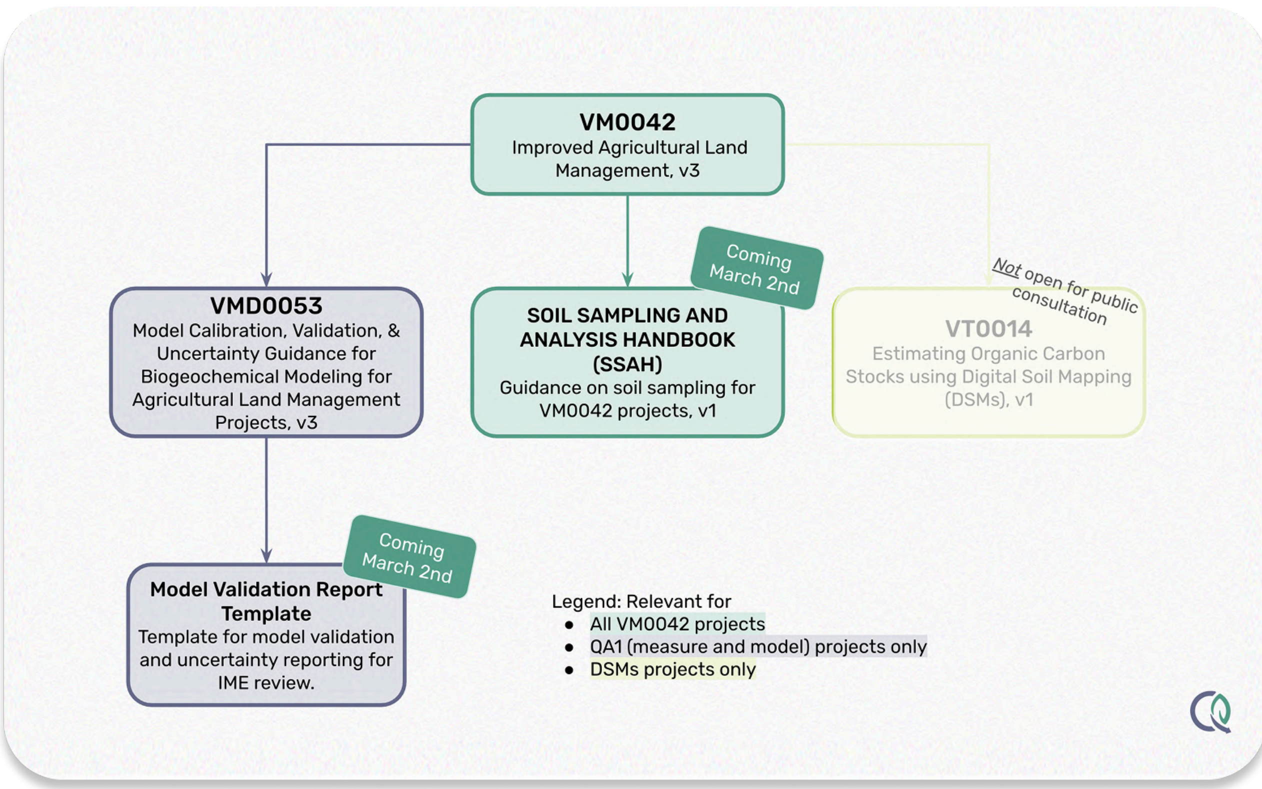
Unpacking Verra's VM0042 Version 3 and VMD0053 Version 3

What these updates mean for your soil carbon project under VM0042, v3

Table of Contents:

VM0042 Version 3 is open for public consultation!

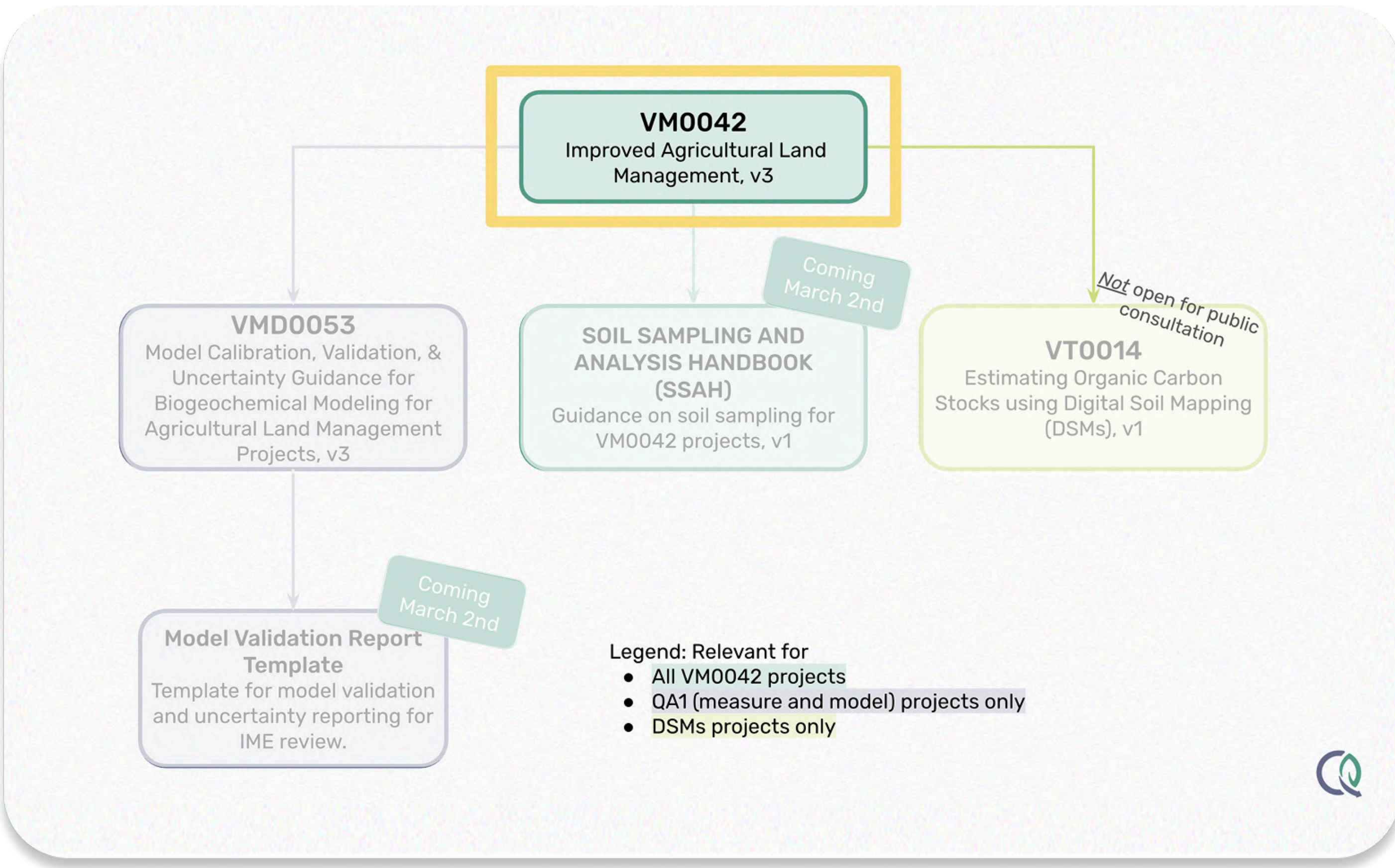
The latest version of Verra's VM0042 is open for public consultation and it offers exciting opportunities for project developers to take advantage of greater clarity and potentially more project gains, without compromising on scientific integrity. Co-authored by Seqana, Terracarbon, and Verra, VM0042, v3 demonstrates how industry experience and practical implementation can help shape evolving methodologies.



In this post, we highlight some of the changes that offer the most impact for projects and point you to where they can be found in VM0042, v3, and VMD0053, v3. **Public Consultation is from February 11-March 31**. During this period, you can provide feedback on the VM0042, v3 and its accompanying documents to help ensure the final version is as comprehensive as possible.

An important note is this resource describes these updates as they are present in the draft of VM0042 available for public consultation; the details of some topics may change in the final version of VM0042, v3.

VM0042 Version 3:



We'll start with the updates that can be found in VM0042, v3 and highlight the implications for new and existing projects.

Cumulative Accounting

Version 3 of Verra's VM0042 introduces **cumulative accounting** (Section 8.3), a major update which significantly improves project economics and scientific integrity.

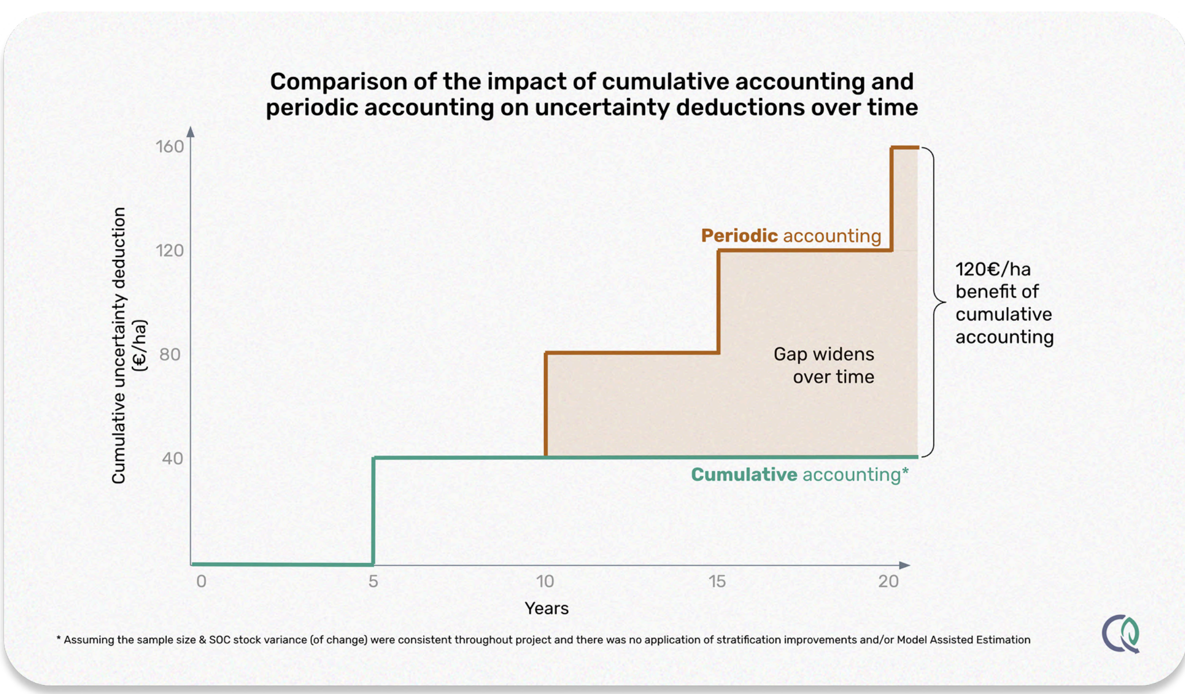
Instead of calculating uncertainty deductions and sampling requirements based solely on the carbon stock change between verification events, as with periodic accounting, cumulative accounting considers the **total SOC sequestered since the start of the project**. The adoption of cumulative accounting fundamentally changes how uncertainty deductions are applied over time.

For project developers, this shift creates meaningful economic and strategic advantages. Because uncertainty is applied to the cumulative total rather than repeatedly deducted at each verification event, projects can significantly **reduce long-term uncertainty deductions and/or sample sizes**, improving overall revenue and project economics.

Below is an example impact of cumulative accounting for a QA2: Measure and Remeasure project.

Assumptions for the example below:

- Annual sequestration rate: 0.3 tC/ha/year
- Verification frequency: every 5 years
- Project duration: 20 years
- SOC stock variance of change: 200 tC^2/ha^2
- Paired sampling
- Carbon credit price: 40 €/tCO_2e



We walk through this example in detail and discuss implications of cumulative accounting across different types of projects, including those leveraging QA1: Measure and Model and Digital Soil Maps (DSMs), in our deep-dive article on cumulative accounting.

Project Developers gain flexibility in their project management to align better with their project goals with cumulative accounting. They have the choice between maintaining sample sizes to benefit from declining relative uncertainty over time, reducing sampling intensity to cut monitoring costs, or combining both approaches to optimize cash flow and long-term returns. In addition, cumulative accounting strengthens scientific integrity, especially for projects using biogeochemical models (BGCMs), by requiring any early overestimation of sequestration to be fully compensated before new credits are issued.

Overall, cumulative accounting improves financial efficiency, enhances methodological robustness, and provides new levers for optimizing MRV strategies. For a detailed breakdown of how cumulative accounting affects your project, reach out to our experts at Seqana.

Clear Guidance on Quantification Units:

The concept of Quantification Units (QUs), geographically defined areas in which emission reductions and/or removals are quantified together with their associated uncertainty deductions, was introduced in VM0042, v2.1. While the concept is retained in VM0042, v3, the guidance on when a project area must be divided into multiple QUs has changed significantly, to the benefit of project developers.

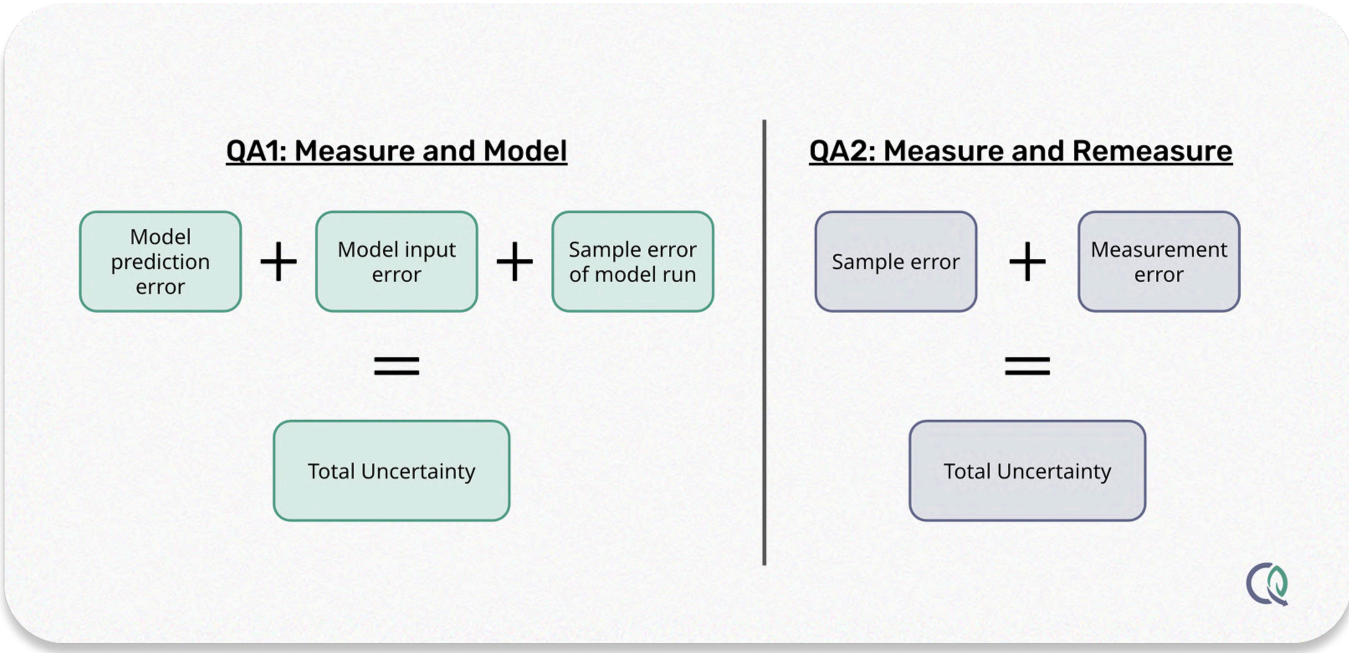
Under VM0042, v2.1, the guidance often resulted in a large number of relatively small QUs. This is typically economically disadvantageous for project developers because the statistical methods used to calculate uncertainty deductions tend to penalize smaller areas. VM0042, v3 addresses this issue by providing clearer guidance aimed at minimizing the number of QUs wherever possible, ideally allowing a project area to be treated as a single QU, while also clearly defining the cases in which separate QUs are strictly required.

In practice, a strict requirement to divide a project area into multiple QUs mainly arises when fields are onboarded in different years. This is common in large-scale projects, where different cohorts of farmers are enrolled annually.

A detailed explanation of when QUs must be separated and how they can later be combined over the course of the project lifecycle can be found in Section 8.1.1.

Clarity on Uncertainty Deductions:

Uncertainty deductions have an immense impact on the available revenue of soil carbon projects; however, they are often underestimated and misunderstood. While earlier versions of VM0042 described the relevant error types, the guidance was not fully clear and was partially incomplete. In Section 8.9, VM0042, v3 clarifies the types of errors that contribute to uncertainty deductions under different implementations of QA1and QA2.



Types of error under QA1:

- ***Model prediction error (MPE)*** reflects the inherent uncertainty in the outputs of biogeochemical models and tends to be the main source of uncertainty in QA1.
- ***Model input error*** encompasses uncertainties in the data used to initialize and run the model.
- ***Sample error of the model run*** arises when the model is applied to only a subset of the project area.

Types of error under QA2:

- ***Sampling error*** results from measuring only a portion of the project area.
- ***Measurement error*** of methods used to determine SOC stock (or other emission sources where applicable) at a sample unit.

VM0042, v3 explains how to calculate the uncertainty deductions for a particular project and makes reporting more intuitive and clear. For projects using QA1: Measure and Model, we have developed a spreadsheet template for calculating and reporting the share of uncertainty deductions derived from the Model Prediction Error, which tends to constitute the main share of uncertainty deductions under QA1. Reach out to our team to get access.

For projects using QA2: Measure and Remeasure, we created a specific tool that offers insights on uncertainty deductions and calculates the Economic Optimum Number of Samples (EONS) by balancing uncertainty deductions and sampling costs. You can find the link to the calculator here.

Explicit allowance of biogeochemical models (BGCMs) for field level quantification

In previous versions of VM0042, running BGCMs, also called Process-based Models (PBMs), was only allowed on a point level with guidance provided on how to compute uncertainty deductions. Running BGCMs on a field level, sometimes referred to as areal modeling, as done by many project developers, required a deviation request because there was no standardized approach on how to properly account for uncertainties when modelling on a field level. VM0042, v3 now *explicitly* allows for field level modelling (see Section 8.9.1.1) and outlines how to properly account for uncertainty deductions. This clarity enables project developers to choose between field level and point level modeling for their project and be compliant without taking additional, time-intensive steps, such as a deviation request.

True-up requirements for BGCMs:

BGCM true-ups must occur at regular intervals to ensure that the BGCM remains unbiased and to ensure that the expected accuracy of the model (i.e. its model prediction error) is maintained. BGCM true-ups are required across all major methodologies, but until now there has been no clear definition of what a true-up entails or how to address the absence of baseline control sites.

VM0042, v3 offers explicit guidance on how to conduct a BGCM true-up. The BGCM true-up must be conducted at least every five years under QA1 and soil samples must be collected to validate the model by demonstrating that the model does not overestimate carbon sequestration (Bias ≤ 0) and that the model has predictive power ($R^2 > 0$). If a model does not pass the BGCM true-up, it must be recalibrated and revalidated. Full explanation and clarification on how to conduct the BGCM true-up can be found in Section 8.9.1.4, including how to conduct a meaningful true-up in the absence of baseline control sites which are not required under QA.

Sampling campaigns at every BGCM true-up are required. We created a specific sample size calculator for BGCM true-up to help project developers identify the sample size needed to conduct a meaningful true-up, without over- or undersampling. You can find the BGCM true-up sample size calculator here.

Leveraging Model Assisted Estimation (MAE) for greater precision:

Model Assisted Estimations (MAE) can be leveraged to improve the precision of SOC Stock Estimates and hence reduce uncertainty deduction and sample sizes. They are explicitly allowed in VM0042, v3 as described in Appendix 11.

MAE is a well-established statistical approach which pairs a "working model" with ground truth samples to more precisely calculate the SOC Stock (change). This increased precision can help project developers reduce their required sample size or final uncertainty deductions.

MAE is unbiased by design. As a result, MAE does *not* require model validation and Independent Modelling Expert (IME) review to be applied in your project. This makes the implementation of MAE in your project easier and faster than Digital Soil Maps (DSMs), which require model validation and IME review. To learn more about the impacts of MAE on your project, check out our blog post on MAE.

Equivalent Soil Mass (ESM) recommendation for soil sampling:

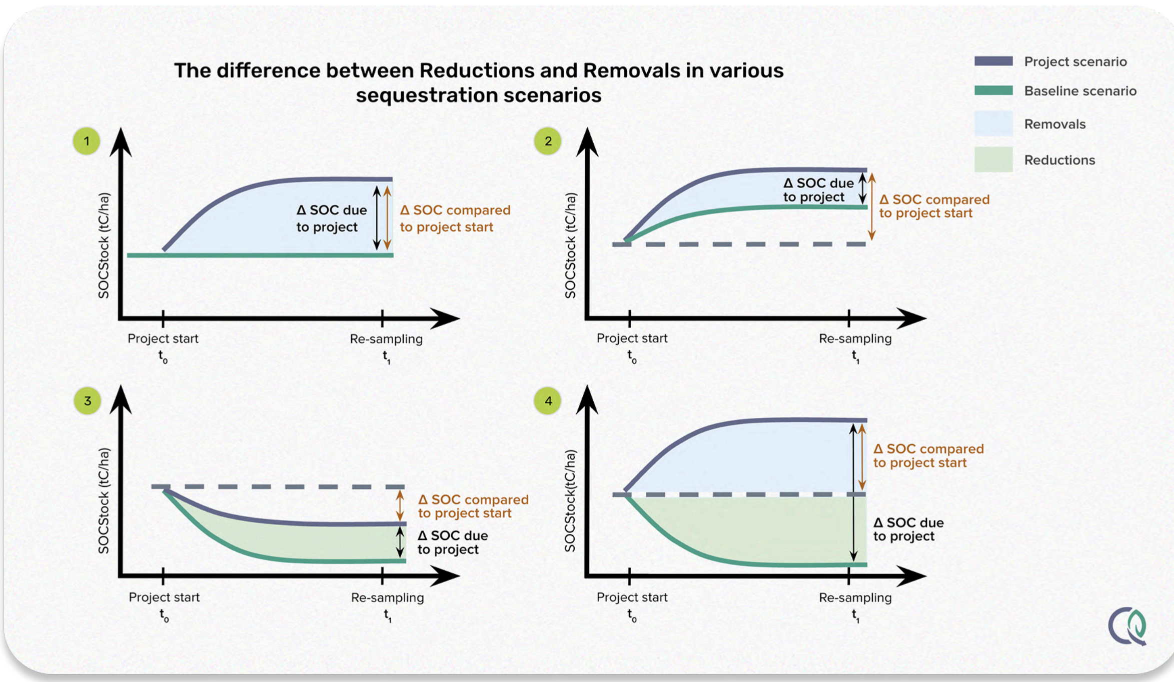
Soil sampling must allow project developers to quantify SOC stock changes using an Equivalent Soil Mass (ESM) approach. ESM estimates soil organic carbon (SOC) stocks that compare carbon contained in the *same mass of mineral soil* rather than a fixed soil depth. While earlier versions of VM0042 required ESM, they also required bulk density sampling to derive soil mass. Because ESM can also be determined *without* bulk density, v3 drops the bulk density sampling requirement and instead refers directly to sampling for ESM-based analysis, see Section 8.2 for more details.

Because bulk density and soil structure can change over time due to management, erosion, or compaction, depth-based comparisons can falsely suggest gains or losses of SOC. The benefit of ESM is that it ensures that the claims are based on real SOC change rather than changes in soil density or volume.

SOC Emission Reductions versus Carbon Removals:

VM0042, v3 provides clear definitions and equations on the difference between SOC Emission Reductions (ERs) and Carbon Removals (CRs), an important distinction when it comes to carbon accounting. Projects may quantify either CRs, or ERs, or a combination of the two depending on their project scenario and its outcomes.

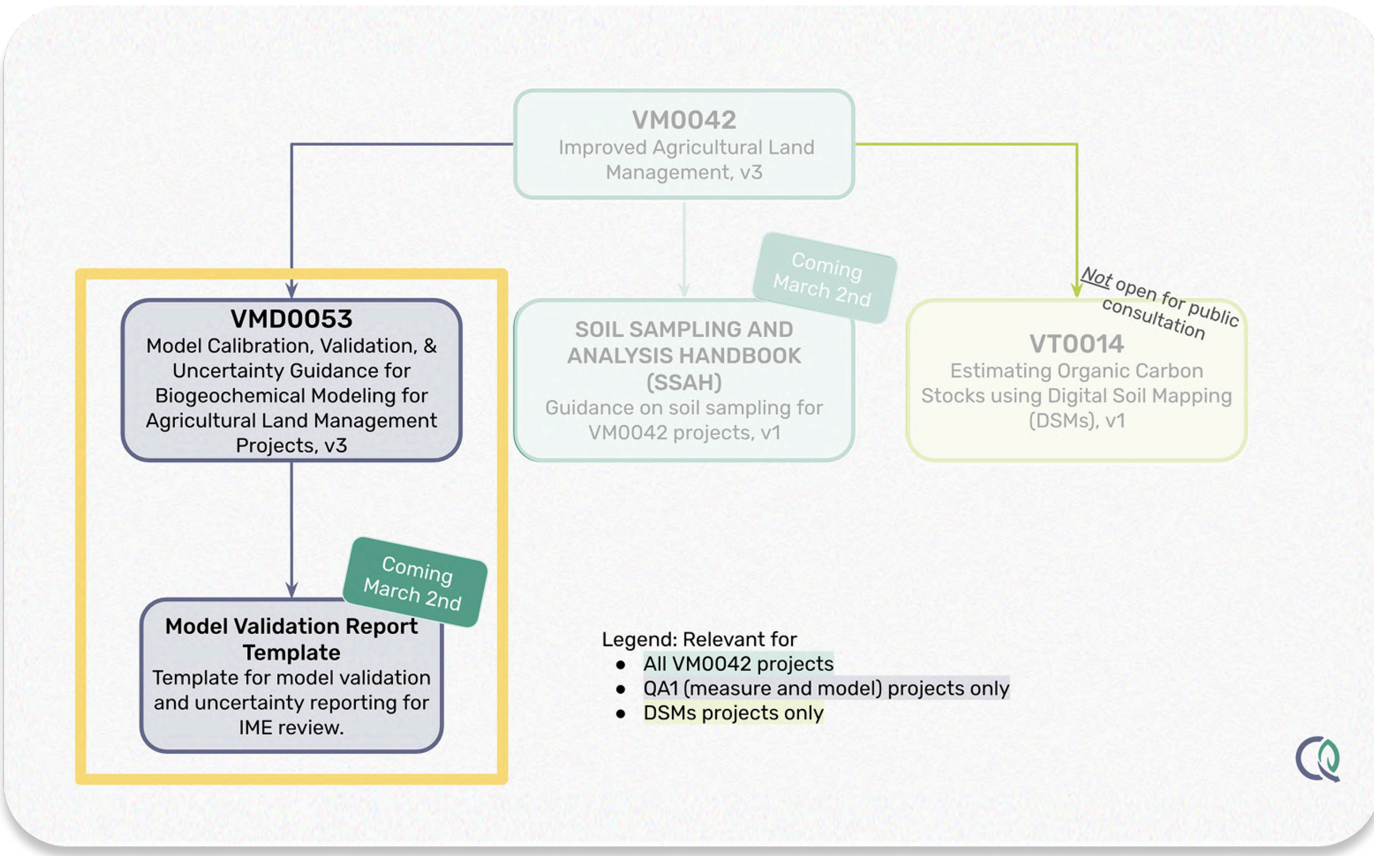
ERs occur when the project scenario demonstrates a decrease in SOC less than in the baseline scenario. This is graphically depicted in Scenarios 3 and 4 below in green. For example, in Scenario 3, the total carbon stock decreased in the project scenario, but it decreased less than it did in the baseline scenario. Because the project resulted in fewer SOC emissions than would have occurred without the project, this is categorized as an ER, even if SOC stock is lower than at the project start.



CRs occur when the SOC stock increases more than the increase of the baseline scenario. This is graphically depicted in Scenarios 1, 2 and 4 above in blue. Once there is a higher level of SOC stock in the project scenario than in the baseline scenario, the sequestration must be categorized as a CR, not an ER. This distinction can be seen in Scenario 4, where the project can claim both CR and ER.

For project developers, it is important to note that CRs and ERs have a key difference. ERs are always permanent. What is unique about SOC ER is that, unlike ER from activities such as reduced fossil fuel combustion, they deliver a wide range of co-benefits, including improved soil health, enhanced water retention and quality, and increased ecosystem resilience. As a result, we assume that project developers will be able to trade these permanent SOC ERs at a premium compared to other types of ER.

VMD0053, v3:



VMD0053 is an additional module relevant for projects that do QA1: Measure and Model, providing guidelines for biogeochemical model (BGCM) calibration, validation and uncertainty.

Updated model validation requirements

The new version of VMD0053 adds one additional model validation requirement, to increase the rigor of model validation and to help see that models are not used in a project domain where they do not perform well.

Previous versions of VMD0053 included two quantitative model validation requirements:

1. **Coverage test:** At least 90% of model predictions must fall within the 90% prediction interval.
2. **Lack of bias:** Mean bias must be less than or equal to the estimated pooled measurement uncertainty (PMU).

VMD0053, v3 introduces a third validation criterion:

3. **R^2 > 0**: which means the model must demonstrate predictive power (i.e., perform better than a model with no explanatory value).

It should be noted that these VMD0053 validation requirements apply to ex-ante validations under QA1. After these requirements have been met for the initial validation, then the Model True-up validation requirements will apply.

If models do not meet the respective model validation requirements for either the ex-ante or Model True-up validations, the models are unable to be used for the project to issue credits until changes have been made and the model is able to pass the validation criteria.

If you need guidance on what to do if your models do not pass the model validation criteria, Seqana is happy to help advise you on the best course of action for your project.

Expanded scope of IMEs: Assessment of model prediction error (MPE)

In previous versions of VMD0053, the Independent Modeling Expert (IME)'s responsibility was limited to confirming that the biogeochemical model (BGCM) meets the model *validation* requirements. Model validation answers a binary question: whether a BGCM can be used for a given project domain.

However, validation alone does not determine the magnitude of the uncertainty deductions associated with the BGCM. Those deductions have significant implications for project economics and risk, and therefore must be managed carefully.

VMD0053, v3 closes this gap by requiring IMEs to also assess whether the model prediction error has been calculated correctly. This model prediction error directly feeds into uncertainty deduction calculations, making the change a critical improvement for market integrity.

Transparent and meaningful reporting of key validation and uncertainty metrics

BGCM validation and uncertainty assessment are complex. As a result, the metrics that matter most to project developers have historically been difficult to interpret, buried in technical detail, or in some cases not reported at all.

VMD0053, v3 addresses this by providing guidance that enables more transparent and meaningful reporting of the key validation and uncertainty metrics in Section 5.2.

To achieve this, two critical enhancements are done:

1. **Making key metrics meaningful for SOC projects:**

   Historically, key metrics influencing model prediction error were assessed across varying time horizons and soil depth intervals, limiting their relevance and comparability for SOC projects. Under VMD0053, v3, these metrics must now be normalized to the target depth and reported as annual values, making results more meaningful and facilitating comparison across projects.

2. **Model Validation Report Template:**

   A standardized template for model validation reports, subject to review by IMEs, will be available by March 2. The template provides structured guidance on reporting model validation metrics as well as the model prediction error, which is critical for determining uncertainty deductions and will require IME review going forward.

Upcoming Webinar with Verra:

Want to dive deeper into these topics with the authors?

We'll cover all of these updates in greater detail and answer your questions on how these changes impact your projects in an upcoming webinar with the other authors of VM0042, v3 and its accompanying documents on **March 11, 2026 at 11:00 EST (16:00 CET).**

Sign up for the webinar here.

Note: These topics are covered as they currently stand in the document for public consultation. Some of these details may change after public consultation has been completed and the post will be updated to reflect the latest changes.