Uncertainty assessment in Global Biochar C-Sink Standard

Preamble

In general, a Global C-Sink Standard is designed to minimize the uncertainty associated with modelling the C-Sink activity.

The Global Biochar C-Sink Standard is designed to use conservative values, i.e. introduce a deliberate bias to lead to a slight overestimation of the associated emissions and underestimation of issued C-Sinks. When it comes to associated emissions, the mean value plus standard deviation is used. When it comes to directly or indirectly determining the amount of stored carbon, conservatism is ensured through a strong focus on representative sampling and regular repeat measurements as well as accurately verifying biochar's incorporation into the matrix.

The approach taken by the 'Global Biochar C-Sink Standard' is that, for each individual value included in the calculation, it is not the value and its associated uncertainty that are used; instead, the value is conservatively adjusted by adding or subtracting the associated uncertainty, and this adjusted value is then used in subsequent calculations. The adjustment toward the conservative side therefore does not take place only at the final result stage, but already when the values are used. Provided that the points described below are followed, there is no uncertainty regarding an overestimation of more than 20%. Such an overestimation would result in the EU CRCF not recognizing C-Sinks.

It is important to note, however, that statistical, mathematical uncertainties are just one small part of the general uncertainties in the project context. Data quality is significantly influenced by the method of data collection. Measurement methods and practices must be well implemented into the very day life project processes and routines to guarantee consequent implementation of the specific process implementation. The validity of a value depends above all on the operator reliably following the specified data collection method, instead of adopting it arbitrarily and without verifiable documentation. Global C-Sink Standards therefore provide translations of dry ISO-standard contents to praxis-ready processes and puts high emphasis on company specific sampling plans for parameters with increased significance that are developed by the client in cooperation with an expert.

Aim of the document

This document aims to provide a clear overview on uncertainty assessment regime in Global Biochar C-Sink Standard.

1. Application of IPCC Guidelines

Global C-Sink Standards show consideration to the IPCC Guidelines for National Greenhouse Gas Inventories and General Guidance and Reporting for information on treating uncertainty (IPCC 2006, 2019). The IPCC lists several causes of uncertainty and the strategy to deal with them.

Causes of Uncertainty	Nature	Strategy implemented in Global C-Sink Standards
Lack of completeness	Bias	Project verification of conceptualization and model formation
Accuracy and precision of the model	Bias	Expert judgement during standard development that leads to standardized project modelling and project verification.
Lack of representativeness of data	Bias	Tailored Sampling plans evaluated by expert judgement (NUSAP approach[1])
Lack of data	Bias and random	Expert judgement or default values as alternative
Statistical random sampling error	Random	Estimate confidence intervals based on statistical theory, Correction of the value based on confidence interval 95%
Measurement error, random component	Random	Correction of the value based on confidence interval 95%
Measurement error, stystematic component	Bias	Calibration of equipment
Misreporting/classification	Bias and random	Expert judgement during validation and verification

2. Implications for uncertainty assessment for Global Biochar C-Sink

Specifically, regarding the monitored parameters in the Global Biochar C-Sink, it is applied as follows. Deviations from the rules result in nonconformities in accordance with the sanctions catalogue.

Value	Nature	Goal	Strategy	Implementation
Methane-emissions of pyrolysis unit	Random	Conservative value setting	Mean of two measurements; Addition of Standard Deviation	Chapter 7.3. of Global Biochar C-Sink Standard "the methane emissions factor of the pyrolysis unit is calculated as the mean of the two measurements plus one standard deviation as the margin of security."

[1] https://www.nusap.net/

	Bias	Minimize systematic bias	The measurement strategy must be endorsed (based on expert judgment) to ensure sufficient accuracy of the measuring instruments and to minimize systematic sources of error in the measurement strategy. Laboratories should preferably be ISO 17025-accredited. If this is not feasible, the expert assessment corresponds to the equivalence assessment specified in Chapter 34, Sections 2 and 3 of Implementing Regulation (EU) 2018/2066.	Chapter 7.3. of Global Biochar C-Sink Standard "For CH4 emission tests, a detailed measurement strategy with precise details of the measurement technology, measurement intervals, and measurement accuracy must be submitted in advance to Carbon Standards for review.»
Lack of data on Methane-emissions of biomass storage	Bias	Conservative value setting	Prevent methane formation by minimizing storage time and other factors that may lead to anaerobic de-composition. Consider modelled methane emissions if conditions can't be guaranteed.	Chapter 6 of Global Biochar C-Sink Standard
Fuel consumption	Random	Minimize risk of reporting and ensure comperability	Grouping all fossil fuels (gasoline/diesel) under the one with the higher default emission factor. Default emission factors given by the standard and monitoring of consumption. Default emission factor given by the standard are treated as having no associated uncertainty.	Chapter 7.1. of Global Biochar C-Sink Standard "For the consumption of diesel or benzine fuel for transportation, chipping, drying, etc., the conversion factor of 2.7 kg CO2eq per liter of diesel fuel is applied (Juhrich, 2016).»

H/C and C content	Random	Ensure representation of potential changes in production	Annex 4 to EBC Standard specifies the eligible analyses methods. A full sample has to be analysed per batch (max. 365 days).	EBC Standard, chapter 6 and annex 4
	Bias and random	Ensure represenativeness of the data	Thanks to the requirements for representative sampling specified in the standard, the standard scheme eliminates the need for operators to coordinate sampling directly with the endorsed laboratories. During the technical endorsement (former TVA) and the sampling plan endorsement process, the company-specific sampling plan is reviewed by experts and, if necessary, adjusted in collaboration with the operator before being finally approved. The procedure is supplemented by sample-taking training and, finally, the requirement to specifically register a sample (with the sampler) at the time of sample taking.	- Company specific sampling plan is endorsed https://www.carbon-standards.com/docs/transfer/4000004DE.pdf - Mandatory sample taker training https://www.carbon-standards.com/docs/transfer/4000101DE.pdf - The sample must be registered in the Biochar Tool (EBC Standar, section 6.2)
	Bias	Minimize systematic measurement errors	Beyond accreditation in line with Article 42 of Implementing Regulation (EU) 2018/2066 Laboratories must complete biochar specific round-robin test to become endorsed.	Approval process for EBC laboratories

Dry matter determination per 10m^3 of produced biochar	Random	Account for fluctuations in the production of the natural product	Increased monitoring frequency and company specific sample plan endorsement. During the technical endorsement (former TVA) and the sampling plan endorsement process, the company-specific sampling plan is reviewed by experts and, if necessary, adjusted in collaboration with the operator before being finally approved.	https://www.carbon-standards.com/docs/transfer/4000200EN.pdf and Chapter 9.2. of Global Biochar C-Sink Standard
Specific persistence based on Ro-analysis	Random and bias	Avoide overestimation of the geologically persistent fraction of biochar.	Statistical analyses of the Ro results to determine whether the evaluation models can be applied. The specific persistence shall be treated as having an associated uncertainty of zero, as the decay function is already considered a conservative basis for estimation.	https://www.carbon-standards.com/docs/transfer/4000264EN.pdf
Margin of safety	Bias and random	Account for potential lacks of data, introduce a deliberate bias to lead to a slight overestimation of the associated emissions	A safety margin in the amount of 20 kg CO2e per ton of biochar is added to account for all additional emissions not covered under the regular assessment	Global Biochar C-Sink Standard, chapter 4.2
Application of biochar to a matrix	Bias	The entire model of emissions and stored carbon becomes	Accurately verifying biochar's incorporation into the matrix considering the required, matrix specific proofs.	Matrix positive list for Biochar C-Sink Global Biochar C-Sink Standard, Chapter 12

		invalid if the biochar is oxidized. This point must rule out any risk that the biochar is not incorporated into a matrix.		