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M002

Future Improvements & Limitations

Summary

This document details future improvements and limitations related to M002 - Methodology for Terrestrial Forest Conservation. Equitable Earth is committed to continually improving and developing its methodologies.

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1 Introduction

1.1 Normative References

The following document should be read in conjunction with:

- M002 - Methodology for Terrestrial Forest Conservation
- Terms & Definitions

1.2 Reading Notes

The sections are divided into:

- **Future improvements:** Limitations that Equitable Earth believes can be addressed with the current 'state-of-the-art' science, technology, and market practices. Equitable Earth has not yet found a way to accurately and efficiently implement these improvements into the current methodology, but is actively working towards including them in a future version.
- **Limitations:** Limitations for which Equitable Earth has no short-term action plan. These often include fundamental limitations which apply to all carbon standards and for which Equitable Earth currently lacks realistic pathways for improvement without significant scientific, technological, or market breakthroughs.

2 Future Improvements

2.1 Eligibility Criteria

Assisted Natural Regeneration (ANR) Activities

- The scope of M002 includes estimating emissions reductions from avoided deforestation and degradation. ANR activities are not currently eligible under M002. Future versions will enable crediting of both reductions and removals by incorporating ANR activities, with requirements and procedures for baseline setting, quantification, leakage, and treatment of non-permanence risk. Future methodology updates may include pathways for retroactive crediting for early monitoring periods.
- Equitable Earth will continue to update M001 (Methodology for Terrestrial Restoration) and M002 to ensure the methodologies are complementary and developers have clear pathways to generate credits for both GHG reductions and removals.

Jurisdictional Reference Level (JRL) Validation

- The JRL must be validated by an independent expert panel in accordance with the Jurisdictional Baseline Validation Methodology, which is currently under development. It will include the requirements, procedures, and any supporting documentation necessary to implement this requirement.
- Equitable Earth is currently developing supporting tools and procedures for establishing and convening an independent expert panel to validate the JRL, as well as risk maps.

Peatlands

- Avoided emissions from the rewetting of peat soils and from the conservation of peat from unplanned conversion are not eligible under M002. A planned update will include criteria and methods for quantifying avoided emissions from peatlands, supported by further R&D and potential beta testing with developers. Equitable Earth will explore options for retroactive crediting of early monitoring periods.
- Equitable Earth acknowledges that impactful conservation projects are often located on peatlands, and it is important that such activities are eligible for

crediting. Peatland emissions are complex to model and monitor, and further development by Equitable Earth is required to ensure accurate accounting. Equitable Earth will develop standardised tools and QA/QC procedures for robust peatland accounting.

2.2 Carbon

Permanence and Buffer Allocation

- The Equitable Earth Programme and M002 require a fixed 20% buffer deduction from verified GHG reductions at the time of credit issuance. Future updates may introduce a risk-based buffer allocation framework with standardised procedures, tools to manage risks, and quantitative methods to proportion contributions to project-specific non-permanence risks. Equitable Earth is also exploring the piloting and integration of alternative innovative mechanisms, such as insurance products, to manage non-permanence risk.

Additional Carbon Pools

- The scope of M002 includes the quantification of woody above-ground biomass (AGB) and below-ground biomass (BGB). A planned update will consider the inclusion of additional carbon pools (e.g., soil organic carbon, dead wood, litter, non-woody biomass) with standardised procedures to ensure consistency and comparability across projects.

Risk Model

AGB Data Validation

- The integrity of the AGB loss data used as model inputs to predict future AGB losses is dependent on the AGB provider's validation procedures.[1] Equitable Earth is committed to collaborating with the AGB provider to explore opportunities to strengthen validation protocols.

Receptive Field

- The risk model's current receptive field is approximately five kilometres (km), though this range is slightly extended with the use of AlphaEarth supplementary layers. Equitable Earth is committed to continually improving

[1] Equitable Earth conducted a comprehensive benchmarking exercise to compare multiple external AGB providers. The objective of this assessment was to select the provider best suited to deliver rigorous, conservative, and accurate AGB data for calculating GHG reductions and removals. Based on this process, Chloris Geospatial has been selected as the primary AGB provider for this version of the methodology.

the model to increase its receptive field and enhance the estimation of spatial risks beyond five km in a future version.

Predicting Risk in Low-Emission Areas

- The risk model learns from past historical events to predict future AGB losses. This means that, in some specific cases, the model may predict lower risk in areas with historically low deforestation (e.g., effective protected areas), potentially overlooking biomass loss risks from surrounding, heavily deforested sites. Equitable Earth will continue R&D efforts to ensure the model captures complex scenarios that account for risks beyond historical trends.

Modelling Risks Beyond Jurisdiction

- Equitable Earth's project baseline estimates are constrained to a single jurisdiction. This may lead to the model predicting low deforestation risk for some jurisdictions with low historical emissions, even when they neighbour jurisdictions with high deforestation rates. Equitable Earth will continue exploring the expansion of the model to predict risk when real threats exist beyond jurisdictional boundaries.

Spatial Variability and Stability

- The model predicts on a per-pixel basis, without any explicit constraint on spatial continuity or spatial coherence. As a result, neighbouring pixels are not guaranteed to form spatially consistent patterns, even when they belong to the same underlying forest or management context (e.g., protected or managed areas). Equitable Earth will continue improving the model to enable more spatially continuous predictions.

Budget Compliance and Local Pressure

- Equitable Earth applies the JRL as a cap on the baseline emissions available for allocation in the jurisdiction, based on the principle that budget compliance is essential to maintain integrity and prevent over-allocation. However, localised pressure in certain project crediting areas (e.g., those exceeding the jurisdictional average) may lead to future emissions surpassing historical emissions. Equitable Earth will continue improving its model to provide a risk-appropriate baseline for all projects.

2.3 Monitoring, Reporting, and Verification (MRV)

Field Calibration

- M002 includes some field data collection requirements, but emphasises estimation and monitoring approaches through remote sensing and other tools. Future methodological updates may allow developers to conduct in situ data collection for specific cases, such as risk model field calibration, supported by standardised procedures and technical guidance to ensure robust and auditable integration with central datasets.

3 Limitations

3.1 Carbon

Carbon Pools

BGB Estimation

- Equitable Earth currently estimates BGB using the IPCC root–shoot (RS) ratio. However, this assumes a relatively constant ratio of above-ground to below-ground biomass for a given plant species or ecosystem. Although this method is widely accepted, it holds limitations due to factors like soil nutrient availability, moisture, and disturbances, which can affect the RS ratio and introduce uncertainty into BGB estimates. Equitable Earth is dedicated to exploring alternative methods to improve the accuracy and precision of BGB estimates.

Additional Carbon Pools

- Equitable Earth acknowledges that additional carbon pools (e.g., soil organic carbon) may be significant for some projects, impacting certification viability. However, additional carbon pools have been excluded from M002 due to measurement complexity, associated high uncertainty, and relevance. Standardised procedures and tools for additional carbon pools are not yet established by Equitable Earth.

Risk Model

AGB Loss Predictions

- The risk model prediction and baseline estimate reflect the current capabilities of state-of-the-art methods. Predicting future risk is inherently complex, and while this method represents Equitable Earth's current best practice for spatial risk estimation, it is subject to the inherent uncertainty and continuous evolution of predictive modelling.

AGB Data Validation

- Equitable Earth's baseline estimation relies on the AGB provider's AGB stock product. Due to the lack of available and sufficiently large AGB change datasets, the product is mainly validated against localised, one-time AGB estimates. Therefore, the accuracy of AGB change estimates is currently inherently tied to the reliability of individual AGB stock estimates, rather than a full-scale evaluation of biomass change over time.

Modelling Global Drivers and Forest Dynamics

- Equitable Earth's model is designed to predict future emissions from forest loss. However, there are limitations in remote sensing and modelling of complex forest dynamics driven by external factors that are not clearly localised at the jurisdiction level (e.g., accelerated natural degradation due to climate change). Such factors may not be fully captured by the model and could lead to inaccuracies in predicted future emissions. Equitable Earth will explore different approaches, such as the use of dynamic baselines, to address this limitation in the future.

Temporal Variability and Stability

- Equitable Earth trained the risk model using data from a single period (2019–2024). While training on multiple periods would lead to more robust predictions, the lack of high-quality data before 2019 is a limitation on the model's temporal variability and stability. Consequently, this constraint prevents thorough time stability testing and introduces uncertainty regarding the representativeness of the model's performance (e.g., RMSE) over the subsequent forecast period. Equitable Earth accounts for this source of uncertainty and makes appropriate deductions.

Auxiliary Covariates

- The model accurately predicts future AGB loss based on historical biomass changes. However, other auxiliary variables, such as jurisdiction-specific policy changes or one-off extreme events (e.g., droughts, floods), have not yet been integrated into the model due to limitations with current approaches for learning complex interactions without imposing predefined structures.

Data Availability & Project Start Date

- Equitable Earth uses different risk model versions due to limitations in AGB data availability. Projects starting on or before December 31, 2024, use a simplified model that relies only on the AGB provider's layers. Projects starting on or after January 1, 2025, use a version of the model with AGB provider layers and supplementary layers. Equitable Earth continually tests model accuracy and uncertainty to ensure high performance, regardless of the project start date.

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