Jason Gray
Branch Chief, Cap-and-Trade Program
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Re: Comments on the California Tropical Forest Standard

Dear Mr. Gray:

We would like to thank the California Air Resources Board (CARB) for proposing the draft California Tropical Forest Standard (CTFS), and for the opportunity to submit comments. We are writing on behalf of Salo Sciences, Inc., a forest monitoring company based in San Francisco, CA. We map forest change by combining ecology, satellite imagery & artificial intelligence, supporting the conservation efforts of government agencies and non-profit organizations. Salo's co-founders have a combined 25 years of experience in ecological remote sensing, with the majority of that experience relating to mapping tropical forests. We hope our unique perspective will clarify and strengthen the CTFS prior to its consideration for adoption by CARB.

The comments we submit to you are related to the technical aspects of the CTFS. Nonetheless, we would like to acknowledge concerns regarding the displacement of indigenous communities. While we support the CTFS as conservation scientists, we do not want the ratification of this standard to lead to the exclusion of indigenous peoples, either from the political process or from their homes. However, we are not qualified to present expert opinions on this topic, and limit our comments to the technical and scientific content of the CTFS. We hope that, by establishing a robust monitoring, reporting & verification (MRV) protocol that emphasizes independent, third-party verification, the CTFS will contain a mechanism to identify both the environmental and the social impacts of sector-based crediting programs. Our comments aim to strengthen the MRV protocol to this end.

From our perspective as conservation scientists, we applaud the CTFS–it is an important and thoroughly developed document. We congratulate you and your staff, and thank you for the years of work spent developing it. We believe it can set a global MRV standard for tropical forest offset credits. We are particularly pleased by the emphasis on a remote sensing-based approach to mapping forest biomass, and by the requirement for uncertainty quantification in the sector plan and report updates.

Over the last decade, the technology and science for mapping forest biomass have made tremendous strides:

- New commercial satellite companies, like Planet, now provide daily, high-resolution & global imagery at a fraction of the cost of previous commercial imagery.
- Public access to active remote sensing systems, such as radar and lidar, has dramatically increased. These sensors tend to be highly sensitive to forest biomass, enabling direct measurements of carbon gain and loss. And new satellites focused on mapping forest biomass directly have recently launched or are slated to launch soon.
- Machine learning algorithms have advanced to the point where reliable identification of forest loss and mapping of forest carbon is possible.
- Greater access to cloud computing resources has enabled rapid satellite-based mapping and monitoring and at an unprecedented scale.

While there are still many improvements that can be made through further scientific and technological progress, the methods for quantifying and monitoring of tropical forest biomass are mature enough for deployment under the CTFS. Importantly, the CTFS includes a discount on the credits issued to a jurisdiction based on quantitative uncertainty measurements. Accordingly, even if the MRV methods used by a jurisdiction cannot produce 100% accurate measurements, the lack of certainty is accounted for and the crediting adjusted.

Given the potential for the CTFS to establish a globally-relevant standard, we believe some MRV components of the CTFS can be clarified and strengthened. These changes will provide jurisdictions with the necessary guidance when developing an MRV plan. Our perspective on these changes is informed by scientific studies on mapping forest biomass with remote sensing, published both by us and by our colleagues.

Chapter 4. Reference Level

Explicitly state proper approach for remote sensing to map forest biomass
Location: 4(d)(1)

This paragraph is the heart of the reference and monitoring methodology, so it is important to be clear about the methodological approach that is being recommended. In order to minimize errors and biases in maps of forest biomass (e.g., Marvin et al., 2014; Clark & Kellner 2012), the procedure for integrating field-based measurements with remote sensing data is as follows. Field-collected data is used to create plot-level estimates of forest biomass. Those plot-based estimates are then used to calibrate remote sensing data using

a model that statistically links the plot data to the remote sensing metric(s) that have known sensitivity to forest biomass. Once calibrated, model-linked remote sensing data is used to map forest biomass (see Baccini et al. 2012). To clarify this approach, we suggest the following language for paragraph 4(d)(1):

"Transparent, high-quality, and spatially explicit data of above-ground biomass developed using remote sensing technology with known sensitivity to variation in forest cover, structure, and biomass that has been calibrated with models linked to ground-level measurements from within the implementing jurisdiction."

Allow the use of ground-level measurements from other jurisdictions where appropriate
Location: 4(d)(1)

Collecting ground-level data in the tropics is arduous and expensive, and in some locations may be infeasible due to physical, environmental, or other constraints. We suggest including a mechanism to allow jurisdictions to include ground-level measurements from similar forest types in nearby jurisdictions participating in CTFS-associated programs. The jurisdiction requiring outside data must demonstrate that the forest types are similar in climate, seasonality, structure, age and disturbance history & other relevant biotic or abiotic variables. By allowing the sharing of ground-level datasets across jurisdictions, models used to calibrate remote sensing data will improve due to the higher volume of data being used to build the model.

Clarify requirement for separate methodologies when forest degradation is included
Location: 4(e)

The wording of this paragraph makes it unclear what the exact requirements of a jurisdiction are when one decides to include both deforestation and degradation as part of its MRV program. Additionally, the wording of the role of peer-reviewed science seems to suggest that scientific publications are needed on regional differences in degradation for each jurisdiction. To clarify the requirements for MRV of both deforestation and degradation, we suggest the following language for paragraph 4(e):

"If an implementing jurisdiction includes both deforestation and degradation in its reference level, the methodology used to calculate average annual emissions from degradation need to be included in the sector plan separately from the methodology used for deforestation, and must be based on peer-reviewed science that is able to reflect regional differences in degradation within the jurisdiction."

Chapter 8: Monitoring and Reporting

Include specific instructions on how the uncertainty deduction will be applied
Location: 8(d)

The percent uncertainty deduction that is applied to credits to be issued to a jurisdiction is a critical part of the CTFS. This mechanism helps to maintain a robust and credible system to issue credits in the face of uncertainty in the measurement and monitoring of forest carbon that can never be reduced to zero. Due to its importance, ARB should update this section to explicitly state the metric (e.g., 90% confidence interval) that should be used when calculating uncertainty, and describe how the uncertainty deduction should be applied (e.g., 1% credit deduction for every 1% of uncertainty).

Chapter 9: Third-Party Verification

Clarifying the independence of third-party verification
Location: 9 (general comment)

Chapter 9 mandates third party verification of the implementing jurisdiction's reported emissions and emissions reductions. The guidelines requiring accreditation, expertise & disclosure of conflicts of interest are clearly stated. Yet the extent to which the third party is truly independent of the jurisdiction is unclear—there seems to be significant leeway for the jurisdiction to define what the independent party is supposed to verify.

What sort of data will these third-parties use to verify a jurisdiction's reporting? Will the third-party be primarily expected to audit the quality of the data and reporting of the jurisdiction? Or will it perform independent data gathering and analysis for comparison with the jurisdiction's data and analysis (i.e. enabling statistically independent verification)?

As we read this section, we understand the role of the third party to be akin to an auditor—to ensure there were no mistakes, oversights, or manipulations in the jurisdiction's reporting. We believe there is an opportunity to strengthen this oversight. We suggest the third party should have the authority to verify the jurisdiction's reporting using independent deforestation, degradation, or emissions data. These data would be independent in the sense that is was not included in the jurisdiction's calibration or reporting, ensuring the reported emissions hold up to scrutiny against new data.

We believe strengthening the role of the independent third-party will be critical to ensuring transparency in CTFS reporting. We believe this independence should include an emphasis on independent data and analysis, not just organizational independence. The credibility of this standard will be depend on how much the public and its governing agencies trust the MRV process, and ensuring each jurisdiction's reporting holds up under truly independent verification will be central for establishing this trust.

Thank you for considering our comments. We look forward to the next version of the CTFS, and we support the leadership of the California Air Resources Board.

David C. Marvin, PhD
President and CEO
dave@salo.ai

Christopher B. Anderson
Vice-president and CTO
cba@salo.ai

References

Baccini, A. G. S. J., Goetz, S. J., Walker, et al. (2012). Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps. *Nature Climate Change*, 2(3), 182.

Clark, D. B., & Kellner, J. R. (2012). Tropical forest biomass estimation and the fallacy of misplaced concreteness. *Journal of Vegetation Science*, 23(6), 1191-1196.

Marvin, D. C., Asner, G. P., Knapp, D. E., Anderson, C. B., Martin, R. E., Sinca, F., & Tupayachi, R. (2014). Amazonian landscapes and the bias in field studies of forest structure and biomass. *Proceedings of the National Academy of Sciences*, 111(48), E5224-E5232.