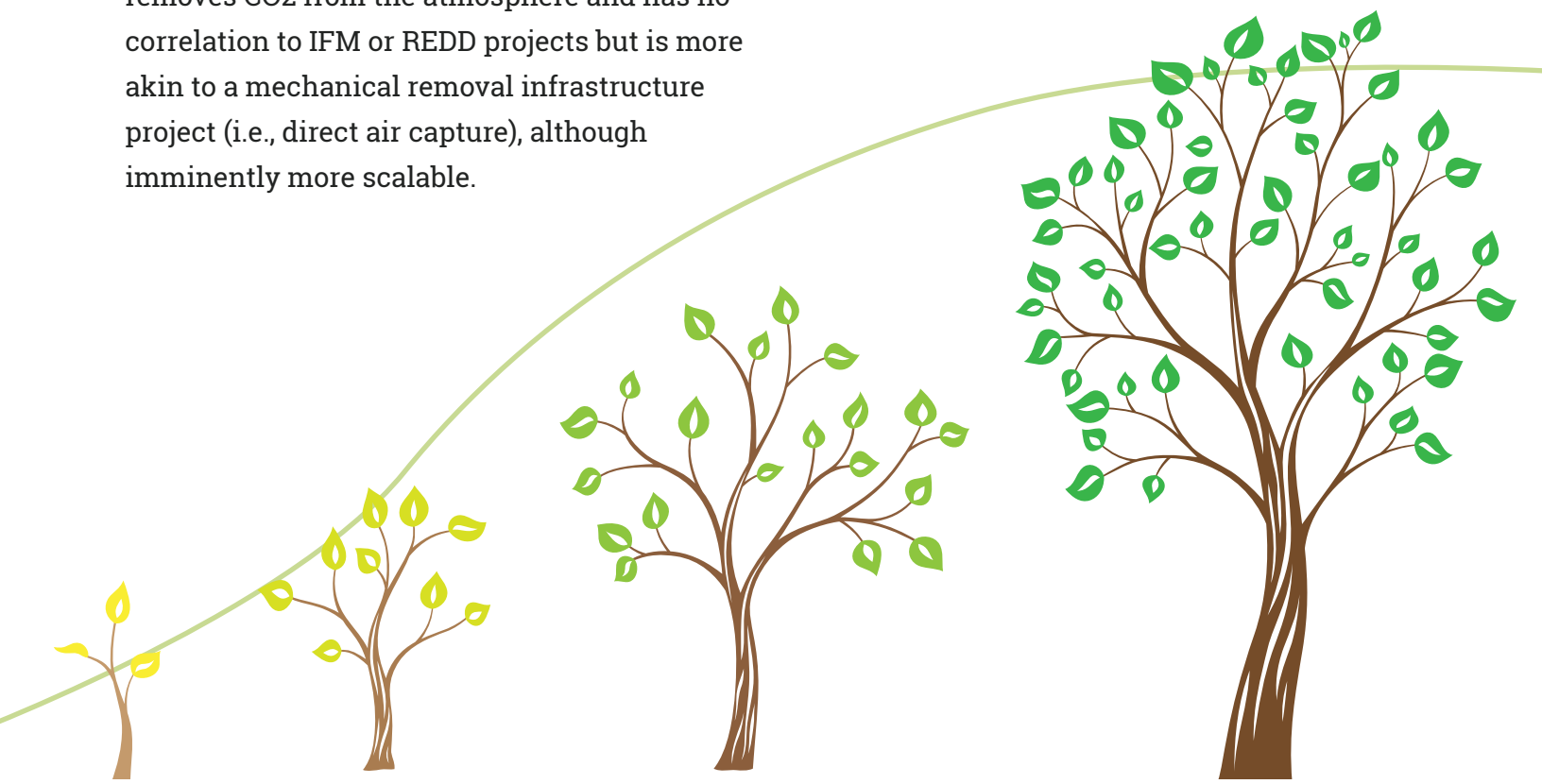
GreenTrees:
The Reforestation Removal Premium

Reforestation is an infrastructure project that removes CO2 from the atmosphere and has no correlation to IFM or REDD projects but is more akin to a mechanical removal infrastructure project (i.e., direct air capture), although imminently more scalable.



The move by American Carbon Registry (ACR) to tag parts of Improved Forest Management (IFM) projects as carbon removals is causing confusion in the marketplace. The great majority of market participants we have spoken to over the past year have deemed the tagging of parts of an IFM credit yield as a “stretch” at best.

ACR has determined that they can define the incremental growth after the initial issuance for the management change decision, as an “IFM Removal.” However, this is specious reasoning because reforestation creates a new carbon removal that did not exist before, while growth on an IFM project typically results from an existing forest recovering from a prior harvesting. As such, it is difficult to say what harvesting and regrowth would have occurred across the landscape in the absence of the project.

At GreenTrees, we are known for our extensive work in reforestation. And for good reason, we believe in creating new forest. Our business is 100% one of asset creation through changing land use.

GREENTREES
ONE ACRE AT A TIME

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The Core Differences Between AR and IFM

1. A Land Use Change vs. An Existing Asset

According to the IPCC, since 1750 one-third of all the emissions in the atmosphere have come from land use change, predominately deforestation. Therefore, it would stand to reason that land-use change like reforestation would be a major way to recalibrate and remove carbon back down from the atmosphere and store it in living systems like forests.

Once a land use change decision has been made, a reforestation project needs to first create the forest before it can generate carbon credits. Whereas, when an IFM project makes a management decision, the decision itself is the act that generates the carbon credits. We will unpack this further, but, the key point is that IFM is an existing asset – an existing forest. In other words, there is no forest creation that needs to take place.

Forest management decisions (IFM) and land use decisions (reforestation) are two distinct fields of planning that can have tremendous impacts on the environment. *IFM considers making effective changes to existing assets, while reforestation considers broader shifts and changes in how the land should be used.* Both offer invaluable insights into better preserving our natural resources.

By creating a new forest, reforestation also restores the forest ecology - fundamentally responsible for creating ecological co-benefits such as water storage/transpiration, habitat, etc. While carbon is the currency, ecological restoration from reforestation represents extraordinary value relative IFM.

2. CapEx is Signficant in Reforestation

The capital required for reforestation is significant. Building a new forest is expensive. Whereas there are virtually no capital expenditures required for establishing a baseline for changing management practices with an existing asset to establish an IFM project.

3. Differentiating Baselines

Establishing a starting point differs based on the project type. IFM projects employ either a model-based method or use an established industry standard to set their baselines; while with reforestation, a change in land use through de novo planting equates to a baseline of zero.

4. Credit Yield is Subject to the S Curve of Growth

The credit yield for a reforestation project is subject to the biological S Curve of growth. Just as humans all start as infants, become teenagers and accelerate their growth before leveling off as adults, the same biological trends occur with with reforestation. *This S Curve fundamentally defines a significant set of financial and biological hurdles for most reforestation projects to overcome because projects generate few credits in their first years, making years of delay before credit revenues can pay for the costs of establishing forests.* The credit yield for IFM is the inverse of reforestation – in IFM, the initial credits are calculated as the result of the differential of existing carbon stock relative to the stock that would have been present in the event of maximum allowable feasible harvesting. Thereafter, the annual growth can either be attributed in part or in whole to carbon and/or reserved for timber thinnings.

5. Reforestation Can Increase Soil Carbon

While both IFM and reforestation credits account for above and below ground biomass carbon, reforestation projects like GreenTrees also account for soil carbon because the project is established on previously tilled land and, as such, results in the recovery of soil carbon stock. reforestation is allowed to count soil carbon for the first 20 years following the date of planting when converting marginal cropland to forests.

6. Risk Premium: Reforestation Subsidizes Project Buffer Contributions

Reforestation projects are significantly less risky than IFM projects. GreenTrees has never had a reversal. To illustrate this point, consider that reforestation project buffer contributions are subsidizing IFM buffer contributions. IFM projects start with a substantial carbon stock (existing forest) and only the fraction of this forest (above the baseline) is designated as credits.

For IFM, only a small percentage of the credits is allocated to the reversal compensation buffer pool. As a result, only a very small fraction of the at-risk overall forest carbon stock (above and below the baseline) is covered by the buffer. In contrast, for reforestation projects the entire carbon stock is verified as project credits and, as such, the buffer is a much larger percentage of the total carbon stock, even when the buffer contribution is the same percentage of credits as an IFM project.

Consider the following tables illustrating a hypothetical example of how the effective buffer contribution between IFM and an reforestation project differs. As noted above, the actual risks to reforestation projects are modest and almost certainly

Consider an IFM project with 200 mtCO2e per acre of above and below ground biomass.

Total AGB and Biomass per Acre	200
Initial Credits Above Baseline per Acre	50
Leakage Rate	40%
Carbon per Acre Net of Leakage	30
Risk Buffer Rating	20%
Buffer Contribution per Acre	6
Net of Buffer to Sell to the Market	24 tons
Typical Forest Mortality Rate per Year	1%
Effective Buffer Contribution	**3%**

Now compare this to a reforestation project with half the tons of above and below ground biomass.

Total AGB and Biomass per Acre	100
Total Creditable Carbon	100
Leakage Rate	0%
Risk Buffer	20%
Buffer Contribution	20
Net of Buffer to Sell to the Market	80
Typical Forest Mortality Rate per Year	1%
Effective Buffer Contribution	**20%**

NOTE: Acts of God Risk do not distinguish between what is above the baseline vs below the baseline. Therefore, if the risk buffer rating for IFM was applied to total AGB, not the creditable part, the IFM project would be negative 10 tons for the first year and assuming a 3% annual growth rate it would take another four years before positive tons accrued under this illustration.

would not emit more than a few percent of the credited carbon; while recent experience with wildfires occurring on IFM projects demonstrates that unplanned occurrences overwhelm IFM project buffers. GreenTrees has never had a reversal and has contributed 1.2 million credits to the ACR buffer pool. Therefore, reforestation projects like GreenTrees are subsidizing IFM projects on a risk adjusted basis.

It is also important that the soil was not included in the above analysis. What Act of God Risk in a forest causes soil reversal? No known situation outside of a meteor. Yet soil sequestration also contributes to the risk buffer required by ACR, further increasing the buffer relative to potential emissions. For reforestation projects, soil provides a significant portion of carbon in the early years as the trees establish their roots and initiate growth – the biological S Curve of Growth.

PROGRAMMATIC AGGREGATION

No Reversals. **Ever.**

GreenTrees aggregates all of its carbon assets across the Mississippi Alluvial Valley and Southeastern US into a pool that functions as an insurance mechanism against reversal. This programmatic aggregation approach adds an internal safeguard against project failure that ensures our credits are a secure investment and makes reverse unlikely.

GreenTrees has never had a reversal in its 20-year history and has a balance of 1.2 million mtCO2 of buffered credits contributed to ACR's buffer pool.

Separately, on the following pages, we provide an analysis of actuarial risks of reversal on the largest existing United States-based reforestation project, GreenTrees.This analysis shows that the existing project buffer contribution of 1.2 million credits is many times greater than the actual risk.

GreenTrees is currently exploring the option of market- based insurance as a superior risk management tool than contributing to any future risk buffer pool, given the misallocation of risk between IFM and reforestation.

7. The Power of Aggregation

To further accentuate this difference in risk profile, the vast majority of IFM projects are single property projects, whereas GreenTrees is an aggregated project consisting of many non-contiguous lands. The reason is that reforestation happens in small increments – targeting primarily marginally yielding agriculture acreage for its new ecologically superior land use (also generating numerous co-benefits). Existing stands have been compiled and cobbled together over time. For GreenTrees, the average size of our reforestation tracts is 200+ acres, whereas most IFM tends to be north of 4,000+ acres. IFM represents a single point of failure versus diversified allocation of geographical risk for GreenTrees.

Since the structure of programmatic aggregation enables reforestation to diversify risk across a pool of assets, a reversal for such a programmatic aggregated project would only occur in the unlikely event of the entire pool of assets experiencing negative growth year over year. In contrast, IFM projects are a single point of failure that do not have the pooling structure to insulate and distribute the risk. **Accordingly, the risk-based discount rate to the price of an IFM credit (even, and especially, the so called "removal" portion) is significantly greater than that of a reforestation credit.**

Actuarially Evaluating the Risk of a Reversal: The GreenTrees Project

The GreenTrees project is the largest reforestation project in North America, and encompasses over 133,000 acres. Using the required ACR risk rating tool, approximately 16.6% of the carbon stored by the GreenTrees project (including soil carbon) is transferred to the ACR risk buffer pool. Seeking to explore insurance alternatives to manage its reversal risk, the GreenTrees project asked a leading parametric insurance underwriter to assess the project's reversal risk. The resulting analysis found a de minimis risk of reversal (0.2%), an extraordinary contrast to the 16.6% required by ACR. The analysis is summarized below and described in more detail in the accompanying source documents.

As noted previously, GreenTrees is an aggregated project, meaning the project aggregates many separate land parcels distributed over a large area. Any disturbance would affect only a fraction of the parcels, and thus affect only a small fraction of the overall sequestration.

Finally, any unintentional reversal that might plausibly occur would only affect the biomass carbon. The soil carbon sequestration, which is a large percentage of the total sequestration in early years when trees are small, is not at risk.

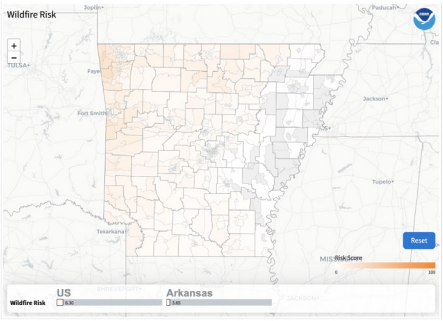
An insurance underwriter evaluated the actuarial risk of reversal for GreenTrees and concluded the following:

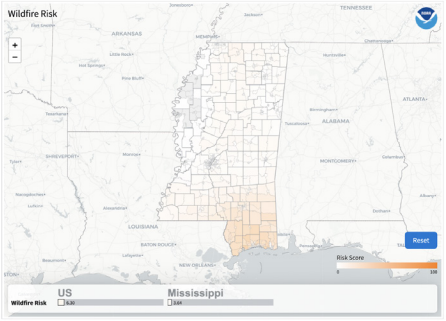
Category	Project Area Risk Score	Probability of Reversal	Notes
Wildfire	1/100	0.1%	Looking at the state level, it becomes evident, that the project area is in the lowest fire risk area.
Flood	2/100	0.1%	The overall probability for floods in the area is higher than with fire, but the impact is significantly lower, as the flood would have to be severe and stay for months, if not years to substantively harm the area. No flood will cover the entire project area over the next 5 years. If water is stagnant for 2-3 weeks, young trees die. But if the water moves, it helps the trees more than it hurts them by introducing oxygen.
Earthquakes	1/100	0.1%	The highest ever recorded earthquake in the project area is of magnitude 4.7, which is not sufficient to destroy trees. Earthquakes are in many cases beneficial to trees, as they loosen up the earth around them.
Disease and Pests	4/100	0.2%	Trees dying from indigenous diseases typically take years, while still removing carbon from the air, thus generating credits, that can be used to offset a potential future reversal.
Hurricanes	2/100	0.1%	Hurricanes typically form over the Gulf of Mexico and quickly deteriorate after making landfall from the south. The southern project area is generally more prone to be hit by hurricanes, but the impact is low, due to rapid deterioration of the storms.

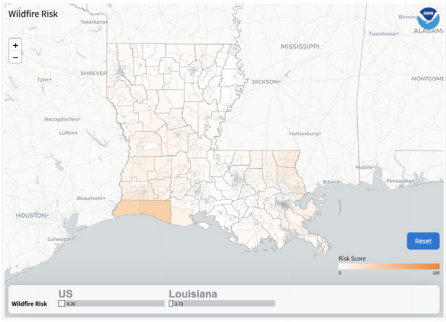
ACR requires a 16.62% buffer of GreenTrees, but the insurance market calculates the risk at 0.2% in the highest incidence – the current buffer is 83x greater than professional actuarial analysis indicates and represents a substantial de facto financial burden to the project and its landowners. Furthermore, this analysis indicates the favorable risk profile of the GreenTrees project and supports a substantial pricing premium relative to any other nature-based solutions.

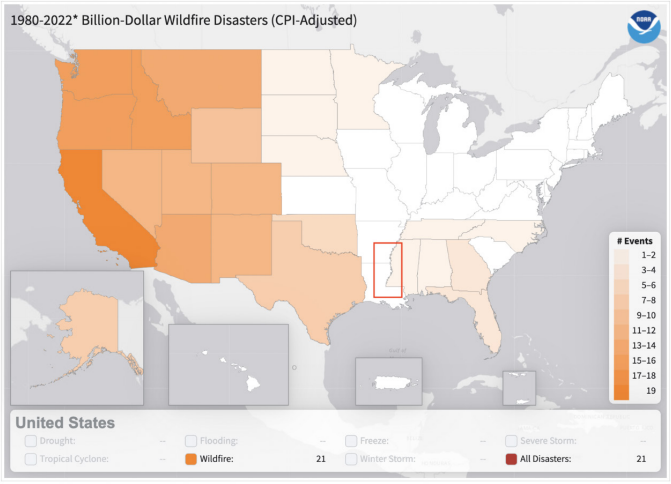
SOURCE DOCUMENTATION

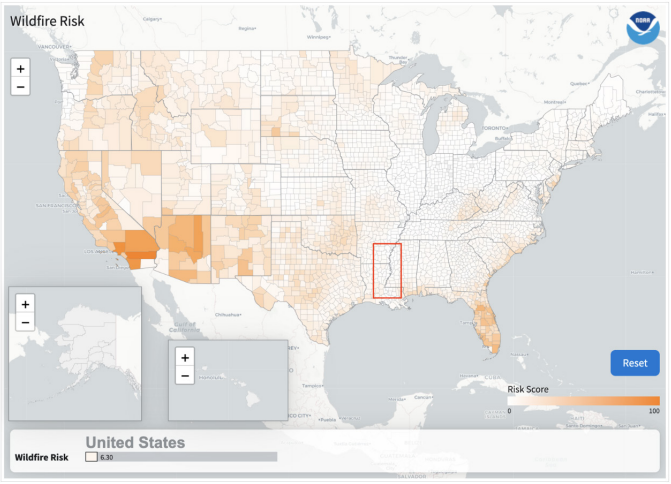
Category	Project Area Risk Score	Probability of Reversal	Notes
Wildfire	1/100	0.1%	Looking at the state level, it becomes evident, that the project area is in the lowest fire risk area.





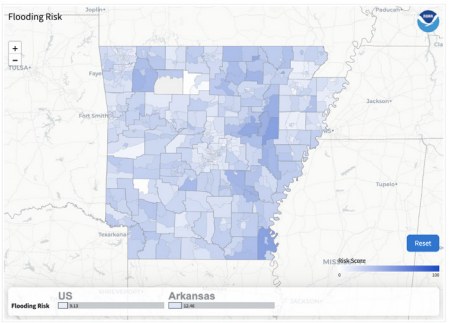


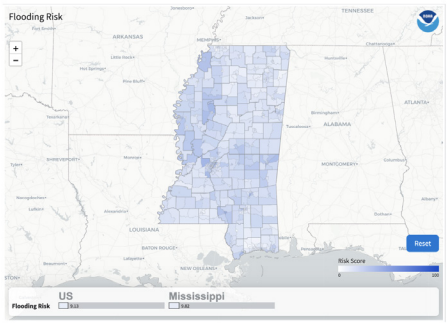


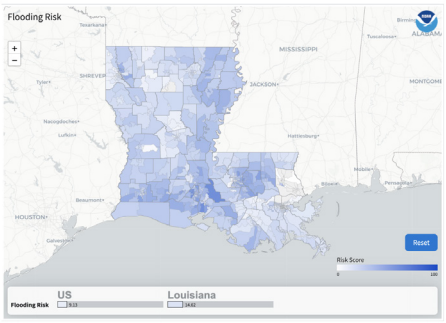


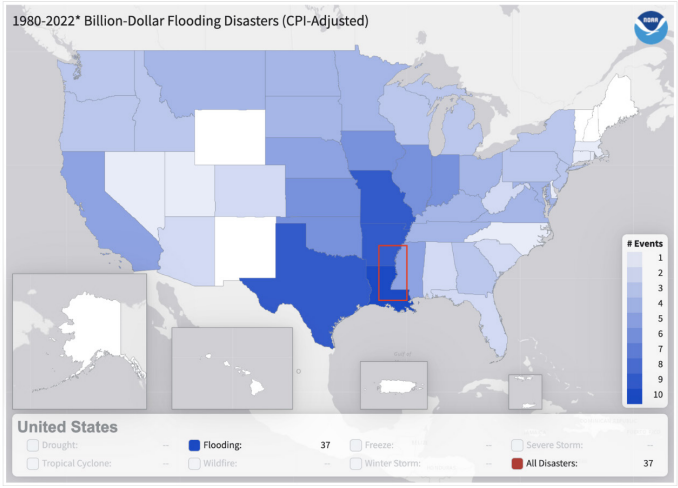
SOURCE DOCUMENTATION

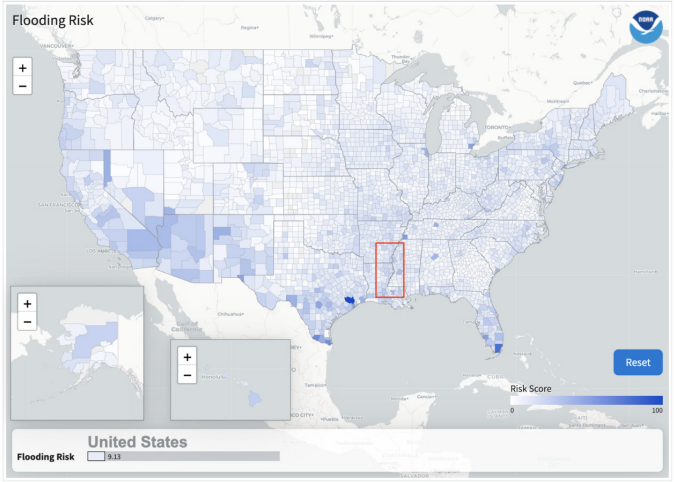
Category	Project Area Risk Score	Probability of Reversal	Notes
Flood	2/100	0.1%	The overall probability for floods in the area is higher than with fire, but the impact is significantly lower, as the flood would have to be severe and stay for months, if not years, to substantively harm the area. It is highly unlikely that flood will cover the entire project for five consecutive years. In flooded lands, only stagnant water has a meaningful impact - 2-3 consecutive weeks of stagnant water may impact young trees - as moving water in a flood typically has a net positive effect on trees by introducing oxygen.





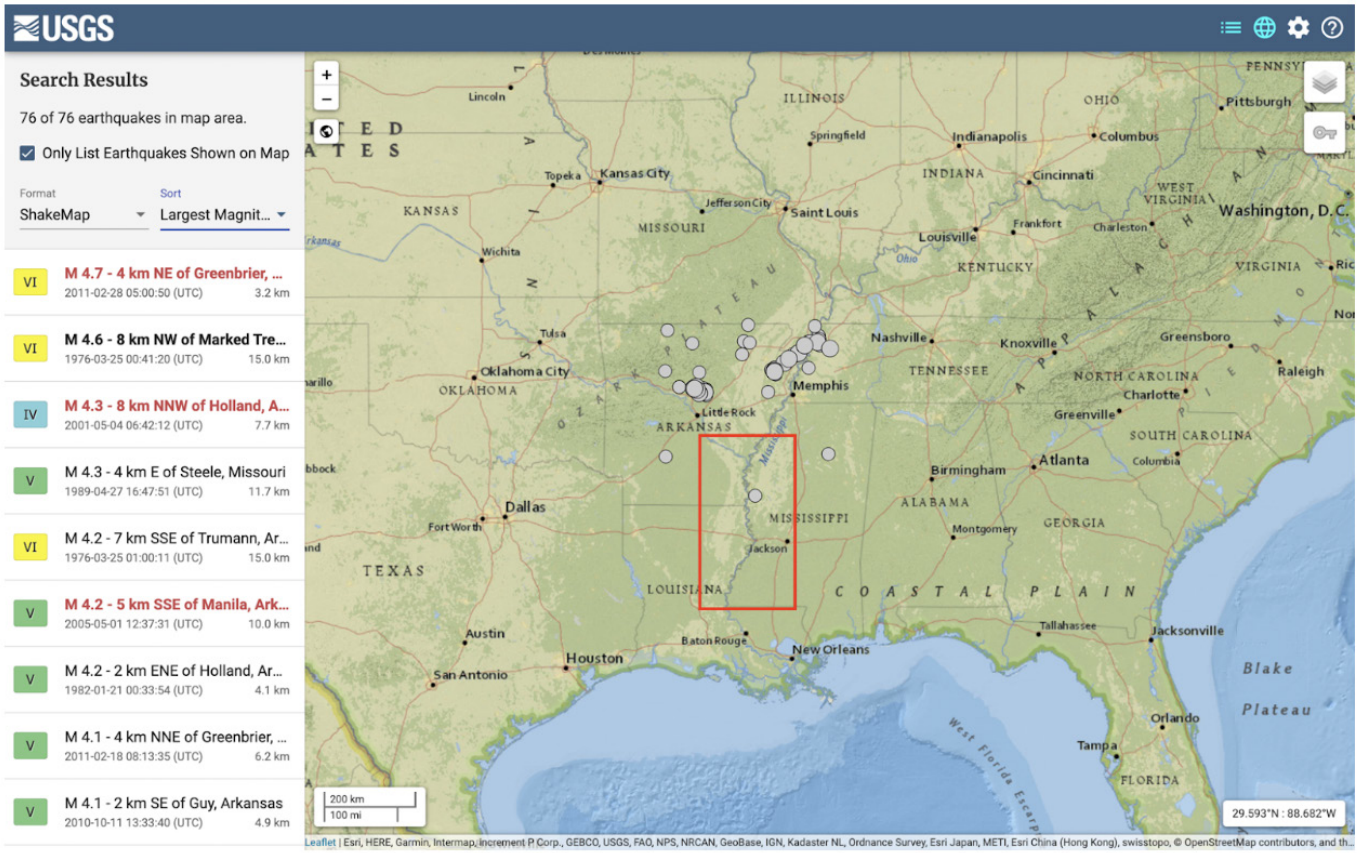






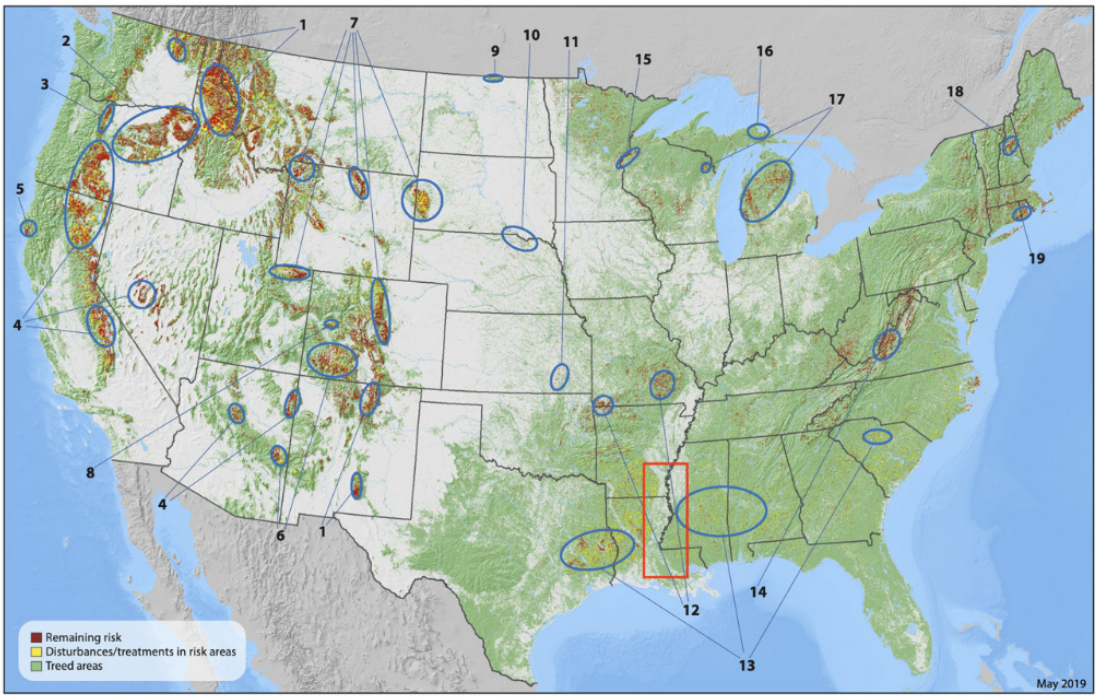
SOURCE DOCUMENTATION

Category	Project Area Risk Score	Probability of Reversal	Notes
Earthquake	1/100	0.1%	The map lists a total of 76 earthquakes in and around the project area since 1979. The only U.S. state in this project, that is frequently hit by earthquakes, is Arkansas, but the affected area is relatively far north of the project area. In addition, the highest ever recorded earthquake in north Arkansas is of magnitude 4.7, which is not sufficient to destroy trees. Earthquakes are in many cases beneficial to trees, as they loosen up the earth around them.



SOURCE DOCUMENTATION

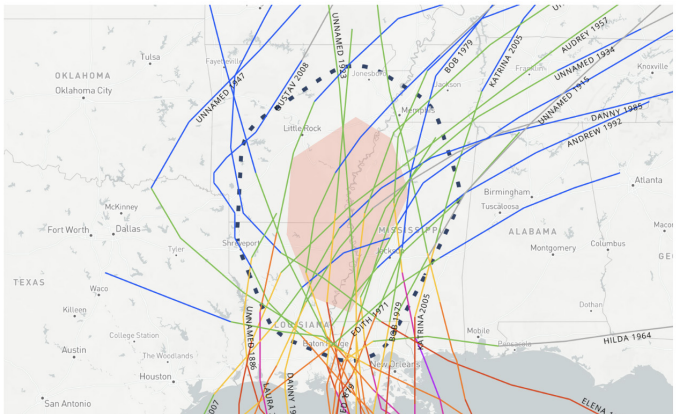
Category	Project Area Risk Score	Probability of Reversal	Notes
Diseases and Pests	4/100	0.2%	The project area is in between two “Southern Pine Beetle” affected areas. The beetles attack and kill southern yellow pine trees. There are no yellow pine trees included in the project. Other than this pest, there are no known diseases or pests in the area or have been in the last 5 years. Trees dying from indigenous diseases typically take years, while still removing carbon from the air, thus generating credits, that can be used to offset a potential future reversal. The GreenTrees forests are well diversified in terms of distance and species and only consist of grown trees, that are significantly more resistant to diseases and pests than smaller ones.



NO.	RISK AGENTS
1	Root disease, western pine beetles
2	Conifer defoliators, balsam woolly adelgid
3	Root disease, conifer defoliators, western pine beetles
4	Western pine beetles
5	Sudden oak death
6	Root disease, western pine beetles
7	Western pine beetles
8	Western pine beetles, conifer defoliators
9	Deciduous defoliators, aspen/cottonwood decline, emerald ash borer
10	Aspen/cottonwood/oak decline, emerald ash borer
11	Dutch elm disease, oak decline
12	Oak decline
13	Southern pine beetle, root disease**
14	Oak decline
15	Conifer defoliators, oak decline
16	Conifer defoliators, maple decline, beech bark disease
17	Oak decline, conifer defoliators
18	Conifer defoliators, beech bark disease, maple decline
19	Gypsy moth/oak decline, root disease

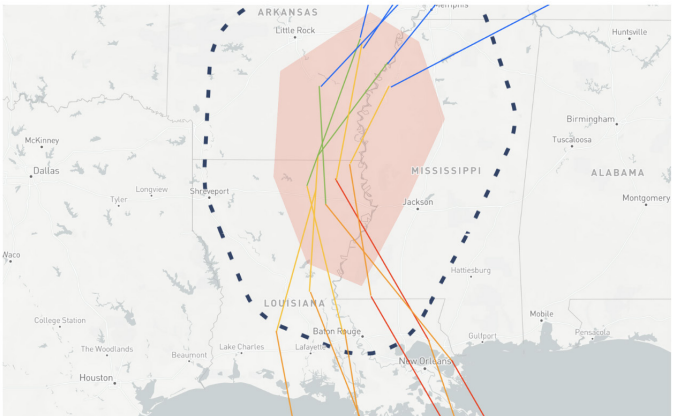
SOURCE DOCUMENTATION

Category	Project Area Risk Score	Probability of Reversal	Notes
Hurricane	2/100	0.1%	Hurricanes typically form over the Gulf of Mexico and quickly deteriorate after making landfall from the south. The southern project area is generally more prone to be hit by hurricanes, but the impact is relatively low, due to rapid deterioration of the storms.



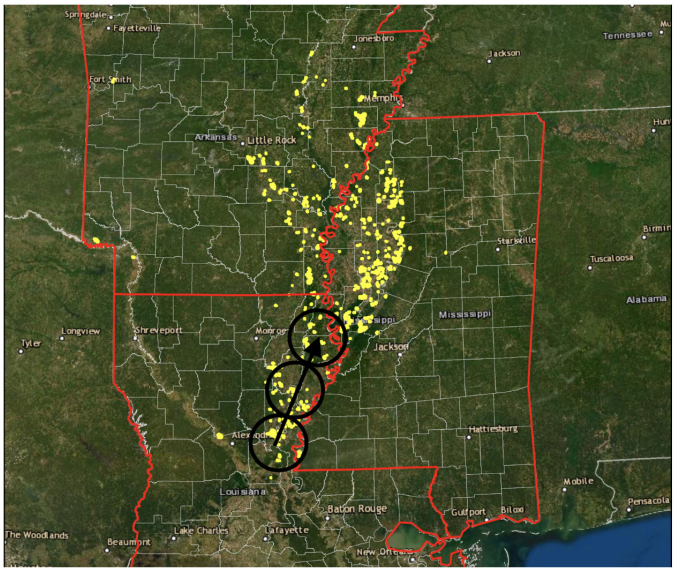
Visualized data show hurricane trajectories from 1880 - 2021. The project area has frequently been struck by windstorms.

Hurricanes typically form over the Gulf of Mexico and quickly deteriorate after making landfall from the south. The southern project area is generally more prone to be hit by hurricanes, but the impact is very low, due to rapid deterioration of the storms after landfall. It takes a CAT 4 hurricane to damage trees enough such that they would be substantially damaged to the point of losing any credit value.



Based on previous hurricane modelling, we predict the visualized worst-case-scenario for the project, to possibly occur over the next 30 years.

Hurricanes will generally be of higher categories when making landfall than in the past. We only see the southern area being affected by hurricanes that are potentially strong enough to destroy trees.



Worst Case Scenario. Our prediction for the next 30 years suggests that it is possible for a CAT 4+ hurricane to hit the northern area of Louisiana, which is the southern part of the project area, comprising approximately 25% of the trees. The strongest winds of a hurricane are located around the eye and are approximately 25- 50km / 16-31mi wide. According to our estimates, destruction of the trees above ground can happen within a radius of 60- 90km / 37-56mi in the center of the storm.

- The trees have grown strong enough over the years and are unlikely to be uprooted – instead, they would simply break. The worst case in this scenario is the destruction of the trees above ground.
- As only 60% of the credits generated are above ground, the worst case is a 0.6 * 0.25 = 15% credit destruction (per credit), which is not enough to cause (would not cause) a reversal, even without considering the deductible of 1.2m buffered credits.