Distributed Atmospheric Impact Valuation (DAIV)

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Near Mt. Mitchell in NC, USA at 2000m

Challenges with modeling short term valuation

- Some previous models used a finite (and short) time horizon.
- Some previous models used a static time horizon.
- Some previous models discounted physical units.
- Continuing disagreements over time preferences.
- Ton-years is a unit of measure, not a model type.
- Short term valuation is different from short term storage.

- The details matter.

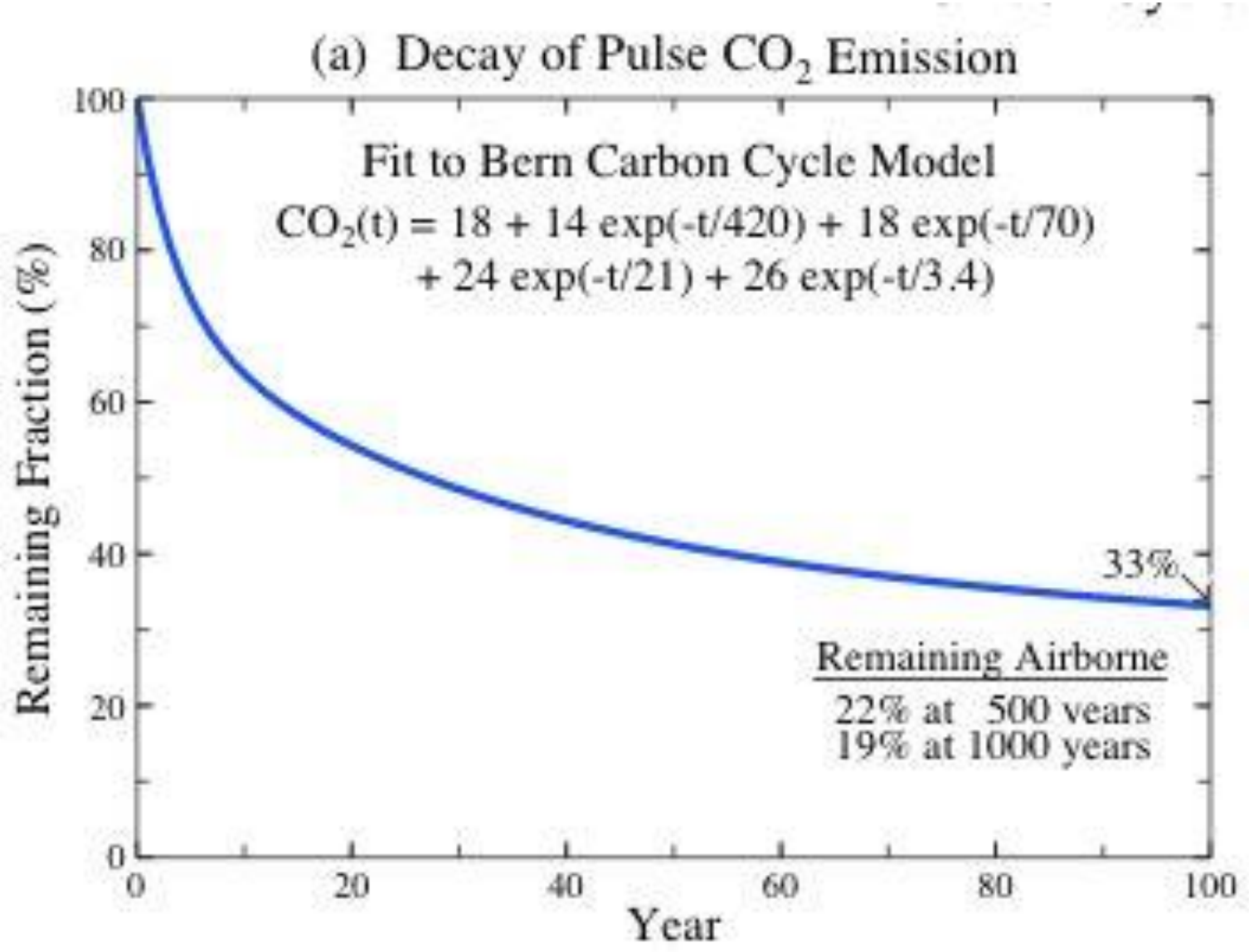
The Distributed Atmospheric Impact Valuation (DAIV) Approach

- The impact of CO_2 is based on its residency and timing in the atmosphere.
- The incentive we provide for climate mitigation efforts depends on timing, urgency, and presumed efficacy.

The Basic Approach

1. Estimate the timing of release of CO_2.
2. Simulate the residency of the released CO_2 in the atmosphere through time.
3. Estimate the present value of the release stream, in full or in parts.

Model of CO2 residency in the atmosphere



DAIV Model Calculations Comparing HWP Pathways

- Assumes Simplified Bern Model Atmospheric Dynamics, D(t).
- Assumes R% Annual Discounting.
- Value calculated from time, t=0 to t = ∞ (ignoring SCC for now).

$$\text{Discounted Ton Years (DTY)} = \int_0^{\infty} e^{-Rt} D(t) dt$$

- Separating value into intervals.

$$\text{Value } (t_1, t_2) = \int_{t_1}^{t_2} e^{-Rt} D(t) dt$$

$$\text{Full Value } = \sum_{n=0}^{\infty} \int_{t_n}^{t_{n+1}} e^{-Rt} D(t) dt$$

DAIV Model Calculations Comparing Pulse Release

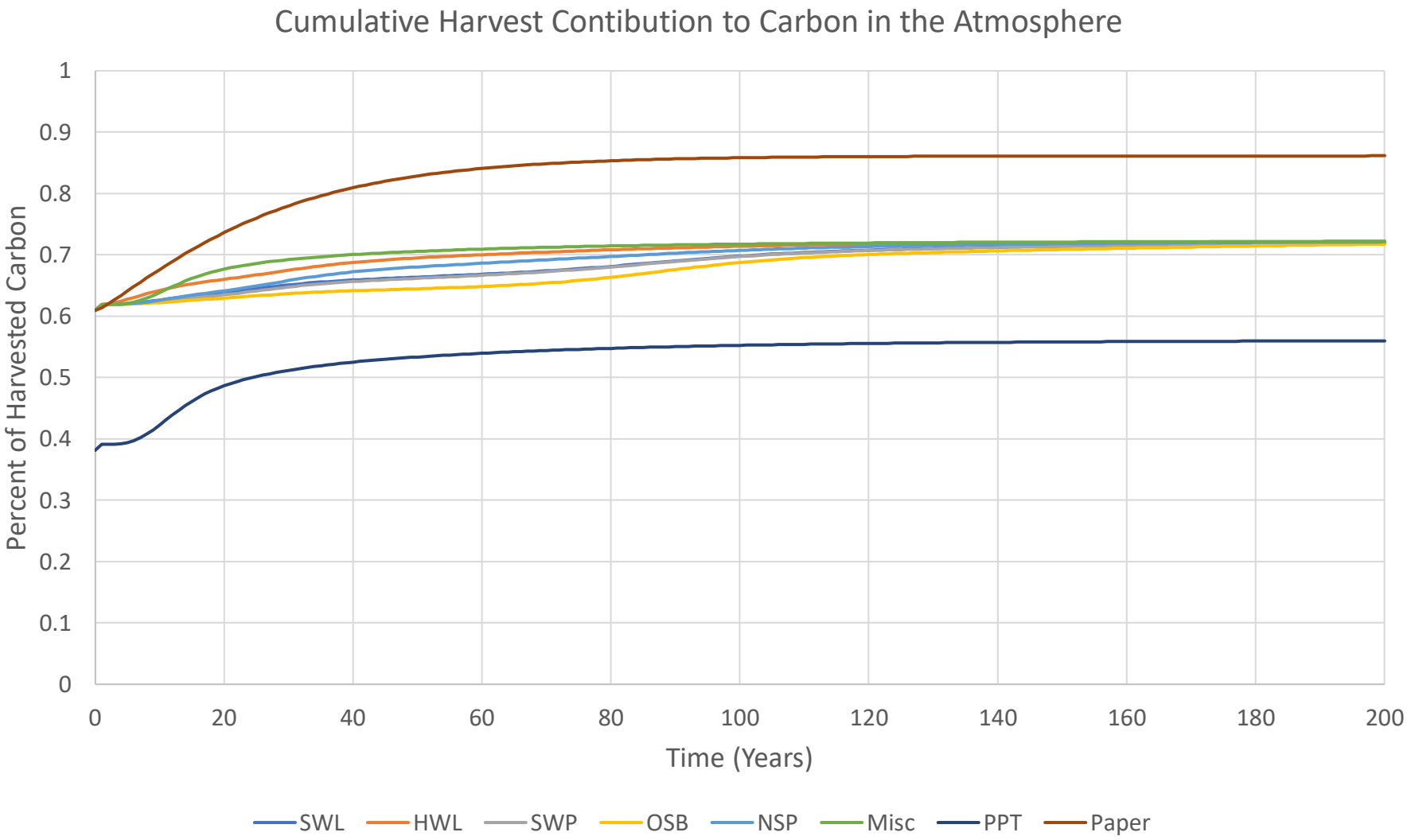
- Value calculated from time=0 to infinity.

$$\text{Value} = \int_0^\infty e^{-Rt} D(t) dt$$

- $\text{Value of a Delay} = \int_0^\infty e^{-Rt} D(t) dt - \int_T^\infty e^{-Rt} H(t-T) D(t-T) dt$

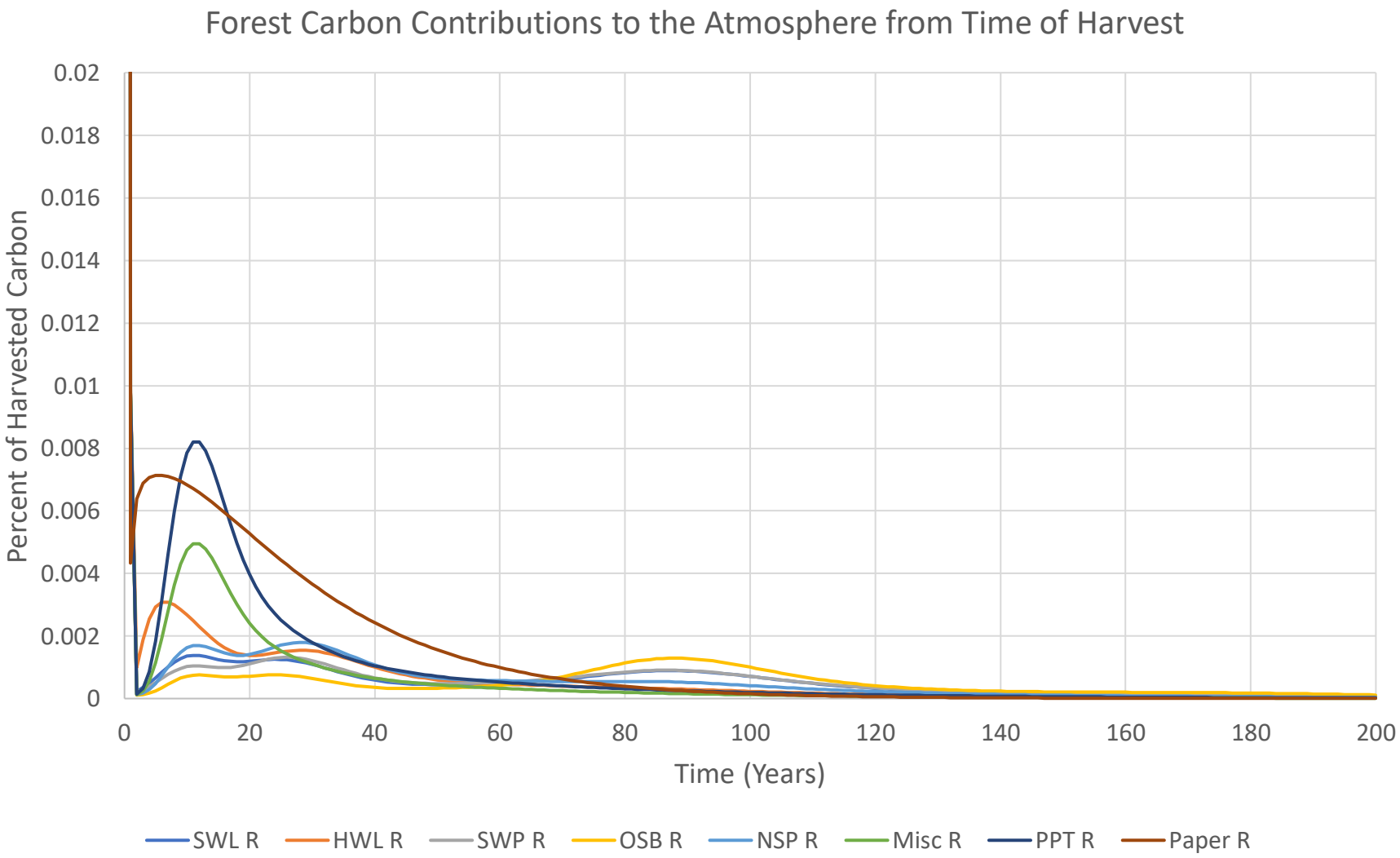
Discounted Value (in DTY) by discount rate R and T-year delay.					
Discount Rate R	1-Year Delay T	5-Year Delay T	10-Year Delay T	50-Year Delay T	100-Year Delay T
1%	41.74	39.70	37.77	25.32	15.36

Example: Forest Harvest Contributions to the Atmosphere



Based on USFS data on waste, processing, removals, recycling, etc.

Fraction of Carbon Released from a Harvest by Primary Product Category



Data on US Forests from Keith Stockman and upcoming USFS report.

The Value of a Release Stream, S(t).

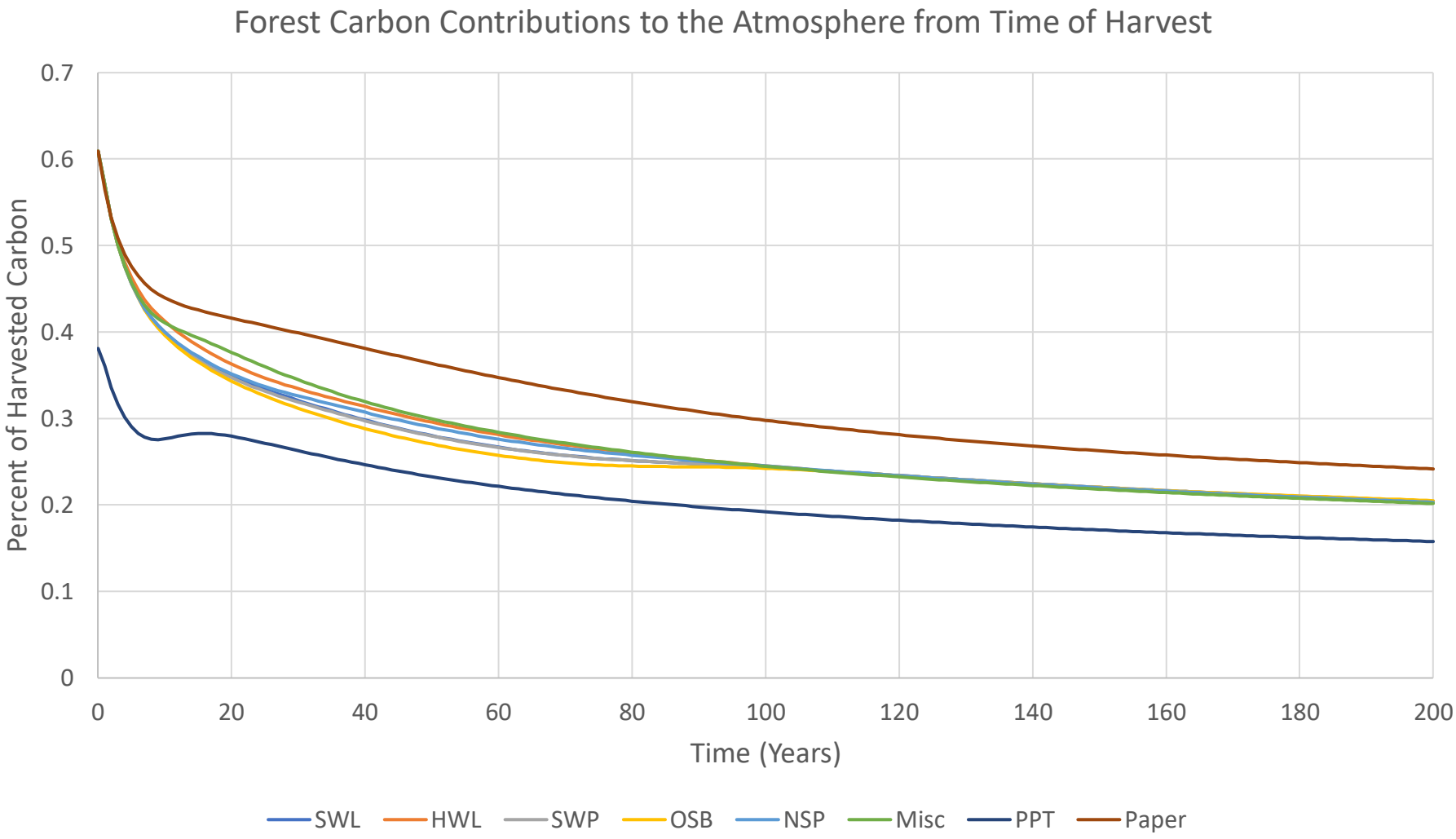
$$C_{atm}(t) = \int_0^t S(\tau)D(t-\tau)d\tau$$

$$\text{Value} = \int_0^\infty e^{-Rt} \left(\int_0^t S(\tau)D(t-\tau)d\tau \right) dt$$

$$\text{Value of a Delay} = \int_0^\infty e^{-Rt} \left(\int_0^t S(\tau)D(t-\tau)d\tau \right) dt \; - \; \int_T^\infty e^{-Rt} H(t-T) \left(\int_0^{t-T} S(\tau)D(t-T-\tau)d\tau \right) dt$$

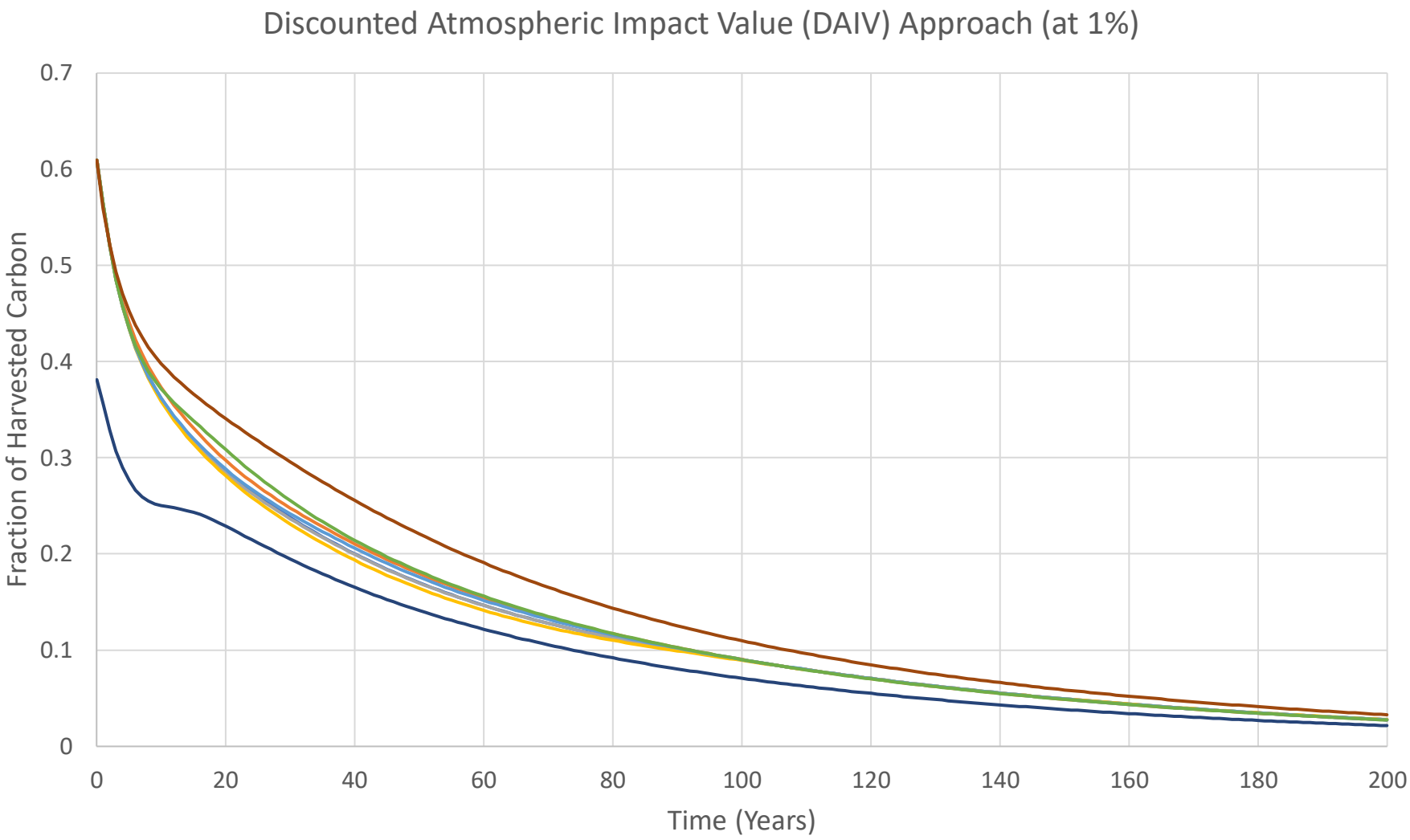
Current calculations for $C_{atm}(t)$ are performed with a discrete sum.

Fraction of Carbon Released from a Harvest by Primary Product Category



Data on US Forests from Keith Stockman and upcoming USFS report.

Present Value of Forest Carbon Released to the Atmosphere



DAIV Model Calculations Comparing HWP Pathways

- Assumes Simplified Bern Model Atmospheric Dynamics
- Assumes 1% Annual Discounting
- Value calculated from time=0 to infinity.

First Year Release: 41.74 Discounted Ton Years (DTY)

SWL (Softwood Lumber)	25.81 DTY
HWL (Hardwood Lumber)	26.50 DTY
SWP (Softwood Plywood)	25.75 DTY
OSB (Oriented Strandboard)	25.40 DTY
NSP (Non-structural Panels)	26.11 DTY
Misc (Miscellaneous)	26.74 DTY
PPT (Piers, Pilings, and Ties)	19.88 DTY
Paper	30.82 DTY

The time preference (discount rate)

- Any time preference should reflect current trends and economics.
- Any time preference should reflect current urgency and progress.
- Any time preference should be fluid and be updated regularly.

There is no magic discount rate.

Time Preference = Economic Rate of Growth + Index of Urgency

Comparing Pulse Release for different Discount Rates

- Value calculated from time=0 to infinity.

$$\text{Value} = \int_0^\infty e^{-Rt} D(t)\,dt$$

- Value of a Delay = $\int_0^\infty e^{-Rt} D(t)\,dt - \int_T^\infty e^{-Rt} H(t-T) D(t-T)\,dt$

Discounted Value (in DTY) by discount rate R and T-year delay.					
Discount Rate R	1-Year Delay T	5-Year Delay T	10-Year Delay T	50-Year Delay T	100-Year Delay T
1%	41.74	39.70	37.77	25.32	15.36
2%	24.88	22.51	20.37	9.15	3.37
3%	18.28	15.74	13.54	4.08	0.91
4%	14.63	11.98	9.81	1.98	0.27
5%	12.29	9.57	7.45	1.01	0.08
6%	10.63	7.88	5.83	0.53	0.03

Calculating an Equivalence

- Equivalence of a Delay

$$\int_0^\infty e^{-Rt} C_{atm}(t)dt = N(\int_0^\infty e^{-Rt} C_{atm}(t)dt - \int_T^\infty e^{-Rt} H(t-T) C_{atm}(t-T)dt)$$

- Equivalence results show only dependence on discount rate

$$\text{One Year Delay Equivalence} = \frac{1}{1-e^{-R}}$$

$$\text{T-Year Delay Equivalence} = \frac{1}{1-e^{-RT}}$$

The DAIV Modeling Approach

1. Can be used to value carbon releasing and storing activities.
2. Can be used to compare similar activities.
3. Can be used to value short term storage.
4. Can be used to value specific intervals of long term (or permanent) sequestration efforts.
5. Solves many of the challenges with previous valuation methods for short term storage.

6. Discount rates should be nimble reflect current economics and current urgency.

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