

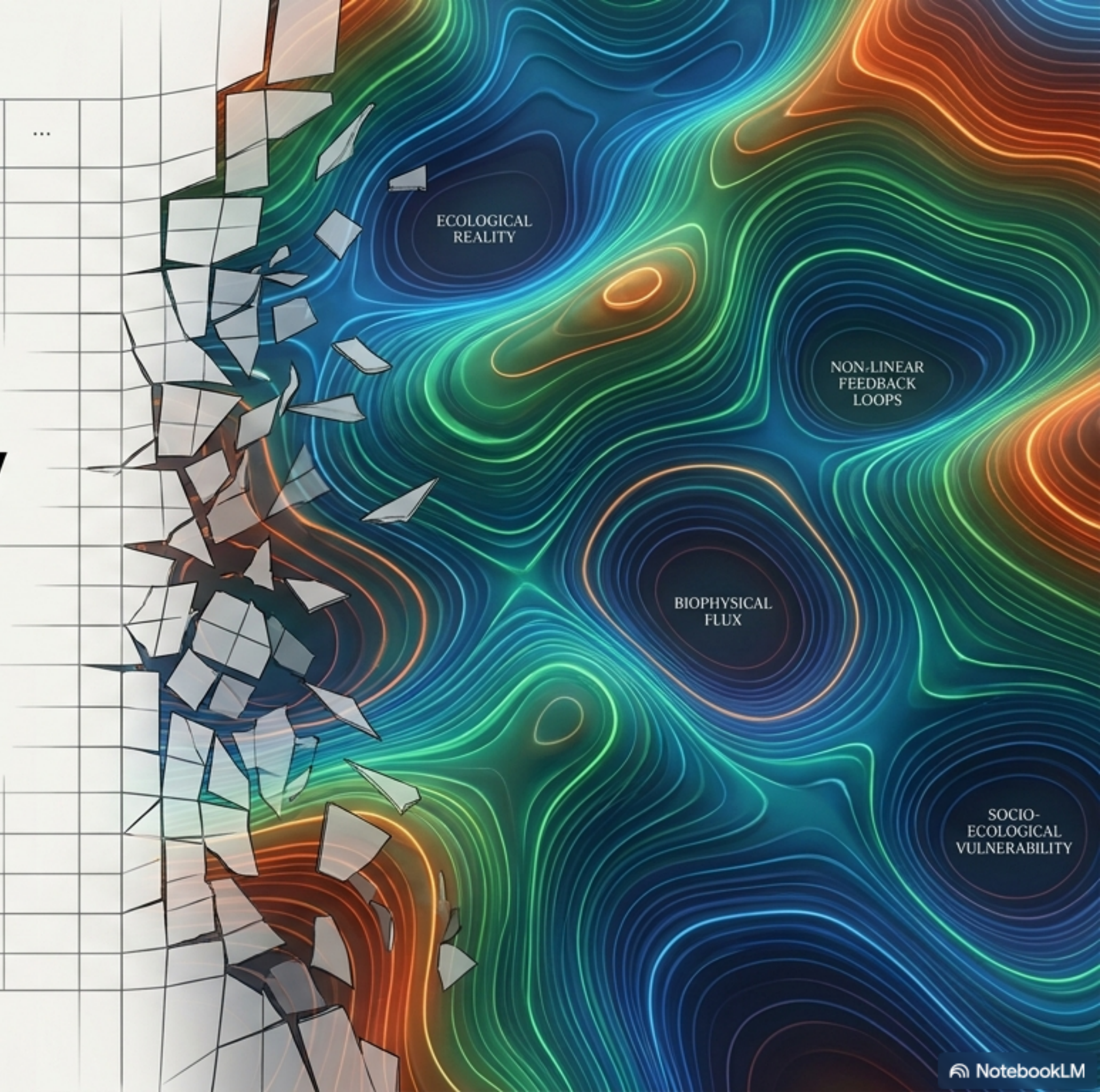
# The Collapse of Admissibility

## *Overcoming Proxy Permanence Failure in Carbon Governance*

A theoretical analysis via the RSVP-TARTAN-CLIO framework, definitively dismantling the illusion of the fungible carbon stock.

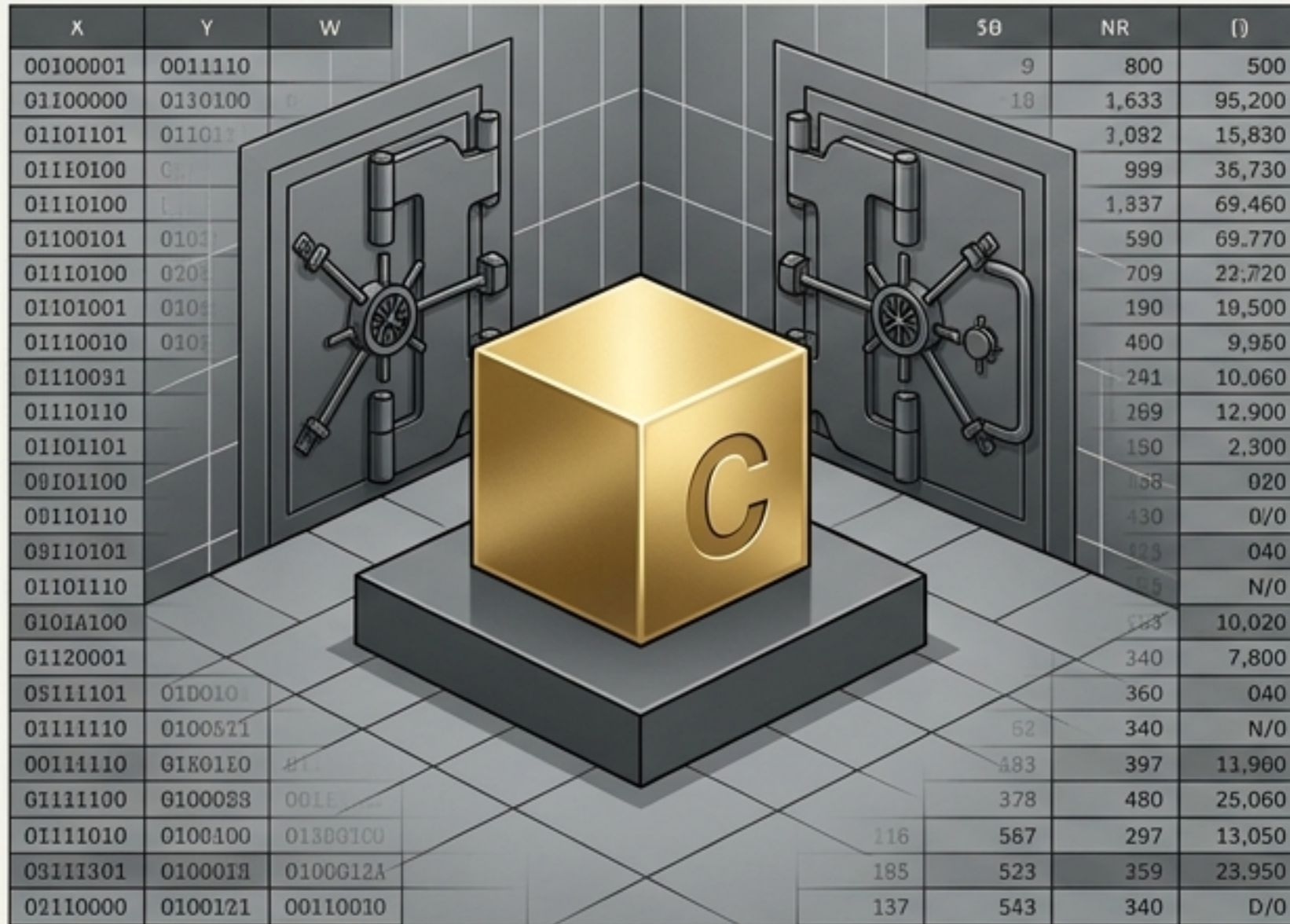
	CARBON STOCK (MtCO <sub>2e</sub> )	JURISDICTION	VINTAGE	PERMANENCE RATING (0-100)	...
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# The Illusion of the Fungible Stock

## The Object Ontology



The Governance Premise: Carbon as a durable, fungible stock. It permits static actuarial ledgers and binary insurance.

## The Field Ontology



The Ecological Reality: Carbon as a dynamic flow. The future state cannot be represented as mere perturbations around a stationary baseline.

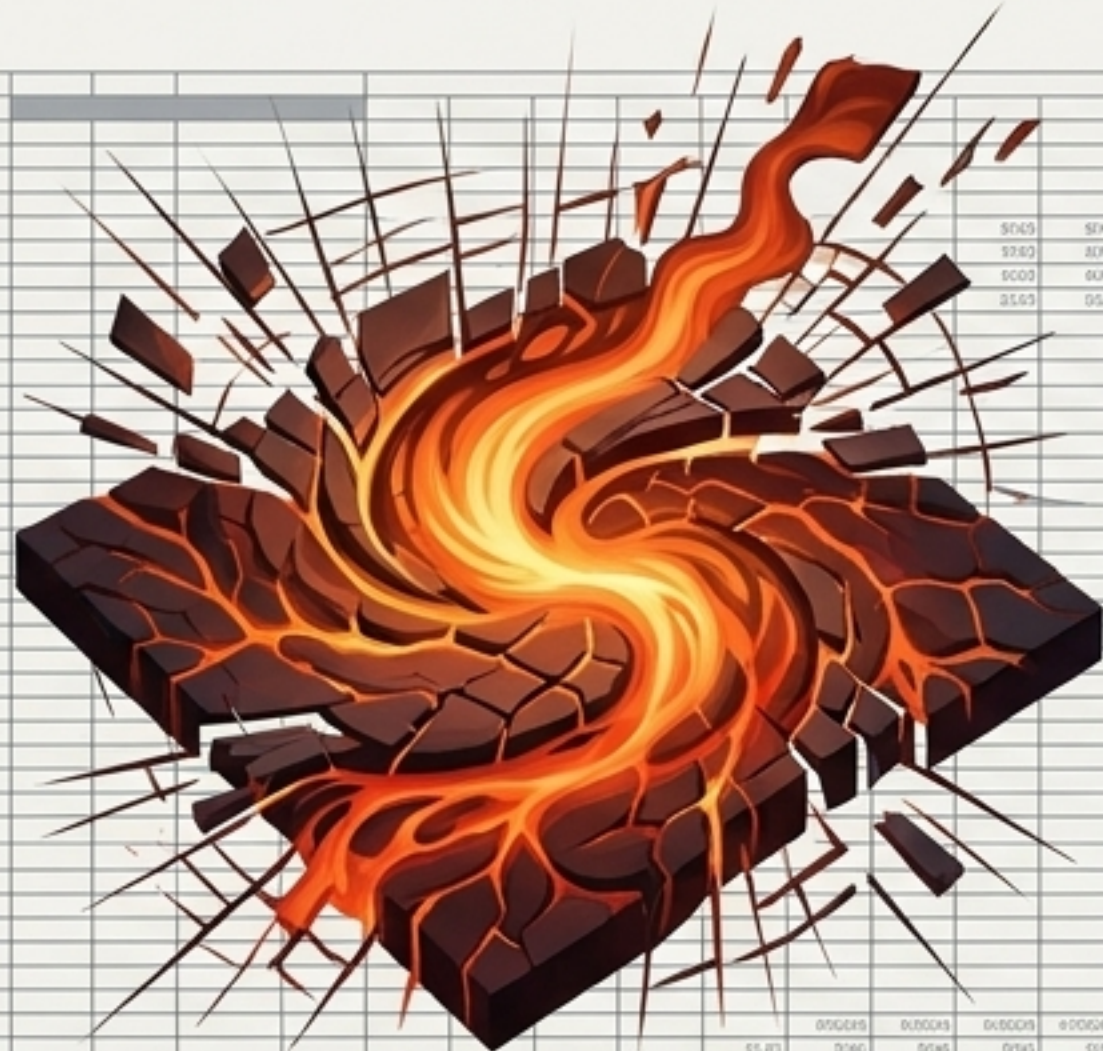
Under nonstationary climate forcing, the Object Ontology is structurally blind to physical reality.

# Three Distinct Empirical Crises in Nature-Based Governance

## I. Forest Disturbance

(Wu et al., 2026)

- CARB buffer pool is undersized by a factor of 6.3
- 41% of active projects face reversal probabilities > 50% under SSP2-4.5



## II. Terrestrial Biodiversity

(Weiskopf et al., 2024)

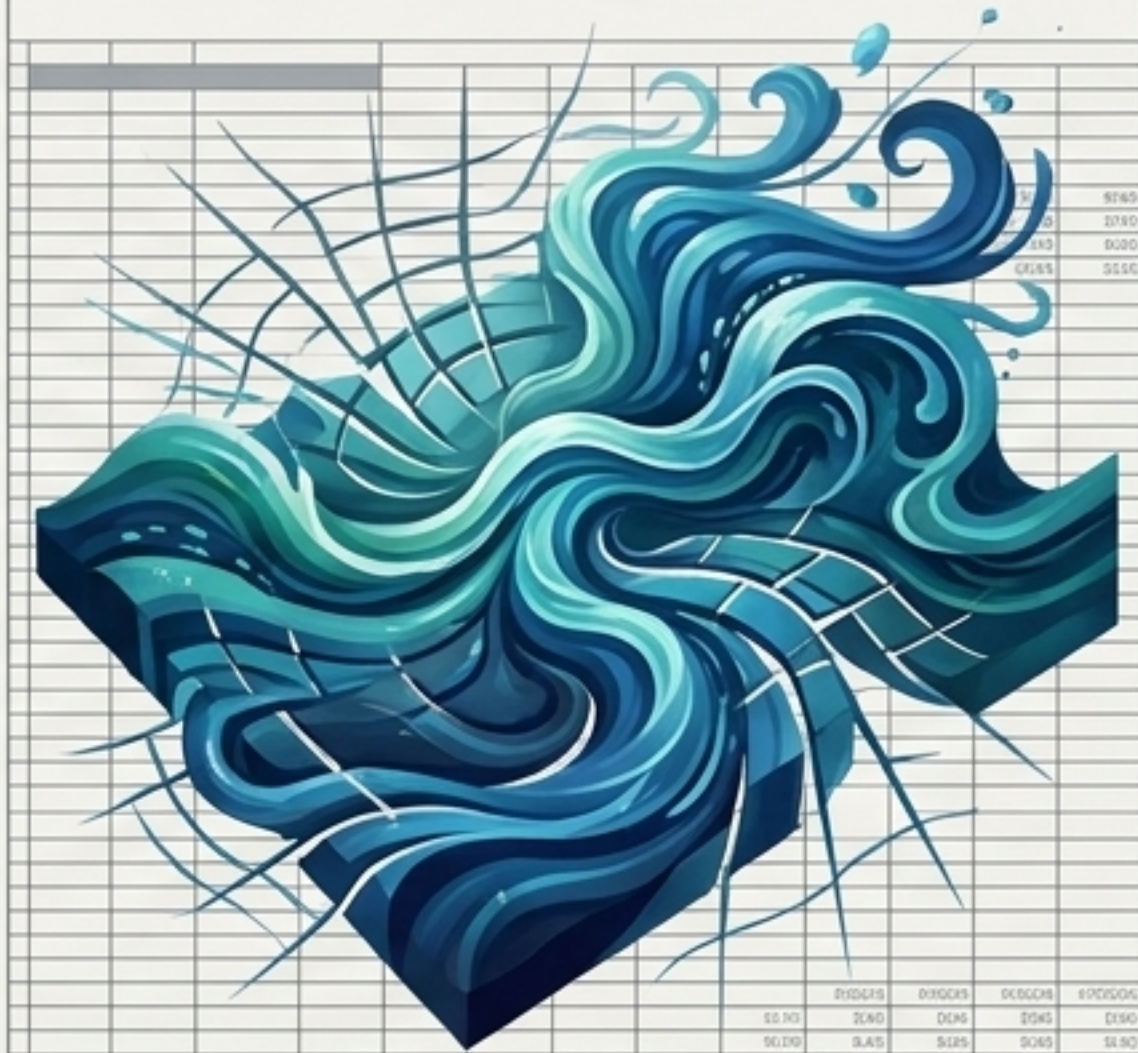
- Biodiversity decline causes 7.4–146.0 PgC of unmodeled carbon losses
- Storage penalty is completely invisible to Earth System Models



## III. Marine RDOC

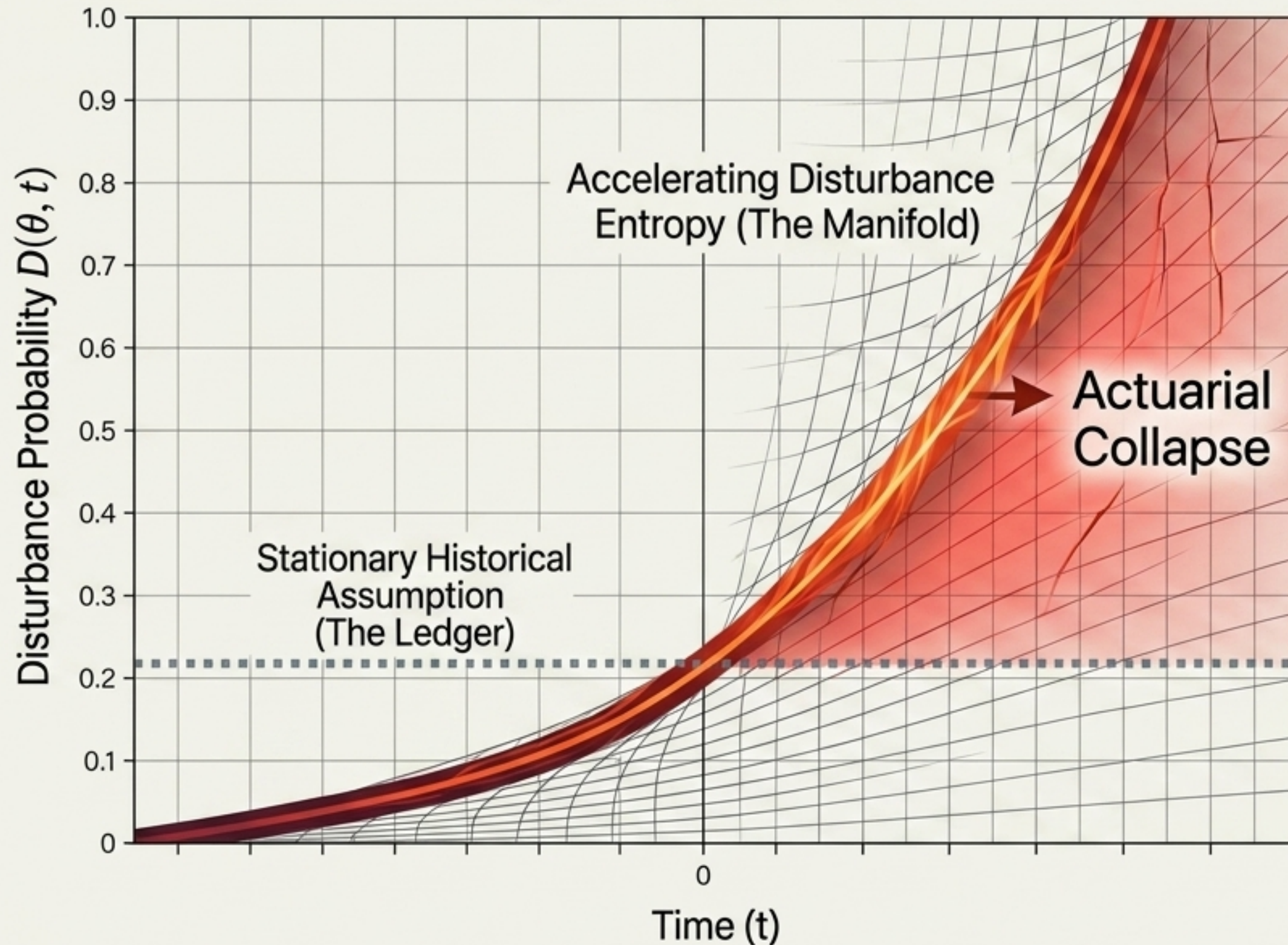
(Watanabe et al., 2026)

- 14–25% of coastal DOC export persists for 100+ years
- Comprises 4–8% of annual NPP but is entirely absent from blue carbon accounting



# Mechanism I: Accelerating Disturbance Entropy

## Activation Curve



## The Empirical Reality

Climate change roughly triples wildfire-driven reversal probabilities over 100 years.

## The Governance Blindspot

Governance models rely on historical calibration. When disturbance frequencies are nonstationary, a buffer pool calibrated at  $t_0$  systematically understates risk for all  $t > t_0$ .

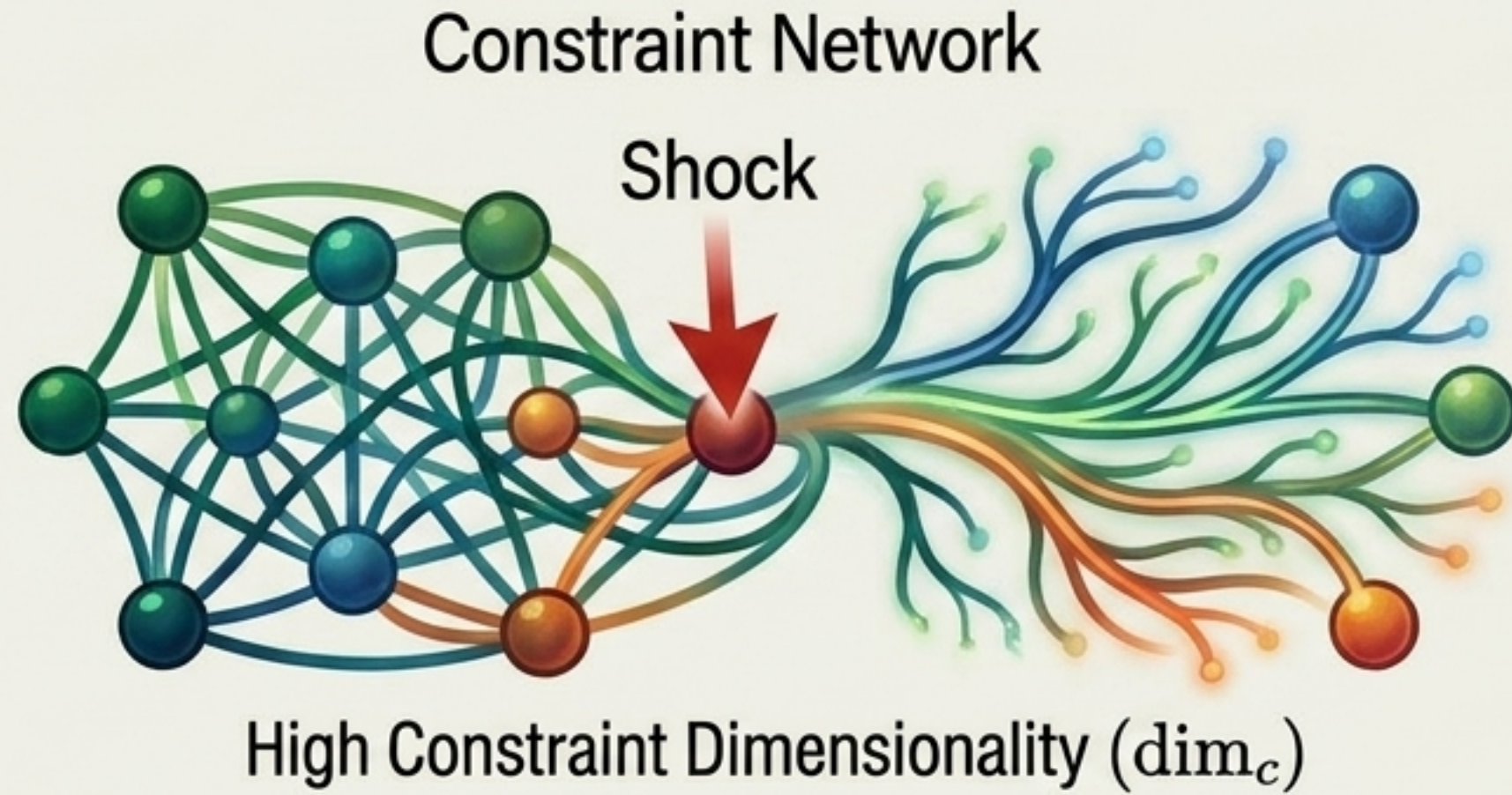
## The Core Takeaway

Under accelerating disturbance entropy, the volume of dynamically probable paths that keep a forest intact progressively shrinks. The ledger assumes independent risk, but the manifold experiences synchronized collapse.

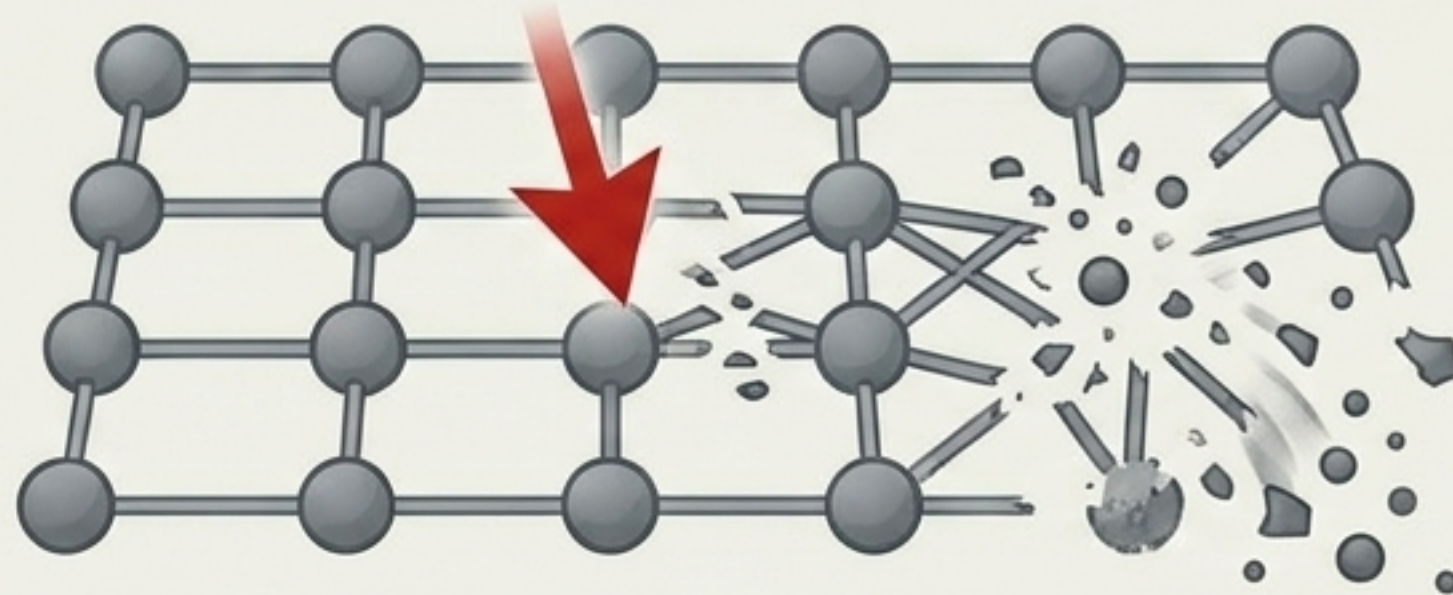
# Mechanism II: Constraint Dimensionality Reduction

Constraint vs. The Manifold

High Biodiversity:  
The Ecological Reality



Earth System  
Models: The  
Governance  
Ledger



## The Governance Blindspot

ESMs reduce global vegetation to a few "Plant Functional Types", deleting within-category diversity.

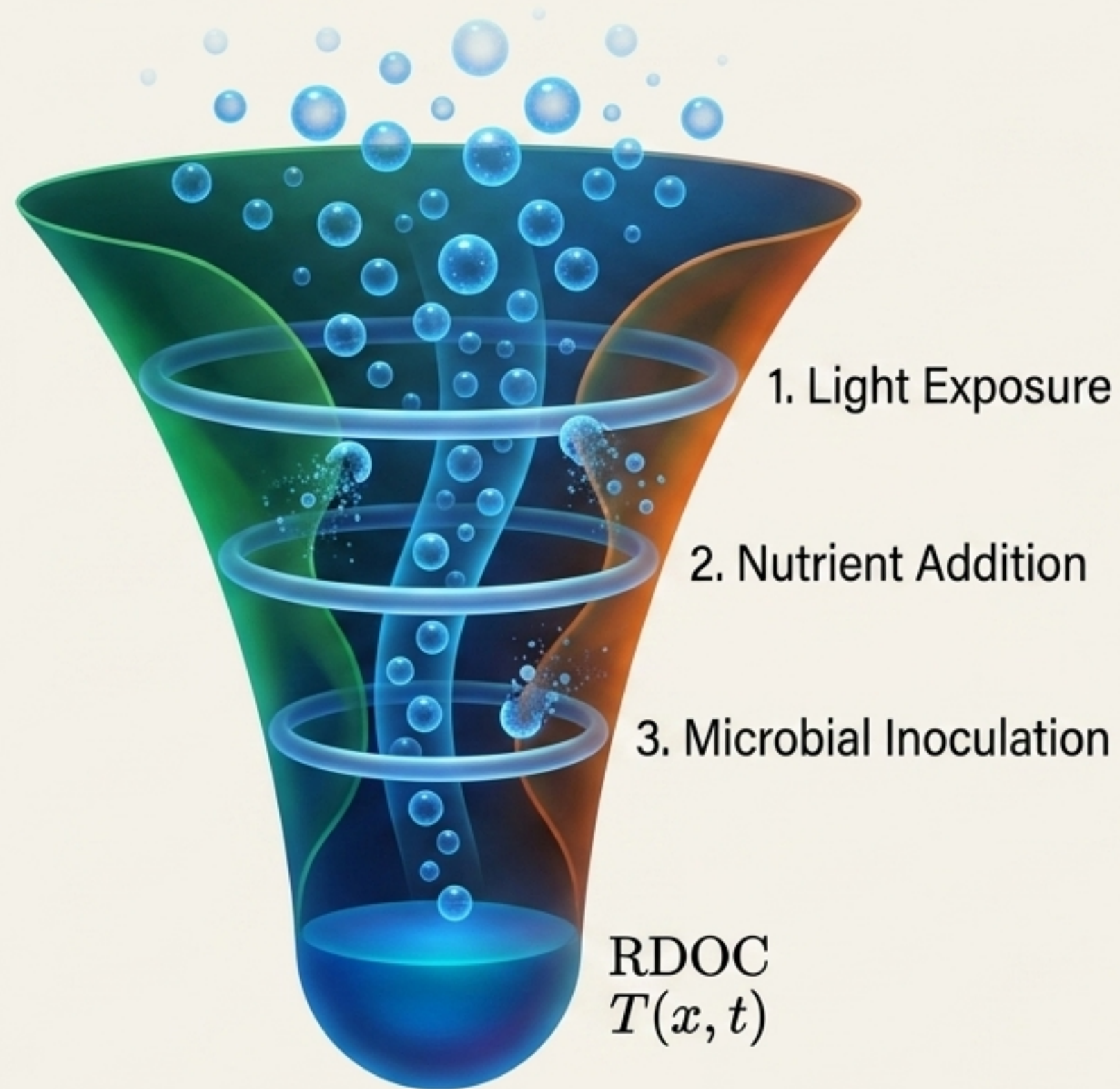
## The Core Takeaway

Biodiversity acts as a literal "Constraint-Density Field"  $\kappa(B)$ .

Removing species removes independent constraint channels.

The ecosystem loses its capacity to absorb perturbations, driving irreversible carbon release.

# Mechanism III: Transformation Accessibility Contraction



Microbial Accessibility Funnel

## The Empirical Reality

14-25% of DOC export from macroalgae and seagrasses persists over 100 years.

It persists operationally, not chemically.

## The Governance Blindspot

Current accounting treats persistence as binary (locked in a reservoir or released).

It ignores the Reactivity Continuum.

## The Core Takeaway

Recalcitrance is dynamical inaccessibility.

Carbon survives because it progressively transforms into configurations that exclude degradation pathways. Permanence is

topological, not a physical lockdown.

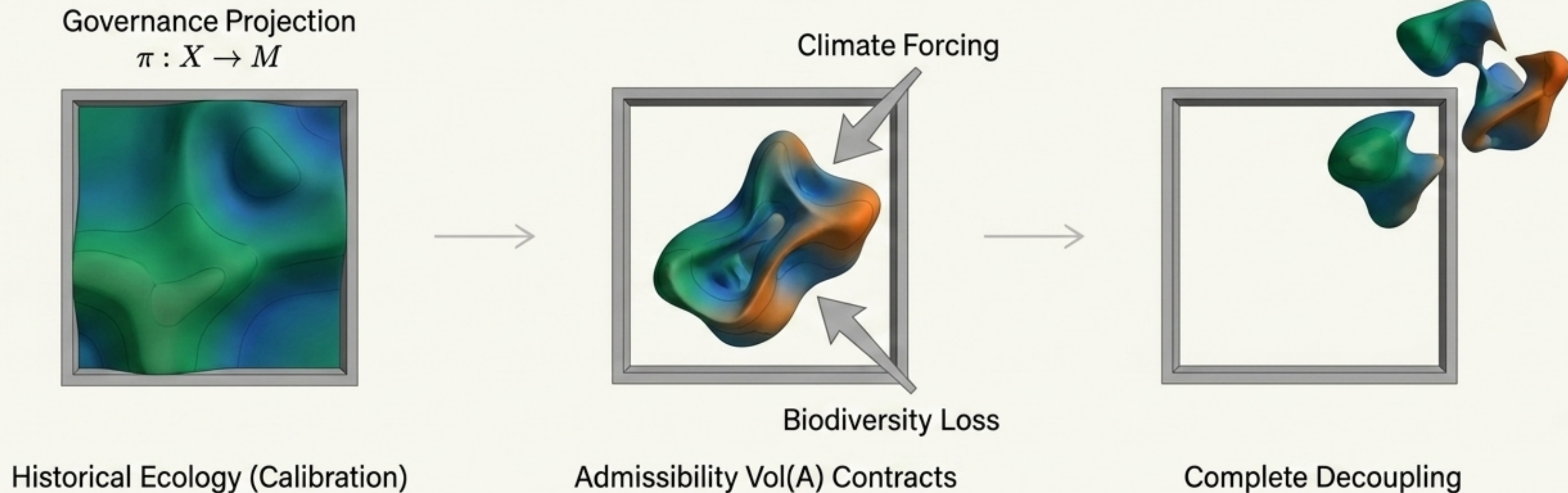
# Synthesis: Three Symptoms of One Disease

	Forest Disturbance (Wu et al.)	Terrestrial Biodiversity (Weiskopf et al.)	Marine RDOC (Watanabe et al.)
The Empirical Reality	6.3x undersized buffer pool	7–146 PgC unmodeled loss	14–25% 100-yr RDOC persistence
The Discarded Variable	$D(\theta, t)$ [Disturbance Manifold]	$\kappa(B)$ [Constraint Density]	$T(x, t)$ [Accessibility Field]
The Mechanism	Entropy expansion	Dimensionality reduction	Trajectory exclusion
The Governance Blindspot	Assumed stationary risk	Omitted from ESMs entirely	Unrecognized by blue carbon

Core Insight: All three protocols apply causal compression—they discard the precise mathematical variables that dictate whether the projected carbon value remains physically meaningful.

# The Unified Theory: Proxy Permanence Failure

## The Admissibility Manifold Collapse

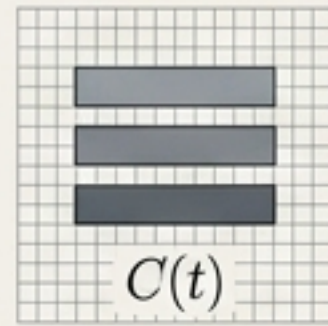


**The Dynamic:** The Admissibility Manifold  $A(t)$  represents ecological trajectories compatible with protocol assumptions. External forcing shrinks this volume.

**The Result:** Symbolic permanence is maintained on the ledger while physical permanence capacity erodes in the manifold. Projection coherence  $\neq$  projection validity.

# The Ontological Shift in Carbon Governance

## Object Ontology (Current)



System View  
Passive reservoir  $C(x, t)$

Persistence  
Default state

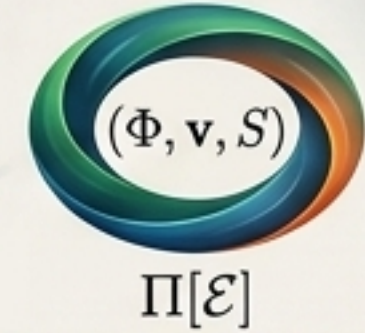
Risk Model  
Stationary probability  $p_i$

Biodiversity  
Treated as a “co-benefit”

Failure Mode  
Discrete reversal event

Insurance  
Flat-rate buffer pool

## Field Ontology (Future)



System View  
Dynamic triple  $(\Phi, \mathbf{v}, S)$

Persistence  
Continuously achieved via  $\kappa(B)$  and  $T$

Risk Model  
Nonstationary geometry  $D(t), T(x, t)$

Biodiversity  
The literal Constraint-density field  $\kappa(B)$

Failure Mode  
Progressive admissibility decoupling

Insurance  
Path-integral permanence functional

# From Binary State to Survival Trajectory

Permanence is a first-passage survival probability, not a  $\{0,1\}$  ledger state.

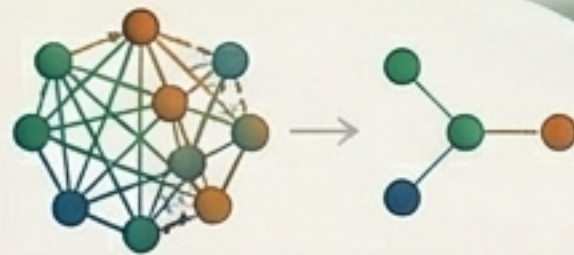
$$\Pi[\mathcal{E}] = \exp\left(-\int \Lambda(\tau) d\tau\right)$$

Disturbance Intensity  
(The Wu mechanism:  
Accelerating fire risk)

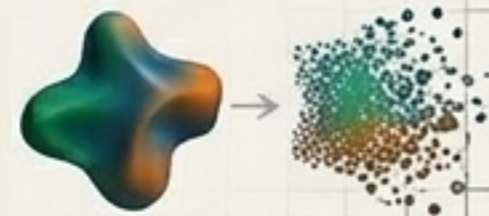


$$\Lambda(\tau) = \lambda_1 D(\tau, \theta) + \lambda_2 \frac{\kappa(B_{\text{ref}}) - \kappa(B(\tau))}{\kappa(B_{\text{ref}})} + \lambda_3 \frac{dS}{dt} + \lambda_4 \frac{d \ln T}{dt}$$

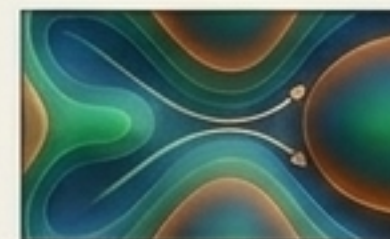
Constraint Erosion  
(The Weiskopf mechanism: Biodiversity loss)



Entropy Acceleration  
(Overall negentropic collapse)



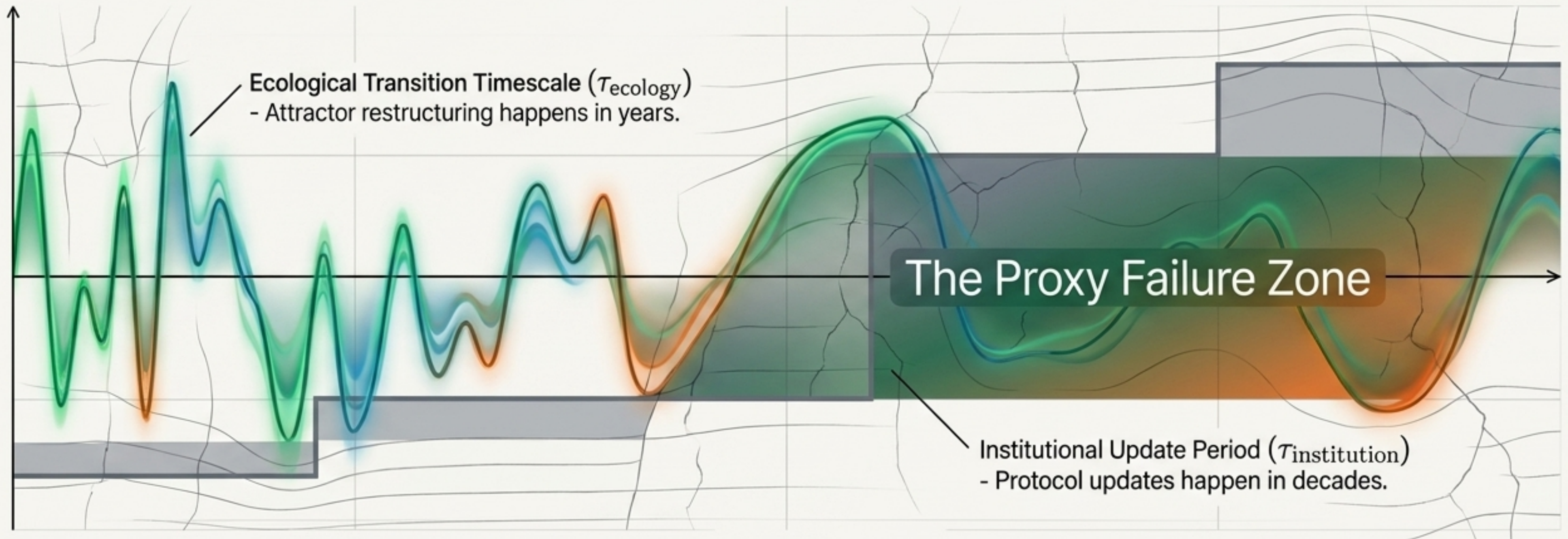
Accessibility Contraction  
(The Watanabe mechanism: RDOC)



**Takeaway:** Effective credited carbon must be dynamically weighted by this trajectory-dependent resilience functional, combining all physical failure mechanisms.

# Synchronization Failure: The Institutional Lag

## Dual-Frequency Wave Diagram



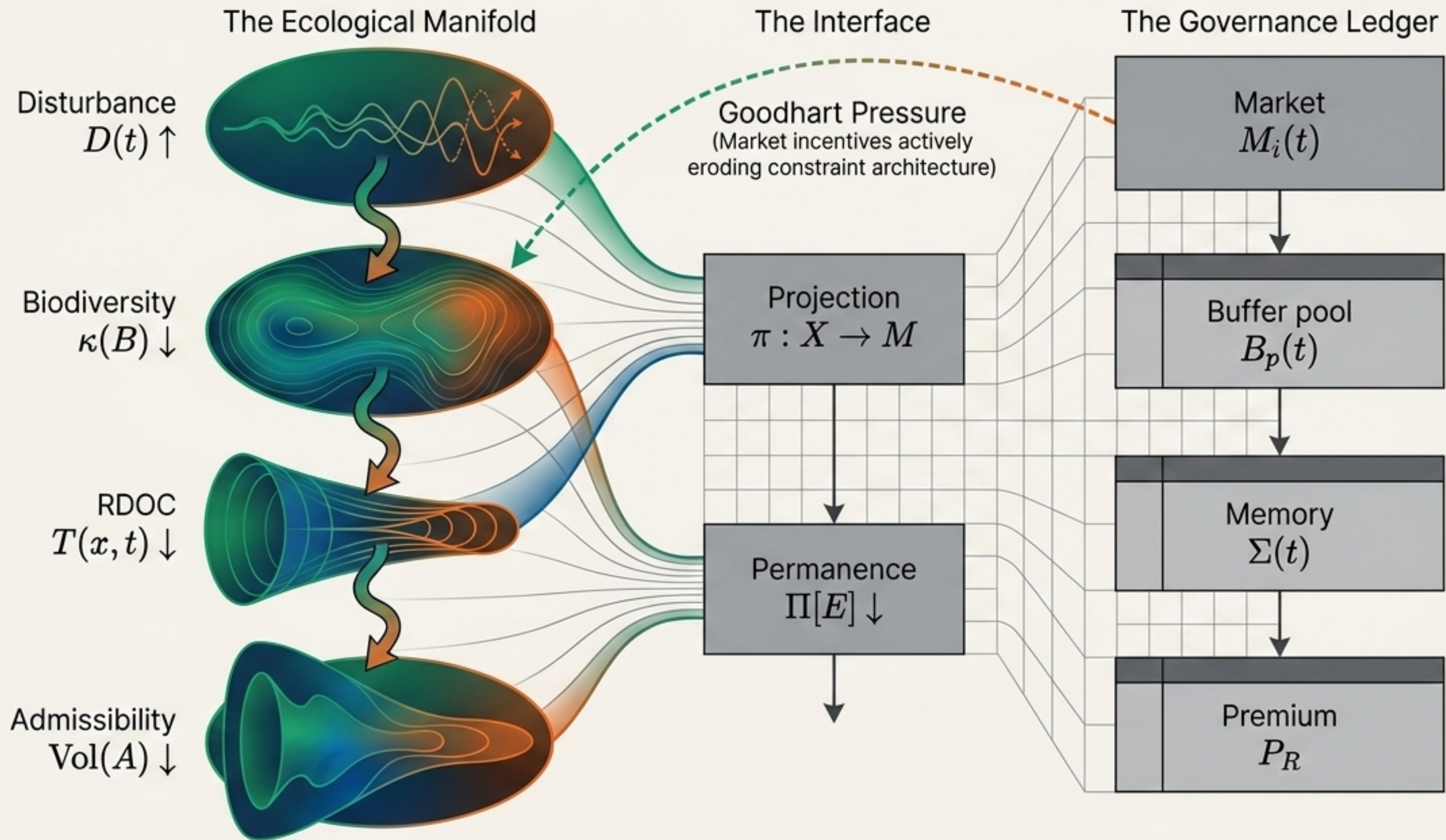
### The Mathematics of Lag

$\tau_{institution} \gg \tau_{ecology}$ . Institutions rely on an institutional memory kernel  $\Sigma(t)$  with slow decay.

### The Consequence

Credits issued inside the Proxy Failure Zone are priced against an admissibility geometry that no longer exists in physical reality.

# The Coupled Socio-Ecological Field



# The Solution: The Resilience Premium ( $P_R$ )

Replacing static reserve functions with a dynamic, self-correcting field operator.

## The Resilience Premium

$$P_R(t) = P_0 \exp(\lambda_1 \Xi_D + \lambda_2 \Xi_B + \lambda_3 \Xi_\Sigma + \lambda_4 \Xi_C)$$

Prices future admissibility maintenance, not past biomass stock.

$\Xi_B$ : Constraint-Channel Erosion

Rate at which biodiversity loss removes independent constraint channels.

$\Xi_D$ : Disturbance Entropy Pressure

Logarithmic contraction rate of resilience-trajectory volume.



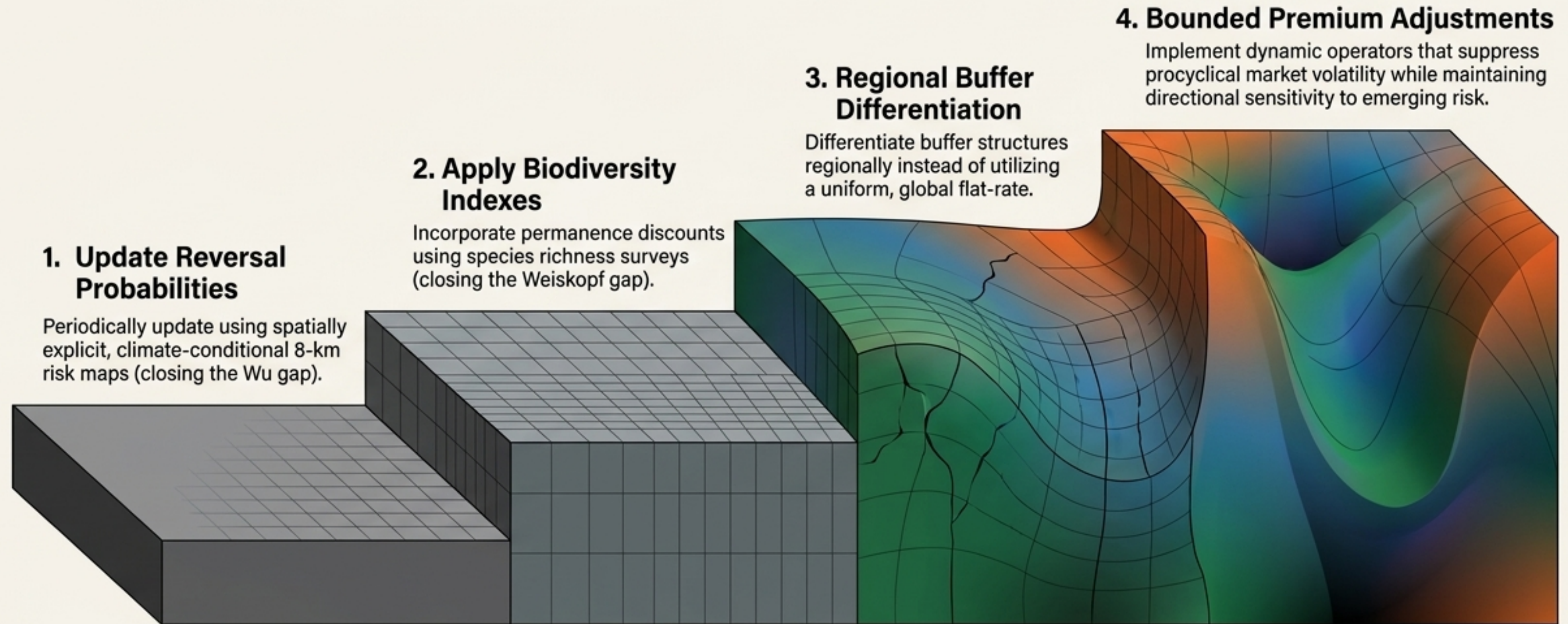
$\Xi_C$ : Contagion Coupling

Systemic fragility propagation across the market network.

$\Xi_\Sigma$ : Governance Entropy

The desynchronization lag between institutional memory and ecological reality.

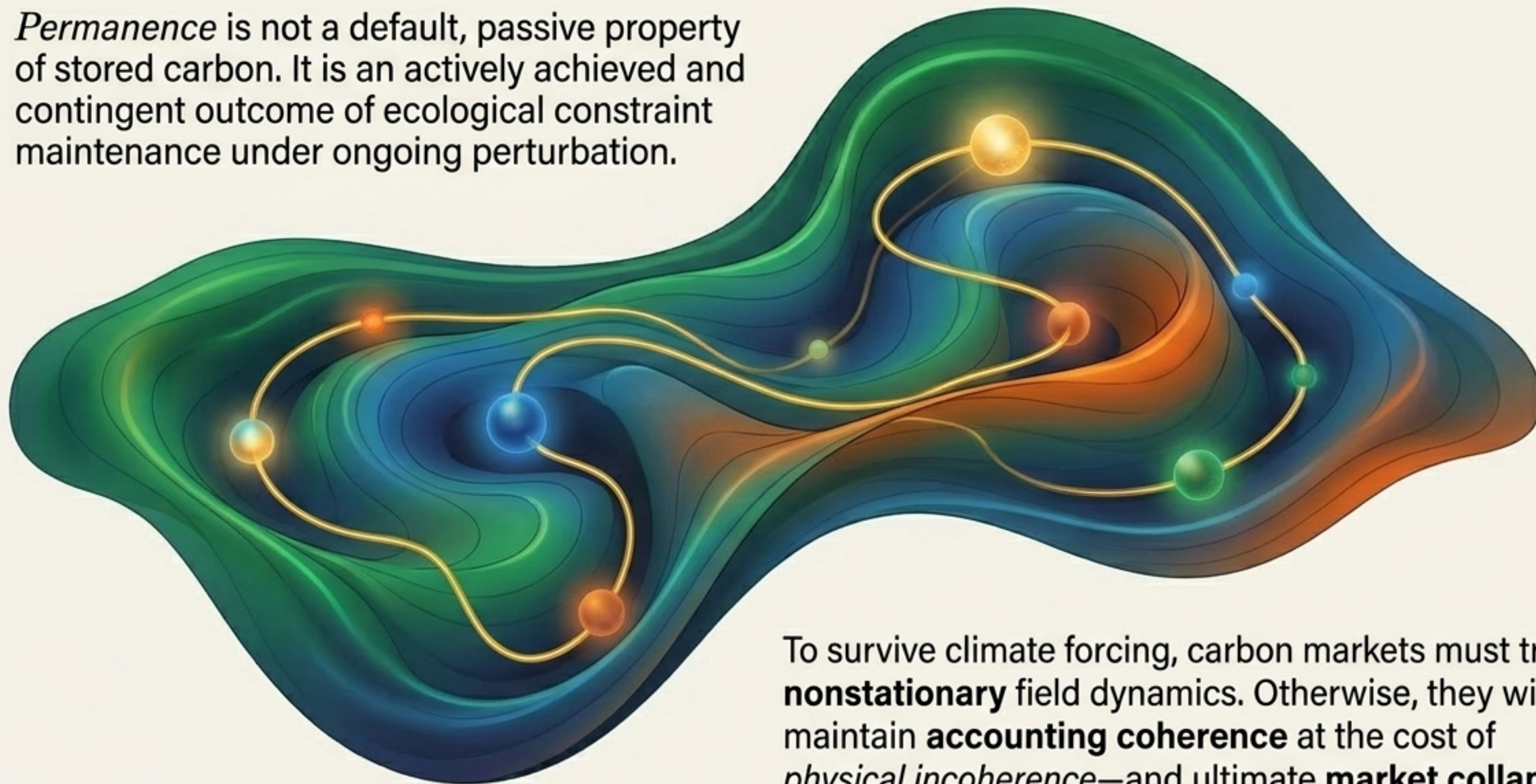
# Bounded Operationalism: A Pathway to Implementation



The framework does not require impossible real-time continuous governance. It requires bounded adaptive updates via a relaxation equation.

# Redefining Permanence

*Permanence* is not a default, passive property of stored carbon. It is an actively achieved and contingent outcome of ecological constraint maintenance under ongoing perturbation.



To survive climate forcing, carbon markets must track **nonstationary** field dynamics. Otherwise, they will maintain **accounting coherence** at the cost of *physical incoherence*—and ultimate **market collapse**.