

Generative Upwelling and Relational Transport: Formal Scope and Analogy Limits

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Abstract

Oceanic upwelling offers a compelling image for a relational process in which changes to surrounding channels and receiving conditions make movement possible for a constrained state. Its scientific use across domains requires a stricter architecture than resemblance alone. This paper reconstructs a minimal physical source model and proposes an analogy-transfer certificate for ocean-inspired relational research. In the source domain, mass continuity under the Boussinesq approximation yields an integrated relation between vertical velocity, an upper boundary value, and horizontal divergence through the water column. A local divergence sign determines a vertical derivative; boundary data and vertical integration determine the resulting velocity. A slab Ekman relation adds wind stress and rotation, while modern coastal-upwelling research adds geostrophic transport, stratification, coastal geometry, mixing, and source-water properties. The proposed certificate records purpose, source and target models, state map, preserved relations, declared disanalogies, open correspondences, observables, comparison models, and failure conditions. Exact commutation carries source trajectories into target trajectories on a declared domain. A vocabulary map alone leaves target dynamics underdetermined. The target construction therefore defines relational upwelling independently through changes in viable receiving paths and finite-horizon access to a declared open region. Six failed mappings separate incompressibility from social conservation, depth from moral rank, buoyancy frequency from generic stability, sea surface from a critical manifold, turbulence from proximity to a tipping point, and vertical compensation from emancipation. The present result is a verified source-domain reconstruction, a heuristic analogy, and a proposed target model. Structural and empirical status remain conditional on mapping, measurement, comparison, and defeat tests.

Keywords: upwelling; Ekman transport; relational transport; scientific analogy; model transfer; boundary conditions; generativity; critical transitions.

Discussion Paper Note

This paper is a preliminary discussion paper intended to share an evolving idea and invite further dialogue, criticism, revision, and independent development. Its definitions, distinctions, and formal constructions remain provisional. Circulation across scholarly and practical communities is part of the purpose of releasing the manuscript at this stage.

The author treats the viewpoints, concepts, and lines of reasoning presented here as contributions to a shared field of inquiry. Similar or related ideas may have appeared in other intellectual, cultural, and disciplinary traditions. The manuscript therefore states its known antecedents, separates the researcher-origin proposal from later formal reconstruction, and leaves historical priority open pending a systematic originality review.

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Status. This working draft records an evolving stage of the author’s position and is circulated for discussion. Definitions, section structure, formal statements, and numbering remain subject to revision. Target-domain empirical validation, historical explanation, moral evaluation, legal analysis, and policy design remain outside its present scope.

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Statement on the use of language models. The exploratory discussions and preparation of this paper involved OpenAI’s Codex. Codex supported exploratory dialogue, formal reconstruction, source discovery followed by website verification, argumentative criticism, and drafting in L^AT_EX. The author selected the research questions, directed and approved the theoretical commitments and epistemic status of the claims, and bears sole responsibility for the manuscript, including its definitions, formal constructions, taxonomy, arguments, conclusions, and errors. Authorship credit remains with the human author. The access level and claim limit for every cited source are recorded in the accompanying literature audit.

Related research programme. This paper is project P017 and the third promoted paper in the research-stage *Generative Injustice* programme. P015 develops a typed lifecycle diagnostic for value circulation, and P016 develops transaction ontology and future-generative positions. The present paper supplies the source-domain and analogy-transfer firewall required before the programme develops its separate criticality-preparation paper. Earlier P004 provides a companion formal-obligation method for topology-bearing claims. Each project states its own premises and revision boundaries.

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1 Introduction

This section establishes the paper’s motivating insight, methodological role, central position, and argument sequence. It first records the researcher-origin relation between generativity and a relational field, then separates the physical source model from the proposed target construction and states the limited thesis defended here.

A constrained state can receive repeated local perturbations while its surrounding system absorbs their effects. An alternative possibility changes the surrounding field: new channels appear, receiving capacity grows, barriers shift, and perturbations acquire pathways through which they can persist. In a research dialogue, Wanhong Huang proposed that relations function as a substrate for value, mechanism, behavior, and norm, and observed that oceanic upwelling may illuminate the relational conditions underlying perturbation-centered escape models. A second intervention in the dialogue distinguished perturbation near a sensitive region from the process through which a system approaches such a region. These two insights motivate the present inquiry.

The attraction of upwelling is precise enough to create risk. In coastal upwelling, winds, Earth’s rotation, coastal geometry, surface-layer transport, continuity, pressure fields, stratification, mixing, and wider circulation jointly shape vertical transport. A phrase such as “creating room above draws states upward” compresses these mechanisms. Moving that phrase into a social or institutional domain can silently import conservation, vertical moral rank, a force law, or a transition theorem. The resulting model may acquire physical vocabulary while retaining an unspecified target mechanism.

Definition 1.1 (Source-target model pair). A *source-target model pair* consists of a source model S with a declared domain and an independently specified target model T . A transfer claim states which objects or relations a partial map $\mu : S \dashrightarrow T$ is intended to preserve, approximate, or use for question formation.

The definition places independent target specification at the beginning of the analysis. The ocean model supplies equations about seawater. The relational model supplies equations or estimands about declared target entities. A mapping connects selected structure after both sides have acquired types.

Claim 1.2 (Transfer-firewall position). Oceanic upwelling currently licenses a verified source-domain reconstruction, a heuristic decomposition of relational transport, and a proposed target model. A stronger structural or empirical classification requires an explicit source-target map, preserved relations, declared disanalogies, target observables, comparison models, and prospective defeat conditions.

The position is affirmative and revisable. It preserves the generative role of analogy while controlling its inferential reach. Four contributions implement it. First, the paper derives the vertical-velocity relation from continuity with the boundary term visible. Second, it places wind-driven Ekman transport inside a wider physical scope. Third, it defines an analogy-transfer certificate and an approximate commutation test. Fourth, it applies the certificate to relational upwelling and records six failed mappings.

Section 2 positions the project within ocean dynamics, transition theory, network modeling, and philosophy of analogy. Section 3 reconstructs the source equations. Section 4 defines the transfer certificate. Section 5 supplies an independent target construction. Section 6 audits failed mappings. Section 7 specifies an empirical promotion programme. Section 8 records research obligations and the provisional position.

2 Source and Method Antecedents

This section locates the proposal within four established research lineages. Its role is bibliographic and methodological: physical oceanography supplies the source model, dynamical-systems research separates transition routes, philosophy and cognitive science supply accounts of analogy and modeling, and network science supplies target-side representational ancestry. Table 1 records the licensed contribution of each lineage.

Ekman’s classical analysis provides an ancestor for wind-driven rotating boundary-layer transport [4]. Modern geophysical-fluid- dynamics texts develop rotating Boussinesq dynamics, stratification, balance, waves, instability, and circulation [12, 17]. Descriptive physical oceanography places these dynamics alongside observed topography, water properties, budgets, forcing, and basin circulation [14]. Thorpe’s treatment of ocean turbulence emphasizes boundary layers, stratified interiors, mixing, dispersion, and energetics [15]. NOAA supplies an accessible account of displaced surface water and compensating rise [11]. Jacox and colleagues show why contemporary coastal-upwelling indices incorporate wind stress, geostrophic transport, mixed-layer structure, model output, satellite data, in-situ observations, and source-water properties [7].

The transition literature supplies a second boundary. Spectral stability can coexist with large transient amplification in non-normal systems [16]. Critical slowing down has defined uses in particular bifurcation settings [13], while fast-slow and stochastic analyses enlarge the mechanism set [8]. Bifurcation-induced, noise-induced, and rate-dependent tipping form distinct routes [1]. These results support a multi-coordinate transition audit and restrain any equation that moves directly from upwelling to generic criticality.

The analogy literature supplies the third lineage. Hesse’s positive, negative, and neutral analogy registers make disanalogy part of disciplined scientific use [6]. Gentner’s structure-mapping account emphasizes relations and systematicity [5]. Morgan and Morrison treat models as mediating instruments between theory and world [9]. Weisberg emphasizes target-directed modeling, idealization, similarity, and robustness [18], while Bartha develops criteria for articulated analogical arguments [2]. The certificate in Section 4 synthesizes these motivations for one bounded project and remains a present- paper construction.

Network science supplies tools for graph structure, dynamics on networks, spectral methods, resilience, and diffusion [10]. These tools make a relational target model possible; they leave the meanings of nodes, edges, states, and interventions to the target domain. The wider generative-justice programme draws on work concerning decolonial transitions and circular value flow [3]. The present paper’s ocean mapping, equations, and certificate remain independently attributable to the present project.

The present paper also has a repository-level companion in P004, which develops a general warrant chain for topology-bearing claims. The current project adds a specialized physical-source reconstruction, boundary-conditioned derivation, source-target commutation test, and failed-mapping audit. This specialization prevents duplication and supplies the source firewall needed by a later paper on relational fields and criticality preparation.

Table 1: Antecedent lineages and their licensed roles in the present argument.

Lineage	Licensed role	Remaining project obligation
Physical oceanography	continuity, rotation, stratification, wind forcing, boundary layers, and observed upwelling complexity	declare approximations, coordinates, boundaries, and omitted mechanisms
Transition dynamics	local stability, transient gain, bifurcation, noise, and rate distinctions	select a target model and transition route
Scientific analogy	positive relations, disanalogies, similarity, mediation, and argument articulation	specify maps, observables, comparisons, and defeat conditions
Network modeling	typed nodes, edges, dynamics, spectra, paths, and diffusion	define target semantics, causal intervention, and measurement
Generative justice	relational value-flow and decolonial research context	establish the exact conceptual relation and originality

3 Source-Domain Transport Model

This section reconstructs the smallest physical source model adequate for the upwelling analogy. It declares coordinates and approximations, derives the vertical-velocity relation from continuity, adds the slab Ekman transport relation, and identifies the additional processes required by coastal oceanography. The derivation concerns an ocean source system throughout.

Let $\mathbf{u} = (u, v, w)$ be velocity in Cartesian coordinates (x, y, z) , with z increasing upward and $\mathbf{k}$ the upward unit vector. Let ρ denote density, ρ_0 a constant reference density, p pressure, f the Coriolis parameter, $\boldsymbol{\tau}$ surface wind stress, and z_s an upper boundary. Table 2 lists the assumptions attached to each formula.

3.1 Continuity and Vertical Integration

This subsection derives the boundary-conditioned vertical transport relation. It begins with compressible mass conservation, specializes to a Boussinesq source model, decomposes the divergence, and performs the vertical integration that the initial dialogue left implicit.

Local conservation of mass is

$$\partial_t \rho + \nabla \cdot (\rho \mathbf{u}) = 0. \quad (1)$$

Under the Boussinesq mass-balance approximation used here, Equation (1) becomes

$$\nabla \cdot \mathbf{u} = 0. \quad (2)$$

Writing $\mathbf{u}_h = (u, v)$ and $D_h = \nabla_h \cdot \mathbf{u}_h$ gives

$$D_h + \partial_z w = 0, \quad \partial_z w = -D_h. \quad (3)$$

Integrating Equation (3) from a depth z to the upper boundary z_s yields

$$w(z_s) - w(z) = - \int_z^{z_s} D_h(z') dz', \quad (4)$$

and therefore

$$w(z) = w(z_s) + \int_z^{z_s} D_h(z') dz'. \quad (5)$$

Table 2: Source-domain assumptions and their analytical functions.

Assumption	Analytical function	Scope consequence
Continuum mass balance	relates density and velocity through a local balance	requires a declared fluid control volume
Boussinesq approximation	uses constant reference density in mass balance while retaining buoyancy effects	supports $\nabla \cdot \mathbf{u} = 0$ in the declared regime
Upward-positive coordinate	fixes signs for w and vertical derivatives	all sign claims inherit this convention
Upper-boundary value	supplies $w(z_s)$ for vertical integration	a rigid-lid example sets this term to zero
Slab Ekman balance	integrates a rotating, wind-driven surface layer	excludes several accelerations, stress details, and coastal corrections
Specified hemisphere and f	fixes rotation-dependent direction	equatorial and variable- f cases require separate treatment

Proposition 3.1 (Boundary-conditioned vertical compensation). *Under Equations (2)–(5), an integrated positive horizontal divergence above depth z makes $w(z)$ exceed the declared upper-boundary value $w(z_s)$. Under the rigid-lid example $w(z_s) = 0$, a positive integral implies upward velocity $w(z) > 0$ at that depth.*

Proof. Equation (5) expresses $w(z)$ as the boundary value plus the divergence integral. The two stated comparisons follow directly from the sign of that integral and the upward-positive coordinate convention. $\square$

The proposition repairs a common compression. The local statement $D_h > 0$ gives $\partial_z w < 0$. A claim about w itself requires vertical integration and a boundary value. The next construction makes this dependence explicit.

Constructed Configuration 3.2 (Shared divergence and distinct vertical velocities). Take a layer $z \in [-H, 0]$ with constant $D_h = d > 0$. Equation (3) admits

$$w_c(z) = c - dz \quad (6)$$

for every boundary value $c = w_c(0)$. At $z = -H$, the choices $c = 0$ and $c = -2dH$ yield $w_0(-H) = dH > 0$ and $w_{-2dH}(-H) = -dH < 0$. The same local horizontal divergence therefore coexists with opposite vertical-velocity signs under distinct boundary values.

The construction gives the paper’s first failed inference in exact form. It also illustrates the general method: source equations gain consequences through their assumptions and boundary data, and an analogy inherits the burden of stating counterparts for any transferred dependency.

3.2 Wind-Driven Surface-Layer Transport

This subsection places continuity within a minimal rotating wind-forcing model. It states the slab Ekman relation, connects its horizontal divergence to a vertical velocity at the layer base, and records the physical processes retained for later refinement.

For nonzero f and reference density ρ_0 , a classical slab relation for depth-integrated Ekman transport is

$$\mathbf{M}_E = \frac{\boldsymbol{\tau} \times \mathbf{k}}{\rho_0 f}. \quad (7)$$

With a specified surface boundary and layer-base convention, the corresponding vertical velocity has the schematic form

$$w_E \simeq \nabla_h \cdot \mathbf{M}_E = \nabla_h \cdot \left(\frac{\boldsymbol{\tau} \times \mathbf{k}}{\rho_0 f} \right). \quad (8)$$

When f is treated as locally constant, Equation (8) can be written through the vertical component of the curl of $\boldsymbol{\tau}/(\rho_0 f)$. Coastal upwelling also involves the shoreline constraint: alongshore wind stress produces an offshore surface-layer transport in the upwelling-favorable orientation, and water from below enters the coastal balance.

Equation (8) is a source-domain idealization. Jacox and colleagues show that a useful coastal index must account for geostrophic transport, spatial wind structure, mixed-layer depth, source depth, nutrient content, observations, and ocean-model dynamics [7]. The analogy consequently gains more from a typed mechanism inventory than from a single arrow between divergence and upward movement.

3.3 Stratification and Stability Scope

This subsection separates ocean stratification from generic dynamical-system stability. It records buoyancy frequency under the chosen coordinate convention and limits its use in the transfer analysis.

For a stably stratified Boussinesq reference state, one common convention is

$$N^2 = -\frac{g}{\rho_0} \frac{d\bar{\rho}}{dz}. \quad (9)$$

With z upward, $N^2 > 0$ corresponds to density increasing downward and supports restoring buoyancy oscillations under the accompanying linearization. This quantity has units of inverse time squared and a specific derivation from density stratification. A target Jacobian spectral abscissa $\alpha = \max \operatorname{Re} \sigma(J)$ is a different mathematical object. Any relation between N^2 and α requires a declared model map. A visual sequence from positive N^2 to zero and from negative α to zero supplies a heuristic comparison whose evidential force is limited to question formation. Identity and transition-law claims require a declared model map and an independent derivation.

The source reconstruction now supports three bounded lessons. Transport depends on field equations and boundaries; vertical compensation requires integrated balance and boundary data; and operational upwelling involves mechanisms beyond continuity. Section 4 turns these lessons into an explicit transfer protocol.

4 Analogy-Transfer Certificate

This section defines the paper’s main methodological construction. It first classifies model status, then specifies the certificate tuple, introduces a commutation error for dynamic claims, and proves two limited results concerning exact transfer and target underdetermination.

Definition 4.1 (Model-status register). A cross-domain proposal occupies one of five revisable registers: *metaphor*, *heuristic analogy*, *structural analogy*, *proposed target model*, or *empirically supported target model*. Each promotion adds explicit objects, preserved structure, target measurement, or comparative evidence.

The registers describe epistemic function. Metaphor can generate a valuable question. A proposed formal target model can remain empirically weak. Structural analogy concerns preserved

Table 3: Model-status registers for cross-domain transfer.

Register	Required specification	Licensed output
Metaphor	source image and rhetorical purpose	orientation and salience
Heuristic analogy	candidate relations and declared disanalogies	research questions and target variables
Structural analogy	typed source and target objects, map, preserved relations, and error domain	conditional cross-model consequences
Proposed target model	target variables, laws, estimands, assumptions, and failure conditions	target-domain hypotheses
Empirically supported target model	identified data link, comparison models, robustness, and bounded replication	domain-limited empirical inference

Table 4: Transfer-certificate fields for the upwelling project.

Field	Present specification	Revision trigger
Purpose P	decompose constrained movement into field, channel, boundary, forcing, and receiving conditions	target use shifts from explanation to prediction or intervention
Source S	rotating Boussinesq ocean model plus coastal-upwelling refinements	additional physical process becomes outcome-relevant
Target T	adaptive relational state model with receiving paths and transition regions	domain-specific entities or laws change
Map μ	candidate relation among pathways, boundaries, transport response, and receiving capacity	typed object lacks a target counterpart
$\mathcal{R}_+$	dynamics depend on surrounding structure; boundaries and forcing alter feasible transport	comparative test rejects the preserved relation
$\mathcal{R}_-$	social quantities lack assumed incompressibility, vertical moral rank, density state equation, and Coriolis force	a target balance law receives independent evidence
$\mathcal{R}_?$	scale separation, path integration, field representation, and transition sensitivity	measurement classifies each item
$\mathcal{O}_T$	paths, edge capacities, barriers, transition times, receiving capacity, and affected outcomes	construct-validity audit changes observables
$\mathcal{N}_T$	actor-attribute, fixed-network, adaptive-network, and rival institutional models	new plausible mechanism enters comparison
$\mathcal{F}$	absent discrimination, unstable mapping, adverse cases, or systematic prediction failure	confidence and status decrease

relations between models, while empirical support concerns the target model’s relation to data. Table 3 records these distinctions.

Definition 4.2 (Analogy-transfer certificate). An *analogy-transfer certificate* is

$$\mathfrak{C} = \langle P, S, T, \mu, \mathcal{R}_+, \mathcal{R}_-, \mathcal{R}_?, \mathcal{O}_T, \mathcal{N}_T, \mathcal{F} \rangle, \quad (10)$$

where P is purpose, S and T are typed source and target models, μ is a partial map, $\mathcal{R}_+$ contains candidate preserved relations, $\mathcal{R}_-$ contains declared disanalogies, $\mathcal{R}_?$ contains open correspondences, $\mathcal{O}_T$ contains target observables and estimands, $\mathcal{N}_T$ contains target comparison models, and $\mathcal{F}$ contains failure and revision conditions.

The certificate turns analogy into an auditable object. Table 4 applies its fields to upwelling. The negative and open registers receive equal visibility with the candidate positive relations.

4.1 Dynamic Structure and Commutation Error

This subsection supplies a precise test for claims that a source evolution and a target evolution share dynamic structure. The construction distinguishes exact commutation, controlled approximation, and vocabulary-level resemblance.

Let Φ_S^t and Φ_T^t be source and target evolution maps over a declared domain $D \subseteq S$, and let d_T be a target metric or discrepancy. Define the finite-horizon commutation error

$$\varepsilon_H(\mu) = \sup_{s \in D, 0 \leq t \leq H} d_T(\mu(\Phi_S^t(s)), \Phi_T^t(\mu(s))). \quad (11)$$

The equation asks whether mapping after source evolution agrees with target evolution after mapping. It requires matched initial conditions, a partial map, a time convention, and a metric. Its value is relative to purpose and tolerance.

Proposition 4.3 (Exact dynamic transfer). *If $\mu \circ \Phi_S^t = \Phi_T^t \circ \mu$ on D for every $t \in [0, H]$, then every source trajectory segment in D maps to a target trajectory segment over that horizon and $\varepsilon_H(\mu) = 0$.*

Proof. For each initial source state $s \in D$ and each admitted time t , the assumed commutation equality identifies the mapped source state with the target state evolved from $\mu(s)$. The discrepancy in Equation (11) is zero pointwise, so its supremum is zero. $\square$

Proposition 4.3 is mathematical and limited. A contrived encoding can commute while carrying little explanatory value. Purpose relevance, measurement, robustness, and comparison therefore remain separate certificate fields.

Proposition 4.4 (Vocabulary-level target underdetermination). *Suppose a source description and a vocabulary map assign the same labels to two target models T_1 and T_2 , while their transition laws produce distinct trajectories for at least one mapped initial condition. The source description and vocabulary map leave the target transition law underdetermined.*

Proof. Both target models satisfy the supplied premises because those premises contain only the shared labels. Their predictions differ by assumption. Selection of one transition law therefore requires an additional structural, empirical, or causal premise. $\square$

The result formalizes a recurring analogy error. Calling both a coastal current and an institutional pathway a “flow” leaves open whether the target obeys a conservation equation, a diffusion law, an optimization rule, a strategic game, or an adaptive network law. Section 5 supplies one independently typed candidate.

5 Relational Target Construction

This section defines the proposed target model and its current evidential status. Its role is constructive: it translates the motivating insight into target variables, intervention contrasts, and measurable pathways while preserving the transfer firewall established above.

Let $X_t \in \mathcal{X}$ be a declared actor, organizational, or institutional state; $R_t \in \mathcal{R}$ a typed relation or network configuration; $C_t \in \mathcal{C}$ a vector of resources, rules, barriers, and receiving capacities; $q \in \{0, 1\}$ a coherent relational intervention; and W_t a Wiener process when stochastic variation forms part of the target model. One adaptive family is

$$dX_t = f(X_t; R_t, C_t) dt + B(X_t, R_t, C_t)q dt + \Sigma(X_t, R_t, C_t) dW_t, \quad (12)$$

$$\dot{R}_t = g_R(R_t, X_t, C_t, q), \quad \dot{C}_t = g_C(C_t, R_t, X_t, q). \quad (13)$$

Equations (12)–(13) belong wholly to the target domain. They permit relation change, source and sink effects, strategic intervention, stochastic variation, and feedback. Their generality also creates an identification burden; an application must select state meaning and functional form.

Let $\mathcal{O}_i \subseteq \mathcal{X}$ be a declared region in which actor i has access to specified branches or receiving relations. For horizon H , define

$$U_i(R, C; H) = \mu_i(\text{Reach}_i^H(R, C) \cap \mathcal{O}_i), \quad (14)$$

where μ_i is a declared measure, vector report, or partial-order object over viable paths. The relational-upwelling contrast is

$$\Delta_U(H) = \mathbb{E}[U_i(R^{(1)}, C^{(1)}; H)] - \mathbb{E}[U_i(R^{(0)}, C^{(0)}; H)]. \quad (15)$$

If $\tau_{\mathcal{O}_i}$ is the hitting time of the open region, a second target estimand is

$$\Delta_{\mathcal{O}}(H) = \Pr(\tau_{\mathcal{O}_i} \leq H \mid do(q = 1)) - \Pr(\tau_{\mathcal{O}_i} \leq H \mid do(q = 0)). \quad (16)$$

Definition 5.1 (Relational upwelling). *Relational upwelling* names a candidate target mechanism in which a persistent change to receiving capacity, external channels, coupling topology, barriers, or relevant resources increases viable access from a constrained position to a declared open region, as measured by target-domain contrasts such as Equations (15)–(16).

The definition preserves the researcher’s core insight: change in the relational field may precede effective perturbation. It also replaces vertical motion with target-defined access. A receiving region may contain employment, housing, knowledge, institutional, communicative, market, or organizational paths in a specified study. Each path requires actual accessibility, persistence, and a declared affected party.

Claim 5.2 (Current classification). The ocean-to-relational comparison currently has heuristic-analogy status, and Equations (12)–(16) have proposed-target-model status. Structural-analogy status depends on a completed certificate and a defended preservation relation; empirical status depends on identified target evidence and comparative tests.

Network theory makes the target representation mathematically ordinary [10]. The distinctive hypothesis concerns the intervention contrast: relation and receiving-capacity changes may explain altered access better than actor-attribute change alone. The ocean analogy motivates this hypothesis, while target data determine its fate.

The relation to criticality remains deliberately limited. A change in R or C may alter local spectral recovery, basin geometry, finite-time gain, stochastic transition probability, or path accessibility. These coordinates can move separately. The later criticality-preparation paper will compare them through a declared toy system and sensitivity analysis. The present paper supplies the source and mapping prerequisites for that work.

6 Failed Mappings and Type Boundaries

This section applies the negative-analogy register to six recurrent transfer errors. Its role is diagnostic: each failed mapping names the source object, the unsupported target inference, the reason for failure, and the repair that would create a legitimate target question. Table 5 provides the compact audit.

Table 5: Failed ocean-to-relational mappings and their repair obligations.

Source object	Unsupported target inference	Type failure	Repair
Incompressibility	conserved social value, opportunity, or generativity	target quantities may be created, copied, transformed, destroyed, and redistributed	specify a balance law with source and sink terms
Vertical coordinate	upward movement carries moral improvement	physical orientation and normative ranking are different relations	define target standing, effects, participation, and evaluative criteria
Buoyancy frequency N^2	direct identity with a generic Jacobian eigenvalue	units, variables, derivations, and model classes differ	construct and test an explicit map between declared models
Sea surface	literal critical manifold or basin boundary	a material interface and a dynamical threshold have different definitions	define the target set and transition criterion independently
Ocean turbulence	perturbations matter only near one critical point	turbulence has multiscale transport and dissipation across regimes	specify the target noise, nonlinear coupling, scale, and transition route
Compensating rise	new receiving capacity guarantees emancipation	access can remain unusable, imposed, unsafe, or capture-prone	estimate viable access and audit safety, plurality, and distribution

6.1 Balance and Replication

This subsection isolates the conservation error. Equation (2) expresses a physical approximation for fluid velocity. Social value and knowledge can replicate, while opportunities can emerge or disappear through institutions. Persons can enter or leave the modeled domain, and one party’s movement may transform another party’s options. A target balance equation is possible when its stock, flow, production, destruction, and boundary terms are independently defined. The ocean equation supplies a question about balance. A target conservation law requires its own definitions, premises, and evidence.

6.2 Orientation and Evaluation

This subsection separates coordinate direction from moral judgment. Ocean depth is measurable relative to a datum. A constrained social position may involve high status, low visibility, centrality, isolation, privilege, dependency, or a mixture. Mapping “up” to improvement imports an ordering absent from the coordinate itself. Equation (14) uses a declared open region and viable-path measure, followed by a distinct normative profile. This repair also allows a transition to receive an adverse evaluation.

6.3 Stability and Transition

This subsection separates three compressed analogies. Buoyancy frequency, spectral abscissa, and basin distance arise from different models. A sea surface is a physical interface; a critical manifold is a model-defined set. Turbulence is multiscale nonlinear motion with transport and dissipation; proximity to a local bifurcation is one condition among many. The source and transition literatures therefore support a vocabulary of distinctions, while the target model supplies its own route.

6.4 Accessibility and Normative Status

This subsection separates increased access from emancipation. A new receiving node can demand exploitative terms, increase surveillance, externalize burdens, or replace one dependency with another. A route can exist formally while costs, credentials, risk, disability, family obligations, or discrimination make it unusable. The safety profile should include viability, plurality, participation,

reversibility, distribution, and cascade exposure. Positive Δ_U or Δ_O then records one dynamic result within a wider assessment.

Constructed Configuration 6.1 (Receiving-capacity counterexample). An intervention adds a target node j and an edge (i, j) , increasing nominal network reach. Access requires a fee above actor i 's feasible resources, so the viable path set in Equation (14) remains unchanged. Graph expansion and effective receiving access therefore diverge.

Constructed Configuration 6.2 (Accessible capture counterexample). An intervention creates a feasible path from i to a new institution and makes $\Delta_U(H) > 0$. The institution acquires exclusive control over portable records and later blocks exit. Initial receiving access and durable plurality therefore diverge.

The two constructions supply target-side defeat cases. They also show why an oceanic compensating-flow image, even when physically accurate, settles only a question about source transport.

7 Comparative Empirical Programme

This section specifies the evidence needed to promote relational upwelling beyond its current status. It organizes study domain, intervention, measurement, comparison, robustness, and defeat tests into one prospective design. The method favours comparisons capable of lowering confidence in the proposed mechanism.

A study must select one bounded domain, such as credential portability within a profession, transition between organizational infrastructures, access to an independent knowledge network, or entry into an alternative market. The unit of analysis, edge types, receiving capacities, barriers, time horizon, and affected parties should be fixed before estimation. Historical and decolonization cases carry additional historiographic and causal burdens and therefore remain beyond the present first test.

Let M_0 be an actor-attribute model, M_1 a fixed-network diffusion model, M_2 the adaptive receiving-pathway model in Equations (12)–(16), and M_3 a domain-specific rival such as price change, selection, strategic sorting, or administrative reform. The relevant empirical question is whether changes in R and C improve explanation or prediction of viable access beyond these alternatives. Table 6 states the minimum design.

Definition 7.1 (Empirical promotion profile). The empirical promotion profile is the vector

$$\mathbf{E} = \langle \text{construct, identification, discrimination, robustness, replication, safety} \rangle. \quad (17)$$

Each coordinate receives its own evidence statement and uncertainty. Promotion uses a declared rule over the profile.

The vector protects against a single attractive fit. A model can predict while using an invalid construct, identify a local contrast while lacking replication, or improve access while producing capture. The certificate and promotion profile serve complementary roles: $\mathbf{C}$ governs the source-target inference, and $\mathbf{E}$ governs target empirical maturity.

Research Obligation 7.2 (Prospective failed-mapping test). The first empirical study should include at least one intervention that expands nominal network reach while leaving viable receiving access stable, and one intervention that increases access while worsening a safety coordinate. These cases test the distinction between topology, accessibility, and normative status.

Table 6: Minimum comparative programme for empirical promotion.

Design component	Required record	Defeat or revision signal
Target construction	typed nodes, edges, capacities, barriers, states, and horizon	unstable meaning across coders or cases
Intervention	complete feasible arrangements for $q = 1$ and $q = 0$	hidden co-intervention drives the contrast
Outcomes	viable paths, time to access, persistence, exit, and affected-party effects	nominal reach changes while effective access remains stable
Comparison	M_0 , M_1 , M_2 , and at least one domain-specific rival	adaptive relation model adds negligible discrimination
Robustness	alternative edge rules, horizons, missing-data models, and negative controls	effect changes sign or disappears under plausible specifications
Normative profile	viability, plurality, participation, reversibility, distribution, and capture	dynamic access accompanies unacceptable effects

Research Obligation 7.3 (Source-model sensitivity). Any manuscript invoking coastal upwelling as more than an orienting analogy should test whether its claimed lesson survives the addition of geostrophic transport, stratification, coastal geometry, mixing, and boundary variability.

These obligations make failed mappings productive. A failed correspondence can refine the target question, reduce the claimed status, or retire the analogy while preserving an independently useful target model.

8 Research Obligations and Conclusion

This section consolidates the remaining obligations and states the paper’s revisable position. It moves from physical specialist review through mapping and target identification to normative and originality audits, then summarizes the limited result achieved by the first draft.

Research Obligation 8.1 (Physical specialist review). Review the coordinate conventions, Boussinesq scope, continuity integration, Ekman transport sign, coastal-boundary interpretation, stratification language, and omitted-mechanism table with a physical oceanographer.

Research Obligation 8.2 (Transfer-map specification). For each target application, complete every field of $\mathfrak{C}$, define the domain of μ , state the preserved relation, estimate or bound ε_H , and record the positive, negative, and open analogy registers.

Research Obligation 8.3 (Target identification). Select one empirical domain and identify Equations (15)–(16) under declared interference, feedback, selection, timing, missing-data, and measurement assumptions. Compare the adaptive receiving-pathway model with actor-attribute, fixed-network, and domain-specific rivals.

Research Obligation 8.4 (Criticality separation). Reserve claims about approach to criticality for a specified transition model that separates local spectral recovery, basin geometry, finite-time gain, stochastic escape, and rate effects. Complete this work in the ‘GJ-P05’ project.

Research Obligation 8.5 (Normative firewall). Evaluate transition accessibility separately from harm, injustice, exploitation, responsibility, and legal wrong. Include affected-party standing, participation, plurality, distribution, reversibility, and capture risk.

Research Obligation 8.6 (Originality and tradition). Extend the literature review across physical-to-social analogy, circulation and transport metaphors, network diffusion, relational sociology, generative justice, capability, infrastructure, and institutional exit. Identify equivalent prior frameworks and revise originality language accordingly.

The initial insight concerned a change in theoretical depth. Spark and turbulence models begin with a perturbation and ask how it propagates or explores. Upwelling directs attention to the field, boundary, forcing, and receiving structure through which movement becomes possible. The source-domain reconstruction confirms that oceanic vertical transport depends on an integrated balance and boundary data, and that wind-driven coastal upwelling contains substantially more structure than continuity alone.

The transfer certificate preserves that insight while controlling its reach. Purpose, source, target, map, positive relations, disanalogies, open correspondences, observables, comparisons, and failure conditions become parts of one auditable object. Exact commutation has a clear mathematical consequence. Vocabulary-level resemblance leaves target evolution open. These two elementary results locate the boundary between structural transfer and evocative language.

Relational upwelling therefore remains a productive and disciplined proposal. It names a target hypothesis in which changes to receiving capacity, external channels, topology, barriers, or resources alter viable access from a constrained position. Its target equations permit independent estimation and defeat. The ocean source supplies questions, distinctions, and candidate structure; target evidence supplies empirical standing.

The wider philosophical implication is modest. Generative activity unfolds through fields of relation, access, constraint, and reception. A theory that tracks only actor capacity can overlook the medium through which capacity becomes effective. A theory that imports the ocean wholesale can overlook the types and agency of its target. The transfer firewall keeps both insights in view and leaves each revision route explicit.

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