

Climate Complexity Patterns — Methodology

Version 1.0 · work in progress, open for comment · Oct 23, 2026 · @Hakim

About this version

This is version 1.0 of the methodology. It is a work in progress, published so that anyone can comment on it and suggest improvements. It describes the atlas as built on 22 October 2026 (atlas v0.9, data to 2024). Points not yet settled are shown openly and listed in §16; they do not hold up the rest.

- **Expert review.** Qualified reviewers are invited to read the whole document or one section. Each section opens with a status tag (Settled, Draft or Open) so it can be read on its own.
- **Corrections.** Anyone who finds an error, an inconsistency or a missing source can write to contact@climatecomplexitypatterns.org. Corrections are logged in §17.
- **Independence.** The atlas is an independent instrument. It is not produced for, funded by or endorsed by any organisation the author works for.
- **How it is built.** Satellite observations are processed in Google Earth Engine. A Python data pipeline reads the public sources and composes the atlas data. The site is a static web application served on Cloudflare, with invitation-only pages behind Cloudflare Access and a read-only connector (Model Context Protocol) for AI assistants. Code and data steps live in a version-controlled repository with automated tests at every change. AI agents write and test code and draft text under the author's direction. A second AI model reviews every method or data change. The author reviews and decides every change before it is published.
- **Cite as.** Climate Complexity Patterns, an independent climate adaptation atlas (2026). Methodology version 1.0. <https://climate-complexity-patterns.hakimhadjel.workers.dev> · CC BY 4.0.

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Overview

The Atlas of Climate Complexity Patterns asks one question of every place: when the climate shock lands, who, if anyone, absorbs it — nature, people, or nobody — and does adaptation money follow the absorber? Risk indices answer "how bad"; finance trackers answer "how much". Neither shows who holds the shock or whether money builds, relies on, replaces or borrows against what holds it.

What the atlas does. It reads three recognised lines of evidence — climate exposure, nature near settlements and multidimensional poverty — side by side for 248 places, and reads adaptation finance from the OECD Creditor Reporting System against them. The lines are never merged. Fixed, published rules place each place in one of five territories (who holds) and in up to five money patterns (how money relates to the absorber). Every value carries a label (Reported, Observed, Estimated, Interpreted), a source and a date. Where a source is silent, the place says why.

What it does not do. It does not rank places, give a single score, judge the effectiveness of any project or fund, set allocations, or state maladaptation. It is indicative and exploratory: it shows where to look more closely.

Key choices.

- Triangulation of independent lines instead of a composite index (§6).
- One reading order for every place: the shock → who holds → where it is heading → does money follow (§7).
- Medians as cut-points, recomputed at each build and held fixed across years (§8, Annex A).
- Adaptation money counted as a floor: Rio marker principal only on the receiving side, never mixed with significant (§C4).
- Gaps shown as findings, each with a named reason (§10).
- Measurement only as precise as the question needs — optimal ignorance and appropriate imprecision (§3).
- People decide; AI widens capacity. AI helps draft readings, check data and answer questions through the connector, but it never replaces human judgement. The rules are fixed and published. Machine-drafted readings are labelled as such and held for human review when confidence is low. The author is accountable for what is published (§10, §13). This follows the [UNESCO Recommendation on the Ethics of Artificial Intelligence](#) (2021, adopted by 193 member states), which holds that responsibility for AI systems must always rest with people. It also follows [UN General Assembly](#)

[resolution 78/265](#) (2024) on safe, secure and trustworthy AI for sustainable development. And it shares the capacity-building aim of the UNFCCC’s AI for Climate Action initiative, which supports developing countries’ own use of AI.

What the 2024 reading shows (atlas v0.9, data date 22 October 2026). Of 248 places, 181 carry a territory; 11 sit at the severity anchor — high exposure, little nature nearby, high poverty and adaptation money below the median: Afghanistan, Angola, Benin, Burundi, Chad, Haiti, Lesotho, Pakistan, Sudan, Uganda and Yemen.

Open questions. Eleven points remain open and are listed in §16, among them whether “unprotected” claims too much, whether low poverty can stand for “protection by people”, and the effect of median cut-points. They are stated where they bite, not hidden.

What it adds. Risk indices such as ND-GAIN, INFORM and the WorldRiskIndex show where risk is high and how countries compare. Finance trackers from the OECD, UNEP and the Climate Policy Initiative show how much money flows and against what need. The atlas builds on both and adds what they were not designed to show: how the pieces combine in each place — who holds the shock, and whether money meets it before or after. It is offered as a contribution to complexity thinking and systems design in climate adaptation, with openly licensed data, methods and tools that anyone can use, test and build on.

Reader's guide

The document has five parts and six annexes. Part 1 says what the atlas is for and where it stands among existing instruments; Part 2 sets out the design; Part 3 documents each line of evidence on a fixed card; Part 4 tests how far the results can be trusted; Part 5 states how the atlas should and should not be used. A reviewer short of time can read the Overview and one row below.

If your field is...	Read	We especially ask
Climate adaptation policy and practice	§1–§2, §7, §9, §14–§15	Does the question matter, and is the reading order useful for decisions?
Complexity, resilience and systems thinking	§2–§3, §9, §15	Is “complexity assets” sound, and are the patterns fair readings of feedback structures?

If your field is...	Read	We especially ask
Indicator and index construction	§4–§6, §8, §11–§12, Annex A	Is a scoreboard without aggregation defensible, and are the cut-points warranted?
Climate science and hazards	C1, C7	Are the hazard direction rules sound and stated with the right caution?
Ecology, land cover and remote sensing	C2, C6	Is nature near settlements a fair proxy for an ecological buffer?
Poverty and human development	C3, §8	Can low multidimensional poverty stand for a human buffer?
Development and climate finance	C4, C5, C8	Are the Rio-marker basis and the "floor" reading correct?
Data, reproducibility and open science	§10, §13, Annex B	Can the results be reproduced from the published sources?

Section status: **Settled** = decided and built; **Draft** = written, open to comment; **Open** = a question still being worked, listed in §16.

Part 1 • Concept

1. Purpose, users and the decisions it serves

Status: Settled.

The atlas is a lens for asking the right question about a place — what holds there, what kind of support fits, and when it should arrive. It is not an allocation tool, and it does not say where money should go.

It serves four audiences. The first three are listed in order of priority; the fourth cuts across them:

- 1. Government teams and the technical advisers beside them** — what protects us, and what are we drawing down? Protect what holds; shift spending from response to prevention; seek grant terms; cross-check what is reported against the Belém Adaptation Indicators.
- 2. The accountability community** — researchers, civil society: is money meeting the absorbers, and where does the data system go blind?

3. **Funds, multilateral development banks and donors** — portfolio questions: is money replacing what could have been built, or relying on nature that nobody pays to keep? A lens on the system, never an assessment of any one fund.
4. **Executives and senior decision makers** across all three — where should we look closer, and what is shifting? The Strategic Signals and the quarterly Strategic Outlook provide a short, signal-first reading of where lines diverge, where the data system goes blind and where patterns shift, each with its evidence. It points to where to look, never to where money should go. The atlas works on mobile, so it can be used on the move. Readers can also connect their own AI assistant to it through the read-only connector (MCP).

Education runs through all four: the atlas moves the reader from a score to a configuration, from need as a gap to assets that absorb, and from certainty to calibrated confidence stated in the calibrated language the IPCC uses.

2. The question: who absorbs the shock

Status: Settled.

When the climate shock lands, who, if anyone, absorbs it — nature, people, or nobody — and does money follow the absorber?

The problem. Adaptation is read through two lenses, and neither shows how a place holds when a shock arrives. Risk and vulnerability indices (ND-GAIN, INFORM, the WorldRiskIndex) answer "how bad is it here?" by folding hazard, sensitivity and capacity into one ranked score, which hides the mechanism. Finance tracking (OECD Rio markers, the UNEP Adaptation Gap Report, Climate Policy Initiative) answers "how much money, against what need?" but not what the money meets on the ground. The policy moment sharpens this: COP30 adopted 59 voluntary Belém Adaptation Indicators and called for adaptation finance to triple by 2035. Triple, to whom, and for which absorber?

Thesis. A place withstands a climate shock when something absorbs it: living systems near where people live (ecological complexity assets) or people's own capabilities (human complexity assets). Where neither is present under high exposure, the shock passes through to lives and is answered after the fact. Reading which absorber works, and how money meets it, reveals patterns that risk scores and finance totals hide. Because the patterns are emergent, the lines are read against each other and never merged.

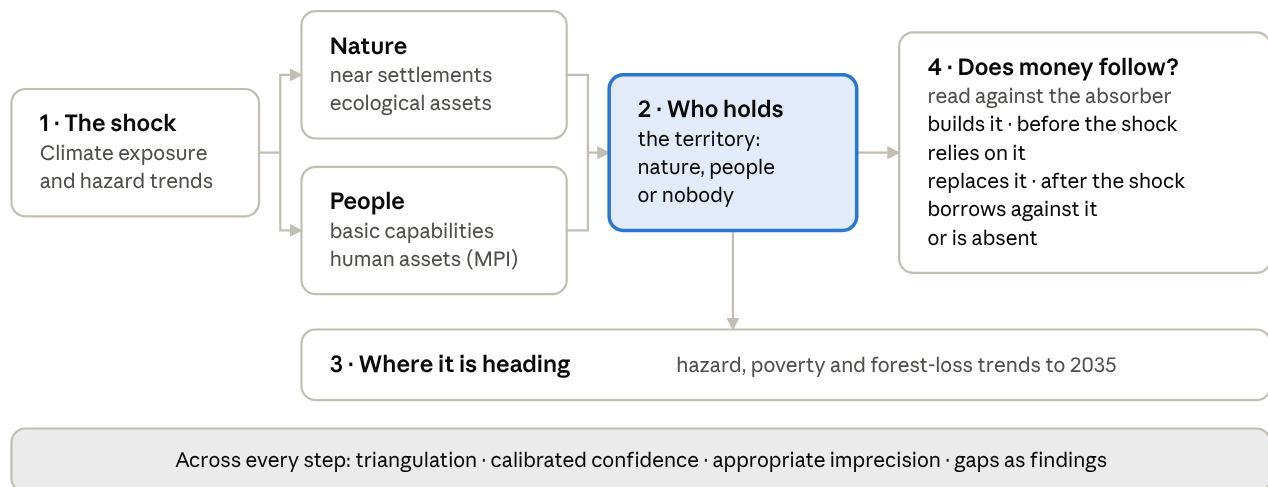
Sub-questions.

1. Where does high exposure meet no buffer?
2. Where is nature carrying the load, and is anyone paying to keep it?
3. Where are people's capabilities carrying it, and on what terms?
4. Where is risk lower today but protection missing?
5. Does money arrive before or after the shock?
6. How did these patterns form, and where are they heading if trends continue?
7. Underneath: where does the data system itself go blind?

Not asked, because they are not the purpose of the atlas: rankings, effectiveness verdicts, the absolute adequacy of finance, maladaptation verdicts.

The framework in one line. The shock meets two absorbers; their configuration says who holds (the territory); money is read against that absorber (the pattern); time shows where it is heading. Across all of it: triangulation, calibrated confidence, appropriate imprecision, and gaps as findings.

Shock meets two absorbers; money is read against the one that holds



conceptual framework · the four steps of every reading

The numbers give the reading order of §7; the territory (highlighted) is what the money patterns are read against.

3. Grounding

Status: Draft — references to be checked against the originals before v1.1.

Complexity assets. The two absorbers are complexity assets. They differ from the five capitals of the sustainable livelihoods framework (Chambers and Conway 1992) in four ways:

- **Configuration, not stock.** A mangrove belt protects because it is continuous between sea and village, not because of its hectares.
- **Slow variables.** Decades to build, a season to lose (Walker and Salt 2006). The asymmetry is the core of the concept.
- **Collective and place-bound.** They cannot be moved or bought quickly.
- **Invisible until they fail.** Protection is a by-product, absent from budgets and indices.

The anchor is the set of principles for building resilience in social-ecological systems (Biggs et al. 2012): diversity and redundancy, connectivity, slow variables and feedbacks, learning, participation and polycentric governance. Two are observed today: nature near settlements (by satellite) and basic capabilities (the Global MPI, grounded in Sen's capability approach; Alkire and Foster 2011).

Supportive and aggravating complexity. The same connectedness can absorb a shock or spread it. The IPCC Sixth Assessment Report names the aggravating side compound and cascading risk (AR6 WGII, SPM B.5). Complexity assets are the supportive side. The claim is not that complexity is good, but that some structures turn connectedness into absorption. Aggravating complexity, the reverse side of complexity assets, is named in readings and never scored.

Triangulation. Each line comes from an independent, recognised public source. Agreement between lines raises confidence; disagreement is a finding to report, not data noise to average away.

Optimal ignorance and appropriate imprecision (Chambers 1997). The atlas measures only as precisely as the question needs. It prefers a robust class (above or below a median) to a false decimal, and an honest gap to an imputed value. The same principle keeps part of the atlas exploratory and experimental. It leaves room to learn from how people use it, to revise assumptions, and to adjust its methodological and ontological standpoint as we discover where it adds value, whom it serves, and how it helps them learn or do a better job.

The IPCC AR6 risk framing. Risk arises from hazard, exposure and vulnerability. The four lines map onto it: climate exposure (hazard and exposure); nature near settlements (ecosystems); multidimensional poverty (human society); and finance as an enabling condition. Confidence uses IPCC calibrated language (§10).

Patterns as traces of feedback. Each money pattern is read as the trace of a feedback structure known from systems thinking (Senge 1990): shifting the burden, an unpriced subsidy with a threshold, borrowed resilience, hidden risk. The atlas observes the trace and states its confidence; it never proves the loop. The severity anchor, and complexity assets as a reading lens, remain the centre of gravity of the atlas.

4. Related instruments and what this adds

Status: Draft.

The atlas is not another index. It is a systems lens across existing instruments. Each of them measures one part of the system — hazard, ecosystems, poverty or money. The atlas reads how those parts interact, and the configurations that emerge from the interaction, which no single measure can show. It uses several of these instruments as inputs and keeps them independent. Where indices aggregate and trackers total, the atlas reads emergence.

Instrument family	What it answers	What this atlas adds
ND-GAIN, INFORM Risk, WorldRiskIndex	How at risk is a country? A composite score, ranked	Uses exposure only, never the composite; asks who holds, not how bad
UNEP Adaptation Gap Report , Climate Policy Initiative, OECD Rio markers, Climate Funds Update	How much money flows, against what need?	Money read against the absorber and its timing (before or after the shock)
Belém Adaptation Indicators, National Adaptation Plans, Biennial Transparency Reports	What do countries report on progress?	An independent cross-line reading; country voices sit beside it, never replaced
Global Forest Watch, Global Mangrove Watch	What condition is nature in?	Nature tied to where people live and read as a buffer
OPHI Global MPI climate overlay (2025)	How many poor people face climate hazards?	Adds the nature buffer, finance, and who holds

What is new, in three points. First, capacity is read as assets that absorb rather than as a deficit. Second, nature and people are read as alternative absorbers of the same shock. Third, finance is read against the absorber that the climate shock meets, which turns a total into a pattern: money that builds, relies on, replaces or borrows against what protects a place, or never arrives.

Open (§16, Q7): a fuller comparison table, with each instrument's coverage, update cycle and treatment of missing data, after expert input.

Part 2 · Design

5. Lines of evidence and how they were chosen

Status: Settled.

Three lines of evidence decide who holds; finance is read against them; an ocean layer gives context only.

Line	IPCC AR6 system	Source	Label	Role
Climate exposure	Hazard and exposure	ND-GAIN exposure score; hazard direction from ERA5 and CMIP6 via the World Bank CCKP	Reported	Question 1 of the territory
Nature near settlements	Ecosystems	ESA WorldCover 2021 and GHSL 2020 at 100 m; direction from Hansen Global Forest Change	Observed	Question 2
Multidimensional poverty	Human society	Global MPI 2025 (UNDP-OPHI)	Reported	Question 3
Adaptation finance	Enabling condition	OECD Creditor Reporting System	Reported	The money patterns
Ocean temperature	Context	Copernicus Marine (OSTIA)	Observed	Never decides a territory or pattern

Selection criteria. Each line had to be (1) a recognised public source with a stated method, (2) global in coverage or explicit about its gaps, (3) openly licensed or citable, (4) repeatable at each data refresh, and (5) as independent as possible of the other lines.

What was left out, and why.

- **ND-GAIN vulnerability and readiness.** Vulnerability contains sensitivity and adaptive capacity, which overlap with poverty: across 108 countries it correlates with the MPI headcount at Spearman $\rho = 0.74$, against $\rho = 0.37$ for exposure alone. Readiness is never read or stored.
- **Income per person.** It would make the atlas a wealth map.
- **Disaster losses.** They are an outcome, not an absorber, and are reported unevenly.
- **Shrubland and grassland as protective cover.** Tested and rejected as a uniform fix (C2).

6. Why no single score

Status: Settled.

The atlas is a scoreboard, not a composite index. The European Commission's guide to composite indicators recognises both forms. A composite needs normalisation, weights and an aggregation rule; a scoreboard keeps its indicators apart. The atlas takes the second road on purpose, for three reasons.

1. **The question is about configuration.** Who holds the shock depends on the combination of conditions, not on their total. Two places can get the same score for opposite reasons: one with deep nature and high poverty, the other with little nature and low poverty. A single score makes them look alike; the atlas shows them as different situations that call for different support.
2. **Compensation would mislead.** In a composite, deep nature can offset high poverty. For adaptation that is false: a forest does not feed a household.
3. **Weights would be arbitrary here.** No defensible rule says how much nature equals how much capability.

What replaces aggregation: fixed rules that place each place by the combination of its lines (§8–§9); one colour layer at a time on the map, so lines are not visually blended (open point, §16 Q5); and twelve published rules, among them no single score, no ranking, and lines kept independent.

7. Reading order

Status: Settled.

Every reading of every place follows the same four steps. The country card, the machine readings and the connector answers all keep this order.

1. **The shock** — how exposed is the place?
2. **Who holds** — nature, people, or nobody (the territory).
3. **Where it is heading** — hazard, poverty and forest-loss directions.
4. **Does money follow** — the money pattern, where finance data exists, or a named reason.

Steps 1–3 exist for every place with a territory. Step 4 is added where finance data exists. Patterns are a lens switched on one at a time, not the default story.

8. Territories: who holds

Status: Draft — names and the median rule are open (§16 Q1–Q3).

Three questions, asked in order, place each place in one of five territories.

- 1. Is climate exposure high? Yes at or above the median of covered places in 2024.
- 2. Is nature near settlements deep? Yes above the median of observed places.
- 3. Is poverty high? Yes when the MPI headcount is 20% or more. Asked only when 1 is yes and 2 is no.

Territory	Exposure high	Nature deep	Poverty high	Places, 2024
High risk, unprotected	yes	no	yes	23
Protected by nature	yes	yes	—	49
Protected by people	yes	no	no	12
Lower risk, protected	no	yes	—	44
Lower risk, unprotected	no	no	—	53
Not determined — poverty not covered	yes	no	no value	11
Not covered by the index	exposure or nature missing			56

Cut-points are medians computed from the data at each build and held fixed across years, so a place moves only when its own value moves. Missing is never read as “not poor” or as safe.

Known weaknesses, stated here and carried to §16.

- **“Unprotected” may overclaim (Q1).** Engineered, insurance and fiscal protection are not observed. 24 high-income places read “Lower risk, unprotected”.
- **“Protected by people” rests on low poverty (Q2),** which is a precondition for absorbing a shock, not a measure of it.
- **Medians are relative (Q3).** Half of covered places are “high exposure” by construction. The classes are comparative, not absolute.

9. Patterns and the severity anchor

Status: Settled; names open (§16 Q1).

Patterns read money against what holds the shock in a place — nature, people or neither — not against its territory name. They apply to every place with finance data, whatever its exposure. A place does not have to be highly exposed to be read, because money that arrives only after disasters, or never, matters at any level of exposure. A place may carry more than one pattern. Each name describes timing, not effect: no pattern is a verdict on effectiveness.

Money...	Pattern	Rule (OECD CRS, mean 2022–2024, per person)	Feedback structure it suggests	Places, 2024
Replaces the absorber	Aid after disasters	Emergency > 1.5 × adaptation	Shifting the burden	54
Relies on it	Nature protects, no funding	Nature deep; adaptation below the median	Unpriced subsidy with a threshold	33
Borrows against it	Protection paid with loans	Grants under 50% of adaptation	Borrowed resilience	24
Is absent	Future risk, no funding	Nature not deep; adaptation below the median	Hidden risk	36
Builds it	Funding before disasters	Adaptation at or above the median; emergency at or below adaptation; grants 50% or more	Virtuous loop	39

Stated on the cards: two rules use "below the median", so about half of places qualify by construction; "Aid after disasters" leans high because adaptation money is a floor. A sensitivity test adding significant-marked money is shown apart, never added.

The severity anchor. Where climate hazards hit hardest, where neither nature nor people can absorb the shock, and where no money builds protection before it, observations converge on the highest severity. Rule: territory "High risk, unprotected" and adaptation money per person below the median. In 2024: 11 places (Afghanistan, Angola, Benin,

Burundi, Chad, Haiti, Lesotho, Pakistan, Sudan, Uganda, Yemen). The anchor is its own outline mark, not a pattern and not a score. Territories and patterns are lenses that show how every other place departs from it. "Not covered" is shown beside it, never read as safety.

10. Labels, confidence and named reasons

Status: Settled for labels and reasons; Draft for confidence.

Four labels. Every value on screen carries one:

Label	Means	Example
Reported	Published by a named source	ND-GAIN exposure, MPI headcount, OECD commitments
Observed	Measured by the atlas from satellite or reanalysis data	Nature near settlements, forest loss, sea temperature
Estimated	Projected by a stated rule	Every value after 2024
Interpreted	Placed by the atlas's own rules	Territories, patterns, the anchor, signals

Confidence uses IPCC calibrated language (low, medium, high, very high), scored from evidence (data age, coverage) and agreement (do the lines agree; does the territory hold if cut-points move $\pm 10\%$). The rules are specified and will appear with the machine-drafted readings.

Named reasons. No blank is silent. Each missing value carries one of a fixed list of reasons:

- not covered by the exposure index;
- the poverty index covers developing countries only;
- poverty not covered;
- not a recipient of official development finance;
- no clear money trace;
- the source has no data in this zone;
- not yet computed in this release;
- fewer than 5 in 100 people are poor here, so money per poor person is not shown.

Tripwire. At every build, if more than 10% of places with finance data, or of exposed developing countries, carry no pattern, the build flags it for review.

Part 3 · Indicator cards

Each line of evidence has one card with the same fields, modelled on the UN SDG metadata template and the per-model chapters of Stanford's InVEST guide: what it measures, why, how it is read, label, coverage, limitations, how to interpret it, sensitivity and status. Parameters and their warrants are listed in full in Annex A.

C1. Climate exposure and hazard direction

Status: Settled. Label: Reported (exposure), Observed (hazard trend), Estimated (hazard projection).

- **What it measures.** The ND-GAIN exposure score (0–1, higher means more exposed), 2026 release, data 1995–2024. Exposure is one part of ND-GAIN vulnerability, across six life-supporting sectors: food, water, health, ecosystem services, human habitat and infrastructure.
- **Why.** It is the IPCC "hazard and exposure" component, kept apart from the social components that overlap with poverty (§5).
- **How it is read.** High when at or above the 2024 median of covered places; the same cut-point for every year.
- **Direction.** The exposure score barely moves over time, so direction comes from three hazards instead: days above 35 °C, the heaviest one-day rainfall, and the longest dry spell.
 - *Observed:* ERA5 trend 1993–2022, Sen's slope with a Mann–Kendall test at 5%.
 - *Projected:* change for 2020–2039 against 1995–2014 under SSP2-4.5, from the World Bank Climate Change Knowledge Portal. "Likely to increase" when the ensemble's 10th and 90th percentiles of change are both above zero; "likely to decrease" when both are below; otherwise "no clear direction". About nine in ten models then agree on the sign, close to the AR6 Atlas notion of a robust signal (at least 80% agreement), so the rule can only under-claim.
 - *Hot-day floor:* where days above 35 °C average under one a year (123 places), no direction is stated; the card says such days are rare.
- **Result, 2024.** Hot days likely to increase in 117 places; heaviest rainfall in 14; longest dry spell up in 5 and down in 5.

- **Coverage.** ND-GAIN covers sovereign states; territories and a few states (Liechtenstein, San Marino, South Sudan) are not covered. For 57 ocean states, hazard values use the land aggregate, with a scope note.
- **Limitations.** A national figure cannot show where hazards fall within a country. Country averaging dilutes local extremes. Heat risk in humid tropical islands runs through humidity, not a 35 °C dry-bulb threshold.
- **How to interpret.** "No clear trend" means the signal is not yet separable from year-to-year variation, or that models disagree. It does not mean no change or no risk.
- **Sensitivity.** The projected rule is deliberately strict. A humid-heat index is a candidate for a later version.

C2. Nature near settlements

Status: Settled. Label: Observed.

- **What it measures.** The share of land within 5 km of settlements that carries protective cover — tree cover, herbaceous wetland and mangroves (ESA WorldCover 2021, classes 10, 90, 95). Settlement means a GHSL 2020 cell with more than 2,000 m² built up per 100 m cell. Measured at 100 m on FAO GAUL 2024 boundaries. Permanent water is left out of the denominator.
- **Why.** It is the observable part of the ecological complexity asset: living systems where people live. Read with the 2001–2025 direction, it shows whether the asset is being drawn down.
- **How it is read.** Deep when above the median of observed places. The card also shows the spread across first-level regions (lowest, median, highest), since a national figure is never uniform.
- **Direction.** Yearly tree-cover loss in the same zone, from Hansen Global Forest Change v1.13 at 30 m, in pixels with at least 30% canopy in 2000 (the [Global Forest Watch](#) default). It is named "direction of change in tree cover", because Hansen and WorldCover are different datasets.
- **Coverage.** 240 places have a level. Of these, 201 have yearly loss figures. 21 have none because the source did not process them, among them 13 Pacific places checked in every version since 2015. 18 very large places are not yet computed and are planned for version 1.1. Micronesia and Sao Tome and Principe are partly observed (17% and 13.5% of their zones), so loss is shown in km² with no percentage.

- **Limitations.** Dryland grass and shrub buffers are not counted, so dryland countries read low. The sea — reefs, seagrass, shallow water — is not measured. A radial zone cannot see where cover sits relative to the hazard. Cropland never counts as protection. Regrowth is not counted. The zone measured at 30 m for loss is slightly larger than the same zone at 100 m: 179 places show an observed share above 100% (up to 113%), so the card caps the share at 100% and loss as a share of the zone may be slightly overstated.
- **How to interpret.** Deep nature near people is a condition for absorption, not proof of it. The distance is a convention, not a proven protection distance.
- **Sensitivity.** Settlement threshold and protective classes tested: the order of the 41 verified countries did not move. Regression on those 41 countries: 41 of 41 match to six decimals. Planned for version 1.1: 2 km and 10 km distances, and 10% and 50% canopy thresholds.

C3. Multidimensional poverty

Status: Draft — the 20% cut-point warrant and the denominator for money per poor person are open (§16 Q2, Q6).

- **What it measures.** The headcount ratio (H) of the Global MPI 2025 (UNDP-OPHI): the share of people deprived in at least a third of weighted indicators of health, education and living standards. The MPI value and survey year are shown beside it.
- **Why.** Read inverted, it is the observable part of the human complexity asset — the basic capabilities a society can draw on (Sen; Alkire and Foster 2011).
- **How it is read.** High when H is 20% or more, asked only when exposure is high and nature is not deep. With no value at that point, the territory is "not determined". For past years, the latest survey on or before that year is used.
- **Money per poor person.** Adaptation money per person divided by H, shown where H is at least 5%.
 - *Why the floor:* below it the ratio explodes and misleads. For example, Tuvalu at 2.1% would read about \$56,000 per poor person.
 - *Cost:* 38 of the 107 places with both values lose the line, among them Brazil, Fiji, Indonesia, the Philippines, Sri Lanka, Tonga, Tuvalu and Viet Nam. A 2% floor would exclude 24; a 10% floor, 53.
 - *Proposed direction (§16 Q6):* divide by people who are poor or vulnerable to poverty, which OPHI also publishes.

- **Coverage.** 109 countries, mostly low- and middle-income. Most high-income countries are not covered. Four Pacific states — the Marshall Islands, Micronesia, Palau and Solomon Islands — have no value.
- **Limitations.** Surveys can be several years old and years differ by country. The global MPI measures acute poverty, so middle-income countries show low shares even where many people are one shock away from poverty.
- **How to interpret.** Low poverty is a precondition for people to absorb a shock, not a measure that they do.
- **Sensitivity.** Planned for version 1.1: 2% and 10% floors for money per poor person.

C4. Money received: adaptation finance by place

Status: Settled for the basis; the significant-marker count on this side is open (§16 Q3).

- **What it measures.** Official development finance committed to each place, from the OECD Creditor Reporting System, activity by activity: all official providers; ODA grants, ODA loans and other official flows; constant 2024 USD; mean of 2022–2024; per person, using UN population.
- **Measures.**
 - Adaptation money with adaptation as the main aim (Rio marker principal).
 - Adaptation as one aim among others (significant), shown beside principal and never added to it.
 - Emergency response and reconstruction relief (sectors 720 and 730).
 - The grant share of adaptation money.
- **Why.** Money is the enabling condition the atlas reads against the absorber, before or after the shock.
- **How it is read.** Medians across the 140 places with finance data, 2024: adaptation (principal) \$1.79 per person a year; significant \$8.92; emergency \$1.50.
- **The floor.** Flows without an adaptation marker are not counted as adaptation money, because a missing marker may mean the provider did not report it. In 2024, 63% of official commitments carried no adaptation marker. Every adaptation figure is therefore a floor.
- **Coverage.** Recipients of official development finance only. 52 placed places are not recipients and carry that reason. Regional and unallocated programmes are counted globally (C8) but cannot be tied to one place.

- **Limitations.** Money outside the CRS is not seen: domestic budgets, private adaptation, providers that do not report. Neither is the purpose behind unmarked flows, or whether money reached the people it was meant for. Two climate funds, GCF and CIF, report no Rio adaptation marker to the CRS since 2018.
- **How to interpret.** A pattern describes the timing and terms of money, never its effectiveness. Disbursements are kept apart from commitments and never added.
- **Sensitivity.** A count with significant money at 40% (the Rio-marker coefficient) is to be reviewed (§16 Q3). It is shown apart, never added.

C5. Money given: the provider side

Status: Settled. Label: Interpreted, from Reported data.

- **What it measures.** For each of 48 provider countries, the same three readings as on the receiving side — before disasters, after disasters, as loans — from their CRS records.
- **Why.** It shows how a provider gives, not only how much.
- **How it is read.** Adaptation is counted as principal plus 40% of significant: the Rio-marker coefficients 100 / 40 / 0 used in the EU climate-tracking method and in providers' UNFCCC reporting. The grant share uses the same counted money. Emergency money and the rule cut-points are unchanged. The card names the share of adaptation giving that goes to regional or unallocated programmes.
- **Result, October 2026 data.** 38 providers read after disasters, 3 as loans, 4 before disasters, 3 with no clear giving trace.
- **Limitations.** Multilateral funds and banks are not read on this side yet. Their reporting differs and the question of how to include them is open (§16 Q4).
- **How to interpret.** A reading of a provider's portfolio timing, not a judgement of its quality.
- **Sensitivity.** At weight 1.0 instead of 0.4, 15 of the 48 providers change reading; at 0.4, 7 change compared with principal only (Australia, Belgium, Germany, Japan, Liechtenstein, Monaco, New Zealand).
- **Why the two sides differ.** The receiving side keeps principal only (C4) until the 40% count is reviewed for places. This is stated wherever both appear.

C6. Ocean layer

Status: Settled. Label: Observed. Context only: never decides a territory or pattern.

- **What it measures.** For the latest full month, how much warmer or colder the sea surface was than the 1991–2020 average for the same month, in °C on a 1-degree grid. Source: Copernicus Marine Service, OSTIA (Met Office); the month from near-real-time data, the baseline from the reprocessed record.
- **Why.** Many island states are mostly ocean. Their land reading leaves out the sea that shapes their exposure.
- **How it is read.**
 - *Baseline:* built once from the 15th of each month across 30 years.
 - *Empty cells:* no value where sea ice covers 15% or more, in the month or in the baseline.
 - *Products disagree:* differences above 8 °C are hatched with no value, because they come from the switch between the two products.
 - *Colour scale:* saturates at ± 5 °C.
- **Limitations.** OSTIA is a gap-filled analysis, not a raw measurement. One month is weather as much as climate: the layer shows a level, not a trend.
- **Sensitivity.** Sampling one day a month moves the baseline by a median of 0.04–0.10 °C, well inside the ± 0.5 °C "near the average" band.

C7. Projection: if current trends continue

Status: Settled. Label: Estimated.

- **What it does.** Extends each line from 2025 to 2035, always captioned "if current trends continue". It is not a forecast.
 - *Exposure:* the straight-line trend of the last ten years.
 - *Poverty:* OPHI's published annual change, never below zero; held level where OPHI gives none.
 - *Nature:* held at its level, with direction in words from forest loss.
 - *Finance:* not projected.
 - *Cut-points:* held at 2024 values.
- **Why.** Ten years is the horizon over which present patterns can be read without pretending to model the future.

- **How it is read.** For patterns and regions — how many places show each pattern and where they cluster. A single country's future appears only on its card, as direction in words: "likely to rise", "likely to fall", "no clear change", "no trend — one data point".
- **Limitations.** A straight line ignores thresholds and tipping points, the very dynamics complexity assets are about. No uncertainty cones are drawn; direction in words with a confidence level is used instead.
- **How to interpret.** A line with one data point shows a level, not a direction.

C8. Global adaptation finance: context

Status: Settled. Label: Context for OECD and UNEP figures; Reported · floor for atlas figures.

- **What it shows.** The macro picture beside the place-level figures, never merged with them: global adaptation finance (OECD 2026), principal and significant markers over time, year-to-year change, and the gap to agreed ambitions.
- **Key figures.**
 - *Global total:* \$34.7 bn in 2024 (OECD).
 - *Gap to ambitions:* Glasgow doubling target \$37.6 bn (2025); COP30 tripling by 2035 at \$95.1–112.8 bn (baseline not yet set); UNEP's estimate of need \$310–365 bn a year (2023 prices).
 - *Markers over time (atlas reading of the CRS, all recipients):* principal-marked adaptation stayed between \$6 and 9 bn a year from 2016 to 2024, while significant-marked roughly doubled, from \$14 bn to \$27 bn, with a peak of \$33 bn in 2022.
- **From the global count to named places, 2023.** OECD total \$33.6 bn → minus mobilised private finance \$2.9 bn → public \$30.6 bn → minus significant-marked money, multilateral climate shares without a marker, and regional programmes → \$5.2 bn principal-marked money tied to a named place: the atlas floor.
- **How to interpret.** The two figures measure different things. The OECD counts from the giving side what providers report providing and mobilising. The atlas counts from the receiving side principal-marked money tied to one place. \$5.2 bn is the floor for named places, not global adaptation finance. Principal and significant are never added.
- **Limitations.** Multilateral bank climate shares are not yet read. Price bases differ: the atlas uses constant 2024 USD, the OECD current USD. A 2018 dip in the place series comes from a change in how one provider marks its projects; the trend line on the summary tile is hidden until version 1.1.

Part 4 · Robustness

11. Coherence: are the lines independent, and do they just track income?

Status: Draft — first run on the atlas data of 22 October 2026.

The three lines are close to independent, which is what triangulation needs. But the exposure line carries a strong income gradient, so the territories partly read development status. This affects open question Q1.

Independence of the lines (Spearman rank correlation, 2024 values):

Pair	ρ	Places
Exposure and nature near settlements	0.00	192
Exposure and poverty	0.37	108
Nature near settlements and poverty	-0.12	109

No pair comes near the 0.95 at which the JRC guide treats one indicator as duplicating another. The moderate exposure-poverty link was known when exposure was chosen over full vulnerability ($\rho = 0.74$).

Income test. Proxy used for high income: not being a recipient of official development finance (52 places). The atlas does not yet store World Bank income groups; a direct test is planned (§16 Q1).

Group	Places placed (territory or not determined)	Read as high exposure
Recipients of official development finance	140	90 (64%)
Not recipients	52	5 (10%)

For non-recipients, 47 of 52 read "lower risk". Two readings are possible, and both need testing.

- **The gradient could be real.** Many tropical and small island developing states are more exposed.
- **It could be built into the measure.** ND-GAIN exposure includes projected impacts on sectors such as food and water, which may move with development.

Either way, "Lower risk, unprotected" in a rich country and in a poor one are different situations. The atlas currently gives them one name.

12. Sensitivity: tested and planned

Status: Draft.

Choice	Tested	Result	Planned
Settlement threshold (nature)	Yes	Order of 41 countries unchanged	—
Protective classes (nature)	Yes	Wide list rejected as a uniform fix	—
Water in the denominator	Yes	Penalised only atoll states, by up to 54%; removed	—
Ocean baseline sampling	Yes	Median shift 0.04–0.10 °C	—
Provider significant weight	Yes	0.4 moves 7 of 48 providers; 1.0 moves 15	—
Distance to settlements	—	—	2 km and 10 km, version 1.1
Canopy threshold (forest loss)	—	—	10% and 50%, version 1.1
Median cut-points (exposure, nature, money)	—	—	±10% hold test; the same test feeds confidence (§10)
Poverty cut-point 20%	—	—	15% and 25%; warrant to check (§16 Q2)

Choice	Tested	Result	Planned
Money per poor person floor	—	Count only: 24 / 38 / 53 places excluded at 2 / 5 / 10%	Poor plus vulnerable as denominator (§16 Q6)
Significant money, receiving side	—	—	Report-only count at 40% (§16 Q3)

No choice yet shows that a result depends on it in a way that would change the main reading. The tests that matter most — the medians and the 20% cut — are not yet run. They come first in version 1.1.

13. Reproducibility, review and corrections

Status: Settled.

- **Human judgement at every step.** The atlas is the product of iterative review, not of automation. Between July and October 2026, the method went through several major revisions, including a full realignment of the concept, and more than a hundred recorded decisions and reviewed changes. Each rule, threshold and name was proposed, tested on the live data where possible, and then accepted, revised or rejected against the thesis and the conceptual framework (§2–§3). Options that were weighed and set aside are kept in the decision record with their reasons; settled choices carry their warrant in Annex A. AI was used to draft, compute and check; every decision was taken by the author.
- **Reproducible.** Every data step is code in the project’s pipeline, reading only named public sources (opening the code to reviewers is open, §16 Q8). Settings live in one configuration file, with their warrants in Annex A. Outputs carry their source, date and price base. Synthetic data is used only in tests.
- **Second review.** Every change to method or data is reviewed twice before it is merged: by the orchestrating model and by an independent second model that only reads and reports. Each review is written down.
- **Regression.** Re-runs are checked against earlier published values. The nature line passed 41 of 41 countries at six decimals.
- **Machine readings.** Readings are drafted by an AI model from each place’s own record, checked automatically, and held for human review when confidence is low or a territory changes.

- **Corrections.** Errors, removals and privacy requests go to contact@climatecomplexitypatterns.org. Every accepted correction is logged in §17.
- **Expert review.** Version 1.0 is open to qualified reviewers. Comments are answered in the change log and folded into v1.1.

Part 5 · Use and limits

14. Theory of change

Status: Draft.

The atlas changes nothing by itself. It works if it changes the question people bring to a decision. The intended chain:

1. **A reader sees a configuration, not a score** — for example, nature carrying the load while adaptation money stays below the median.
2. **The configuration prompts a sharper question** — is anyone paying to keep this forest? Why does money arrive after disasters here and before them elsewhere?
3. **The question reaches the people who decide**, through government teams and their advisers, the accountability community, and funds and donors, in that order. It travels through the country card, the Strategic Signals and the quarterly Strategic Outlook.
4. **Over time, money shifts toward building absorbers before the shock**, and the data system closes the gaps the atlas names.

What the atlas can show about its own effect. Pattern shifts are recorded at each data refresh from a 6 October 2026 baseline. A move from "Aid after disasters" to "Funding before disasters" in a place would be a trace consistent with the chain. It would not prove the atlas caused it.

15. Limitations and risks of misuse

Status: Draft.

Limitations.

- **Indicative, not diagnostic.** Territories come from three national figures and fixed cut-points. They prompt a closer look; they do not describe conditions inside a country.
- **National scale.** Exposure and poverty are national; nature shows a regional spread, but the territory uses the national value.

- **Finance is a floor.** Only marked flows count; most official commitments carry no adaptation marker.
- **Nature is read on land,** without drylands' grass and shrub buffers or the sea.
- **Surveys age.** Poverty surveys can be several years old.
- **Engineered, insurance and fiscal protection are not observed** (§16 Q1).
- **Machine readings can be wrong.** Low-confidence readings are held for human review.

Risks of misuse, and the guard against each.

Risk	Guard
Read as a ranking of countries	No ranks, no sorting by severity, counts only; the connector declines ranking requests and says why
Read as a verdict on effectiveness	Pattern names describe timing, not effect, and the cards say so
Read as an assessment of one fund or provider	Funds shown only side by side, presence not amounts; never keyed to one fund; independence statement
Used to allocate money	Signals point where to look closer and never recommend where money should go
Gaps read as safety	"Not covered" shown beside the anchor with its reason, hatched, never coloured as low risk
Repackaged by AI assistants	The connector serves curated definitions, label · source · date with every figure, and a "Cite as" line; it tells assistants not to attribute to the atlas what it did not produce
Gaming or measure-as-target	Rules published and fixed between versions; changes logged; sources external to the atlas

16. Open questions register

Status: Open — the working list for v1.1.

ID	Question	Affects	What would settle it
Q1	Does "unprotected" overclaim, since engineered, insurance and fiscal protection are unseen? Does exposure track income (§11)?	§8, §9, territory and pattern names	A direct income-group test; a rename such as "no ecological or human buffer observed"; a review of the 24 high-income places now "Lower risk, unprotected"
Q2	Can low poverty stand for "protected by people"? What warrants the 20% cut?	§8, C3	A framing or rename; a source for the 20% line or a test at 15% and 25%
Q3	Median cut-points make half of places "high" by construction. Keep and state as comparative, change the cut, or show a scale? Count significant money on the receiving side at 40%?	§8, §9, C4	The $\pm 10\%$ hold test; a report-only 40% count
Q4	Should multilateral funds and banks be read on the provider side, and how?	C5, C8	Their reporting checked; independence test passed
Q5	Colour scales against the real spread of the data (80% of countries use about 17% of the exposure ramp); one colour layer at a time as the guard against a blended score	§6, the map	Quantile or data-range scales tested with readers
Q6	Money per poor person: divide by poor plus vulnerable to poverty instead of poor only?	C3	Check that the vulnerable share is in the data; count how many places return
Q7	A fuller comparison with related instruments: coverage, update cycle, treatment of missing data	§4	Expert input

ID	Question	Affects	What would settle it
Q8	Open the pipeline code to reviewers, and under what licence	§13	A decision on access and licence
Q9	When does a place get a full reading rather than a short card?	§10	A threshold on the number of lines present, with its count
Q10	A humid-heat index for tropical islands	C1	Availability in the source

Q11 · Nature direction in words — settled. 201 places carry yearly tree-cover loss, but no rule turns the series into words, so every card reads "direction not yet computed". Because loss only counts one way, the words should describe the *pace of loss*, not cover going up or down. The rule:

- Read 2011–2024 only, the years the source processed consistently, leaving out 2025, which may be incomplete.
- Use the same test as the hazards: Sen’s slope with a Mann–Kendall test at 5%.
- Words: "tree-cover loss speeding up", "loss slowing", or "no clear change in the pace of loss".
- Below a floor of cumulative loss under 0.5% of the zone, say "little tree-cover loss" and state no direction.

Affects C2 and C7. Settled; applied in the next data release.

17. Versions and change log

Status: Settled — updated at every release.

Version	Change
Methodology 1.0	First complete version, published as a work in progress and open to comments and suggestions. Adds the concept, related instruments, coherence and income test, sensitivity table, theory of change, risks and open questions register.

Version	Change
Atlas v0.9	Connector for invited users; global adaptation finance context (C8); provider basis at 40% of significant (C5); places and boundaries following UN practice; Strategic Signals; reading order; revised pattern rules and a fifth pattern; severity anchor; hazard direction rules.
Atlas settings S1–S11	Exposure chosen over full vulnerability; median cut-points; finance basis.

Convention for plans. Planned work is dated by methodology version, not by external events. Version 1.1 is the next revision: it carries the sensitivity tests in §12 and the answers to the open questions in §16. Later work is marked version 2.

Annexes

Annex A. Settings and their warrants

Every parameter has a warrant: a named convention, a measured result, or a stated judgement. Settings live in one configuration file and change only with a logged decision.

ID	Setting	Value	Warrant type	Warrant
S1	Time horizon	2005–2035; observed to 2024	Judgement	Poverty and finance lines are thin before the mid-2000s; ten years ahead at most
S2	High exposure	At or above the 2024 median of covered places	Judgement	Simple, transparent, no arbitrary absolute line (open, Q3)
S3	Deep nature	Above the median of observed places; 5 km zone	Convention + judgement	Forest-proximate people radius (Newton et al. 2020)
S4	High poverty	MPI headcount 20% or more	Judgement	Warrant to verify (open, Q2)

ID	Setting	Value	Warrant type	Warrant
S5	Not determined	No poverty value where it is needed	Rule	Missing is never read as "not poor"
S6	Not covered	Exposure or nature missing	Rule	No territory without both
S7	Past years	Best observation on or before each year	Rule	No extrapolation backward
S8	Projection	Trend, change or held level; "no clear change" under 0.01	Judgement	"If current trends continue", not a forecast
S9	Finance basis	Commitments; mean 2022–2024; principal only; sectors 720 + 730	Convention	Rio-marker practice; three-year mean smooths spikes
S10	Low money per person	Below the median of places with finance data (\$1.79)	Judgement	Relative, not an adequacy line (open, Q3)
S11	Pattern thresholds	Emergency > 1.5 × adaptation; grants < 50%	Judgement	Material excess of response over planned adaptation; loan-dominated adaptation
—	Money per poor person	Shown where poverty is 5% or more	Judgement	Below it the ratio explodes (open, Q6)
S13	Provider significant weight	0.4	Convention	Rio-marker coefficients 100 / 40 / 0
—	Hazard direction	Observed: Sen's slope, Mann-Kendall 5%; projected: 10th and 90th percentiles of change share a sign	Convention	Standard trend test; AR6 Atlas robust signal
—	Hot-day floor	Under one day a year above 35 °C	Judgement	Near-zero threshold indices give meaningless trends

ID	Setting	Value	Warrant type	Warrant
—	Forest canopy	30% tree cover in 2000	Convention	Global Forest Watch default
—	Ocean baseline	1991–2020, 15th of each month	Convention + tested judgement	WMO climate normal; sampling tested
—	Tripwire	More than 10% without a pattern	Judgement	Flags a rule that leaves too many places unread

Annex B. Sources, licences and dates

Source	Used for	Version or data date	Licence
ND-GAIN Country Index (University of Notre Dame)	Exposure	2026 release, data to 2024	Source terms, to confirm
Global MPI (UNDP–OPHI)	Poverty	2025	CC BY 4.0
OECD Creditor Reporting System, Data Explorer API	Finance, both sides	Data to 2024, read Oct 2026	OECD terms, to confirm
OECD, Climate Finance Provided and Mobilised (2026)	Global context (C8)	2026	OECD terms, to confirm
UNEP Adaptation Gap Report	Estimate of need (C8)	2023 prices	Source terms, to confirm
ESA WorldCover	Protective land cover	2021, v200	CC BY 4.0
GHSL built-up surface (European Commission JRC)	Settlements	2020	CC BY 4.0
Hansen Global Forest Change (UMD)	Forest loss	v1.13, 2001–2025	CC BY 4.0

Source	Used for	Version or data date	Licence
FAO GAUL	Boundaries for nature	2024	FAO terms, to confirm
ERA5 and CMIP6 via the World Bank Climate Change Knowledge Portal	Hazard direction	1993–2022; 2020–2039	CC BY 4.0
Copernicus Marine Service, OSTIA	Ocean layer	Monthly; baseline 1991–2020	Copernicus Marine licence
UN World Population Prospects	Per-person figures	Same years as finance	CC BY 3.0 IGO
Natural Earth; Marine Regions	Base map; ocean zones	1:110m; current	Public domain; to confirm

Annex C. Places and boundaries

The atlas reads 248 places: sovereign states, territories with land, and island states drawn with their exclusive economic zones. Where it corrects a contested place, it follows UN practice — UN map lines, names and status words, place by place — and takes no position of its own. Corrections are drawn over a Natural Earth base map. Corrected so far:

- Western Sahara
- Palestine
- the occupied Syrian Golan
- Crimea and Sevastopol
- Northern Cyprus and Somaliland
- the Sudan–South Sudan boundary

Other cases wait until a recognised authority asks. The boundaries and names shown and the designations used do not imply official endorsement or acceptance by the author.

Annex D. Glossary and acronyms

- **Absorber.** What takes the climate shock in a place: nature near settlements, people's capabilities, or nothing.
- **Complexity assets.** Ecological and human structures that absorb shocks. They are configurations, slow to build and fast to lose, collective, and invisible until they fail.
- **Floor.** A figure that counts only what is marked, so the true value may be higher.
- **Named reason.** The stated cause of a missing value, from a fixed list.
- **Pattern.** A rule-based reading of how money relates to the absorber: builds, relies on, replaces, borrows against, or is absent.
- **Principal / significant.** OECD Rio markers. Adaptation is the main aim, or one aim among others. Never added together.
- **Severity anchor.** High exposure, no ecological or human buffer, and adaptation money below the median. A reference point, not a score.
- **Territory.** One of five placements saying who holds.
- **Triangulation.** Reading independent lines of evidence against each other instead of merging them.

Acronyms.

Acronym	Meaning
AI	Artificial intelligence
AR6	IPCC Sixth Assessment Report
CCKP	World Bank Climate Change Knowledge Portal
CIF	Climate Investment Funds
CMIP6	Coupled Model Intercomparison Project, phase 6
COP	Conference of the Parties to the UNFCCC
CRS	OECD Creditor Reporting System
EEZ	Exclusive economic zone
ERA5	Fifth-generation ECMWF climate reanalysis
ESA	European Space Agency
FAO GAUL	FAO Global Administrative Unit Layers

Acronym	Meaning
GCF	Green Climate Fund
GHSL	Global Human Settlement Layer
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre of the European Commission
MCP	Model Context Protocol (how AI assistants connect to the atlas)
MPI	Multidimensional Poverty Index
ND-GAIN	Notre Dame Global Adaptation Initiative
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
OPHI	Oxford Poverty and Human Development Initiative
OSTIA	Operational Sea Surface Temperature and Ice Analysis
SIDS	Small island developing states
SSP2-4.5	Shared Socioeconomic Pathway 2, intermediate emissions
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WGII	IPCC Working Group II (impacts, adaptation and vulnerability)
WMO	World Meteorological Organization

Annex E. References

Foundational reading. The work started from a review of the IPCC Sixth Assessment Report, Working Group II, *Impacts, Adaptation and Vulnerability* (2022), read with Chambers on participation and knowledge (1997) and the resilience literature (Walker and Salt 2006; Biggs et al. 2012). *Other works that shaped the framework are listed below.*

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Annex F. Instruments and platforms reviewed

Instruments and platforms consulted while designing the atlas, listed without judgement of their quality. Each was consulted on its public website between July and October 2026.

Instrument or platform	What it offers
ND-GAIN Country Index	Vulnerability and readiness scores by country
INFORM Risk Index (European Commission JRC)	Composite risk of humanitarian crisis
WorldRiskIndex	Composite disaster risk by country
UNEP Adaptation Gap Report	Adaptation finance needs and flows
Climate Policy Initiative, Global Landscape of Climate Finance	Climate finance flows
Climate Funds Update	Multilateral climate fund approvals
OECD Creditor Reporting System and Rio markers	Development finance by activity
World Bank Climate Change Knowledge Portal	Historical and projected climate data by country
Google Earth Engine Data Catalog	Public satellite and geospatial datasets

Instrument or platform	What it offers
Google DeepMind, AlphaEarth Foundations	A satellite embedding model and dataset for mapping the planet
Copernicus Marine ocean visualisation tools	Viewers for ocean temperature and other sea data
Global Forest Watch	Forest cover and loss
Global Mangrove Watch	Mangrove extent and change
OPHI Global MPI and its climate overlay	Multidimensional poverty and hazard exposure
Belém Adaptation Indicators (UNFCCC)	Country reporting on the Global Goal on Adaptation

Suggestions of other instruments to review are welcome at contact@climatecomplexitypatterns.org.