SUPPLEMENTAL MATERIALS (SM3)

METHODOLOGY FOR ASSESSMENT OF ADAPTATION EXTENT

We assessed extent of adaptation of the 1682 academic articles identified by the Global Adaptation Mapping Initiative (GAMI) database. Each article documented one or more adaptation actions.

For each article, we coded the depth, scope, speed, and challenge to limits of the adaptation action documented. Depth refers to the novelty of the action and the extent to which it departs from standard practice. This is related to academic work on incremental and transformative adaptation. Higher depth actions are more transformative in more ways. Scope refers to the geographic and sectoral reach of the adaptation action. Speed describes the time required to implement the adaptation and observe results. And limits describes whether an adaptation action challenged constraints that may otherwise have prevented adaptation action. We developed a table to define each element, and to define high, medium, and low categories within each. We circulated this table to the GAMI leadership team and external reviewers to receive feedback and ensure that our definitions were consistent. Table summarizes the definitions used for this assessment.

Table 1. Defining high, medium, low categories for depth, scope, speed, limits of adaptation.

Depth	*Question 4.4 in GAMI Protocol*
Depth relates to the degree to which change reflects something new, novel, and different from existing norms or practices. Extent to which actions offer potential to lead to positive systemic change. Incremental actions are taken to tackle the source of risk and reduce risk, while transformation goes beyond the source of risk, e.g. farmers seeking alternative livelihoods when farming is not feasible anymore in the face of drought.	
High	High depth (in-depth) change is more transformative: it might involve radically changing practices by altering frames, values, logics, and assumptions underlying the system. This might involve deep structural reform, complete change in mindset, radical shifts in perceptions or values, and changing institutional or behavioral norms. Adaptation actions are increasingly radical (depth of change), including altering of values, re-framing of problems, and dramatic changes in practices.
Medium	Medium (moderate) depth describes incremental changes: a shift away from existing practices, norms, or structures, but only to a limited degree. Perspectives, values, and practices are changing to involve novel or more radical approaches (depth of change). Changes in risk perception may be medium depth.
Low	Low (limited) depth follows business-as-usual practices, with no real difference in underlying values, assumptions, or norms. This includes practices that are largely expansions of existing practices. Adaptations largely are incremental by expanding existing practices, with limited evidence of novel change beyond business-as-usual practices (depth of change).
Scope	*Question 4.5 in GAMI Protocol*
Scope refers to the scale of change – geographic or institutional.	

High	High (broad, large) scope refers to large-scale and system-wide changes that involve an entire organization, a country or large region, and large populations. Broad scope efforts may be multi-dimensional, multi-component, and/or multi-level. Development of networks, inter-organizational coordination are more likely to lead to changes of broad scope. Adaptation is implemented at or very near its full potential across multiple dimensions. Adaptations are widespread and substantial, including most of the possible sectors, levels of governance, actors (e.g. nationally implemented legislation or policy), or reflect widespread changes in behavior (scope of change). For example, this may include numerous cities or national-level changes, or institution-wide change. It may also address shifts in underlying norms and behaviors across entire populations.
Medium	Medium scope could describe multiple communities or households acting without coordination, a single sector taking action, or a small regional action. Adaptation is expanding and increasingly coordinated. There are growing efforts that exceed business-as-usual practices and challenge the fundamental attributes of the social-ecological system. There is some expansion and/or mainstreaming of change (scope of change) to include a wider region, or involvement of coordinated, multi-dimensional, multi-level adaptation.
Low	Low (small) scope might refer to local initiatives, activities taken by individuals or households. Adaptation is largely localized. There are primarily disjointed adaptation initiatives, with limited evidence of coordination or mainstreaming across sectors, jurisdictions, or levels of governance (scope of change). This could be a single city or government department.
Speed	*Question 4.6 in GAMI Protocol*
Speed of change refers to the dimension of time within which changes are happening.	
High	High (fast) speed adaptation actions are either (a) those described as being fast for their type of action (e.g., building a bridge in a year might still be considered fast) or (b) those that can take place and see results within 1-3 years.
Medium	Medium (moderate) speed adaptations are those that occur or see results over 3-5 years. Adaptations are increasingly exceeding business-as-usual behavioral or institutional change to reflect accelerated adaptive responses (speed of change).
Low	Low (slow) speed adaptations are those that take 5 years or more to be executed or to see results. Adaptations are largely slow, consistent with existing behavioral or institutional change, and limited evidence of accelerated adaptive response (speed of change). Change is evident, but not rapid.
Limits	*Question 6.4.2 in GAMI Protocol*
Evidence that limits are being challenged or overcome	

High	Soft limits are present (as identified in questions 6.1.1 and 6.2.1) and there is evidence that these soft limits are being overcome. (The occurrence of adaptation is not itself evidence that limits are being overcome) Hard limits are being approached, if not overcome. Adaptations exceed soft limits and begin to approach hard limits. If no hard limits, exceed soft limits by a substantial margin.
Medium	Soft limits are present and are being addressed or challenged but limited evidence that they are being overcome. Adaptations may overcome soft limits but do not challenge or approach hard limits.
Low	Limits are present and are a current or potential future limit on the level of adaptation possible. Adaptations may approach but do not exceed or substantively challenge soft limits.

We also developed a protocol to assess robustness of each element. For every article, we assigned four robustness scores: one each for depth, scope, speed, and limits based on the quality of the paper and the relevance of the paper to the issue (e.g., how clearly and explicitly it addressed speed of adaptation). We discussed this protocol as a group and went over an example to ensure we all had a similar understanding of the criteria.

Four team members then all coded the same 25 articles on depth, scope, speed, and limits and robustness (high, medium, low) for each element. We reviewed our answers, discussed discrepancies, and arrived at a common understanding (reflected in Table 1). This step was meant to ensure consistency across coding. Next, the team members coded all 1682 articles in the GAMI database for depth, scope, speed, limits, and robustness for each.

We then divided the GAMI database into fourteen region*sector combinations, following the divisions used by the GAMI protocol. (Table 2). Many articles fall into more than one region or sector if they, for example, involve comparative work or adaptations that address multiple issues. Each article was assigned to a region based on the countries involved (as coded by GAMI coders) and using global regions. Papers could also be assessed as “not applicable” or “unable to assess” if the article provided insufficient information on the element in question (e.g., speed) to provide a score.

Table 2. Articles in each region*sector combination

	Cities	**Food**	**Health**	**Ocean**	**Poverty**	**Terrestrial**	**Water**
Africa	249	397	132	23	338	49	50
Asia	77	404	185	53	269	66	84
Australasia	6	17	27	8	11	5	9
Central & South America	12	57	21	3	38	12	14
Europe	67	45	45	22	11	22	9
North America	66	88	81	28	52	52	72
Island States	15	38	42	35	41	12	19

For each region*sector combination (n= 49), team members then filled out a summary table that provides the following information:

- Region and Sector
- Variable (Depth, scope, speed, limits)
- Ranking (High, Medium, Low)
- Number of papers that support the ranking (e.g., number of papers in Africa*Ocean combination that demonstrated high depth adaptation)
- Number of papers that assessed the variable in question (i.e., number of papers that actually addressed depth; often less than the total number of papers in that region*sector because some papers were unable to be assessed)
- % of papers assessed that support the ranking (divide number of papers support by number assessed)
- Citations (a list of author name, title, journal for all articles that, e.g., documented high depth adaptation)
- Level of agreement (see Table 3 for specifics, generally high agreement if a supermajority of papers assessed agreed on the ranking, medium if a majority agreed, and low if a general spread of responses); a justification for the agreement assessment
- Robustness ranking (high, medium, low) (see Table 3 for specifics, draws on the robustness rankings for the given variable by article and also considers overall region*sector evidence); a justification for the agreement
- Overall confidence ranking (see Table)

If fewer than 5 studies addressed the element in question (e.g., speed), either because there were too few papers in the region*sector (e.g., Central & South America, Oceans), or because many of the papers did not provide enough information to assess a given element, then the ranking in the final table was given as “Insufficient information to assess”.

Level of agreement, robustness at the region*sector level, and overall confidence were assigned based on the criteria found in Table 3. Our confidence assessment was informed by the GRADE-Cerqual guidelines for assessment of confidence in qualitative evidence, adapted and simplified to integrate the IPCC’s uncertainty guidance language.

Table 3. Confidence assessments standards

Level of Agreement	
Level of agreement across the papers assessed (how many of the papers assessed agreed, e.g., what was the spread) Example: All studies provide evidence of autonomous adaptation. There is variation in the details of these processes, but no general disagreement over the generalized statement of evidence on this. Studies 67-70 additionally address the sufficiency of evolutionary adaptation. All studies indicate consensus that the pace of adaptations does not appear to be sufficient to keep pace with the rate of climate change.	
High	No or very minor concerns about the extent to which the underlying literature is consistent with your key statement; This could be assessed by number cutoffs but also requires judgement. For example, if a supermajority of studies agree to the

	answer (e.g. >70% of studies agree that adaptation is High Depth, 20% medium, and 10% low)
Medium	Minor to moderate concerns about the extent to which the underlying literature is consistent with your key statement; This could be assessed by number cutoffs but also requires judgement. For example, if a majority of studies agree to the answer (e.g., 50% of studies agree that adaptation is High Depth, 40% medium, 10% low); This could also include the case where the answers are split between two close answers (e.g., 45% High, 45% Medium, 10% low)
Low	Moderate to serious concerns about the extent to which the underlying literature is consistent with your key statement; This could be assessed by number cutoffs but also requires judgement. For example, if studies are evenly split between the categories with no clear pattern (e.g., 33% High, 33% medium, 33% low); Or categories are split bimodally (e.g., 45% High, 10% medium, 45% low);
Robustness	
Robust evidence considers the # of articles assessed, the type of articles; relevance of articles (e.g., do they address the question directly or is it inferred by coders). and adequacy of methods. *Types* of articles (all GAMI articles are scientific peer-reviewed publications, so high). *Adequacy* of evidence relates to quantitative or qualitative volume of evidence base, and this is based on the richness of the information (e.g., is speed barely mentioned or discussed in depth). *Relevance* of the literature relates to the extent that the literature provides a range of contexts and reflects what I am really asking (e.g., can the papers in the Africa*Cities category really reflect the entire range of adaptation in African cities? Or do they only address East Africa, or mostly address Europe and mention Africa?). GAMI questions that can help with this assessment: Quotes for each question; Summary; Description of Response and Implementation Tools (3.1.1-3.2.2); Methods (7.1); Adequacy (7.2); Coherence (7.3); Relevance (7.4)	
High	No or very minor concerns about the extent to which the underlying literature is consistent with your key statement; You feel certain that there is good quality evidence upon which to base the conclusions drawn; Numerous articles provide an answer to the question; They address the issue directly (not inferred by coders), and have no methodological concerns (e.g., they have large sample sizes or detailed case studies)
Medium	Minor to moderate concerns about the extent to which the underlying literature is consistent with your key statement; You feel reasonably sure there is good evidence upon which to base the conclusions drawn; Multiple articles provide an answer to the question; At least some of them address the issue directly; there are only a few studies with methodological concerns or the concerns are minor
Low	Moderate to serious concerns about the extent to which the underlying literature is consistent with your key statement; You are not entirely certain that the evidence upon which conclusions are based is solid; Only a few articles address this topic (must be more than 5 or we do not assess and label this as “Insufficient

	information"); They may not address the topic directly, or they may have methodological concerns (either concerns are frequent or severe or both)
Confidence	

How confident are we in our ultimate conclusion (e.g., that adaptation in African Cities is occurring with limited depth)? This will be a combination of the level of agreement and robustness of the evidence provided.

High agreement Limited robustness of evidence *(E.g. medium confidence)*	High agreement Medium robustness of evidence *(E.g. high confidence)*	High agreement Robust evidence (high) *(E.g. very high confidence)*
Medium agreement Limited robustness of evidence *(E.g. low confidence)*	Medium agreement Medium robustness of evidence *(E.g. medium confidence)*	Medium agreement Robust evidence (high) *(E.g. high confidence)*
Low agreement Limited robustness of evidence *(E.g. Very low confidence)*	Low agreement Medium robustness of evidence *(E.g. low confidence)*	Low agreement Robust evidence (high) *(E.g. medium confidence)*

The ranking for each variable was collected in a table, along with the overall confidence ranking. An "overall" extent of adaptation score for each region*sector combination was assessed based on the rankings for each element (depth, scope, speed, limits) and given a confidence assessment based on the confidence for each element. The four scores for ranking and four scores for confidence were compiled using the following logic:

Overall High ranking / confidence if there are:	Overall medium ranking / confidence if there are:	Overall low ranking / confidence if there are:
4 high rankings/confidence	4 med	4 low
3 high; 1 med	1 high; 3 med	1 high; 3 low
3 high; 1 low	3 med; 1 low	1 med; 3 low
2 high; 2 med	2 med; 2 low	
	2 high; 2 low	
	2 high; 1 med; 1 low	
	1 high; 1 medium; 2 low	

Thus, a region*sector that had medium depth, medium scope, low speed, and low limits assessment with medium, high, low, and medium robustness scores, respectively, would be assessed an overall medium extent of adaptation with medium confidence. Very low confidence or insufficient information assessments were treated as low confidence for purposes of assessing overall extent.

A narrative description was added to each by selecting illustrative examples for each element within each region*sector. These examples are not necessarily representative of the category (especially for sectors with a large number of studies).