Title:

Climate as a risk factor for armed conflict

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Summary:
We assess current understanding of the relationship between climate and conflict, based on the structured judgments of experts across disciplines. The experts agree climate has affected organized armed conflict within countries. However, other drivers are judged substantially more influential, and the mechanisms of climate–conflict linkages are a key uncertainty. Intensifying climate change is estimated to increase future conflict risk.

Main Text:

Research over the past decade has established that climate variability and change may influence the risk of violent conflict, including organized armed conflict[1,2]. But use of different research designs, data sets, and methods has resulted in divergent findings and stark questions about legitimate approaches to scientific inference[1,3-9]. Past analyses, many from authors of this article, have both asserted and refuted a substantial role for climate in conflicts to date and have repeatedly triggered dissenting perspectives[1,3-6,9-22]. Even syntheses have failed to clarify areas of agreement and reasons for disagreement[2,4,5,8,9,12,13,23-26]. There are important uncertainties about when and how climate causes conflict to date and under future scenarios[8,23,27,28]. The lack of clarity on current knowledge limits informed management of the risks of conflict to states and human security and the risks of continuing greenhouse gas emissions.

Expert elicitation is a well-vetted method for documenting the judgments of experts about available evidence[29] (Methods). For societally relevant topics with divergent evidence, experimental comparisons of structured elicitation and group-panel assessment have long suggested that individual elicitation paired with collective assessment could better reveal the state of knowledge than either approach in isolation[30-32]. Here, we develop a first such synoptic assessment of the relationship between climate and conflict.

The assessment approach and expert group

The focus here is organized armed conflict within countries (Extended Data Fig. 1). Previous crosscutting analyses of climate and conflict have combined individual-level violence (e.g., suicide, domestic violence) through to war between countries[2,4,9]. However, drivers of suicide fundamentally differ from drivers of world wars. To enable a focused evaluation, the social scale of violence is constrained to organized armed conflict within countries (i.e., state-based armed conflict, non-state armed conflict, and one-sided violence against civilians)[33]. These forms of violent conflict may affect or be affected by conflict in neighboring areas or external intervention. In evaluating climate's effects, climate-related variability, hazards, trends, and change are all included (e.g., related to temperature, precipitation, modes of variability such as El Niño Southern Oscillation, and extreme events such as droughts and floods).

The author team of this manuscript consists of 3 assessment facilitators and a climate and conflict expert group. The 11-person expert group is a sample of the most experienced and highly cited scholars on the topic, spanning relevant social science disciplines (e.g., political science, economics, geography, environmental science), epistemological approaches, and diverse previous conclusions about climate and conflict (Methods). Selection of the expert group targeted expertise necessary to resolve scientific disagreement about the contribution of climate to conflict risks globally and in conflict-prone regions, which requires consideration of

comparative and crosscutting analyses and replicable empirical research. For climate and conflict overall, however, the scope of relevant expertise in scholarship, practice, and policy is vast. Semi-structured interviews with purposively sampled stakeholders were used to inform the project.

The expert group participated in 6-8 hour individual expert-elicitation interviews and a subsequent 2-day group deliberation (Methods). The interview and deliberation protocols were collectively developed by the author team and then administered by the assessment facilitators. 950 transcript pages from the interviews and deliberation were iteratively analyzed and distilled. Results presented here include subjective probabilistic judgments documented individually (Extended Data Figs 2–4) and the origins of these judgments in the scientific literature (Supplementary Information). The approach establishes a foundation for assessing—across the full academic field—the strengths and limitations of current understanding and the reasons for disagreement.

This assessment approach complements existing crosscutting reviews, meta-analyses, and perspectives on climate and conflict (e.g., [2,8,9,17,23,25-27]). The methods here go beyond previous syntheses by (1) systematically characterizing judgments about well-quantified risks and also more uncertain outcomes that may carry large consequences; (2) thoroughly exploring how these judgments are underpinned by present-day knowledge; and (3) rigorously combining individual and collective deliberations to minimize biases.

The climate–conflict relationship

The experts agree that, over the last century, climate variability, hazards, and trends have affected organized armed conflict within countries (Figs 1 and 2). They also agree that other conflict drivers are much more influential for conflict risk across experiences to date, compared to climate variability and change (Fig. 3).

Estimates of conflict risk related to climate to date overlap across experts (Fig. 1). Across the experts, best estimates are that 3–20% of conflict risk over the last century has been influenced by climate variability or change, and none of their individual estimated ranges excludes a role of climate in 10% of conflict risk to date. Throughout this assessment, risk is defined as the potential for consequences where something of value is at stake, which can be represented as probability multiplied by consequences[34]. Under this definition, an influence of climate on conflict risk can involve a changed likelihood of conflict occurring (e.g., the frequency of conflict outbreak or duration of conflict) or altered magnitudes of the resulting harmful consequences (e.g., number of deaths, destruction of assets, or legacies of violence). The definition allows for consideration of the initial outbreak and continuing incidence of violent conflict and its consequences[34].

In evaluating conflict drivers to date, each expert individually ranked causal factors that have most influenced the risk of conflict over the last century, drawing from a list of 16 factors collectively generated by the expert group (Fig. 3a, left column). Each expert also ranked factors based on how much uncertainty there is about their influence[35] (Fig. 3a, right column).

Across experts, four drivers are ranked as particularly influential for conflict risk to date: low socioeconomic development, low state capability, intergroup inequality (e.g., ethnic differences across groups), and recent history of violent conflict (Fig. 3a). The experts indicate more uncertainty about the influence of low socioeconomic development and recent conflict history, as compared to low state capability and intergroup inequality. There is high agreement that low socioeconomic development is one of the best predictors of intrastate conflict onset and continuing incidence[36]. Yet there is uncertainty about whether it is proxying for other mechanisms or is directly related to conflict risk, especially through fewer livelihood opportunities increasing the ease of mobilizing rebels (Supplementary Table 1). Similarly, recent conflict history is a strong predictor of subsequent conflict[36]. But there is uncertainty stemming from the many causal mechanisms possible, including more individuals with knowledge and weapons to fight, persistent factors contributing to instability, or continuation of grievances from previous violence.

Climate variability and/or change is low on the ranked list of most influential conflict drivers across experiences to date, and the experts rank it as most uncertain in its influence (Fig. 3a, Extended Data Tables 1 and 2, Supplementary Table 2). This judgment of uncertainty is perhaps unsurprising given the divergent research findings to date, which have motivated this expert assessment[1,3-7,9]. Within a risk framing, such uncertainty is important to assess when outcomes have low or difficult-to-quantify probabilities yet may carry large consequences relevant to ongoing decision-making[31,34,37].

The experts agree that additional climate change will amplify conflict risk, along with the associated uncertainties (Fig. 2). Climate variability and change are estimated to have substantially increased risk across 5% of conflicts to date (mean estimate across experts). By contrast, ~2°C global mean temperature increase above preindustrial levels is estimated to substantially increase conflict risk with 13% probability, rising to 26% probability under a ~4°C scenario. A "substantial" increase in conflict risk was defined in the elicitation as involving severe and widespread impacts, based on criteria for key risks developed and applied in assessment by the Intergovernmental Panel on Climate Change[34].

The judgments about increasing conflict risk in the ~2°C and ~4°C scenarios incorporate a hypothetical *current societies* constraint, i.e., assuming societies with current levels of socioeconomic development experience additional climate change. Even with this constraint, uncertainties increase notably. The range of individual expert estimates for a substantial increase in conflict risk due to climate grows from 0–15% of conflicts to date to 10–50% probability in the ~4°C scenario (Fig. 2).

Climate–conflict linkages

Across experts, there is low confidence in the mechanisms through which climate affects the risk of conflict (Fig. 3, Extended Data Tables 1 and 2). For each conflict driver across experiences to date, each expert estimated the frequency with which climate variability and change increased or decreased conflict risk through the driver or, by contrast, had negligible effect (Fig. 3, Extended Data Figs 5 and 6). For the four conflict drivers ranked as most influential overall, the experts estimate their climatic sensitivity to be relatively low (low socioeconomic development, low state capability, intergroup inequality, and recent conflict history in Fig. 3b). Non-climate factors

and historical processes importantly shape these conflict drivers (Extended Data Table 1). However, where climate has affected conflict risk via these top-four conflict drivers, the experts estimate that climate has most often increased risk rather than decreased it (Fig. 3c).

By contrast, the causal factors judged most sensitive to climate are ranked as much less influential for the risk of conflict overall. In particular, economic shocks and natural resource dependency are judged to be likely climate–conflict linkages across experiences to date (Fig. 3b), yet their overall influence on conflict risk is much lower (Fig. 3a). Further, the experts estimate that climate has had more variable and uncertain effects in both increasing and decreasing conflict risk through these linkages (Fig. 3c).

Climate-related hazards, variability, and change can cause economic shocks through impacts on agricultural productivity or food prices or through the direct and indirect consequences of disasters such as floods, droughts, heat waves, or cyclones (Extended Data Table 2). Such shocks could heighten conflict risks through several potential mechanisms, including: reduced opportunity costs for violence, where adverse impacts on livelihoods make participation in violence relatively more attractive; uneven economic impacts precipitating the collapse of intergroup bargains; or deleterious effects on long-run socioeconomic development. The consequences of climate-related economic shocks are highly variable and depend on the affected areas and timing (e.g., growing-season drought in rain fed versus irrigated croplands), affected sectors and groups (e.g., exports impacting state capability and/or employment), and political will and response capacity (e.g., availability of cash transfers or alternative livelihoods).

Linkages via natural resource dependency also underscore uncertainty due to context-specific and multifaceted interactions (Extended Data Table 2). Climate-related resource scarcity can increase conflict risk, yet it can also stimulate cooperation to ensure fair distribution of resources, or decrease conflict risk if more time is spent on procuring food or conditions are unfavorable for sustaining an armed group[38,39]. Climate-related resource abundance can also have conditional and complex effects if there are higher opportunity costs for violence or, instead, improved conditions for mounting and sustaining conflict.

Into the future, climate change could increase the risk of conflict through channels beyond climate-variability effects to date (Extended Data Table 2). Because such linkages exceed historical experiences, uncertainties increase especially under large magnitudes of climate change, e.g., ~4°C global mean warming (Fig. 2). Extrapolation from historical relationships is fraught with uncertainty because complex climate–conflict linkages partly depend on future socioeconomic development pathways, macroeconomic patterns (e.g., global recession), shifts in state capability, ideological fluctuations, and the state of global order and cooperation (e.g., via the UN Security Council).

Future climate–conflict linkages could involve exacerbation of climate–conflict connections present in experiences to date, climate change impacts fundamentally beyond previous experiences, or circumstances where existing response capacities reach limits. Across these categories, relevant climate change risks include substantial economic impacts, climatic extremes and associated disasters, impacts on agricultural production, or differential climate change impacts increasing intergroup inequalities (Extended Data Table 2). Such impacts could also

reveal “missing” institutions, where governance mechanisms do not yet exist to address emergent climate change risks (e.g., the potential for substantial increases in migration).

The potential for risk reduction

The experts agree that conflict risk related to climate can be reduced with substantial investments in conflict risk reduction (Extended Data Fig. 7 and Table 3). For conflicts to date, the experts estimate a 67% probability that climate-related conflict risk could be reduced through investments addressing known drivers (mean estimates across experts). For a ~4°C scenario, however, the estimated potential for reducing climate-related conflict risk drops to 57% probability, given more severe climate change impacts.

The potential for synergies exists between conflict risk reduction and climate change adaptation (Extended Data Table 3). Similar factors determine vulnerability to both climate change and armed conflict. Specific measures addressing these factors can ameliorate climate–conflict linkages and advance sustainable development and human security, interlinked with the quality of governance, the persistence of structural inequities, and capacity across levels of government. Relevant adaptation options (e.g., crop insurance, training services, cash transfers, postharvest storage, improved land tenure) can support food and livelihood security and economic diversification beyond agricultural livelihoods. Further, consideration of climate could be incorporated into standard conflict risk reduction via conflict mediation, peacekeeping operations, and post-conflict aid and reconstruction. Climate–conflict linkages could be reduced by addressing environmental challenges in building cooperation and peace or by preventing relapse into conflict in societies with especially high vulnerability and exposure to climatic hazards[40].

However, there is a need to increase understanding of both the effectiveness and the potential adverse side-effects of different actions (Supplementary Table 3). Trade-offs include the ways climate responses can create new problems or unintended consequences, potentially affecting conflict risk[2]. For example, actions that are adaptive from one perspective, such as food export bans following climate-related crop failures, can increase instability elsewhere. Adaptation policies favoring some groups over others or displacing climatic hazards to more vulnerable groups could also affect conflict risk. Limitations in reducing conflict in general will also apply to climate–conflict linkages, such as challenges in predicting the onset and severity of conflict or in addressing the root causes of exclusion and unequal access to services and markets. Effective management of the risks will benefit from improved evidence and also approaches appropriate for deeper, difficult-to-quantify uncertainties.

Analytical challenges

Challenges in analysis strongly contribute to key uncertainties identified in this assessment, especially (1) the relative importance of climate as a driver of conflict, (2) the mechanisms through which climate affects conflict, (3) the conditions under which they materialize, and (4) the implications of future climate change for conflict risk (Supplementary Table 4).

In understanding why conflict occurs, tight causal inference is elusive for many fundamental questions of interest, including what most distinguishes countries with conflict onset versus not, and how particular cases can be understood in the context of broader patterns (Supplementary

Table 4). Model design and interpretation of reported results are limited accordingly (e.g., see the sections on model design, the garden of forking paths, and the file drawer in Supplementary Table 4). Causal inference is more feasible for temperature variability as compared to slow-trending variables such as levels of socioeconomic development, state capability, or intergroup inequality. This limits understanding of climate's relative importance for conflict, the mechanisms and mediators of climate's effect on conflict, and its interactions with other conflict drivers (e.g., the degree to which climate modulates the timing of conflict versus increasing the overall number of conflicts that occur). Compared to studies of the outbreak of war, the climate and conflict literature has been less focused on theory and mechanisms of effects, such as through process tracing and examination of case studies to generate hypotheses for subsequent systematic testing.

Relationships between conflict drivers and outcomes tend to be temporally bounded and place dependent[41] (Supplementary Table 4). As is also the case for general conflict studies, much empirical evaluation to date has examined climate–conflict linkages since 1945, a period in which organized armed conflict has predominantly occurred in unique conditions resulting from the breakdown of colonial empires and the rise of weak independent states. Analysis has focused on contexts where climate variability has led to conflict, rather than resilient, cooperative, and peaceful outcomes evident in ethnographic works.

Analyzing the effects of climate variability through such approaches leads to multiple uncertainties about implications for the future. Future climate–conflict linkages will involve climate variability, mean climate change, and diverse resulting climate change impacts, even though empirical investigation has focused largely on climate variability (e.g., temperature or precipitation variability). Open questions pertain to the ways climate affects distinct phases in conflict, ranging from its onset and escalation through to termination. The future will entail societal adjustments to new climate baselines, potential limits to such adaptation, and thresholds in climate change impacts for which historical precedents do not exist. The implications for conflict will be importantly modulated by state systems and the policies of major powers, which will also be impacted in uncertain ways by climate change.

Conclusion

The aim of this analysis has been a comprehensive and balanced assessment of the relationship between climate and conflict risks, reconciling contradictory findings in comparative and empirical research. Based on the methods applied here, there is agreement that climate variability and change shape the risk of organized armed conflict within countries. In conflicts to date, however, the role of climate is judged to be small compared to other conflict drivers, and the mechanisms of climate's effect on conflict are uncertain. As risks grow under additional climate change, many more potential climate–conflict linkages become relevant and extend beyond historical experiences.

What is the usefulness of resolving the scientific disagreement and identifying areas of agreement? For those focused on climate, synoptic understanding of the climate–conflict relationship is important even if climate's role is relatively minor among the drivers of conflict. Given that conflict has pervasive detrimental human, economic, and environmental consequences, climate–conflict linkages, even if minor, would significantly influence the social

costs of carbon and decisions to limit future climate change. For those focused on conflict, the assessment has pointed to the different ways climate may interact with the major drivers of conflict risk. Effectively managing such interactions will require mainstream and holistic, rather than myopic, consideration of climate's role across diverse settings and attention to uncertainties that will persist. And finally, appreciation of the future role of climate change and its security impacts can help prioritize societal responses, which could include enhanced global aid and cooperation.

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End Notes:

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Main Text Figure Captions:

Figure 1. The estimated relationship between climate and conflict risk to date. Each expert provided subjective probabilistic judgments of the percent of total conflict risk related to climate across experiences over the last century. The estimated 1st, 50th, and 99th percentiles are shown for each expert.

Figure 2. Estimated changes in the relationship between climate and conflict risk under increasing climate change. For three scenarios, each expert estimated the likelihood that climate leads to negligible, moderate, or substantial changes in conflict risk. For violent conflicts to date (blue), probability estimates indicate how frequently climate variability and change have led to the specified changes in conflict risk. For a ~2°C (orange) and a ~4°C (red) scenario, probability estimates indicate potential changes in conflict risk compared to today's climate. For these hypothetical ~2°C and ~4°C scenarios, each expert considered associated effects of climate change for current societies, assuming, for example, current levels of socioeconomic development, population, and government capacity. Open circle: individual estimate; filled circle: mean across experts.

Figure 3. Factors driving conflict risk and their relationship to climate in experiences to date. (**a**) Rankings of causal factors most influencing conflict risk. Each expert individually ranked six causal factors most influencing violent conflict to date, and then ranked six causal factors for which there is the most uncertainty about their influence. Aggregated weighted rankings of the causal factors are indicated: a factor ranked first in the listing of an expert is assigned a value of 6, through to a value of 1 for a factor ranked sixth. (**b** and **c**) The relationship between factors driving conflict risk (from **a**) and climate in experiences to date. Two measures are shown: (**b**) climate sensitivity and (**c**) increase–decrease ratio. For conflicts to date in which each causal factor is relevant, climate sensitivity is the estimated fraction of these conflicts for which climate has affected conflict risk, increasing or decreasing it. Of this, the increase–decrease ratio is the fraction allocated to increased conflict risk. For climate sensitivity, a higher value indicates that climate variability and change have more frequently modulated conflict risk through the factor. For the increase–decrease ratio, a value of 1 indicates climate sensitivity estimated only to increase conflict risk, whereas a value of 0.5 indicates climate sensitivity equally increasing and decreasing conflict risk. Filled circle: mean across experts, with circle size indicating the number of experts who ranked the factor in their top-six list; range for each factor: minimum and maximum values across the 11 experts.

Methods:

The structure of the expert assessment

The expert assessment combined three primary phases: (A) in-depth, full-day expert-elicitation interviews, conducted individually with each member of an 11-person climate and conflict expert group; (B) an in-person, two-day deliberation of the expert group on the interview results and associated extensions; and (C) development of a synthesis manuscript co-authored by everyone in the expert group. The author team of this manuscript consists of the climate and conflict expert group (WNA, HB, MB, JDF, CSH, JFM, JO, PR, JS, KAS, NU) and the assessment facilitators (KJM, CMK, CBF). Stanford University IRB reviewed and approved the human subjects involvement in this research project, including associated procedures for informed consent.

Each of the expert-assessment phases has substantial precedence in the applied-decision-sciences and assessment literature[29,37]. For decades, combination of the three phases has been recommended[30-32], but not yet attempted, to reduce biases that arise in expert-panel assessment

(phases B and C) without sufficient attention to the range of individual perspectives on the literature and its uncertainties (phase A).

The assessment facilitators identified the expert group through extensive literature searches for publications on climate and conflict and additional suggestions from HB, MB, JDF, and KAS for general conflict scholars. For each potential expert (~65 in total), the facilitators determined disciplinary background, affiliation, published work and associated metrics, collaborators, relative emphasis on comparative and crosscutting analyses including replicable quantitative empirical research, previous conclusions about climate and conflict, and relative focus on climate versus conflict. From this evaluation, 12 experts were identified based on a goal of spanning a wide range of relevant perspectives, in line with expert-elicitation best practices. In particular, the experts were selected to encompass a wide range of relevant disciplines (e.g., political science, economics, geography, environmental science), career stages and institutions, beliefs about the strengths of connections between climate and conflict, and relative focus on climate versus conflict. 11 of these experts accepted invitation to participate in the project, forming the expert group.

Phase A: expert elicitation

Expert elicitation is a well-vetted interview method from the applied decision and policy-analysis sciences[29]. The interview approach documents the subjective probabilistic judgments of experts, using question formats that minimize cognitive biases and overconfidence. Associated practices include exploring thinking first about more extreme possibilities as compared to anchoring on initial best guesses; applying backwards analysis in which an expert considers and explains how he or she could be incorrect; and specifically challenging experts to evaluate the literature and interpretations of other experts where there are disagreements.

The interview approach also involves extended exploration of the bases of expert judgments in available evidence, along with the strengths and limitations of that evidence. For this expert assessment of climate and conflict, relevant forms of evidence include empirical observations and datasets, case-based analyses, statistical analyses, theory and its testing, simulation and descriptive models, and experimental results. These forms of evidence, published in the peer-reviewed literature, draw from different disciplinary approaches and methods of research.

To develop wide-ranging understanding of societal questions relevant to evidence on climate and conflict, the assessment facilitators also conducted short, semi-structured interviews with a range of purposively sampled stakeholders who work on conflict risk reduction or climate change adaptation across professional and geographical contexts (Project Data 1[42]). Perspectives from these stakeholder interviews informed, in particular, the semi-structured question follow-ups during the individual expert-elicitation interviews.

The individual expert-elicitation protocol for this assessment characterized expert judgments on the evidence across four progressive themes: (1) the relative importance of causal factors increasing conflict risk, (2) the relationship between climate and conflict risk to date, (3) the relationship between climate and conflict risk in the future, and (4) the implications for climate change adaptation and conflict risk reduction.

The assessment facilitators drafted the individual expert-elicitation interview protocol. Each member of the expert group individually reviewed the clarity and effectiveness of the draft protocol. These reviews especially considered questions most important for evaluating the state of knowledge on the topic and reasons for disagreement across lines of evidence. The assessment facilitators, in turn, revised the expert-elicitation interview protocol, the expert group reviewed it a second time, and on that basis, the assessment facilitators prepared a final version of the interview protocol, along with implementation notes. In parallel, the assessment facilitators tested the interview protocol with two advanced graduate students researching climate and conflict. See Methods Files 1 and 2 for the final individual expert-elicitation interview protocol and associated response sheet[42].

To support the expert-elicitation interviews, the assessment facilitators developed a briefing book of relevant literature, including suggestions from the expert group (Methods File 3[42]). The goal of the briefing book was to ensure that expert judgments about the state of knowledge, as documented in the interviews, thoroughly built from a full range of available evidence. The experts individually reviewed the briefing book in advance of the expert-elicitation interviews.

Each expert-elicitation interview was administered over 6-8 hours by KJM, assisted by CMK, at the home institution of the expert. Based on audio recordings, transcripts were prepared by CMK for each interview (constituting 787 pages in total) and then summarized anonymously by KJM with each expert randomly assigned an identifying number (Project Data 2[42]). Per the Stanford University IRB approval for this project and associated informed consent of the participating experts, the anonymized transcript summary is provided in Project Data 2[42], but not the raw transcripts themselves.

Phase B: group deliberation

The second stage of the assessment was the in-person, two-day deliberation of the full expert group. Its design was based on best practices for strategically exploring perspectives[37,43]. In particular, the deliberation combined full-group discussions, small-group discussions, and individual reflections preceding those discussions. The biggest areas of disagreement and most wide-open questions were considered through different modes of interaction, in addition to the discussions: short stage-setting perspectives expanding thinking on the full range of possibilities; construction of conceptual graphics to reveal understanding of the experts' mental models; and development of summary text. The deliberation was moderated by KJM.

The assessment facilitators drafted the group-deliberation agenda in advance of the meeting, with revision following the expert group's individual review of it (for the final agenda and associated individual workbook, see Methods Files 4 and 5[42]). Based on audio recordings of the group deliberation, transcripts were again prepared (constituting 163 pages in total), with points raised then combined anonymously with the analysis of the individual expert-elicitation interviews (Project Data 2[42]).

After the group deliberation, each expert revisited his or her judgments from the individual expert elicitation, updating them in some cases.

Phase C: synthesis manuscript

The summarized transcripts from the individual expert-elicitation interviews and group deliberation were analyzed by KJM through qualitative content analysis. Unique points raised were coded across the assessment themes. Commonalities and differences in expert perspectives were identified iteratively and inductively through multiple rounds of synthesis. Throughout the resulting summary, each expert is consistently identified with his or her randomly assigned number, and group deliberation inputs are referenced as GD.

The nature of the corresponding traceable accounts—the linkages from expert judgments to their basis in the underlying evidence—was evaluated. Degree-of-certainty descriptors[37] were applied accordingly to characterize existing evidence (*limited* to *robust*) and agreement about the evidence (*low* to *high*). This approach draws from guidance developed for and applied by lead authors in assessments by the Intergovernmental Panel on Climate Change, as well as from analysis of it[35].

Data were analyzed in Microsoft Excel and RStudio. In plots of subjective probabilistic judgments elicited, each expert's randomly assigned identifying number is used. For questions about historical and future conflict risk, as well as most influential causal factors, measures of sensitivity and increase–decrease ratio, related to climate, are defined in the analysis of judgments made. Sensitivity is $(I + D) / T$. Here, I is the sum of probabilities assigned to the moderate and substantial increase categories for relevant elicitation questions. D is the sum of probabilities assigned to the moderate and substantial decrease categories. T is the total probability assigned across the substantial, moderate, and negligible change categories. The increase–decrease ratio is $I / (D + I)$. An increase–decrease value of 1 indicates weighting of the moderate and substantial *increase* categories, but not the decrease categories. An increase–decrease value of 0.5 indicates equal weighting of the increase and decrease categories.

This analysis synthesized the 950 pages of interview and group-deliberation transcript, along with the subjective probabilistic judgments documented, into a first draft of this manuscript. The full expert group then commented heavily on the draft through multiple rounds of revision.

Data Availability Statement:

All data generated or analyzed during this study are included in this published article (and its supplementary information file) or are available in the Stanford Digital Repository (https://purl.stanford.edu/sy632nx6578). Stanford University IRB approved the human subjects involvement in this research project. Per that approval and associated informed consent, anonymized transcript summaries are provided, but not the raw transcripts themselves.

Extended Data Figure and Table Captions:

Extended Data Figure 1. Scope of the expert assessment. The risk of organized armed conflict within countries is shaped by interactions between the government and societal claimants (gray rounded arrows). Conflict and climate change are interconnected through climate impacts on drivers of conflict (center green/brown arrow pointing to the left). They also are interconnected through the consequences of conflict for climate-related vulnerability and exposure (center brown arrow pointing to the right). These interactions depend on their geographic and temporal

context. Against this backdrop, the assessment successively documented expert judgments across several themes: (1) drivers of conflict risk in experiences to date (gray rounded arrow on the left), (2) the relationship between climate and conflict risk to date and in the future (center of figure), and (3) implications for climate change adaptation and conflict risk reduction (top and bottom of figure). Throughout this figure, green arrows indicate interactions decreasing risk, whereas brown arrows indicate interactions increasing risk. Participating experts were selected to encompass a wide range of expertise on conflict, climate, or their combination. Figure illustration by K. Marx.

Extended Data Figure 2. Individual expert judgments about the relationship between climate and conflict risk. This figure provides raw numbers for each expert's subjective probabilistic estimates documented in the elicitation. For each expert, the first six rows correspond to the six causal factors the expert ranked as most influencing conflict risk to date, drawing from a list of 16 factors collectively generated by the full expert group. The next three rows correspond to past examples of organized armed conflict overall (labeled as Past) and to conflict risk under ~2°C and ~4°C scenarios (labeled as 2°C and 4°C). Numbers within each row are estimated probabilities. For each causal factor (the first six rows), the probabilities reflect judgments of how frequently climate variability and change have led to substantial, moderate, or negligible changes in conflict risk for violent conflicts to date involving the factor (probabilities ordered as: substantial decrease, moderate decrease, negligible change, moderate increase, substantial increase). For total risk of violent conflict to date (Past), the probabilities reflect judgments across past examples of conflict overall. For the ~2°C and ~4°C scenarios, specified probabilities reflect judgments of potential changes in conflict risk compared to today's climate; these hypothetical scenarios consider effects for current societies, assuming, for example, current levels of socioeconomic development, population, and government capacity. Shading categories visualize patterns. Causal factor abbreviations: recent history of violent conflict (RH), conflict in neighboring areas (CN), low socioeconomic development (SD), economic shocks (ES), vertical income inequality (VI), intergroup inequality (II), low state capability (SC), corruption (CR), illiberal democracy (ID), mistrust of government (MG), political shocks (PS), external intervention (EI), population pressure (PP), physical geography (PG), natural resource dependency (NR), climate variability and/or change (VC). Confidence levels[37] are indicated in the rightmost column: very low (vl), low (l), medium (m), high (h), and very high confidence (vh).

Extended Data Figure 3. Before–after comparisons of elicited expert judgments, part 1. After the group deliberation, each expert individually revisited his or her judgments from the individual expert elicitation, updating them in some cases. All adjustments made are depicted in this figure and in Extended Data Figure 4. Across expert-elicitation interview questions, individual updates following the group deliberation are modest. This figure indicates individual expert judgments about the relationship between climate and conflict risk for the six most influential factors ranked by each expert, for conflicts to date overall, and for ~2°C and ~4°C scenarios for current societies overall. Data shown are the initial judgments of each expert during the individual expert elicitation interviews. Estimates updated after the group deliberation (see Extended Data Fig. 2 for final estimates) are shown in red.

Extended Data Figure 4. Before–after comparisons of elicited expert judgments, part 2. After the group deliberation, each expert individually revisited his or her judgments from the individual expert elicitation, updating them in some cases. All adjustments made are depicted in this figure and in Extended Data Figure 3. Across expert-elicitation interview questions, individual updates following the group deliberation are modest. (**a**–**d**) In these plots, initial judgments during the individual expert elicitation are compared to the revisited judgments updated in some cases. Where judgments are updated, figure panels are repeated, showing the initial estimates in gray (**a** repeats Fig. 1, **b** repeats Fig. 2, **c** repeats Extended Data Fig. 6a, **d** repeats Extended Data Fig. 7). Detailed description of each panel and the symbols used is provided in the legends for Figs 1 and 2 and Extended Data Figs 6a and 7.

Extended Data Figure 5. Sensitivity and increase–decrease ratio for the relationship between climate and conflict risk: the judgments of each expert. For each expert, two measures are used to characterize elicited judgments about the relationship between climate and conflict risk: climate sensitivity and increase–decrease ratio. (**a**) Sensitivity and increase–decrease ratio are shown for the six most influential conflict drivers considered by an expert (light blue; mean across causal factors) and for past examples of violent conflict overall (dark blue). (**b**) Sensitivity and increase–decrease ratio are shown for conflict risk overall under ~2°C (orange) and ~4°C (red) scenarios. Expert number is specified for each data point. A comparison of blue, to orange, to red data points indicates that they shift to the right and upwards. This shift illustrates the overall judgment that, with intensifying climate change, climate is expected to increasingly affect conflict risk (illustrated by greater sensitivity, the upward shift). Additionally, this impact will increasingly serve to intensify rather than diminish conflict risk (illustrated by greater increase–decrease ratio, the shift to the right). For full definitions of the climate sensitivity and increase–decrease measures, see Methods.

Extended Data Figure 6. Sensitivity and increase–decrease ratio for the relationship between climate and conflict risk: judgments for most influential conflict drivers. Two measures are used to characterize elicited judgments about the relationship between factors driving conflict risk and climate in experiences to date: climate sensitivity and increase–decrease ratio. (**a**) Sensitivity and increase–decrease ratio are shown for each causal factor (mean across experts; causal factor abbreviations as in Extended Data Fig. 2). The size of each data point indicates the number of experts who ranked the causal factor in their top-six-factor list. (**b** and **c**) Mean sensitivity and increase–decrease ratio are repeated for each factor from **a**, shown as circles. For each factor, the range indicates the maximum and minimum sensitivity (**b**) and increase–decrease ratio (**c**) across the 11 experts. In **a** and **c**, for causal factors with 100% estimated for negligible change (sensitivity=0), the increase–decrease ratio is assigned a value of 0.5. Panels (**b**) and (**c**) are repeated from Fig. 3, but with different sorting of factors, to enable comparison with panel (**a**) here. For full definitions of the climate sensitivity and increase–decrease measures, see the Fig. 3 caption and Methods.

Extended Data Figure 7. Estimated potential to reduce climate-related conflict risk. For three scenarios (experiences to date, a ~2°C scenario, and a ~4°C scenario), each expert estimated the reduction in climate-related conflict risk that could occur with substantial investments in conflict risk reduction. Probability estimates are indicated for substantial decrease in conflict risk, moderate decrease in conflict risk, or negligible change. Substantial investments

include measures and policies to address known conflict drivers, which are expected to contribute to risk reduction. For past examples of organized armed conflict overall (blue), probability estimates indicate a risk reduction deficit[34]. For the ~2°C and ~4°C scenarios here, probability estimates assume the global mean warming levels are reached in the second half the 21st century. Probability estimates encompass the range of socioeconomic development pathways that could occur over that timeframe. Symbols used: open circle – individual estimate; filled circle – mean across experts.

Extended Data Table 1. The climatic sensitivity of most influential conflict drivers to date. Expert judgments about the state of knowledge on climate–conflict linkages are characterized for the most-influential factors driving conflict risk in experiences to date (see Fig. 3a). The available knowledge basis for each climate–conflict linkage is described through the level of evidence and the degree of agreement[37]. This approach linking expert judgments to their basis in the underlying scientific literature draws from guidance iteratively developed for and applied in assessments by the Intergovernmental Panel on Climate Change[35]. Summary terms for the type, amount, quality, and consistency of available evidence include *limited*, *medium,* and *robust*. The degree of agreement is characterized as *low*, *medium*, or *high*; the degree of agreement goes beyond consistency of evidence to consider the extent of established, competing, or speculative explanations across the full scholarly community. The assessment input relevant to this table's summarized entries draws from both the individual expert-elicitation interviews and the group deliberation (see Supplementary Tables 1 and 2 for the extended judgments about current knowledge).

Extended Data Table 2. Climate–conflict linkages to date and in the future. Expert judgments about the state of knowledge on climate–conflict linkages are characterized for linkages judged to be most salient to date (see Fig. 3b) and emergent in the future. The available knowledge basis for each climate–conflict linkage is described through the level of evidence and the degree of agreement, as in Extended Data Table 1[37]. The assessment input relevant to these summarized entries draws from both the individual expert-elicitation interviews and the group deliberation (see Supplementary Table 2 for the extended judgments about current knowledge).

Extended Data Table 3. Entry points for reducing climate–conflict risks. Expert judgments are provided for different entry points and approaches for conflict risk reduction and climate change adaptation. The available knowledge basis for each potential response is described through the level of evidence and the degree of agreement, as in Extended Data Table 1[37]. The assessment input relevant to these summarized entries draws from both the individual expert-elicitation interviews and the group deliberation (see Supplementary Table 3 for the extended judgments about current knowledge).

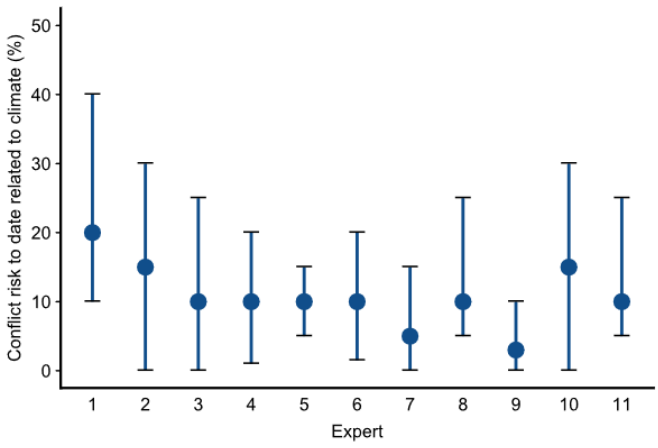

Conflict risk to date related to climate (%)
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
Expert

Figure 1.

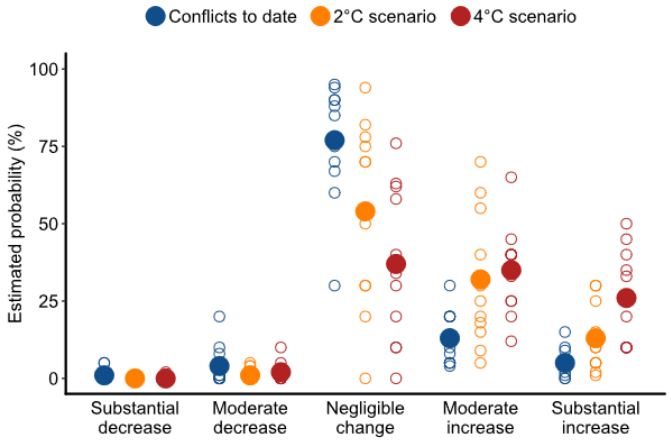

Conflicts to date
2°C scenario
4°C scenario
Estimated probability (%)
100
75
50
25
0
Substantial decrease
Moderate decrease
Negligible change
Moderate increase
Substantial increase

Figure 2.

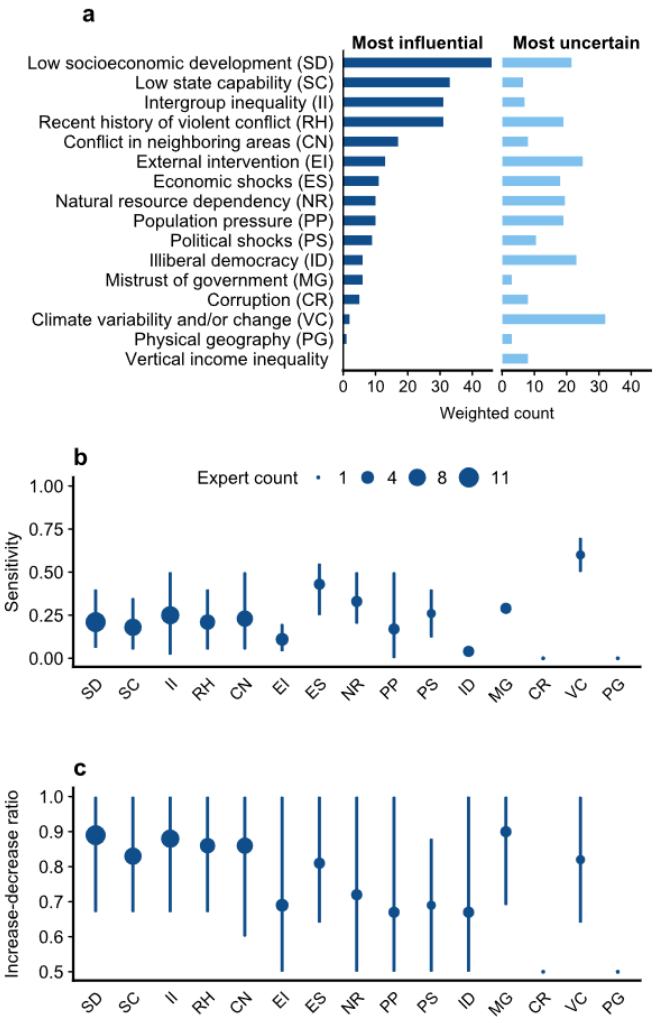
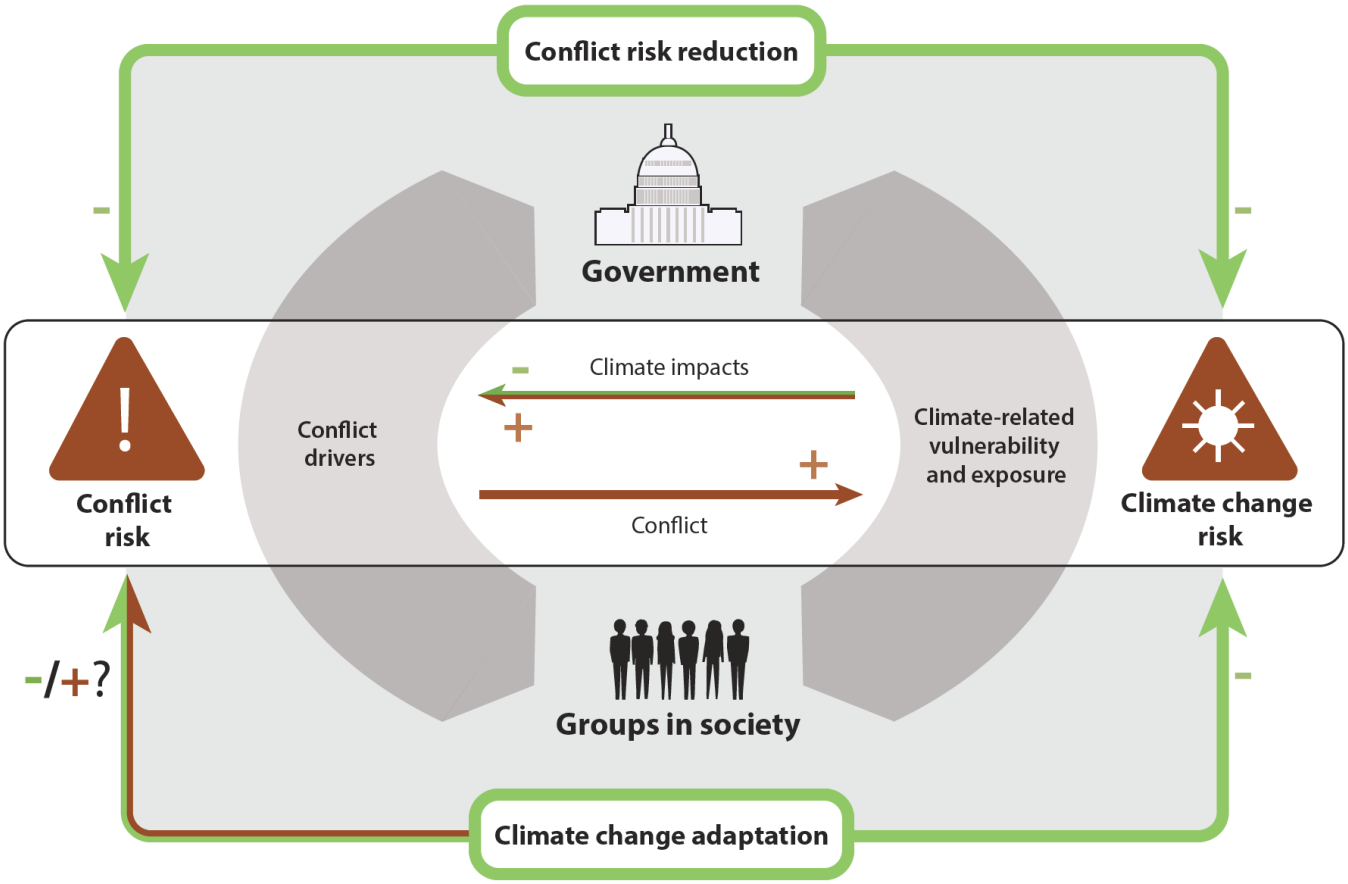

a
Most influential
Most uncertain
Low socioeconomic development (SD)
Low state capability (SC)
Intergroup inequality (II)
Recent history of violent conflict (RH)
Conflict in neighboring areas (CN)
External intervention (EI)
Economic shocks (ES)
Natural resource dependency (NR)
Population pressure (PP)
Political shocks (PS)
Illiberal democracy (ID)
Mistrust of government (MG)
Corruption (CR)
Climate variability and/or change (VC)
Physical geography (PG)
Vertical income inequality
0 10 20 30 40
0 10 20 30 40
Weighted count
b
Expert count 1 4 8 11
Sensitivity
1.00
0.75
0.50
0.25
0.00
SD SC II RH CN EI ES NR PP PS ID MG CR VC PG
c
Increase-decrease ratio
1.0
0.9
0.8
0.7
0.6
0.5
SD SC II RH CN EI ES NR PP PS ID MG CR VC PG

Figure 3.



Extended Data Figure 1.

Expert 1

ES	0	10	50	30	10	m
SD	0	0	90	10	0	l
SC	0	0	70	20	10	l
II	0	10	70	20	0	l
NR	0	10	70	20	0	l
RH	0	10	70	20	0	l
Past	0	0	70	20	10	l
2°C	0	0	30	60	10	m
4°C	0	0	10	45	45	m

Expert 2

SD	0	5	70	20	5	h
II	5	10	50	25	10	m
PS	0	5	60	30	5	m
EI	0	5	80	15	0	h
SC	0	10	65	20	5	m
PG	0	0	100	0	0	vh
Past	5	10	60	20	5	m
2°C	0	0	70	25	5	m
4°C	0	0	40	40	20	l

Expert 3

SC	1	1	94	2	2	m
PS	3	3	88	3	3	l
EI	1	1	96	1	1	m
SD	1	1	94	2	2	l
ID	1	1	96	1	1	m
CN	1	1	95	2	1	m
Past	2	3	85	5	5	l
2°C	1	4	75	18	2	l
4°C	1	1	63	25	10	vl

Expert 4

RH	0	1	95	4	0	l
SD	1	1	86	10	2	m
SC	1	1	90	7	1	l
ID	1	1	96	1	1	l
CN	1	1	93	4	1	l
II	1	1	94	3	1	l
Past	1	1	88	8	2	l
2°C	1	1	78	15	5	l
4°C	1	2	62	25	10	l

Expert 5

RH	0	0	83	10	7	m
CN	0	0	85	9	6	m
SC	0	5	82	8	5	m
II	0	1	88	7	4	l
MG	0	8	74	10	8	l
SD	0	5	77	12	6	l
Past	2	8	67	14	9	l
2°C	0	4	82	9	5	l
4°C	0	2	76	12	10	vl

Expert 6

SC	0	0	95	5	0	m
II	0	0	95	5	0	m
PP	0	0	100	0	0	m
SD	0	0	85	15	0	m
ES	0	0	75	20	5	l
CN	0	0	95	5	0	m
Past	0	0	90	10	0	l
2°C	0	0	70	20	10	l
4°C	0	0	34	33	33	vl

Expert 7

RH	0	0	70	20	10	m
SD	0	0	60	30	10	h
SC	0	0	70	20	10	m
CN	0	0	60	30	10	m
II	0	0	50	40	10	h
MG	0	0	70	25	5	m
Past	0	0	95	5	0	h
2°C	0	0	20	55	25	m
4°C	0	0	20	40	40	h

Expert 8

RH	2	10	60	20	8	l
SD	0	5	80	15	0	l
NR	0	10	80	10	0	m
ES	5	15	45	25	10	m
CN	2	10	60	20	8	l
VC	5	20	30	30	15	m
Past	5	20	30	30	15	l
2°C	0	0	30	40	30	m
4°C	0	0	10	40	50	m

Expert 9

RH	0	0	95	5	0	l
SD	0	1	92	6	1	l
PP	0	1	98	1	0	m
SC	0	2	93	4	1	m
EI	2	5	86	5	2	l
II	0	0	98	2	0	l
Past	0	1	94	4	1	m
2°C	0	0	94	5	1	l
4°C	2	10	58	20	10	vl

Expert 10

SD	0	0	70	20	10	vl
II	0	0	60	30	10	vl
NR	0	0	50	35	15	vl
CN	0	0	50	35	15	vl
PP	0	0	50	30	20	vl
VC	0	0	50	25	25	vl
Past	0	0	90	5	5	m
2°C	0	5	50	30	15	m
4°C	0	5	30	40	25	l

Expert 11

II	0	0	70	15	15	m
CR	0	0	100	0	0	h
EI	0	0	95	5	0	h
MG	0	0	70	20	10	m
SD	0	0	70	20	10	h
ID	0	0	95	5	0	h
Past	0	0	75	20	5	l
2°C	0	0	0	70	30	h
4°C	0	0	0	65	35	m

Estimated probabilities (%)

	Substantial decrease		Negligible change		Substantial increase	
F1	0	0	70	15	15	m
F2	0	0	100	0	0	h
F3	0	0	95	5	0	h
F4	0	0	70	20	10	m
F5	0	0	70	20	10	h
F6	0	0	95	5	0	h
Past	0	0	75	20	5	l
2°C	0	0	0	70	30	h
4°C	0	0	0	65	35	m

Most influential causal factors

Past examples of conflict

Future climate scenarios

Confidence level

Extended Data Figure 2.

Expert 1

ES	0	0	30	50	20	m
SD	0	0	90	10	0	l
SC	0	0	70	20	10	l
II	0	10	70	20	0	l
NR	0	10	60	30	0	l
RH	0	0	70	30	0	l
Past	0	0	70	20	10	l
2°C	0	0	30	60	10	m
4°C	0	0	10	45	45	m

Expert 2

SD	0	5	70	20	5	h
II	5	10	50	25	10	m
PS	0	5	60	30	5	m
EI	0	5	80	15	0	h
SC	0	10	65	20	5	m
PG	0	0	100	0	0	vh
Past	5	10	60	20	5	m
2°C	0	0	70	25	5	m
4°C	0	0	40	40	20	l

Expert 3

SC	1	1	94	2	2	m
PS	3	3	88	3	3	l
EI	1	1	96	1	1	m
SD	1	1	94	2	2	l
ID	1	1	96	1	1	m
CN	1	1	95	2	1	m
Past	2	3	85	5	5	l
2°C	1	4	75	18	2	l
4°C	1	1	63	25	10	vl

Expert 4

RH	0	1	95	4	0	l
SD	0	0	95	5	0	l
SC	0	0	97	3	0	vl
ID	0	0	99	1	0	l
CN	0	1	95	4	0	l
II	0	0	97	3	0	l
Past	0	1	95	4	0	l
2°C	0	1	93	6	0	vl
4°C	0	2	86	10	2	vl

Expert 5

RH	0	0	83	10	7	m
CN	0	0	85	9	6	m
SC	0	5	82	8	5	m
II	0	1	88	7	4	l
MG	0	8	74	10	8	l
SD	0	5	77	12	6	l
Past	2	8	67	14	9	l
2°C	0	4	82	9	5	l
4°C	0	2	76	12	10	vl

Expert 6

SC	0	0	95	5	0	m
II	0	0	95	5	0	m
PP	0	0	100	0	0	m
SD	0	0	85	15	0	m
ES	0	0	75	20	5	l
CN	0	0	95	5	0	m
Past	0	0	90	10	0	l
2°C	0	0	70	20	10	l
4°C	0	0	25	25	50	vl

Expert 7

RH	0	0	70	20	10	m
SD	0	0	60	30	10	h
SC	0	0	70	20	10	m
CN	0	0	60	30	10	m
II	0	0	50	40	10	h
MG	0	0	70	25	5	m
Past	0	0	95	5	0	h
2°C	0	0	50	45	5	m
4°C	0	0	30	60	10	h

Expert 8

RH	2	10	60	20	8	l
SD	0	5	80	15	0	l
NR	0	10	80	10	0	m
ES	5	15	45	25	10	m
CN	2	10	60	20	8	l
VC	5	20	30	30	15	m
Past	5	20	30	30	15	l
2°C	0	0	30	40	30	m
4°C	0	0	10	40	50	m

Expert 9

RH	0	0	95	5	0	m
SD	0	1	92	6	1	m
PP	0	0	100	0	0	vh
SC	0	2	93	4	1	m
EI	2	8	80	8	2	l
II	0	0	98	2	0	h
Past	0	1	94	4	1	m
2°C	0	0	94	5	1	m
4°C	1	5	44	40	10	l

Expert 10

SD	0	0	70	20	10	vl
II	0	0	60	30	10	vl
NR	0	0	50	35	15	vl
CN	0	0	50	35	15	vl
PP	0	0	50	30	20	vl
VC	0	0	50	25	25	vl
Past	0	0	90	5	5	m
2°C	0	5	50	30	15	m
4°C	0	5	30	40	25	l

Expert 11

II	0	0	70	15	15	m
CR	0	0	100	0	0	h
EI	0	0	95	5	0	h
MG	0	0	70	20	10	m
SD	0	0	70	20	10	h
ID	0	0	95	5	0	h
Past	0	0	75	20	5	l
2°C	0	0	0	70	30	h
4°C	0	0	0	65	35	m

Estimated probabilities (%)

	Substantial decrease		Negligible change		Substantial increase	
F1	0	0	70	15	15	m
F2	0	0	100	0	0	h
F3	0	0	95	5	0	h
F4	0	0	70	20	10	m
F5	0	0	70	20	10	h
F6	0	0	95	5	0	h
Past	0	0	75	20	5	l
2°C	0	0	0	70	30	h
4°C	0	0	0	65	35	m

Most influential causal factors

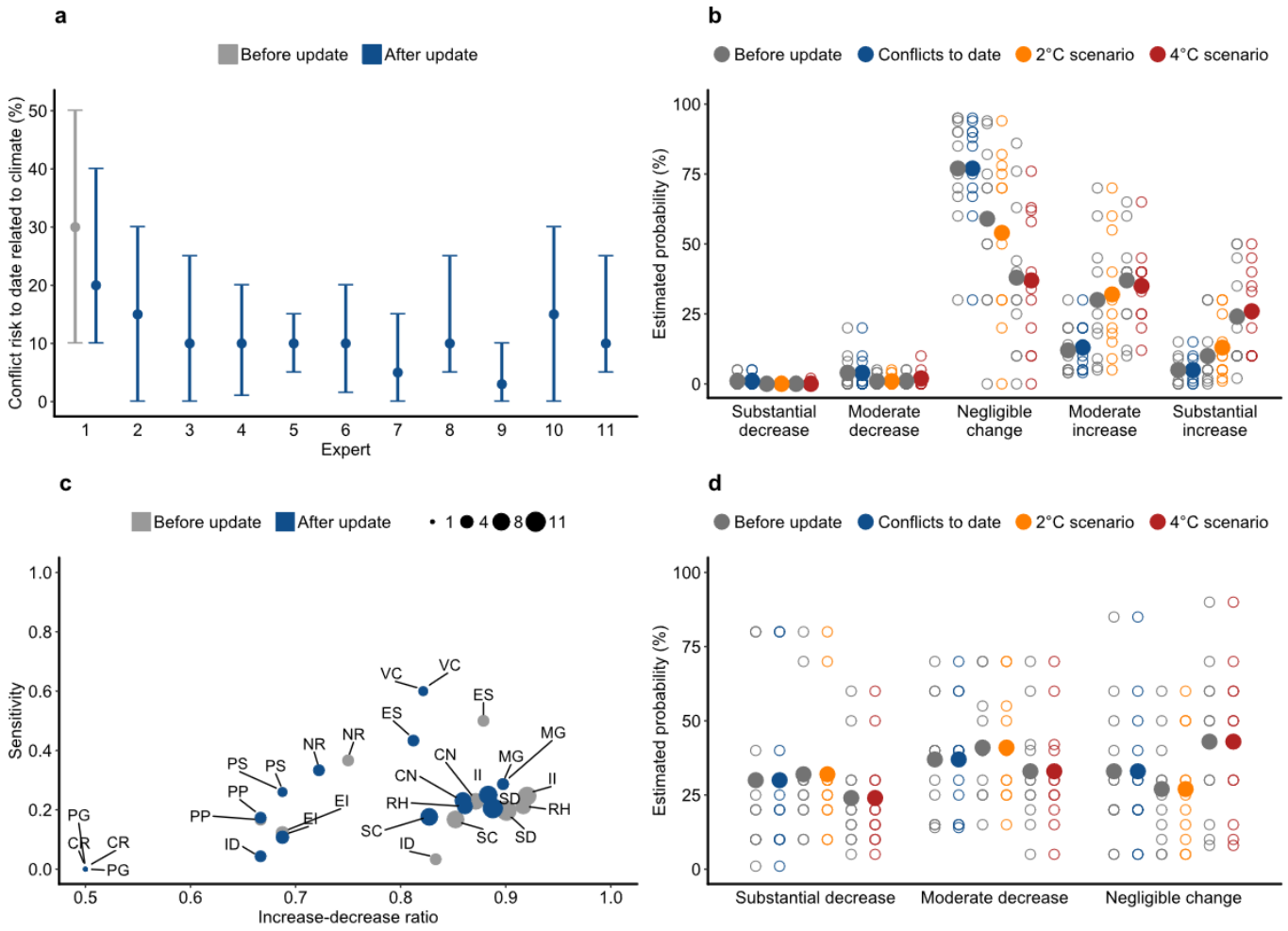
Past examples of conflict

Future climate scenarios

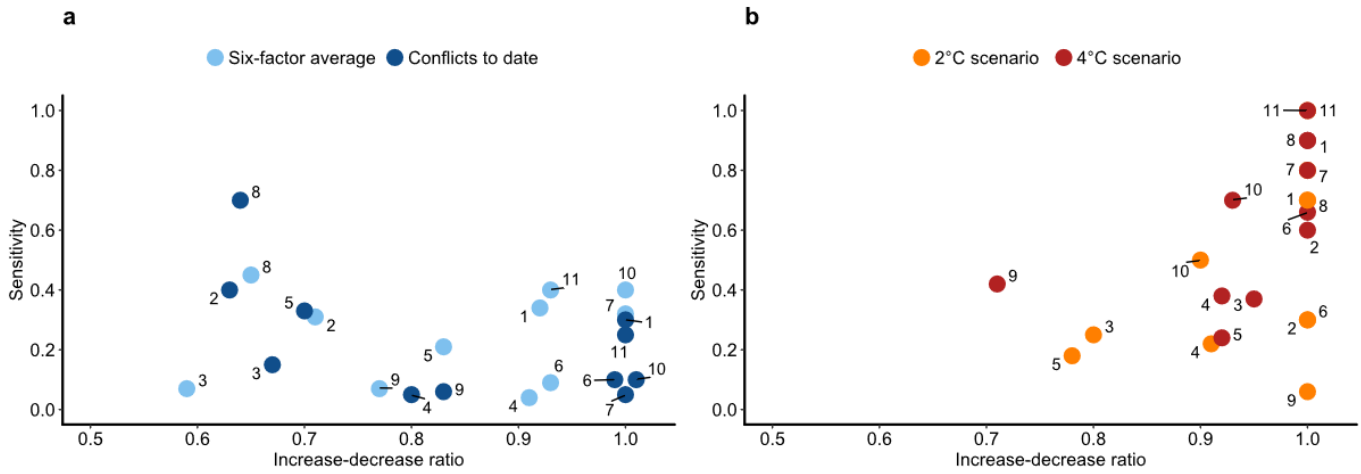
Adjusted values in red

Confidence level

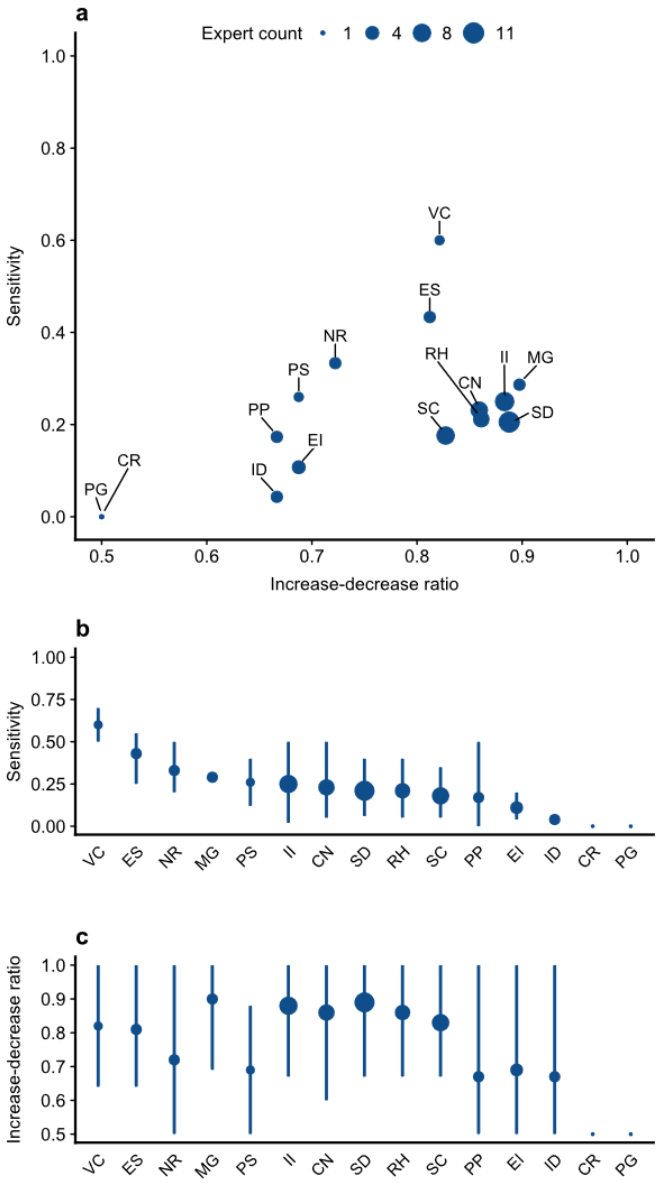
Extended Data Figure 3.



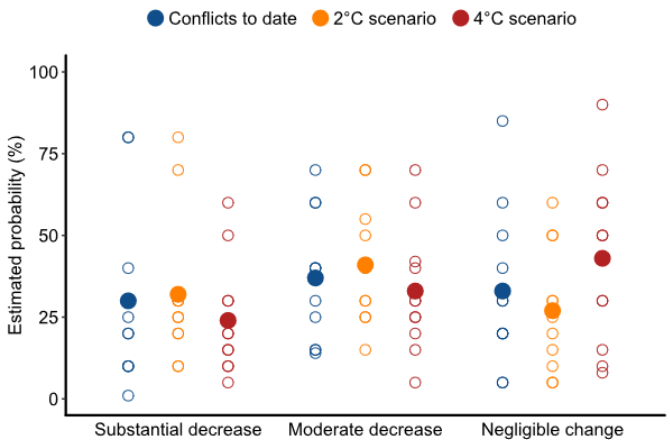
Extended Data Figure 4.



Extended Data Figure 5.



Extended Data Figure 6.



Extended Data Figure 7.

Extended Data Table 1.

Low socioeconomic development
Climate to some degree affects long-term socioeconomic development. There is greater uncertainty about resulting consequences for conflict risk. Climate–conflict linkages through low socioeconomic development could result from reduced opportunity costs for participating in violence, increased grievances, or increased vulnerability to climate-related risks and lower capacity to respond. [Evidence: *medium*, Agreement: *low*/*medium*]
Low state capability
Low state capability has persistent, difficult-to-change features. Some climate sensitivity increasing conflict risk could arise from climate-related shocks that decrease state capability. For instance, climate-related reductions in the taxable resource base could decrease the state's ability to project power across its territory or provide services supporting societal resilience. Climate-related shocks can also overly increase demands on the state, e.g., exacerbating intergroup inequalities when the state inadequately or unfairly distributes disaster assistance. [Evidence: *limited*, Agreement: *low*/*medium*]
Intergroup inequality
Intergroup inequalities and associated political exclusion, linked to non-climate factors and historical processes, may increase climate-related vulnerability of marginalized groups. Resulting differential impacts and exacerbated inequality could have potential consequences for conflict risk, e.g., via perceptions of unfairness, violent expression of grievances, or, by contrast, reduced ability to mobilize rebel groups. [Evidence: *limited*, Agreement: *low*]
Recent history of violent conflict
To the degree that previous episodes of conflict are triggered by climate, persistent legacies of violence could be carried forward through many intermediaries that create conflict traps. Recent conflict also increases climate-related vulnerability and decreases adaptive capacity, magnifying the impacts of climate-related hazards. [Evidence: *limited*/*medium*, Agreement: *medium*/*high*]
Conflict in neighboring areas
To the degree that episodes of conflict are triggered or exacerbated by climate, spillover of conflict could occur for multiple reasons, many of which are unrelated to climate. [Evidence: *limited*, Agreement: *medium*]
External intervention
The main and most potent forms of external intervention are political, unrelated to climate. Potential climatic sensitivity could arise through international involvement following climate-related shocks or perceived risks to shared natural resources, reducing or increasing conflict risk. [Evidence: *limited*, Agreement: *low*]

Extended Data Table 2.

Most likely linkages to date
• **Economic shocks:** Economic shocks are robustly correlated with conflict, and they can be a linkage between climate and conflict, e.g., via climate-related agricultural shocks, price shocks, or disasters, especially in low-income countries. The linkage can be mediated by reduced opportunity costs for participating in violence, by collapse of intergroup bargains, or by consequences for long-run socioeconomic development. Consequences for conflict depend on affected regions, sectors, or groups, along with timing and response capacity. [Evidence: *limited*/*medium*, Agreement: *medium*]
• **Natural resource dependency:** Climate-related resource scarcity and abundance have variable effects dependent on contexts, e.g., differential implications for rural producers versus urban consumers. Scarcity or abundance can, in some cases, increase conflict risk, whereas in others they can stimulate cooperation or otherwise decrease conflict risk. Centrality of agricultural livelihoods, issues of food access, and food prices can create linkages between climate and conflict risk, particularly in low-income countries. [Evidence: *medium*, Agreement: *low*]
Potential additional linkages in the future
• **Direct and indirect future economic impacts:** Especially under large magnitudes of climate change (e.g., ~4°C global mean warming), impacts triggering economic shocks or limiting economic development could particularly affect poor, conflict-prone regions or undermine democratic institutions and global cooperation. The degree to which globalization and economic integration will cushion versus amplify risk is uncertain. [Evidence: *limited*/*medium*, Agreement: *low*]
• **Global cooperation and international systems:** With increasing climate change, global cooperation could increase or decrease, affecting conflict risk. For example, concerted development assistance or, by contrast, securitization of climate responses and military engagement would differentially affect conflict risk. Climate impacts exceeding historical experiences may reveal “missing” institutions where global governance mechanisms do not yet exist, potentially challenging global cooperation and increasing conflict risk. Changes in world order, related to climate change or not, will modulate potential linkages between climate and conflict risk. Additionally, improved state capability and socioeconomic development could compensate for increased conflict risk due to climate change. [Evidence: *limited*, Agreement: *medium*]
• **Extreme events and disasters:** Extremes and associated disasters exacerbated by climate change could challenge state capability, authority, and legitimacy with competing claims around government responses. Climate-related impacts could, for example, trigger political shocks through government’s inability to adequately respond to climate-related risks. [Evidence: *limited*, Agreement: *low*]
• **Differential climate change impacts:** Poor, peripheral, or excluded regions may experience disproportionate climate change impacts, increasing conflict risk through exacerbated inequalities. Such populations may have, however, more limited mobilization capacity. Inadequate or unfair government assistance to marginalized groups could also increase conflict risk following climate-related impacts or disasters, e.g., again through exacerbated intergroup inequality. It could also decrease conflict risk, e.g., through increased self-reliant adaptation. [Evidence: *limited*, Agreement: *low*]
• **Food security:** Low-income countries dependent on agricultural production have high climate change vulnerability, given livelihoods and state capability shaped by agricultural income susceptible to climate change impacts. Implications for conflict risk can arise through economic impacts or price shocks creating political instability. Structural transformation of economies away from agriculture could reduce such climate–conflict linkages. [Evidence: *limited*, Agreement: *low*]
• **Migration:** Under large magnitudes of climate change, migration could occur at greater rates and scales (e.g., in response to desertification, extreme events, land loss, or livelihood impacts), as compared to adaptive and often beneficial environmentally related migration to date. The implications for conflict risk are uncertain given potential changes in migration dynamics, processes, and distances as well as host-community and country responses. There is also potential for increases in trapped populations unable to migrate, which may face greater climate-related risk and associated consequences for conflict risk. [Evidence: *limited*, Agreement: *low*]
• **Water:** Under large magnitudes of climate change, uncertainties increase regarding the persistence of historical cooperation around water. [Evidence: *limited*, Agreement: *low*]
• **Nonlinearities and tail risk:** Under large magnitudes of climate change, potential nonlinearities and tail risk (e.g., related to substantial sea level rise, increasingly inhospitable or uninhabitable regions, mass migration, or interconnected global economic impacts) limit the relevance of current relationships between climate and conflict for understanding possible future outcomes, with difficult-to-reduce uncertainties about societal responses, adaptation limits, and implications for conflict risk. [Evidence: *limited*, Agreement: *high*]

Extended Data Table 3.

Risk reduction
• **Adaptation opportunities and constraints:** Even without an explicit conflict focus, adaptation can decrease conflict risk because similar factors contribute to climate change vulnerability and elevated conflict risk, for example for marginalized groups. Adaptive responses can also create new problems or unintended consequences, potentially increasing conflict risk. Violent conflict increases climate change vulnerability, decreases adaptive capacity, and reduces the feasibility of implementing adaptation. [Evidence: *medium*, Agreement: *medium*]
• **International peacekeeping:** The international standard treatment model (e.g., mediation, peacekeeping operations, post-conflict aid and reconstruction) is largely effective and relevant to climate-related organized violence. Embedding climate into standard conflict risk reduction could involve focusing on regions with climate-related vulnerability and exposure and recognizing that peacekeeping increases adaptive capacity. Predicting and preventing organized violent conflict is hard for both conflict onset and severity, including where climate might be relevant. There are associated challenges for resource allocation. In particular, identifying areas prone to conflict is much simpler than understanding how to address fundamental drivers of conflict, and the relative importance of climate compared to other drivers is hard to evaluate. [Evidence: *medium*, Agreement: *medium*]
• **International development assistance:** International development assistance can help countries reduce climate-related conflict risk, for example, through strengthening state capabilities to buffer climate-related shocks or through decreasing the sensitivity of livelihoods to climatic variability. However, there are uncertainties about the effectiveness of different actions and the potential for adverse side-effects. [Evidence: *medium*, Agreement: *low*]
• **State capability building:** Improved local-level government institutions and conflict resolution mechanisms, along with national and subnational adaptation policies, could reduce climate–conflict linkages. State capability building can, in principle, reduce disproportionate climate-related impacts for marginalized groups, but with challenges in implementation. [Evidence: *medium*, Agreement: *low*]
• **Economic diversification and resilience:** Adaptations buffering income to climate-related shocks, such as access to credit or irrigation, could reduce implications for conflict risk. Improved food production and security, including economic diversification beyond agricultural livelihoods, could also reduce climate–conflict linkages. [Evidence: *medium*, Agreement: *low*]
• **International governance:** Incorporation of climate change adaptation into global governance, treaties, and fora related to both climate and security could reduce climate-related conflict risk. Actions adaptive at one scale can have negative externalities increasing conflict risk, which is important to consider in policy design. [Evidence: *limited*, Agreement: *low*]
• **Migration:** Enabling adaptive migration could reduce potential climate–conflict linkages. With increasing magnitudes of climate change, new institutions for managing migration and relocation may be needed. [Evidence: *limited*, Agreement: *low*]

Supplementary Table 1. Drivers of organized armed conflict. Expert judgments about the state of knowledge are characterized for most-influential factors driving conflict risk in experiences to date (ordered as in Fig. 3a). The available knowledge basis is described through the level of evidence and the degree of agreement[37]. This approach linking expert judgments to their basis in the underlying scientific literature draws from guidance iteratively developed for and applied in assessments by the Intergovernmental Panel on Climate Change[35]. Summary terms for the type, amount, quality, and consistency of available evidence include *limited*, *medium*, and *robust*. The degree of agreement is characterized as *low*, *medium*, or *high*; the degree of agreement goes beyond consistency of evidence to consider the extent of established, competing, or speculative explanations across the full scholarly community. The assessment input relevant to the entries draws from both the individual expert-elicitation interviews and the group deliberation (Project Data 2[42]). Expert number is specified for the expert-elicitation interview inputs, and group-deliberation inputs are indicated as GD.

Low socioeconomic development
Definition of socioeconomic development: the well-being of people and the opportunities they have to be economically productive, often proxied by GDP per capita among other measures (Expert input: 6, 9, 10)
Importance for conflicts to date and uncertainties: • Low socioeconomic development, as GDP per capita, is one of the best predictors of intrastate conflict onset and incidence. It is the single most robust covariate in cross-section and time series. (Expert input: 1–4, 6, 7, 10, 11) [Evidence: *robust*; Agreement: *high*] • However, there is uncertainty about why, including correlation versus causation—the degree to which socioeconomic development as per capita GDP is directly related to conflict risk as compared to proxying for other mechanisms (e.g., economic shocks, grievances, low state capability, recent history of violent conflict). Isolating the role of socioeconomic development from other correlated factors is empirically challenging. (Expert input: 1–4, 6–8, 10, 11) [Evidence: *medium*; Agreement: *low*] • Low socioeconomic development, especially in combination with inequalities, could increase grievances and motivations for violence. Such effects are especially relevant to people who are not the poorest (e.g., extremely poor populations can't afford military equipment). (Expert input: 2–5, 7, 11) [Evidence: *medium*; Agreement: *low*] • The opportunity cost theory of rebel mobilization posits that rebel leaders are more able to recruit and fund soldiers in a society where alternative means of income are scarce. (Expert input: 2–7, 9, 11) [Evidence: *medium*; Agreement: *medium*] • Low socioeconomic development interacts with and can contribute to low state capability (e.g., via low tax revenue), another underlying driver of conflict. Low state capability reduces efficient provision of services and goods thereby increasing grievances, it limits socioeconomic development (e.g., via the absence of effective, impartial political and legal institutions and underpinning bureaucracy), and it also reduces the projection of authority, including policing and monitoring capabilities and accommodation of claims. (Expert input: 2–6, 9, 10) [Evidence: *medium*; Agreement: *medium*] • Conflict traps undermine both economic development and state capability. (Expert input: 3) [Evidence: *robust*; Agreement: *high*]
Low state capability
Definition: low coercive capability, limited ability to regulate and distribute power among claimants, and low bureaucratic capability to provide services and goods. Low state capability can be linked to low socioeconomic development and the political context. (Expert input: 1–9)
Importance for conflicts to date and uncertainties: • Intrastate conflict is concentrated in weak states. (Expert input: 6, 7) [Evidence: *robust*; Agreement: *high*] • Low state capability together with political shocks explains much historical civil war. New states forming from former colonies have low state capability (e.g., given little history of taxation and local authority) and new political competition (e.g., given new authority such as a UN seat or profits from cash-crop marketing). There is associated vulnerability of the center following political shocks that favor rebel groups or reduce capability of the center. (Expert input: 3) [Evidence: *medium*; Agreement: *medium*]

- State ability to project power across its territory, with coercive capability to defeat mobilizing rebel groups, is important because small rebel groups can do enormous, long-lasting damage. (Expert input: 2, 4, 5, 7–9) [Evidence: *medium*; Agreement: *high*]
- Ineffective or absent formal institutions for power sharing and transfer increase reliance on violence (e.g., informal bargains backed by threat of violence). (Expert input: 1, 4, 6) [Evidence: *medium*; Agreement: *medium*]
- Political stakes are high in weak states because access to services, resources, and security requires access to political power, with winners and losers. (Expert input: 1, 6) [Evidence: *medium*; Agreement: *medium*]
- In weak states, inefficient provision of services, including their role in buffering shocks, leads to grievances for which the state doesn't have administrative capacity or willingness to learn about, address, or suppress. (Expert input: 4, 6, 8, 9) [Evidence: *medium*; Agreement: *medium*]
- There is uncertainty because it is difficult to isolate the role of state capability from other correlated factors (e.g., GDP per capita is a poor proxy for state capability, even though it has been used as such). (Expert input: 1, 6, 8) [Evidence: *robust*; Agreement: *medium*]

Intergroup inequality

Definition: horizontal, systematic inequality among groups (Expert input: 9, 11)

Importance for conflicts to date and uncertainties:

- Intergroup inequality across multiple dimensions (e.g., political, economic, ethnic, social) is robustly linked to conflict. (Expert input: 1, 2, 4, 6, 9–11) [Evidence: *robust*; Agreement: *high*]
- Inequalities among groups can drive formation of conflict parties and enable mobilization, through identifiable differences and collective identities motivating self-sacrifice. For example, it can be easier to mobilize groups along ethnic lines, even if the grievance itself is political or economic, unrelated to ethnicity. (Expert input: 1, 2, 4, 5, 10, 11) [Evidence: *medium*; Agreement: *high*]
- Different societal cleavages can serve as the foundation for identity groups challenging the state. Across such potential cleavages, ethnicity has been prominent in contemporary conflicts, perhaps because it is detectable, permanent, and often geographically clustered (e.g., far from the capital with less access to power and less state monitoring and suppression). Such conclusions have emerged despite uncertainty stemming from poor measures and conceptualization of ethnic diversity. (Expert input: 2, 4, 7, 9, 10) [Evidence: *medium*; Agreement: *medium*]
- Political inequality, including exclusion from power, can provide a basis for conflicts. For example, less access to services and resources, decreased economic prospects, or greater vulnerability to state predations can lead to mistrust or mobilization to increase share of power. (Expert input: 2, 4, 6, 9, 10) [Evidence: *medium*; Agreement: *high*]
- Inequality in the size, strength, and capability of groups contributes to conflict in determining groups' threat capacity and associated access to power. Lack of threat of force to hold government accountable increases conflict likelihood for excluded groups. (Expert input: 6) [Evidence: *limited*; Agreement: *medium*]
- Economic inequality among groups can also increase conflict risk, sometimes interconnected with political inequality (e.g., via systematic exclusion from employment opportunities) or exacerbated grievances, noting that the poorest groups may not have sufficient capacity to mobilize. (Expert input: 1, 2, 4, 6, 10) [Evidence: *medium*; Agreement: *high*]
- There is uncertainty, especially around correlation versus causation, because intergroup inequality is slow changing, difficult to measure, and difficult to isolate from other conflict drivers (e.g., ethnic differences versus economic conditions). (Expert input: 1, 3, 4, 8, 10) [Evidence: *medium*; Agreement: *low*]

Recent history of violent conflict

Definition: recent history of conflict within a country within the last few years or sometimes even decades (Expert input: 3, 5, 7, 9, 11)

Importance for conflicts to date and uncertainties:

- Recent history of violent conflict is a strong predictor of subsequent conflict. Instability and violent conflict tend to repeat themselves, with momentum of violence once it has begun. (Expert input: 1–5, 8, 9) [Evidence: *robust*; Agreement: *high*]
- Conflict traps arise for many reasons, about which there is uncertainty and difficulty in isolating conflict autocorrelation from other persistent factors. (Expert input: 1–4, 7–9, 11) [Evidence: *medium*; Agreement: *low*]
- Potential causal mechanisms include the following: 1) the ability to organize a violent group and overcome the collective action problem can persist (e.g., commitment problem already overcome, greater ease of recruiting individuals with knowledge and weapons to fight), 2) recent history of violent conflict is simply an indicator for underlying instability or other persistent factors contributing to conflict (e.g., poverty, low state capability, resource scarcity intersecting with economic marginalization and intergroup inequalities), 3) violent conflict can breed new violent conflict (e.g., resentment and grievances carried over from previous conflicts not well resolved, losing parties

wanting to get back into power), 4) violent conflict can exacerbate other factors causing conflict (e.g., reduced socioeconomic development and investments in society, reduced state capability). (Expert input: 1–4, 7–9, 11) [Evidence: *medium*; Agreement: *low*]

Conflict in neighboring areas

Definition: conflict in neighboring areas, especially bordering countries (Expert input: 3, 4, 6–11)

Importance for conflicts to date and uncertainties:

- There is strong spatial clustering of conflicts, and spatial correlation is a statistical fact especially for sub-Saharan Africa. Conflict in a neighboring country can increase the likelihood of or directly cause civil war in another country. There are many reasons for such knock-on or contagion effects. (Expert input: 3, 4, 6–11) [Evidence: *robust*; Agreement: *high*]
- Diverse potential causal mechanisms include the following: common risk factors or conditions, availability of arms, linkages among groups or displaced populations, ethnic ties across borders dragging other countries into conflict (i.e., colonial boundaries bearing no relationship to ethnic boundaries), rebel groups seeking refuge across border and potentially receiving support or causing conflict there, external intervention where leaders pressure each other by supporting rebels in other countries, economic effects of conflict in neighboring areas (e.g., reduced economic growth and deterred investment, capital flights or skilled-worker migration), or inspiration spreading from one country to another. (Expert input: 3, 4, 6–11) [Evidence: *medium*; Agreement: *medium*]
- There is uncertainty because it is hard to distinguish spatial correlation of conflict versus actual causal interactions (e.g., correlation in covariate conditions causing conflict versus actual spillover of conflict, clustering versus diffusion of conflicts, domestic causes and common shocks versus cross-border influences). Despite advances in geospatial methods and reduced-form regression-based analysis of spillovers, uncertainty remains. (Expert input: 3, 6–10) [Evidence: *medium*; Agreement: *medium*]

External intervention

Definition: intervention by other states or actors (e.g., military assistance, arms, money, foreign sanctuaries, transnational ideologies proposing alternative forms of legitimate government), occurring for different reasons (Expert input: 2, 4, 5, 7, 9, 11)

Importance for conflicts to date and uncertainties:

- External intervention is common in civil wars, shaping onset, duration, severity, and termination of armed conflict. (Expert input: 2, 3, 5, 7, 9, 11) [Evidence: *robust*; Agreement: *high*]
- Different types of external intervention have different effects, with military intervention and peacekeeping most studied. (Expert input: 4) [Evidence: *medium*; Agreement: *medium*]
- External intervention can enable groups to mount rebellions. (Expert input: 1, 2) [Evidence: *medium*; Agreement: *medium*]
- Proxy wars (i.e., civil wars with major power support) involve military or financial support to groups, securing borders, safeguarding interests, or increasing influence of global or regional powers in a region or as part of contest with another regional or global rival—increasing the duration and severity of the conflict. (Expert input: 2, 3, 7, 9, 11) [Evidence: *robust*; Agreement: *high*]
- Neutral peacekeeping (e.g., UN) can be effective in preventing recurrence of violence through reducing likelihood of re-mobilization, providing signal of international attention, reassuring aggrieved populations, contributing to state building, etc. (Expert input: 4, 9) [Evidence: *robust*; Agreement: *medium*]
- There is uncertainty because intervention is hard to measure and to evaluate across diverse mechanisms and countervailing effects (e.g., whether external intervention is essential for mobilization and persistence of insurgency, whether far-state intervention instigates onset or exacerbates duration, how it depends on international world order). (Expert input: 3, 5–7, 9) [Evidence: *medium*; Agreement: *low*]
- There is also uncertainty about the relationship between conflict risk and foreign economic assistance (e.g., development aid, relief aid), which can be substantial in low-income countries, making societies more resilient or sometimes serving as a lootable commodity of war. (Expert input: 1, 3, 6, 9) [Evidence: *limited*; Agreement: *low*]

Economic shocks

Definition: short-term economic changes such as price shocks or economic crises (Expert input: 5)

Importance for conflicts to date and uncertainties:

- Economic shocks affect the strategic interaction between governments and armed groups, especially in low-income countries. (Expert input: 1, 6, 8) [Evidence: *medium*; Agreement: *medium*]

- Economic shocks can affect governments by leading to reduced government capacity, lowered tax revenue, reduced provision of services, or decreased ability to appease challengers—thereby increasing vulnerability to demonstrations or overthrow. (Expert input: 1, 6) [Evidence: *medium*; Agreement: *medium*]
- Economic shocks can enable mobilization through reduced opportunity costs for rebels joining arms movements, as income in productive sectors decreases. However, effects differ across labor-intensive versus capital-intensive sectors and for producers versus consumers. (Expert input: 1, 6, 8) [Evidence: *medium*; Agreement: *low*]
- Theory exists for how economic shocks could increase conflict risk (e.g., increased grievances, increased uncertainty, decreased government capacity). However, effects are dependent on economic context (e.g., low-income versus high-income country context) and type of shock (e.g., oil price shocks, food price shocks), with limited persuasive evidence. (Expert input: 1, 2, 4–6, 8, 11) [Evidence: *limited*; Agreement: *low*]

Natural resource dependency

Definition: centrality of natural-resource cultivation and exploitation to livelihoods and economies, for either renewable (e.g., agriculture) or nonrenewable (e.g., mining) resources, often expressed as percentage of GDP (Expert input: 1, 7, 10)

Importance for conflicts to date and uncertainties:

- Interactions between natural resource dependency and conflict risk are multifaceted, context specific, and conditional on state capability. Different natural resources are associated with different directions and magnitudes of effects on conflict risk. Findings are inconsistent and divergent, even for oil for which effects appear strongest. (Expert input: 1, 5–7, 9, 10) [Evidence: *medium*; Agreement: *low*]
- Both natural resource scarcity and abundance can induce conflict. (Expert input: 5, 8, 9, 11) [Evidence: *medium*; Agreement: *low*]
- Natural resource scarcity can increase conflict risk through decreased economic production (e.g., for agricultural or pastoral livelihoods) and opportunity costs for mobilization, but with differential effects across groups. (Expert input: 8–11) [Evidence: *medium*; Agreement: *low*]
- Natural resource abundance can increase conflict risk when valuable resources (e.g., oil, mining, cash crops) fund other activities or provide motivation for conflict. (Expert input: 1, 3, 5, 8–11) [Evidence: *medium*; Agreement: *low*]
- Dependence on export commodities for state revenue can increase conflict risk (e.g., via "wheat traps" or resource curse dynamics making governments less representative). (Expert input: 1, 7, 9, 10) [Evidence: *medium*; Agreement: *medium*]

Population pressure

Definition: population size, population growth, youth bulge, or migration (economic, refugee, internal, international, etc.)

Importance for conflicts to date and uncertainties:

- Countries with greater population size have more civil wars. (Expert input: 3, 4, 6, 9) [Evidence: *robust*; Agreement: *high*] Potential mechanisms include larger potential pools of dissidents or greater difficulty and cost of monitoring, policing, and managing the population. (Expert input: 4, 6, 9) [Evidence: *medium*; Agreement: *low*]
- Civil war risk is greater in countries with large numbers of young men, especially in poor countries with high unemployment. However, there is difficulty in distinguishing effects of low socioeconomic development, low state capability, and youth bulge. (Expert input: 1–3, 7, 10) [Evidence: *medium*; Agreement: *low*]
- Effects of population growth for conflict risk depend on social, demographic, and political contexts. (Expert input: 3, 4, 7, 10) [Evidence: *medium*; Agreement: *low*]
- Effects of migration for conflict risk are multifaceted, contingent, and contested (e.g., economic migration is often broadly beneficial, refugee migration can sometimes be a risk factor). (Expert input: 1–4, 6, 9) [Evidence: *medium*; Agreement: *low*]

Political shocks

Definition: political shocks are diverse: death of a dictator; assassination; falling out of former allies; canceled or contested election; coup; emergence of a new government; protest triggering government crackdown; external intervention creating instability and shock (Expert input: 2–4, 6, 9)

Importance for conflicts to date and uncertainties:

- Political shocks can trigger civil conflicts, dependent on type of shock, state capability, and context. (Expert input: 2, 4, 9) [Evidence: *robust*; Agreement: *medium*]
- Political shocks can serve as coordinating devices for rebellion, revealing opposition to government and stimulating mobilization. (Expert input: 2) [Evidence: *medium*; Agreement: *medium*]

- Low state capability increases vulnerability to political shocks that create opportunities for rebel groups to seize power (e.g., institutional political constraints are absent, the central government is unable to buy off opposition). (Expert input: 3) [Evidence: *medium*; Agreement: *medium*]
- Effects of political shocks, which can be destabilizing or stabilizing, are hard to predict, with shocks creating uncertainty. (Expert input: 2, 4–6) [Evidence: *medium*; Agreement: *low*]

Illiberal democracy

Definition: a state with some democratic procedures in place, but without the actual practice of democracy (e.g., with repression of civil liberties or controlled elections) (Expert input: 3, 4, 6, 7, 9, 11)

Importance for conflicts to date and uncertainties:

- Illiberal democracies and anocracies, on average, have more political instability and conflict risk compared to strict autocracies and true democracies. (Expert input: 3, 4, 9) [Evidence: *robust*; Agreement: *medium*]
- The reasons why regime type and political institutions matter for conflict risk are complicated and debated. For example, in going from autocracy to democracy there are more formal channels to voice grievances, but repressive capacity decreases. The relative importance of motivation versus potential for mobilization is debated. (Expert input: 1, 2, 6, 9) [Evidence: *medium*; Agreement: *low*]
- Greater rate of civil war outbreak can result from greater uncertainty in political succession, greater vulnerability to political shocks, lack of democratic process for conflict resolution, increased inequalities and mistrust of government, etc. (Expert input: 3, 4, 7, 11) [Evidence: *medium*; Agreement: *low*]

Mistrust of government

Definition: lack of trust following from corruption, illiberal democracy, etc. (Expert input: 7, 11)

Importance for conflicts to date and uncertainties:

- Illegitimacy of government, including corruption, poor representation, or unfair elections, can increase mistrust, motivation for violence, and conflict risk. (Expert input: 1, 5, 7, 11) [Evidence: *limited*; Agreement: *medium*]
- There is uncertainty because mistrust of government is correlated with and interacts with other factors (e.g., intergroup inequality, low state capability), challenging understanding of its independent role. (Expert input: 1, 7, 11) [Evidence: *limited*; Agreement: *low*]

Corruption

Definition: illegitimate, ineffective government with abuse of power for private gain (e.g., elites pocketing money, rents associated with positions of power, wider misallocation of resources) (Expert input: 11)

Importance for conflicts to date and uncertainties:

- Corruption can drive perceptions of intergroup inequality, increasing conflict risk. (Expert input: 11) [Evidence: *limited*; Agreement: *medium*]
- There is uncertainty because data on corruption are poor, with differing forms of corruption relevant across contexts. (Expert input: 7) [Evidence: *limited*; Agreement: *low*]

Physical geography

Definition: potentially relevant physical geographical factors are diverse: size of the state, presence of mountainous territory, distance to coast and rivers, distance to urban areas, etc. (Expert input: 2, 5)

Importance for conflicts to date and uncertainties:

- Physical geography can shape abilities or opportunities to fight. (Expert input: 5) [Evidence: *medium*; Agreement: *medium*] For example, mountainous, inaccessible territory can enable rebel groups to avoid detection and repression. (Expert input: 2, 5) [Evidence: *limited*; Agreement: *low*]
- Larger states are harder for the center to control, with peripheral areas at increased risk of long-running conflicts. (Expert input: 2) [Evidence: *medium*; Agreement: *medium*]
- Controlling territory with valuable resources can potentially motivate conflict. (Expert input: 5) [Evidence: *medium*; Agreement: *medium*]
- The diversity of physical geographical factors limits generalization about their influence on conflict risk. (Expert input: 5) [Evidence: *medium*; Agreement: *low*]

Supplementary Table 2. Climate–conflict linkages to date and in the future. Expert judgments about the state of knowledge on climate–conflict linkages are characterized through (1) most-influential factors driving conflict risk in experiences to date (see also Fig. 3 and Extended Data Figure 6) and (2) other linkages potentially relevant in both the past and the future. The assessment input relevant to the entries draws from both the individual expert-elicitation interviews and the group deliberation (Project Data 2[42]). Within bracketed text following each entry, available evidence and the degree of agreement[35] are specified, along with the relevant assessment input (see Supplementary Table 1 for summary terms and abbreviations). The relevant time frame of conflict is also indicated: *past* and/or *future*.

SOCIOECONOMICS
Economic shocks
• Economic shocks, which are robustly correlated with conflict, can be a linkage between climate and conflict especially in low-income countries (e.g., via climate-related agricultural shocks, price shocks, or disasters). (Expert input: 1–4, 6, 8) [Time frame: *past*, *future*; Evidence: *medium*; Agreement: *high*] • Across experiences to date, the linkage may result from reduced opportunity costs for participating in violence (i.e., where adverse climatic impacts on livelihoods make participation in violence relatively more attractive), from differential economic impacts or reduced state capability precipitating the collapse of intergroup bargains, or from consequences for long-run socioeconomic development. (Expert input: 1, 2, 4, 6, 8) The implications for conflict risk depend on affected areas (e.g., rain fed croplands), timing (e.g., growing season), affected sectors or groups (e.g., exports impacting both state capability and employment), and response capacity (e.g., availability of insurance). (Expert input: 2, 8) [Time frame: *past*; Evidence: *limited*; Agreement: *medium*]
Low socioeconomic development
• Climate variability and overall climatic conditions to some degree affect economic growth and long-term socioeconomic development, but with more uncertainty about how climate-related impacts on socioeconomic development in turn shape conflict risk (e.g., via reduced opportunity costs or increased grievances). (Expert input: 1, 2, 4–6, 8–11) [Time frame: *past*; Evidence: *medium*; Agreement: *low*] • Low socioeconomic development increases climate-related risks for societies and economies, given greater vulnerability and lower capacity to respond, but again with more uncertain consequences for conflict. (Expert input: 4, 7, 8) [Time frame: *past*; Evidence: *robust*; Agreement: *medium*] • Socioeconomic development into the future will partially compensate for the increase in conflict risk due to climate change, with unevenness and uncertainties. (Expert input: 5, 8) [Time frame: *future*; Evidence: *medium*; Agreement: *medium*]
Direct and indirect future economic impacts
• Large magnitudes of climate change will limit economic development, especially for countries that experience higher temperatures, which tend to be poor and more conflict prone. (Expert input: 5, 8) [Time frame: *future*; Evidence: *medium*; Agreement: *medium*] • Sustained economic crises or contraction due to climate change could undermine democratic institutions, with domestic and international dimensions interacting to increase conflict risk (e.g., more authoritarian regimes, diminished foreign aid regime, international world order threatened with large-magnitude climate change). (Expert input: 6) [Time frame: *future*; Evidence: *limited*; Agreement: *low*] • The degree to which globalization and economic integration will cushion versus amplify risk, including climate-related economic shocks, is uncertain (e.g., open trade borders, trade, and financial flows reducing impacts versus exacerbating exposure to global price shocks). (Expert input: 5, 8, GD) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]
NATURAL RESOURCES
Natural resource dependency
• Dependence on diffuse renewable resources can create a linkage between climate and conflict risk (e.g., via climate-related impacts on agricultural production). (Expert input: 1, 4, 6, 8) [Time frame: *past*, *future*; Evidence: *medium*; Agreement: *medium*]

- For renewable resources (e.g., agricultural productivity) across experiences to date, there is disagreement about whether and to what degree scarcity versus abundance increases conflict risk. (Expert input: 1, 3, 4, 9, 10) [Time frame: *past*; Evidence: *medium*; Agreement: *low*]
- Climate-related resource scarcity can stimulate cooperation (e.g., for equitable and fair distribution), which is hard to measure and evaluate. It can decrease conflict risk (e.g., more time spent on procuring food, difficult conditions for sustaining a large armed group, fewer resources available to be gained). Or it can increase conflict risk (e.g., differential impacts on producers versus consumers, increased competition, lower opportunity costs for violence, livelihoods driven towards extractives, existing political arrangements and bargains destabilized). Similarly variable effects are possible into the future as well. (Expert input: 1–4, 6, 8–10) [Time frame: *past*, *future*; Evidence: *medium*; Agreement: *low*]
- Climate-related resource abundance, additionally, can have variable effects. Such effects include decreased conflict risk (e.g., higher opportunity cost for violence) or increased conflict risk (e.g., more resources available to be gained through fighting, improved conditions for mounting and sustaining conflict). (Expert input: 3, 4, 10) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]

Food security

- Centrality of agricultural livelihoods, low socioeconomic development, issues of food access, and food prices can create linkages between climate and conflict risk, with differential implications across contexts (e.g., for rural producers versus urban consumers). (Expert input: 5, 7, 9, 10) [Time frame: *past*; Evidence: *medium*; Agreement: *low*]
- Low-income countries dependent on agricultural production have high climate change vulnerability (i.e., livelihoods and state capability both dependent on agricultural income). There is potential for increased conflict risk under increasing climate change—for example, if political consolidation were to break down following economic impacts and destabilizing intergroup inequality, if collapse of agricultural livelihoods or changes in productive regions trigger mass migration, or if crop failures propagate through global markets and create political instability following price shocks. (Expert input: 4, 6, 9, 10) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]
- With increasing climate change, impacts to food production will be shaped by changes in extreme events and exhibit threshold effects, with potential for adaptation through technological options, reduction in food waste, and land-intensiveness of diets, as relevant to potential consequences for conflict risk. (Expert input: GD) [Time frame: *future*; Evidence: *robust*; Agreement: *medium*]
- Structural transformation of economies away from agriculture might reduce, to an uncertain extent, climate-related agricultural impacts, associated economic shocks, and potential consequences for conflict risk. (Expert input: 4, 8, 9) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]

Water

- For relatively well-functioning states globally over the last decades, water has been a cause for cooperation more than war. (Expert input: 2, 6, 9) [Time frame: *past*; Evidence: *robust*; Agreement: *high*]
- For large magnitudes of climate change, uncertainties increase regarding the persistence of historical cooperation around water. (Expert input: 6) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]

GOVERNANCE

Low state capability

- Low state capability has persistent, long-run, difficult-to-change components shaped by historical, geographic, environmental, and other slow-changing factors (e.g., linked to colonialism, decolonization, and state formation). (Expert input: 1, 3, 6) [Time frame: *past*; Evidence: *robust*; Agreement: *high*]
- Some climate sensitivity of state capability, increasing conflict risk, could arise from climate-related shocks that decrease state capability (e.g., a revenue shock resulting from reduced agricultural income and associated decrease in the taxable resource base) or that increase demands on the state, exceeding its capacities (e.g., exacerbated intergroup inequality when the government is unable to assist affected groups, amplifying grievances or triggering political shocks). (Expert input: 2–4, 8, 10) [Time frame: *past*; Evidence: *limited*; Agreement: *medium*]
- Weak or illegitimate political institutions, with the state inadequately or unfairly distributing resources or arbitrating claims, could increase conflict risk following climate-related impacts. (Expert input: 1, 7, 10) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]
- Subnational reach of the state, important for armed conflict, could have some climate sensitivity (e.g., via accessibility of roads). (Expert input: 6, 9) [Time frame: *past*, *future*; Evidence: *limited*; Agreement: *low*]
- Improvements in state capability into the future could compensate for the increase in conflict risk due to climate change (e.g., via political consolidation of central government or more effective macroeconomic policies in weak states), with uncertainty and unevenness. (Expert input: 8, GD) [Time frame: *future*; Evidence: *medium*; Agreement: *medium*]

Political shocks

- Most political shocks are not related to climate but rather to diverse sociopolitical developments (e.g., contested elections, coups, external intervention). (Expert input: 2) [Time frame: *past*; Evidence: *robust*; Agreement: *high*]
- Climate-related impacts (e.g., on food prices or migration) could, to some degree, trigger political shocks, including through government's inability to adequately respond. (Expert input: 2, 3) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]

Regime type

- Illiberal democracy and anocracy are largely independent of climate. (Expert input: 3, 4) [Time frame: *past*; Evidence: *medium*; Agreement: *high*]
- Climate could, to some degree, affect socioeconomic development, state capability, and, in turn, the stability of regimes (3, 4) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]
- Illiberal democracies may be less concerned about perceived legitimacy, decreasing likelihood of assistance in response to climate-related impacts and disasters. (Expert input: 11) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]

Mistrust of government

- Inadequate, unfair, or unreliable government assistance in response to climate-related impacts and disasters may increase mistrust of government, also in interaction with differential impacts and marginalization. This mistrust could have variable effects, for example exacerbating perceptions of intergroup inequality and thereby increasing conflict risk or, alternatively, increasing self-reliant adaptation and thereby decreasing conflict risk. (Expert input: 5, 7, 11) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]
- Contexts with built-up mistrust of government may be more susceptible to destabilization following climate-related impacts (e.g., food price shocks, disasters). (Expert input: 5) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]

External intervention

- The main and most potent forms of external intervention are political, unrelated to climate. (Expert input: 2, 3, 9) [Time frame: *past*; Evidence: *robust*; Agreement: *high*]
- Potential external-intervention connections between climate and conflict could arise through international involvement (e.g., aid) following climate-related shocks, reducing or increasing conflict risk; perceived risks to shared natural resources; or spillover effects. (Expert input: 2, 9, 11) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]

Global cooperation

- With increasing climate change, global cooperation could increase (e.g., with concerted development assistance or solidarity in the face of severe impacts or spillovers from climate cooperation into other realms). It could also decrease (e.g., with securitization of climate responses and military engagement, global fragmentation, or decreased development assistance or international peacekeeping following climate change impacts). There are substantial uncertainties and implications for conflict risk. (Expert input: 2–5, 7, 9–11, GD) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]
- Estimates of conflict risk are conditional on background conditions (e.g., post-World War II institutions, state systems), and it is difficult to encompass possible systemic changes in forecasts of future conflict. Changes in international world order, systems, and institutions could shape the implications of climate change for conflict risk (e.g., given changes in aid, peacekeeping operations, democracy, or sovereignty), but with substantial irreducible uncertainty. (Expert input: GD) [Time frame: *future*; Evidence: *limited*; Agreement: *high*]
- Climate change impacts may exceed historical experiences (e.g., loss of territorial integrity such as through the inundation of small island nations, mass migration), revealing "missing" institutions where global governance mechanisms do not yet exist. The absence of such mechanisms could decrease efficacy of global cooperation and thereby increase conflict risk. (Expert input: 5, 11) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]

INEQUALITIES

Intergroup inequality

- Intergroup inequalities and associated political exclusion, linked to non-climate factors (e.g., ethnicity, religion) and historical processes, may increase climate-related vulnerability of marginalized groups. This could lead to differential impacts, exacerbated inequality, and potential consequences for conflict (e.g., via increased perceptions of unfairness exacerbated in times of crisis when government inadequately or unevenly assists marginalized groups and grievances are eventually expressed violently). (Expert input: 1, 2, 4–11) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]

Differential climate change impacts

- Poor, peripheral, or excluded regions may experience disproportionate climate change impacts, increasing conflict risk through exacerbated inequalities. However, such populations perhaps have more limited mobilization capacity. (Expert input: 4, 6, 7, 11, GD) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]
- The sentiment of the developing world suffering the consequences of the developed world's previous economic development may exacerbate, challenging the functioning of the UN and other bodies, with indirect, remote implications for conflict risk. (Expert input: 9) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]

CONFLICT

Recent history of violent conflict

- To the degree that previous episodes of conflict are triggered by climate, persistent legacies of violence could be carried forward through many intermediaries. (Expert input: 4, 5, 7, 8) [Time frame: *past, future*; Evidence: *limited*; Agreement: *medium*]
- History of conflict increases climate vulnerability and decreases adaptive capacity (e.g., via economic downturn, increased reliance on agriculture), exacerbating climate-related impacts and potential consequences for conflict risk. Increasing climate change could exacerbate associated conflict traps. (Expert input: 4–7, 9) [Time frame: *past, future*; Evidence: *medium*; Agreement: *high*]

Conflict in neighboring areas

- To the degree that episodes of conflict are triggered or increased in duration by climate, spillover of conflict could occur for multiple reasons, many of which are unrelated to climate. (Expert input: 2, 4–6, 8, 10) [Time frame: *past*; Evidence: *limited*; Agreement: *medium*]
- Climate-related impacts that diffuse or cross borders (e.g., migration, food price shocks) could create conflict spillovers. (Expert input: 3, 5, 7, 8, 10) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]

OTHER

Migration

- Climate-related migration is often adaptive and beneficial, not increasing conflict risk. (Expert input: 1, 4, 6, 8, 9, 11, GD) [Time frame: *past*; Evidence: *medium*; Agreement: *medium*]
- Internal and international climate-related migration in response to economic shocks (e.g., food price shocks, agricultural livelihood impacts) or other stressors, although often neutral or positive in its effects, could in some cases be a potential linkage between climate and conflict risk (e.g., given destabilization requiring political and economic adjustment, long-run migration dynamics exacerbating over time, or tensions between communities). There are differential implications across contexts and migration types (e.g., short-term versus long-term, internal versus international, forced versus voluntary). (Expert input: 2–4, 8, 9, GD) [Time frame: *past*; Evidence: *limited*; Agreement: *low*]
- Large, rapid migrations related to extreme weather events can be destabilizing and also challenging for the international system (e.g., via exacerbated economic tensions or political-extremism reactions), potentially in some cases with implications for conflict risk. (Expert input: 7, 10, 11) [Time frame: *past, future*; Evidence: *medium*; Agreement: *low*]
- Under large magnitudes of climate change, migration could occur at greater rates and scales (e.g., in response to desertification, extreme events, land loss, or livelihood and economic impacts), as compared to historical migration related to environmental changes or disasters. The implications for conflict risk are uncertain. For example, there are uncertainties around the persistence of historical migration dynamics, migration processes and distances, host-community and country responses, long causal chains potentially linking climate-related migration and conflict risk, and potential "missing" institutions." (Expert input: 1, 3–4, 6, 7, 9–11) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]
- Climate change impacts could also reduce beneficial forms of migration. Resulting trapped populations, unable to migrate, may face greater climate-related risk and potential associated consequences for conflict risk. (Expert input: GD) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]

Physiology and psychology

- Hot temperatures may increase human aggression and associated risk of interpersonal violence but with uncertain consequences of such micro-level physiological effects for larger-scale conflict. (Expert input: 1, 3, 8) [Time frame: *past, future*; Evidence: *limited*; Agreement: *low*]

- Under large magnitudes of climate change, regions could become inhospitable for outdoor work and activities, affecting economies and migration. Uncertainties regarding international responses are potentially relevant to conflict risk. (Expert input: 9) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]

Extreme events and disasters

- Extremes and associated disasters (e.g., cyclones, droughts, floods) exacerbated by climate change could challenge state capability, authority, and legitimacy with competing claims around government responses (e.g., given distributional consequences or induced migration). (Expert input: 2, 3, 7, 10, 11) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]

Response trade-offs

- Responses to increasing climate change may create new problems or other unintended consequences (e.g., if large tracts of land were used for bioenergy to achieve negative emissions, decreasing land availability for food, biodiversity, and human settlements), potentially affecting conflict risk. (Expert input: 11) [Time frame: *future*; Evidence: *limited*; Agreement: *low*]

Nonlinearities and tail risk

- Under large magnitudes of climate change, potential nonlinearities and tail risk (e.g., thresholds, feedbacks, cascading systemic failures in complex interconnected systems) limit the relevance of current relationships between climate and conflict for understanding possible future outcomes. Such potential impacts could include series of climate-related disasters, substantial sea level rise, regions becoming increasingly inhospitable to outdoor work or uninhabitable, accelerated rural depopulation or mass migration, or interconnected global economic impacts. (Expert input: 1–7, 9–11, GD) [Time frame: *future*; Evidence: *limited*; Agreement: *high*]
- For such nonlinearities and tail risk, there are difficult-to-reduce uncertainties about resulting consequences, societal responses, and adaptation limits. These uncertainties include implications for conflict risk and its many potential linkages with climate change impacts, and they are intertwined with deep uncertainties about non-climatic drivers of conflict (e.g., global order, configuration of states and alliances, ideological/nationalistic trends). (Expert input: 1–7, 9–11) [Time frame: *future*; Evidence: *limited*; Agreement: *high*]

Supplementary Table 3. Climate–conflict implications for conflict risk reduction and climate change adaptation. Expert judgments about the state of knowledge are characterized across different entry points and approaches. The assessment input relevant to the entries draws from both the individual expert-elicitation interviews and the group deliberation (Project Data 2[42]). Within bracketed text following each entry, available evidence and the degree of agreement[35] are specified, along with the relevant assessment input (see Supplementary Table 1 for summary terms and abbreviations).

Adaptation opportunities and constraints
• A mean versus variance problem challenges adaptation related to conflict risk. Organized violent conflict can be enormously damaging, pointing to potential benefits from upfront adaptation investments where climate is relevant. At the same time, many substantial climate change impacts (e.g., affecting livelihoods and human well-being) will be well short of the threshold of organized violence, and overly focusing on conflict could be maladaptive (e.g., in terms of distribution of resources, policy design, or actions taken). (Expert input: 2, 9, 11, GD) [Evidence: *medium*; Agreement: *medium*]
• Organized violent conflict increases climate change vulnerability, decreases adaptive capacity, and reduces the feasibility of implementing adaptation (e.g., reducing economic growth, undermining governance processes, decreasing investments, increasing short-term focus). (Expert input: 4, 5, 9, 11, GD) [Evidence: *medium*; Agreement: *high*]
• Even without an explicit conflict-risk orientation, adaptation can decrease conflict risk because similar factors contribute to climate change vulnerability, lack of adaptive capacity, and elevated conflict risk. However, there is important dependence on context. (Expert input: 4, 9, GD) [Evidence: *limited*; Agreement: *medium*]
• Adaptation that assists marginalized groups, within and across countries, can reduce conflict risk. To be successful, such efforts need to consider perceptions of fairness in the distribution and implementation of interventions, as well as political exclusion increasing both climate change vulnerability and conflict risk. By contrast, poorly designed interventions (e.g., with governments opposing external assistance) could increase conflict risk. (Expert input: 6, 7, 9, 10, GD) [Evidence: *limited*; Agreement: *medium*]
• Conflict-sensitive adaptation could emphasize adjustments that reduce conflict risk rather than contribute to it, but with uncertainties about the effectiveness and potential adverse side-effects of different actions. (Expert input: 4, 5, GD) [Evidence: *limited*; Agreement: *medium*]
• However, adaptive responses to increasing climate change may also create new problems or unintended consequences (e.g., via interactions across regions, policies favoring some groups over others, or displacement of climate-related hazards to more vulnerable groups), potentially affecting conflict risk. (Expert input: 11, GD) [Evidence: *limited*; Agreement: *low*]
• Climate-resilient sustainable development will decrease conflict risk (e.g., via improved economic opportunities, increased ability to address grievances and solve conflict peacefully, or increased resilience to shocks). However, there are limits under large magnitudes of climate change. (Expert input: 4, 9, 11) [Evidence: *limited*; Agreement: *medium*]
• With increasing magnitudes of climate change, adaptation needs will increase, along with recognition of its importance. At the same time, resources available for adaptation may decrease and limits to adaptation effectiveness will occur. (Expert input: 4, 7, 11, GD) [Evidence: *limited*; Agreement: *medium*]
• Predictive models and risk assessment can be used to prioritize and stage climate-related relief resources (e.g., through famine early warning systems). Such planning can proactively anticipate political instability and ameliorate conflict dynamics. (Expert input: 10) [Evidence: *limited*; Agreement: *low*]
International peacekeeping
• The international standard treatment model (e.g., mediation, peacekeeping operations by the UN and regional organizations, post-conflict aid and reconstruction of institutions and infrastructure), largely effective, is relevant to climate-related organized violence. Embedding climate into standard conflict risk reduction could involve focusing on regions with climate-related vulnerability and exposure and recognizing that peacekeeping strengthening societies can increase adaptive capacity and reduce vulnerability (e.g., in preventing relapse into conflict and supporting socioeconomic development, institution building, stability, and trust). It could also involve environmental challenges as a basis for building cooperation and peace. Sensitivity to context is important, and there is dependence on international world order. (Expert input: 2–4, 6, 10, 11, GD) [Evidence: *limited*; Agreement: *medium*]
• Predicting and preventing organized violent conflict is hard for both onset and severity, including where climate might be relevant. There are resulting challenges for resource allocation. These challenges include, for example, the fact that organized conflict is rare and conflict-risk ratings are similar to lists of countries already at war, that diagnosing

problems is different from understanding how to address fundamental drivers, and that the relative importance of climate against the backdrop of known drivers is hard to evaluate. (Expert input: 2, 10) [Evidence: *medium*; Agreement: *high*]
- Large magnitudes of climate change could reduce capabilities and resources of peacekeeping actors. (Expert input: 4) [Evidence: *limited*; Agreement: *low*]

International development assistance

- International development assistance can help countries reduce climate-related conflict risk. Relevant entry points include consideration of climate-related risks in development projects or humanitarian aid, of the ways conflict decreases adaptive capacity and increases vulnerability, or of implications of strengthened state capability for managing climate-related shocks. However, there is a need to avoid potential adverse side-effects (e.g., with short-term projects not sustained, interventions not sensitive to context, or aid distributed unfairly). (Expert input: 2, 4–6, 11, GD) [Evidence: *medium*; Agreement: *medium*]
- International assistance strengthening state capability could reduce climate–conflict linkages. For example, it could increase administrative capability to provide services buffering climate-related shocks or build institutions fundamental to long-run economic growth. However, there are uncertainties about the effectiveness of different actions, especially by outsiders, and also climate-specific challenges (e.g., environmentally related cabinet and ministerial positions are often marginal). (Expert input: 4, 6, 10, 11) [Evidence: *limited*; Agreement: *low*]
- International assistance supporting socioeconomic development could reduce climate–conflict linkages. For example, it could reduce sensitivity of rural livelihoods to climatic variability or decrease inequalities for marginalized vulnerable groups. However, there are uncertainties about the effectiveness of different actions, especially by outsiders. (Expert input: 2, 5, 7, 10, 11) [Evidence: *medium*; Agreement: *low*]
- Increasing climate change may increase demand for development assistance, potentially simultaneously decreasing countries' ability and commitment to provide it. (Expert input: 7) [Evidence: *limited*; Agreement: *low*]

State capability building

- Improved local-level government institutions and conflict resolution mechanisms (e.g., via multi-stakeholder governance processes) could reduce climate–conflict linkages (e.g., related to land, natural resources, climate-related shocks, and scarcity). (Expert input: 1, 10) [Evidence: *medium*; Agreement: *low*]
- State capability building can, in principle, reduce disproportionate impacts for marginalized groups. For example, it can address the root causes of exclusion, increase public services and investments, support socioeconomic development, increase decentralization of government, program aid to reach marginalized communities, or increase access to information and markets. Such measures can reduce associated climate–conflict linkages. However, in practice, building state capability can also make a state more repressive and provoke opposition from excluded groups. (Expert input: 5, 6) [Evidence: *medium*; Agreement: *low*]
- National and subnational adaptation policies can reduce climate–conflict linkages (e.g., assessing and responding to climate-related vulnerability and exposure of people, livelihoods, and infrastructure). (Expert input: 11) [Evidence: *limited*; Agreement: *medium*]

Economic diversification and resilience

- Economic instruments or other adaptations buffering income to climate-related shocks (e.g., social safety nets, insurance, access to credit, irrigation) could reduce implications for conflict risk. (Expert input: 1, 8) [Evidence: *medium*; Agreement: *low*]
- Economic diversification beyond agricultural livelihoods could reduce climate–conflict linkages. Such diversification can be supported through different approaches (e.g., education or training services, micro-finance initiatives, cash transfers, economic growth). However, there are uncertainties about their effectiveness. (Expert input: 1, 4, 8, 10) [Evidence: *medium*; Agreement: *low*]
- Improved food production and security through a variety of adaptation options (e.g., crop insurance, drought-resistant crops, irrigation, postharvest storage, food aid, improved land tenure) could reduce climate–conflict linkages. However, there are uncertainties about their effectiveness and potential adverse side-effects. (Expert input: 1, 2, 4, 6, 10, 11) [Evidence: *medium*; Agreement: *low*]

International governance

- Incorporation of climate change adaptation into global governance (e.g., UNFCCC and its subsequent treaties) could reduce climate-related conflict risk. For example, such incorporation could include taking into account, in adaptation aid transfers, the potential implications of climate change impacts and adaptation for conflict risk and of conflict for climate change vulnerability. (Expert input: 11, GD) [Evidence: *limited*; Agreement: *low*]

- Treaties and global fora related to security could incorporate climate change considerations, reducing climate-related conflict risk. (Expert input: 4, 5, GD) [Evidence: *limited*; Agreement: *low*]
- New institutions outside the international climate regime could address risks for which global governance doesn't exist at present (e.g., global food security, mass climate-related migration), thereby reducing climate-related conflict risk. (Expert input: 11, GD) [Evidence: *limited*; Agreement: *low*]
- Actions that are adaptive at one scale or from one perspective (e.g., individual countries) can have negative externalities increasing conflict risk (e.g., export bans in response to climate-related crop failures affecting global markets and potentially political stability or human well-being elsewhere). Such externalities are important to consider in policy design. (Expert input: GD) [Evidence: *limited*; Agreement: *medium*]

Migration

- Enabling adaptive migration (e.g., via improved property rights, education, free mobility across national borders, aid and programming supporting internal migration, or treatment of migrants) could reduce potential climate–conflict linkages (e.g., following climate-related agricultural shocks, desertification, or climate-related disasters). There are potential benefits for both origin and destination locations (e.g., increasing remittances, knowledge flows, technology transfers, or international cooperation). (Expert input: 1, 3, 10, GD) [Evidence: *limited*; Agreement: *low*]
- Potential adverse side-effects of government-driven resettlement, increasing conflict risk, need to be managed (e.g., increased marginalization or inequalities among groups). (Expert input: GD) [Evidence: *limited*; Agreement: *low*]
- With increasing magnitudes of climate change, new institutions for managing increased migration may be needed (e.g., increasing absorptive capacities of destinations). Such institutions could also reduce potential climate–conflict linkages. (Expert input: 1, 3, 10, GD) [Evidence: *limited*; Agreement: *low*]

Supplementary Table 4. Analytical challenges in evaluating conflict and the role of climate. Expert judgments about analytical challenges are characterized for key uncertainties and knowledge gaps limiting current understanding. The assessment input relevant to the entries draws from both the individual expert-elicitation interviews and the group deliberation (Project Data 2[42]). Relevant assessment input is specified for each entry (see Supplementary Table 1 for abbreviations).

Importance of climate for conflicts to date and uncertainties
• Across statistical analyses with a range of research designs, climate, especially temperature, is a significant additional risk factor explaining conflict. (Expert input: 8, 10) • However, potential causal relationships are diverse, multi-step, complex, and difficult to isolate, model, and understand in total. (Expert input: 2, 4–6, 8, 10) • Temperature effects are higher confidence than precipitation effects (e.g., with more measurement error for precipitation and more variable empirical results). These effects also interact with and potentially explain effects seen for other measures (e.g., drought indices, El Niño effects). (Expert input: 2, 6, 8, 10) • Empirical analyses to date have focused more on temperature than on other climatic variables and climate impacts. This focus has resulted, for example, from challenges of data availability or model design, from direct connections of temperature to future climate projections and associated policy discussions, or from larger effects for temperature such as through agricultural mechanisms. (Expert input: 1, 7, 10) • Across studies on the relationship between climate variability and conflict, effect sizes and even directions of effect differ across settings, with wide confidence intervals. (Expert input: 8, 10) • The relative importance of climate as compared to other factors shaping conflict risk is uncertain. (Expert input: 6, 10)
Defining episodes of conflict and challenges of data availability
• Conflict onset, continuation, escalation, and termination are different phenomena. As a result, they potentially require different treatment theoretically and empirically. For example, in conflict episodes, the collective action problem is most relevant in mobilization of organized violence, as compared to its continuation; once achieved, violent organization generally persists until another shock occurs; the best predictor of conflict in a given year is conflict in the previous year. Distinct treatment of onset and incidence is less well embedded in climate and conflict analyses as compared to other conflict research. Distinct treatment of conflict onset, continuation, and termination is important given different determinants and also potential misattribution of effects to serially correlated climate variables. (Expert input: 2, 3, 9, GD) • Other complications in conflict-episode definitions and data sets can arise. They include, for example, measurement error around the relatively low 25-death threshold often used, choices around more-than-one conflict ongoing in countries, implications of a small number of countries with relatively poor data quality dominating low-threshold conflict onset data, or temporal displacement between initial conflict onset and a higher 1000-death threshold. (Expert input: 2, 3) • Country-level conflict, socioeconomics, and climate data have been favored because they are available (e.g., because governments, the UN, and other agencies have collected them through time), even when they may not be the best data for research questions of interest. Subnational evaluations have increased in recent years. (Expert input: 7) • Disaggregated data in space and time can enable separate treatment of individual events. However, improved collection of data enabling disaggregated treatment is expensive and work intensive (e.g., via surveys focused on individual experiences), and subnational treatment may also increase disagreement across different lines of evidence. (Expert input: 6, 7, GD) • Observational data on climate have limitations. For example, there is necessary interpolation of missing data between stations, conflict itself shapes availability and potential bias in instrumental temperature and precipitation data, and high-resolution satellite data are available only relatively recently. (Expert input: 7, 10)
Choices about model design
• Disagreement among statistical results from similar data sets arises from different choices about methods of empirical modeling (e.g., panel design, model specification, handling of dataset limitations). These choices can be linked to disciplinary perspectives (e.g., fixed effects with no controls versus inclusion of conditioning factors or controls to explore why climate–conflict relationships exist). Overall, there is agreement that analytical challenges are notable (e.g., endogeneity, omitted variable bias). (Expert input: 2–5, 6–8, 10)

- There is agreement that climate–conflict linkages exist. In the interpretation of results from different model designs, there is disagreement on effect sizes, relative importance of the linkages, and societal responses (e.g., to climate variability versus climate change). (Expert input: 5)
- Inclusion of controls can enable social and political conditioning variables to capture desired dimensions. (Expert input: 4)
- Tight causal inference is a big challenge for questions of interest (e.g., what most distinguishes countries with conflict onset versus not, how can particular cases be understood in the context of broader patterns). The conflict literature therefore identifies correlational covariates for conflict onset or continuation as well. (Expert input: 3)
- Methods of applied econometrics support causal identifications by dealing with cross-sectional and omitted variables through fixed effects and time controls. For slow-trending variables, regressions without exogenous variation can generate hypotheses but not causal statements (e.g., including interactions between climate and other variables can develop hypotheses about the importance of mediating variables but not well-positioned causal inference on mediating roles). Adding control variables to regressions can be associated with risk of misinterpretation (e.g., if controlling for a variable drops a coefficient to zero, it may be a channel mechanistically for a relationship of interest). (Expert input: 8)
- In applied econometrics, avoiding omitted variable bias enables isolation of causal effects of changing variable X on outcome Y. However, there are limits to questions that can be asked. That is, it is more difficult to evaluate, secondarily, variables Z sitting between X and Y, which often are not randomly assigned. And it is exceptionally difficult to evaluate the relative importance of a set of X variables on outcome Y, which would require independent causally identified regressions for each of the variables. (Expert input: GD)
- As a result, applied-econometrics, reduced-form approaches are limited in understanding why relationships are occurring or why effect sizes vary across contexts. For example, low-frequency variables of interest are less amenable to causal identification, whereas high-frequency variables are more amenable but arguably less interesting. (Expert input: 3, 8)
- Meta-analyses of reduced-form statistical analyses build confidence in climate impacts on conflict despite debate over model choices and aggregation of conflict across different social and temporal scales. (Expert input: 1, 6–8, 10)

The garden of forking paths and the file drawer

- There are choices, conscious and unconscious, about independent variables (e.g., different operationalizations of exogenously varying climate variables), dependent variables (e.g., with heavy reliance on the UCDP/PRIO armed conflict database with its strengths and limitations or without consideration of lagged effects relevant to conflict incidence), and model design (e.g., lag structure). These choices affect results yet are not conceptualized, taken into account, or consistently handled (e.g., disaggregated analysis incompletely encompassing dynamics at greater scales, then with forking options for interpretation of variability in standard errors). (Expert input: 3, 7, GD)
- Such forking paths affect the meaning of p-values and standard errors, lowering confidence in hypothesis testing of studies. (Expert input: 3)
- The conflict literature has therefore prioritized repeated appearance of simple associations to build confidence, which has occurred less in the climate–conflict literature. (Expert input: 3)
- Development of theories that guide data and model choices is one response (e.g., for spatial and temporal resolution of data, model specification, or choice of lags or not). However, forking paths are also relevant in the development of causal maps across a large range of possible mechanisms. (Expert input: GD)
- In addition to different operationalizations, choices about model design yield divergent results, even from the same data sets. (Expert input: 3, 7)
- At least initially, well-identified climate and conflict studies with "null results" may have been harder to publish. (Expert input: 10, GD)

Understanding mechanisms through case studies and statistics

- Compared to the broader conflict literature, the climate and conflict literature is less focused on understanding mechanisms. For example, there is greater focus on methods and statistics and less focus on theory and mechanisms of effects. (Expert input: 6, 7)
- Evaluation of mechanisms for climate–conflict linkages is challenged by the large number of possible mechanisms and multi-step interactions with different potential importance across contexts. (Expert input: 1, 4, 7)
- Effect sizes in reduced-form analyses provide indication of the importance of climate. However, the relative importance of climate compared to other factors, especially slow-moving variables, is difficult to infer despite relevance for resource allocation in policymaking and other responses. (Expert input: 1, 8)
- Mechanisms for climate–conflict linkages and the relative importance of climate for conflict, such as for well-established temperature effects, can be evaluated by testing conditional or context-specific effects. However, there are challenges of limited sample sizes and weakened causal inference. (Expert input: 2, 7)

- Examining case studies, even though they are not representative, can create insight and intuition about possible mechanisms and strategic interactions. Such examination can generate hypotheses for subsequent systematic testing (e.g., iterating between mixed-methods case-studies evaluations and large-N analysis). (Expert input: 1, GD)
- Associated process tracing can involve in-depth qualitative research including on-the-ground work, experimental evidence, and surveys, also in combination with quantitative research. (Expert input: GD)
- Selection of cases can be random, then with exploration of existing models' performance in explaining the outcomes. It can also be more structured, picking most likely cases to explore a given hypothesis (e.g., associated with natural resource dependence or climate-related impacts). Such exploration can increase or decrease confidence in the hypothesis or generate new hypotheses. (Expert input: GD)
- Smoking-gun evidence of climate effects may be elusive in individual cases. However, there is potential for better understanding ways or contexts in which climate can be a main driver in interaction with other factors and mechanisms, or at least for understanding that climate-related mechanisms may have had some role. (Expert input: GD)
- The gap between aggregated quantitative studies and locally focused ethnographic and contextual studies is problematic and hasn't substantially narrowed. There is weak common ground across disciplines and approaches. (Expert input: 7)
- Conflict involves complex social phenomena, which will be inevitably interpreted differently by different experts. (Expert input: 11)

Climate variability versus change

- For many reasons, consequences of short-term variations in the climate may differ from consequences of long-term climate change. Reasons for potential differences include short-run versus long-run responses, short-term versus cumulative impacts, exceedances of thresholds over time, tactical timing responsive to climatic conditions versus overall frequency of violence, or potential for adaptation. (Expert input: 1–9, GD)
- Future climate change risks may fundamentally differ (e.g., in scope, intensity, and type) as compared to impacts of climate variability and change to date. There are implications for potential linkages to conflict and for the degree to which historical precedents are relevant in understanding future outcomes. (Expert input: 2, 4, 5, 11)
- Qualitative evaluations of long-run historical climate changes coincident with civilization breakdowns extend so far into the past that relevance for the next 100 years is unclear. (Expert input: 2)
- Uncertainty about future climate–conflict linkages and adaptation potential arises from empirical work largely isolating and evaluating the effects of climate variability and anomalies (e.g., as necessary to evaluate climate consequences for relatively rare conflict episodes). By contrast, the future will involve both mean climate change and climate variability. Empirical evidence can create understanding of sensitivities and mechanisms. However, thorough, consistent evaluation of the similarities and differences between such empirical work and possible future outcomes is needed. (Expert input: 1–3, 7–11)
- Uncertainty about future climate–conflict linkages and adaptation potential also results from difficult-to-anticipate adjustments to new climate baselines; questions about whether more conflict overall could result; and difficult-to-anticipate societal, economic, institutional, and technological developments. (Expert input: 1–3, 7–10)
- As another source of uncertainty, scarcity versus abundance effects, associated with either competition or cooperation over natural resources, are divergent. For example, there are questions surrounding heterogeneous resources, renewable versus nonrenewable resources, point versus diffuse resources, and the many possible climate–conflict linkages. (Expert input: GD)
- The climate and conflict literature has been sensitive to claims of environmental determinism. It has responded with a suite of more nuanced framings (e.g., probabilistic framings, context-specific framings, emphasis on climate–cooperation linkages in addition to climate–conflict linkages). (Expert input: 1, 5)

Limits to extrapolation

- Relationships between conflict drivers and outcomes tend to be temporally bounded as well as context dependent (i.e., different drivers matter at different points in time, out-of-sample prediction and forecasting are weak). These limitations are relevant to climate–conflict forecasts as well (e.g., adding in climate as an additional risk factor doesn't improve the clarity of forecasting). (Expert input: 1, 4, 10, GD)
- Ideally there would be more out-of-sample testing of models, but it is limited by conflict being rare. (Expert input: 3)
- Uncertainties about the relevance of historical-conflict analyses for future eras are diverse. For example, they include the following: historical breakdown of colonial empires and the rise of weak independent states, conditions conducive to conflict, are unique; whereas state capability and socioeconomic development have improved, some collapsed and failed states are stuck, including in conflict traps; future socioeconomic and institutional development are inherently uncertain, also in interaction with climate change impacts and responses; and international world order can shift unpredictably. (Expert input: 1–4, 6, 7, 9, 10)

- For climate–conflict forecasts, additional questions arise around the potential for and limits to adaptation (e.g., with baselines shifting, extremes relative, and short-run and long-run responses relevant). (Expert input: 10, GD)
- For climate–conflict forecasts, threshold effects could additionally be associated with climate change impacts and also their interactions with conflict drivers, for which historical precedents don't exist. (Expert input: GD)

Triggers versus structural factors

- It can be helpful to distinguish factors triggering conflict versus slow-changing structural factors contributing to underlying conflict propensity. The latter may determine overall conflict risk, yet with shocks or other short-term changes often shaping timing of mobilization. Climate potentially contributes, to different degrees, in either category or to their interconnections (e.g., climate-related shocks triggering conflict or also carrying over into longer-term implications for other conflict drivers). (Expert input: 8, 9 GD)
- As a related framing, climate variability and change can function as a threat multiplier, not creating problems but making them worse. (Expert input: 11)
- Evaluation of triggering effects can be challenged where conflict traps are playing out. (Expert input: 2)
- Into the future, increased frequency and/or intensity of shocks could increase conflict risk unless adaptation occurs. It is also important to consider changes in the factors conditioning the consequences of shocks (e.g., with some variables, such as GDP, easier to forecast compared to others, such as ethnic exclusion). (Expert input: 2)

Diverse evidence and disciplines

- Multiple lines of evidence, with differing research designs and even epistemologies, leading to similar conclusions build confidence in them (e.g., considering statistical analyses, case studies, and intervention experiments with different research designs). (Expert input: GD)
- In evaluation of climate–conflict linkages, different disciplinary approaches emphasize different modes of analysis, inference, and treatment of uncertainties. There are implications for judgments about the role of climate in conflicts to date. (Expert input: 4, 5, 10)