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Multi-method evidence for when and how climate-related disasters contribute to armed conflict risk

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ABSTRACT

Climate-related disasters are among the most societally disruptive impacts of anthropogenic climate change. Their potential impact on the risk of armed conflict is heavily debated in the context of the security implications of climate change. Yet, evidence for such climate-conflict-disaster links remains limited and contested. One reason for this is that existing studies do not triangulate insights from different methods and pay little attention to relevant context factors and especially causal pathways. By combining statistical approaches with systematic evidence from QCA and qualitative case studies in an innovative multi-method research design, we show that climate-related disasters increase the risk of armed conflict onset. This link is highly context-dependent and we find that countries with large populations, political exclusion of ethnic groups, and a low level of human development are particularly vulnerable. For such countries, almost one third of all conflict onsets over the 1980-2016 period have been preceded by a disaster within 7 days. The robustness of the effect is reduced for longer time spans. Case study evidence points to improved opportunity structures for armed groups rather than aggravated grievances as the main mechanism connecting disasters and conflict onset.

1. Introduction

Disasters resulting from natural hazards are posing threats to human security and economic development globally. Disasters cause thousands of fatalities, millions of people displaced and hundreds of billion US$ in damage, with the majority of victims in the last decades resulting from climate-related extreme events (IDMC, 2018; Munich RE, 2019). With ongoing climate change, extreme weather events will increase in frequency and intensity (IPCC, 2018). Together with economic and population growth, including in exposed areas, the risks posed by climate-related disasters (herein after disasters) like droughts, floods, landslides, heat waves and storms will rise in the future.

Given the disruptive nature of disasters, their effects on societal stability including the risks for intrastate armed conflict (herein after conflict) have long been discussed. In UN Security Council debates about climate change and security, for instance, disasters played a key role (Peters, 2018). The war in Darfur after 2004 has been called by then UN-Secretary General Ban Ki-Moon "the first climate war" (Conca, 2018) and various policy makers have linked the 2006–2009 drought disaster in Syria to the onset of the civil war in 2011 (Selby et al., 2017). Several cross-case studies discern a link between disasters and conflict onset. The identified interlinkages relate to increased risks rather than deterministic relationships and further identify vulnerability factors such as ethnic heterogeneity (Schleussner et al., 2016), political exclusion (von Uexkull et al., 2016) and economic underdevelopment (Eastin, 2018). Interlinkages between climate-related disasters, conflict and migration have also been reported (Abel et al., 2019). Other scholars, by contrast, are unable to find a disaster-conflict relationship (Salehyan and Hendrix, 2014; Slettebak, 2012; van Weezel, 2019).

As of yet, no consensus on the topic has emerged, also because the results derived from different methods and data have so far rarely been triangulated (Ide, 2017; Solow, 2013). Further, most studies focus merely on identifying whether a link between climate-related disasters and armed conflict exists (Sakaguchi et al., 2017; Xu et al., 2016). Going beyond that and studying also the pathways connecting both

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phenomena ("how") and the relevant contextual factors ("when") would not only produce more compelling evidence on disaster-conflict links, but also enable more specific policy advice by peace scholars (Hegre et al., 2016) and climate researchers (Andrijevic et al., 2020).

We address this gap by conducting an integrative multi-method study on the relationship between climate-related disasters and armed conflict risk worldwide. Specifically, we combine and cascade event coincidence analysis (ECA), qualitative comparative analysis (QCA) and case studies. While all three methods have been successfully used in environmental security and climate-conflict research, this is the first study which integrates and triangulates results from these approaches in a systematic way. This allows us to identify whether (ECA), in which contexts (QCA), and finally how (case studies) disasters increased the risk of conflict onset in the period 1980-2016.

In short, we find an increased risk of armed conflict onset immediately after climate-related disasters. Improved opportunity structures for armed groups to escalate violence in ongoing conflicts is the main mechanism behind this link. Yet, the relationship between disasters and conflict is highly conditional, occurring almost exclusively in countries with ethnic exclusion, low levels of human development and large populations.

The remainder of this paper is structured as follows. In the next section (2), we provide a brief review of the literature on climate change, disasters and conflict. We then introduce our research design, methods and data in further details (3). The subsequent sections present key findings (4) before drawing a conclusion discussing the results (5).

2. Disasters and the climate-conflict debate

Journalists, think tanks and decision makers discuss the potential security implications of climate change at latest since 2007 (McDonald, 2013). Scholars from a wide range of disciplines – including political science, geography, economics and anthropology – have picked up these concerns (Koubi, 2019). They agree that climate change is unlikely to affect interstate conflict risks. Some early statistical studies issued strong claims about an impact of higher temperatures and changed precipitation patterns on intrastate armed conflict risks (Burke et al., 2009; Hsiang et al., 2013), but were criticised for not being sufficiently robust (Buhaug, 2014; Buhaug et al., 2014). Case studies provided similarly equivocal results (e.g., De Juan, 2015; Selby and Hoffmann, 2014)

However, even large deviations in temperature and precipitation might have little impact on resilient societies with a high capability to adapt to such extremes. Climate-conflict research is hence increasingly focusing on disasters (Brzoska, 2018), defined as complex emergencies that result when destructive natural hazards (e.g., high temperatures, low rainfall, very intense winds) strike vulnerable socio-economic systems (Cohen and Werker, 2008). In other words, the occurrence of a (climate-related) disaster indicates the occurrence of (i) an extreme (weather) event and (ii) socio-economic destruction caused by this event due to the presence of vulnerability factors.

Most types of disasters are predicted to increase in frequency and intensity because of climate change, but also due to (vulnerable) populations and economic assets increasingly being located in exposed areas (IPCC, 2018). Furthermore, because armed conflict also increases vulnerability to disasters (Siddiqi, 2018; Walch, 2018), a vicious cycle could emerge in the very worst case, where disasters fuel violence and violence further increases disaster risks. This is insofar more pressing as many countries identified as vulnerable to conflict outbreaks are at the same time also emerging 'hot spots' for future climate impacts (Schleussner et al., 2018). Consequentially, both policy makers and scholars are increasingly discussing the security implications of climate-related disasters (Peters, 2018; Xu et al., 2016).

Yet, despite formidable efforts, research on disasters and conflict onset remains ambiguous. Several quantitative studies detect a link between the onset of climate-related disasters and the occurrence of various forms of violent conflict, although the link is often dependent on the presence of scope conditions like ethnic heterogeneity (Schleussner et al., 2016), political exclusion (von Uexkull et al., 2016) or autocratic governance (Wood and Wright, 2016). This is in line with other studies finding that disasters in general (no matter whether they are climate-related or not) increase the risk for armed conflict onset (Kikuta, 2019; Nel and Righarts, 2008).

However, other statistical analyses are unable to link natural disasters (including climate-related ones) to conflict onset (Bergholt and Lujala, 2012; Ghimire et al., 2015; Omelicheva, 2011). They argue, among others, that disasters increase logistical constraints for combatants (Salehyan and Hendrix, 2014) or strengthen social cohesion (Slettebak, 2012), and can hence even reduce conflict risks. These divisions are also reflected by case study research, which fundamentally disagrees about the relevance of droughts for the civil war in Syria (Ide, 2018), armed violence in Darfur (De Juan, 2015) and small-scale conflicts in Kenya (Schilling et al., 2012). The literature thus remains divided and little consensual knowledge on disaster-conflict links exists.

We argue that our integrated, multi-method study addresses a main driver of these inconsistent findings. Methodological divisions need to be overcome to produce comprehensive evidence on the climate-conflict and disaster-conflict links (Solow, 2013). Various methods have different advantages such as high generalisability of correlations (ECA), strong attention to conditional causation (QCA) and considerable potential to trace causal links (case studies) which, when integrated, produce compelling evidence (Ide, 2017). A focus on conditional causation is important, for example, because climate-related disasters can act as "risk multipliers", that is, disaster-conflict links might only occur in very specific social, political and economic settings (Buhaug, 2015). However, existing studies have only considered a rather narrow set of context factors, while we test 15 of them using a method designed to detect conjunctural causation (QCA).

Furthermore, most research still focuses on whether rather than how disasters increase conflict risks. A systematic literature review by Xu et al. (2016), for instance, reveals that only 16.7% of the available studies empirically analyse the mechanisms connecting disasters and conflict. While often theoretical propositions about causality are made, validity (as well as policy relevance) of results is likely to be higher when mechanisms linking disasters and conflict are identified empirically. Concordantly, a group of climate conflict experts recently found that "the mechanisms of climate–conflict linkages remain a key uncertainty" (Mach et al., 2019: 1).

Here, we conduct the first study analysing such causal mechanisms for a larger number of cases. With respect to the short-term dynamics of climate change, two broad categories of mechanisms are of particular relevance for the disaster-conflict nexus. They can be distinguished as grievance- and opportunity-based (Brzoska, 2018).

Grievances are predominantly linked to the perceptions of socio-economic and/or political injustices as causes of armed conflict. Several mechanisms can be involved in the creation or intensification of grievances after climate-related disasters. Prominent among them are perceptions of unequal distribution of disaster-related vulnerability, deprivation, relief or reconstruction support. Disaster impacts often reflect if not intensify pre-existing inequalities and make them more acute and/or visible due to the disaster's magnitude (Wisner et al., 2004). Disaster can also trigger (often temporary) migration flows that can accelerate competition for resources and jobs as well as ethnic animosities in the receiving regions (Brzoska and Fröhlich, 2015). Crucial for conflict onset is whether grievances become so severe that victims and their supporters initiate armed conflicts or support armed groups initiating such conflicts (Ide, 2016).

Opportunities refer to factors that enhance the ability of actors to engage in collective violence. Again, this may result from material as well as non-material mechanisms. Disasters can, for example, weaken local government structures, both in the affected areas (due to the destruction of infrastructure, state facilities etc.), but also in other regions (from where troops and funds are channelled to the disaster area). The resulting power vacuum can be exploited by challengers of the government to prepare and start the next offensive (Nel and Righarts, 2008). If a disaster affects territory controlled by a rebel group, the latter can be severely weakened, while the provision of aid allows state forces to win the support of local populations and gather intelligence. In these situations, disasters provide opportunities for governments to start a violent campaign (Eastin, 2018). People whose livelihoods are deprived by disasters might also be more likely to be recruited by state forces and violence entrepreneurs (Barnett and Adger, 2007; Cederman and Vogt, 2017).

Grievances and opportunities are not full opposites. Rather they partly overlap, for instance, with respect to opportunities for rebel forces to recruit or mobilise followers which increase with grievances. Beyond such overlap, however, the juxtaposition of grievances versus opportunities is analytically useful as it helps to distinguish mechanisms where affected populations are in focus versus others where actual or potential armed groups are the prime actors.

3. Research design and methods

3.1. Research design

As already indicated, we combine three methods well established in environmental security research in our study: event coincidence analysis (ECA), qualitative comparative analysis (QCA) and case studies. Our multi-method analysis is conducted in an integrative and interactive instead of a purely sequential manner (Fig 1). While the ECA establishes correlations important for the QCA and the case studies, both methods provide relevant context in terms of vulnerability profiles and causal pathway identification to interpret the ECA outcomes. At the same time, the case studies provide causal evidence for the conjunctural causation detected by the QCA and helps to identify false positives or negatives, while the QCA identifies relevant scope conditions to be considered in the case study analysis.

Our sample includes all countries with sufficient data availability for the time period 1980-2016, thereby avoiding concerns about sampling biases (Adams et al., 2018). Our independent variable is the occurrence of a climate-related disaster according to MunichRE's (2019) NatCatSERVICE database, including the categories meteorological events (e.g., droughts), hydrological events (e.g., floods), and climatological/extreme temperature events (e.g., heat waves). The dataset is considered one of the most comprehensive registers of natural hazards that have cause economic damage worldwide (Wirtz et al., 2014), and we obtained permission to use it for this particular study.

Our dependent variable is the onset of an intrastate armed conflict according to the widely used UCDP/PRIO Armed Conflict Dataset (version 17.2) (Gleditsch et al., 2002). Such conflicts are characterised by the involvement of at least one government of a state and more than 25 battle-related deaths per year.[1] For ongoing conflicts, we only count conflict onsets as new if they occurred at least 24 months after the last database entry for the same conflict. Furthermore, we only consider conflicts for which the day of the onset is precisely known in order to allow for a high temporal resolution of the analysis. We use the country as the level of analysis because disasters can impact conflict risks well beyond their specific location, for instance if the state is weakened or migration flows are triggered (Brzoska, 2018; Ghimire et al., 2015). In the case studies, we also consider the relationship between locations of disasters and conflict-related violence.

3.2. Event coincidence analysis

The ECA deployed is based on an established methodology to detect event coincidences between event series (Donges et al., 2011; Donges et al., 2016). The number of events in both series thereby is very different. We count 176 conflicts onset events over the time frame considered compared to more than 10,000 disaster events. In our analysis the ECA is conditioned on the occurrence of a conflict onset, testing for “risk enhancement” with respect to the coincidence with disaster occurrence (Schleussner et al., 2016). The risk enhancement test does not allow for a conclusion of and does not imply any direct causal linkage per se. Conditioning the ECA on the occurrence of disasters would allow to test for a direct “trigger” relationship, but the two orders of magnitude difference between the number of disaster occurrences and conflict onsets already indicate that such generalizable “trigger” relationships cannot be deduced.

We count a coincidence if a disaster has occurred in the same country within a coincidence window of 7 or 30 days before the conflict onset. If multiple disasters occur within the coincidence window and the same country, we only count this as one coincidence. We tested statistical significance by using a Monte Carlo approach and surrogate event series (see appendix 5 for details).

3.3. Qualitative comparative analysis

QCA is used here to detect the conditions that make a country vulnerable to experiencing at least one disaster-conflict coincidence during the 1980-2016 period (*discon*). As this outcome is binary, we employ the crisp-set variant of QCA, requiring the calibration of all data into values of 0 or 1 (Schneider and Wagemann, 2012).

As we deem to explain such vulnerability to disaster-conflict links for a longer time-period, we focus on explanatory factors that are largely time-invariant and use the average values for the period 1980-2016 if not otherwise specified. Following good practices in QCA (Marx and Dusa, 2011) and avoiding problems related to models containing too many variables (Achen, 2005), we initially use six explanatory factors (or causal conditions in the QCA terminology): large population (*larpopu*), exclusion of at least one ethnic group from political power (*excl*), the persistence of an at least partially democratic political system during the 1980-2016 period (*persdemoc*), a high level of human development (*hdi*) and agricultural dependence (*agridep*). Nine further conditions are used during robustness tests. All conditions are derived from the existing literature on disaster vulnerability and conflict risk (see appendix 1 for further details).

For the calibration of an at least partial democracy (polity2 score > 0), political exclusion of ethnic groups (value ≥ 1) and high human development (HDI ≥ 0.7), we draw on well-established thresholds (Marshall et al., 2016; UNDP, 2017; Vogt et al., 2015). We mostly use natural gaps in the data to calibrate the other conditions. All calibration decisions are subjected to robustness tests. We always report the parsimonious solution which is most robust (Baumgartner and Thiem, 2017) and perform a battery of 25 robustness tests (see appendix 1 for further details).

3.4. Case studies

The case studies focus in greater detail on the individual onsets of armed conflicts in the 7 and 30 day period after a climate-related

[1] We take the date when a conflict reached 25-battle related deaths in a given year (StartDate2) as the start date of the conflict. This date does not necessarily coincide with the start of armed fighting. In fact, in most cases, the onset date is preceded by low-intensity fighting. In addition to the 25 deaths threshold, the UCDP/PRIO Armed Conflict Dataset also provides starting dates for the first battle-related death in the conflict (StartDate). This date is less widely used in the literature as it leads to biased data. This is so because all conflicts that cross the one-death, but not the 25-deaths threshold in a given year are not reported by the dataset. In addition, if conflicts re-erupt after long time periods, StartDate remains the same, which means that renewed conflict onsets cannot be explained by the analysis. We have still performed our analysis based on the StartDate variable, but the resulting small sample size for our period of analysis does not allow for robust conclusions.

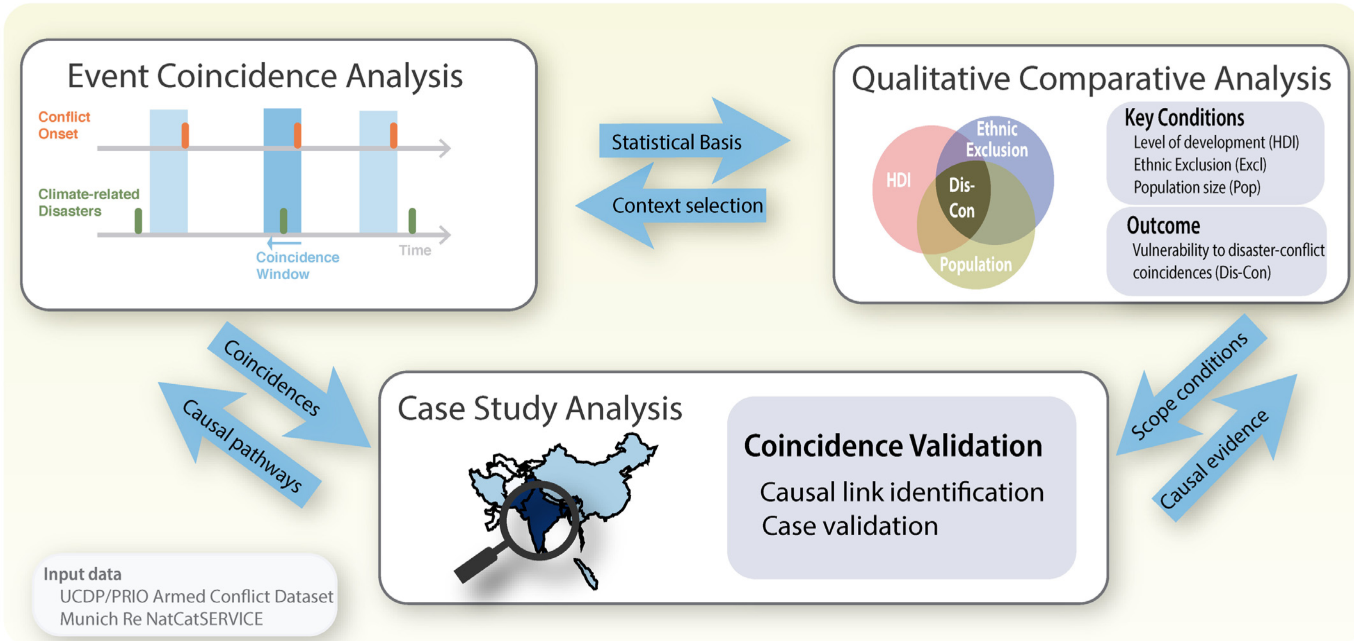

Fig. 1. Cross-scale methodological approach for the disaster-conflict nexus. Blue arrows indicate how the methods complement each other in our integrated analysis.

disaster. As the first step, the number of cases is reduced to unique armed conflict onsets as our sample contains several coincidences in which more than one disaster preceded the onset date of armed conflicts. In the next step, we use data on combatant deaths from UCDP's Georeferenced Event Dataset (GED) (Sundberg and Melander, 2013) to trace the dynamics of violence for eight time periods: one, three, six and twelve months both prior and after the disaster.

Cases in which there is no significant increase in armed conflict activity are unlikely to be true positives, but rather resulting from UCDP's particular definition of conflict onset (pre-existing disputes cross the threshold of 25 battle-related deaths). We classify all such cases as not "theoretically possible". Further, armed conflict occurring in or close to disasters locations are more likely to be linked to disasters than armed conflict at distant locations, unless disaster are so destructive as to have effects beyond their immediate location. With this consideration in mind, co-location of disasters with armed conflict events for one year after disasters is established by the use of geo-coded data from GED and MunichRe. Specifically, co-location is recorded when disasters occur within the geographical polygon of conflict events in GED. In cases of no co-location and five or less disaster-related fatalities, unique conflict onset cases are classified as not "theoretically possible".

The investigation and determination of plausible causal links is the final step in the case study analysis. To do so, several standard sources as well as the scientific literature are consulted (see appendix 3 for further details).

It is often difficult to empirically distinguish between the two pathways to armed conflict — grievances and opportunity — discussed above, not least because a particular consequence of disasters may increase both grievances and opportunities (Taydas et al., 2011). However, by combining a number of considerations it is generally possible to suggest whether grievances or opportunities are more likely to have been the relevant factor. These include information about the extent and type of migration, the distribution of disaster-related income losses, external support for alleviation of disaster losses, as well as the way in which disasters affect the position of governments, both in material terms as well as in the perceptions of relevant groups.

In sum, the analysis checks whether a disaster-conflict link for these cases is first, possible and secondly, plausible, and, finally, whether grievance and/or opportunity-based explanations are most suitable (see Table S4 for a summary and further information on the operationalisation). It hence not only cross-checks the correlations found by the ECA and the scope conditions identified by the QCA, but also studies the potential pathways connecting disasters to conflict onset. To our knowledge, this is the first case study analysis in the climate and environmental security field conducted for such a large set of cases. Appendix 2 provides a full list of cases studied and guides through the raw dataset provided by appendix 4.

4. Results

On the global level, the ECA reveals no statistically significant risk enhancement relationship between disasters and conflicts, although one should notice that for a 7 day period, a statistically significant number of about 10% of armed conflict onsets globally have been preceded by hydrological disasters such as floods or storm surges (Fig. 2a). The lack of significant coincidences on the global level indicates that there is no generic risk enhancement of climate-related disaster occurrence for conflict onset. However, it is possible that such risk enhancement mechanisms exist for countries characterised by specific vulnerability profiles.

QCA is well suited to reveal such vulnerability profiles. Here, we report the results for the 30 day coincidence window as they meet the methodical requirements in outcome variation much better. The results are robust for a 7 day window as well (see appendix 1).

Fig. 2b and Table 1 summarise the results of the QCA. We find that the simultaneous presence of a large population (*larpopu*), exclusion of ethnic groups from political power (*excl*) and a lower level of human-development (~*hdi*) is a quasi-sufficient condition for countries being vulnerable to experience armed conflict onsets after climate-related disasters. The explanatory power of all other (combinations of) conditions tested is minimal. The solution term found by the QCA meets established standards regarding consistency (score: 0.92) and is robust to a battery of robustness tests (see appendix 1). It explains the absence of disaster-conflict links in 99% of the countries where such links are indeed absent, and the presence of disaster-conflict links in 63% of the countries where they are present (overall explanation rate: 95%). These numbers are remarkable as the QCA focused on structural conditions,

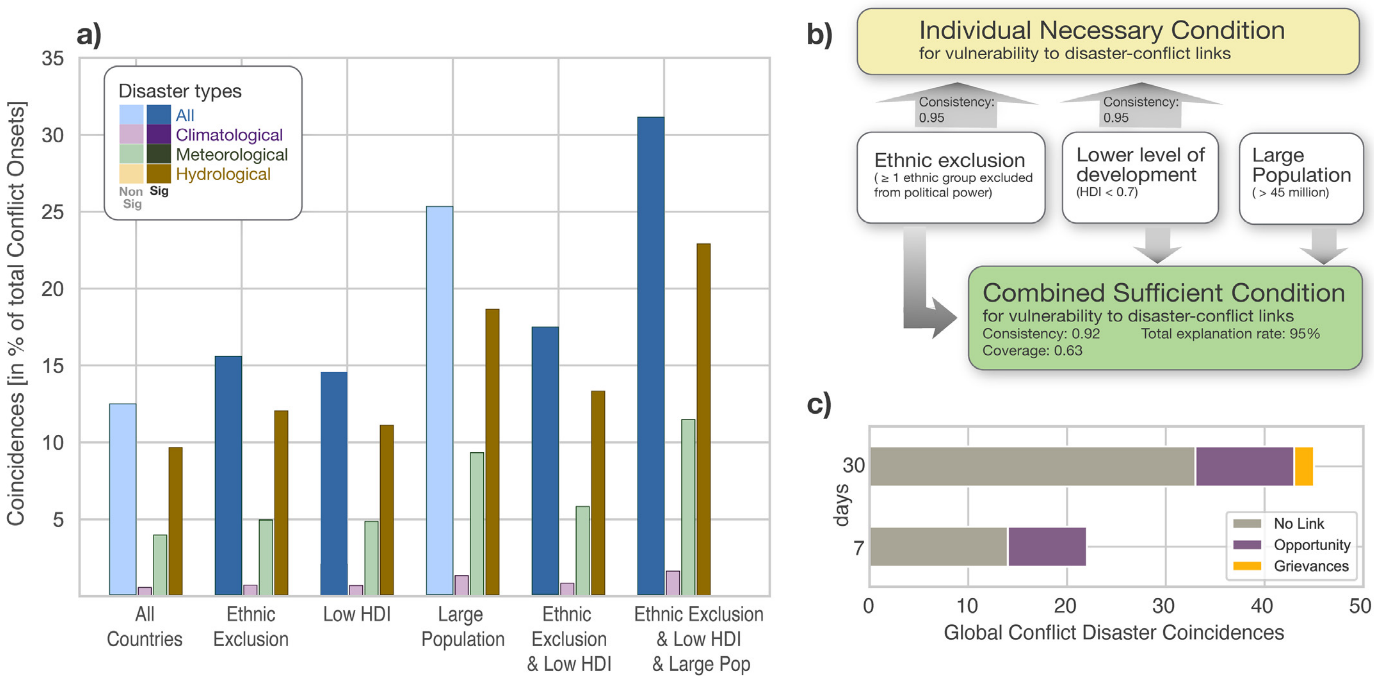

Fig. 2. Conflict onsets and climate related natural disasters
a: Share of armed conflict onsets with a disaster occurrence in the same country within 7 days before the onset for different extreme event types (coincidences). Results are shown for different country groupings based on vulnerability conditions. Full colours indicate statistical significance (sig) at the 95% level. b: Results of the QCA for vulnerability conditions for disaster-conflict coincidences. c: Results of the case study analysis regarding the existence and nature of causal pathways for disaster-conflict coincidences.

Table 1
Results table of the QCA (for sufficient conditions). Cases in parentheses are potential false positives/negatives according to the qualitative analysis and thus unlikely to contradict the analysis (see appendix 1)

solution formula	larpopu * excl * ~hdi -> discon
solution formula (written out)	large population * ethnic exclusion * ~human development -> vulnerability to disaster conflict links
solution consistency	0.92
solution coverage	0.63
cases covered	Bangladesh, China, Egypt, India, Indonesia, Iran, Myanmar, Nigeria, Pakistan, Philippines, Thailand, Turkey
coincidences covered	33
cases not covered	Burundi, Iraq, Mali, Nepal, (Russia), Sri Lanka, (Syria)
coincidences not covered	12
contradictory cases	(Ethiopia)

* = and ~ = absence of -> = sufficient for

while armed conflict onset is often strongly driven by dynamic and temporally highly variant factors, such as past violence or economic downturns (Cederman and Weidmann, 2017). The high and robust necessity scores of political exclusion of ethnic groups (0.95) and a lower level of human development (0.95) suggest that these are quasi-necessary conditions for the occurrence of a disaster-conflict coincidence (see Fig. 2b).

Applying the vulnerability profile and relevant thresholds identified by the QCA to filter the country groupings in the ECA significance test increases statistical robustness. For countries characterised by the QCA-identified sufficient condition for vulnerability, we find that 31% of all conflict onsets are preceded by a disaster within 7 days. Interestingly, the magnitude of disasters does not affect the results, indicating that even small-scale events can accelerate conflict risks in vulnerable contexts. Again, hydrological events appear to drive that signal with a 23% coincidence rate (Fig. 2a). For 30 days, these values would be even higher, but are not statistically significant (Figure S1 in appendix 5). The results are robust to the exclusion of India, the country with the by far highest number of disaster-conflict coincidences (Figure S2 in appendix 5).

Being spatially explicit reveals regional differences in vulnerability profiles and disaster-conflict coincidence occurrences. Our QCA-identified vulnerability profile relates mainly to characteristics of countries in West, South and Southeast Asia, which are also the regions that exhibit the highest number of coincidences (Fig. 3). South and Southeast Asia are particularly vulnerable to hydrological extremes, most often in relation to monsoon rains or tropical cyclones (MunichRe NatCatSERVICE, 2019). The identified vulnerability profiles might therefore be interlinked with the importance of hydrological extremes in our analysis. Droughts could be more relevant for conflict onsets in other parts of the world, such as Sub-Saharan Africa (Busby et al., 2014) or the Middle East (Feitelson and Tubi, 2017).

The combined ECA-QCA approach on the global level hence allows us to identify country vulnerability profiles (thus addressing the *when* question) and reveals a statistically significant risk enhancement of climate-related disasters for armed conflict onset (thus addressing the *whether* question). At the same time, the ECA-QCA approach does not allow for answering the *how* question, that is, to identify the actual mechanisms underlying potential disaster-conflict links. Identifying such pathways in a case-based analysis is highly important to confirm such links (McKeown, 1999) and formulate policy recommendations (Gilmore et al., 2018).

The case analysis reveals that a majority of the unique disaster-conflict cases identified by the ECA are theoretically plausible. This true for 14 out of 22 cases in the 7 day coincidence window and 27 out of 45

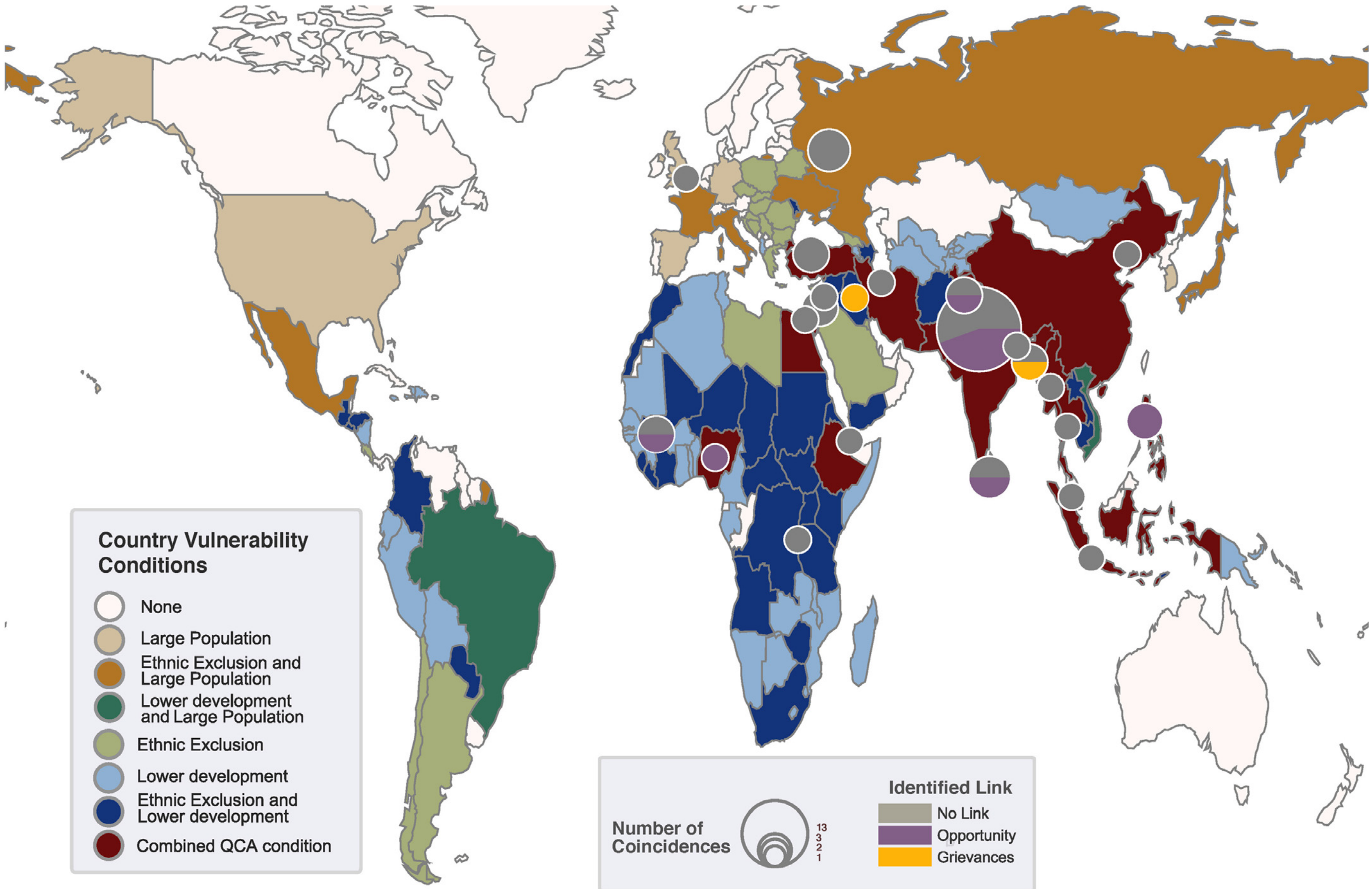

Fig. 3. Country vulnerability profiles and observed coincidences.
Mapping of country vulnerability conditions identified in the QCA analysis (country colour coding) overlaid with observed disaster-conflict coincidences per country (30-day window).

cases in the 30 day window. Further qualitative analysis of the conflict dynamics suggests a plausible disaster-conflict link in 8 (12) cases for a 7 (30) day window (see Fig. 2c and appendix 2).

While these numbers might not seem very high, one should keep in mind that false positives are a common (and usually unaccounted) issue in all statistical analyses, and that false negatives are likely to exist as well. Indeed, the number of non-plausible links identified by the case study analysis is substantially lower than the median estimate of our Monte Carlo test of 19 (for a 7 day window) or 50 (for a 30 day window) coincidences (see also appendix 5). This implies that our applied statistical test is assessing a higher number of 'by chance' coincidences than we have identified in the detailed case study analysis. The literature and database information available also might not always be sufficient to identify a plausible disaster-conflict link even if it would exist. Further, the qualitative analysis reveals that two of the contradictory cases not covered by the QCA, Russia and Syria (see Table 1), are likely to be false positives, hence increasing the strength of the QCA results even further.

The case study analysis provides information on the causal mechanisms through which disasters and conflict onset are connected. For all 8 plausible cases in the 7 day window (and ten of the 12 cases in the 30 day window), there is no evidence in the consulted literature that disaster-linked increases of grievances were a driver of conflict. As revealed by the QCA results, grievance-producing factors such as ethnic conflict and low levels of human development are present in almost all the countries where disaster-conflict coincidences occurred.

Only in the 30 day window, and even there only for two cases, disaster-related grievances facilitated armed conflict onset, and both cases are related to a (perceived) insufficient handling of the disasters by the government. When Bangladesh was hit by strong thunder storm in July 2016, widespread criticism about insufficient disaster management by public authorities occurred, but was met by increasing repression (a reaction that is far from uncommon, see Wood and Wright, 2016). The resulting grievances fuelled support for religious anti-government groups. This result could be driven by the short time-period we are analysing as a translation of grievances into armed conflict onset might require a longer period than 30 days (as, for example, non-violent ways to articulate dissent are used first and armed groups need time to organise themselves).

The opportunity pathway is far more prevalent. It explains all 8 eight plausible cases in the 7 day window and 10 out of 12 cases in the 30 day window. This leads us to conclude that in our analysis, increased incentives for the exertion of violence (especially by rebels) is the most relevant causal link behind disaster-conflict coincidences. A case in point is a drought affecting Mali beginning in June 2009 which helped the militant Al-Qaeda in the Islamic Maghreb (AQIM) armed group operating primarily in Southern Algeria to recruit fighters and extent its area of operation into Mali. Similarly, severe landslides and cyclones in the Philippines have weakened government structures in contested regions various times (among others, in 1993 and 1999), hence setting the stage for violent conflict escalation by the Communist Party of Philippines and the Moro National Liberation Front (see also: Eastin, 2018; Walch, 2014).

The opportunity pathway identified can be interlinked well with the QCA results. Politically excluded ethnic groups can take the (temporary) weakness of a state after a climate-related disaster as an opportunity to intensify a violent campaign (Detges, 2016; Eastin, 2018). Similarly, a low level of human development in combination with a disaster might reduce the opportunity costs of (deprived) individuals to join an armed group (Barnett and Adger, 2007; Linke et al., 2018). Finally, a large population increases the pool of potential recruits and makes it harder to quell unrest or mediate conflicts, especially if state capacities are weakened by a disaster (Blattman and Miguel, 2010).

5. Discussion and Conclusion

An increasing number and intensity of climate-related disasters, high levels of armed violence around the world, and the associated political concerns about the security implications of climate change make the links between climate-related disasters and armed conflict onset an important field of study. But as of yet, little consensual knowledge exists on whether such disasters increase conflict risks, also because limited attention has been paid to the context factors conditioning such a link and especially to relevant causal pathways.

We address these issues by conducting an integrated, multi-method analysis on whether, when and how climate-related disasters contribute to armed conflict onset. By triangulating findings from event coincidence analysis (ECA), qualitative comparative analysis (QCA) and qualitative case studies, we find that there is no deterministic or generic relationship between disasters and conflict. But in countries characterised by the political exclusion of ethnic groups, low levels of economic development and large populations, climate-related disasters significantly enhance the risk of conflict onset in the subsequent 7 day period. Contrary to the findings of other studies (Birkmann et al., 2010), this effect is largely independent of the severity of disasters. Beyond validating the results of the ECA and QCA, our case study analysis reveals that changed opportunity structures, especially for non-state armed groups, are the most relevant causal pathway connecting climate-related disasters to armed conflict onset.

At this point, it is important to remember that our analysis uses a high temporal resolution and rather short time lags (a maximum of 7 or 30 days) between disasters and conflict. It is hence possible that at least in some cases, the disaster did not impact whether an armed conflict onset occurred, but rather influenced its timing. In other words: The armed groups perhaps planned for a conflict escalation for quite a while and then used the disaster as an opportunity to stage it (Landis, 2014). As the mobilisation of grievances is usually demanding and takes some time (Fearon and Laitin, 2003), future research should also assess whether the grievance mechanism is more important if larger coincidence windows are employed (although this would make it harder to trace the impact of a disaster).

Also, the short coincidence window deployed is well-suited for fast-onset disasters such as floods or storms, but hardly captures the temporal profile of drought impacts often lasting for months or even years. Therefore, our findings are not in contradiction with previous work outlining the relevance of drought for conflict risk (Detges, 2016; Schleussner et al., 2016; von Uexkull et al., 2016), but rather supplement these results. Studies of the links between slow-onset disasters and conflicts with integrated multi-method research designs are hence promising. Especially the QCA part of such studies would also benefit from integrating more local-level and dynamics factors, although this would involve laborious collection of qualitative data.

Our findings have important policy implications. The interlinkages between conflict escalation and vulnerability profiles are not unidirectional. The presence of armed conflicts often leads to development setbacks and intensified political exclusion (Denny and Walter, 2014), hence undermining the adaptive capacities of societies and increasing their vulnerability to extreme weather events (Siddiqi, 2018). Given the empirical dominance of the opportunity pathway, strengthening state capacities to limit the negative impacts of a climate-related disaster could reduce the likelihood of armed conflict eruption in the short term. However, more important, reducing political exclusion and raising levels of human development not only promote more inclusive societies, but also makes countries more resilient to armed violence in a climate-changed world.

Author statement

The research was designed by all authors and coordinated by TI. The ECA was performed by CFS, the QCA by TI and the case study analysis by MB. TI, MB and CFS contributed equally to the analysis and writing of the manuscript with support of JFD. Figures were created by CFS in coordination with the other authors.

Declaration of Competing Interest

The authors declare no conflict of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.gloenvcha.2020.102063.

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