Connecting theories of cascading disasters and disaster diplomacy

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Disaster diplomacy examines how and why disaster-related activities (disaster risk reduction and post-disaster actions) do and do not influence peace and conflict processes, especially whether or not a causal chain can be established between dealing with disaster risk or a disaster and outcomes in peace or conflict. Cascading disasters might provide a useful theoretical framing for mapping out causal pathways for disaster diplomacy. In conceptually exploring the intersection between disaster diplomacy and cascading disasters, this paper concludes that both disaster diplomacy and cascading disasters have limitations because they try to develop focused causal chains which, when examined with respect to the root causes of disasters, are actually multiple, complex, intertwined causal chains. This situation does not obviate analysis or understanding of disaster diplomacy and cascading disasters. It emphasises the need to adopt and retain social perspectives from the root of disaster studies.

Keywords: cascading disasters, disaster diplomacy, normal accidents, vulnerability

1. Introduction

This paper presents a conceptual exploration of disaster diplomacy intersecting with cascading disasters to advance the theory of both fields. Cascading disasters refer to progressions of disaster-related impacts which are said to produce multiple cause-effect chains. Disaster diplomacy examines how and why disaster-related activities (disaster risk reduction and post-disaster actions) do and do not influence peace and conflict processes. The keys for both cascading disasters and disaster diplomacy are (i) whether or not a causal chain can be established between the beginning of a disaster or a disaster-related activity and (ii) the resulting consequences. For cascading disasters, this causal chain leads to the ultimate disaster impacts witnessed. For disaster diplomacy, the causal chain is from dealing with disaster risk or a disaster towards outcomes in peace or conflict. Given the parallels between disaster diplomacy and cascading disasters, the latter might provide a useful theoretical framing for mapping out the former's causal pathways.

The next section examines and critiques the theory of cascading disasters followed by the third section providing similar material for disaster diplomacy. Both sets of critiques have parallels, indicating the importance of examining cascading disasters and disaster diplomacy together. These points are consolidated in the fourth section which indicates how disaster diplomacy, disaster risk reduction, and disasters are a series of interconnected cascades and thus intersect well with cascading disasters theory. The conclusions summarise this paper's contributions.

2. Theory and critiques of cascading disasters

2.1. Defining cascades

Recent discussion within disaster risk reduction has been exploring and developing the notion of "cascading disasters" or "cascading effects" (Pescaroli and Alexander, 2015). The definition provided by Pescaroli and Alexander (2015, p. 65) is:

Cascading disasters are extreme events, in which cascading effects increase in progression over time and generate unexpected secondary events of strong impact. These tend to be at least as serious as the original event, and to contribute significantly to the overall duration of the disaster's effects. These subsequent and unanticipated crises can be exacerbated by the failure of physical structures, and the social functions that depend on them, including critical facilities, or by the inadequacy of disaster mitigation strategies, such as evacuation procedures, land use planning and emergency management strategies. Cascading disasters tend to highlight unresolved vulnerabilities in human society. In cascading disasters one or more secondary events can be identified and distinguished from the original source of disaster.

Examples given include (i) 11 March 2011 when an earthquake off the coast of Japan led to a tsunami which killed thousands of people and damaged a nuclear power plant; (ii) the 2002 floods in Central Europe leading to power plants being knocked offline and chlorine gas cloud being released; and (iii) the 2010 eruption of Eyjafjallajökull volcano in Iceland which closed most European commercial air flights.

The ethos behind the original theory of cascading disasters and cascading effects is twofold. First, a non-cascading disaster is said to have a single cause which propagates linearly through sequential events in a chain connected by readily identifiable mechanisms. Second, a cascading disaster begins with a single cause with one or several specific mechanisms leading to consequences, but each consequence can be both an effect and a cause of other effects. Each dual cause/effect stage leads to its own causal chains of further effects which might also be potential causes. The chains end when only effects are seen which eventually peter out.

This theory of cascading disasters can be examined and critiqued in three fundamental ways. First, the delineation of cause and effect. Second, the mechanisms of transitioning from causes to effects. Third, the assumption of the "unexpected", "unanticipated", and "secondary" descriptors within the definition of "cascading disasters.

2.2. Cause and effect

The first critique, examining the delineation of cause and effect within a disaster, requires returning to basic definitions and seminal literature from disaster research. Defining a disaster has long been discussed (e.g. Quarantelli, 1998). UNISDR (2017) recently defined a disaster to be "A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts". This definition matches the history of the field of disaster research which accepts that disaster risk is a combination of hazard and vulnerability and, while the hazard can be a trigger, catalyst, influencer, or input into the disaster, the real and root cause of disasters is vulnerabilities (Alexander, 1993; Hewitt, 1983a, 1997; Lewis, 1999; Wisner et al., 2004).

From the disaster literature's baseline (Alexander, 1993; Blaikie et al., 1994; Hewitt, 1983a, 1997; Lewis, 1999) and more recent expostulations (Alexander 2012; Deloughrey et al., 2015; Gaillard 2010; Krüger et al., 2015; Wisner et al., 2004), vulnerability is a long-term, multi-causal, deep-rooted process within society. It describes quantitatively and qualitatively how people live, where they live, why they live in these ways and these locations, and what they can and cannot do about their situation. Vulnerability is rooted in political, cultural, and historical processes leading to individuals and groups having differing levels of power,

resources, abilities, and options to deal with their situation, including hazards which might impact them, vulnerabilities they experience, and approaches for tackling their vulnerabilities. Everyone has some modicum of power, resources, abilities, and options, but many individuals and groups have much more than others, so they can choose to use their situation to create or reduce vulnerabilities for themselves and for others. Too frequently, vulnerabilities and disasters are considered minimally, leading to the creation of disaster risk through augmenting or failing to deal with vulnerabilities. Consequently, vulnerabilities are an ever-present, chronic condition which would be known and identified if action were taken to do so. Yet the typical situation is that vulnerabilities are accepted and discussed mainly after a disaster has occurred which reveals these vulnerabilities.

As such, disaster theory provides a poignant critique of the model of cascading disasters. Since disasters are caused by vulnerabilities and each vulnerability is multicausal, no single cause of a specific disaster can truly be identified. In many instances, such as the three examples of cascading disasters given above, a specific hazard delineated in space and time can be pinpointed as the start of when vulnerabilities were identified and when the potential for disaster became evident. But vulnerability as a long-term process embedded within societal norms means that each disaster was caused long before a specific hazard manifested. It also means that each disaster has multiple causes.

Taking an example away from the cascading disasters literature, the 12 January 2010 earthquake in Haiti illustrates this situation, based on Schuller and Morales (2012) and Mika (2018). Prior to 1804, Haiti was a French colony, exploited by the European power as its pearl in the Caribbean for sugar cane, coffee, and tobacco planted and harvested by slaves. Haitian slaves rebelled in 1791, winning the war in 1803 and declaring independence on 1 January 1804 as the first free Caribbean country after Europeans arrived.

Colonial powers were upset by this freedom, with France demanding reparations which were eventually paid off in 1947 and the US continually controlling Haitian politics. The behaviour of the US and France was ironic considering that both countries had, within living memory, succeeded in their own revolutions for achieving their own freedom. Moving into the twentieth century, American marines invaded Haiti in 1914 to take Haiti's foreign cash reserves to New York and then occupied the country from 1915-1934. Two brutal dictators, François (Papa Doc) Duvalier from 1957-1971 and afterwards his son Jean-Claude (Baby Doc) Duvalier, pillaged their country with on-again-off-again support from France and the US. The Haitians rose up in 1986, forcing Baby Doc to flee to and settle in France, leading to a series of Haitian elections and coups, frequently controlled or influenced by the US.

In 2004, the UN took over the country and was in the midst of reconstructing Haiti for true independence and self-governance when the earthquake rumbled. The seismic shaking toppled buildings and triggered landslides, killing over 200,000 people. All consequences of the shaking and of the collapsed buildings are from the primary overall disaster—a disaster of more than two centuries of social and infrastructural neglect. This long-term undermining of Haiti and the creation and perpetuation of vulnerabilities and hence disaster risk was fed by outside powers for their own interests, often with amenable Haitians such as the dictators and their militias. This situation caused the disaster in a complex web of inter-related causalities focused on multi-layered, intertwined vulnerabilities.

Apart from vulnerability as an overarching, embracing concept, it is challenging to argue for a single cause which can be identified as the beginning of the disaster which appeared on 12

January 2010. Any cascades evident on that day—such as fires, fuel spills, and power outages, all of which occurred and which could be framed as cascading disasters—are small compared to the vulnerability cascades of the previous years dating back to 1804 (or 1791 or 1492) which were the causes of the 2010 earthquake disaster.

Cascading disasters theory has started along this pathway (Pescaroli and Alexander, 2016) to fully embrace this articulation of vulnerabilities as the root and real cause of disasters rather than starting with the manifestation of a specific hazard. Pescaroli and Alexander (2016) explicitly reject the "toppling domino" analogy, plus the original definition states that "Cascading disasters tend to highlight unresolved vulnerabilities in human society". The baseline, though, is that disaster research's history (Alexander, 1993; Blaikie et al., 1994; Hewitt, 1983a, 1997; Lewis, 1999) explicates how all disasters highlight the problem of vulnerabilities which, by definition, need to be resolved, hence a cascading framing provides nothing new in this regard.

2.3. Cause to effect

A second critique of cascading disasters theory explores the mechanisms of transitioning from causes to effects or to other causes within the chain presented as being a disaster. Through "Normal Accidents" theory, Perrow (1984, 1999) laid out and refined difficulties in developing and analysing such a chain. He suggested two properties for technology and infrastructure affected by a disaster.

The first property is complexity referring to the number of components within a system and the ability to analyse those components. The second property is coupling referring to the connectivity amongst components and how fast changes propagate amongst different components. Higher complexity yields increasing problems of understanding possible failures within the system. Tighter coupling yields increasing problems of rapid failures of components. Where many system components have the possibility of failing simultaneously or in rapid sequence, then a disaster could be seen as being close to inevitable because possibilities for rapid, complex cascades are in-built. In such cases, the systems have known vulnerabilities which have been designed into the systems.

Consequently, it is hard to determine where a cascading disaster begins. The definition of cascading disasters highlights disasters as "events" in numerous ways, implying boundedness in space and time with definitive starting and end points. The diagrammatic depiction in Pescaroli and Alexander (2015) presume demarcated events identified as causes transitioning neatly into more demarcated events as causes or effects, then eventually terminating through a sequence of other demarcated events as effects. Pescaroli and Alexander (2016) progress from this view by introducing continua of space and time into the mapping of specific packages of vulnerability and event sequences, but still analyses cascading disasters from the perspective of delineating specific start and end points with interactions that can be neatly mapped and that neatly follow on from each other.

Regarding space and time, Perrow's (1984, 1999) two-dimensional map of complexity and coupling indicates that moving from cause to effect happens at different spatial and temporal scales which can be difficult to discretise into neat loops or packages. These cause(s)-effect(s) chains are rarely linear, instead involving feedbacks, overlaps, integrations amongst systems, and blurring between cause and effect. Pescaroli and Alexander (2016) address this point through indicating the importance of feedbacks and loops, but they apply ideas based in

ecology which (i) are still highly mechanistic by seeking single-track cause-effect trajectories that (ii) have been shown to have poor applicability to society, especially given rote assumptions in ecosystem science which do not always hold in disaster contexts (Lewis and Kelman, 2010). Rather, the complexity and coupling across space and time scales of vulnerabilities leading to disasters is inherent in the long-standing understanding of disaster as a process (Hewitt, 1983a, 1997; Lewis, 1999; Wisner et al., 2004). Instead of being new and innovative, and instead of being based in ecology, these ideas were inherent in the initial conceptualisations of disaster theory explaining disasters as emerging from vulnerabilities with deep and broad connections across space and time scales. This work relied on social science research, rather than ecosystem science, which is essential given that the baseline for disasters is society, not ecosystems.

As such, causes of, effects from, loops of, and their overlaps regarding disasters cannot be as precisely marked as indicated by the theory of cascading disasters. Instead, where a disaster, its causes, and its effects start and stop are perpetually unclear. The example of Haiti above illustrates in terms of being uncertain whether the 2010 earthquake's causes began in 1492, 1791, or 1804 while the disaster's effects are still not fully completed or understood (Mika, 2018). These aspects are the wide-scale considerations.

Connecting to the micro-level, Perrow's (1984, 1999) "Normal Accidents" demonstrates further ambiguities with cascades. For Fukushima, the disaster cascade really began at the design and siting stage of the nuclear power plant leading to the cause and effect of inundation during a tsunami which damaged the power plant's components. Compared to the documented mistakes at the beginning which is where the real disaster started (National Diet of Japan, 2012)—which could even be taken back to the selection of nuclear power—how important is it to create a cause-and-effect box for a tsunami, for water entering the power plant, for a failure of a specific component upon encountering water, or for all of them? From a cascading disasters theory point of view, these points are crucial and fit into the diagram from Pescaroli and Alexander (2015). From the perspective of wider disaster literature, such as in section 2.2 and Perrow (1984, 1999), these discussions regarding cascades are interesting and useful from technical points of view, but they are less relevant regarding disaster causes being multi-scalar vulnerabilities. Instead, we can and should identify and highlight the fundamentals which caused the disaster process over the long-term, for which Pescaroli and Alexander (2016) provide a step forward, but ecosystem science is not actually necessarily to achieve this approach.

2.4. "Un"-ness

The third critique brings together sections 2.2 and 2.3 as it pertains to descriptors in the definition of "cascading disasters". Hewitt (1983b, p. 10) wrote:

> The language of discourse is often a good indicator of basic assumptions. In hazards work one can see how language is used to maintain a sense of *discontinuity* or *otherness*, which severs these problems from the rest of man-environment relations and social life. That is most obvious in the recurrent use of words stressing the 'un'-ness of the problem. Disasters are *un*managed phenomena. They are the *un*expected, the *un*precedented. They derive from natural processes or events that are highly *un*certain. *Un*awareness and *un*readiness are said to typify the condition of their human victims. Even the common use of the word [disaster] 'event' can reinforce the idea of a discrete unit

in time and space. In the official-sounding euphemism for disasters in North America, they are '*un*scheduled events'.

By mentioning "unexpected secondary events", "unanticipated crises", and "unresolved vulnerabilities", the definition of "cascading disasters" (Pescaroli and Alexander, 2015) persists in the views of "un"-ness and of disasters as events or shocks. This approach is reinforced through the adoption by cascading disasters theory (Pescaroli and Alexander, 2016) of modern interpretations of "panarchy" (a set of self-contained loops set into a hierarchy of scales) which explicitly takes up the notion of "unexpected or unpredictable shocks", but Pescaroli and Alexander (2016) later challenge the alleged unexpectedness and unpredictability of cascading disasters. This approach points out fundamental errors in panarchy's conceptualisation based on Hewitt (1983ab) amongst many others (e.g. Lewis, 1999; Perrow, 1984, 1999; Wisner et al., 2004) that the "un" discourses reveal assumptions of disasters as isolated, one-off, exceptional shocks which cannot be considered beforehand. The reality of disasters is that they are continual, normal, typical, ever-present, ever-happening processes which characterise society through vulnerabilities, even if only revealed when a hazard appears.

Whereas "In cascading disasters one or more secondary events can be identified and distinguished from the original source of disaster" (Pescaroli and Alexander, 2015), disaster research explains that the original source of disaster is the complicated, coupled vulnerabilities which can never be distinguished from the consequences of harm and damage when a hazard manifests—a perspective embraced by Pescaroli and Alexander (2016) and applied for infrastructural vulnerability related to space weather and cybersecurity by Pescaroli et al. (2018) and related to European floods by Nones and Pescaroli (2018). Similarly, when Japan built the Fukushima nuclear power plant on the coast, the vulnerabilities were known and engrained (National Diet of Japan, 2012). The inundation of the nuclear power plant on 11 March 2011 does not have to be interpreted as a cascading effect, nor a cascading disaster, nor a secondary effect, nor a secondary disaster. The problems with the nuclear power plant from the beginning, and perhaps with nuclear power from the beginning, are the real disaster—the disaster which had already been created during siting, design, and construction; the tsunami consequences were knowable before the impact (National Diet of Japan, 2012). Even the sequence of failures at Fukushima after the tsunami struck was knowable based on Perrow's (1984, 1999) work. Such discussion repeats the vulnerability pathways described by Pescaroli and Alexander (2016), including for Fukushima, showing how their construction of vulnerability pathways (moving away from panarchies) is the standard disaster mantra of long-term root causes of vulnerabilities which indicate how and why disasters happen through vulnerability-related complex and coupled interactions, feedbacks, loops, and cascades.

The idea of disasters being "unexpected", "unanticipated", and "unpredictable", such as from modern interpretations of panarchy and other ecosystem-based resilience approaches, is thus challenged—including by Pescaroli and Alexander (2016) for cascading disasters—especially when considering prior literature on the importance of surprise and foreseeability (Glantz, 2003; Streets and Glantz, 2000). Gifis (1991, 195-196) describes that in the context of law "Foreseeability encompasses not only that which the defendant foresaw, but that which the defendant ought to have foreseen". The case of Fukushima is clear: As detailed by the National Diet of Japan (2012), all the events of 11 March 2011 were foreseeable, so a tsunami hitting the coastline and inundating the nuclear power plant was neither unexpected nor unanticipated nor unpredictable. In the case of Eyjafjallajökull in 2010, the impacts of volcanic ash on aircraft were well-known long before the volcano erupted (Casadevall, 1994)

as was Eyjafjallajökull's propensity to emit ash (Sturkell et al., 2003) and the world's dependency on air transport (Ishutkina and Hansman, 2008). The grounding of most commercial flights in Europe due to a volcanic ash cloud from Iceland was foreseeable according to Grifis' (1991) definition—with the consequences even more foreseeable based on the experience of the shutdown of US airspace after the terrorist attacks of 11 September 2001.

The question then arises whether or not any interlinkages, and hence potential cascades, could ever be a surprise? To a large degree, this question is unanswerable since we do not know everything which we do not know. This question can nonetheless be partly answered by indicating that, from Perrow (1984, 1999), where high complexity and tight coupling exist, surprises can emerge which are too quick to deal with. Consequently, Perrow (1984, 1999) recommends avoiding systems designed with both high complexity and tight coupling. In other words, that surprises emerge in situations such as Fukushima and Eyjafjallajökull should not be surprising. The systems which produce these surprises are readily identifiable and alterable long before surprises arise. We choose not to alter the systems despite Perrow's (1984, 1999) recommendations.

The reason for continuing with highly complex and tightly coupled systems is often argued as being efficiency and lower costs. These systems sometimes produce short-term efficiency and cost savings for long-term inefficiency and higher costs. If these systems are to be retained, then the costs and consequences should be openly admitted, so that risks taken are openly accepted and the differences of time scale are factored into decisions—which would fully embrace the "un"-ness critique.

In summary from this critique, differentiating cascading and non-cascading disasters is not feasible when examined in the context of disaster literature. Whether one chooses to conclude that all disasters or no disasters are cascading is moot. The key is that vulnerabilities cause disasters and vulnerabilities are knowable and addressable long before problems arise when a hazard intersects with these vulnerabilities. It is possible to label the sequence of vulnerabilities as cascading vulnerabilities, such as in Haiti until 2010. It is also feasible to label hazard sequences as cascading hazards (e.g. Gill and Malamud, 2016), such as on 18 May 1980 when, at Mt. St. Helen's in Washington, USA, rising magma and gases inside the mountain triggered an earthquake leading to a landslide which sufficiently weakened the mountain's flank to allow trapped gases and magma to blast laterally as an explosive volcanic eruption (Kanamori and Given, 1982). Starting the description of a cascading disaster at the point of such hazards, or terming the sequences with "un"-ness as done by panarchy, is inadequate for understanding, dealing with, and preventing disasters.

3. Theory and critiques of disaster diplomacy

3.1. Defining disaster diplomacy

Disaster diplomacy investigates how and why disaster-related activities do and do not influence conflict and cooperation (Kelman, 2012, 2016). The suggestion of "disaster-related activities" incorporates (i) pre-disaster work such as preparedness, prevention, readiness, planning, and damage mitigation, and (ii) post-disaster actions including response, reconstruction, and recovery. Disaster diplomacy case studies are not just about what happens when a volcano erupts in a war zone (Klimesova, 2016) or when enemies consider sending and accepting humanitarian aid (Akcinaroglu et al., 2011). They also examine the situation

before a disaster manifests, such as how a flood warning system could potentially bring together communities (Ahmad and Ahmed, 2003) or how vaccination campaigns might generate lasting ceasefires (Hotez, 2010).

Based on the empirical evidence of case studies, the overall conclusion from disaster diplomacy is that disaster-related activities do not create new initiatives in achieving peace or reducing conflict, but a diplomatic process with pre-existing conditions can be catalysed or supported (Kelman, 2012, 2016). If this form of catalysis occurs, then the disaster-related activities influence diplomacy in the short-term, but not in the long-term.

In the short-term, over weeks and months, all forms of disaster-related activities have the potential to affect diplomacy, such as by spurring it on or by providing a space in which peace efforts could be pursued. For that to occur, a pre-existing basis must exist for the reconciliation. This could be ongoing negotiations, formal or informal cultural connections, or trade links. Nonetheless, disaster diplomacy is not necessarily successful over the short-term, since disaster-related activities can sometimes foment conflict and reduce diplomatic opportunities—or have no impact at all on peace and conflict. Irrespective of short-term results of disaster diplomacy, over longer time periods, non-disaster factors have a more significant impact on diplomacy than disaster-related activities. Examples of non-disaster factors are leadership changes, mutual distrust, belief that an historical grievance should supersede current humanitarian considerations, or a desire for conflict due to the advantages gained from it.

These conclusions have been corroborated through case studies covering inter-state conflict, intra-state conflict, pre-disaster activities, post-disaster activities, bilateral relations, and multilateral relations including extensions to sub-national case studies and non-state-level relations and conflicts (Glantz, 2000; Holloway, 2000; Kelman, 2012, 2016; Ker-Lindsay, 2007; Koukis et al., 2016). Thus far, the evidence shows that disaster diplomacy sometimes has the potential (but never the inevitability) for improving relations at different scales and amongst different parties, but only in the short-term and only if a non-disaster-related pre-existing basis is available.

An example emerges from 26 December 2004 when a large-magnitude, shallow earthquake shook Aceh, Indonesia, causing tsunamis around the Indian Ocean and inundating communities in more than a dozen countries around Asia and Africa (Enia, 2008; Gaillard et al., 2008; Klimesova, 2016; Le Billon and Waizenegger, 2007). The two countries with the highest death tolls, Indonesia and Sri Lanka, were each embroiled in long-standing, internal political conflicts which had been particularly violent over the previous three decades. Aceh, Indonesia, and eastern Sri Lanka were centres for this violence and were especially badly hit by the tsunami. Clear disaster diplomacy opportunities emerged in each location. Both areas required major efforts at post-conflict and post-tsunami reconstruction, neither of which could be completed by the local or national authorities alone. With a large international presence and with the need for extensive efforts to clean up and rebuild from the violence and from the tsunamis, opportunities existed for disaster diplomacy.

Amidst the international humanitarian response, the Indonesian government and Acehnese separatists negotiated for and eventually signed a peace deal on 15 August 2005. Despite occasional violence continuing, the peace has lasted in Aceh. Yet the situation was not a new phenomenon representing disaster diplomacy because negotiations had started amongst the conflicting parties on 24 December 2004, just 48 hours before the earthquake and tsunami

(Gaillard et al., 2008). Gaillard et al. (2008) demonstrated that the 26 December 2004 situation provided diplomatic space in which peace could succeed if the parties involved sought reconciliation. It is impossible to know whether or not the ongoing negotiations would have succeeded in the absence of the earthquake and tsunami, as many previous efforts had failed. Analyses demonstrate how the parties involved were already in the process of reducing conflict and aiming for long-term peace, meaning that the earthquake and tsunami disaster could be used as an excuse to achieve their long-term goal of an agreement if they wanted it—and they did want it, so they made peace happen (see also Enia, 2008; Klimesova, 2016; Le Billon and Waizenegger, 2007).

Simultaneously in Sri Lanka, distribution of the humanitarian aid; access to areas which were not under government control, mainly in the north and east of the country; and perceptions that people affected in the south were not being treated fairly with regards to post-tsunami aid led to a spiralling up of the violent and non-violent conflicts. Deals were reached regarding aspects of humanitarian aid and post-tsunami reconstruction, but those deals were then broken or ruled unacceptable in Sri Lankan court of law. In November 2005, Sri Lanka elected a hard-line president who campaigned on a platform of pursuing military means for ending the violent conflict. A military victory by Sri Lanka's government was achieved in 2009 and this peace has held across Sri Lanka.

Disaster diplomacy never emerged in Sri Lanka because the major parties involved had numerous reasons for avoiding peace, with examples being the personal power achieved by continuing the conflict, concern that dealing with the violent parties in the north and east would legitimise them, and mutual mistrust of parties involved (Beardsley and McQuinn, 2009; Hyndman, 2011; Wickremesinghe, 2006). These aspects dominated efforts at conflict resolution through disaster response and substantially hindered distribution of post-tsunami aid.

This case study illustrates the standard disaster diplomacy pattern seen across the world and throughout history that disaster diplomacy never fully manifests, a conclusion which extends beyond government-to-government relations (Kelman, 2012, 2016; Klimesova, 2016). Glantz (2000) details the long history of Cuban and American weather and climate scientists collaborating while Fidel Castro led Cuba. These collaborations fed into disaster risk reduction and occurred most likely because the governments were not fully aware of them, or pretended such, but made no discernible difference to US-Cuba relations. Ker-Lindsay (2007) explains how the media and vociferous grassroots expectations fuelled Greece-Turkey earthquake diplomacy after lethal tremors struck each country three weeks apart in 1999. He then examines how the push from below nearly derailed the careful, measured approaches towards rapprochement which the élites in each country had been enacting before the earthquakes and were seeking to continue afterwards. In the end, the success in Greece-Turkey rapprochement following decades of conflict resulted because those controlling the process wanted to end the difficulties, not because of earthquakes, wildfires, or the desires of parties outside the élite structures in both countries.

Such complex webs of interactions involving all disaster and diplomacy activities mean that any linear analysis of correlations and connections is unlikely to provide a complete picture. A given starting point in space and time for analysing disaster diplomacy does not necessarily yield a specific, predictable outcome for a given case study. With the high importance of pre-existing conditions in determining whether or not disaster diplomacy becomes even a short-term catalyst, it is hard to determine where the starting point for analysis should actually be.

Consequently, disaster diplomacy is best viewed as a long-running process with multiple parties interacting, rather than as a snapshot phenomenon which either works or does not work, as a binary choice. Disaster-related activities are one influence amongst many on all forms of diplomacy, including but not limited to government-to-government relations; however, trade, resource management, sports, culture, personalities, domestic politics, and non-domestic politics are also major influences on both disaster-related activities and diplomacy.

The diplomacy pathways which yield peace and conflict are created and pursued by those with the power to do so, deliberately and inadvertently. These parties include politicians, civil servants, the media, business leaders, movie and sports stars, and grassroots movements amongst many others, as is defined by theories of multi-track diplomacy (Diamond and McDonald, 1993; Kurbalija and Katrandjiev, 2006). Similarly, disaster-related activities are pursued by choices, just as vulnerability is created and maintained by choices (section 2.2). Combining disaster-related and diplomatic-related activities therefore becomes a highly complex, tightly coupled combination of choices and actions by a highly complex, tightly coupled combination of parties—paralleling the dimensions of Perrow's (1984, 1999) "Normal Accidents".

This conclusion about disaster diplomacy not being observed, and why it is not observed, is foreseeable. There is no particular reason why decades or centuries of differences could or should be overcome overnight, simply because a hazard manifested, such as a hurricane destroying a town, or because a disaster risk reduction endeavour moved forward, such as a multinational building code being promulgated. In contrast, as per section 2.3, dealing with and averting disaster is a long-term process, and so is diplomacy, requiring thoughtful, careful steps, whilst ensuring that all key parties continue to support the long-term goals and to serve mutual interests.

At least, this is the description of dealing with disaster and diplomacy in theory. In practice, many disaster-related and diplomatic activities are initiated reactively with limited planning, especially responding after a major event such as death and damage through a disaster or such as a diplomatic crisis. In theory, if someone or a group decides that disaster diplomacy is desirable, then using their power to actively lobby for, support, and implement it are pathways to follow. Meanwhile, if someone or a group decides that disaster diplomacy is not desirable, then using their power to actively lobby against it and to undermine efforts for it are pathways to follow. In practice, policy is frequently created in an ad hoc manner fuelled by media, clashing power interests, and many other events and processes.

Although no successful examples of new diplomacy based only on disaster-related activities have yet been identified, leading to the conclusion of disaster diplomacy being unsuccessful, many historical archives have not been explored while future disaster risk reduction or disasters could lead to new, lasting diplomacy by luck or by design. For the moment, the evidence available shows that disaster diplomacy might work only over the short-term with pre-existing conditions which support it, especially because causal chains are difficult to discern due to the complexity and coupling of disaster- and diplomacy-related processes.

3.2. Cause and effect

In developing a framework to analyse disaster diplomacy case studies, Kelman (2012) consolidated research questions into the following quintet, slightly paraphrased here:

1. How are disaster-related activities influencing diplomacy-related activities?
2. To what degree are those diplomatic activities new and to what degree were they ongoing prior to the disaster-related activities?
3. How legitimate is the diplomacy according to the parties involved? How are the parties involved trying to make the diplomacy succeed or fail?
4. How long does the connection between the disaster-related and diplomacy-related activities last? Why does the connection persist or fade away?
5. How well do disaster diplomacy efforts address long-standing vulnerabilities which are the root causes of disasters?

Kelman (2012, 2016) answers these questions for multiple case studies across a multitude of types concluding that no case study satisfactorily answers all the questions meaning that disaster diplomacy cannot be shown to work.

The setup of these questions and the analyses in Kelman (2012, 2016) might end up being a self-fulfilling prophecy in that disaster diplomacy is defined in such a way that it is bound to fail. That is, the criteria sought to accept a case study as being fully successful disaster diplomacy might be so restrictive and narrow as to be impossible to meet in reality. Instead, the set of five questions might be more helpful as a framework within which to explore disaster diplomacy case studies. The answers, however, might not indicate whether or not the case study is actually disaster diplomacy. Instead, discussion around the five questions for a particular case study would indicate the presence or absence of attributes and aspects of disaster diplomacy.

Suggesting that disaster diplomacy either happens or does not happen thus becomes a misnomer. Rather, exactly as in section 2.2, individuals and groups have differing levels of power, resources, abilities, and options regarding each of diplomacy-related activities and disaster-related activities. Disaster-related activities are one influence amongst many on various forms of diplomacy-related activities. Just as linear progressions from a cause to an effect are hard to discern in disasters making the cascading concept difficult to apply in reality, progressions from disaster-related activities to diplomacy are hard to discern in reality making the disaster diplomacy concept difficult to apply in reality.

As such, when parties with a certain level of power, resources, abilities, and options choose to seek diplomacy, then it has a high likelihood of some level of success, whether or not disaster-related activities are one or the main reason for wishing to seek diplomacy. Hence, the potential but not inevitability emerges of the catalytic effect of disaster-related activities on diplomacy. Disaster-related activities are one potential excuse amongst many for seeking diplomacy, with other possible reasons for diplomacy potentially including economic, philosophical, or cultural interests.

Disaster diplomacy explicitly examines only the unidirectional potential of disaster-related activities to influence diplomacy-related activities. The reverse is also possible, but is not part of the disaster diplomacy literature because the influence of diplomacy on disasters and disaster-related activities has long been studied. The definition of disasters as being caused by vulnerabilities, discussed above, automatically accepts that disasters are inherently political meaning that any efforts to deal with disasters are also inherently political involving all forms and manners of diplomacy (Hewitt 1983a, 1997; Lewis, 1999; Wisner et al., 2004).

While some might argue that technical decisions in building codes and calculations of return periods are objectively determined, two levels of politics emerges. First, quantitative science has been shown to be inherently biased due to the numerous decisions which occur based on training, structured thought within bounded rationality, disciplinary norms, and human approaches to thinking and analysing (e.g. Martin, 1979). For instance, return period calculations select a mathematical distribution for the parameter being studied, typically assume an unchanging baseline for the parameter, and determine the timeframe over which data are collected or modelled for the return period calculation. These decisions are subject to debate and personal bias. The second level of politics in technical decisions related to disasters is implementation. Any planning regulation or building code has politics inherent in the level of safety or risk it aims to achieve (e.g. the design return period); the contingency desired; its voluntary or obligatory level; and how it is promulgated, monitored, and enforced.

Given that all disaster-related decisions and all disasters are imbued with politics, all aspects of disaster diplomacy must be imbued with politics. Thus, it is difficult to comprehensively analyse disaster diplomacy as the sequence presented or through a checklist of questions. Diplomacy-related activities are one influence amongst many on various forms of disaster-related activities but progressions from diplomacy-related activities to disaster-related activities are hard to determine due to the variety of influences over various space and time scales.

4. Cascades within disaster diplomacy

4.1. Bringing the critiques together

The picture built up in section 3 of any potential disaster diplomacy case study is of multiple interactions resulting from multiple inputs to and multiple outputs from the case study. Determining the reasons for different levels of disaster diplomacy emerging as outcomes is thus not straightforward. Mapping the various influences yields an input cascade from disaster-related activities, diplomacy-related activities, and their interactions. Mapping the various consequences yields a similar output cascade. Where these cascades begin and end, in time and space, could never be clear.

For diplomacy, many diplomatic processes are difficult to pinpoint temporally and spatially. For temporal delineation, diplomatic processes are frequently attributed to individuals, whether appointed or elected. They are referred to as "architects" of negotiating positions such as for Aceh (Aspinall, 2005) and Bosnia and Herzegovina (Jung, 2012). Yet it is hard to presume that a diplomatic process begins with or could be attributed solely to a specific individual. For Bosnia and Herzegovina, the named "architect" (Jung, 2012) is Richard Holbrooke who was appointed to the position by the political leaders at the time based on his long-term service. For Aceh, the named "architects" (Aspinall, 2005) are Susilo Bambang Yudhoyono who was elected President of Indonesia and Damien Kingsbury who was selected by an Acehnese party to be one of their advisors. These individuals ended up in their positions partly as a result of their stance on and experience regarding the conflicts, rather than them commencing their viewpoints at the time of taking up their respective positions. The question of "When does a diplomatic process begin and end?" is therefore difficult to answer in order to follow the cascade through to signing a peace deal or a declaration of war.

Spatially, a sovereign territory is frequently chosen as the unit of analysis, with the country name being used interchangeably with the capital's name and the government while international borders are seen as hard boundaries delineating the country, the capital city's influence, and the government's demesne of control. Studies of diplomacy involving non-sovereign jurisdictions, such as cities and provinces, are termed para-diplomacy, micro-diplomacy, and proto-diplomacy (Baldacchino and Milne, 2009; Duchacek et al., 1988; Tavares, 2009) indicating that different scales apply for diplomatic endeavours. For public diplomacy, Gunaratne (2005, p. 755) even suggests that "Because of such obvious interconnections and interdependence of all people and nation-states, we have to study the world-system as a single unit of analysis". Allied sentiments were behind the long-standing drive for "Global Systems Science" transcending geographical and spatial boundaries to try to understand and predict human-nature interactions (IGIS Symposium, 1989; Sneider et al., 1999) through an all-encompassing framework, on which disaster diplomacy and cascading disasters could potentially have drawn.

Simultaneously, the reality of borders is porosity, with different levels of flow being continual for people, goods, and information. These levels vary from being (i) almost entirely open borders internationally such as for countries in the Schengen Agreement and sub-nationally for travelling within any Schengen country, to (ii) almost entirely closed borders such as with North Korea from the end of the Korean War until at least the beginning of 2018. The "soft borders" concept is well-established in conflict studies (Mostov, 2008), indicating the challenge of attributing a specific spatial delineation to any diplomatic process. Nor has there regularly been assumptions that a government represents the jurisdiction it governs, even in locations with a modicum of democracy (Dauer and Kelsey, 1955).

Due to non-sovereign diplomacy, soft borders, and lack of representativeness, the question of "Where does a diplomatic process begin and end?" is therefore difficult to answer in order to follow the cascade through to signing a peace deal or starting a war. Further complications arise when considering all the parties involved. For the example of Bosnia and Herzegovina above, the "architect" Holbrooke was based in the USA and he collaborated with a former Prime Minister of Sweden, Carl Bildt, while the accords were negotiated in Ohio and signed in Paris. For the example of Aceh above, Kingsbury was based in Australia and the deal was reached in Helsinki with leadership from a former President of Finland, Martti Ahtisaari. Pinpointing specific locations for diplomacy processes presents complications.

The same challenges of input and output cascades exist for disaster-related activities, covering disasters and disaster risk reduction. As discussed in section 2.2, disasters are processes rooted in vulnerabilities with multi-scalar inputs and outputs across space and time. As discussed in section 3.2, even technical interventions such as building codes are political processes. They take time to formulate, codify, promulgate, monitor, and enforce—or time is required for avoiding any such actions, such as through corruption (Lewis, 2011). They have inputs from multiple locations, often involving international science, politicians in a legislature (national or sub-national), and technical input from around the jurisdiction(s) involved—all of which could also be inputting into creating disaster risk by avoiding the application of known technical knowledge (Lewis, 2003). Consequently, the question "Where and when does a disaster process begin and end?" is difficult to answer (see also Deloughrey et al., 2015). The disaster is not the point at which buildings collapse and people become casualties, but a disaster instead is a process encompassing long-term endeavours across multiple time and space scales (see also Quarantelli, 1998).

Disaster diplomacy as a cascading process thus appears at the intersection of multiple, connected input cascades leading to multiple, connected output cascades—within even necessarily having specific, identifiable nodes from the inputs converge and from where the outputs converge. Determining the causal chain as a cascade from disaster risk reduction or a disaster to specific peace and conflict outcomes becomes an almost insurmountable task. The models and definitions of cascading disasters and disaster diplomacy each break down when encountering the reality of multiple, interacting, cross-scalar processes.

Yet this critique in itself deserves critique. Is too much being asked of a single model, whether of cascading disasters, disaster diplomacy, or their intersection? As in section 3.2, trying to explore disaster diplomacy as a causal cascade could be ensuring that no disaster diplomacy case studies are ever accepted as being successful.

This situation might not be problematic since it manifests from basic definitions. By definition, both disaster and diplomacy involve many cascades. Aiming to decouple all such cascades from each other obviates both definitions, making the discussion nonsensical. Consequently, aside from affirming difficulties with cascading disaster theory, bringing it together with disaster diplomacy to seek cascades within disaster diplomacy further highlights the importance of disaster and diplomacy as processes rather than events. This approach accepts and resolves the "un"-ness critique in section 2.4.

Disaster diplomacy becomes an element to explore within the ripple effects of disaster-related activities. This task would be completed by identifying and mapping out various interacting cascades, to determine the manners and mechanisms in which influences on peace and conflict are present or absent. Seeking to determine specific causal chains—as with cascading disasters—would appear to be the wrong question to ask.

4.2. Cascading disaster risk reduction?

In referring to "the failure of physical structures, and the social functions that depend on them, including critical facilities" (Pescaroli and Alexander, 2015, p. 65), the fundamental definition of cascading disasters effectively defines a disaster (Quarantelli, 1998; UNISDR, 2017). Similarly, the definition of cascading disasters highlights "the inadequacy of disaster mitigation strategies, such as evacuation procedures, land use planning and emergency management strategies" which is exactly the ethos of defining disaster as a process. Disaster as a process goes deeper, in terms of highlighting the vulnerability process as the root cause of the disaster process which is observed through inadequate preparedness, planning, codes, regulations, and management strategies but which results from deeper and wider societal processes such as governance, inequity, and injustice (Blaike et al., 1994; Hewitt, 1983a, 1997; Lewis, 1999; Wisner et al., 2004). Pescaroli and Alexander (2015, p. 65) expound that "Cascading disasters tend to highlight unresolved vulnerabilities in human society" which is exactly what a disaster does because the disaster process by definition is the "unresolved vulnerabilities". These aspects start to be brought into cascading disasters by Pescaroli and Alexander (2016).

Similarly, disaster diplomacy's fundamental limitation might be the definition that it "explicitly examines only the unidirectional potential of disaster-related activities to influence diplomacy-related activities" (section 3.2). Disaster-related activities, including the disaster process, are political by definition, requiring diplomacy-related activities (sections 2.2 and 3.2). As with the fundamental difficulty of cascading disasters theory being that it

assumes that a cascade starts at a specific point in space and time, the fundamental problem with disaster diplomacy could be similar in assuming that disaster-related activities start at specific points in space and time.

Consequently, assuming an axiomatic and identifiable beginning point for disasters and disaster-related activities excludes key cascades and parts of causal chains, including where implementing disaster-related activities creates or exacerbates conflict. This situation was seen in post-tsunami Sri Lanka when tsunami-related humanitarian aid was used as the reason for bickering amongst the warring parties, leading to continual conflict and, against a background of other violence, the reversion to military action. It is not that the post-tsunami humanitarian relief operation caused the bickering and the subsequent violence, but that it was used as an excuse to continue the lack of diplomacy which was already desired for other reasons. Blaming the humanitarian aid for more conflict, and seeing this situation as a cascading disaster from a tsunami to a conflict, would miss the long-term processes which led to disaster diplomacy being non-viable long before the 26 December 2004 earthquake.

Such situations could be envisioned for disaster risk reduction. Conflicts over building codes and planning regulations are common and well-documented at the local level, such as for Tokyo (Sorenson, 2005) and Denver (Godschalk, 2004), which has led to violent conflict in places such as Brazil (Alston et al., 2000). Cross-border, wider-scale diplomatic conflict has emerged for river management (Glantz, 2005) and groundwater (Gleick, 1993) which intersect with disaster risk reduction measures. Blaming the disaster risk reduction measures for the conflict and lack of diplomacy begins at the wrong starting point, especially when both Glantz (2005) and Gleick (1993) explain how extensive cooperation is also seen in their case studies.

Consequently, disaster risk reduction diplomacy should not start with disaster risk reduction measures to examine their impacts on diplomacy. Instead, it would be more fruitful to examine how diplomacy permitted the disaster risk reduction measures to be enacted in the first place. Koukis et al. (2016) provide such details for Greece and Turkey. That is, cascading disaster risk reduction does not start with the disaster-related activities, just as cascading disasters do not start with the deaths and damage (which are often labelled as being the disaster).

5. Conclusions

Cascades and cascading effects do not occur just within disasters, disaster risk reduction, and disaster diplomacy; cascades cause disasters, disaster risk reduction, and disaster diplomacy, because all three are processes based in cross-scalar vulnerabilities without clear spatial or temporal delineation. Vulnerabilities as the root causes of disasters mean that neither cascading disasters nor disaster diplomacy can be spatially or temporally delineated. Furthermore, neither has a clear chain in which causes and effects can be marked, no matter how clear or clearly delineated the hazards are. Neither cascading disasters nor disaster diplomacy begin with a triggering hazard, but are part of the long-term vulnerability processes causing disasters.

Consequently, establishing well-defined causal chains cannot provide the full picture of cascading disasters or disaster diplomacy. Instead, causal chains are highly complex and tightly coupled (after Perrow, 1984, 1999) with multiple inputs to, outputs from, and interactions amongst the chains (as noted by Pescaroli and Alexander, 2016 with beginning

applications to scenarios in Pescaroli et al., 2018 and Nones and Pescaroli, 2018 from an infrastructural vulnerability perspective). In effect, multiple input and output cascades are generated, without necessarily having clear starting or ending points or nodes in space or in time. Cascading disasters theory is now moving towards this reality, but could do much better by dropping the reliance on ecosystem science paradigms. Disaster diplomacy theory has not fully embraced this reality because the definition from the beginning has been examining a unidirectional sequence starting with disaster-related activities and ending with outcomes in peace or conflict.

This paper has conceptually explored the intersection between disaster diplomacy and cascading disasters to advance theory in both fields. The key finding is that both disaster diplomacy and cascading disasters have limitations because they try to develop focused causal chains which, when examined with respect to the root causes of disasters (being vulnerabilities), are multiple, complex, intertwined causal chains. This conclusion does not obviate analysis or understanding of cascading disasters, disaster diplomacy, or their intersections. Instead, it emphasises the need to adopt social perspectives which have long been the baseline for disaster studies and which have proved adept at explaining the fundamental causes and continuation of disasters as societal processes through the vulnerability process.

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