1 Introduction: Defining Disaster

On December 26, 2004, roughly 30 kilometers (19 miles) beneath the ocean floor, a massive rupture took place along the India and Burma Plates (parts of the Indo-Australian and Eurasian Plates, respectively) about 160 kilometers (99 miles) off the northern coast of the Indonesian island of Sumatra. Within fifteen minutes, mega-tsunami waves unleashed by the 9.1-magnitude earthquake began arriving on the coasts of Sumatra's Aceh Province.[1] Over the next many hours, the colossal waves would strike along the coasts of fifteen countries and trigger the transformation of urban, coastal, and political landscapes across the Indian Ocean.[2]

The 2004 Indian Ocean Tsunami (also known as the Asian Tsunami, Sumatra Tsunami, Boxing Day Tsunami, and the Sumatra-Andaman Earthquake) unfolded over a period of hours. Yet the temblor below the ocean did not mark the beginning, nor did receding waters mark the end, of this expansive, historic catastrophe. Approximately a quarter of a million lives were lost (though, as is typical with catastrophes of this scale, we may never know the exact number). In Aceh Province alone, 35,000 children were orphaned, and many of these were soon preyed upon by human traffickers.[3] As many as 1.7 million people were displaced as the sea swallowed entire villages.[4] The saltwater damaged tens of thousands of hectares of agricultural land, while vegetation up to hundreds of meters inland disappeared in an instant. The human and financial cost of the catastrophe was staggering, and in many ways, the damage endures. Many years later, those who experienced or were affected by the calamity continue to grapple with their trauma, struggling with post-traumatic stress disorder (PTSD), depression, and/or anxiety.[5]

Disasters are not acute occurrences. They do not end when the earth has stopped shaking nor when a hurricane has moved back out to sea. For starters, the factors and mechanisms that can create conditions for a disaster to unfold are in place long before the actual hazard arrives, be it an earthquake, a big storm, a fire, a flood, a tornado, or any other force, natural or otherwise. Moreover, ramifications of disaster – for the environment, society, and the individual – can remain long after the smoke has cleared. These may include damage to the urban built environment and infrastructure, environmental degradation,

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[1] Karan, "Introduction," 7.

[2] These were Indonesia, Sri Lanka, India, Thailand, Somalia, Myanmar, Maldives, Malaysia, Tanzania, Seychelles, Bangladesh, South Africa, Yemen, Kenya, and Madagascar. See Juran, "Indian Ocean Tsunami, 2004," 198.

[3] Jasparro and Taylor, "Transnational Geopolitical Competition and Natural Disasters," 289.

[4] Schreurs, "Improving Governance Structures for Natural Disaster Response," 261.

[5] See, for example, Frankenberg and colleagues, "Mental Health in Sumatra after the Tsunami"; Kar, Krishnaraaj, and Rameshraj, "Long-Term Mental Health Outcomes."

political conflict or instability, the threat of epidemic disease, displacement, destitution, or trauma. Rather than signify an extreme event that is over in seconds, minutes, or hours, disasters instead represent long processes, with a beginning that predates their unfolding and an end that is seldom easy to locate. As historian Andy Horowitz has observed, "Their causes and consequences stretch across much longer periods of time and space than we commonly imagine."[6]

Disasters are also great revealers. As I have noted elsewhere, calamitous events lay bare the strengths or weaknesses in a state; they expose underlying power structures, political interests, economic and diplomatic concerns, social divisions and tensions, as well as who among the populace is most valued, and, conversely, who is deemed disposable and thus rendered more vulnerable to potentially dangerous hazards by targeted structural inequities.[7] Although this can be true in both rural and urban catastrophes, as well as environmental ones (consider major oil spills, for example), disasters are especially revealing when they occur in cities where most of the earth's population now lives. Today, roughly 55 percent of the global population, equivalent to about 4.2 billion people, lives in urban areas. By 2030, this number is expected to grow to 60 percent; one out of every three people will live in cities with at least half a million inhabitants.[8] Densely populated, diverse, industrial, and built up, cities are microcosms of the global order. For centuries, people have been attracted to what they have to offer: opportunities for employment and education, trade and commerce, access to resources such as hospitals and schools, as well as the conveniences of retail, entertainment, airports, and so on. Yet many, especially our most populated coastal urban areas, have become capitals of vulnerability.

Although cities are not necessarily more vulnerable to natural hazards than rural areas – in fact, analyses on earthquake-related casualties have found that in some parts of the world, rural communities suffer disproportionately – a hazard's effects are likely to be catastrophic on a grander scale.[9] The industry, built environment, and larger concentration of inhabitants in cities mean that

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[6] Horowitz, *Katrina*, 3.   [7] Ermus, *The Great Plague Scare of 1720*, 217–18.

[8] United Nations Department of Social and Economic Affairs, *The World's Cities in 2018*.

[9] See Wyss, "Disadvantage of the Rural"; Weber, "Rural Areas May Suffer Disproportionately in Quakes"; Hewitt, *Regions of Risk*, 218. See also Oven and Bankoff, "The Neglected Country(side)." Writing about earthquakes, geographer Kenneth Hewitt too has noted, "The worst catastrophes are generally those in which severe shaking affects large, densely occupied urban areas. However, this is less frequent than disasters affecting rural and small settlements, partly because these involve much larger areas within earthquake-prone regions." Hewitt, *Regions of Risk*, 197. One hazard to which urban areas are more uniquely vulnerable than the countryside is extreme heat (or heat waves). Whereas natural landscapes can absorb the sun's heat, the urban built environment – including buildings, roads, sidewalks, and so forth – reflects it, causing what is known as the heat island effect.

any major disturbance could be costlier and affect more people. An urban disaster is also more likely to affect regions far beyond the city limits. Many urban areas are home to critical infrastructures, manufacturing plants, and/or commercial ports on which disparate parts of the world rely. Significant interruptions can therefore have major implications for daily life across the globe, affecting, for example, regional or global economies or the global supply chain (the price and availability of certain items).[10] These factors are part of the reason urban disasters garner so much more attention in the media than rural disasters, which in turn results in rural areas having less access to the resources necessary to increase resilience. Not attracting the eyes of the world means less aid and personnel, less financial support, and therefore a diminished ability to make necessary changes to laws and building regulations.

Still, cities are cast with unique vulnerabilities. On October 31, 2018, designated World Cities Day by the United Nations, the Department of Economic and Social Affairs (UN DESA) reported that the majority of the world's cities are vulnerable to at least one type of hazard, including earthquakes, cyclones, floods, droughts, landslides, and volcanic eruptions.[11] And at least partly as a result of anthropogenic (human-caused) climate change, as well as human activity such as the destruction of natural storm barriers (for example, mangrove forests), the paving over of floodplains (which increases surface runoff and therefore flood risk), and other forms of human encroachment, such hazards are more frequently resulting in disasters. Between 1970 and 2019, the number of catastrophes resulting from extreme weather events jumped fivefold, accounting for 50 percent of disasters across the globe, 45 percent of all reported deaths (91 percent of which occurred in developing countries), and 74 percent of all reported economic losses.[12] This increase in the frequency and intensity of extreme events, combined with the exposure and lack of preparedness of communities around the globe, has resulted in what I call the "new disaster realities" of our era, in which we are forced to reckon with the consequences of humanity's exploitations. Many of the world's largest, most densely populated cities, moreover, are situated along coastlines, which exposes them to hazards from which inland settlements are mostly shielded: cyclones and coastal storms, tsunamis, and, increasingly, the slow disaster of rising seas resulting from anthropogenic climate change. Today, it is worth noting, roughly 10 percent of the global population lives in a low-elevation coastal zone (less than 10

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[10] Rural disasters too can destroy important crops, livestock, and so forth, with similarly important implications for the price and availability of goods around the globe, yet urban disasters nevertheless garner more attention in the media.

[11] Ibid., 9.

[12] United Nations, "Climate and Weather-Related Disasters Surge Five-Fold over 50 Years."

meters of elevation), even though this represents only 2.2 percent of the earth's land surface,[13] and about 40 percent (more than 2.5 billion people) live within 100 kilometers (62 miles) of the coast.[14] In fact, coastal metropolises – such as Tokyo, Mumbai, Osaka, New York, Buenos Aires, and many, many others – are home to a majority of the world's urban population (roughly 53 percent).[15]

The importance of cities and urban vulnerabilities in discussions about disaster, then, cannot be overstated, hence the purpose of the present Element. By looking at a series of case studies from around the world, this concise history examines how cities have experienced urban disasters, including earthquakes, tsunamis, cyclones and floods, fires, and disease epidemics. It is intended as an introduction to the subject of urban disasters that explores many of the central concepts and ideas that help define their study, as well as the role of human decisions in the process of disaster-making. Some of the questions it seeks to answer include: Why do disasters happen? What is the relationship between cities and disaster? How have cities responded in times of crisis, and what kind of practices, infrastructures, and/or institutions have urban areas introduced to prevent disasters? Relatedly, in what ways have catastrophes served to change cities in the long term? Perhaps most importantly, what does this all mean for us today as the cities of the world face the ongoing effects of climate change? This Element will explore the effects of disasters on urban populations, infrastructures, laws, building regulations, public health policies, and a number of other elements over the past 300 years. In the end, the reader will find that urban disasters are a complex marriage of destruction and renewal, of failures and opportunities, of winners and losers.

Consistent with the nature of both urban and disaster history, this Element is informed by scholarship from across disciplines. The study of disasters, like the study of cities, is fundamentally and necessarily interdisciplinary. Disaster history borrows and benefits from findings and perspectives in a host of other disciplines and fields that unite to provide a fuller understanding of the countless complex factors that contribute to a disaster's unfolding. Disaster history also benefits from a global or transnational approach that considers the broader effects and implications of a disaster across time and space and allows for comparisons from which we can draw lessons for the present. Disasters, after all, are always with us: on our newsfeeds, on our televisions, in our literature, perhaps in our region or neighborhood, in our past, and in our future. In this era

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[13] United Nations, "Ocean Conference Fact Sheet"; McGranahan, Balk, and Anderson, "Low Coastal Zone Settlements," 16.

[14] United Nations, "Ocean Conference Fact Sheet."

[15] Barragán and Andrés, "Analysis and Trends of the World's Coastal Cities and Agglomerations," 12–13.

of climate change, extreme weather, disease, and general unrest, we need lessons from the past perhaps more than ever. This Element is one small contribution to the cause.

1.1 Central Concepts and Terminology

Beyond the scope of the present paragraph, I do not employ the phrase "natural disaster" anywhere in this Element, and the reason is simple: *natural* disasters do not exist. The term "natural disaster," which denotes an "act of God" or an adverse event that occurs through natural processes – which is to say, beyond human influence or control – is, at best, problematic. The very origins of the word "disaster" itself – from Greek and Latin terms for "bad star" or "ill-starred event" – point to this understanding of disasters as natural occurrences beyond our control. Consequently, the label of "natural disaster" removes, too often deliberately, all responsibility from human actors and their decisions in creating a disaster, when in fact, the human element is central, if to varying degrees. Consider, for example, a hurricane. The characteristics that define a hurricane – a rotating storm with strong winds, rain, a low-pressure center, and so forth – are not, in themselves, synonymous with "disaster." While at sea, in other words, a hurricane is little more than a big storm.[16] The *disaster* results when this large, rotating system approaches a coastline made vulnerable by factors such as coastline development and large populations, inadequate flood and/or wind infrastructure, lack of storm barriers (natural or otherwise), construction in low-lying areas, and so on. Put another way, although a hurricane itself is not human made (even if these storms *are* becoming stronger and more frequent as a result of anthropogenic climate change), its development into a disaster will result not merely from its movement inland but, largely, from human decisions made on the ground for decades or even centuries before its arrival. In place of "natural disaster," then, I use "hazard," "natural hazard,"[17] or "extreme event" to refer to a naturally occurring event – such as a big storm, earthquake, or volcanic eruption – that can trigger widespread damage among a population rendered vulnerable by human-driven factors and decisions.[18]

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[16] Oliver-Smith, "Introduction," 7.

[17] The United Nations Office for Disaster Risk Reduction (UNDRR) defines "hazard" as a "process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation ... Natural hazards are predominantly associated with natural processes and phenomena." United Nations Office for Disaster Risk Reduction, "Terminology."

[18] One could also argue, as disaster and health scholar Ilan Kelman has, that the phrase "natural hazard," used in this Element to refer to these naturally occurring phenomena, is also problematic for reasons similar to those just listed, which is to say, there is no such thing as a natural hazard. A natural event, like a hurricane (to use the same example), is not in and of itself any

What, then, does it mean to be vulnerable? What *is* vulnerability, and what, in turn, does it mean to be resilient? In some ways, these two central concepts go hand in hand. In the context of disaster studies, vulnerability – from the Latin *vulnerabilis*, meaning to wound or injure – refers to the conditions or circumstances in place that increase the exposure and/or susceptibility of a community, society, system, or an individual to the detrimental effects of a hazard. These conditions can be shaped by physical, social, economic, and/or environmental factors – for example, colonialism, capitalism, white supremacy, gender, religion, age, disability, and so on – and they determine the extent to which a natural event, like a hurricane or an earthquake, becomes a disaster.[19] Vulnerability, in other words, does not merely exist but is constructed. Meanwhile, resilience – from the Latin *resilire*, which means to rebound or spring back – refers to the capacity of a person, system, community, or society to resist, absorb, adapt to, or recover from the effects of a hazard.[20] It too is constructed, more often than not, to the benefit of the wealthy and advantaged. Vulnerability thus signifies a lack or absence of resilience, and vice versa. It is important to note, as Bavel and colleagues have, that "Determinants of vulnerability, although situationally specific, often incorporate various aspects of distribution of wealth, resources, support, and opportunity, while resilience is determined to a significant extent by social, economic, and political institutions and the context in which they function."[21] In effect, this results in urban landscapes that comprise various levels of vulnerability. A single city can have areas that are considered resilient to a particular hazard, and others that are vulnerable to various degrees. The more resilient neighborhoods are likely to be whiter and more affluent, while more vulnerable areas tend to be home to racial and ethnic minorities and to households of lower socioeconomic status (SES). These, in turn, may be marked by shoddier construction and/or be built in low-lying areas or otherwise less desirable geographic locations. In this context, it is useful to introduce the concept of risk. Risk, we can say, is "'a product of three major elements: exposure to hazards . . ., the frequency or severity of the hazard, and the vulnerability.' More precisely, it is the likely level of loss from a given magnitude of hazard combined with the potential for harm."[22] And this potential for harm, this *risk*, is not evenly distributed. Instead, like resilience, it is determined

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more a *hazard* than it is a disaster, unless we – humans – make it so. Kelman, *Disaster by Choice*, 40; Kelman, "Natural Disasters Do Not Exist," 3.

[19] United Nations Office for Disaster Risk Reduction, "Terminology."

[20] Ibid. The introduction to Remes and Horowitz's volume *Critical Disaster Studies* includes a valuable discussion on the terms introduced here and the extent to which they are, essentially, political. See Horowitz and Remes, "Introduction," 1–8.

[21] Bavel et al., *Disasters and History*, 24.

[22] Birkmann, "Risk and Vulnerability Indicators," 21; Modica and Zoboli, "Vulnerability," 61.

to a large degree by political, economic, and social motivations that, through the decisions of human actors, can influence the level of risk a particular area is exposed to in the face of a hazard.

Hazards, vulnerability, risk, resilience – these are some of the more central concepts mentioned throughout this Element. I would also like to draw attention to my use of perhaps the most central terms in this Element: "urban" and "disaster" (and, by extension, "catastrophe," "calamity," and "crisis"). By "urban" – from the Latin *urbs*, meaning city or large town – I mean in or related to a city, *including* the urban periphery, which is to say the settled areas extending from the city center (such as the suburbs). A city proper, by which I mean the urban area within official city limits, does not operate alone or exist in isolation. It functions in tandem with surrounding areas that provide a workforce, clientele, foods, materials, and other resources, and that often represent an extension of the city's identity. Based on these understandings, I use the terms "city," "urban area," and "urban center" inter-changeably. The word "disaster," meanwhile, is typically understood as a sudden, overwhelming occurrence that causes extensive damage. In fact, the Oxford Dictionary defines it as "a sudden accident or natural catastrophe that causes great damage or loss of life," but, as we have already seen, this definition is problematic.[23] For one, there is no such thing as a "natural catastrophe," nor are disasters sudden occurrences. Instead, as I discussed earlier, disasters must be understood as long, drawn-out events with a history *and* a future. The United Nations Office for Disaster Risk Reduction (UNDRR) thus offers a more detailed definition of the term: "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources." The words "catastrophe" and "calamity" are defined in much the same way. Oxford defines the former as "an event causing great and usually sudden damage or suffering; a disaster," and the latter as "an event that causes great damage to people's lives, property, etc."[24] Finally, the word "crisis" comes to us from the Greek *krisis*, meaning either "decision," or as Hippocrates and Galen used it, "the turning point of a disease." Despite this medical origin, however, Oxford now defines it as "a time of intense difficulty or danger . . . when decisions must be made." Rather than a sudden and/or destructive event, it is, more broadly, a time of challenge or difficulty. Based on these understandings, this Element uses "disaster," "catastrophe," and "calamity" interchangeably, but uses "crisis" to refer more broadly to any significant time or instance of emergency.

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[23] "Disaster, n." *OED Online*.

[24] "Catastrophe" comes to us from the Greek and Latin terms *katastrophē* and *catastropha*, respectively, which means "overturning" or "sudden turn," while the Latin *calamitatem* or *calamitas* refers to disaster, damage, or misfortune.