Promoting societal resilience to cascading risk and concurrencies

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Abstract

Climate change is not just about modelling and understanding hazards or weather. Societal resilience has to consider wider systemic dynamics and to explore how risks interact for going beyond the existing approaches to adaptation. It is a matter of understanding the root causes of problems, promoting strategic efforts that could be efficient and feasible.

This chapter offers a reference point for scholars and practitioners who are approaching the management of complex systems and are willing to explore the implications for business as usual. At the same time, it builds evidence to support experienced readers in going beyond silo thinking and conventional wisdom. Examples and theories are used together to propose that climate resilient societies need shifting toward the understanding of common points of failures between different threats, and promoting effective multi-sectoral partnerships.

The sections are developed to progress in complementary steps. Are there any lessons learned from the COVID-19 pandemic that could be applied for promoting climate resilient societies? What is cascading risk and how does it relate to concurrent and compounding events? What can be learned from the field? Are there differences between remote and urban areas? The discussion proposes a reflection on how limitations in time scales, budgets, and operational capacity could affect resilience, offering an approach to move beyond the status quo and promoting societal resilience.

Keywords: Cascading risk; concurrent events; compound events; resilience; climate change; adaptation.

1. Introduction: do pandemics and climate change have something in common?

It was a long and dark winter. In that period, there was an increased number of rumours about a crisis going out of control in a G7 country. Some videos were emerging on social media and newspapers, but it was still “just” somewhere in the middle on the geographical map. It was far, and the common belief both on the streets and in the classrooms was that something like this “would have never ever happened to us”. At the end of the day, it was hard to understand how many things were really more than just the result of fake news. Everyone agreed it was an effect of mismanagement, but it was attributed to something very cultural and very local. Borders would have stopped the problem, a problem elsewhere. Government would have taken decisive actions. And, if all this would have been enough, then technology would have sorted it out as it was always doing. It would have been another episode of the rubberneck effect of the media. Then, suddenly, that “reasonable worst-case scenario” written by emergency planners became the reality worldwide. It was early 2020, and the “probabilities” became facts when history decided it was time to shake some daily routines and assumptions.

The crisis triggered by the COVID-19 pandemic has exposed the interdependencies and vulnerabilities of our societies, revealing the systemic nature of risk and our reliance on technology (Gordon and Williams 2020). It has never been a problem affecting “just” the healthcare sector or increasing “just” the mortality: the impacts of the pandemic have been amplified by underlying drivers, background conditions, and unsolved vulnerabilities at all levels of governance and economic structures. Before the event itself, there was an awareness of some challenges of dealing with pandemics, such as the implications of lockdowns, but they were simply not thought through well enough (Kelman 2020). To some extent, the COVID-19 pandemic could be considered the latest of many unanswered “wake up calls” for actions in disaster risk reduction and resilience. It remained in the background of societal concerns for generations, and it was occasionally brought up in the media before being forgotten again or put in the non-priority list of things to do. Until some years ago, there were still memories of the stories told by the grandparents that survived the Spanish Flu of 1918-20. The management of the SARS outbreak in 2003 had difficulties, but the bullet of a world-changing pandemic was dodged. The 2009 H1N1 influenza pandemic was (kind of) dealt with. The 2014-16 Ebola outbreak was looking grim, but it gave the illusion of being under control. International organisations were on watch to develop mitigation action, and something was allegedly being done or was on their way.

Experts worldwide were assuming that a new critical event was not a matter of “if”, but of “when”. Plans and coordination were supposed to be in place and the pandemics were the top priorities of risk registers. But were those risk registers fit for purpose when considering the extent of interdependencies, including movement of people, service, and goods?

Unsurprisingly, they were not. The Independent Panel for Pandemic Preparedness and Response's (IPPR 2021) suggested that "Despite the consistent messages that significant change was needed to ensure global protection against pandemic threats, the majority of recommendations were never implemented...National pandemic preparedness has been vastly underfunded, despite the clear evidence that its cost is a fraction of the cost of responses and losses incurred when an epidemic occurs" (IPPR 2021, pp.16-17). Does this sound like something familiar? It is. The Stern Review on the Economics of Climate Change argued nearly two decades ago that: "The costs of stabilising the climate are significant but manageable; delay would be dangerous and much more costly...A range of options exists to cut emissions; strong, deliberate policy action is required to motivate their take-up" (Stern et al. 2006, p. 7- 8).

There are some challenges for addressing pandemics that are common to something (apparently) different such as climate change: sudden shifts in the operational scenarios are happening quickly, across geographical and ecological scales, with non-linear changes in the intensity and frequency of hazard (United Nations Office for Disaster Risk Reduction, UNDRR, 2019). It is the broader picture of systemic and complex risk. The management of the COVID-19 pandemic has been affected by higher levels of uncertainties and unpredictability, because "changes in one system may evolve and impact other systems" (Heynes et al. 2020). The evolution of the virus did not stop the environment from going on, following other routes and recombining together vulnerabilities to other hazards. We must go beyond learning how to deal with future waves of infections or weather events; we must also understand how to create resilience at the societal level and move beyond "traditional" risk management approaches (Linkov et al. 2014). The use of precursors and risk understanding reality and drive indicators is becoming gradually more inadequate, for the changes in hazards and vulnerability (including exposure) patterns (UNDRR 2019). In 2020 alone, first line emergency responders across the globe have been challenged by the recombination of COVID-19 with other natural hazards, such as earthquakes in countries such as Spain, drought in California, forest fires in China, flash flooding in cities such as Milan and Palermo, and heat waves across the world. Across Europe, a lack of effective response and preparedness was perceived that should lead to the development of a more connected response capacity for the future (Pescaroli et al. 2021).

This is easier to say than to do. Models and long-term forecasts used for climate, as well as the fast evolutions of the virus, are based on temporal dimensions that can be hard to understand for the public and policymakers, challenging intuitions (Manzanedo and Mannig 2020). In other words, they can be too fast (evolution of virus variants) or relatively slower (creeping changes, including human-caused climate change, Glantz 1994ab).

New actions have to go beyond addressing the hazard itself, increasing flexibility of response toward the identification of drivers across systems (UNDRR 2019). This is far from being just technical jargon, and this chapter will develop a practical analysis of how to promote societal resilience to cascading risk and concurrencies. The second and third sections examine complexity by explaining different components, how they can interact with climate change dynamics, and how they can be operationalized. The fourth and fifth sections propose some practical lessons learned from the experience of the London Climate Change Partnership, and we discuss the potential differences and similarities between urban and remote areas. Finally, the discussion adopts a perspective identifying commonalities among climate change and other phenomena, to support the definition of practical actions across research disciplines and policies.

Using climate change follows the definition of IPCC (2014) referring to “a change in the climate's state that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer”. Extreme weather events are intended as “events that are rare at a particular place and time of year”. Conversely, resilience here uses more of an operational approach. It starts with the definition of the United Nations Office of Disaster Risk Reduction: “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.” (UNDRR 2017). The definition of resilience, though, cannot stop here due to all the problems with and critiques of the UNDRR (2017) definition which are raised throughout the chapter to indicate how to do better. Overcoming this definition’s limitations indicates how the ability to cope with the consequences of climate change is a process that includes both planning and decision making across sectors.

2. Climate change, networks and complex systems

Climate change risks are not self-standing and they cannot be considered solely in their physical dimensions. For example, the impact of “flooding” is not purely the result of mm of rainfall, and the implications of “heatwaves” are not just associated with the degrees of temperature reached. Instead, every phenomenon including climate change is context dependent, and reflects the dynamic relation between hazards and vulnerabilities (including exposures). The impact of any trigger can be amplified or mitigated by how societies progress in certain spaces, in certain time, with well- defined political, economic, and cultural features (UNDRR 2019). Understanding the relation between climate change and resilience must be considered through relations across spheres such as the built environment, operational routines, and human and organisational behaviours.

In the early 1970s, Barry Commoner proposed the ground-breaking work “The closing circle.” In this work everything was interconnected, and the social ramifications of environmental decline were stated out. More specifically: “the environmental crisis from its overt manifestations in the ecosphere to the ecological stresses which they reflect, to the faults in productive technology-and in its scientific background-that generate these stresses, and finally to the economic, social, and political forces…”(Commoner 1971, p.5). Everything evolved since this work, time changed, and new disciplines emerged. Authors such as Hewitt (1995) argued that events such as disasters are socially constructed, and they are shaped within their local cultural and environmental contexts. Their creation can be amplified by negative feedback processes that inhibit mitigation, such as negligence or corruption, or balanced by positive feedback, such as the application of good governance (Alexander 2000). It has been suggested that addressing longer term problems requires acting on their root causes, mitigating hazards but also acting complemery on reducing societal vulnerabilities (Wisner et al. 2004).

Gradually, technology acquired a wider role in day-to-day activities modifying the operational context of reference. New routines such as remote working or globetrotting became possible just on the assumption that several and complex networks assure the availability of services that remain highly reliable. It was a gradual process of modified anthropic spaces and accelerated for example with the development of aviation, energy, and telecommunications. The shift to a just-in-time production model in most of the industrialised nations implied a streamlined system where inventories and waste were reduced, but also drastically increased the relevance of supply lines and shipping. The analysis of possible chain of causes and effects that could cause incidents or malfunctions became more difficult. New interdependencies created new vulnerabilities, and multiple non-linear failures had to be "expected" because of higher complexity in the system, as well as the existence of too many components and lack of precursors (Perrow 1998). At the same time, it was noted that disturbances could spread quickly between the components (tight coupling), and when they can cause cascading effects that can scale up to the point of being unstoppable (Perrow 1998).

The evolution of the internet and services impacted societal behaviours widely and can be used to express further how this concept can affect every day' activity. For example, in the last decade many countries started transitioning to a cashless society, where payments are done through contactless credit cards and web-based applications. These require a backbone of highly reliable invisible utilities to work (Krausmann et al. 2016). Digital banking such as ATMs and payment gateways that allow fund transfer depend on stable internet access, and this is just the tip of the iceberg: deep down the line they all are dependent on as satellite systems for their synchronisation (time). The same satellite systems are also needed for aspects such as ensuring the deliveries, distributions, and the supply chain (space). In other words, the "simple" act of buying groceries in a random supermarket located in a random country is far more complex than any shopper would suspect. It is now dependent on the availability of infrastructure located in outer space and connected to other technological assets that are standing between the customer and the payment to the supermarket, and the supermarket and its suppliers. These, in turn, need other services to work, such as a stable energy supply and have practical consequences for managing and preventing crises.

Linkov et al. (2019) argued that the large complex system created by increasingly interconnected social, technical, and economic networks are requiring a shift away from traditional risk analysis methods that focus on analysis specific components. These became inadequate both in terms of costs and objective feasibility, requiring instead more complementary approaches on building resilience and facilitating adaptation. The idea is that resilience could be "threat agnostic", assuming that at "some stage, some threat or combination of threats will materialise and disrupt the system" (Linkov et al. 2019). Following this perspective, it is important to understand how scenarios could recombine together and which common points of failures could emerge. This has to be done considering both the implications of climate change and network interdependencies, and their common point of failures in society.

3. Cascading risk and concurrencies

Complex systems can be seen as the result of different dynamics that overlap, and the implications of their relations for building societal resilience tends to be underrated. Figure 1 provides a synthetic reference about specificities and commonalities of compound, interacting, interconnected and cascading risks explained by Pescaroli and Alexander (2018):

- Compound risk is referred mainly to physical components and the environmentantal domain. It considers the possibility of concurrencies between natural events such as weather extremes. This is particularly relevant for this chapter, because it is directly associated with the idea that climate change could increase complexity though affecting the distribution and combination of events. Field et al. (2012) refers to it as “a special category of climate extremes, which result from the combination of two or more events, and which are again ‘extreme’ either from a statistical perspective or associated with a specific threshold”. Compound risk includes those extremes occurring simultaneously or successively or resulting from the combination of average events. Some examples include high sea-level rise coincident with tropical cyclones, heat waves amplifying wildfires, or systems wide feedbacks such as droughts and heat waves occurring in areas with both dry and wet conditions.
- Interacting risk is referred to physical dynamics where primary hazardous events, such as earthquakes, generate secondary hazards, such as tsunamis. In other words, it is associated with the natural environment and its causal chain. Gill and Malamud (2014) found that geophysical and hydrological hazards can be triggered by most of the other types of hazard, while geophysical and atmospheric causes are the most common trigger. These patterns can be relatively common as for example hurricanes can generate storm surges upon impacts.
- Interconnected risk is used in network science, multi-criteria assessment, and modelling. It is focused on the interdependencies that are the basis of interactions between society, environment and technology. Interconnected risk can be intended as the pre-condition for cascading risk. For example, it can be associated with the dependencies between infrastructure systems or the networks of the financial systems.
- Finally, cascading risk is specific to the anthropogenic domain and the management of societal and infrastructure nodes. It is associated with the non linear process in which, given a triggering hazard, new secondary events such as the disruption of critical infrastructure (CI) are escalating the impacts of the disaster (Pescaroli and Alexander 2016). One of the most known examples is the Eyjafjallajökull in April 2010 and the cross border effects caused by the disruption of air transportation. However, it can be noted that cascading events can be triggered both by natural or technical phenomena, such as weather or mechanical failures, and human actions, such as mistakes or malicious attacks. In all cases, cascading risk is amplified by societal and organisational vulnerabilities, including challenges of sustainability, and its causal chains have the potential for recombining together with higher uncertainties.

These dynamic risks share some commonalities, such as having complex causality chains. Adaptation to climate change needs to to leverage and prioritise the measures that could consider together technology, society, and weather. This is essential for different aspects such as: a) promoting and efficient use of resources that promote the buy-in of stakeholders;

b) addressing coordination challenges; c) increasing the flexibility in the face of uncertainties. Cross cutting strategies include developing measures on the built environment and asset management, as well as multi-criteria decision support and warning systems (Pescaroli and Alexander 2018).

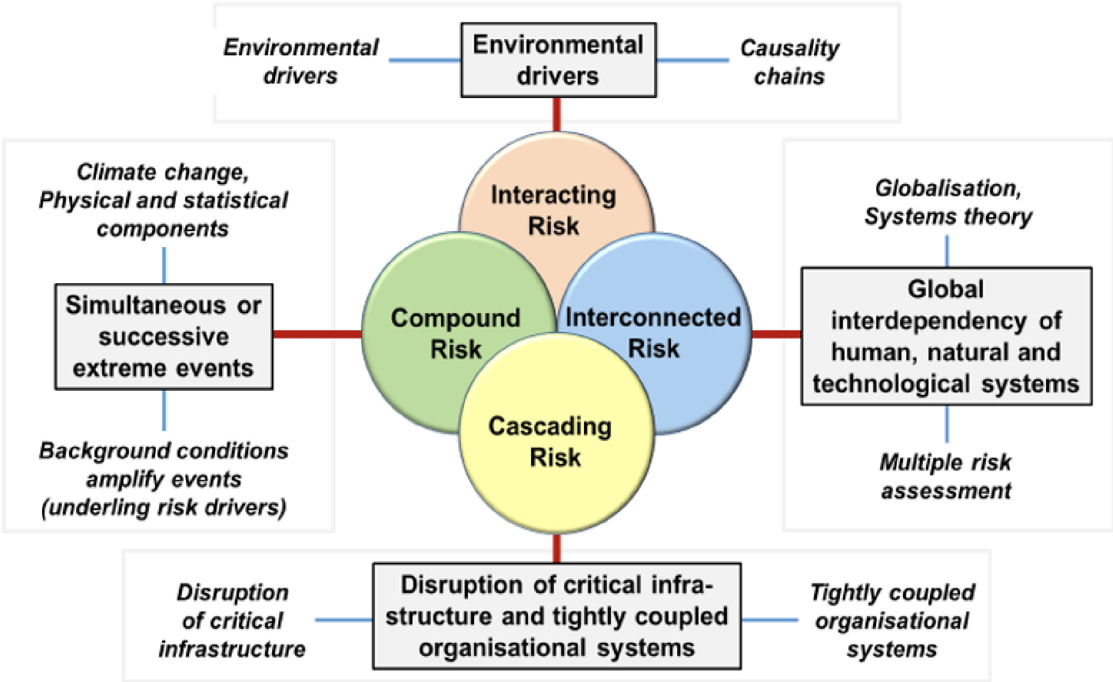

Figure 1- Compound, Interacting, Interconnected and cascading risk (Pescaroli et al. 2018)

Adopting a systemic perspective, further considerations need to understand how the relation between cascading and compound risk could interact with CI. Those are intended as “the physical structures, facilities, networks and other assets which provide services that are essential to the social and economic functioning of a community or society” (UNDRR 2017). It is both a problem of addressing root causes of sustainability and supporting the operational capacity of emergency management. It is known that climate change can affect multiple CI sectors and needs to be included in new cross-cutting strategies, engaging the private sector or acknowledging the wider implications of dealing with disruptions in governance (Casajus Valles et al. 2021). In recent years, different national and international organisations across the world produced recommendations to increase CI climate resilience and improve the reliability of service provision (e.g. OECD 2018).

There are different patterns that need to be taken into account, that share common challenges. Adopting a stakeholders’ perspective, there is agreement that cascading events could become more common because of climate change (Pescaroli 2018). For example, temperature changes can affect both energy supply and demand, changing patterns of consumption. Extended periods of dry weather can reduce water supply or compromise its quality, slowing sewages, or affecting transport. Although arrangements for cold and hot weather are different, in both cases good emergency planning should connect weather forecasting with the response of social and health services. Even including more cases, the key points do not change. Flooding and sea level rise are particular threats to most physical assets while storms are known to affect communications and energy distribution. Common planning should assure that infrastructure mapping is overlapped with risk maps, including societal effects of possible disruptions. As noted by Alexander (2017), “failure to recognize the makings of an emergency, and consequently to mount a timely response, is one common problem to be tackled through planning; failure to identify and help the people most at risk is another” (Alexander 2017 p. 157). Other problems can be associated with the cascading effects of disruptions of other services, such as energy disruption impacting telecoms, or the primary impact of compound events on phone or cable lines reducing the speed of the internet connections. Clearly, it is essential to evolve practices into a more holistic approach that could go beyond the focus on single risks (Linkov et al. 2014; 2019).

The recombination of cascading risk with concurrencies and compound risk implies the possibility of complex scenarios that could compromise the effectiveness of emergency management. Figure 2 illustrates that an initial event of variable intensity can produce disruptions in CI and technology, which could amplify the overall impact of the event (Pescaroli et al, 2018). Different primary triggers could impact on the same vulnerabilities, independently if they originate in the environmental domain, such as weather causing a blackout, or can be associated with malicious intent such as cyber attacks or hybrid warfare. In this phase, first responders could be already challenged in scaling up their efforts due to their highly resilience on technology. Further concurrencies and compounding events could exacerbate the situation, and could cause a knock out scenario if not balanced by positive feedback. In the next section is provided an operational focus on power failure that will be used to demonstrate that this scenario is far from “crying wolf” and requires to be carefully thought through in both short and long term investments.

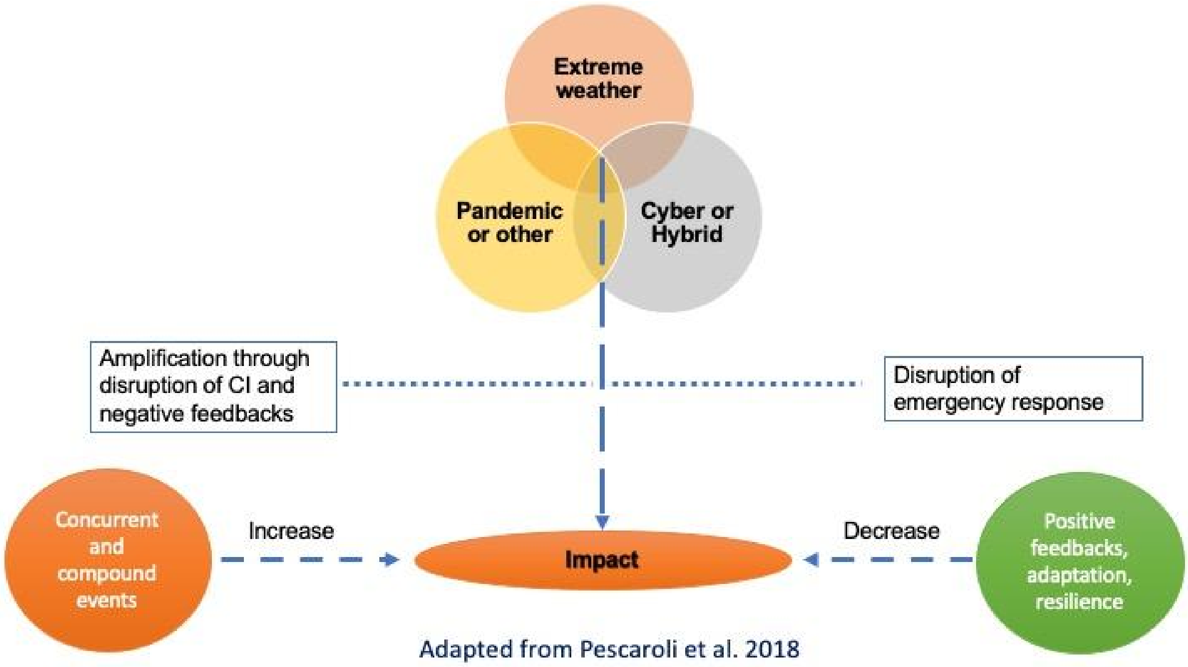

Figure 2 - Scenario of cascading risk and concurrency (Pescaroli et al. 2018)

3.1 Learning from power outages and blackouts

There are plenty of precursors to consider for understanding complex scenarios, cascading effects and concurrencies. The most explanatory examples though are the one associated with disruptions to energy infrastructure, both because of its vulnerability to weather and its primary role for societal functions. In this section, we intend power outages and blackouts as synonymous with partial or total loss of power supply to some end user. Everything depends on electricity, but the grid can be disrupted by both the direct impacts of hazards, effects of aging and deterioration, mismanagement, or malicious intent such as cyber attacks. In other words, power failure may be triggered by particular hazards or threats, such as flooding, storms, heatwaves, ash clouds, geomagnetic storms, terrorism, cyber warfare, etc. However, outages are often more rooted in the decision making that is affecting the reliability of the infrastructure assets. Cascading effects originating in the energy sector can challenge operational capacity in all other infrastructure, as well as societal resilience both in the short and longer term (Petermann et al. 2011; Royal Academy of Engineering 2016).

The concurrence of power outages with other hazardous conditions results in a recombination of all the elements and can be exacerbated by pre-existing weaknesses. Peaks in energy consumption are also associated with extreme weather, both cold and hot, as it is used to activate mitigation such as cooling and heating. For example, they can happen in concurrence of heat waves. On the one hand , this could increase the possibility of wildfires. On the other hand it could act as a stressor on the health sector, and the importance of refrigeration in food consumption, supply and production. Similarly, cold weather and snow in concurrence with power failures which can be associated with loss of life related to the increased need of heating, or carbon dioxide poisoning. More in general, it can be noted that power outages can become: a) direct threats to life, disrupting healthcare (e.g. home injuries and reduced reliability of emergency services), refrigeration, water and food supply; b) Indirect threats to life, causing disruptions that impact the crises and hamper recovery, such as loss of telecoms, transport, loss of cash flow or impacts on the vulnerable population. Finally, they can create challenges for operational capacity limiting the capacity of emergency response and continuity management (Petermann et al. 2011; Royal Academy of Engineering 2016).

There are different explanatory examples that can be brought from events across the globe. The 2012 Hurricane Sandy was distinguished by interacting physical dynamics, cascading effects caused by infrastructure failures, and indirect life losses due to the joint effect of extended power outages and cold weather (Pescaroli and Alexander 2018). In December 2015, the city of Carlisle, in Cumbria, England suffered the consequences of Storm Desmond, including 2,128 properties flooded in Carlisle and approximately 60,000 homes subject to power outages across northern England. The Royal Academy of Engineering (2016) pointed out lack of household preparedness, and failure of services such as mobile phone systems that hampered communications.In 2017 Hurricane Maria impacted on a poorly resilient electricity grid, weakened by years of reduced maintenance. The joint effect of the natural hazard and the long lasting power disruption affected all levels of society, with effects on sectors such as healthcare. The 2018 power network overload in Cascais, outside Lisbon, happened during one of the most severe heat waves of the decade. In July 2019, extreme heat caused transport disruptions in the United Kingdom, followed a month later by a blackout in southern England during an extended period of severe heat.

Since the beginning of the COVID-19 emergency it has been clear that the cascading effects caused by the pandemic could re-combine with concurrent events such as heatwaves, wildfires, flooding, earthquakes, hurricanes, chemical disasters and targeted cyber-attacks (Clark Ginsberg et al. 2020). The 2021 blackout in Texas is an excellent example of what could go wrong in those cases. Early in February the region was affected by a blizzard, but a preparedness process known as “winterization” of the grid was not adequately undertaken. A forthcoming period of severe weather was expected with icy conditions. A first winter storm (10-11) caused several days below freezing, and was followed by a disaster declaration of the Texas Governor. Between the 13 and 17 of February, what is unofficially known as “Winter Storm Uri” impacted the area. A peak of consumption happened while the grid was weakened by inadequate winterization that caused freezing of the supply and of many control instruments in the power plant. Nearly one week from the warnings, it was decided to undertake rolling outages to limit the possibility of a more catastrophic event. Something went wrong, the restoration efforts were burdened. In the next few days, the blackout worsened the impact of the ongoing freezing temperatures and snow, now associated with a new storm unofficially known as Winter Storm Viola (15-20 of February*)*. The situation was stabilised gradually between the 20th and the 24th of February. The Homeland Security Digital Library specifies that “over 4.5 million households and businesses were left without heat, water, and electricity for several days,” with estimated costs between $195-$295 billion (www.hsdl.org/c/tl/2021-texas-power-crisis). Hospitals that were already under pressure from the pandemic had to operate with emergency generators and with several disruptions, including for example delays in vaccinations.

In conclusion, complex scenarios cannot be considered just by managing emergencies but need deeper actions on their root causes and operational context. These include addressing the common point of failures between hazards at the societal and organisational levels, promoting stress testing, understanding supply chain vulnerability, and developing public-private partnership (Pescaroli et al. 2021). The next section will examine a case study, learning from applications and limitations of how multi-sector partnerships could support societal resilience to cascading risk and concurrencies in the field of climate change. This will be followed by additional considerations on the differences between urban and rural areas.

4. The role of multi-sector partnership for supporting societal resilience to cascading risk and concurrencies

Addressing systemic risk requires working across geographical and sectoral boundaries, and the role of multi-sectoral partnership becomes vital in order to support a coordinated action. The London Climate Change Partnership (LCCP) was established in 2001, bringing together public, private, and voluntary sector organisations to support London's climate resilience. Its role has been now complementary to the new London Resilience Strategy (GLA 2020).

The LCCP is managed by a coordinator based in the Environment team in the Greater London Authority (GLA). Its activities include commissioning research, for example into the impacts of climate change on people, infrastructure, buildings, and nature; carrying out projects, for example social housing adaptation retrofit, or producing sector-specific guidance, tools, and resources; and facilitating knowledge exchange, through standing groups on topics like heat risk or transport adaptation, through ad-hoc science-to-practice events, or through attending external events like local climate commissions and panels. The LCCP can also provide a unified voice advocating on behalf of the policies, programmes, and support London needs from the government to adapt.

The LCCP's main focus is on climate change adaptation in Greater London. However, decision-makers in London are aware that a well-adapted London in a poorly adapted UK is a meaningless proposition due to the geographical interdependencies and connectivity with surrounding areas and beyond. Stakeholders from beyond London are frequently invited to participate in partnership activities to learn and to promote their own good practice. The LCCP can also bring in perspectives and approaches from DRR, organisational capacity/change, and other disciplines to improve learning and to contextualize adaptation for a wider range of actors.

While it is often difficult to monitor the impacts of adaptation activities, the LCCP has successfully influenced policy and practice among its partners. The partnership's heat risk science-to-practice exchange led to robust and progressive overheating policy in the London Plan, London's spatial development strategy (GLA 2021). Engagement with the GLA's food policy team led to a commitment to consider resilience in the 2018 London Food Strategy (GLA 2018). A Transport Adaptation Steering Group, led by Transport for London (TfL), provides a consultative body for TfL's adaptation work, which includes research into the relationship between weather and transport network performance. The LCCP also worked with London Resilience to promote and disseminate the Anytown (Hogan 2013) approach to identifying interdependencies and potential points of failure between and among infrastructure systems.

The LCCP is able to carry out its activities because it benefits from committed resource in the form of a manager to maintain a wide network, forge relationships, manage communications, bring in expertise where needed, be a “match-maker,” facilitate meetings, set agendas, and attend to the fundamental tasks of administration. Its structure is designed to meet basic aims and objectives while allowing for flexibility to include different agendas and viewpoints, incorporate new learning, and respond to shifting priorities. As summer 2020 approached in the midst of COVID-19 lockdown, the LCCP’s heat risk network was quickly expanded and used as a channel to support Public Health England in disseminating and gathering feedback about its advice and guidance for managing a heatwave during the pandemic (LCCP 2020).

Despite the clear need for core coordination support for partnership working, the value of this function and the “hidden” work underpinning it often goes unrecognized by funders. Obtaining resource--let alone secure or long-term resource--for core coordination activities is a persistent challenge that has resulted in the collapse of similar partnerships across England (Committee on Climate Change, 2019 p. 24) and an erosion in capacity and support for adaptation in the last several years.

5. Remote and urban: Are remote areas more resilient?

In the previous section, LCCP has provided a specific example from a large city which is prominent in its region, country, and the world. Yet not everyone in or all parts of London have the same prominence or are fully integrated into the city’s advantages. Anywhere, typical groups can be less involved and London is no different with respect to undocumented people, people in difficult domestic situations, people who do not speak any language in which information is provided, people with disabilities, and homeless people. At times, some of these people find ways through the difficulties, but it is rarely easy and their vulnerabilities tend to be exacerbated by marginalisation. They usually have fewer opportunities to pursue their own resilience or to work through resilience with others around them. Individuals in prominent locations can therefore be made to be less resilient by the structures and systems in which they are placed and with which they are forced to deal.

Do similar patterns appear for locations? Are remote areas inherently less resilient than less remote areas? Ultimately, the answer comes down to three principal questions:
(i) What is the meaning of ‘remote’?
(ii) What is the meaning of ‘resilience’?
(iii) Over what timeframe do we wish to answer this question?

The term ‘remote’ is a subjective value judgement (Bocco 2016). Standard presumptions are a ‘remote location’ being far from a centre or hard to reach, statements which certainly depend on each specific context. Calculating the time, distance, or time-distance combination to arrive at a place entails selecting the starting location, which is arbitrary. It is much easier to explain that the locales are remote from each other than to indicate which one is remote overall.

‘Resilience’ also displays ambiguities and subjectivities (Alexander 2013). While UNDRR’s (2017) definition was suggested earlier, many other, disparate approaches are accepted with extensive and intensive debate continuing over the term’s meaning, applicability, usefulness, and detriments. At times, resilience in the same situation depends on the perspective being adopted. For example, in at least three episodes in history, one part of the defeat of an army invading Russia was attributed to the winter weather, indicating that this weather contributed to resilience for the defenders while sapping resilience from the attackers. As such, little absolute or objective resilience might exist, meaning that--irrespective of attempts to generate indices and scales, often arbitrary--comparing contexts such as London and remote areas might present difficulties.

Another difficulty, and the third question, is the timeframe being considered. Aspects of temporality were alluded to section 1. Short-term resilience might not be retained over time as cascades manifest, especially if adverse impacts widen and deepen. Meanwhile, concurrencies might induce short-term problems making it appear as if resilience is diminished, yet long-term observations indicate that resilience exists because major issues were evaded. As the time scale of analysis expands, it can become more difficult to attribute cause and effect, because the potential nodes become increasingly distant and connections between them can become increasingly tenuous.

Consequently, establishing similarities and differences between urban and supposedly remote locations can be confounded by the definitions and timescales adopted. The question ‘Are remote areas more resilient?’ does not have a clear-cut answer, moreover because actions taken have a significant influence on the assessment of resilience. A city without mechanisms such as LCCP is likely to be less resilient to climate change because it does not consider the topic rather than because of its size, its urban label, or its remoteness index. Remote areas receiving extensive support from their country, such as in Norway away from the main cities (Berg and Lysgård, 2002), will have more opportunities to pursue resilience measures than those receiving less attention, such as indigenous settlements in Canada. Many of the latter lack basic infrastructure including wastewater treatment and local healthcare facilities while the people live in overcrowded dwellings in disrepair (Perreault et al., 2020).

The consequence is decisions made are generally the largest influence on generating or undermining resilience, rather than the specific characteristics of people of places. Resilience is a process which applies to all types of places, but decisions need to be made to support or avoid this process. Since much is definitional with respect to remoteness, centrality, ruralness, urbanness, and resilience--and since choices can be made under any circumstances to do better or worse with respect to resilience--options exist to achieve the level of resilience sought by any location.

6. The time gap? A call for promoting societal resilience to cascading risk and concurrencies

Adapting to climate change means more than just acting on hazards, especially as climate change adaptation adds nothing new to disaster risk reduction. Placing climate change adaptation as a subset of disaster risk reduction ends artificial separation of these fields, recombining those processes with other features of contemporary societies, such as economics and governance, adopting a systemic perspective (Commoner 1971; Linkov et al. 2014; 2019; UNDRR 2019). In the good and the bad, it is a matter of taking responsibility and being held accountable for reducing or amplifying risk. Disasters are mitigated, exacerbated or caused by human decisions and how they are translated into policies and actions (Alexander 2000). Climate change makes no exception. Doing nothing or doing too little is part of the options available, and influences everything else. As argued by Wisner et al. (2004): “It may be said that disasters do not happen, they unfold...in the case of ‘slow-maturing’ or slow-onset disasters such as famine, the even slower HIV-AIDS pandemic or climate change, processes which can unfold over a period as much as 30–80 years or more, this dramatic, time-dependent characterisation is less inappropriate. However, even in sudden-onset cases, the pre-conditions for disasters...may have been forming over a long period.” (Wisner et. al 2004, p. 107). This can be common to different experiences, such as the ones emerging in pandemics and weather, as they all share common roots of vulnerabilities.

The starting point for action may be counterintuitive. Until now, the narrative on climate change has been often hampered by the idea that the phenomena was something indefinite, that would have happened “one day in the future”. It has been associated with medium and longer term scenarios that were hard to justify for investment seeking short-term gain, distinguished by budget constraints where climate change was hard to fit in as a ilfe-saving priority. Even in realities such as London, where stakeholders have been trying to integrate climate change in practice, the values of investments may still be “hidden”. The responses to past research have highlighted that difficulties were associated with “a view that impacts are too far ahead and local authorities look to 4-5 years planning dates” (Pescaroli 2018).

Similarly, understanding and acting on root causes could be harder due to the complexity of networked causal chains. Tools such as the UNDRR disaster resilience scorecard for cities (UNDRR 2017) can provide some additional benchmarking across the fields, but needs constant efforts to progress to, to compare it with current scientific thinking, and to get buy in from stakeholders. This cannot be assumed or taken for granted: there are still major implementation gaps between policies in the domains of climate change adaptation and disaster risk reduction, associated with factors such as institutional or intersectoral barriers (Booth et al. 2020), but which could easily be overcome by enfolding action on climate change into other ongoing processes, rather than seeing climate change as a separate or different topic. The experience of the LCCP highlights the many efforts needed for coordination, but despite their vital role, these are not necessarily supported or recognised by funders.

There may be an operational aspect that could inhibit decisive action: the focus on time scales dominated by uncertainties. In the case of local authorities, economic constraints may simply orient the decision to postpone investments, because the arguments are framed to be too ephemeral to justify resource allocation. Meanwhile, private organisations approach decisions in the field of continuity management and resilience by considering aspects such as their risk appetite, intended as the acceptable level of exposure they are willing to undertake. This is oriented, for example, by considerations including reputational risks, operational capacity, and legal compliance. If a problem is perceived as generically "forthcoming" and not included in any mandatory requirements, it may not be high priority enough to be addressed in the risk assessments. Similarly, if it is not directly affecting any of the core functions and processes that have been prioritised through the business impact analysis, it could remain stuck in a grey area of responsibility without progressing. However, nearly half a century after Barry Commoner's work, is it still true that the effects of climate change are associated with strategic foresight more than a short term operational frame? What are the implications of changing perspectives, shifting from considering climate change as a possible source of "future crisis", to the current manufactured discourse of it being"unfolding emergency"?

The very same use of language creates barriers that justify inaction interfacing between science, policy, and practice. For example, the use of the concept of "probability" in reports such as those from the Intergovernmental Panel on Climate Change (IPCC 2014) has been distinguished by differences in interpretation, context dependencies, and mismatches with policy needs (Wardekker et al. 2008). Crises can be "creeping", with climate change being one "creeping environmental change" among many, giving a sense of illusion of control or simply a margin of uncertainty that allows moving forward without action-related change (Glantz 1994ab. Instead, emergencies require "an urgent, non-normal response" and they "may include a declaration that leads to the suspension of normal activities" (Alexander 2017), keeping in mind that change is ever-present, so little exists which is truly "normal" while the end of any emergency phase must avoid going back to the "normal" which created the conditions permitting the emergency to manifest. The precursors to the COVID-19 pandemic and the lack of preparedness suggest the existence of similar dynamics of ignored warnings and fragmentation in the participatory actions (Independent Panel for Pandemic Preparedness & Response 2021).

Work on cascading risk and concurrencies suggests that complex scenarios will happen, and it is needed to prioritize those common actions that could be useful independently of the nature of the primary hazard threats. In other words, there are common points of failures that can be identified and addressed in the practicality of continuity and resilience management (Pescaroli and Alexander 2016; Linkov et al . 2019; Pescaroli et al. 2021). Moving down in the "to-do list", societal resilience to climate change is an illusion that can be rooted in the lack of understanding of systemic dynamics. It cannot be seen in isolation, but it sits within wider actions including pollution prevention, dealing with all disasters, promoting health and wellbeing, and tackling inequities. Any kind of new form of development should consider moving beyond silos, using complementary disciplines for understanding complexity (Pescaroli and Alexander 2018; UNDRR 2019).

It could be argued that the primary enemy to tackle are those artificial differentiations that contribute to creating grey areas of coordination. In other words, societal resilience to cascading risk and concurrencies requires activation of a process of simplification to avoid contradictory messages that could give grounds for inaction. For example, what are the baselines that could be common among separate fields such as emergency management, operational continuity, and crisis response? What is "Returning to normal" if the "normal" created the disaster problems in the first place? Ensuring flexibility of response and the availability of resilience capacity seems the critical operational needs, but is this anything more than ensuring "sustainability" of actions? Clearly, everything is context dependent. There are different societies, with cultural, political and ecological specificities. The very same use of technology can vary and be different. Ultimately, it is a matter of how decisions are taken and how actions are followed up once this is done.

7. Conclusions

Climate resilient societies are more than just chimerae lost in jargon. They sit within wider resilience contexts, to ensure that the process of resilience does not become fixated on a single phenomenon such as climate or climate change. This chapter considered cascading risk and concurrencies, explored lessons learned, and compared urban and rural areas. What emerges is the need to go beyond disciplinary and operational silos, embracing systemic dynamics and taking ownership of decision making. It means including but going beyond the understanding, modelling, and projections of weather features, because hazards have to be contextualised in societies dependent on services and technologies. Disasters can be amplified by the disruptions of infrastructure and the re-combination of cascading risk with concurrent events, requiring a shift in how adaptation is thought through. The timeframe in which this is happening is not anymore a vague future, but it is now, requiring decisive action across disciplinary fields and agencies. Resilience efforts can prioritise tackling root causes and common failure points between distinct threats, including the COVID-19 pandemic. Fundamentally, it is a matter of taking responsibility and holding decision making and decision-makers accountable.

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