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THREE EMERGENCIES OF CLIMATE CHANGE: THE CASE OF LOUISIANA'S COAST

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1 Abstract

Climate challenge brings three, not just one, emergencies. These are the visible, conceptual and existential, all of which are urgent and important. The three emergencies are starkly highlighted in Louisiana, where historical coastal development and climate-induced sea level rise is causing visible emergencies in the form of extensive land loss and increased impacts of flooding and storm surges, leading to forced relocation of settlements. The visible emergencies cannot be overcome without addressing conceptual emergencies where current ways of organising, thinking and approaching the challenges are inadequate for the scale, nature and rate of change. The conceptual emergencies, in turn, cannot be overcome without addressing the existential, where different cultures, values and identities are needed to overcome existing conceptual challenges. Louisiana's state government is beginning to go beyond the visible to wrestle with the conceptual and, to some extent, awareness is growing about the existential. The need to address the conceptual and existential will only increase as the limits of current approaches to addressing the visible emergencies become more apparent. As such, the case highlights how climate change will force a transformation that will be characterised by fundamentally new social attributes. The nature of what emerges, however, is not guaranteed and will depend on how those in Louisiana and beyond seek to work with all three emergencies and their interconnections.

Key words: adaptation; flood risk; relocation; sea level rise; social learning; transformation

2 Introduction

Climate change is changing everything. Across the globe families, communities, local governments and nations are starting to wake up to the new reality of a changing climate. As impacts increase, the conversation about climate change is shifting and the number of governments and institutions declaring a climate emergency is growing. Yet much confusion remains about how to respond, especially given that the climate emergency is very different to most threats that humanity has faced in the past.

Climate change is a symptom of the way current societies have developed, emerging from interconnected patterns of economic activity, mobility, food production, consumption, and energy (Fazey et al. 2018). The climate challenge intersects with many other issues, including the current global pandemic of COVID-19 (Everingham and Chassagne 2020, Le Quéré et al. 2020). Climate change can only be addressed by changing the systems, structures, institutions, strategies, assumptions and worldviews that underpin high carbon societies and which give rise to certain actions, behaviours and technologies (O'Brien and Sygna 2013). Declaring a climate emergency thus opens up Pandora's box, requiring questions to be asked about many assumptions and systems underpinning contemporary societies.

It has been estimated that as of February 2021, 1,897 jurisdictions in 34 countries have declared a 'climate emergency', covering 826 million citizens (climateemergencydeclaratop.org 2021). However, the levels of response appropriate to these emergencies appear to be limited. We suggest in this paper that one reason for this discrepancy is that climate change involves three, not one, emergencies, all of which are urgent and important but rarely addressed simultaneously (Figure 1, Table 1). The first is the 'visible' emergency, where people, governments and communities must react to the direct impacts of a changing climate and implement tactical responses such as avoiding risks of stranded assets, growing socio-economic inequality and infrastructure re-design (Bank of England 2017, Lomborg 2020). Visible emergencies may evolve through cumulative, incremental change which finally generates shocks requiring a societal response, particularly where human life and property is threatened. It is thus around the visible emergencies that most action occurs.

Second, there are less visible and tangible 'conceptual' emergencies (Figure 1, Table 1). These occur when conditions in which familiar concepts no longer make sense and where new modes of cognition are needed. For example, fundamentally different concepts, approaches, and strategies are needed to transcend piecemeal and silo-based approaches that have contributed to the emergence of climate change and to work with highly interconnected issues across contested knowledge, goals, and ethical and aesthetic concerns (Hanlon et al. 2012). This requires, for example, finding ways to help create shifts in entrenched rules, norms and modes of governance (Gorrdard et al. 2016), or creating new notions about progress, development, happiness, equality and wellbeing and economy (Wright 2013, Gatersleben et al. 2014, Hobson 2016, Geissdoerfer et al. 2017). As existing ways of working increasingly become ill-suited to the scale or nature of the visible emergency, working with the conceptual becomes ever more important. Doing so, however, is difficult because it requires challenging the status quo and existing patterns of sense-making.

Finally, climate change brings an 'existential' emergency (Figure 1, Table 1). This includes real and immediate threats to fundamental tenets like culture, values, beliefs, assumptions and identities that shape how people relate to the world. Overcoming the existential emergency requires reformulating new identities and cultures in ways better aligned to the new and emerging world. Just as the visible cannot be addressed without innovating conceptual frames, the conceptual emergency cannot be addressed by ignoring the existential. People cannot continue to live as their parents, their peers, their tribe or their culture has done for generations before, nor can they expect the same for their children.

Instead, overcoming the existential emergency will require changes in many expectations and assumptions about what it means to be human, although the immediacy of this emergency may vary between locations, depending on their exposure and vulnerabilities to climate change.

Overcoming the climate challenge requires surfacing and working with all three emergencies simultaneously. This, in turn, requires three different levels of learning (Argyris and Schön 1978) (Table 1). Addressing the emergencies must go from asking ‘are we doing things right?’ to asking ‘what are the right things to be doing?’ and ‘what is right?’ or even ‘who am I?’. Participatory futures methods and approaches that encourage surfacing of deeper and less immediately visible conceptual and existential issues are thus needed that take stakeholders beyond single loop to double and triple loop learning (Reed et al. 2010, Kristjanson et al. 2014, Sharpe et al. 2016, Butler et al. 2020). As the impacts of climate change begin to accrue the need for addressing all such questions becomes more apparent as current ways of responding become increasingly ineffective, requiring shifts in higher order levels of operation.

An example of this evolution is the coast of Louisiana, USA. Here, communities and cities are experiencing major land loss due to erosion and permanent inundation, and increasing exposure to hurricanes and storm surges which, as highlighted by a recent government report, threaten the very existence of Louisiana (OCD and FFL 2019). The conceptual and existential emergencies, in other words, are also becoming more visible, immediate, urgent and important. These are highlighted by signs of significant policy direction changes, such as the August 2020 announcement by Louisiana’s Governor of a commitment to net zero emissions for 2050 and the formation of a Climate Change Task Force. The aim of this paper is to use Louisiana as an example of how stakeholders are working with all three emergencies to overcome interconnected climate and other human-induced biophysical challenges. We first outline the history of development along the Louisiana coast, explain the three emergencies emerging for the region, and then describe how realization of the emergencies is unfolding. The three emergencies framing provides a diagnostic tool for change-makers to examine the extent to which action is being focused towards enabling deeper, systemic forms of change likely to be more effective in addressing highly interconnected sustainability challenges.

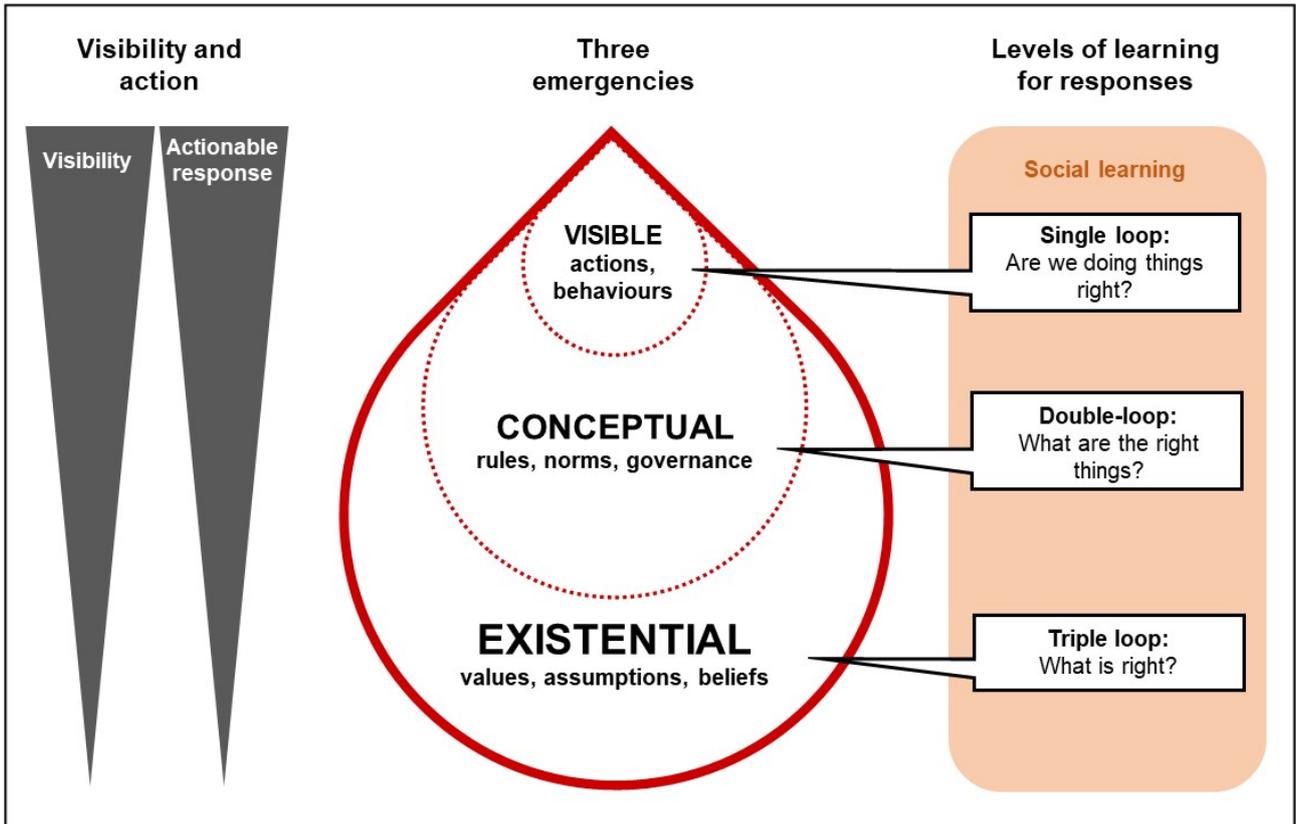


Figure 1. The three emergencies, their relative visibility and actionable response, and associated levels of learning required for responses

Emergency	Explanation	Domain where change is needed	Domain of learning	
Visible	<p>Impacts of changing climate</p> <p>Impacts of transitions</p>	<p>Emergencies from the immediate impacts of a changing climate on lives, health including mental health, assets, livelihoods and/or wellbeing. These may be sudden shocks, such as climatic (e.g. floods and droughts), economic (e.g. financial crises, commodity price collapses), or political (e.g. revolts). They may also include slowly changing stressors that culminate at critical thresholds (e.g. unaffordable food prices, finite water resources). Many of these have greatest impact on those already most disadvantaged.</p> <p>Emergencies arising from transitioning to low carbon economies or other interconnected challenges. Transitions to low carbon can affect assets or livelihoods leading to stranded assets when markets shift (e.g. expertise, industries or infrastructure). This often interplays with rising inequalities, with those most disadvantaged being particularly vulnerable and less able to respond as markets change. Rapid transitions to Covid to new ways of spending, for example, often affected those in the least secure/well paid jobs.</p>	<p>Actions, behaviours, technologies, decisions, investments, government policies and programs</p>	<p>Single-loop learning that asks: 'Are we doing things right?' (e.g. learning to improve interventions, rebuilding to withstand future shocks, learning to develop new technologies)</p>
Conceptual	<p>Concepts & approaches</p> <p>Systems & structures</p> <p>Rules, norms and governance</p> <p>Mindsets, worldviews, assumptions</p>	<p>Emergencies where new concepts, approaches, tools and capacities are needed to work with complex, highly interconnected issues, across social scales, with stakeholders with diverse values and to overcome problems created by past approaches and thinking.</p> <p>Emergencies arising from the way current systems and structures limit the uptake of new behaviours, technologies, concepts and approaches. For example, the systems and structures in cities are often designed around motorized transport, which limits possibilities for major expansion of cycling or new concepts of transportation or mobility. Without changing systems and structures, many alternative practices (e.g. for low carbon living) will not emerge.</p> <p>Emergencies from limited capacity of informal and formal rules, norms and modes of governance based on traditional concepts to work with the new interconnected challenges and for rapid and equitable systemic action towards low carbon economies. New rules, norms and modes of governance are urgently needed to support structural systemic and more equitable forms of change.</p> <p>Emergencies arising from mindsets and assumptions that support current ways of working and limit emergence of new patterns, concepts and ways of working. Examples include concepts and assumptions of what constitutes progress, development, happiness or wellbeing, and away from carbon-based economic growth towards regenerative economic systems. Changing mindsets and many underlying assumptions are part of the process to overcoming all of the previous emergencies.</p>	<p>Systems, structures, formal and informal rules, norms, strategies, approaches, modes of governance</p>	<p>Double-loop learning including changes in strategies and approaches driving single-loop learning. It involves asking 'What are the right things to be doing?' (e.g. re-structuring government to be networked rather than siloed, or developing new legislature or constitutions)</p>
Existential	<p>Values and ethics</p> <p>Cultures and identity</p> <p>Psychological wellbeing</p>	<p>Emergencies requiring a re-evaluation of values and ethics, such as pioneer values that made it possible and desirable for coal mining but which may no longer be relevant given climate change. Many indigenous cultures are, for example, finding they need to reinvent or re-establish cultural codes and values (e.g. honour, courage, or manhood) to meet the challenges they are facing.</p> <p>Emergencies that include threats to a way of life, a culture, often in a particular place. For example, loss of neighbourhood ice hockey rinks in Canada, or heritage and cultures of whole communities from thawing permafrost or sea level rise. This includes species extinction in the sense this takes part of the web of life out of existence, with certain species often playing a significant role in cultures or sacred stories. Some CEOs of fossil fuel companies are advocating a fundamental identity shift away from being a conservative industry that argue their existence is important because they support an energy dependent society and economy to a new identity for the industry formed around being the aspirational leaders of an inevitable global change to low carbon.</p> <p>Emergencies that make it difficult for an individual to make sense of the world. People now can become overwhelmed by a world changing so fast and so radically they no longer understand it and cannot fathom their place within it. This can manifest as coping strategies that include drugs, alcohol and other forms of addictive behaviour.</p>	<p>Values, beliefs, cultures, identity</p>	<p>Triple-loop learning that involves changes in higher order thinking processes. It asks: 'What is right?' (e.g. ethics of human impact on the planet, or appropriateness of particular economic models)</p>

Table 1: The three emergencies of climate change

3 Historical development of the emergencies in Louisiana

Climate change is colliding with many other sustainability issues in the coastal region of Louisiana, especially the Mississippi River Delta, USA to generate the three emergencies. The region is experiencing rapid and major coastal land loss that is intersecting with climate change to threaten the existence of many communities. The immediate coastal region in Louisiana is approximately 43,700 km² and contains over 40% of the continental USA's coastal wetlands (OCM 2010). Louisiana's coastal wetland loss is greater than all other states in the contiguous USA combined, with 4,800 km² of coastal wetlands having been lost over the last 80 years (Couvillion et al. 2017). The Louisiana coast is projected to lose an additional 3,100 – 10,700 km² over the next 50 years if no action is taken (CPRA 2017).

Land loss is exacerbated by climate change driven sea level rise (Blum and Roberts 2009). It also intersects with other climate change impacts, such as increasing exposure to hurricanes and storm surges (Frazier et al. 2010), which globally are also increasing in frequency and intensity under a changing climate (Knutson et al. 2020). The combination of bio-physical changes in the Delta and growing impacts of climate change means that the 2.2 million coastal county residents in Louisiana are under threat of being impacted by land loss in the next four decades (Crossett et al. 2013) with 1.2 million potentially impacted by sea-level rise alone by 2100 (Hauer et al. 2016). Population response to land loss in the 20th century was localized, but examination of population data shows a potential tipping point related to population migration when a neighbourhood loses at least 50% of its land area (Hauer et al. 2019). The region also includes the city of New Orleans and the Port of South Louisiana - the largest shipping centre by tonnage in the USA; (USACE 2016) - which will be increasingly exposed to the escalating frequency and intensity of extreme weather events as land is lost around them.

The loss of land is due to a combination of natural ecosystem dynamics, interacting with a legacy of engineering projects, natural resource management decisions and economic activities. The delta was created over the last 7,000 years by sediment from the Mississippi River which formed a complex of coastal marsh, swamp, and estuarine environments (Saucier 1994, Day et al. 1997). Humans primarily settled on the highest land located next to tributaries where sediments were deposited. As settlements and economic activities developed, the need to protect people and land from flooding led to the construction of artificial levees along the banks of the Mississippi. Initially these were built by landowners or municipalities. However, after the catastrophic Mississippi River Flood of 1927, when many of the levees were breached, the federal government constructed a major flood control system that has since largely isolated the Louisiana coast from riverine sediment. This significantly limited recharge of sediment throughout the delta (Allison et al. 2012), limiting the ability of coastal wetlands to counteract deltaic subsidence, which also increased in the 20th century due to drainage of urban areas and extraction of subsurface oil and gas (Chan and Zoback 2007). Extensive canal systems were dredged through the wetlands to support oil and gas extraction and processing in 1950-1970, further altering wetland hydrology and estuarine fresh-saltwater gradients (Swenson and Turner 1987, Bass and Turner 1997, Reuss 2004).

Loss of land is already having major impacts. In 2014 the National Oceanic and Atmospheric Administration removed over 40 place names from official nautical charts from just one single parish alone (Westington 2014). The combined vulnerability of communities due to land loss, storm surges and hurricanes also intersects with major social and economic change. Oil and gas operations have moved to deeper waters offshore and increasingly utilize automation, depressing jobs and services in local communities. Louisiana's substantial commercial fishery has also been impacted as global competition (Mosbrucker 2019). Many residents who could afford to relocate to higher ground have

moved, businesses such as banks and grocery stores have closed in high risk areas, and local government services such as schools and libraries are being rebuilt on higher ground further from the communities they serve. The changing landscape – physically, economically, and demographically – and the realities of combined land loss and climate change are threatening a way of life and forcing state and local governments to reconsider how they operate within a rapidly changing set of conditions.

4 The three emergencies on Louisiana's coast

The Louisiana coast's escalating crisis demonstrates more than one kind of emergency. First, it includes visible emergencies, such as the urgent need to restore and sustain the coastal ecosystem, to cope with shifting socio-economic and demographic conditions, resettle impacted communities, and respond to threats to life during hurricanes and storm surges. Decades of research on the dynamics of the natural system provide a foundation for planning remedies for the bio-physical system under the 2017 Coastal Master Plan. Recent work has described the economic consequences of land loss (Barnes et al. 2017), and the Coastal Master Plan prioritises storm surge protection measures to reduce economic damage. But the enduring social impacts of disturbance and displacement and the increasing vulnerability of people and their livelihoods to hurricanes and floods is less well understood, limiting the ability of governments to respond effectively.

Funding of \$50 billion has been proposed to enhance coastal adaptation and address some of the visible emergencies, utilizing a variety of strategies and interventions (Figure 2). Wetland restoration actions will restore and maintain 1,000 km² of coastal marshes by dredging and restoring connections between the coast and the Mississippi River using controlled diversions. Risk reduction actions include adapting homes and protecting infrastructure to reduce their exposure. Yet, even with full implementation of the plan, the coast will still lose 3,800 – 7,700 km² within 50 years depending on the future scenario for environmental conditions (Figure 3). Low, medium and high scenarios represent different sea-level rise rates and also uncertainty about the subsidence of Louisiana's deltaic coast. Thus, even with extensive action, the visible emergency will continue, including the need to evacuate people from high risk areas during storms, accommodate immigration in areas of higher land, work with a new and shifting physical, environmental, and socio-economic map of Louisiana, and adjust social service delivery to take into account issues of social justice and equity (Hemmerling et al. 2020). The visible emergency will also include continued, albeit as yet quantified, impacts on the wider economy of the Louisiana State.

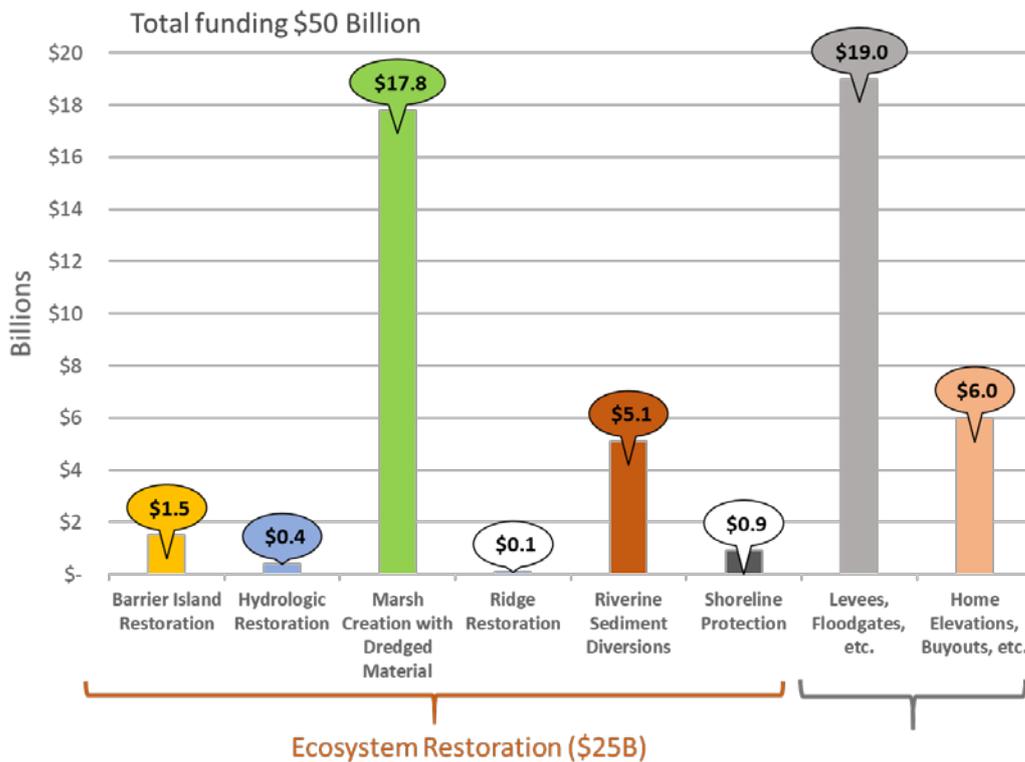


Figure 2. Strategies and interventions proposed by the 2017 Coastal Master Plan that primarily focus on the visible emergency (modified from CPRA 2017).

The land loss in Louisiana and the pattern of current responses described above also brings to light conceptual emergencies. This is starting to manifest through growing recognition that established approaches cannot cope with the scale increase in the visible emergencies for much longer, and that new thinking or approaches will be needed (Burge et al. 2020). Many existing assumptions about management or governance may no longer hold, new business models are likely to be needed and embedded social inequality in Louisiana society must be acknowledged and tackled to reduce the human cost of visible emergencies. The limits of conceptualizing change as a linear and compartmentalized operation, focusing solely on meeting day-to-day needs, and applying standard interventions based on past experience are becoming apparent. State and local agencies, for example, increasingly need to work across departments and silos in ways they are not accustomed or set up to do. New approaches are needed that include long-term planning, take into account uncertainty, major change, and support integrated working that see causes of land loss and social inequity as being inherently intertwined. This includes establishing new forms of governance, structures and approaches that can deal with the trauma and anxieties that major change brings, and at a pace appropriate to the rate of change being experienced.

The conceptual emergency is also becoming more visible in relation to the economy. For example, the Federal Government is sending revenues derived from newly-discovered fossil-fuel resources in the Gulf of Mexico to Louisiana for coastal restoration (Baurick 2020). Hence, paradoxically, resources to address the visible coastal emergencies partly driven by climate change are derived from

oil and gas revenue. Clearly, this is not sustainable in the long term and different concepts of economies will be required.

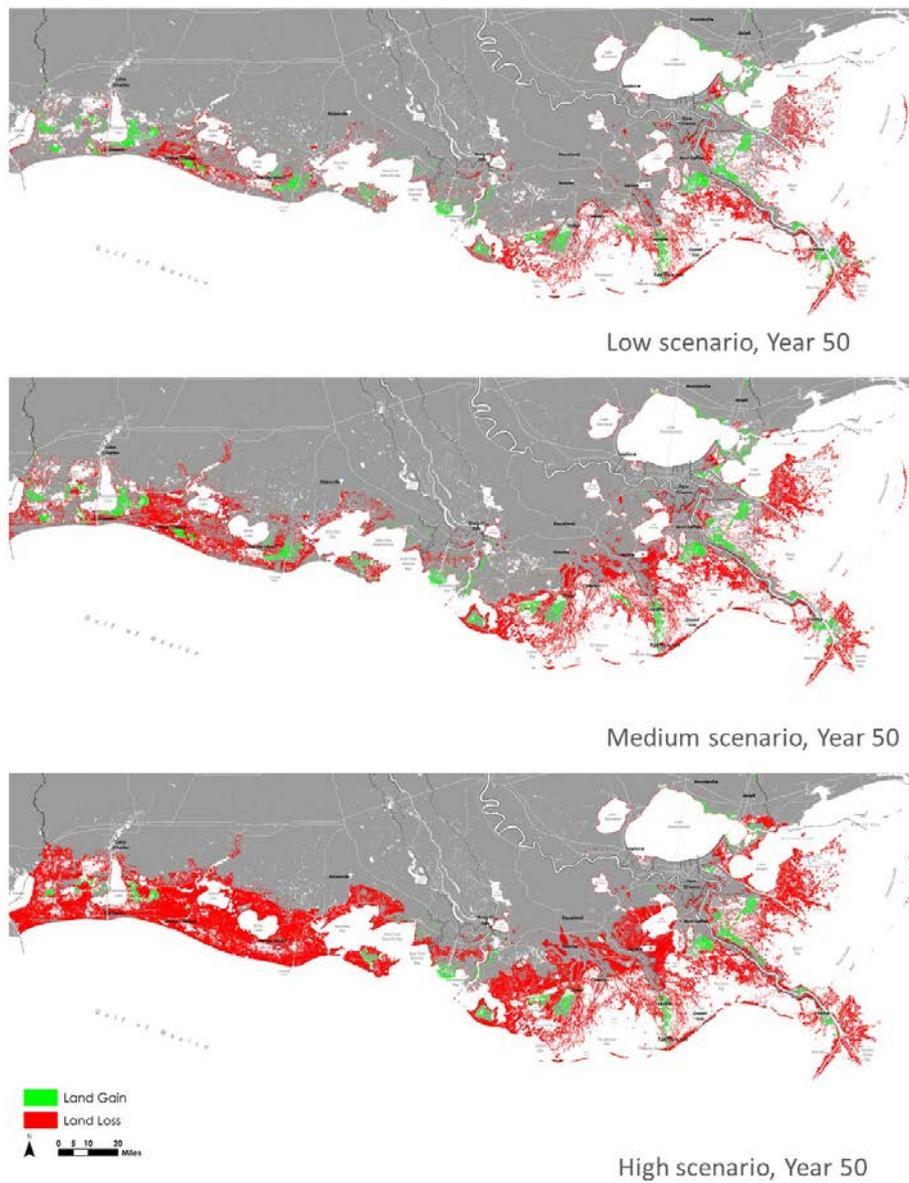


Figure 3. Future projections of coastal land gain and loss in 50 years (i.e. by 2067) for low, medium and high environmental scenarios with implementation of the 2017 Coastal Master Plan (CPRA 2017). The environmental drivers and values used in scenarios included precipitation, evapotranspiration, sea level rise, subsidence, storm frequency and average storm intensity.

Addressing the conceptual cannot be realized without addressing an existential emergency related to identity and culture, values and psychological issues. Many coastal communities are deeply associated with fishing, oil and gas industries, giving rise to a particular coastal identity and culture (Box 1). This identity is changing, however, as flood risk and insurance costs rise, which particularly disadvantages poorer households. Declines in the fishing and onshore oil and gas industries continue, and many families are facing the need to migrate. These chronic stresses are amplified by visible shocks such as the 2010 Deepwater Horizon oil spill. Identity and culture are not easily transplanted, and current practices cannot be retained by those who choose to remain as their livelihoods are altered.

Similarly, land loss and climate change will eventually raise questions about the identity of Louisiana as a whole. Fossil fuel companies faced with climate change are, for example, having to question their identity as existential threats of a growing population of environmentally concerned millennials, environmental activism, and racial and social justice movements continue to build momentum (Schuller 2020). A new search for what it means to be a coastal community, or what it means to be a Louisianan in a world where its geographical shape, demography, and relationship to the coast has changed will be needed to ride the existential threats – both literal and in terms of identity and culture – will be required. As the conceptual emergencies become increasingly apparent, value orientations, identities and cultural practices that underpin conceptual ways of working will also need to change.

Box 1: Three emergencies facing the community of Isle de Jean Charles

A community currently undergoing resettlement in the Louisiana Coast is Isle de Jean Charles (IDJC). IDJC has been in existence for over 250 years. The current efforts for resettlement highlight the need for state and coastal residents to confront the three emergencies.

Visible emergencies: These arise from the storm surges, flood risk and rising sea levels which threaten lives and livelihoods, and particularly poorer households. When tides or strong winds inundate the access road, residents cannot get to work or get their children to school. Many residents have relocated to safer inland areas, fracturing the community. This, however, brings transitional impacts for some families, such as enhanced inequalities because they are no longer able to rely on supplementing food from wild resources obtained along the coast. Broken social networks, the loss of services and investment and unavailability of insurance represent visible signs of a continuing visible emergency which local politicians highlight to pressurise the state to respond.

Conceptual emergencies: The authorities have had to start thinking very differently about their role in relation to citizens required to leave their homes for resettlement. These circumstances are not covered within existing rules and norms of governance. Should poorer or wealthier households be prioritized for resettlement? How should the state secure land for their new homes and to what standards? Likewise, new approaches and ways of working with the integrated challenges that resettled communities face are having to be developed.

Existential emergencies: The IDJC community also faces an existential emergency in terms of their identity as islanders and ‘bayou people’. How will they maintain traditions and culture away from the water? Will they still be themselves when they resettle, or a diminished shadow? How will their traditional values and way of life meld with new livelihoods? How will this influence wider notions of wellbeing and considerations of what is important, and this community’s story in the future? The fact that the continued existence of communities in many parts of the delta can no longer be guaranteed may require a shift in conceptual assumptions for state planners. But for those who live in these communities the emergency manifesting in the present is existential.



<http://isledejeancharles.la.gov/>

5 Emergence from the emergencies

While there has been extensive attention to some of the visible emergencies in Louisiana, recognition of the need to find new ways of thinking, working and learning are also now emerging. That is, the situation is forcing government, NGOs and communities to go beyond asking ‘are things being done right?’, to ‘what are the right things to be doing?’ and ‘what is right?’. In the case of Louisiana, questioning of the conceptual and existential dimensions is emerging as new and radically different bio-physical, social and economic conditions take shape.

Another major step forward has been an unprecedented process initiated by the Governor of Louisiana, John Bel Edwards in October 2018. Recognising the depth of the crisis in coastal governance, Governor Edwards mandated that all cabinet-level officials, leaders and executives from the state’s 29 agencies should participate in a 2-day workshop in New Orleans, with the goals of creating co-ownership and understanding of the full breadth of the coastal crisis; raising awareness of all state agencies to the long-term impacts of environmental change and its implications; and increasing collaboration among state agencies that can optimize opportunities and reduce the negative consequences of increasing flood risk and land loss (CPEX 2019).

The deliberations, facilitated by using various futures and social learning methods, showed evidence of double-loop learning at the conceptual emergency level with participants questioning assumptions, rules and norms around governance. In particular, how state politics and governance operate was recognised as a key driver of some of the challenges, such as the partisan divide in state politics regarding climate change, the incentives within government for short-term and siloed practices and responses, and the dependency on the oil and gas industry and federal disaster relief funding that enables structural and non-structural coastal response measures. Thus, while participants felt that the Louisiana Government couldn’t directly control climate change they did highlight that they had agency over the nature of politics and governance, with wide agreement that ‘business as usual’ was not an option. There were also some signs that triple-loop learning was emerging and desire to start questioning existential issues, such as ‘living with water’ rather than ‘living against water’, and recognising the paradox that revenue for coastal restoration was partly dependent on the oil and gas industry, even though it was also a significant driver of climate change and thus the wider cultural changes occurring in the Louisiana Coast.

Specific innovations and actions were also identified as being important for helping create shifts in governance and politics. These included provision of a new governance structure with roles and responsibilities that incorporate resilience-thinking into agency behaviour and actions; integrating the Coastal Master Plan into all agency investments and remits; finding funding for implementing the plan; developing a bi-partisan strategy and ownership of the governance challenge to over-ride electoral cycles and factionalism; revision of the educational curriculum to include coastal issues; and a Blue Ocean Strategy to build workforce skills for an inevitable future water-based economy. Finally, there was agreement that a more effective social learning culture would be needed amongst stakeholders to exchange ideas, experiences and scale innovations across agency siloes. There were also some existing initiatives that had considerable promise and needed further support to help create further shifts at a conceptual level, notably LA SAFE (Louisiana’s Sustainable Adaptations for Future Environments project, which trialled a whole-community approach to coastal adaptation), the Watershed Initiative (establishing coordinated catchment management bodies), and the Cyber Security Commission (a cross-agency collaboration to tackle an unprecedented homeland security threat). Since the October 2018 workshop several other actions have been implemented, such as Governor Edwards’ successful 2019 re-election campaign based on a bi-partisan agenda regarding the coastal crisis, and alignment of all agencies’ remits and investments to the Coastal Master Plan.

Overall, the three inter-dependent emergencies are forcing state and other agencies to rethink their responses to visible emergencies and increasingly question key conceptual foundations upon which their reactions to the visible issues are based (Table 2). For example, in August 2020 Executive Orders were given by the Governor to create a Climate Change Task Force that synergises ongoing coastal adaptation efforts (<https://gov.louisiana.gov/index.cfm/newsroom/detail/2647>), as well as establishing resilience officers to work across interconnected issues.

More significantly, this may represent the beginnings of ‘strong emergence’. ‘Weak emergence’ occurs when the properties of a system noticeably change, generated by the dynamics and interactions of different system components (Holman 2010), which in Louisiana are land loss, levels of employment, human mobility and the growing emphasis on coastal adaptation. ‘Strong emergence’, however, occurs where novel, coherent, higher order complexity and structures coalesce to disrupt existing system structures, causing them to differentiate and ultimately coalesce into something new. Such strong emergence would be expected when deeper conceptual and existential features that characterise communities, institutions and associated societies begin to change. Thus while strong emergence, such as a fundamentally different economic, social, governance and environmental configuration of the Louisiana Coast is a long way off, a major shift is inevitable as the environmental crisis and its impacts accrue. The critical question now facing the region is thus not whether it will change, but the nature of this change and whether and how it can be stewarded towards new cultures and identities more aligned to the emerging environmental conditions. Effective stewardship will require stimulating new patterns of governance and explicitly giving attention to addressing all three emergencies simultaneously.

6 Conclusions

This paper has shown how examining climate change challenges through a lens of three rather than one emergency can give a more nuanced and realistic account of what is required to respond. The three emergencies thus provide a useful diagnostic tool for exploring underlying issues that must be addressed if pressing 21st Century sustainable development problems are to be effectively tackled. The case of coastal Louisiana is far from unique. Many other regions are increasingly being forced to wrestle with all three emergencies as the limits to current modes of operation, conceptual foundations, and existential notions of what it means to be human are becoming apparent. As highlighted by Louisiana, strong emergence from climate change will be inevitable in some form. What is not clear, however, is how this process will unfold. The challenge, therefore, is to actively steward change towards something different that is more viable and aligned to a changing world. Such stewardship must begin from the premise that major change is inevitable and by working with all three emergencies in synergy. This would need to include rapidly experimenting with new approaches that help stimulate change at visible, conceptual and existential levels. Such experimentation must also be underpinned by innovations in the thinking, values and cultures that ultimately determine how change is understood and is expected to come about.

Emergency	Sub-domain	Examples of the emergency	Extent and types of responses
Visible	Bio-physical & climate impacts	Physical damage to assets and impacts from land loss, increased flood risk, saltwater intrusion, hurricanes and storm surges. This creates challenges for families and local businesses. Many of the challenges are an interplay between land loss and climate change impacts, with a need to also address the underlying drivers, such as lack of sediment recharge, while also reducing risk in the face of hurricanes and storms.	Extensive attention, including levees, floodwalls, pumps, managed evacuations, limits to movement during storms, houses built on stilts, efforts to restore some wetlands, structurally adapting infrastructure, relocating people, removing structures to enable flood water flow. Approaches are, however, not keeping pace with the scale of issues and sometimes exacerbate them (e.g. river management that limits sediment recharge).
	Transition risks	Combined land loss and climate change, with changes to the oil industry are increasingly limiting what can be sustained locally. There are rising insurance costs for families, losses in asset value as communities become less viable, disinvestment in high-risk areas, banks hesitant to support investments, reduced strategic investment, and increased difficulties for families to sell homes.	There are few direct attempts to address emerging transitional impacts. Given low levels of state scale government in local affairs, communities and families are often left to manage transitional risks and longer term stressors themselves.
Conceptual	Concepts & approaches	Emergencies that demand new approaches to work with the complexity, such as to simultaneously restore ecological dynamics and reduce flood risk across communities or that can also address inequalities during community relocations (e.g. when a family is relocated they can be divorced from subsistence opportunities they have on the coast). Novel and creative multi-solving or systemic approaches are needed.	Limited attention, but some new concepts are emerging (e.g. ‘adapting’, ‘restoring’ or viewing flood infrastructure as ‘buying time’ rather than an ‘end solution’. Federal funding (FEMA and HUD) are moving away from structural elevations to buyouts or Nature-Based Solutions. New approaches are becoming part of the newly created Coastal Protection and Restoration Authority, designing with nature projects (e.g. diversion), LA SAFE adaptation plans, Louisiana Watershed Initiative.
	Systems & structures	Current systems and infrastructure are not capable of dealing with the interconnected challenges. For example, many local lifelines that people rely on, such as drainage, trash pickup, services for the elderly are difficult to maintain given higher water tables making drainage difficult and an aging demographic as young people move for employment. Many services rely on local taxes, which are declining as property values and people living in higher risk areas decrease. Sparsely populated higher risk areas are becoming more costly to maintain in absolute terms and per capita.	There are few direct attempts to address these systemic and structural issues. A big challenge is the taxation system. Most coastal parishes include urban centers on higher land where property values and thus taxes, are maintained as immigration away from higher risk areas occurs. Retail centres also provide sales tax revenue. While wealthier parishes operate as single entities, demands for these parishes to provide greater service provision to sparsely populated areas is likely.
	Rules, norms & governance	Emergencies where rules, norms and modes of governance are insufficient for the nature and scale of the challenges, such as silo based government departments that cannot cohere effective action. New norms, rules and governance mechanisms are needed for land use decisions, financing, how government aid operates, social inequalities and poverty, state versus federal relationships, and for planning and oversight with a longer-term view and for policies that can achieve multi-outcomes.	While action is still limited, there are signs that the need for something new is beginning to be recognised. For example, Executive Orders from the State Government – a Climate Change Task Force and establishing Resilience Officers is helping create cross-working and communicate across agencies and to look at drivers in interconnected ways.
	Assumptions, mindsets, worldviews	Changes are needed in assumptions, mindsets, or worldviews if new concepts, approaches, systems and governance are to emerge. For example, command and control mindsets led to emphasis on levees and big infrastructure and unsustainable development in flood prone areas. New notions of what constitutes development, progress, or ‘living with water’ is required.	The examples of emerging concepts and new approaches suggest there are the beginnings of a shift in deeper assumptions about what progress might mean in relation to the scale of the challenges. As yet, however, there is still limited evidence of any major or deeper change.
Existential	Values and ethics	To address the conceptual emergencies new ‘values’ and notions of ‘value’ are urgently needed. Patterns of life, especially in areas with larger populations, have been based around a separation of humans and nature, with activities focused on being ‘against water’, and underpinned by particular values (e.g. protection, exploitation). New values around ‘living with water’ are needed.	Limited direct attention, although it gains some attention in small scale workshops, New Orleans’s Urban Water Plan, and planning efforts like LA SAFE. The notion of ‘living with water’ is now a common phrase but the sense of how to do it is lacking.
	Cultures & Identity	Impacts from loss of a bayou lifestyle, identity and sense of place and increasingly fractured communities. This is forcing new questions about what it means to be a coastal community.	There are no direct efforts working on these issues, although various organisations are increasingly recognising threats to culture and identity, such as in Houma’s Rougarou Fest, school curriculum, and by cultural organizations.
	Psychological wellbeing	Anecdotal sense that mental health issues are rising, manifesting as, for example, domestic or substance abuse. It is anticipated that such issues may increase as impacts of significant economic shifts/changes, increased flood risk, loss of social networks etc accrue.	Limited attention to this issue in relation to climate change and land loss.

Table 2: How the different emergencies are unfolding along Louisiana's coast and the extent and kind of responses that are being enacted.

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