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Making Space for Proactive Adaptation of Rapidly Changing Coasts: A Windows of Opportunity Approach

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Abstract: Coastlines are very often places where the impacts of global change are felt most keenly, and they are also often sites of high values and intense use for industry, human habitation, nature conservation and recreation. In many countries, coastlines are a key contested territory for planning for climate change, and also locations where development and conservation conflicts play out. As a "test bed" for climate change adaptation, coastal regions provide valuable, but highly diverse experiences and lessons. This paper sets out to explore the lessons of coastal planning and development for the implementation of proactive adaptation, and the possibility to move from adaptation visions to actual adaptation governance and planning. Using qualitative analysis of interviews and workshops, we first examine what the barriers are to proactive adaptation at the coast, and how current policy and practice frames are leading to avoidable lock-ins and other maladaptive decisions that are narrowing our adaptation options. Using examples from UK, we then identify adaptation windows that can be opened, reframed or transformed to set the course for proactive adaptation which links high level top-down legislative requirements with local bottom-up actions. We explore how these windows can be harnessed so that space for proactive adaptation increases and maladaptive decisions are reduced.

Keywords: climate change adaptation; maladaptation; decision-making; windows of opportunity; coastal planning

1. Introduction

The challenges facing coastal regions globally under a changing climate are immense due to the potent cocktail of increasing development, historic land reclamation and reduction of nature-based coastal protection and the risks of increasing floods and storms [1]. Despite widespread calls and policy pronouncements articulating the urgency and need for society to adapt to climate change, there is still limited evidence of implementation of proactive coastal adaptation globally [2]. There appears to be a mismatch between the growing number of high level legislative and policy instruments supporting the development of proactive coastal adaptation [3] and actual implementation of dynamic and proactive adaptation. For example, new research by Hino et al. [2] has shown that there are few global efforts to facilitate managed retreat of coastal development. This may be because there is a social and political reluctance to retreat and because we have tended to view the coastline as fixed, rather than as a dynamic interface that adjusts and moves (typically inland) as sea level rises [4].

Although knowledge is seen as instrumental to "devising robust adaptation strategies" [5] (p. 16), knowledge is not the key constraint to proactive adaptation. In many cases, knowledge of coastal

climate change risks is good where sea level rise, coastal erosion and storm risks are increasingly well accepted [6], underpinning strategic plans such as flood risk and shoreline management plans in England and Wales [7]. However, despite this knowledge, there are important constraints on decisions [8] including current institutional values and inertia, governance and funding arrangements. These often create path dependencies that can reduce our capacity to deliver short-term adaptation objectives and encourage maladaptive decisions at the coast [9,10]. Thus, although high level legislative requirements for adaptation and non-statutory tools to support proactive adaptation exist, national to local scale infrastructure and development decisions are typically reactive and often favour avoidable lock-ins [11]. These decisions create a path dependency that reduces incentives to implement sustainable proactive adaptation strategies, increasing the risks of maladaptation [12]. Land use decisions often prioritise other societal needs (e.g., regeneration or job creation) with limited climate change or adaptation considerations, and may typically increase coastal assets and society risks.

Coastal adaptation crosses many conventional policy sectors and as Newell [13] observes, narrowly focussed policies are often ineffective and can exacerbate the problems they set out to solve; understanding cross-sectoral interactions can help to resolve this. Furthermore, proactive coastal adaptation needs to be embedded within both practice and strategic thinking, so that all (e.g., planning, regeneration, transport, social) decisions in coastal communities support proactive adaptation [14]. Researchers are also calling for more research that can support continuous transformative adaptation [15,16], identify mechanisms to enable implementation of adaptation pathways [8], help mainstream adaptation [17,18] and "support the initiation of broad-based societal consideration of transformative actions" [19] (p. 7160). We address some of these research gaps by seeking to understand the barriers limiting proactive adaptation and identifying recent, emerging or novel ideas that can create space for proactive adaptation. The primary aim of our paper is thus to address this question:

> How can we find and open up windows of opportunity in current decision-making, to better design and implement proactive adaptation?

This paper lies at the confluence of several strands in the broad literature on environmental governance, and addresses policy challenges of climate change adaptation, specifically in the context of coastal change where high uncertainty and complexity necessitate new strategies and paradigms. The following section situates this work and outlines our understanding and application of proactive adaptation. The paper then discusses the key barriers to implementation of strategic, proactive adaptation in decision-making practices. This analysis illustrates the wide range of factors that currently limit proactive adaptation decisions resulting in maladaptive responses, such as continued development or maintenance of assets in at risk locations where strategic, long-term policies recommend adaptation. We argue that current decision-making processes display few, and narrow, windows of opportunity for future adaptive responses. We identify current and emerging policies and practices that are creating windows of opportunity for more proactive adaption. Using examples from the UK, we discuss these opportunities, providing insights into where and how spaces for proactive adaptation might be opened up. This is followed by a discussion of what further transformations in policy and practice may enlarge these windows of opportunity to facilitate greater capacity for proactive adaptation, thereby reducing maladaptive decisions.

2. Governance Challenges of Climate Change Adaptation

There are numerous approaches and academic debate [15] surrounding climate change adaptation strategies and plans and how they support the implementation of sustainability in practice. They range from approaches designed to embed adaptation into existing development planning, policy and decision making (mainstreaming adaptation, e.g., [17]), aligning adaptation with sustainable development (sustainable adaptation, e.g., [20]), to transformative changes in governance that facilitate larger scale, step changes to improve our social and ecological resilience to climate change

(transformative adaptation [21]). There is also growing literature on maladaptation, seeking to identify how and why maladaptive decisions occur and identifying strategies for reducing the risks of maladaptation [12,14]. In parallel to this climate change adaptation focussed work, there is growing research exploring how sustainability (e.g., [22]) and ecosystem-based approaches [23] can be mainstreamed into decision-making practice. Collectively, this body of work is trying to improve our capacity to reshape our social ecological systems so they are sustainable and resilient in a changing climate. Whilst the approaches are different, common social, political and governance challenges have been identified in the literature (Table 1).

Table 1. Summarising different approaches to climate change adaptation.

Adaptation Type	Key Principles	Governance Arrangement	Social & Political Challenges	Key Challenges
Incremental Adaptation	Incremental adjustments often enacted in response to particular events	Subtle changes to existing policies and frameworks	Political decisions (e.g., severe event response) can overrule incremental adaptation; change may be too isolated and thus have minimal effect	Managing trade-offs between short term and long term interests
Mainstreaming Adaptation	Adaptation embedded into current policy and governance arrangements	Incorporate into and (partially) reframe existing governance	Sectoral nature of existing frameworks Lack of willingness to change	How to best embed
Adaptation Pathways	Flexible dynamic adaptation paths show differential risks	Develop independent adaptation pathways	Adaptation pathways are separate from non-climate policies Lack of willingness to change	How to implement pathways to avoid maladaptation
Transformation	Develop new approaches to support adaptation	Create new governance arrangements	Lack of willingness to change Institutional inertia persists	Willingness to transform
Maladaptation	Decisions that reduce adaptive capacity	Existing governance limits proactive adaption capacity	Sectoral and conflicting nature of existing frameworks Lack of willingness to change Time and spatial scale mismatches	Willingness to change existing structures; Identifying and avoiding maladaptive decisions

References: [12,17,19,24].

As illustrated by Table 1, the governance arrangements for climate change adaptation vary and often sit outside of the main policy formulation and implementation sphere; adaptation is thus often separate from other sustainability initiatives and from current practice and strategic planning of government bodies [22,25]. This can be problematic as most maladaptive responses at the coast arise from those actions, which are not climate change, flood or storm focused such as coastal development and regeneration [9].

Each of these approaches might be proactive or reactive. Proactive or planned adaptation "denotes actions undertaken to reduce the risks and capitalize on the opportunities associated with global climate change" [26] (p. 265). Proactive adaptation consists of largely government-led activities and procedures that are put in place prior to a perceived hazard event or climate change, typically involving collective actions for the public good [27]. This contrasts with reactive adaptation that is undertaken in response to events at the time that they occur [28].

Early work, e.g., by Fussel [26], characterised proactive adaptation in contrast to responsive adaptation, and suggested that it could be both anticipatory and planned. Furthermore, proactive adaptation is expected to be more effective in reducing overall climate change impacts compared to reactive actions. However, many authors suggest that proactive adaptation requires a demanding set of

information and risk assessments, including details of effective measures to minimise uncertainty and design incentives to make them attractive and acceptable. However, as Grothmann and Patt [29] have highlighted a set of critical socio-cognitive factors also condition adaptation decisions and responses, which subvert the more linear and rational decision-making process, and which may militate against proactive responses. A key challenge identified across the literature is the need to understand the multiple factors that interact to impede adaptation, and how these might be overcome to improve implementation [30,31].

3. Methods

Our analysis of the barriers to, and windows of opportunity for, proactive adaptation to address multi-scale change at coasts is generated from two related research activities. The first, is conceptual and empirical work supported by an international collaborative project, MAGIC (Multi Scale Adaptation to Global Change in Coastal areas), that undertook a series of interviews and workshops with decision-makers from environment and other sectors in the county of Cornwall in UK, to investigate maladaptation and multi-scale adaptive decision-making. The second is a knowledge exchange fellowship designed to aid United Kingdom practitioners in identifying policy barriers and opportunities to reframe current approaches to facilitate more proactive coastal adaptation.

This paper draws on data from a series of interviews with decision-makers from a range of agencies, including local government and statutory government agencies in England and Scotland, participatory workshops involving academics and practitioners on risk (October 2015) and making space for coastal adaptation (June 2017), and reviews of operational projects (2014–2017) where we engaged with policy and decision-makers on coastal management and adaptation to climate change. An initial tranche of interviews were undertaken with nine environmental managers in of 2014 after a stormy winter that caused £20 million damage to the Cornish coastline. The focus was to understand what decisions were made in the recovery period, and how the decisions were legitimised. To develop the analysis of these interviews, a workshop was designed to investigate how environmental managers negotiate demands to manage coastal risks (October 2015). Before and after interviews were conducted with the 16 participants, and recordings from the workshop were thematically analysed. A year later participants were contacted to discuss their most salient learning from the day. In parallel, between 2016 and 2017 semi-structured group interviews were carried out with Environment Agency and Cornwall Council staff specifically examining barriers and opportunities to coastal adaptation. We synthesise findings across a series of case studies and also use empirical research to describe vignettes to illustrate the extent to which proactive adaptation does and does not occur. We identify windows of opportunity and where, why and how these occur, and indicate what conditions and pre-conditions might support proactive adaptation.

4. Identifying Windows of Opportunity for Proactive Adaptation

The term "windows of opportunity" was first applied in an environmental policy context in 2005 where windows of opportunity were defined as "critical moments when advocates of new policies have opportunities to draw attention to their problems or to find new solutions or have policies accepted and adopted," [32] (p. 1064). The notion of critical moment is broadly analogous to a decision point, a common term in adaptation literature [16,24]. To date, there has been limited reference to windows of opportunity, policy windows or adaptation windows in climate change adaptation, resilience or environmental policy literature. References that do exist typically refer to windows that open up and create opportunities for more transformative approaches to climate change adaptation due to extreme events [3,33,34]; changes in political circumstances [33]; paradigm shifts and policy innovations [35–37]; temporal planning windows [38]; and through adaptation frameworks [34].

We illustrate how windows of opportunity can be applied to adaptation decision-making in coastal areas. In this context, we define windows of opportunity as a series of individual or collective decisions (across the full range of sectors influencing resilience of coastal areas) that can either limit or

enhance the ability to create physical, behavioural or political space for proactive adaptation. When any local development, planning, flood risk or adaptation specific decision-making occurs, policy, institutional or behavioural constraints on and opportunities for proactive adaptation can be identified. Four key windows are apparent: (1) open; (2) closed; (3) reframed; and (4) transformed (Table 2). These fit well with the simple metaphor [13] of windows where one can visualise closed windows that limit adaptive capacity and open windows that facilitate it. The type of windows operating in decision-making and policy formulation (Table 2A) can enlarge or narrow opportunities and capacities for proactive adaptation (Table 2B). Furthermore, these windows are often time-bounded; they may open as a result of a particular event, but close after a short time (Table 2C).

Table 2. Windows of Opportunity for Proactive Adaptation.

Window Type	Icon	Description	Example
(A) Type of Window			
Closed		Practices or behaviours that restrict implementation of climate change adaptation.	EC Habitats Directive makes no reference to climate change; modern protected freshwater marshes imped managed realignment [39]
Open		Practices or behaviours that enable implementation of climate change adaptation.	Shoreline management plans are non-statutory policies for coastal flood and storm risk management in a changing climate [7]
Reframed		Existing windows that can be reframed to enable proactive adaptation decisions.	Changes to existing policies that reduce long terms risks to climate stressors, such changing shoreline management plans to be event-triggered rather than based on temporal epochs (Local government environmental decision maker, personal communication)
Transform		Windows that can be transformed into a different state, leading to a substantive policy or paradigm shift.	The Copenhagen Cloudburst plan is an example of a policy transformation that occurred in response to the opening of an ephemeral window [38]
(B) Effects of Decisions on Adaptive Capacity			
Open/Expand adaptation space		Actions that enlarge our physical, political or social adaptive capacity.	Decisions taken now that retain or expand the physical adaptation space for planned future policy changes such as managed realignment [2]
Close/Narrow adaptation space		Actions that shrink our physical, political or social adaptive capacity.	Decisions taken now that reduce physical adaptation space for planned future policy changes such as managed realignment [9]
(C) Time-Limited Opportunities			
Ephemeral		Windows that open periodically such as after an extreme event, but then close.	Hurricane Sandy and the 1995 Dutch floods were seen as events that enabled transformative policy changes to be developed or adopted [3,32]

According to the literature on adaptation pathways, "decision points" are key points where decisions are taken that influence the direction of adaptive decision making, and can result in positive or negative shifts from maladaptive to proactive responses or vice-versa, respectively [24]. Similarly, proponents of mainstreaming adaptation focus on identifying opportunities for small, in depth changes in governance that can improve our adaptive capacity [15]. In both cases, the barriers to delivering adaptation are discussed at a conceptual level—where problem analysis is typically focused on the need for adaptation (e.g., [33]) rather than on the practical barriers to delivery of adaptation.

Identifying where the windows of opportunity lie and how they might be enlarged or opened to provide space for proactive adaptation might allow policy-makers and practitioners to identify and negotiate barriers to proactive adaptation which occur now in a range of sectors that limit options for adaptation. In applying the windows concept, we asked a series of questions to analyse coastal decision-making to identify key barriers to implementing proactive adaptation, and how transformative shifts can be facilitated:

1. What are the social, political, governance and funding barriers to implementing proactive, sustainable climate change adaptation?
2. What opportunities exist for windows of opportunity for proactive adaptation?
3. What enabling conditions can aid the reframing and transforming process?
4. What actions might open or enlarge space for proactive adaptation?

4.1. Existing Barriers and Constraints to Proactive Adaptation

It is clear from our interviews that practitioners are aware of, and indeed look for means to avoid, maladaptive responses to coastal flood, erosion and storm risks. Many coastal managers express an awareness of the limitations of their current approaches and a desire to deliver proactive adaptation.

> *" . . . the structural methodology of managing emergency events doesn't necessarily lend itself to the nuanced and long-term management of the environment".* Local Government employee

> *"If you're not careful, what you do is actually turn off your emotions. So decisions are made mathematically. And yet, deep down, you know it's not the best decision, but you know it's the only possible decision given the circumstance"* Environmental decision-maker

However, clear, well-supported and financed mechanisms to aid practitioners in delivering proactive adaptation are lacking, where institutional inertia, path dependencies and non-coastal, climate unaware policies (e.g., regeneration) often impede adaptation (i.e., windows are firmly closed) and so encourage maladaptive decisions. Perceived risks to the economic viability of remote, rural regions such as the risk that critical infrastructure (e.g., the mainline railway) may be abandoned in the future, are also conditioning maladaptive behaviours. Together these factors are leading to continued maladaptive responses to coastal climate change risks despite the fact that clear adaptation pathways exist to manage coastal erosion and flood risks in the form of non-statutory shoreline management plans [7].

We group these barriers into four categories (Table 3) to structure our discussions and link them to causes of maladaptation and conditions that can support proactive adaptation which are already established in the literature. Our interviewees noted that a key barrier to proactive adaptation is the high initial cost of adaptive responses (such as realignment of housing, roads or other critical infrastructure) compared to "patching up repairs" that are less expensive over short-term, politically aligned five-yearly rolling funding timescales. This means short-term "quick fix" decisions are made, rather than taking a strategic approach that may have lower long-term costs and greater benefits for society.

Table 3. Barriers to implementing proactive adaptation.

Barrier Type	Example	Maladaption Type(s)	Proactive Adaptation Corollary
Fragmented (Siloed/Sectoral)	Responsibilities are siloed within and between institutions, making strategic, proactive adaptation difficult. This is especially acute because coastal decisions that are often separate from those on land.	Institutions lack mandates to implement adaptation as many sectors (e.g., roads and rail) are beyond the remit of the local authority trying to adapt; maladaptive choices result.	Multidimensional adaptation requires coordinated decision making across sectors between multiple organisations.
Disjointed (conflicting)	Strategic planning frames (e.g., Shoreline Management Plans) are overridden by emergency response (rebuild after an extreme event) and politically driven short-term (e.g., <5 year) policies	Political agendas and timescales encourage maladaptive responses.	Interdependent planning frames
Disjointed (at risk development continues)	Continued development of large scale infrastructure. Avoidable lock-ins that increase the value of assets protected.	Reduced incentive to adapt; path dependency and narrowing of adaptation options. Traditional "hold the line" flood alleviation schemes more financially viable.	Increase incentives to adapt; social and policy transformation to support sustainable, proactive adaptation.
Timescale (mismatch)	Coastal engineering decisions for hard engineering last 80–100 years; the cost benefits to build them are based on current assets at risk.	Path dependency by committing capital to long-term interventions; assumptions are made that current land uses will remain for the life of the structure, limiting proactive adaptation choices.	Intertemporality is recognised and planned for; engineering decisions today are assessed against future vision of coastal communities
Institutional inertia	Reluctance/limited self-perceived ability to adopt new approaches or transform fragmented policy and governance arrangements.	Stagnation, status quo and a lack of mechanisms to overcome fragmentation of responsibilities fosters maladaptive decisions.	Social processes to unlock institutional stagnations are needed to enable transformation.

Refs: [5,12,15].

4.1.1. Fragmented and Disjointed

At the coast the disconnect between adaptation and everyday decision-making is amplified because of the traditionally sectoral nature of coastal planning, and its disconnect with marine and land-based policies (Table 3). In practice, our interviewees felt that this can mean that coastal climate change adaptation is viewed as a coastal engineering and geomorphology risk management problem rather than as a societal challenge impacting coastal communities. This is reinforced by land-based decision making and funding policies that encourage development at coastal risk zones. For example, where large new housing or shopping re-developments will be directly impacted by a risk factor such as flood risk in England, they are required to make a contribution towards the cost of this risk management infrastructure. If the development is not near a zone of risk there is no requirement to contribute to pay for risk management infrastructure. In practice this means that additional development in areas already protected by flood risk infrastructure is approved—and their contributions help support improvements to this infrastructure. Environmental decision makers interviewed felt this needed to be "*broadened and made more flexible*" so that more sustainable citing of new or regenerated assets can occur. Similarly, the partnership funding model is predominately paired with EU or UK regeneration funding within Cornwall. One environmental decision-maker said that the "*partnership funding mechanism at the moment enables us to increase our assets at risk*" where "*we make a* [flood risk] *scheme viable from the growth* [it is partnered with] *and what that will bring in the future*". The policy statement for partnership funding [40] also makes no reference to adaptation or realignment of the coast, and thus is poorly connected with the statutory Climate Change Act (2009) and non-statutory shoreline management plans (hereafter, SMP).

These mechanisms promote further development in risky locations. Whilst new developments are subject to a flood risk assessment and site-specific adaptations are often required (e.g., raising land levels) "*these decisions are made within the context of current flood alleviation infrastructure*" (Environmental decision-maker) rather than being mindful of future adaptation strategies. This is leading to continued development in zones that have been identified as areas for future managed realignment. This is

despite mounting evidence of the catastrophic and expensive impacts of recent coastal storms on society and natural coastal protection assets [4], further demonstrating the societal risks and costs of this disconnect between land-based planning decisions and framing coastal adaptation as shoreline management [3,5].

In England and Wales, there is an existing proactive adaptation policy in place in the form of a non-statutory SMP. SMPs are sectoral regional-scale risk assessment and proactive adaptation planning tools that have local-scale (e.g., community level) policy recommendations that involved public consultations prior to their adoption by local government. They provide recommended adaptation pathways at different time horizons. One interviewee stated, "*SMPs are completely based on climate change; they should be an effective adaptation tool*." These are further supported by national scale climate change adaptation reporting (under the UK's Climate Change Act 2009) and flood risk policies that encourage making space for water and natural flood management approaches [41]. Despite these high-level strategic policy frameworks, proactive adaptation is limited. One interviewee stated "*even where it* [an SMP] *is in place we still do not follow it when an extreme event happens*". Another interviewee remarked, "*there is a disconnect between the policy and the doing side*." An example of how current decisions are supporting development in an area scheduled for managed realignment by 2050 is at Wherrytown, in Cornwall, outlined in Box 1.

A raft of national and local government policies create barriers to the delivery of local scale adaptation plans. For example, central and local sources of post 2013–2014 storm recovery funding were used to rapidly rebuild coastal defences and damaged road infrastructure rather than use this event and these funds to implement agreed plans to relocate road infrastructure inland. In one location, at Seaton, Cornwall, the recovery response of rebuilding the road in its original location directly conflicted with the adopted shoreline management plan recommendation of managed alignment now [7]. This decision was taken despite the fact some enabling social and financial conditions for proactive adaptation were present: (1) the shoreline management plan had been adopted, so, whilst non-statutory in nature, it was approved; (2) the local population were supportive of adaptation plans to realign the road inland; and (3) a local landowner felt the need for location so great, that they were prepared to donate the required land. Thus, recovery funding was not optimised to deliver adaptation; instead, a maladaptive response was taken to repair a road that the SMP recommended was moved inland.

Our interviewees suggested that the availability of central recovery funding after extreme events further undermines adaptive capacity as "*Why would you allocate scarce resources on adaptation when central government will repair the status quo after an extreme event?*" Barnett and O'Neill [12] (p. 212) argue "If adaptation actions reduce incentives to adapt, . . . then such actions are maladaptive." In this case, strategic adaptation plans were overruled by the short-term central government response to an extreme event—which provided funding to quickly repair coastal infrastructure (roads, railway lines, coastal defences) damaged by storms.

Box 1. Disjointed policy and maladaptation in Werrytown, Cornwall.

Werrytown connects the regionally important towns of Newlyn (main fishing port) and Penzance (regional centre). This area is scheduled for managed realignment by 2050, where the SMP policy could allow realignment forward (as an offshore breakwater) or realignment landward, where the coast would move inland. A realign forward option would help protect the coast against future storm damage but not sea level, whereas the realignment option could address both future risks. However, land-based and emergency response decisions are narrowing future potential opportunities to realign landwards. The coastal defences were damaged during the 2013–2014 storms and immediate repairs were made to reinstate the defences in their current position—rather than using the storm event as a window of opportunity for more proactive adaptation. One Cornwall Council employee acknowledged the maladaptive decision for the Wherrytown frontage, describing a lack of time to conduct appropriate consultation processes to adhere to long term planning and when describing the SMP and discussed that adhering to the SMP was "part of the box ticking exercise" but one that was unrealistic given the timeframes for recovery works. Cornwall council has also recently (2016) approved demolition of a supermarket and rebuilding one double its size right within the area scheduled for managed realignment which has moderately high flood risk from 2050 and very high flood risk from 2100. The development was approved with modifications to allow for the high flood risk—in terms of emergency evacuation plans and raising ground levels—but no consideration of the long-term SMP policy recommendation was made. This is creating an avoidable lock-in and the demolished site is now for sale, where even more develop may soon occur, further reducing the physical space for landward realignment.

4.1.2. Timescale Mismatch

Several timescale mismatches further reinforce the barriers created by sectoral and non-statutory adaptation frameworks. In many areas, repairs or renewal of existing hard coastal defences are required due to structures reaching the end of their design life or through damage by storms. The design life of hard engineering structures is typically greater than 80 years and decisions now will thus commit future societies to a path dependency that is difficult to change. This in and of itself is not overly problematic where the adaptation pathway is to "hold the line" for all future planning horizons. However, this is particularly problematic where there are short-term plans for realignment (such as from 2055) but where repairs are taken now to maintain the current hold the line status. The funding model of assessing current (rather than future) assets at risks also leads to maladaptive behaviour where coastal engineering structures being designed now for a design life of 80–100 years are assuming that the current infrastructure assets will remain in situ and thus at risk. There is no strategic planning for land nor a visioning tool to help identify future configurations of assets, such as moving of roads, houses or railway infrastructure—so allocation of flood risk funding is based on current assets rather than future alternative scenarios such as a realignment of assets. Government agency staff responsible for flooding said, "*Deciding what should go on land* [in the future] *is not our job*" and "*we do not have the resource to undertake consultations about future land use*". This problem is further amplified by the short-term funding cycles (five-yearly) of key infrastructure providers and conditions of their contracts—to return the railways or road infrastructure in an identical condition, with no locational flexibility. The tension in communicating and planning for long time horizons were articulated in the workshop in a discussion between two participants:

> *Respondent 1: "People don't live in the long term. People live in the short term. That's the thing, a plan that looks 100 years ahead, ha!"*
>
> *Respondent 2: "I was at county hall last week and they were talking about health and social care moving towards a 15 year set budget. And everyone's saying yeah, yeah, yeah, that's really great. But then somebody said what about the political agenda every five years. Unless you can set it in stone and say whatever happens, this will happen. But you can't."*

Local government agency staff have identified differing planning horizons as a major barrier to transformative adaptation as these organisations have no mandate to consider strategic, long-term adaptation of their assets on land in coastal areas. "*I think people just think those, it's like those decisions are*

for another time, they're never for now. And you just wonder when is the now going to be?" (Local Government employee). This contrasts with the non-statutory SMP requirement to consider adaptation at various time epochs to 2100. In practical terms, this means that coastal engineering decisions now that are typically designed to last for 80–100 years are being made on the assumption that the current spatial configuration and value of assets at risk will stay the same or increase through time. This timescale mismatch and fragmentation of responsibility between organisations hampers the ability of local staff to work with these organisations to implement proactive adaptation.

4.1.3. Institutional Inertia: Organisational Space for Decision Making

Individuals inside public institutions in charge of strategic adaptation management often have a large number or responsibilities beyond this particular remit. Management of the risk of environmental change occurs alongside the on-going management of organisational risks and responsibilities. The interplay between these organisational risks and environmental or societal risks can result in decisions that diverge from long term strategic planning [42]. Two examples from Cornwall and one from central government illustrate this point. First, each county is granted a revenue support grant (RSG) by central government, a proportion of which is granted based on the length of coastal defences in a region (Environmental decision-maker interviewee). Within the RSG, only adult social care and education are ring-fenced, which in practice means that funding allocated centrally for defences is often used to support other seemingly more urgent issues rather than for coastal flood risk management or coastal adaptation (Environmental decision-maker interviewee). Similarly, the county has a Community Infrastructure Levy (CIL) that selects priority topics that benefit from the levy applied to all developments within the county. One Environmental decision-maker said, "*We argued the case for flood and coastal management to be included as* a priority *topic for this levy—but it was rejected* [by the council]." Meanwhile, at the national level, there are currently no specific financial mechanisms by which coastal adaptation can be costed or paid for and the funding model for flood risk management is also not currently designed to consider adaptation. The problems this causes were highlighted by an interviewee, "*It is very hard to get funding for adaptation work, as it doesn't deliver the economic benefits for the current government/help to meet their Medium Term plan for flood risk* [of protecting an additional 300,000 homes by 2021]" ([43] for details). This view was also expressed by an interviewee from Local Government: "*The financial incentive is to increase assets at risk, increase the value. The general funding model is fundamentally flawed*". Thus, national and local financial and political support for coastal adaptation is currently limited.

Organisational risks, such as reputation or funding uncertainty, are issues that adaptation decision makers have to deal with in their roles (even if not officially in their remit). With the expanding role of social media in the communication of severe events, reputational risk is becoming an increasing concern for public and civic organisations. Anticipating and managing organisational risks that emerge around planning for or responding to an event can fundamentally inform organisational adaptation decision making space, opening up or closing down options for the decision maker. For example, during the 2013–2014 storms in the UK, central government announced that it would assign funds to the affected councils and that works to re-establish business as usual would be completed within a short space of time (i.e., 20–22 months of the storms occurring). This added a layer of reputational risk to the decisions on how to implement reactive "recovery" works—such as pressure to adhere to the timeline (mainly due to reputation with the public) meant that space for adaptation decision making became narrower as long terms plans conveyed in the SMP would take too much time to consult on as described by an Environmental decision-maker, "*the repairs are in super fast time because the government has said, there's your money, spend it by October, so we've totally accelerated a repair programme when you usually do two a year we're doing twenty in six months*". This accelerated timeframe constrains the ability of the public organisations to comply with the long-term adaptation plans, especially as normal consultation procedures cannot be adhered to as described in the Wherrytown example above. Instead quicker to implement engineering options were implemented against the better judgement of several

decision makers. The often implicit role of the decision maker to balance the demands of organisation and societal risk does not necessarily lead to maladaptation, but this interaction does make adaptation options that manage across these risks more appealing to the decision maker compared to options that simply manage the societal or environmental uncertainty.

Together, these barriers mean that, more often then not, the management of flood and storm risks (the main tool for climate change adaptation at the coast in England) is highly reactive. The reactive nature of coastal planning extends beyond England where one Scottish flood engineer interviewed said, "*We are wholly reactive at the coast and have no resource to develop an SMP*".

4.2. Making Space for Proactive Adaptation

A first step towards more proactive adaptation is to identify any current or forthcoming approaches that practitioners are using that can provide windows of opportunity for proactive adaptation. These can be windows that are already open or windows that could be enlarge with some minor reframing (Table 2). These "chinks of light" can be used to demonstrate the potential benefits and opportunities for proactive adaptation as part of climate and non-climate related decision-making. The objective is to identify pre-existing or emerging behaviour, political, policy or institutional spaces that can support the transition to more proactive decision-making. In the Cornish context, a few planning, governance and social windows that are already open or are starting to be reframed could be better harnessed to deliver proactive adaptation.

In terms of strategic planning, in addition to SMPs, central government is requiring coastal authorities to establish Coastal Change Management Areas (CCMAs) where coastal climate change risks are most acute. These strategic planning tools provide further impetus to develop strategies to support adaptation at the local government scale. In Cornwall, the council is currently creating a "*supplementary planning document for coastal erosion to advise planners*" (Local Government Employee). This, if approved, will create a coastal erosion zone that limits the types of development that can occur within this buffer. This will help maintain physical space for future landward adaptation.

Earlier we identified some of the governance silos and avoidable lock-ins that are persisting, partly as a result of the current partnership funding model for flood risk infrastructure in England. However, the partnership funding model also has some strengths which might constitute "windows". Until the shift to partnership funding, coastal flood risk infrastructure was financed by the Environment Agency. The partnership funding model required the Environment Agency to work much more closely with partner organisations than previously. This has helped shift the focus from flooding to the wider multifunctional benefits that flood risk infrastructure can provide. This is further supported by the requirement to assess the ecosystem services provided by different options associated with a local flood risk scheme [44,45]. More crucially, it has required relationships to be forged between government bodies, community groups and non-governmental organisations. One environmental decision-maker's comment illustrates this well "*Partnership funding makes things happen, it is easier to get people on board*." If the current problem of partnering flood risk funding with growth funding can be resolved (such as via adaptation funding from an infrastructure levy), there is strong potential for these relationships to be further developed to support proactive adaptation.

The infrastructure challenges associated with future landward realignment also become more apparent. In relation to discussing whether the immediate storm response could have been more proactive, a key impediment was identified—the main trunk sewer runs immediately behind the exiting defence. Some discussion between different interviewees illustrated differing viewpoints ranging from this being something "*fixed*" (Respondent 1) that would restrict landward realignment to an issue that Respondent 2 said "*we need to tackle*". Water and sewerage infrastructure decision-making was beyond the responsibility of either organisation interviewed where "*privatisation was fundamentally opposed to public sector risks*" and "*this* [disjointed management] *structure undermines our public sector ability to manage risks*". Our interviewees suggested that the recent change in flood risk funding from

annual to five-yearly timescales that other infrastructure providers use (e.g., highways and water) should better align priorities between organisations which might help address some of these issues.

Proactive adaptation can also be facilitated by identifying processes or techniques from other contexts and sectors that provide enabling conditions. Placeshaping, also referred to as placemaking, is emerging as a research area (e.g., Steamline, 2017) [46] and practical tool (e.g., Scottish place standard, Scottish Government, 2016) [47] designed to engage local communities about what they want their communities to look like, now and in the future. In Cornwall, the county council is already using a placeshaping model as part of their investment and economic growth plans [48] where placeshaping expos have been held in key regeneration areas (Environmental decision-maker). These events area designed to create open forums to bring different government agencies, local businesses and infrastructure providers together along with the general public to proactively discuss change, economic and social change within their communities. One interviewee who participated in these expos said,

> " . . . *the placeshaping group is fantastic, I was manning a stand on sustainable coastal management, it was one of 10 stands. Railway, hotels, the arts, a new doctor's surgery and housing were other stands. I was able to talk to people about it* [coastal change], *but not in the context of 'I've come to talk to you about flood risk management'. Because it wasn't a formal consultation, nor was it tied directly to flood risk, it allowed me to have very different conversations. Normally if you have a SMP consultation you get a very skewed perspective. On the whole, people thought that* [managing the coast differently] *sounds sensible,* [and that it will be] *interesting to see what comes forward."*

Scotland has recently (Scottish Government, 2016) [47] created an online Place Standard tool for local authorities to use as part of their development planning process. This is currently focussed on present day communities but can easily be reframed to ask people what they would like their future community to look like. The streamline project is currently exploring how future community visioning can be used to discuss what aspects of their community are important and their perceptions of change. Might it be possible to reframe the Scottish Place Standard to include both current and future visions of their communities? Could this approach be applied in Cornwall? For example, how might we reframe neighbourhood planning processes using a climate aware place standard tool? Will this enable us to shift from the current neighbourhood planning focus on development control issues (e.g., dog waste, planning applications, nuisance behaviour) into climate change resilient placemaking, where local communities are asked *What do we want our community to be like in 2050?* Might this approach create effective windows of opportunity that bridge the timescale mismatch between long-term coastal engineering infrastructure design life and much shorter term socio-political and development timescales?

5. Conclusions: Enabling Conditions for Proactive Adaptation

We identify a series of enabling conditions that can support the reframing, transforming and/or opening of adaptation windows to better facilitate proactive adaptation. Specifically, we identify three critical conditions to opening spaces for proactive adaptation. First, it is necessary to move from sectoral approaches to inclusive processes for strategic planning and decision-making which consider multiple risks to move towards adaption governance and planning. Second, novel methods and innovations are needed to understand risk in more dynamic and multi-dimensional ways and to enable future visioning that crosses conventional sectoral and geographical boundaries. Third, we need multi- and cross-scale governance, with an emphasis on meso-scale regional initiatives. These new governance arrangements need to help society move beyond adaptation visions into more tangible adaptation planning frameworks that are embedded as part of on-going development, regeneration and coastal risk management decisions.

The urgent need to create more inclusive processes and to assess multidimensional risks was illustrated well by the Wherrytown example outlined in Box 1, as damage from the 2013–2014 storms demonstrated the risk to key infrastructure (water and highways)—these are beyond the

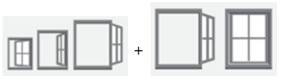
immediate responsibilities of local council and Environment Agency risk management authorities. Comprehensive, inclusive multidimensional risk assessments and governance are urgently needed to ensure that strategic assessments and planning communities and for more resilient road and sewerage networks takes place alongside flood and storm risk management decisions. This, alongside more comprehensive, inclusive placemaking to reshape communities, would help ensure they remain connected and essential infrastructure maintained as climate change risks increase.

The new normal of austerity and increased financial uncertainty mean that government agencies are increasingly likely to turn to partnerships to harness available knowledge and funding [49]. Partnerships between public, civic and private organisations will allow an expansion of capacity but will also bring with it new concerns. The polycentric nature of such potential governance arrangements requires careful negotiation and integration, both at the meso-scale and across scales to ensure that adaptation values within and between organisations are fairly reflected in adaptation decisions [50]. These organisations are close enough to specific place-based contexts to be aware of local needs and values, but are also able to leverage the power and capital available to large organisations, hence initiatives driven at this scale can offer fruitful operating spaces for adaptation decision making.

The windows of opportunity concept can perhaps aid practitioners and policymakers in identifying instances where decision-making can reframed or transformed to better enable proactive adaptation. We have explored how a windows of opportunity approach might help identify specific policies, practices or institutional frames that can and reframed within Cornwall and Scotland. This has involved a series of iterative discussions with practitioners to explore what reframing of current policies might be possible to help maintain physical space for future, planned coastal adaptation. Recent or emerging initiatives from Cornwall and Scotland show how reframing of existing policies or creation of new transformative approaches (e.g., placemaking in Scotland) can help build both the social capital and practical mechanisms required to deliver proactive adaptation. We have summarised this potential at a conceptual level (Table 4) and by returning to our example of Wherrytown (Box 2). Table 4 applies the different windows identified in Table 2 to illustrate how different spaces might be opened up to move to proactive adaptation. Derived from our empirical analysis and from literature and experience of adaptation in other contexts, in shows how transition from current to proactive adaptation requires shifts in decision framing, the pre-conditions and processes and outcomes association with identifying and opening adaptation spaces. Box 2 explains some of the adaptation options discussed in Werrytown, Cornwall.

Identifying windows of opportunity and understanding how they operate in this way can support sustainability and adaptation mainstreaming and dynamic adaptation pathway approaches to help deliver transformational change necessary for sustainable adaptation to climate change in coastlines worldwide.

Table 4. Opening windows to proactive adaptation.

	Current	**Transitional**	**Proactive**
Problem Stage	Identification of current adaptation barriers and opportunities	Reframe and/or transform governance, rules and policies	Improved space for proactive adaptation and adaptation mainstreaming
Windows			
Decision Frame	Current decision frames are predominately maladaptive. Timescale mismatch impedes proadaptive decisions	Reframe or transform by unlocking stagnation or via new approaches. Harness ephemeral openings for transformative change.	Climate centric—all decisions are made within a climate resilient/proactive adaptation frame.
(pre) Conditions	Inflexibility and climate unaware policies Sectoral, fragmented and conflicting governance Risk reduction measures are made in isolation reducing adaptive capacity	Shift from sectoral to inclusive processes and actors Multidimensional and dynamic risks are taken into account Coordination of multi and cross-scale governance improves.	Flexibility to adapt governance rules to be climate resilient. Coordinated, inclusive and risk aware multiscale decision making frames exist
Processes	Lack of mandate within organisations to take proactive decisions Conflicting mandates between organisations	Social learning, placeshaping and partnerships to build social capital. Second order risks are explicit Policy changes improve adaptation readiness	Conflicting policies and timescale mismatches are better aligned Adaptation plans are formalised so that short-term decisions are made within a proactive adaptation context
Outcomes	Avoidable lock-ins continue; Increased assets at risk Physical space for land-based adaptation is developed	Windows reframed/transformed to enable proactive adaptation More physical space for land-based adaptation is retained	Proactive adaptation underpins all decisions Physical space for land-based adaptation (managed realignment) is increased
Adaptation space		Maintained or enlarged	
Adaptation choices	More constrained Reinforce some adaptation options over others (e.g., realign forward) as less land is available for land-based realignment Ephemeral windows are unlikely to be available for proactive adaptation.	Adaptation space widens Ephemeral windows can be used as catalysts to expedite reframing or transformation	Less constrained Ephemeral windows are better harnessed for proactive adaptation

Box 2. Opening adaptation windows in Wherrytown.

In Wherrytown, a number of alternative responses to recent storms and the post-storm decision to approve demolition of one supermarket and replace it with one double its size within the zone of planned managed realignment were explored. Some constructive ideas for opening up windows of opportunity emerged, to help maintain flexibility for future adaptation whilst ensuring there is some economic and social value in the interim period. These ideas would help ensure society can create necessary growth now without making decisions that unnecessarily increase our long-term societal risks.

One interviewee reflected that *"Managed Retreat policy exists . . . but there are no actual MR plans in place in most locations."* A first priority is thus to create a multi-agency governance mechanism that can facilitate the development of local managed realignment plans. In the absence of these plans, or whilst they are being created, small changes can be made to planning policy now that can help retain physical space for landward realignment—thereby keeping managed realignment options open whilst local plans are developed. These included stricter planning requirements whereby the new development would be granted temporary planning permission, so that the new development would not encourage "snowballing" of additional assets in space suitable for landward realignment and that the structure itself could be readily moved as required. For the old development site (i.e., the old supermarket), a condition of planning could have required much more from the developer than demolition such as converting the site to a temporary exhibition, green or car parking facility that generated revenue rather than demolished and sold for development. If an adaptation fund were available from reframing central government flood risk financing or from prioritising adaptation as one of the community infrastructure levy topics, then the local government could have bought the site and generated revenue as outlined earlier. These are small shifts in current planning policy and financing of adaptation, which could help maintain physical space for future landward realignment—whilst communities and democratic representatives are engaged via improved neighbourhood planning/placeshaping to identify the most suitable adaptation options for this area. To operationalize ideas such as these, the preconditions outlined above would need to be in place.

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