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Experimental participatory methodology brings local pasts to contemporary climate action

Sarah Kerr^{1*} , Uffe Krogh^{1,2} and Felix Riede^{1,3}

Abstract

This paper presents a Danish case study area experiencing cultural and natural environmental changes exacerbated by anthropogenic climate change. It describes and evaluates an experimental methodology that was developed to create and support engagement between the local community and climate action in the case study area. The methodology draws upon approaches and concepts from the research fields of environmental history, community archaeology and socio-hydrology. It is argued that this bespoke community-based, historical socio-hydrology methodology both bridges disciplinary divides and aids transdisciplinary collaboration with non-academic sectors. The methodology's strengths lie in its use of narratives that are new to the audience, highly localised and concretely anchored in the landscape. This effectively engaged the community in climate communication and climate action within the local area. It is proposed that this methodology can be adapted for other case studies to support technocratic approaches to climate action.

Highlights

- We combine environmental history, community archaeology and socio-hydrology
- We report on a project of citizen engagement in local climate action
- Local and historical socio-hydrology can contribute to climate action, outreach and engagement

Keywords: Community archaeology, Environmental history, Socio-hydrology, Storytelling, Climate change, Transdisciplinarity

Introduction: Towards community-based historical socio-hydrology

Changing climate is demanding ever more political and public attention. Tackling environmental and climate-related challenges has long been seen as achieved primarily through technological and managerial solutions relating to the transition to renewable energy, cleaner production or changes in hydrological regimes (Castree

et al. 2014; Hulme 2020). Yet, the relative slow progress of the transition indicates that schemes of genuinely sustainable climate change mitigation cannot be readily configured without the inclusion of non-technocratic approaches and more comprehensive social transformations that heed culturally constituted values and worldviews (Zheng et al. 2021). There are, however, vast differences in how different fields approach extreme climatic events, mitigation, resilience and action, as McPhillips et al. (2018) highlighted in their conceptual analysis of major disciplines including hydrology, the social sciences, ecology and engineering. While there is

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growing awareness that a multi-pronged approach is required when tackling climate change, as evident in European-level reports which call for greater interdisciplinarity (European Union 2013) or transdisciplinarity (Vienni Baptista et al. 2019), barriers to interdisciplinary communication and collaboration persist. This is not a task to fall to future generations, rather it stands clear that political decisions taken now will have long-term consequences on sustainable mitigation, the global environment including sea-level change, as well as the future availability and costs of recourse (Clark et al. 2016). This paper reports on a transdisciplinary and experimental participatory methodology developed to engage the local community of As Vig, on the east coast of Jutland, central Denmark, with climate action in relation to dynamic inland and coastal waters. It is argued that this (i) offers one possible rejoinder between pertinent disciplines and stakeholders concerned with climate change adaptation; (ii) can provide a more intimate relationship between the consequences of, and solutions to, local climate-crisis manifestations; and (iii) can support climate action in relation to the locality. This paper describes the historical socio-hydrology methodology in the context of the varying disciplinary perspectives from which it derived and then evaluates its efficacy when utilised in the local community of As Vig.

In order to erode the disciplinary barriers noted by McPhillips and colleagues, the bespoke methodology combines aspects from the fields of environmental history (Adamson et al. 2018; Carey et al. 2014; Hughes 2009) and community archaeology (Marshall 2002; Moshenska and Dhanjal 2011) with socio-hydrology (Konar et al. 2019; Sivapalan et al. 2014, 2012 (Fig. 1)).

This interdisciplinary approach, that is, the process of integrating information from multiple disciplines, was furthered into the realms of transdisciplinarity through elemental collaboration between Aarhus University and non-university sectors (Pohl 2008; Vienni Baptista et al. 2019) including Hedensted Municipality, museums and local nature guides. In practical terms, the transdisciplinary methodology, forthwith called a historical socio-hydrology approach, utilised anchored storytelling with the local community in their immediate landscape. Through a series of seven workshops and field trips between May and September 2018, the variety of stakeholders engaged 165 local citizens with their immediate landscape and worked together to unpack the temporal dimensions of cultural and natural environmental change.

One of the effects of global climate change felt most acutely in Denmark are changes in the hydrological cycle leading to, in particular, more precipitation and rising sea levels. As Vig is located in the Region of Central Denmark, a political and administrative unit as well as a geographically distinct area. The region on the whole is facing ever-more urgent climate change as it comprises both major inland waterways and eastern and western coastlines. As Vig is a low-lying area on the eastern coast, making it both a popular holiday destination and an area vulnerable to hydrological changes. The extensive and easily accessible sandy cove is dotted with summer cottages and holiday homes used by recreational fishermen, sailors, surfers, walkers and cyclists, yet it is frequently threatened by storm-surge seas. An equilibrium was sought in the construction of an enclosing 1.9-m-high dyke plus most of the individual houses have

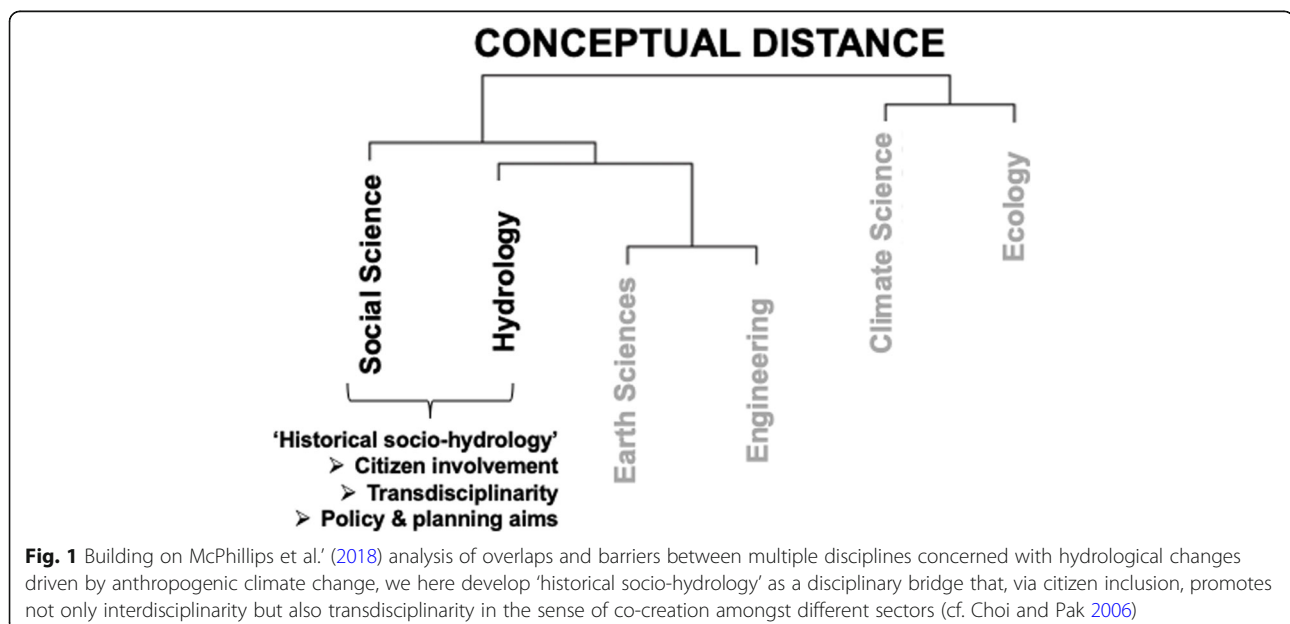


Fig. 1 Building on McPhillips et al.' (2018) analysis of overlaps and barriers between multiple disciplines concerned with hydrological changes driven by anthropogenic climate change, we here develop 'historical socio-hydrology' as a disciplinary bridge that, via citizen inclusion, promotes not only interdisciplinarity but also transdisciplinarity in the sense of co-creation amongst different sectors (cf. Choi and Pak 2006)

their own private dykes. In addition, the creek Skjold Å that bisects the neighbourhood has a high tide barrier, restricting influxes of seawater (Fig. 2). At present, the dykes and the tide barrier are appropriate measures for As Vig: they will, however, fail to be sufficient in the long term. The Danish Meteorological Institute has suggested that levels of the Danish inner waters will increase by up to 140 cm by 2100 doubling during storm activity to almost 3 m above the present levels (Olesen et al. 2014). The risk of extreme events, such as the massive, costly and deadly floods that occurred in western Germany and Belgium in 2021, is becoming a reality (COWI 2021). As a consequence, the high tide barrier would be closed more often and for longer periods of time. The result would be the restriction of stream water, normally leading into the cove, to the inland area behind the summer cottages. The cottages, therefore, are at acute and rising risk from both inland and coastal waters.

The As Vig region and its inhabitants are and will continue to experience the local impacts of global changes as anthropogenic climate change unfolds. As such the methodology was a local approach addressing global issues. Through evaluating the effectiveness of a historical socio-hydrology approach, this paper argues that climate action and solutions may be sought in ‘glocal’ approaches that deploy socio-hydrological history to trace lines between the diverging perspectives. Presented below is the approach piloted in order to co-create understanding of contemporary environmental challenges, as seen in light of nested local-to-global histories, and to strengthen local citizen-driven climate initiatives. The initiative reported here cannot be seen as functioning in isolation from other political and technological

adaptation and mitigation measures; however, it presents a cost-effective supplement that can be readily transferred to other settings and climate change adaptation challenges.

Methodology

A non-technocratic, transdisciplinary experimental methodology was created to engage the local community of As Vig with local climate action in relation to the increasing risks posed by inland and coastal waters. Within the framework of the Coast to Coast Climate Challenge project (C2C CC 2017; C2C CC n.d. (Table 1)), this took the form of seven meetings in As Vig between the stakeholders and community members in which the hydrological issues were communicated in the context of both contemporary global climate change and historical environmental and cultural changes in the area. Three possible adaptation scenarios were communicated to the community for consideration. The first scenario discussed was business-as-usual (Scenario I); that is, no action is taken. Scenario II considered allowing the water to advance into less valuable parts of the area e.g. low-lying fields, and even allowing some summer cottages to flood. Finally, Scenario III opted for securing the area further and pumping water from Skjold Å creek into the bay, thus protecting the housing yet at ever-increasing costs. Each scenario communicated to the community was associated with increased risks downstream, financial costs and benefits that needed to be negotiated. While Scenario I simply delayed major decisions until some point in the future, Scenarios II and III would, respectively, entail the abandonment of many summer cottages or greatly increase costs in relation to ever more intensive technology-aided water management. With



Fig. 2 Drone photograph of the at-risk summer cottages in the As Vig area, looking inland over the creek, Skjold Å, that bisects As Vig (centre left). Copyright: Hedensted Municipality

Table 1 The coast to coast climate challenge project

As the second lowest lying country in Europe, Denmark is undeniably going to be affected by the changing climate; particularly, the instability associated with excessive water and unpredictable weather patterns. As water has no regard for municipal or disciplinary boundaries, the solutions required to deal with this issue needs to be interdisciplinary and cross-organizational in nature. In response to this common threat and funding from the EU LIFE program, the Region of Central Denmark has taken on the role of facilitating the climate change adaptation project coast to coast climate challenge (C2C CC) to safeguard tangible and intangible valuables. One of the C2C CC goals is thus to enhance the municipal authorities' capacity and enable them to develop and implement climate adaptation plans in their respective areas: the project at As Vig is one sub-project of the C2C CC. C2C CC covers a large territorial area (13,008 km² and just over 1.3 million inhabitants) and involves 15 municipalities from the Region of Central Denmark and three from the North Denmark Region, and works to create a climate-resilient region by the following:

- > Formulating a joint long-term strategy among local stakeholders;
- > Implementing climate adaptation plans in the municipalities as the necessary analyses and activities have been coordinated;
- > Identifying and improving resources and capacities among citizens and municipalities as well as among utilities and companies in water trading.

The project component we report here supplements the otherwise mainly managerial, technical, and entrepreneurial initiatives with a focus on local histories, values, and citizen engagement.

considerable and undeniable physical impacts, and additional intangible changes to cultural identities, it was crucial for the municipality that the citizens who either live permanently in the area or have their summer cottages there participated in the decision-making process. As such, the meetings comprised workshops, bus tours and field-walks allowing for two-way discussion of the scenarios and the community members were invited to collaborate in formulating responses to these risks.

Central to facilitating discussion and collaboration was setting the scenarios in their historical, cultural and climatic context through citizen-near storytelling. The methodology adopted the view held throughout many climate-change communication programmes that narrative formats are considered effective engagement for climate issues, especially if the aim is to generate behavioural effects (Morris et al. 2020; van der Leeuw 2020). Narratives, following in the definition set out by Constantino and Weber (2021), are stories about how the world works and the role of humans within. They have the potential to accelerate attention upon the topic discussed as, unlike a chronicle, they can engage with emotions and moral values (Cronon 1992). As such, people may engage more viscerally with, thus react more potently to, narratives than numbers. In addition, where a narrative begins and ends profoundly alters its meaning and impact and can allow for the generation of new perspectives (Cronon 1992). The methodology incorporated these viewpoints by communicating narratives that were environmental and cultural histories focusing on the landscape, the people within, and their interactions (Bergthaller and Mortensen 2018). This provided a focal

point to the narratives: the climate-history, culture-history and the three scenarios. The interrelationships between these foci were strengthened through their in-tandem communication at the workshops and excursions on foot and bus.

Choosing which narratives would be communicated was a highly interdisciplinary and experimental element of the methodology. It derived, in part, from applied environmental history, setting it apart from many other approaches to climate action, which have largely been dominated by engineering, managerial and natural science approaches. Applied history, that is the inclusion of knowledge of the past when addressing issues of the present, emerged quite separately from environmental history. In tandem, however, they gained prominence throughout the 1970s and 1980s (Cronon 1992; Neustadt 1988; Stearns and Tarr 1981) and their combination is frequently adopted in the approach to contemporary and projected climate change (Carey et al. 2014). Their synthesis was centred in this methodology and underpinned by a wider environmental humanities movement that has embraced greater interdisciplinarity including influences from developments in history, archaeology, literature studies and the arts more broadly (Bergthaller et al. 2014; Robin 2018). Encouraged by interdisciplinarity, the environments, cultures, economies and politics of the past are less frequently viewed as isolated histories (Chakrabarty 2009, 2014). Rather, there is greater agreement that understanding the 'complex interweaving of our ideas of climate with their physical and cultural settings' over time may assist the response as the gossamer shifts in the present and future (Hulme 2008). This 'conjoining' (sensu Chakrabarty 2014) then, of historical and environmental perspectives can be considered as vital, not only for thinking about the past but also for acting in contemporary anthropogenic contexts. This provided the methodological foundation for centring climate-history and culture-history in a story-telling approach.

By centring historical and environmental narratives alongside the present-day scenarios, this methodology diverged from the climate-action initiatives which deal with acute climate-related loss of sites and monuments (e.g. Collete 2007; Fatorić and Seekamp 2017). Rather, it attempted to proactively integrate environmental history into the land-use planning process as an instrument in citizen-driven climate adaptation, akin to similar efforts in Scotland (Dawson et al. 2017) and the Netherlands (Fatorić and Egberts 2020). In contrast to many other projects at the interface between climate change and cultural heritage, however, this methodology did not strive to stimulate community-led preservation or research but rather utilised cultural heritage (i.e. history and archaeology) on a local scale to improve multivocal communication around challenges and solutions. This element of

the approach emerged from the viewpoint that local environmental and climate change issues can be added to the palette of applications of history in order to support global climate crisis mitigation (c.f. Jackson et al. 2018; Rockman 2015).

A further influence to the narratives' content was converging the conjoined historical and environmental perspectives with the independently derived insights of socio-hydrology, specifically a focus on locally nested context. Socio-hydrology, which emerged only in recent decades, has made valid contributions to the understanding of human-water interactions specifically in relation to the management of waterways, systems and supplies (Nüsser 2017). The approach frames water-related planning and engineering solutions within their local societal context (Sivapalan et al. 2014). Therefore, the narratives created through this methodology were saliently localized to highlight the uniqueness of the area and its cultural heritage yet were not detached from the global issue. In practice, this meant the stakeholders embraced the ICOMOS mantra that 'every place has a climate story' (ICOMOS Climate Change and Cultural heritage Work Group 2019, p. 17). This principle essentially suggests that local-scale environments are linked to global climate change, even if the relationship is difficult to detect, they are globally connected. By focusing on local narratives, the methodology built upon socio-hydrology's emphasis on local case studies while extending it with a greater historical sensibility to create a bespoke historical socio-hydrology approach (Mondino et al. 2020; Mostert 2018). This merging of seemingly disparate approaches sought to achieve more robust and knowledge-led debates and decisions on the variety and impact of the municipality's adaptation scenarios (Fatorić and Egberts 2020).

A further development in archaeology, particularly over the past three decades, that influenced the methodology is greater exploration of cultural identities. Cultural identity can be considered as multi-faceted, dynamic, sometimes contested and always created from experiences within our environment, gender and age, amongst numerous other factors such as ethnicity, religion and class. In archaeology, the focus is on the representations of these facets in the past's material culture and detecting their emergence, decline or shifts (Graves-Brown et al. 1996). At the intersection of archaeology and heritage, however, there is greater focus on how representations of the past are one such contribution to modern cultural identities (Dawson et al. 2017). They can be considered historical reservoirs: historically constituted yet fluid and permeable (Pratt 2005; Sommer 2009). In the present, therefore, cultural identities can be impacted when representations of the past are altered—including by climate change. If the natural heritage and

the physical landscape of As Vig are considered intrinsically linked with the community's cultural identities then the latter are subject to shifts as the former are threatened by increasing water levels. As such, climate change is a cultural, as much as it is an environmental, problem and can be addressed by engaging with its cultural dimensions. Cultural identities, much like narratives, can galvanise action, from building social movements to catalysing political change. While there is little research on what these actions could be in the context of climate change, this principle was embraced through the inclusion of culture-history in the interdisciplinary narratives. It was considered that shifts of cultural identities, or the potential of transformations in the future, may foster greater engagement with climate change mitigation, enhanced energy for preserving heritage or forgetting what is partially lost.

The way in which the relationships between the narratives and the scenarios were communicated was influenced by shifts within the disciplines of archaeology and history. Over the past two decades, there has been increased attention upon strands of climatic, environmental and cultural change over the long-term and how each is related to the other (Cultural Heritage and Climate Change in Western Sweden 2016; ICOMOS Climate Change and Cultural heritage Work Group 2019; Rockman 2015; Rockman et al. 2016). Stressing this interrelationship has been influenced further by the rise of critical heritage studies which argues that issues relating to the environment cannot be divorced from social and political negotiations, cultural and indeed moral values. These overlapping concepts from history, archaeology and heritage often coalesce in so-called Contemporary Archaeology and, in its more applied variant, Community Archaeology (Harrison 2012; Moshenska and Dhanjal 2011) which often engages communities in the actual landscapes under discussion.

State-of-the-art practice in Community Archaeology influenced the methodology in that the stakeholders brought the community into the As Vig landscape allowing the emphasising of past climate change and human action impacts, those projected due to future climate change, and the interrelationship between people and the environment (Alagona and Simon 2010; Lave et al. 2018). In addition, curators from Glud Museum and Vejle Museerne participated in the field walks and contributed with presentations on the area's environmental history. The inclusion of museums was crucial as they can be considered important loci and actors of local knowledge; not only can they act as curators and custodians of such knowledge against which global processes such as climate change can be measured, but they can also act as platforms for democratic debate (e.g. Cameron et al. 2013; Cameron and Deslandes 2011; Rees

2017; Salazar 2011). Museums of cultural history are arguably especially significant in this regard as anthropogenic climate change, and the decisions required to face it are by their essence cultural rather than natural, scientific or technical (Jackson et al. 2018; Riede 2019).

Bringing this confluence of disciplines, approaches and concepts into application is neither straightforward nor trivial. Therefore, the process of conveying the narratives was inspired by *Climate Visuals*, a charitable company based in the UK, who devised seven core principles for effective climate change communication (Corner et al. 2015). These principles encourage telling new stories, showing emotionally powerful images and creating a balance between local yet severe climate impacts and large-scale climate change causes. As such, these were the foundational methodologies integrated into the field walks, bus tours and workshops.

Results and discussion: Engagement and decision-making through narratives

The transdisciplinary, experimental methodology aimed to allow the community to contribute to the selection of an adaptation scenario for the As Vig area in light of inland and coastal water-level increases. Community archaeology, or outreach, events provided the setting for multivocal conversations between the municipality, the museums and university, and the community in relation to the three adaptation scenarios outlined above. The result of using a bespoke historical socio-hydrology approach during these events meant that the present-day decision-making processes in relation to future scenarios were set in the highly localised context of As Vig's socio-hydrological history. The series of meetings concluded with the community rejecting the three scenarios posed and, instead, creating their own adaptation scenario. They merged aspects of Scenarios II and III to create Scenario IV which included letting some areas flood, securing other parts through higher dikes and pumping excess water into the cove. The creation of a new, community-devised scenario suggests that the methodology successfully engaged the community in climate communication and contributed to the generation of climate action. The efficacy of the methodology in contributing to this result will now be evaluated. It will illustrate three key points of its bespoke framework—new and highly localised narratives anchored physically in the landscape—and argue that this is a useful blueprint for other contexts.

The use of narratives was central to the methodology and the content included two important factors to engage the community. Firstly, they included new information that was unknown to some members of the community. For example, humans have lived in the region of Central Jutland for over 13,000 years interacting

with and responding to the climatic and environmental changes. It was communicated that in the early Holocene (10,000–6200 BCE) inhabitants encountered rising sea levels as well as extreme events such as a tsunami generated by a submarine landslide off the coast of Norway resulting in marked changes in sea levels and groundwater levels. More recent socio-hydrological narratives, such as historical storm surges, were discussed. In, for example, South Jutland (Fruegaard et al. 2015), the Netherlands, Germany and Norway (Bondevik et al. 1997), storm surge records are well-known and well-documented as demonstrated in their inclusion upon flood pillars viewable to the general public. In Northern Jutland, historical storm surges and coastal flooding are strongly present in folk memory and local identities (Poulsen 2019). In the Region of Central Denmark, however, the corresponding information has been less systematically recorded and analysed resulting in little transmission of this knowledge within local communities such as As Vig. Recent archaeological investigations of, for instance, the Nørre Vosborg manor were therefore included in the events to illustrate the impacts of storm surges on the landscapes and people specific to the Region. At Nørre Vosborg, increased storm-surge frequency led to the displacement of settlements and the eventual abandonment of affected coastal stretches (Kock 2015)—a powerful parable for future projections.

These narrative arcs were enhanced with imagery such as historic maps. Maps can provide a bridge between desk-based planning scenarios (which themselves commonly deploy maps) and personal values or experiences linked to particular places. Here, they served to indicate landscape changes over more recent centuries emphasising how water levels, technology and settlement patterns have altered and the historical depth of present-day landscape features. Much of Jutland's wetlands were utilised for hay production until the second half of the nineteenth century after which tile drainage was introduced to allow for cereal and grass production (Beucher et al. 2016). This land-use change was defined in two of the maps utilised, allowing clear visualisation of its impacts on the wetlands (Fig. 3a, b). In particular, an area of approximately 100 ha in As Vig's southern extent was entirely drained between the creation of these maps. Land drainage correlated with a transformation in the human-coast relationship in Scandinavia, the Mediterranean and across the Atlantic, as coastlines became spaces less associated with work to spaces of leisure (Byskov 2007; Löfgren 2002), as As Vig continues to be in the present. This new narrative demonstrated that the landscape now used for summer houses was 'naturally'—that is, in the pre-industrial age—wetlands (Fig. 3). It was then situated in its wider context allowing connections to be traced between As Vig's specific situation and

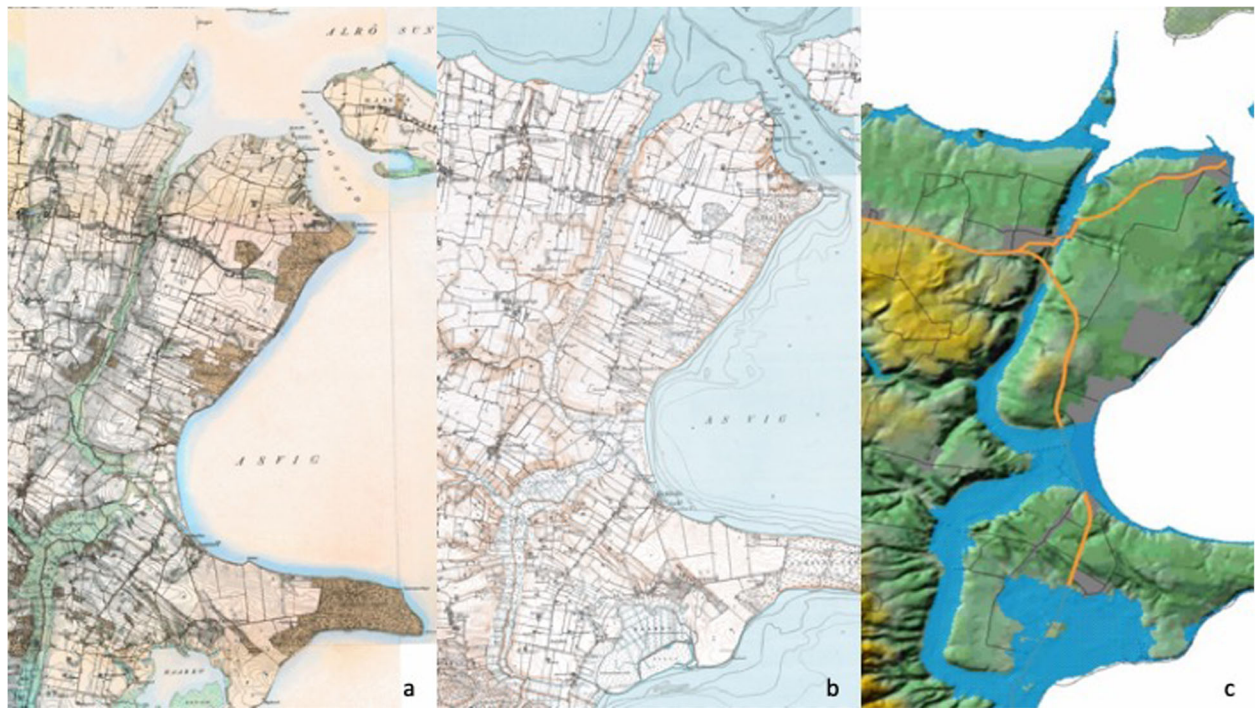


Fig. 3 Map **a** (left) was published in the last decades of the nineteenth century, map **b** in the first half of the twentieth century. These historic maps demonstrated the extent of wetlands in the area prior to drainage, most notable in the south (bottom centre), as well as land-use patterns prior to the establishment of coastal tourism. Map **c** displays evocatively the potential future threats and highlights water returning to those areas previously drained. (Maps **a** and **b** Copyright: Agency for Data Supply and Efficiency; Map **c** Source: (C2C CC, n.d.)

hydrological issues facing the nation. It was included that, since 1975, approximately 35% of Danish wetlands have been actively drained to allow for new land use rather than altered by natural geological processes (Greve et al. 2014). As such, the historical maps played a privileged role in communication, yet they also served as useful primers for developing and assessing story lines of future landscape change. The inclusion of a water-level projection map (Fig. 3c) starkly demonstrates the correspondence between historical drainage areas and areas likely to be threatened in the future.

The implications of using new narratives to generate climate action relied on the likelihood that they can act as thought-provoking springboards that stimulated discussion. The opposite reaction is thought to derive from seeing and hearing the same, or most common, images and stories about climate change. For example, seeing images of emaciated polar bears can generate fatigue and cynicism due to the familiarity, even normality, of those images. By communicating previously unknown information to the community, therefore, the discussions at As Vig were free from apathy, which can halt engagement and create feelings of ennui (Corner et al. 2015). The negative result of using new stories was the potential that they would be misunderstood: in contrast, the familiar, even emblematic, polar bear images are

implicitly understood due to the enduring narrative which has surrounded them. A lack of comprehending fully new stories could impact other judgements; for example, whether the community members would go on to share the story with others or be motivated by it (Corner et al. 2015).

The second element of the storytelling used to engage the community was high localisation. For example, one of the field walks was conducted through the tunnel valley along Skjold Å, created in the last ice age by the scouring of the Fennoscandian glaciers. Here, the stories centred on the landscape changes of the tunnel valley and how the area has been utilized through the millennia, with some of the local citizens contributing with their own stories from their lifetime or even local legends. This had a number of results. Firstly, it underlined the uniqueness of the area and as such the importance of taking action. For the community members, awareness of the area's importance was implied in their willingness to join the events; therefore, in that regard, local importance did not necessarily need to be stressed nor that the hydrological issues were relevant to them. However, emphasising the uniqueness allowed for furthering the positive emotional connection to place and attempted to overcome any trivialising of the deep connectedness between the environment and the people

occupying the area across time. Moreover, it allowed the granularity of As Vig's unique situation to be identifiable to the community and, with this, a deeper understanding of the situation and its temporal immediacy was communicated.

Localising the narrative may have contributed to the creation of Scenario IV through stimulating cohesion between individuals and place and individuals and the rest of the community. The connection between individual and place was supported through the relative ease of comprehension of the local context, due to its small scale, and the likelihood that some of the information was already known. For example, the position of the current Nørre Vosborg, after the original was destroyed, would be known to those living in the locality. In addition, the location of Skjold Å creek and tide barriers were known to the community participants as were the present flood risks. Furthermore, there was a sense of collective commonality as each person had a link to As Vig, whether as their place of permanent residence or their holiday home. It was important that this was supported as none of the three scenarios posed to the community involved strengthening the houses' individual dykes: they comprised community-wide approaches, rather than individualistic. By localising the historical socio-hydrological narratives of As Vig and the present situation, it created the sense of sharing the past and present. This connectivity was enhanced through the two-way knowledge exchange. Throughout the bus tours, workshops and walks the community members added to the narratives with personal experiences of As Vig, including accounts of flooding or landscape changes. This further grounded and personalized the narratives in a way that numbers and maps alone cannot achieve. Tacit local knowledge added an invaluable and, at times, unexpected dimension that can be situated somewhere between local ecological knowledge, personal accounts and citizen science. This impacted the results of the community outreach methodology in that it provided the participating community a known, highly localised, even personal, starting point from which to begin the discussion and reflection on how to protect the area from the contemporary climate challenges.

The new localised narratives were also anchored physically within the landscape. By retelling the stories from the workshops and bus tours within the very landscape under discussion, there was a sense of having 'history beneath our feet'. The physical situating of the historical socio-hydrology narratives allowed the opportunity to see or touch important parts of the story and to see changes in the landscape. Coastline and water-level fluctuation over the past centuries and millennia could be literally pointed out allowing identification of the impacts and the human responses, even resilience. For

example, by standing on the coastline at Snaptun on the eastern coast of Jutland, 7 km north of As Vig, it was possible to identify the now-submerged settlements of the late Mesolithic Ertebølle Culture (5300–3950 BCE). Snaptun is located on the southern edge of the mouth of the Horsens Fjord. During the late Atlantic period (ca. 4000 BCE), the water level within the fjord was low preceding a marked rise which surpassed even the levels of today (Skriver et al. 2018). As a consequence, all the Ertebølle settlements in the Horsens Fjord are 0.5 to 1 m below current sea level, whereas the later Neolithic settlements are situated further inland from today's coastline (Skriver et al. 2018). Coupled with the act of walking through As Vig, the stories resulted in the community experiencing the climate and landscape in a more intimate way than the workshops allowed. This resulted in a process of 'becoming knowledgeable' (Ingold 2010, p. 121), the creation of a deeper understanding of the risks of the areas and the impacts of the different scenarios which allowed for better-informed decision making.

The result of the anchored storytelling was the community's deepened understanding of the socio-hydrological history and the scenarios, and this should not be understated. It is, however, difficult to assess. Becoming knowledgeable through the process of walking and talking is not a formalised transmission of information, rather it is improvisatory (Ingold 2010) and a highly individualised experience. Ingold describes a lack of a final destination in 'knowledge growing' (Ingold 2010, p. 122). Therefore, much like the landscape itself which continues to and has always changed, the community members' knowledge is in constant formation and never complete or finished (Ingold 2010, p. 136). With this in mind, the results of the storytelling can be viewed as the provocation of further knowledge and understanding. This is clear when considering the stories that were selected for the outreach events. These past environmental changes, such as tsunamis, are not direct analogues for future climate changes and adaptations. The stories were not intended to be possible solutions to the water levels and land-use issues of today and the future; rather, they included the reactions effected by these past inhabitants to become a useful canvas upon which discussions on the future were anchored. Likewise, the individual relationships with place and community cohesion generated through storytelling gave the citizen stakeholders a more robust platform from which to commence the difficult discussion on individual responses to climate change.

While discursive change is difficult to measure, let alone quantify, local citizens were highly engaged in the project. Of the three scenarios posed by the municipality, each was rejected in favour of a community-created Scenario IV. The creation of a new scenario, that

suits As Vig's particular issues, suggests a strengthening of individual relationships with place while the collective decision indicates greater social cohesion. The uniqueness of the scenario—indeed it was not put forth by the municipality—illustrates the continuation of the localising and anchoring embedded in the narratives. Since agreeing on the collective preference, the community has been pushing the municipality to work faster on implementation. The experimental methodology was enacted at a time when climate change discourse was arguably undergoing a transformation nationally and internationally. An increasing number of people are engaging with the climate crisis and are increasingly considering humanity's impact on the planet. While the local narratives generated grass-root citizen adaptation, the use of balance between local yet severe climate impacts and large-scale climate change causes (Corner et al. 2015) allowed for greater cohesion between local and global. It is arguably by localizing this issue through history-based community integration that local discursive change is created which scaffolds change seen nationally, even globally.

In the later stage of the project, the cooperation between the municipality, community members and stakeholders was formalized and a working group created representing landowners, farmers, cottage owners, regular households and miscellaneous users. It is presented that this new engagement with climate change adaptation is the result of this project-specific, experimental methodology. In particular, the use of new, local and anchored narratives about past climate and landscapes allowed for the envisioning of more narrative-like future scenarios for those same landscapes under the anthropogenic climate. This, in turn, facilitated emotive ignition and made space for a two-way dialogue that allowed the community to tell their own stories and find their own links between the environment and cultural identities. This situated the issue as a cultural, as well as environmental problem, as such created the sense that individuals and groups can respond and make an impact in mitigation. This working group is now collaborating with the municipality on the recommendation for the city council to approve.

Conclusion: The applicability of historical socio-hydrology

The transdisciplinary methodology presented here builds on insights from socio-hydrology, community archaeology and a conjoined environmental/applied history. It was this combination that allowed for a more intimate relationship between the consequences of and possible solutions to climate change, particularly inland and coastal water-level rise. The methodology's outreach events were used to create a common understanding of

As Vig stretching from its environmental and cultural history to the challenges and possible solutions facing its community today. The creation of new, powerful and localised narratives, deploying existing archaeological and historical knowledge together with hydrological assessments, emphasized the way environmental and climatic variations have shaped the area throughout history—from late ice age landscape changes and the first human settlements, to changes in human land-use and exploitation of the area in the industrial period. The process of storytelling allowed space for emotional and personalised responses, with the narratives themselves a canvas upon which participatory discussions on the future of water levels and land-use were articulated and anchored. Likewise, the setting of the two-way communication in As Vig including the landscape deepened the connections between the present water management issues with hydrological, environmental and cultural changes over time. This in turn allowed the community to have better-informed discussions and make better-informed decisions on the future adaptation scenario.

The need to make adaptation decisions in relation to contemporary climate change and associated alterations to hydrological regimes is becoming increasingly urgent today. Such measures, including those which were put forward to As Vig's community, are often costly and contentious. Centring local narratives and creating a more intimate and deep-time relationship between place and community allows for greater engagement with climate change policies. This heightened engagement led to citizen-driven participation and initiatives, with the community pressing for results from the municipality. This historical socio-hydrology can, therefore, be considered a cost-effective approach to local climate change mitigation and certainly a cost-effective way to include multivocal perspectives and interdisciplinarity alongside technocratic approaches.

More than 3 years later, the local citizens are still highly engaged in the mitigation process and are pushing the municipality to safeguard the area through the community-generated scenario. This enduring engagement was, at least in part, brought about by the approach set out here. The process of gaining better-informed decision making and strengthened citizen-driven climate initiatives is adaptable for other areas facing current and future climate challenges. Particularly, historically informed citizen stakeholder engagement offers a useful and usable blueprint for reaching out to municipal and citizen stakeholders within the framework of larger climate change adaptation measures and their implementation. Key to this applicability in other contexts is maintaining glocality. Making the connection between local and national or global allowed for a balance between the oftentimes overwhelming scale of climate

change and the individual input to and engagement with mitigation. This duality was further reflected in the shift from individual, private dykes to a community-wide approach to a global problem. This scaling-up from individual decisions to the global issues was achieved through the process of setting the former in its temporal and environmental context and successfully traced lines between the diverging perspectives.

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Code availability

Not applicable

Authors' contributions

The CRediT author statement is as follows: Sarah Kerr: Methodology; writing—original draft; writing—review & editing; and visualisation. Uffe Krogh: Methodology; writing—original draft; writing—review & editing; and project administration. Felix Riede: Conceptualization; methodology; writing—original draft; writing—review & editing; supervision; project administration; and funding acquisition. The authors read and approved the final manuscript.

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Declarations

Competing interests

The authors declare that they have no competing interests.

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