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# Dealing with Climate Change in the German Wadden Sea: Perceptions, Measures, and Contestation on Hallig Hooge

Carola Klöck  
CERI, Sciences Po Paris  
56 rue Jacob  
75006 Paris, France  
[carola.kloeck@sciencespo.fr](mailto:carola.kloeck@sciencespo.fr)

## Abstract

The Halligen in the German North Sea are a special type of island that are highly exposed to the adverse impacts of climate change. How do the Halligen adapt to these impacts, and what are the controversies and conflicts surrounding the adaptation process? In line with the recent “political turn” in critical adaptation research, we understand adaptation as a social and political—and therefore inherently contested—process. To uncover the contested nature of adaptation, we carried out a case study of Hallig Hooge, the largest inhabited Hallig, based on semi-structured interviews with Hallig residents. We first examine how the local population on Hallig Hooge perceives and responds to the impacts of climate change. In a second step, we then identify tensions or controversies that surround the adaptation process. The interviews reveal a high level of climate change awareness. The local population notices many different changes, but does not necessarily perceive these as threatening, not least because a range of adaptation measures is available and partly already being implemented. While the population approves of adaptation in principle, there are inherent tensions. Notably, we identify three partly overlapping controversies regarding, first, a general dichotomy of man vs. nature; second, the role of different actors and types of knowledge; and third, the objective of adaptation. Hence, the local population questions many regulations and restrictions associated with environmental protection; feels that their experience and local knowledge is not taken seriously enough; and worries that too many innovations may fundamentally change the character of the Hallig. Overall, the adaptive capacity of Hallig Hooge is high, but long-term climate change and adaptation to it raise the question of what it is that should be protected and preserved. This question is a political one, and it can only be answered through dialogue with the local population.

## Key words

adaptation to climate change; perceptions; political nature of adaptation; community-based adaptation

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## Abstract

The Halligen in the German North Sea are a special type of island that are highly exposed to the adverse impacts of climate change. How do the Halligen adapt to these impacts, and what are the controversies and conflicts surrounding the adaptation process? In line with the recent “political turn” in critical adaptation research, we understand adaptation as a social and political—and therefore inherently contested—process. To uncover the contested nature of adaptation, I and a team of student researchers carried out a case study of Hallig Hooge, the largest inhabited Hallig, based on semi-structured interviews with Hallig residents. We first examine how the local population on Hallig Hooge perceives and responds to the impacts of climate change. In a second step, we then identify tensions or controversies that surround the adaptation process. The interviews reveal a high level of climate change awareness. The local population notices many different changes, but does not necessarily perceive these as threatening, not least because a range of adaptation measures is available and partly already being implemented. While the population approves of adaptation in principle, there are inherent tensions. Notably, we identify three partly overlapping controversies regarding, first, a general dichotomy of man vs. nature; second, the role of different actors and types of knowledge; and third, the objective of adaptation. Hence, the local population questions many regulations and restrictions associated with environmental protection; feels that their experience and local knowledge is not taken seriously enough; and worries that too many innovations may fundamentally change the character of the Hallig. Overall, the adaptive capacity of Hallig Hooge is high, but long-term climate change and adaptation to it raise the question of what it is that should be protected and preserved. This question is a political one, and it can only be answered through dialogue with the local population.

## 1 Introduction

Adaptation has received growing political and academic attention over the past years as the impacts of climate change are increasingly felt, particularly on small islands (Nurse *et al.* 2014). Small islands are “at the frontline” of climate change discourses, being among the first and worst affected by climate impacts (Kelman and West 2009; Lazrus 2012). A growing body of research thus explores adaptation in small island states, including their degree of vulnerability, options for and barriers to adaptation, or local knowledge and traditional ways of responding to environmental change (e.g. Barnett and Campbell 2010; McNamara 2013; Kuruppu and Willie 2014; Petzold and Ratter 2015; Robinson 2017; Weir and Pittock 2017; Klöck and Nunn 2019).

Much research on adaptation, including adaptation in island contexts, has been rather technical and focused on geophysical exposure to climate change hazards as well as mainly “hard” infrastructural responses to these hazards. Yet, a more critical approach to adaptation practice and research has emerged in the past years. This strand of research highlights the political nature of adaptation (Eriksen *et al.* 2015; Klepp and Chavez-Rodriguez 2018; Mikulewicz 2018). Adaptation is intertwined with politics and power. It produces winners and losers, and thus potentially reinforces existing inequalities (Nightingale 2017; Mikulewicz 2018).

Both research on adaptation in islands and research on the political nature of adaptation has focused on the developing world. Much less attention has been paid to adaptation in developed countries, and to dependent islands and subnational island jurisdictions, particularly those in non-tropical waters (Walshe and Stancioff 2018).

This paper therefore examines adaptation on Hallig Hooge in the German Wadden Sea. Halligen are a special type of low-lying undiked marsh islands that only exist in the North Sea. Human settlements are located on man-made dwelling mounds (“Warften”), with the remaining marshlands regularly being inundated during high tides and/or storms. As such, the Halligen are highly exposed to a changing climate, notably sea level rise and more frequent and/or more intense storms. The Halligen’s vulnerability to climate change and natural as well as anthropogenic adaptation, notably to sea level rise, have been the subject of a number of (technical) studies (Deicke *et al.* 2007; Hofstede 2008; Kumbruck *et al.* 2011; Wöffler *et al.* 2012; Schüttrumpf *et al.* 2013; Jensen 2014; Schindler *et al.* 2014b; Schindler and Willim 2015). The media have accordingly portrayed the Halligen as “sinking”, its inhabitants potentially becoming climate refugees, just like atolls in the Pacific and Indian Ocean (Collectif Argos 2010; Der Spiegel 2011; Ionesco *et al.* 2017: 68f; Preker 2017). Yet, the perceptions of the local population has not been studied extensively (but see Häußling and Ziesen 2014; Schmidt *et al.* 2014; Döring and Ratter 2018). While islands in developed countries may have resources for adaptation, in contrast to developing countries, the local population may not want adaptation—at least not in the way envisaged from outside. In contrast to previous work, we therefore specifically understand adaptation as political, and examine perceptions and adaptation measures at a specific point in time against this backdrop of adaptation as a political process. A more in-depth, long-term study would be required to better understand how contestations, conflicts and collaboration emerge over time between different groups and interests, and how these are nested in power relations, but this is beyond the scope of the present study. Instead, we here first document (1) how the community perceives changes in their environment (if any) and (2) how they respond to these changes. This helps us (3) to identify what conflicts and controversies emerge in this process, that is, to explore the contested nature of adaptation. The paper addresses these questions through a case study of Hallig Hooge, based on qualitative, semi-structured interviews with residents. The case study was carried out as part of a student-led research project that involved five Bachelor students under the guidance of the author.

In the remainder of this article, we first outline the analytical framework that sees adaptation as a political and contested process, where local perceptions, values, and knowledge are key to success. In section 3, we provide a brief background of the case study site and explain data collection and analysis. In section 4, we present our results, which we discuss in section 5. We conclude in section 6.

## **2 Analytical framework**

The starting point of this research is twofold: (1) we view adaptation as a political and therefore contested process. (2) Much of adaptation, and therefore also its interpretation and contestation, happens at the local level. These assumptions form the basis of the analytical framework and are explained in greater detail below.

First, we agree that adaptation is essentially a *political* process and should therefore be “conceptualized explicitly as a contested social-political process that mediates how individuals and collectives deal with multiple types of simultaneously occurring environmental and social changes” (Eriksen *et al.* 2015: 524). Adaptation is not neutral; values and interests influence how communities and individuals respond to climate change (Eriksen *et al.* 2015: 524; Klepp and Chavez-Rodriguez 2018; Mikulewicz 2018). Accordingly, to what extent an adaptation intervention is perceived as successful depends on the actor(s) and scale(s) at which the intervention is assessed (Adger *et al.* 2005). Vulnerability differs even within a small community (Granderson 2014). As a result, and as any policy intervention, any adaptation measure produces winners and losers. Contestation and conflict are inevitable, yet rarely noted, especially in small island contexts (Nightingale 2017; Mikulewicz 2018; Walshe and Stancioff 2018).

Second, we here focus on *local* adaptation. Adaptation is a multilevel process, with measures being taken at the international, national and local levels. While at the former levels, adaptation consists largely of policies and plans, more concrete adaptation measures are implemented at the local level, including both ‘hard’ and ‘soft’ measures (Adger 2001; Fenton *et al.* 2014). Research thus emphasises that for adaptation to be effective, it needs to reflect community perceptions and priorities (Barnett 2008; Granderson 2014; Eriksen *et al.* 2015). As Klepp and Chavez-Rodriguez (2018: 11) write, “‘good’ adaptation must take local contexts, values, and interpretations of ‘good living’ into consideration in order to make adaptation meaningful and successful” (see also Eriksen *et al.* 2011). In this context, we also note that the needs and values, priorities and preferences as identified by a community may differ considerably from the assessment of external actors, as well as from one community member to another. Adaptation outcomes may not reflect this divergence but is shaped by, and shapes, inequalities and power politics (Granderson 2014; Buggy and McNamara 2016; Nightingale 2017).

If adaptation is political and happens mainly at the local level, contestation and conflict at the local level surround the adaptation process. To understand how a local community adapts to climate change (or why it fails to do so), we need to understand local perceptions of change and of adaptation to this change, and can then identify and document the diversity of perceptions as well as (potential) conflicts. This is the purpose of the present study of Hallig Hooge, although we here focus on perceptions at one point in time, and do not trace conflicts, collaboration and underlying power structures over time. We now proceed to presenting the case study site and our empirical approach.

### **3 Materials and methods**

#### **3.1 The case study site: Hallig Hooge and climate change**

There are only about a dozen Halligen in the German and Danish North Sea. Hallig Hooge is the second largest Hallig, with an area of about 5.5 km<sup>2</sup>, a coastline of about 11 km and a population of just over 100 (Government of Schleswig-Holstein 2014), distributed over 10 dwelling mounds (see figure 1a).

*figures 1a and 1b about here*

*caption: “1a. Location of Hallig Hooge in the German Wadden Sea. Source: <http://www.sportbootbaefen-nordfriesland.de/fileadmin/Sportbootbaefen/Design/karte.gif>; 1b. view of Hallig Hooge. Coastal protection and building concentrations on dwelling mounds are clearly visible.”*

“Hallig” literally means “flat” or “low” (Government of Schleswig-Holstein 2014: 6) and captures the nature of this type of island very well. On average, the Halligen are just decimetres above mean sea level rise; only the dwelling mounds are significantly higher, with an average elevation of about 4.5–5.0m above sea level (Schindler *et al.* 2014b).

The Halligen only emerged in the Middle Ages, when sea levels rose and parts of the then continuous salt marshes were permanently flooded (Meier 2004). Halligen are regularly flooded during high tide and floods further eroded the Halligen. This was the case for Hooge as well until the coastline was artificially stabilised and a low summer dike was built in the beginning of the 20<sup>th</sup> century (Jensen 2014). Since then, flooding of the lowland marshlands (called “Landunter”, literally “land under”) mainly occurs in winter (October to March). Only the dwelling mounds remain above sea level during Landunter (see figure 1b). The frequency of these flooding events varies strongly. On Hooge, an average of five Landunter events per year have been recorded, with significant year-to-year variation (Deicke *et al.* 2007; Schindler and Willim 2015). Climate change and sea level rise is expected to lead to more frequent flooding of the Halligen. This has potential ramifications for cattle grazing (Deicke *et al.* 2007) as well as tourism, but also leads to vertical accretion, as each Landunter event brings sediments onto the marshlands. Yet, the relationship between inundation frequency and sedimentation is not fully understood. It is thus not clear whether more frequent inundations will lead to accelerated vertical accretion, and to what extent the Halligen could grow with sea level rise. On average, the mean sea level rose by 2.8mm/year between 1951 and 2008, and by 4.6mm/year between 1971 and 2008 at the Wyk tide gauge, while mean high water rose by 5.0mm/year (Jensen *et al.* 2011; Wahl *et al.* 2011; Schindler *et al.* 2014b). These rates are higher than those for the southern German Bight because land subsidence is stronger in the eastern German Bight (Wahl *et al.* 2011).<sup>1</sup> In contrast, vertical marshland accretion rates on Hooge were around 1mm/year between 1915 and 2011, and hence too slow compared to sea level rise (Schüttrumpf *et al.* 2013; Karius *et al.* 2014; Schindler *et al.* 2014b).

Overall, the Halligen are strongly influenced by human interventions and can be described as an “anthropogenic” marshland (Schindler *et al.* 2014a: 236). Apart from the low summer dike, the coastline is fortified through a revetment (“Halligigel”), embankments, and groynes (for an overview, see Jensen 2014). Additionally, after the storm surge of 1962, which led to massive damage on the Halligen, the government of Schleswig-Holstein introduced a comprehensive programme to strengthen and increase the height of the mounds. Each dwelling mound now also has a small dike (“Ringwall”), and each house has a fortified shelter or “rescue room” (Hofstede 2008; Government of Schleswig-Holstein 2014). As Grimm *et al.* (2012: 54) however note, “The existing coastal protection measures like revetments and dwelling mounds on the Halligen are based on tradition and do not consider future developments.”

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<sup>1</sup> Increase in mean sea level and mean high water result from various processes. While current increases have been accelerating since the 1990s, they are not unusual for the German Bight. Monitoring of sea level changes is needed to track acceleration rates and to better attribute changes to specific causes, such as climate change and land subsidence.

The Halligen and the larger ecosystem of the German Bight are highly dynamic. Even if significant uncertainties regarding future changes in sea level rise, storm and flooding frequency and vertical accretion remain, there is consensus that the Halligen are strongly exposed to climate change. To what extent existing measures are sufficient and/or can be extended to address future climate change is unclear (Government of Schleswig-Holstein 2014: 27). At the same time, the Halligen are an important element of the larger system of the German Bight and serve as a first defence line against storms and flooding for the mainland (Kumbruck *et al.* 2011; Grimm *et al.* 2012; Wöffler *et al.* 2012; Schüttrumpf *et al.* 2013; Schindler and Willim 2015).

### **3.2 Data collection and analysis**

This paper reports the results of a student-led research project. Five Bachelor students collected and analysed data under the guidance of the author. We conducted fieldwork on Hooge during a one-week period in November/December 2017. Additionally, we returned to Hooge in April 2018 to present and discuss preliminary results with the local population. Overall, we conducted 24 semi-structured interviews. Additionally, we also spoke with two people on neighbouring Langeness as well as two people in Husum on the mainland. On Hooge and Langeness, we contacted as many residents as possible, while we talked to two organisations working on and with the Halligen, the responsible authority, the “Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein (LKN.SH)” on the one hand, and the WWF’s Wadden Sea Office on the other.

Each interview was conducted by two team members. Interview length ranged from 14 to 60 minutes, with the average interview taking about 35 minutes. In total, we spoke to 12 women and 10 men. In two cases, we interviewed a couple. To guarantee anonymity to our interview partners, all quotes below are only identified by a numerical code.

Our interview guide followed the three guiding questions of the case study (see introduction above). We thus asked for the special circumstances of living on a Hallig; perceptions of environmental change; responses to these changes; and areas of conflict. With regard to response measures, we also specifically asked to what extent respondents perceived these measures to be successful; whether they saw the need for additional measures; and who was or should be responsible for deciding, implementing and funding adaptation measures.

All interviews were audio-recorded and transcribed, and the transcripts analysed with MaxQDA. The analysis followed the steps of qualitative content analysis (Richards 2015). We first developed a common coding scheme that reflected our three guiding questions (perceptions of climate change; responses to these changes; and conflicts/contestation). We added sub-codes as necessary, for instance for individual adaptation measures. Additionally, our coding scheme contained codes for the specific circumstances of living on a Hallig and socio-economic aspects not directly related to climate change (see also the discussion below). Each transcript was coded by one team member, on the basis of the common coding scheme, and checked by an additional team member for consistency. All inconsistencies were discussed with the entire team, and the coding adjusted as necessary. Finally, we searched for common themes as well as differences across the interviews under each of the main codes (perceptions, including specifics of Hallig life;

response measures; conflict and contestation). These three themes were confirmed at the presentation workshop on Hooge, and structure our results in the next section.

## 4 Results

### 4.1 Perceptions of climate change

Life on a Hallig is special, dominated by nature, characterised by remoteness, (geographic) openness and (social) closeness at the same time. All interview partners highlighted that living on a Hallig means living with nature. Nature dominates, if not determines, life. Only the ferry connects the community to the mainland, yet the ferry schedule depends on the tide and weather conditions. Particularly in winter, the ferry does not come every day, and may not come for several days in case of storms and flooding, which occur regularly. While such conditions may be seen as harsh by outsiders, the local population does not share this negative view; interview partners highlighted that these natural conditions are not threatening but “normal” and typical of Hallig life (Interviews #9, #10, #13, #23). Several interviewees specifically explained that their closeness to nature and the elements is in fact “marvelous” (Interviews #13, #7). Even Landunter floodings are seen as positive and contributing to a sense of community and togetherness (Interview #9, #18, #20).

Given their close relationship with nature, it is not surprising that most (but not all) interview partners notice changes in their environment. These changes are quite diverse and include, among other things, warmer winters, shorter summers, more rainfall, shorter but more extreme storms with stronger winds, changing and stronger currents, or changing flora and fauna, for example different species of fish or grass in the marshlands. Interestingly, there is no consensus in terms of what changes can be observed. Several interview partners even argue that they do not observe changes at all (Interviews #3, #23), or emphasise that changes also have occurred in the past and that current changes, if there are any, are nothing new (Interviews #14, #17, #19). Overall, however, changes seem noticeable. In particular, weather patterns are described as getting more extreme and less predictable (Interview #16, #17). Storms and associated flooding are frequently mentioned, with three storms standing out in the collective memory of the community: Anatol (December 1999), Christian (October 2013) and Xaver (December 2013; e.g. Interviews #1, #3, #16, #20, #24). These storms were particularly strong and threatening, with wind speeds of up to 143km/h<sup>2</sup> and water levels reaching only a few centimeters below the ringwalls, reminding the population of the heavy flooding of 1962 that destroyed several houses. While storms are not described as becoming more frequent, they seem to get more intense (Interview #3, #5, #7) and behave differently in terms of wind direction and currents (Interview #1, #17). These changing winds and currents result in higher water levels during Landunter events (e.g. Interview #7). Just as storms, Landunter events are described as more intense but not necessarily as more frequent (Interview #3, #5).<sup>3</sup> This increasing intensity is related to changing winds and currents, notably during storms (Interview #3, #17) but also to sea level rise. Although small changes in mean water levels are rather imperceptible (Interview #4), the Hallig population is very much aware of scientific measurements and predictions for future sea level

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<sup>2</sup> See records in the Extreme Wind Storms (XWS) Catalogue, <http://www.europeanwindstorms.org/>.

<sup>3</sup> Note that some interview partners find that Landunter is getting more frequent (Interview #17, #21).

rise, and worry about the implications (Interviews #13, #21, #22). In this context, coastal erosion seems less problematic than erosion along the tidal creeks (“Priele”) that pervade the marshlands: “The tidal creeks are getting wider and thus the water eats the Hallig from the inside out, so to speak,” diminishing the overall area of the Hallig (Interview #2).

Most changes in the environment, be that more extreme storms, more flooding, or changes in flora and fauna, are ascribed to climate change. To most—but not all—interviewees, it is clear that “the climate is changing. We all notice this and see it every day” (Interview #12). And this changing climate affects the Hallig and its population directly and personally (Interview #13), today and in particular in the future (Interview #5, #12). Yet, what exactly this future holds for the Hallig and its population remains unclear. Interview partners expect future changes, especially more intense and/or more frequent storms (Interview #3, #4, #13), but also emphasise that changes are long-term (Interview #10, #20) and marked by pervasive uncertainties (Interview #3, #13, #19). There may be scientific models and scenarios, but these may or may not come true; in the end, “we all do not know what really will be” (Interview #21; see also Interview #14). Even the future of the Hallig itself is uncertain: “We thus don’t know how long the Hallig can be upheld,” says one interviewee (Interview #3), while others ask whether their children and grandchildren will still have the opportunity to be living on the Hallig (Interview #5, #23, #16).

#### **4.2 Responding to climate change**

Despite future uncertainties, there is a clear need to act now. The consensus among the Hallig population is that adaptation measures are inevitable and necessary, and that these must be taken today to protect the Hallig and its population against an uncertain future: “of course you must act now, because we don’t know what the situation will be in 150 years” (Interview #17; see also e.g. Interview #12, #13).

In this context, many interview partners emphasise that protecting the Hallig is not only in the interest of the Hallig population, but also in the interest of the mainland. After all, Hallig Hooge as well as neighbouring islands serve as a natural buffer for the mainland coast. Interviewees therefore liken the Halligen to a “breakwater” for the mainland (e.g. Interview #2, #17, #20) or a “bulwark” (Interview #3, #13) and explain that the Halligen dampen the impact of waves for the mainland with its much larger population. Without the Halligen, the mainland would be much worse off and therefore depends on the existence of the Halligen (e.g. Interview #16, #23, #24)—which additionally represent unique ecosystems that are in themselves worthy of protection (Interview #11).

Further, interference with nature is nothing new on the Halligen: “For as long as the Halligen existed, man sought to stabilise them” (Interview #21). Today, the entire coastline around Hooge is fortified (see section 3 above), which prevents coastal erosion and land loss, particularly during storm events (Interview #9, #22). Without such protection, the Halligen likely would no longer exist or soon disappear (Interview #24). While the coastline is constantly monitored and the diverse protection measures (such as the summer dike, breakwaters, groynes, etc.) maintained, discussions now revolve around upgrading these measures to keep up with sea level rise, including by increasing their height and trying out new materials and designs (Interview #9, #21, #22).

Beyond measures along the coastline, the dwelling mounds—where all buildings are located—receive particular attention when it comes to adapting to changes. The dwelling mounds have been raised and fortified throughout their history (Meier 2004). More recently, the severe flooding of 1962 led to a comprehensive fortification programme, with all inhabited dwelling mounds strengthened between 1997 and 2007 (Hofstede 2008); at present, several dwelling mounds are being reinforced, with additional reinforcements planned for the remaining mounds. However, several interviewees are dissatisfied with both past and present reinforcements (Interview #3, #15, #19; see also below); they criticise that the dwelling mounds were not raised further, notably because recent storms such as Xaver (December 2013) indicated that present mound heights are likely insufficient given sea level rise and increased storm intensity (Interview #6, #12, #13, #16).

While it is technically possible to raise the dwelling mounds further, this may require at some point that houses are torn down and re-built. Already after the 1962 flood, several houses had to be rebuilt, and since then have also included a fortified shelter room that is to withstand flood and storm even when the rest of the building may be severely damaged (Interview #9, #15; see also section 3 above). Rebuilding causes concerns, even if interviewees recognise that rebuilding may become inevitable in the long term (Interview #2, #6, #11). Rebuilding is expensive and poses practical questions: “where should I live if this [house] was to be destroyed and rebuilt?” (Interview #17; see also e.g. Interview #8). Further, our interviewees note that they are emotionally attached to their houses and want to continue to live in their beautiful old houses rather than in new modern houses (Interview #9, #13), even if these could be built to take into account higher sea levels, as does a current building project on Hooge that includes a raised floor (Interview #13).

Overall, we can thus distinguish between three types of measures: reinforcement of the coastline, of the dwelling mounds and of the houses. All three types of measures are necessary and important, interviewees agree, yet responsibilities differ. While coastal protection is formally under the authority of the federal state of Schleswig-Holstein, flood protection is the responsibility of each individual citizen (Government of Schleswig-Holstein 2014: 8); see also Interview #21). This question of responsibility—and therefore of funding—is of concern to our interviewees. They depend on and appreciate public support that has so far been granted (Interview #7, #13, #23), but recognise that funding is limited and hence fear that funding may be cut at some point, especially given the small population on the Halligen (Interview #5, #13). “Technically, the limit [of what is possible] has not been reached. There is still a lot to be done. But who should pay?” (Interview #21). It is in this context that interviewees again point out that the Halligen are valuable buffers for the mainland as well, and therefore of general interest (see above).

### **4.3 Contestation**

Our interview partners agree that all the measures are useful and necessary—indeed, “the more protection, the better” (Interview #9). When it comes to the precise location, timing or type of measure, however, disagreements exist, which emphasises the inherently contested nature of adaptation (see above). Specifically, our analysis reveals in particular three controversies or

tensions, regarding first, an opposition of *man vs. nature*; second, the role of different *actors* in decision making; and third, the *object* of adaptation.

First, the interviewees embed their discussion of climate change in a broader discussion of environmental protection. Hallig Hooge lies within the natural park Wadden Sea, but is not part of the national park. Instead, all inhabited islands and Halligen form, together with the national park, a UNESCO biosphere reserve. While the Hallig population supports environmental protection, they are often critical of the many regulations and restrictions that this special status implies. For example, several interviewees note that geese are protected. Since cows are not permitted on the marshlands in spring, when they arrive, the geese have left little grass (interview #5, #14, #15). Our interview partners emphasise that they have always lived closely with nature and know how to deal with and preserve nature. The specific rules and restrictions are thus experienced as patronising, and as a threat to agriculture, formerly the main source of livelihood (Interview #1, #10, #17, #19, #24). To some extent, therefore, protection of the environment and protection of the population do not go together, and from the point of view of some interview partners, the environment often dominates, at the expense of the local population: “I think it is strange that environmental protection always comes first. After all, it’s also about the people who live here” (Interview #1).

Second, and related to the first controversy, we find tensions between two groups of actors: the local population on the one hand, and “experts” from the mainland on the other (see also Häußling and Ziesen 2014). Many Hallig inhabitants often have lived there for many years, if not generations, and are thus intimately familiar with the environment that surrounds them. Yet, this local knowledge does not seem to have the same weight as the scientific and technical knowledge of the coastal engineers and coastal protection authorities from the mainland. Our interview partners feel that their experience is not taken seriously enough—although it is them that experience the storm and Landunter floods and know from where the waves come, for example, whereas the “experts” have no way of knowing, no first-hand experience. Yet, “things indeed often look different from the desk as compared to on the ground. And therefore we want to be listened to more,” says one interviewee (Interview #23), while another adds “I wish they would come to us more and would ask the people who know the situation” (Interview #4; see also Interview #7, #10, #15, #16). In this context, interview partners point out that decisions by the authorities are not always comprehensible. For example, many inhabitants wanted to raise the dwelling mounds further when these were strengthened after 1962. This was denied on financial grounds, although the recent storms show that further increases are now inevitable (see above; e.g. Interview #4, #15, #19). Nonetheless, even if the interviewees identify past mistakes and call for better communication and cooperation with the authorities, they also admit that cooperation is necessary and that it has improved over the past years and decades. There is more exchange and dialogue today, with the authorities asking for the opinion and approval of the Hallig population (Interview #6, #9, #10, #22).

A third controversy concerns the objective of adaptation: what is it that is to be preserved, and how? The community has discussed a range of adaptation measures, including rather “freaky” (Interview #21) futuristic options in the context of the programme Hallig 2050 and its futures workshops (Government of Schleswig-Holstein 2014; Häußling and Ziesen 2014), although none

of these have yet been implemented. Many Hallig inhabitants are rather skeptical towards such innovative methods like floating buildings or hydraulic dikes around the dwelling mounds: “But do you really want high-tech dwelling mounds?”, asks one interviewee, adding that “I don’t need a high-tech house. Really, I don’t!” (Interview #1). Instead, interview partners suggest looking back at how their ancestors have lived with environmental challenges. The knowledge and experiences of the past generations needs to be “archived” and preserved for present and future generations (Interview #1, #2). In this context, several interviewees note that many adaptation measures would not only be unaffordable (Interview #4, #21) but would also change the character of the Hallig. For example, rebuilding would mean losing the traditional thatched houses that are typical of the Halligen—which would in turn negatively impact tourism (Interview #1, #2). Indeed, even more traditional methods like raising the summer dike around the Hallig would fundamentally change its character: “Of course you can technically keep the Hallig, you can continue strengthening the dwelling mounds, or at some point you could build a dike around it. But then it would no longer be a Hallig. And we don’t want that. Nobody wants that” (Interview #22; see also Interview #24).

## 5 Discussion

Hallig Hooge and its neighbouring Halligen (and islands) are highly exposed to the adverse effects of climate change, notably sea level rise and intensifying storms. As a result, the Halligen are often perceived as “sinking” and “doomed to disappear” from the outside, as visible in many media articles (Der Spiegel 2011; Preker 2017) but even popular-scientific publications (Ionesco *et al.* 2017). In contrast, the Hallig population does not share this negative view, at least not for the foreseeable future. While exposure may be high, so is adaptive capacity (Kerber 2018). In particular, significant amounts of finances are available, as is climatic data and technical expertise. These financial and technical capacities make the Halligen stand out compared to other low-lying islands in tropical waters such as those in the South Pacific (see also Petzold 2015)—although research has repeatedly highlighted the resilience of (Pacific) island societies (Campbell 2009; Barnett and Campbell 2010; Nunn and Carson 2015; Barnett and Waters 2016).

Limited financial resources are a major barrier to successful adaptation in island contexts in the developing world (Barnett 2005; Betzold 2015). Even in developed country contexts, studies note a general reliance on external support—which is rarely readily forthcoming (Muir *et al.* 2014; Marino and Lazrus 2015; Petzold 2015). While the Halligen also rely to a large extent on financial and technical support from higher levels of government, there has been so far a relatively high level of political will to invest in the Halligen, partly because of the successful lobbying by the Halligen (Interview #3, #13). Further, the Halligen’s function as a first defence line for the mainland is well documented (see section 3 above). Accordingly, the current coalition government of Schleswig-Holstein thus “want[s] to safeguard the long-term inhabitability of the North Frisian Halligen in times of a changing climate” (Government of Schleswig-Holstein 2017: 71).

Even if the local population does worry about the extent to which they can count on external support in the long run, they are rather confident about financial support from the mainland in the short run. As a result, the Hallig population does not feel immediately threatened by climate change. There is no fear of the Hallig disappearing any time soon, and migrating because of

climate change is not (yet) an option. This result is in line with other studies. Even in highly exposed and vulnerable contexts, climate change is not seen as an immediate threat, but rather as a spatially and temporally distant future possibility (Tompkins 2005; Betzold 2015). And as in the far away South Pacific, the Hallig population worries more about social and economic challenges. Our interview partners thus point to demographic change and an aging population, missing infrastructure, lack of jobs and lack of housing (Interview #6, #7, #8, #13, #15), a situation that is common to many rural and peripheral places, on islands and beyond (Marino and Lazrus 2015; Nunn and Carson 2015; Petzold 2015). These socio-economic questions have implications for the long-term survival of the Hallig. Here, interviewees highlight important social changes that undermine the fundamental Hallig character. For example, a dike around Hallig Hooge would mean losing the regular inundations of Landunter events that make the Halligen so unique. Tangible changes have implications for non-tangible dimensions of life, and this in turn affects perceptions of what is desirable, what it is that should be protected and preserved, and how. In this context, several interviewees also describe a loss of community, declining solidarity, and a general disquiet within the community, not least because of many new arrivals on the Hallig whose mainland attitudes and mentalities may not necessarily chime with the indigenous Hallig population (Interview #7, #14, #18, #23).

While our interview partners recognise that some level of change is inevitable (Interview #8), several interviewees do desire continuity and resist changes, both in the community and in the environment (Interview #17). This also translates into a certain level of resistance to overly technical solutions like “high-tech” dwelling mounds or houses. Rather, the local population wants to re-value and revitalise traditional knowledge and traditional adaptation practices, calling for more attention to their local experiences and expertise. On the one hand, this resistance contrasts with other case studies that have documented a local demand for engineered ‘solutions’, notably seawalls, rather than softer less intrusive, adaptation measures (Betzold and Mohamed 2017; Nunn and Kumar 2018; Cooper *et al.* in press). On the other hand, the call for traditional and local knowledge and practices aligns well with research on community-based adaptation that documents the value of such local approaches and calls for integrating local and scientific knowledge forms (Reid *et al.* 2009; McNamara and Prasad 2014; Petzold 2015; Lauer 2017). Nonetheless, there are also certain limits to such bottom-up, community-driven approaches. Local perceptions and priorities may be short-term and focus on keeping the status quo, potentially at the expense of long-term sustainability (Young *et al.* 2014), and traditional practices may no longer work well under changing climatic conditions (McCubbin *et al.* 2015).

## **6 Conclusion**

The Halligen are a unique ecosystem off the coast of the German and Danish North Sea coast. Their specific geology makes the Halligen highly exposed to climate change. While environmental changes and opportunities for adaptation are well researched from a technical point of view, we know less about how the local population experiences and responds to these changes. Starting from the assumption that adaptation is a social and political, and therefore contested, process, we here examined climate change on Hallig Hooge from the point of view of its residents. Based on semi-structured interviews, we examined whether the local population notes any changes in their

environment and if so, which; how they respond to these changes; and which controversies or tensions emerge in this context.

Our analysis finds a high level of climate change awareness in the local population. The Hallig inhabitants notice many changes in their environment, and generally attribute these to climate change. They are also aware of, and already implement, a set of adaptation measures, reinforcing the Hallig as such, the dwelling mounds as well as actual houses. While adaptation is seen as inevitable and nothing new in the Hallig context, adaptation is also contested. We can discern three types of overlapping and intertwined tensions: first, there seems a certain incompatibility between environmental protection on the one hand, and social protection on the other. Second, technical and scientific expertise from the mainland seems to dominate in decision-making, at the expense of local knowledge and experience, which the Hallig population resents. Third, while many adaptation options are technically feasible, they are not always socially desirable, for some innovative technical solutions potentially change the basic character of the Hallig. Overall, this raises the question of what it is that needs to be protected and preserved—which is a fundamentally political question.

While much adaptation research and practice has often been rather technocratic, there is a recent ‘political turn’ that emphasises the socio-economic, cultural and political dimensions of climate change vulnerability and adaptation. Adaptation is never neutral. Local perceptions and power dynamics shape, and are shaped by, adaptation. This case study has started from such a political understanding of adaptation, and demonstrates the existence of contestations and conflicts even within a relatively small community. It hence aligns with Granderson (2014) and others (Eriksen *et al.* 2015; Nightingale 2017; Klepp and Chavez-Rodriguez 2018) in calling for more in-depth, grounded and critical research that takes into account divergent local and non-local expert views to better understand when, how and why communities adapt to climate change—or fail to do so.

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