enhance

Partnership for Risk Reduction

ENHANCE

Enhancing Risk Management Partnerships
for Catastrophic Natural Disasters in Europe

Grant Agreement number 308438

Deliverable 7.2: Development of a Multi-Sector-Partnership in the Wadden Sea case study

Authors: Birgit Gerkensmeier (Helmholtz-Zentrum Geesthacht)
Beate M.W. Ratter (Helmholtz-Zentrum Geesthacht)
Manfred Vollmer (Wadden Sea Forum)

SEVENTH FRAMEWORK PROGRAMME

Title	DEVELOPMENT OF MULI-SECTOR-PARTNERSHIPS IN THE WADDEN SEA CASE STUDY
Author(s)	BIRGIT GERKENSMEIER (HZG), BEATE M.W. RATTER (HZG), MANFRED VOLLMER (WSF)
Organisation	HELMHOLTZ-ZENTRUM GEESTHACHT (HZG)
Deliverable Number	D 7.2
Submission date	30.04.2014

Prepared under contract from the European Commission.
Grant Agreement no. 308438.
This publication reflects only the author's views and that the European Union is not liable for any use that may be made of the information contained therein.

Start of the project: 01/12/2012
Duration: 48 months
Project coordinator organisation: IVM

Due date of deliverable: Month 17
Actual submission date: Month 17

Dissemination level

X	PU	Public
	PP	Restricted to other programme participants (including the Commission Services)
	RE	Restricted to a group specified by the consortium (including the Commission Services)
	CO	Confidential, only for members of the consortium (including the Commission Services)

Contents

Executive Summary

This report describes a multi-sectoral stakeholder partnership in the Wadden Sea Region (WSR). The WSR represents a transnational area which is composed of parts of the Dutch, German and Danish mainland and coastal waters. Regarding natural forces, storm surge events as well as the long-term increase of the mean sea level pose major risks to the WSR. Management of these risks related to natural hazards has played a strong role over centuries and represents an important issue with regard to the cultural-historic development of the WSR. The current state-of-the-art in storm surge management is characterised by governmental top-down decision-making, as well as highly developed coastal engineering protection measures. The currently applied all-out focus on technical measures might restrict stakeholder and society from considering potential increased risks in the WSR. Many of these risks are directly or indirectly connected with the existence of coastal protection facilities in the WSR – but in contrast to the constructive measures against storm surges and sea level rise, these risks to some extend need additional options and measures to be managed successfully.

The ENHANCE project will analyse and support the process with the objective to overcome obstacles and stimulate developments towards an integrative coastal risk management. The aim is to introduce the topic of integrative coastal risk management to the Wadden Sea Forum (WSF), an already existing multi-stakeholder forum in the WSR. This multi-sectoral partnership (MSP) is sensitized for the importance of raising awareness towards a variety of risk and their cascading effects. The intention is to initiate an exchange of knowledge and experience and to provide a basis for further collaborative management processes. In order to support risk assessment process within the MSP, the project will provide upgraded scenarios of climate induced changes for the trilateral Wadden Sea area. Moreover, ENHANCE will develop qualitative scenarios in form of narrative future visions. These scenarios will take under consideration the existing culture of risk in the North Sea States as much as different risk perceptions amongst institutions and sectors. Exchange of knowledge and experiences will be fostered by collaborative processes, organised in several workshops as well as in-depth interviews. In addition, a cross-national personalized online survey will be conducted. With regard to the work in the WSF, the survey provides the opportunity to reach stakeholders beyond the WSF but potential future partners in risk management. The results will guide the work of the MSP in order to meet the needs of the broad Wadden Sea community in risk management. As an MSP with an advisory function, the WSF is working towards a management scheme of how to cope with risks due to natural hazards and address the responsibilities of stakeholders of different sectors, especially including the private sector.

1 Motivation and objectives for the partnership

This report presents the objectives for a multi-sectoral partnership in risk management in the Wadden Sea Region (WSR). As a tool in risk management this partnership could provide a support towards an integrative coastal risk management in the WSR. In the first chapter the current situation of risk management is described. Based on these facts, the motivation and objectives to introduce a multi-sectoral partnership is illustrated (chapter one). In the second chapter, details about practical steps and activities of the partnership and their consequences in risk management are outlined.

1.1 Overview about the Wadden Sea Region and its characteristics in risk management

The case study area of the Wadden Sea Region (WSR) include the seaward areas of the Wadden Sea, the bordering North Sea as well as the affected landside – where hydrological threats put risks on inhabitants and areas in human use. The ecosystem of the Wadden Sea represents, amongst other capacities, a buffer system for the storm surges. The North Sea represents key elements from which storm surge events as well as long-term threats such as sea level rise originate. For the landward limitation of the research area, the case study will follow the definition of the Wadden Sea Forum, encompassing the administrative units of municipalities/counties/provinces in Denmark, Germany and The Netherlands along the Wadden Sea coast. In administrative terms, the Dutch Wadden Sea provinces, the German counties of Niedersachsen and Schleswig-Holstein adjacent to the Wadden Sea and the four Danish Wadden Sea municipalities are part of the case study area (Figure 1).
This coastal region is characterised by a variety of different profound transformative processes, which result from natural forces as much as from human activities. Both of these issues have put the WSR and its population at risk since settlement and farming started and intensified since the late Bronze Age (Lotze et al. 2005, Knottnerus 2005). Resultant from these continuous risks, mainly deriving from the fight with and against the sea, the WSR has always been a highly vulnerable area. A continuous improvement of measures to handle these risks took place over centuries, and represents a specific characteristic of the WSR.
The management of risks related to natural hazards played a strong role over centuries. Storm surges did, and still do, pose a major threat to the region. These periodic events cause frequently extreme high water levels along the North Sea Coast and associated estuarine regions. Meteorological conditions (depression systems crossing the North Sea on specific tracks) as well as morphological conditions (shallow water areas in front of the mainland) constitute preconditions for the occurrence of storm surges. If these preconditions materialise, strong landward directed winds "force" the water to the coast and cause an accumulation of water masses, i.e. a rise in water level (Gönnert 2003). During the last few centuries the WSR has been affected by periodic storm surge events of different characteristics and destructiveness. These events caused enormous losses of lives, livestock and land.

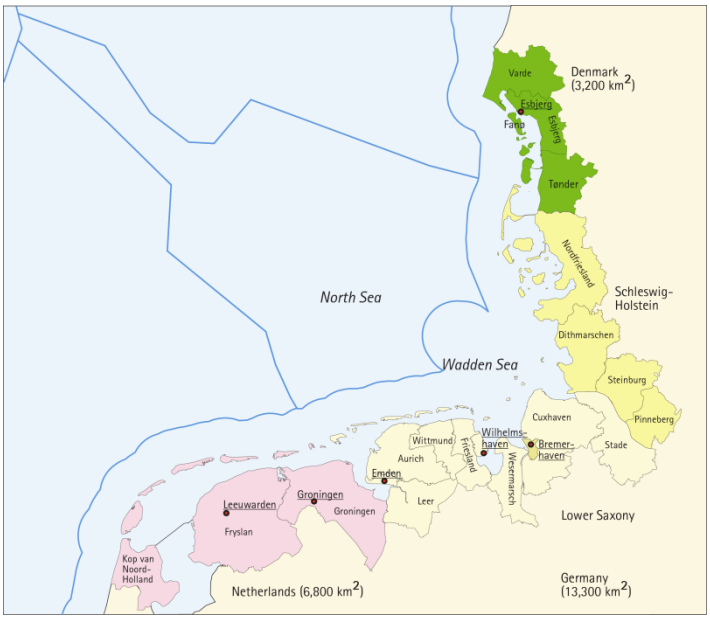

Figure 1 The Wadden Sea Region, as defined by the Wadden Sea Forum
Sources: Common Wadden Sea Secretariat (CWSS) EEZ: Exclusive Economic Zone

As mentioned before, the population in the area began to cope with these risks hundreds of years ago and developed mechanisms to protect themselves and their belongings. At the beginning, artificial mounds (dwelling mounds) were built up to create safe areas. These small-scale protection measures were developed little by little, becoming ring dykes (comp. Oost et al. 2012), before dyke construction started along the coastline.
Since the 10th century continuous improvement of these protective measures came along with systematic embankment and drainage of the coastal marshes (Lotze et al. 2005). An almost closed, linear coastal protection facility provided an enormous boost of increased population and increased agricultural use of the low-lying marsh area (Kabat et al. 2012). The management of water, here and in the hinterland, enabled an intensive use of the areas behind the dykes. As a result of this intensified use, vulnerability of the Wadden Sea Region increased at the same time, due to the fact that storm surges frequently caused dyke breaches and flooding and as a consequence resulted in huge damages in the used and populated areas (von Storch & Woth 2008). Along with the blocking of intruding waters from the sea, necessity increased in the marshes to maintain and improve the protection facilities, in order to prevent uncontrolled dyke breaches (Kabat et al. 2012; for a more detailed description see Gerkensmeier et al. 2013).
Important for the current level of coastal protection were the past disastrous storm surge events in the 20th century. In 1953 and 1962 two disastrous storm surges hit the North Sea Coast and caused extensive damages to the area including losses of live and infrastructure. In consequence a further immense improvement in coastal protection was initiated. Over the

years, several state led programs were undertaken with enormous technical effort and huge financial input, in order to improve coastal protection facilities along the Wadden Sea coast. Based on these improvements, coastal protection facilities along the Wadden Sea coast were able to withstand, so far, all incoming extreme storm surges without major destruction.

1.2 Reason for the partnership

Analysis of currently applied risk management strategies and measures due to storm surge events in the three countries of the WSR showed similar management strategies applied in each of the three states. Coastal protection along the North Sea coast is mainly managed by governmental institutions. In all three countries, responsibility for coastal protection issues lies predominantly in the hands of ministries on national or regional/federal levels. As a consequence of the disastrous storm surge events of 1953 and 1962, the Netherlands and Germany in particular, implemented improved coastal protection strategies and strengthened their administrative structures (for a detailed description see Gerkensmeier et al. 2013).
These processes have been accompanied by two important issues: First of all, during the last century, especially following the improvement period after 1953, taking responsibility of coastal protection have shifted from being a task of residents in the low-lying areas (who benefit from protection measures) to a task of governmental institutions. Governmental institutions took the lead in coastal protection issues and most of the tasks are nowadays institutionalised and are no more, or to a lesser extend, related to the inhabitants in the flood-prone areas. In Germany, these circumstances superpose the fact that traditionally the person, who benefits from coastal protections measures, is responsible for it. This basic regulation is defined by statutory rules. In Schleswig-Holstein for example, these rules transfer the responsibility of strategic planning and managing construction works to its governmental institutions and transfer as well the responsibility of dyke maintenance to the dyke associations[1]. The situation in Lower Saxony is quite similar[2]. Along with the process of shifting responsibility, there is to denote a certain alienation of the people's involvement in coastal protection awareness. The obligatory residential charge for dyke maintenance is hardly recognised as such or is considered as ransom of the residents' responsibility. Related to this shift of responsibilities, the current storm surges management is characterised by a dominance of governmental actors, where decision-making processes are organised in a hierarchic top-down order. Governmental actors include ministries, state agencies, counties, provinces and municipalities as well as dyke associations[3] and water boards. Dominance of these governmental stakeholders leaves less room for other stakeholders from different sectors especially in the field of coastal protection issues (see Gerkensmeier et al. 2013). Furthermore, technical improvements, with their evidenced reliability, over the past years led

[1] Water law of Schleswig-Holstein (as amended on 11.02.2008) § 62 (3)
[2] Dyke law of Lower-Saxony, amongst others dyke mandatory (*Deichpflicht*), § 6
[3] Dyke associations are the German version of water boards with a comparable organization structure and responsibility in all three Wadden Sea states along the North Sea coast (NLWKN 2008). The current state of the German dyke associations is related to a long historic development; its original structures predominantly results from loose forms of loose interest groups and village communities.

to a deep trust in construction measures and coastal engineering by society and among responsible actors. After hundreds of years fighting the sea, followed by decades of secured storm surge management, people feel safe behind the dykes. The current state-of-the-art in coastal engineering protection measures is characterised by ample trust among the population. The unparalleled way of fighting the sea, goes hand in hand with a deep trust but also importantly with a loss of awareness of the risks from storm surges. There is a certain danger that the success of the recent technical measures and technical-mathematic approach lead to a "perception of security" (von Storch et al. 2008).

Both the shift of responsibility to governmental institutions and the deep trust in the highly developed constructive coastal protection facilities has led to a kind of mental lock-in of stakeholders and society. This all-out focus on technical measures restricts stakeholders and society from considering potential increased risks besides the storm surge risk in the WSR. Many of these risks are directly or indirectly connected with the existence of coastal protection facilities in the WSR – but in contrast to the constructive measures against storm surges and sea level rise, these risks to some extend need other (additional) options and measures to be managed successfully.

Existing high developed coastal protection measures along the Dutch, German and Danish North Sea coast provide high protection level under current climate conditions and most likely for the next decades (comp. MLR 2001; MELUR-SH 2013; NLWKN 2007; Delta Programme 2013, Sterr 2008). With regard to the more distant future, the level of safety of current coastal protection measures as well as the potential improvements of these facilities is still under discussion. Besides construction-related limits, uncertainties about changes in storm surge climate related to climate change are very high. In addition to uncertainties about future storm surge climate, further hazards and risks related to other sources than storm surges will arise and increase the vulnerability of the WSR. These risks need a comprehensive and improved risk management.

Hazards and threats, beside storm surges, which put the WSR at risk both today and in future, are related to sea level rise and increased river discharge and include challenges of draining the land due to increased land subsidence and higher water levels in the North Sea (sea level rise), as much as losses of sand deposits, coastal shorelines, salt marshes and other erosion processes. Climate change, demographic changes as well as changes in economics and land-use issues in the WSR are additional drivers that might increase the vulnerability of the WSR. Impacts of these issues mentioned before are, however, burdened with huge uncertainties that increase difficulties to adapt specific management measures.

These diverse challenges and risks make it obvious that the WSR is a region of multifaceted risks. In many cases these risks are directly or indirectly linked to each other. Cascading effects between these risks could influence their time of occurrence and the amount of damages. Managing these risks needs first of all an increased awareness of these risks and their potential impact on society. Improved risk management in the WSR has to take multifaceted coastal risk into account, and develop strategies that include flexible and multifunctional measures.

Major obstacles with regard to this development towards an integrative coastal risk management include the current perception of a governmental top-down decision-making approach and the existing deep trust of actors and society in highly improved technical protection facilities (which block out the water). This fact is underscored by a first pilot study that was realised by the HZG at a section of the WSR along the German Wadden Sea coast. An online survey was conducted in March 2014 in the district (*Kreis*) of Dithmarschen in order to assess stakeholders' storm surge risk perception and resilience (for a more detailed description see section 2.5). Within this survey, the stakeholders mostly agree on the high effectiveness of the hard protection measures (dykes system and flood gates); the soft measures such as coastal nourishment as well as spatial planning measures (e.g. coastal setbacks) and building codes receiving lower values. Stakeholders' trust in constructive coastal protection measures and in coastal defence is evidenced with more than three quarters of the respondents assigning very high and high trust to these measures (based on a 5 stage ranking system from very high to very low trust). In comparison, emergency response procedures and teams, emergency warning systems and responsible authorities are awarded lower levels of trust (one-fifth assigned very low/low trust categories).
At this point the ENHANCE project will support the process to overcome these obstacles and stimulate if not support developments towards an integrative coastal risk management. A multi-sector-partnership should be introduced in the area as a potential tool to raise awareness towards a variety of risks and their cascading effects, initiate an exchange of knowledge and experience and provide a basis for further collaborative management processes.

1.3 Objectives of the partnership

In consideration of current and future risks which will threaten the WSR, a comprehensive risk management is necessary in order to cope with the variety of risks in the WSR. Future risk management needs to contain the dominant governmental decision-making processes and preferably involve a broad partnership to improve coastal risk management on a cross-sectoral level. Stakeholders and sectors, like agriculture, harbour businesses, tourism and environmental NGOs, can play their role in future risks scenarios and commit partial responsibility for prevention. Additionally, their knowledge and experience in dealing with natural hazards so far is important to face the variety of risks properly.
Recent risk management is dominated by limiting storm surge damage and the prevention of flooding through dyke construction and maintenance. However, climate change scenarios for the Wadden Sea Region, including the southern North Sea, point to an increasing number of storm surges, higher precipitation in winter and spring, increasing temperature and changes in growing seasons (based on information of Norddeutsches Klimabüro, Coastal Atlas[4]). This could lead to erosion of beaches and impacts on infrastructure, which will be relevant to

[4] http://www.coastalatlas.org/; the Coastal Atlas is an online information tool about possible future climate change in the Wadden Sea region. The concept has been developed by the North German Climate Office (HZG) and implemented in the *Norddeutscher Klimaatlas* for the first time.

tourism and to other sectors. Higher water levels in the hinterland will affect farming and living conditions. Shifts in temperature will have impacts on healthcare, for reasons including new diseases arriving. Finally, nature protection will be effected through impacts on salt marshes, dunes, breeding birds, etc.
The broad variety of impacts demonstrate a need for multifarious stakeholder involvement as an integrative part in coastal risk management, in order to address future challenges in risk prevention, protection and management. The various scenarios, which also encompass worst case scenarios for changes in atmosphere and water level, will be introduced to the MSP in order to elaborate on prevention and protection measures.
In consideration of the current situation in coastal risk management as described before, it is the objective of the MSP to introduce initial steps towards a collaborative, cross-sectoral, coastal risk management within the WSR. The MSP can initiate a snowballing effect and inspire other stakeholders to open up their mind towards a broader thinking about risks and uncertainties and stimulate a process of awareness, growing on the conception of causal relation of climate change effects and impacts of natural hazards. A comprehensive understanding of linear and non-linear (direct or indirect) relationships between different risks, impacts and consequences can foster the development of successful coastal risk management strategies in the WSR.

1.4 Constitution of the partnership

The MSP in the WSR can initiate new directions of thought on how to manage multifaceted risks and uncertainties in the WSR. Since 2002, a partnership on a trilateral level is working towards sustainable development in the coastal region. The case study will introduce risk management to the existing partnership, which will integrate this topic in their future activities.
The Wadden Sea Forum (WSF) as an existing MSP represents a transnational and cross-sectoral stakeholder forum in the WSR, and has longstanding and wide-reaching experiences as a multi-stakeholder community in advanced and sustainable development of the trilateral Wadden Sea Region (Wadden Sea Forum 2013). As a partner of the ENHANCE project, close collaboration between the project and the stakeholder forum takes place.
The WSF consists of representatives from the sectors of Agriculture, Energy, Fisheries, Industry and Harbour, Nature Protection, and Tourism, as well as from local and regional governments. National governments are represented as observers (Wadden Sea Forum 2005; Wadden Sea Forum 2010). In Table 1 the most relevant stakeholder organisations currently represented in the WSF who are concerned with risk management, are represented.
Until now, the issues of coastal protection as well as risk management were not discussed in the Wadden Sea Forum. At the last WSF Steering Committee meeting in January 2014 it was decided to focus on climate change, climate adaptation and risk management in the future work of the WSF. The ENHANCE project has already stimulated the WSF to broaden the scope of its work. The objectives of the ENHANCE project were presented earlier to the WSF and it became clear to the stakeholders that cooperation on risk management would be

beneficial for the WSF and the development of the WSR. The various climate scenarios visualised and described in the climate atlas for the WSR by the Helmholtz Zentrum Geesthacht (HZG), increased the stakeholders' awareness of increasing risks in the coming decades. This background information, the current discussion in the trilateral Wadden Sea cooperation together with the setup of ENHANCE led to the agreement to more actively face the challenges of risk management in the WSR as a whole. From this collaboration the stakeholders and sectors expect support for a healthy sector development.

Table 1 Most relevant stakeholders represented currently in the WSF (NL= Netherlands; GE=Germany; DK= Denmark)

Agriculture	Danske Landbrug & Fødervarer, DK LHV für Ostfriesland e.V., GE Bauernverband Schleswig-Holstein e.V., GE LTO Noord, NL
Tourism and Recreation	Watersportverbond, NL Nordseetourismus Husum, GE Royal Dutch Touringclub ANWB, NL
Nature and Environment Protection	Seas at Risk (SAR), NL WWF-Wattenmeerbüro (Husum), GE Waddenvereniging, NL Danish Ornithological Society, DK Bund für Umwelt und Naturschutz (BUND), GE
Fisheries	Niedersächsische Muschelfischer GbR, GE Rømø Fiskeriforening, DK Erzeugergem. Schleswig-Holstein.Muschelzüchter e.V., GE Danmarks Fiskeriforening, DK Erzeugergem. der deutschen Krabbenfischer GmbH, GE Dutch Fish Product Board, NL
Industry and Harbour	IHK für Ostfriesland und Papenburg, GE Groningen Seaports, NL Rømø Harbour, DK Verband Deutscher Reeder, GE IHK Oldenburg, GE Brunsbüttel Ports, GE
Energy	NAM B.V., NL Wirtschaftsförderungsgesellschaft Nordfriesland, GE Statkraft, GE RWE Dea AG, GE
Local Government Authorities	Nationalpark Waddensea DK Insel- und Halligkonferenz, GE

	Vereniging van Waddenzeegemeenten, NL Gemeente Ameland, NL The Danish Wadden Sea Municipalities, DK City of Norderney, GE
Regional Government Authorities	Region Syddanmark, DK Landkreis of Dithmarschen, GE Landkreis of Nordfriesland, GE Landkreis of Aurich, GE Provincie Groningen, Fryslan, Noord Holland, NL
State Government Authorities (Observers)	Ministry of Economic Affairs, NL Niedersächsisches Umweltministerium, GE Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, Referat N I 2, GE Ministerium für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig- Holstein, GE Miljøministeriet, Naturstyrelsen, Gram, DK
Research	Leibnitz-Institut für Ostseeforschung Warnemünde(IOW), GE Helmholtz Zentrum Geesthacht, GE

1.5 Integrating the partnership in the current way of addressing risks in the Wadden Sea Region

Risks, mainly due to storm surges and coastal protection, in the WSR are managed on national or regional, but not on transnational, levels. Coastal Protection is a major focus of interest in risk management at the Wadden Sea coast. In all three Wadden Sea countries coastal protection has priority over other concerns. In all the three countries, decision-making in coastal protection is performed by governmental actors. In general, coastal protection includes storms surge protection as well as protection against coastal erosion. Both issues are closely linked to each other. Current storm surge protection in the WSR is highly characterised by technical measures on a high engineering standard. The key issue of all these strategies, especially in the Netherlands and in Germany, is based on the philosophy of keeping the water out of the low-lying hinterland areas. This "close-off"-strategy includes the periodic changes in water level related to tidal cycles of high and low waters as well as excessive water levels in terms of storm surges. According to the "general plans for coastal protection" in the Netherlands and Germany, the future focus of coastal protection lies on dyke building and strengthening (Delta Programme 2013; NLWKN 2007; MLR 2001; MELUR-SH 2013). In spite of the high standard of coastal protection, the existing considerable low level of vulnerability is still accompanied by residual risks. Construction elements can never be totally safe. In addition, prospected climate change with - amongst others - intensified storm activity, sea level rise, and increased run off from the hinterland can increase vulnerabilities and residual risks in the WSR.

These future challenges will go beyond the capacity of the existing coastal engineering measures and beyond financial scopes. On the one hand, construction-dominated coastal protection measures and strategies themselves will reach their limits, especially with the challenges caused by future climate change impacts. On the other hand, increased risks and their impacts need more flexible options. This will include moving away from the stringent strategies to defend the current shoreline in order to handle a variety of risks (storm surges as well as increased discharges, challenges of draining the low-lying areas, etc.). First steps in this direction towards more flexible options to adapt to future challenges have been initialised e.g. in Schleswig-Holstein, which started to address the issue of possible retreat and natural coastal system adjustment in its current master plan for coastal protection as a possible option for long-term strategies (Sterr 2008; MLR 2001; MELUR-SH 2013).

A major pressing issue related to an integrative coastal risk management plan arises from the challenges in management of terrestrial drainage that are closely linked with coastal protection strategies. In most cases, facilities like floodgates are installed that allows natural drainage of the inland waters during low tide periods. Significant increased sea level rise will reduce drainage capabilities of the lowlands (CSLR 2010) and increase the levels of cost and effort required to protect these mechanisms. Scientific results by Sterr (2008) based on expert evaluation assume an increase of cost for drainage in Schleswig-Holstein's coastal plains along with increasing dyke construction costs.

An advanced MSP in risk management can not only enhance the awareness and perception of risks but also utilise the window of opportunity for new cooperation in risk prevention and management.

2 Improvement in risk management introduced by the partnership

2.1 Intention of the partnership

By initiating the MSP, practical conditions for collaborative processes in coastal risk management are significantly enhanced. Related to the need for an improvement in governance processes in comprehensive coastal risk management structures, the partnership could play a major role. The partnership contributes to raise stakeholders' perception and awareness towards the need for cross-sectoral integrative risk management and facilitates the process of the exchange of information, knowledge and experiences between stakeholders and institutions and across the three countries. With regard to the huge amount of information and knowledge available, the partnership embraces the task of merging this knowledge and enhancing a targeted flow of information and knowledge into strategies and practical applications. The partnership will come up with a management scheme of how to cope with risks due to natural hazards. Also the responsibilities of stakeholders and private partnerships will be addressed. It is intended that the WSF as a permanent MSP deals with risk management, adaptation and improvement of measures even after the period of ENHANCE. This would be a long lasting result of the project.
With regard to the structure and function of the WSF, the partnership is equipped with an advisory function aimed at the governmental bodies of the WSR. Related to this advisory function, common needs and ideas of improved risk management can be communicated by the partnership to the governmental institutions at state- or Länder-level. At this point stakeholders from different sectors and governmental levels like municipalities and provinces are able to create a bottom-up development of an improved coastal risk management. The trilateral perspective of the WSF and the partnership may enable the participants to communicate common needs and suggestions for improvement to decision-makers of all the three countries.
The good experience of the longstanding international cooperation in the Trilateral Wadden Sea Cooperation (TWSC) on transboundary ecosystem-based collaboration in order to conserve a World Heritage site (CWSS 2010) is the basis of the WSF. The longstanding cooperative multi-stakeholder partnership WSF represents the MSP. The trilateral perspective in coastal risk management constitutes a major advantage with regard to developing common risk management approaches for a coherent ecological system and a cultural entity as well as for a more homogeneous pattern of spatial development. The MSP would be unique in terms of collaborative transnational governance and measures in coastal risk management.

2.2 Gaps and challenges for the partnership related to the current state of the art in risk management in the WSR

As already described in D7.1 the improvement of MSP can be fostered by the application of the capital concept. Partnerships to increase resilience represent a governance structure that may favour the coordinated management of particular stakes in a collaborative process. The

MSP on coastal risk management in the WSR is able to contribute to a shift from top-down decision-making in coastal protection towards including an overall governance perspective of coastal risk management. Communication is an important key element of this governance process, aiming at the improvement of communication between partners sectors and the involved authorities/local governments, which certainly already exists but there is still room for improvement. Especially communication between actors from different federal or national states has to be improved in order to exchange knowledge and increase coordinative actions. Communication between the involved governmental actors and other stakeholders as well as the public takes place in most cases only in terms of obligatory "participation" processes (applied mainly in plan approval procedures). The implementation of a permanent MSP provides a basis to enhance communication processes as well as improving the transfer of knowledge. The transnational level of the WSF represents an important characteristic here that increases the transfer in the different Wadden Sea countries.
Existing human capital in terms of scientific support will enhance the knowledge base for risk management. Particular assessments of climate change scenarios are needed to elaborate a sound risk management cycle.
The MSP benefits from the environmental capital. The existing cooperation on nature protection between the three Wadden Sea states provides knowledge and experience of collaborative action of more than 30 years. The designation of the Wadden Sea as World Heritage Site in 2009 was an approval of transnational integrated nature protection. This can be used as best-practice example for implementing a well-functioning MSP. This goes hand in hand with the political capital, supporting coordinated nature protection and monitoring measures for the whole Wadden Sea area. With a deeper involvement of the MSP in political decision-making, improvements in coastal and risk management can be made.
Besides investment in coastal protection measures, there is a lack of financial capital provided for an improved and coordinated management of the coastal area. Therefore, the provision of financial capital is needed not only in order to improve MSPs in risk management but also for specific adaptation measures, e.g. the use of farm land for flood prone areas, dyke relocation, experiences with alternative spatial use and, not least, endeavours to increase acceptance of alternative risk management in society.

2.3 The role of the private sector in the partnership

As outlined under chapter 1.2, the private sector is part of the MSP. The private sector, particularly agriculture, tourism and harbour business will be affected by risk management measures, regardless if prevention, protection or recovery strategies prevail. The private sector is affected and has to be involved in developing joint and acceptable measures. Based on experience, the success of such strategies should have a more integrative character rather than a top down decision-making process. To meet these challenges, new responsibilities have to be defined and the private sector has to assume liability nd, not least, some burden of investments.

2.4 Limits of the partnership

Considering that the WSF has a limited advisory function in the WSR, the capabilities of the MSP are certainly limited. There is currently no discussion appearing about the legal status improvement of the MSP. As discussed in ENHANCE the legal status of a MSP will affect its effectiveness – not stating that a MSP necessarily is more effective the higher their legal status is. The MSP in the WSR is consciously selected as a voluntary, advisory MSP. Even if the WSF has a legal status as a non-profit society, no normative power in decision-making outside the forum exists. Experiences during the project and beyond will show the potentials and limits of this performance type. Nevertheless, a trilateral MSP, also anchored in decision-making as an advisory board, will not be ignored. Risk management measures require more and more acceptance and understanding within society with its stakeholders and interest groups.
Regarding the defined future risks, discussion about uncertainties and prevention measures will be limited in some cases by the inadequate availability of credible data and projections of future changes. These limits are in most cases related to limitations in predictions of risks and impacts related to climate change in scientific, dynamic modelling. In order to cope with these limits and to deal with existing uncertainties the MSP is advised to focus on the development of flexible measures and strategies that render possible adaptations of these measures to future changes. Sustainability in the current development not least is about opening the windows of opportunities without compromising future generations.

2.5 Enhanced performance within the existing partnership

The WSF represents a well-functioning multi-sector partnership related to the topic of sustainable development of the WSR. The extension of this existing MSP to the topic of coastal risk management has just started. Intention to undertake the task of risk management was given by the WSF Steering Committee and by the ENHANCE project. Due to these conditions, the MSP will focus first of all on access to information, increased communication and growing awareness about the variety of coastal risks, their interdependencies and cascading effects. Based on increased communicative and collaborative processes, the MSP can create a cross-sectoral understanding between stakeholders about different types of risks and uncertainties threaten the WSR. This understanding is the basis for the elaboration of management needs and the transition to recommendations and tools to enforce coastal risk management.
Traditionally, there is a specific working group of the WSF installed which deals with integrated coastal zone management. This working group presented their recently approved new strategy on Integrative Coastal Zone Management (ICZM) for the WSF at the ministerial Conference of the Trilateral Wadden Sea in February 2014. For the currently started new working period the WSF has tasked this ICZM working group to extend their ICZM focus on risk management in order to submit governance and management instruments for beneficial application at the next trilateral Conference. ENHANCE is invited to cooperate in this

assignment with the following actions which will be taken by the ICZM group as part of the MSP:

- Elaboration of an inventory of risk scenarios in the WSR;
- Compilation of risk perceptions among society and sectors;
- Information about deficits in risk perception and responsibilities
- Elaboration of elements for being prepared for coping and living with risks.

According to the work plan of the case study, a first stakeholder workshop will be held in May 2014 to commonly compile and evaluate the major interests. Based on the needs of the stakeholders, the ENHANCE case study will elaborate a determined work plan, defining specific tasks and measures, which will be carried out in the following months.

2.6 Improvement of risk information of stakeholders

The ENHANCE project fosters the cross-sectoral sensitisation of stakeholders towards different coastal risks in the WSR and enhances the transnational exchange of knowledge and experiences. The existing multi-stakeholder forum (WSF) will benefit from the activities of the ENHANCE case study that brings the topic of coastal risk management into focus of the work of the WSF. Activities of ENHANCE will assist the WSF to initiate new paths of thought about the varieties of risk in the WSR, increase awareness of cascading effects between these risks and raise awareness for direct and indirect impacts as well as uncertainties related to these risks. The project can also foster a growing awareness of new responsibilities for society and stakeholders.
Activities within the ENHANCE case study will stimulate a process of becoming aware of the interdependencies of risks and their impacts and start a communication process between all affected sectors about how to deal with these risks and resultant uncertainties, especially with regard to future changes (e.g. climate change).
Projections and visions for the future of the WSR will be developed based on existing qualitative research, on qualitative risk scenarios[5] and on dynamic and statistical modelling which are already available for single risks and impacts in the region. It is the aim of the ENHANCE project to merge these results and to confront them with integrated stakeholder scenarios in order to create a comprehensive multi-risk scenario for the WSR.
The ENHANCE project will produce two different types of scenarios in order to assess (future) low probability – high impact risk scenarios: For Type A, projected scenarios of climate induced changes, developed from the Helmholtz Zentrum Geesthacht (HZG) as well as other institutions, will be worked up for the trilateral research area. HZG has wide, scientific experiences and background in modelling climatic changes in the North Sea Region.

[5] Qualitative scenarios are herewith understood as visionary narratives of future development based on experiences, regional cultural frames and a visionary dialogue process as defined by Possekel (1999).

Type B scenarios, which will be developed by the ENHANCE project, are visionary, narratives of future visions. These scenarios will be developed based interviews and workshops with the stakeholders. The qualitative type B scenarios are rooted in the understanding of risks as mental constructs that are different between individuals as well as institutions or sectors.
These qualitative scenarios will be founded on stakeholders' risk awareness and perceptions as a major element. The results will help to understand the culture of risk that exists in the North Sea States. Risk culture and risk perceptions are important driving factors in risk management which requires a discussion about risks as a mental construction. Despite the huge variety of risk definition[6], for the partnership in the WSR risk should be understood as a result of different mental constructions that result from the perception of each affected person as well as their interpretations and responses which depend on social, political, economic and cultural contexts and judgments (comp. Luhmann 1993; IRGC 2005). Single actors as well as societies are involved in the process of perceiving risks. Hence, evaluation of risks is a process taking place within societies (Renn et al. 2011). These processes have to be considered for the development of risk scenarios that should be used as a basis for further risk management actions. Both types of scenarios will bring together existing scientific results as well as assessment of risks and benefits by stakeholders from different sectors. The resulting set of risks and impacts provides a basis for defining aims and goals in the partnership. A comprehensive set of risks and related uncertainties of different short- and long-term impacts on different sectors can lead to a tool to enhance communication and discussion about them.
The ENHANCE project will definitely help to get a better understanding of possible risks in the future. For the Wadden Sea case study we are aiming at raising awareness of and between stakeholders from different sectors of risks and uncertainties in the WSR. A first pilot study was realised in the district of Dithmarschen (Schleswig-Holstein, Germany) by Gonzales-Riancho et al. (2014).
The pilot study had the aim to assess stakeholders' storm surge risk perception and resilience, in order to understand the adaptive (short- and long-term) capacity of the community in Dithmarschen to organise itself before, during and after the event. An analysis of the opinions of various stakeholders has been carried out on: (a) the availability of storm surge risk information and its consideration in the decision-making process (b) the institutional preparedness, (c) the individual as well as sectoral preparedness, (d) the feasibility of coordination mechanisms (partnerships); and (e) on the feasibility of various potential policy options.
The pilot survey underlines the necessity of raising awareness of risks and impacts especially in terms of sectors, which have not yet been integrated in (storm surge) risk management

[6] In economics: the possibility that an event will occur, which will impact an organization's achievement of objectives; Sociology: risk is defined as an inherent characteristic of decisions in the light of hazardous events (Luhmann 1993, Renn 2008, Birkmann 2012); risk management: risk is defined as a function of the probability or threat of quantifiable damage, injury, liability, loss, or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through preemptive action (comp. UN/ISDR 2004).

along the Wadden Sea coast. Results of the online survey underline a high consensus for involving stakeholders related to the emergency (in the study area Federal Agency for Technical Relief[7], Red Cross, fire brigades, etc.) and coastal protection (Agency for Coastal Protection, National Parks and Ocean Protection[8], dyke associations) in a multi-sector partnership in risk management in the WSR. The highest disagreements are related to the involvement of sectoral stakeholders, such as the agriculture/livestock, tourism and industry private sectors, the environmental stakeholders (Wadden Sea National Park and environmental conservation organisations) and NGOs.

The current top-down decision-making processes appear to hinder the sensitisation of stakeholders from sectors and institutions besides the currently involved governmental sector. Regarding the aim to foster an MSP in the WSR, these results support the necessity to involve initial awareness campaigns on the relevance of different sectors' involvement in coastal risk management. Nevertheless, the surveyed stakeholders identify a MSP as a promising tool in coastal risk management. Expected benefits of potential partnerships are the increased collaboration and responsibility sharing between stakeholders, and the gain of knowledge in risk management. Long-term planning, increased budget and involvement of society are ranked second, followed by increased discussion, involvement of sectoral objectives and risk sharing. Major difficulties of potential partnerships are considered to relate to people's time and commitment, and to an effective implementation of the decisions. Budget, guidance and knowledge as well as collaboration and empowerment are also considered as challenges.

The presented results of the pilot study give first insights into stakeholders' risk awareness and possible capability of a MSP in the WSR. During the work of the ENHANCE project, the analysis will be broadened, based on the developed framework, on the national (Germany) and on international level (including the Netherlands and Denmark). The survey will be performed as personalised online-survey. Findings of this survey will be used to capture the stakeholders' opinion in the WSR towards integrative coastal risk management. With regard to the work in the WSF, the survey provides the opportunity to reach stakeholders beyond the WSF and provide insights on risk awareness and needs of changes in risk management on a broader level (more stakeholders will be asked than represented in the WSF). These results will guide the work of the MSP in order to meet the needs of the broad Wadden Sea community in risk management.

In cooperation with the WSF, ENHANCE will undertake several stakeholder workshops as well as in-depth interviews with stakeholders. Workshops with the WSF and interviews will

[7] The Federal Agency for Technical Relief (Technisches Hilfswerk), with its voluntary basis of about 80,000 voluntary experts, is as an authority in the Department of the Federal Ministry of the Interior. It is in charge of the emergency operations.

[8] The Schleswig-Holstein's government-owned Agency for Coastal Protection, National Parks and Ocean Protection (Landesbetrieb Küstenschutz, Nationalpark und Meeresschutz, LKN) is in charge of the supervision of construction and maintenance of coastal protection facilities. In terms of maintenance of coastal facilities, the LKN guides and supervises the Water Boards and Land Associations (MLR, 2001).

be used for the Type B scenarios, finitely provide input to the work of the WSF and assist the WSF to initiate new paths of thought about the varieties of risk in the WSR. The initial workshop will take place in May 2014 and start the dialogue between and with the members of the WSF about risks and uncertainties in the WSR, about current strategies and governance structures. It is the aim to encourage a broadened vision about risks in the WSR in general and their possible future impacts. In the second workshop in fall 2014 we intend to focus on perceived risks and improvements in risk management in order to increase resilience in the Wadden Sea Region. The workshops will be organised as iterative process with the integration and adaptation of results from the previous meetings as well as inputs from the surveys and interviews.

3 Research in the context of ENHANCE WP 4-6

3.1 Links to the thematic Work Packages

A MSP as discussed in ENHANCE is a long-term endeavour and ordinary top-down decisions should be shifted towards a participatory approach which can help to replace government with governance structures. For the case study and for the risk management in the WSR, a major focus will be on existing and changing governance structures as well as on the analysis of stakeholders' behaviour in an already established community of stakeholders (WSF). In close collaboration with the WSF, the case study will be able to analyse different governance indicators of importance. Observations and experiences from the case study will be fed back into the work on this topic (lead by HZG) and help to improve the work on governance indicators for successful multi-sectoral risk management processes. The main focus of its contribution lays on its transnational perspective, longstanding cooperation and voluntarily collaboration in newly developed governance structures. Results will be communicated and included in the process of testing and improving the governance indicators, presented by the Work Package 2 of ENHANCE.

Successful risk management in the Wadden Sea Region in order to increase resilience might be highly dependent on a shift from government to governance processes (see above). The state-of-the-art in coastal management, especially in storm surge management and coastal protection, showed that the current construction-dominated strategies based on top-down decision-making processes might be challenging in future. The currently predominating and widespread mental lock-in, characterised by a deep trust in technical measures, is in need of transformation processes towards a) a broader vision of the requirements in future risk management, b) an opening for more flexible strategies, and c) adaptable governance structures. Within the project, an exchange of experiences and a discussion concerning processes of open governance methods in MSPs will be undertaken more in detail in Work Package 6 (regulatory policy instruments). Based on the proposed sub-groups of MSPs by the Work Package 6 (MSP of type public private partnership; MSP of type open governance methods; MSP of type critical infrastructure systems) the case study will contribute to the analysis of methods of the MSP-type of open governance.

Additionally, the work of the Wadden Sea case study is able to contribute to the discussion on the legal status of the MSP. The legal status of the Wadden Sea Forum can be described as an advisory function. Discussion about different possibilities of legal status has to be introduced, potentially in the Work Packages 6 (regulatory policy instruments), 8 (scientific synthesis and outreach) or 9 (policy dissemination). The Wadden Sea case study could contribute to this discussion with the help of the experience of the Wadden Sea Forum and its stakeholders.

3.2 How does the MSP deal with insurance/ economic instruments?

Economic instruments like insurances are only partly available in the WSR, depending on the hazard event. In all three countries, storm insurance is available. In all cases it is not part of any policy, but it can be bought as an optional extension to basic policies. In a study of the European Commission Maccaferri et al. (2012) identified for the Netherlands, Germany and Denmark a high penetration rate[9] (ca. 90%) for storm insurance was identified. This high penetration rate constitutes a comprehensive coverage of damages related to storm events (Maccaferri et al. 2012).

Apart from that, in the Netherlands, private flood insurance is generally not available, neither for storm surge damages nor for damages resulting from flood events. In Germany private insurance is available in large parts for flooding but not for storm surges. The damages are defined as natural perils (damages from natural hazards); they are insurable by supplemental insurance against natural hazards and are a supplement to home content or building insurance (Botzen & van den Bergh 2008). But the acceptance of this supplement insurance is relatively low in Germany. Thieken et al. (2006) showed that in today's market penetration of flood insurance are only about 10% for private households. Experience from the flood event in 2002 in central and southern Germany confirmed that in Germany a larger portion of flood damages is covered by governmental funds and donations than by insurance companies (Botzen & van den Berg 2008). In Germany, storm surge damages are not insurable. Both building insurance and home content insurance officially exclude damages from storm surges. Denmark is the only country where a governmental storm surge scheme (stormflodsordningen) covers some storm surge damages under specific conditions.

The described situation in the three countries underlines the fact that spreading risk from storm surges to different sectors and/or institutions, authorities etc. are not applied in coastal risk management, yet. There is the need to prove if experiences with economic instruments used in other case studies will provide new insights in managing risk in the Wadden Sea Region. Results of the pilot study (Gonzale-Riancho et al. 2014) highlight a predominant rejection of proposed economic instruments. Land use taxes are considered very inadequate by two-third of the surveyed stakeholders. All of the measures proposed – namely tax exemptions, grants/subsidies, insurance, incentives/compensation for giving up land, public contracts, service concessions and catastrophe bonds – are also rated very inadequate/inadequate (Gonzales-Riancho et al. 2014). This initial impression suggests that it is necessary for potential economic instruments and adaptation options to be appropriate and site-specific.

3.3 How does EU legislation influence the operation of the MSP?

Various recent EU directives and policies like the Marine Strategy Framework Directive (MSFD; Directive 2008/56/EC), the Water Framework Directive (WFD), the EU Floods Directive (Directive 2007/60/EC), the Common Agricultural Policy (CAP), the Common

[9] "Penetration rate" measures the percentage of global insurance premiums over a country's gross domestic product (Maccaferri et al. 2012)

Fisheries Policy (CFP) and the Integrated Maritime Policy (IMP) increasingly aim at a thematically and spatially integrative orientation. In connection with the Natura2000 regulation, the European Union's (EU) main strategies so far are directing their efforts predominantly towards the protection of marine and terrestrial ecosystems and their biodiversity.

EU legislation can support the implementation of MSPs. Regional and national decision-making is very much focussed on political power and concerned responsibilities. To foster integrative approaches, guidelines and directives of the EU play an important role.

The EU Flood Directive is one of these examples. The Directive (2007/60/EC) has been installed in national and federal law in the WSR countries and requires risk maps for flood risks, especially for inland floods. Coastal regions have to be integrated, too. But these demands are handled differently on each national level. By 2015 the Directive mandates risk management "approaches"/ maps as well as management plans, which must focus on measures for each specific region. These strategic maps could provide a basis for improving coastal risk management and should be included in the work of the MSP as a source of information.

The proposed Directive on Integrative Coastal Zone Management (ICZM) represents another example of an important EU Directive with regard to improve coastal risk management. Integrated Coastal Zone Management was implemented on voluntary basis in some European countries. There are still large gaps in implementation as responsibilities are not shared and horizontal cooperation does not really function yet. A proposed Directive on ICZM/Marine Spatial Planning would help to change structures and establish cross-border and cross-sector cooperation. Such a Directive would be especially useful for an integrated risk management. The WSF with its ICZM approach is in discussion with representatives of the EU Commission as well as with the North Sea Commission about challenges and obstacles of EU legislation on transnational coastal zone management.

4 References

Birkmann, J. (2012), 'Risk', in Borowsky, T. (eds.), Encyclopaedia of natural hazards, Dordrecht, Heidelberg, New York, London, pp. 856-862.

Botzen, W.J.W., and J.C.J.M. van den Berg (2008), 'Insurance against climate change and flooding in the Netherlands: present, future, and comparison with other countries', Risk Analysis, 28 (2), 413-426.

CPSL (2010), CPSL Third Report The role of spatial planning and sediment in coastal risk management, Wadden Sea Ecosystem No. 28, Common Wadden Sea Secretariat, Trilateral Working Group on Coastal Protection and Sea Level Rise (CPSL), Wilhelmshaven, Germany.

CWSS; Common Wadden Sea Secretariat (2010), Sylt Declaration, Ministerial Council Declaration of the Eleventh Trilateral Governmental Conference on the Protection of the Wadden Sea, Common Wadden Sea Secretariat, Wilhelmshaven, Germany.

Delta Programme 2013; Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs, Agriculture and Innovation (2012), Working on the Delta – the road towards the Delta Decisions, The Hague, Netherlands.

Gerkensmeier, B., Ratter, B.M.W. and M. Vollmer (2013), 'Risk Profile case study 3', ENHANCE project deliverable 7.1, restricted access.

Gonzales-Riancho, P., Gerkensmeier, B. and B. Ratter (2014), 'Storm surge resilience in Dithmarschen' (in preparation)

Gönnert G. (2003), 'Sturmfluten und Windstau in der Deutschen Bucht - Charakter, Veränderungen und Maximalwerte im 20. Jahrhundert', Die Küste, 67, 185-365.

IRGC; International Risk Governance Council (2005), Risk governance: Towards an integrative approach, White paper No 1, Geneva.

Kabat, P., Bazelmans, J., Dijk, van J., Herman, P. M. J., Oijen, van T., Pejrup, M., Reise, K., Speelman, H. and W. J. Wolff (2012), 'The Wadden Sea Region: Towards a science for sustainable development', Ocean & Coastal Management, 68, 4-17.

Knottnerus, O.S. (2005), 'History of human settlement, cultural change and interference with the marine environment', Helgoland Marine Research, 59, 2-8.

Lotze, H.K., Reise, K., Worm, B., Van Beusekom, J., Busch, M., Ehlers, A., Heinrich, D., Hoffmann, R.C., Holm, P., Jensen, C., Knottnerus, O.S., Langhanki, N., Prummel, W., Vollmer, M. and W.J. Wolff (2005), 'Human transformations of the Wadden Sea ecosystem through time: a synthesis', Helgoland Marine Research, 59, 84-95.

Luhmann, N. (1993), Risk: A Sociological Theory, Berlin.

Maccaferri, S., Cariboni, F. and F. Campolongo (2012), Natural catastrophes: Risk relevance and insurance coverage in the EU, European Commission, Joint Research Centre, Scientific Support to Financial Analysis Unit, Institute for the Protection and Security of the Citizens (eds), Ispra.

MLR; Ministerium für ländliche Räume, Landesplanung, Landwirtschaft und Tourismus des Landes Schleswig (2001), Generalplan Küstenschutz – integriertes Küstenschutz-management in Schleswig-Holstein. Kiel, Germany.

MELUR-SH; Ministerium für Energiewende, Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein (2013), Generalplan Küstenschutz des Landes Schleswig-Holstein – Fortschreibung 2012, Kiel, Germany.

NLWKN; Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (2007), Generalplan Küstenschutz Niedersachsen/Bremen Festland, Norden, Germany.

Oost, A.P., Hoekstra, P., Wiersma, A., Flemming, B., Lammerts, E.J., Pejrup, M., Hofstede, J., Van der Valk, B., Kiden, P., Bartholdy, J., Van der Berg, M.W., Vos, P.C., De Vries, S. and Z.B. Wang (2012), 'Barrier island management: Lessons from the past and directions for the future. Ocean and Coastal Management', 68, 18-38.

Possekel, A. (1999), 'Living with the Unexpected – Linking disaster recovery to sustainable development in Montsserrat', Heidelberg, Berlin, Springer.

Renn, O. (2008), Risk Governance: Coping with uncertainty in a complex world, London, Earthscan.

Renn, O., Klinke, A. and M. van Asselt (2011), 'Coping with complexity, uncertainty and ambiguity in risk governance: A synthesis', AMBIO, 40, 231-246.

Sterr, H., (2008), 'Assessment of vulnerability and adaptation to sea level rise for the coastal zone of Germany', Journal of Coastal Research, 24, 380–393.

Thieken, A., Petrow, H., Kreibich, H. and B. Merz (2006), 'Insurability and mitigation of flood losses in private households in Germany', Risk Analysis, 26 (2), 385-395.

UN/ISDR; International Strategy for Disaster Reduction (2004), Living with Risk - A global review of disaster-reduction initiatives Volume II, New York, Geneva.

Von Storch, H. and K. Woth (2008), 'Storm surges, perspectives and options', Sustainability Science,3; 33 - 44.

Von Storch, H., Gönnert, G. and M. Meine (2008), 'Storm surge - An option for Hamburg, Germany to mitigate expected future aggravation of risk', Environmental Science & Policy, 11, 735-742.

Wadden Sea Forum (2005), 'Breaking the Ice', Wilhelmshaven.

Wadden Sea Forum (2010), 'Without Frontiers – achievements in cross-border, cross-sector, communication and cooperation', Wilhelmshaven.

Wadden Sea Forum (2013), 'ICZM Strategy for the Wadden Sea Region', Wilhelmshaven.