THE TOLERANT LANDSCAPE
STRATEGIES FOR A LESS VULNERABLE URBAN ENVIRONMENT

Arne Loeper

M.Sc. (Integrated Urban Studies); Dipl. Architect

Chair in Sociology and Social History of Towns
Faculty of Architecture
BAUHAUS University Weimar

arne.loeper@tolerante-landschaft.de

Summary: Climate change is considered to be one of mankind's most serious problems. Cities are of outstanding importance in combating the accompanying risks. The project "The Tolerant Landscape" deals with adaptation and mitigation issues at an urban scale. This contribution concentrates on the impacts on low-lying areas along rivers and coastal zones like Hamburg-Wilhelmsburg, the case study of the project. These flood-prone areas are vulnerable to extreme natural events. To achieve sustainable urban structures an adaptation of the building environment towards a controlled temporary floodable structure is essential. There is a need for strengthening the risk perception and awareness of flood plain occupants to change their behavior in the case of exposure to a hazardous incident.

Key Words: Climate change, urban scale, physical vulnerability, social vulnerability, extreme natural event, tolerant landscape, Hamburg-Wilhelmsburg, floodable structures, cascading compartments, multiple-coded interspaces, risk awareness.

THE TOLERANT LANDSCAPE
STRATEGIES FOR A LESS VULNERABLE URBAN ENVIRONMENT

I. INTRODUCTION

For three decades climate scientists and meteorologists have debated the phenomenon of global climate change. The anthropogenic impact of industrialized and emerging nations on global warming cannot be denied any longer. Since the release of the 4th IPCC Assessment Report (AR4) in winter and spring 2007, the issue has risen to the forefront and the discussion has become indispensable to the general public. The Working Group II Report "Impacts, Adaptation and Vulnerability" concentrates specifically on the climate impacts of human civilizations and ecosystems worldwide. One of the central findings of the Working Group II is that climate change is with "*high confidence*"[1] not preventable anymore (IPCC, 2007).

That means that today global climate change is considered to be one of the most serious present-day and future problems of mankind. It will challenge all areas of (urban) life and demands many interdisciplinary and comprehensive efforts to keep the most unlikely anticipated consequences at an endurable scale. Prof. H. J. Schellnhuber[2], director of the Potsdam Institute for Climate Impact Research, pointed out that urban regions have to tackle three essential future trends (Schellnhuber, 2008):

1. Warming of the atmosphere;
2. Growing interaction of dryness and intense rain;
3. Rising sea level.

Cities are of outstanding importance in combating the accompanying risks of global climate change, as on the one hand they produce approximately 80% of anthropogenic greenhouse gas emissions and on the other hand they are highly vulnerable to environmental threats (Rahmstorf / Schellnhuber, 2007).

"The Tolerant Landscape Project" incorporates both, mitigation and adaptation, the two main strategies to confront global climate change. This paper concentrates mainly on how to cope with

1 : Terminology for the degree of confidence in being correct defined by the IPCC Forth Assessment Report (IPCC, 2007)

2 : Hans Joachim Schellnhuber is a prominent German climatologist; Founding Director of the Potsdam Institute for Climate Impact Research (PIK); Distinguished Science Advisor for the Tyndall Centre; Longstanding Member of the Intergovernmental Panel on Climate Change (IPCC); Chief Government Advisor on Climate & Related Issues for the German G8-EU twin presidency in 2007; Member of the High-Level Expert Group on Energy & Climate Change advising J.M. Barroso, President of the European Commission.

the impacts of climate change on low-lying areas along rivers and coastal zones. The aim of the project is to identify, illustrate and formulate sustainable and progressive urban planning strategies for flood endangered urban regions.

The research describes a combination of possible integrated adaptation and mitigation issues in an urban scale. It outlines scientific perspectives on the issue of how to improve or transform the urban and cultural landscape in order to limit physical and social vulnerability to environmental threats.

The findings are applicable for growing metropolises with similar future challenges like Hamburg-Wilhelmsburg, which the case study of the project examines. Wilhelmsburg is a former and partly present-day harbour district that is based on a river island on the south side of Hamburg. There coexist both, a high physical vulnerability and a socially vulnerable and marginalized population. The city of Hamburg intends to transform the district. The intention is to develop a climate friendly and resilient urban quarter in the course of the International Building Exhibition (IBA) 2013.

It is predicted that the current intentions to develop Wilhelmsburg with this degree of flood protection are not sustainable in the long term and will fail if the projected impacts of climate change become reality.

> *„Disasters will happen. To lessen their impacts in the future, we need to reduce our social vulnerability and increase disaster resilience with improvements in the social conditions and living standards in our cities. We need to build (and rebuild) damaged housing and infrastructure in harmony with nature and design cities to be resilient to environmental threats even if it means smaller, more liveable places, and fewer profits for land and urban developers and a smaller tax base for the city (Cutter, 2006).“*

The project has been personally initiated by the author and is supported by the Chair in Sociology and Social History of Towns, Faculty of Architecture, Bauhaus University Weimar and the Institute for River and Coastal Engineering, Technical University Hamburg-Harburg. The research involves a combination of qualitative interviews with interdisciplinary experts from governmental and non-governmental organizations, literature based research, experiments and simulations.

II. GENERAL PRESUMPTIONS AND BACKGROUND ANALYSIS

1. Climate Impacts on Urban and Cultural Landscapes

There is no doubt, global climate change will usher another paradigm shift in urbanism. The evidence of the projected scenarios of the IPCC will force the societies to reflect their behaviour concerning the immediate of environmental threats (IPCC, 2007). Generally the system “Town” has been dissociated from its natural environment in modern times. This has happened because

of technical advancements and excessive cultivation (Beck, 2007). Both have had enormous impacts on the environment. Climate change reverses the process and is getting inexorably hazardous for the livelihood of many societies. Towns and urban agglomerations have to assume that many of their conditions and protective mechanisms will shift adversely. Global warming will directly influence urban heat islands, the growth and diversity of vegetation, food and energy production, the health and welfare of urban residents, drinking water supply and floodwaters (Dow / Downing, 2007). But, the conditions will vary depending on prevailing regional circumstances. On the one hand already drought-bothered regions will be confronted by worsening drought, flash floods and soil erosion. On the other hand many coastal regions will have to tackle stronger intense rain and storm surges. Coastal Cities have to prepare for increasing water quantity inside the urban boundaries (Dow / Downing, 2007). That raises the question, "How sustainable are settlement strategies in low-lying urban areas?" The answer is that we have three alternatives for the long-term:

First, there is a need for permanent measures to strengthen levees, flood control measures and municipal drainage systems with immense technical and financial efforts to keep the "expected" impairments at an endurable scale. These institutional efforts lead to three consequences, although they are combined with information campaigns.

1. If a hazardous natural event doesn't occur for a long time, the risk awareness and the municipal preparedness will erode (APFM, 2006). [Subliminal oblivious danger]

2. Large technical protection issues carry the risk, in case of technical failure, that the protected inhabitants are not able to resist the hazard. In these cases a catastrophe with a great number of victims must be expected (APFM, 2006).

3. The limits of adaptation will be dictated by overcrowding costs and the political response concerning an obviously increasing risk of collapsing institutional protection systems.

The second alternative involves the adaptation or integration of the building environment towards a controlled temporary floodable structure. The buildings must be constructed to withstand natural shocks. This strategy intends to keep the flood waves low through providing floodplains inside the urban fabric. It also includes sump drainage. The goal must be to develop distinctive quarters in harmony and coexistence with nature (Cutter, 2006).

Finally, one can discuss the surrender of urban areas and retreat of hazardous low-lying sites. This would be the last option. It would be adherent with unpopular resettlement programmes (FEMA, 1998; Hornemann / Rechenberg, 2006).

Global Warming will definitely force the modern societies to a cultural rearrangement of the relation between civilizations and nature. The rising sea levels make coastal cities immediately vulnerable to future calamity.

Table 1: FACTORS CONTRIBUTING TO FLOODING

Meteorological Factors	Hydrological Factors	Human Factors
• Rainfall • Cyclonic storms • Small-scale storms • Temperature • Snowfall and snowmelt • Cyclones	• Soil moisture level • Groundwater level prior to storm • Surface infiltration rate affected by vegetation, soil texture, density, structure and soil moisture. • Presence of impervious cover such as snow and ice • Channel cross-sectional shape and roughness • Synchronization of run-offs from various parts of watershed	• Land-use activities such as urbanization increase run-off volume and rate • Occupation of the flood plain obstructing flows • Structural flood control measures such as embankments in the upstream • Greenhouse gas emissions which may affect climate change and frequency and magnitude of precipitation events • Decrease in conveyance of the river channels owing to build up of river debis, restriction of waterways, dumping of mineral, wastes and rubbish • Mining and other industries alter water regimes, pollute water channels and affect ecosystems; can also alter water courses

Source: APFM, 2006

2. The Geography and Topography Elbe-Isle

The Elbe-Isle is located in Hamburg, in close proximity to the south of the historical centre. The river island is situated in a glacial valley approximately 110 kilometers upstream of its estuary mouth. The Isle is integrated into the Elbe-Estuary, surrounded by the two main side arms: The Norderelbe (northern stream) and the Süderelbe (southern stream). With a size of fifty-two square kilometers the Elbe-Isle is the largest European river island (SUL, 2008).

In spite of the long distance between the town and the coast, the river inside the urban area is still highly influenced by the tidal conditions of the North Sea. This effect has formed one of the most dynamic water landscapes in the world. The tide expands 179 kilometers inbound up against the man-made Elbe flood barriers of Geesthacht[3] twice a day. The difference between mean high

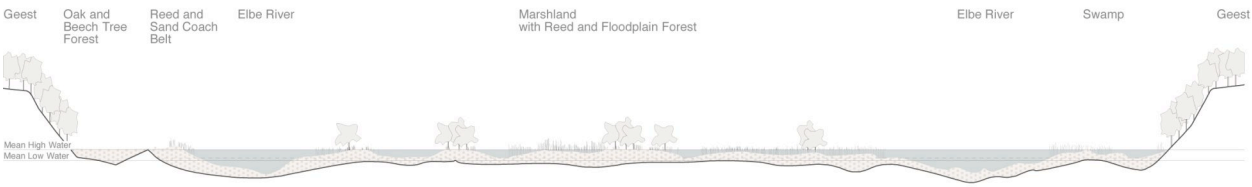
3 : Town eastwards of Hamburg (see on Figure 1) below

tide and mean low tide is three and a half meters in Hamburg. The natural condition of the islands was a tide influenced temporary floodplain [like a sandbank] (SUL, 2008).

FIGURE 1: THE "UNTERELBE" – THE TIDE-INFLUENCED STREAM COURSE BETWEEN GEESTHACHT AND THE NORTH SEA

This map shows the tide-influenced part of the river Elbe ("Unterelbe") and its estuary mouth. The flood-prone dyke-protected areas are lightly grey marked.
Source: SUL, 2008, modified by the author

FIGURE 2: ABORGINAL TOPOGRAPHY OF THE ELBE ISLAND



This section describes the aboriginal topography of the Elbe Island. The marshland was able to absorb huge amounts of water, coming from tide dynamics and storm surges.
Source: SUL, 2008, modified by the author

3. Human Activities and Settlements

In the medieval time, human activities like dyking for land reclamation and farming started on the island. Insular dwelling mounds arose. Since these times the human activities increased continuously over centuries and the natural function of the island was displaced more and more.

FIGURE 3: PRE-MODERN EVOLUTION OF THE ELBE ISLAND

The pre-modern Elbe Island within the river Elbe (grey colour) was transformed complied with nature. To the beginning of the 13th century the large Island Görriswerder showed a coherent empty area (first figure). From the 17th century on the archipelagos were segmented into smaller islands as a consequence of impoldered areas (reddish colour, figures 2 and 3).
Source: SUL, 2008, modified by the author

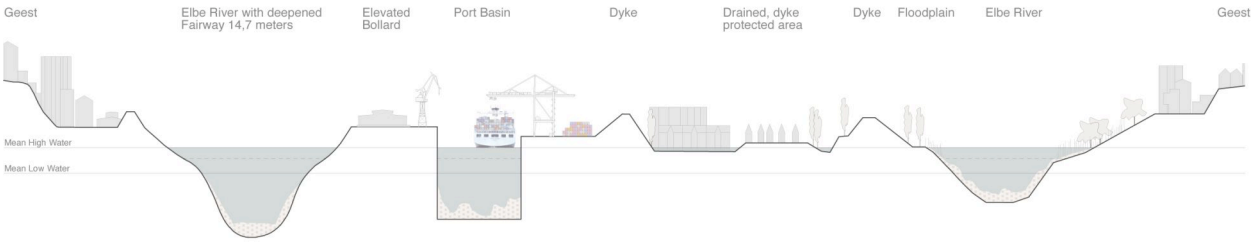
Today the naturally dynamic water topographies are widely eradicated. The result is an artificial cultural and urban landscape with a quite complex and sensitive land drainage system. The

northern and the western part of the Island is occupied and shaped by the harbour with port basins, docks and large-scale traffic infrastructure systems like railroad tracks and motorways. During the 1920's Fritz Schumacher, former director of Hamburg's building and urban development authority established the absolute priority that all new residential quarters be built on the higher situated north side of the river because of the high expenses for flood protection on the Elbe Island (BSU, 2005). This changed in the period of National Socialism when the industrialization of the Island began and more central areas were occupied. The existing settlements for dockworkers, which were established attached to the factories, shipyards and port facilities, had to be extended (BSU, 2005). In contrast, to that the southeastern part of the Island was always sparsely populated by single farmsteads with a highly adapted way of life. Today the Elbe isle accommodates the districts of Wilhelmsburg and Veddel and totals approximately 49.000 inhabitants (SAHSH, 2007). The districts have to handle a huge image problem. The population is widely dominated by socially marginalized groups such as immigrants (many without German language skills), low-educated, unemployed and other socially disadvantaged groups. Over decades Wilhelmsburg and Veddel were regarded to be the place, where all disagreeable was collected, especially by the mostly gentrified quarters of the north of Hamburg (BSU, 2005).

FIGURE 4: (POST) MODERN EVOLUTION OF THE ELBE ISLAND

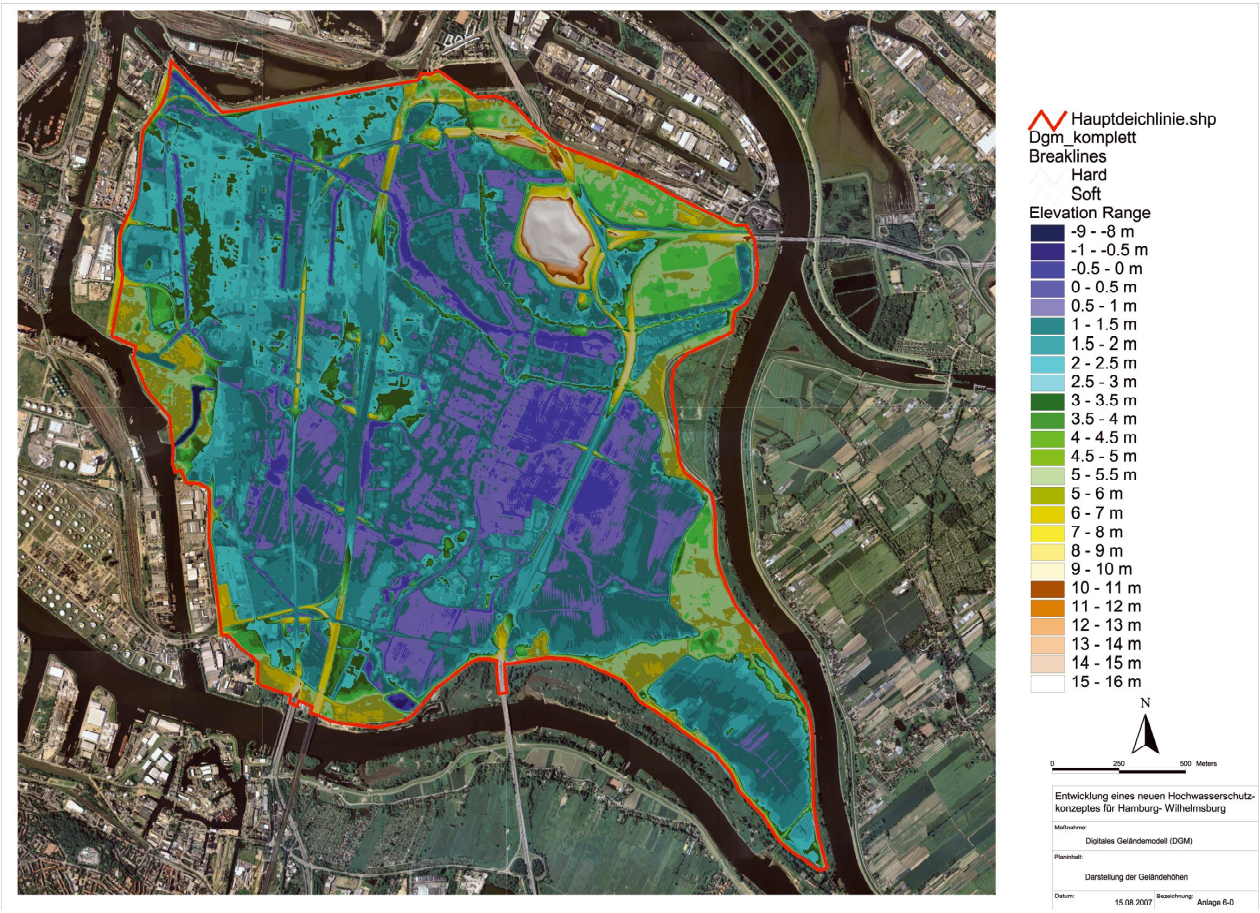
The (post-) modern Elbe Island has been developed to a man-made artificial urban landscape, with port facilities (dark blue) and other impoldered urban quarters (reddish colour). Municipal areas are shown in light grey. During the evolution the island has forfeited the ability to absorb tide dynamics and floodwaters.
Source: SUL, 2008, modified by the author

FIGURE 5: PRESENT-DAY TOPOGRAPHY OF THE ELBE ISLAND



The present-day Elbe Island is dominated by (former) port facilities and a complex canal-system. Dykes protect all settlements against tide-dynamics and floodwaters as you can see in the section.
Source: SUL, 2008, modified by the author

FIGURE 6: DIGITAL TERRAIN MODEL OF THE PRESENT-DAY TOPOGRAPHY



Large parts of the impoldered Elbe isle (red border) would be normally highly tide influenced twice a day because of its elevation range (mean high water +2,09 m). Dark blue areas are the lowest lying areas (compare legend).
Source: TUHH, unpublished map, 2007

4. The winter storm Vincinette

It is well known that the Elbe isle is a hazardous place. Heavy storm surges with destructive impacts happened numerous times in the past. The most famous flood was at the 16th February 1962. The calamity was the tragic outcome of the winter storm Vincinette. In the course of this devastating natural event more than 300 people drowned or were struck dead after the dykes collapsed in many places. The size of the catastrophe can be traced back to the fact that the inhabitants were unprepared, the authorities and emergency agents overburden and the levees decrepit. The major lessons the authorities learned were to strengthen the institutional emergency management and to start a program for reshaping and heightening the dykes (Herlin, 2005).

III. MODERN CITIES AND NATURE - THE SOCIOLOGY OF ROOT CAUSES

In order to confront the future challenges of climate change it is of fundamental importance to get knowledge about the predominant urban characteristics of a place. Especially unsafe physical conditions, sociocultural circumstances and the vulnerability of the resident population are of highest importance. Disasters are the result of the interaction between vulnerability and hazards (Wisner, Blaikie et al., 2005).

> *"It is the interaction between nature and society that produces the vulnerability of places" (Cutter, 2006: 3).*

The causes, which evoke vulnerability, are wide spread. Two of them are essential for the approach to a "Tolerant Landscape":

5. Risk and vulnerability as sociocultural heritage of modernization shifts

The German sociologist Ulrich Beck exposes that vulnerability has a future reference but is based on the "cultural wounds" of the past (Beck, 2007; Hilhorst/Bankoff, 2004; Bankoff, 2004). That means basically that we have to look back into the past to understand why vulnerability arose.

Cities are always the image of multidimensional processes, which are defined by social, geographical, ecological, economical and political drivers. This implies that human civilization always adapted their settlements to the topological, geographical, and climatic conditions of the surrounding environment. Complied with cultural evolution specific local/regional settlement and building typologies were developed. These traditional typologies emerged and were adapted continuously in line with the slow spatial and climatic variances over a long period. It was possible to presume the essential prevailing conditions to be constant for generations. With the rise of industrialization and foremost the initiation of modernization a break in the constant evolution happened. In this time the social, economical and political drivers broke open the compact urban structures. The "new" cities developed along existing and new transportation corridors of the industrialized world such as railroad tracks, rivers, canals and roads. The desire

to exclude everything disagreeable outside the cities was abandoned through the belief that mankind is able to dominate the world by technical, institutional and rational solutions, including nature (Beck, 1992).

From today's perspective, this impetus towards unlimited expansion did not involve only positive achievements. With modern comforts lots of unexpected side effects came up. The disengagement of the modern societies from their environment concerning perception and behaviour can be characterized by three main aspects:

1. Institutionalization
2. Dangerous sense of security
3. The loss of context-relations

Institutionalization | In contrast to the traditional social order modern individuals are initially free of social ties like classes, collective, clans and families. In parallel with the decline of these traditional community ties that provide interdependent and cooperative help and protection a process comes up that Beck describes with the terms *"institutionalization and standardization"* (Beck, 1992). This means that the redundant individuals fall into line of self-elected dependences. This can be distinguished as a shift from the (post) traditional / pre-modern community arranged social order to a society regulated social system (Beck, Giddens, et al., 1994). Simultaneously with the disappearance of the traditional interdependences and cooperatives the cultural reproduction of the traditional knowledge and experiences about how to deal with environmental threats are not receivable anymore (Beck, 1992). The erosion of (collective) self-protection skills and local knowledge implicates that individuals are totally dependent on institutional protection mechanism and their unimpeachable effectivity. Beck identified this as *"disappropriation of discernment"* (Beck, 2007). It illustrates the transformation from "*knowledge"* to "*unawareness"* or rather "*not able to know" (no / limited access to knowledge)* and from the *"own power of judgement"* to *"blind thrust in institutions"*.

The "references of the past", the reminders of endured experiences are essential to evaluate the exposure of multidimensional stressors such as the anticipation of hazardous incidents in a specific context (de Vries, 2007).

Dangerous sense of security | Another sign for the erosion of local, historical knowledge is the faith in technology and the trust in the advance of modern societies. Beck stressed that the un-reflected trust in large-scale technical solutions, which are institutionalized and under stewardship of experts are the true danger (Giddens, 1991; Beck, 2007). Each big solution inheres big risks!

> *"Where large-scale structural flood control measures, such as dykes, reservoirs, levees and floodwall have been constructed, protected communities generate a false sense of security over a period of time « (APFM, 2006: 10)."*

In this coherency Lee Clarke and James Short pointed out that effective management of public known risks (flood, air pollution, crime, economical crises, climate change, etc.) and institutional legitimacy are based on the trust of humans in a significant way (Short/Clarke, 1993). This trust in Institutions will be distressed if great shortcomings or more or less loss of control concerning risk management is getting obvious (admitted or not deniable). Beck sees the reason for these institutional failures in the need of constant institutional effort to get control of the uncontrollable, the unknown risks (Beck, 2007). Trust in institutions has to sustain its position everyday. The bigger the supposed technical solution, the more hazardous the breakdown will be in case of failure. The effort to cope with catastrophic risks often creates the real potential of a catastrophe (Beck, 2007). Obviously extreme natural events are turning into catastrophes because of anthropogenic decisions, social disparities, and incoherent historical developments, which produced risks (APFM, 2006; Alexander, 2000).

Whenever protection systems avert danger from extreme natural events the trust in big technical issues and institutionalization increases. The bias of modern individuals to disbelieve unexperienced catastrophes is identified by de Vries as an absence of the cognitive level (de Vries, 2007).

The loss of context-relations | the loss of context-relations means that the close-up range of a place disappears more and more in the perception of modern Individuals (Beck, 1992). This is in contrast to the traditional way of life where the close-up range matched the living space. The reasons for these trends are based on the modernization and individualization shifts of societies. It can become apparent in long distances between social environments (working, living and social bounding). While in former generations the whole life took place in local rather rural communities or neighborhoods (social environment = context), modern individuals have to commute long distances (Beck, 1992; Giddens, 1991). The speed of modern lifestyles evokes blindness for the nearby context. The reality of modern conduct of life builds on consisted social environments (social environment = $\sum$ of all context fragments). The "placeless" way of life makes modern individuals vulnerable to specific risks in a specific context. It can be estimated as a lack of the cognitive risk perception. That means basically that the correct interpretation of signals does not work.

Box 1

On 26th December 2004 the undersea **Indian Ocean earthquake** reached a magnitude of 9.1 on the Richter scale. More than 225.000 people fell victim to the released disastrous tsunami. The most affected countries were Indonesia, Thailand, Sri Lanka and India. Many people recognized the natural warning signs of the receding ocean and frothing bubbles minutes before the first wave stroked the land but few victims were alert to the danger. Instead of evacuating the beaches people got curious and walked there.

The Andaman Islands were also badly affected by the tsunami. Protected native tribes populate the Isles. These indigenous people were able to interpret the natural signs and escaped from the coastal area. They suffered few to no losses.

6. The correlation of social and physical vulnerability

After a catastrophe happens it gets obvious that coherencies between physical and social vulnerability exists. Marginalized groups such as the poor, females, children and the elderly have the highest vulnerability (Wisner, Blaikie et al., 2005; Cutter, 2006; Warner, 2007). The degree of vulnerability can additionally increase though ethnical, cultural, social, and structural disadvantages like segregation and parallel societies (Wisner, Blaikie et al., 2005; Cutter, 2006). Social vulnerability is the consequence of intrasocial lapses and efforts (Beck, 2007). For instance, the inner city poor are most frequently the dwellers of places with highest vulnerability. The reasons are most affordable rents and land prices. In parallel with the statistical rise of exposure to extreme natural events (as outcome of climate change) the hazardous risks for disasters of these urban quarters increases (IPCC, 2007). As a consequence of unfortunate circumstances the land prices and real estate values in these urban areas decrease which accelerates segregation trends. Beck evaluates this ecological expropriation as a historical novelty of capital depreciation in spite of constant structure of ownership (Beck, 2007).

> *"While physical vulnerability is reduced through the construction of disaster-resistant buildings, changes in land use, and restoration of wetlands and floodways, a marked reduction in social vulnerability will require an improvement in the overall quality of life for the inner city poor« (Cutter, 2006: 3)."*

IV. *"THE TOLERANT LANDSCAPE"* - FUNDAMENTAL APPROACHES BASED ON RESEARCH FINDINGS

The "Tolerant Landscape" Research Project is focusing in detail on mitigation and adaptation efforts to face climate change in flood-prone areas. The idea implies an interaction of natural, cultural and urban features in one place. The project postulates that urban development in flood-prone areas with its special conditions cannot become successful, if the development proves to be contrary to nature. "Tolerance" is a synonym for mutual acceptance and fault-tolerance (resilience) between the needs of urban structures and it dwellers on the one hand and nature on the other hand.

7. Three in One: Natural Landscape – Cultural Landscape – Urban Landscape

The following ideas are basic principles for the concept of "Tolerant Landscape". The focus lies on the cohesion of cities in a time of climate change. Aspects such as mitigation and adaptation, social and physical vulnerability, tradition and sustainability are considered. Modern cities were developed in contrast to the natural environment, as mentioned above (Sieverts, 1999). In multidimensional cultivation processes the aboriginal landscape was transformed to cultural and urban areas. One outstanding intention of the International Building Exhibition 2013 memorandum (IBA Hamburg Wilhelmsburg) which is reflected in the case study of the "Tolerant Landscape" is a renunciation from the "dictatorship of the necessity of technical control of water and flood protection" and to cultivate the development of the numerous

waterfronts (BSU, 2005). This requires a (re)transformation of existing artificial urban landscape.

What would a (re)transformation look like? – post industrial or superrural? The answer is not a return to the initial status of the context. It focuses on the reintegration of the aboriginal functionality of the marsh landscape and the reimplementation and modification of traditional settlement typologies in flood-prone areas.

Recovering the original functionality of marshlands | The prevailing characteristic of a marshland is the ability to absorb, to buffer, and to release floodwaters. This feature is called dynamic retention capability. In urban areas this ability is strongly restricted by structural flood protection measures. The measures are one significant cause for the physical vulnerability of towns with regard to flooding. In (man-made) narrowed fluvial topographies relentless flooding of waters can overrun the catchment ability with an increase of mortal danger to affected dwellers as a consequence [Jakarta, March 2009]. The re-dynamisation of retention capabilities is important to improve the resilience of urban areas and to obtain safer environments.

Dyking of the Elbe-Island also increased the flood danger for the historically densely populated north bank in the past. The existing structures hardly provide any adaptation capacities. It will worsen in terms of climate change if the flood management practice will continue unmodified.

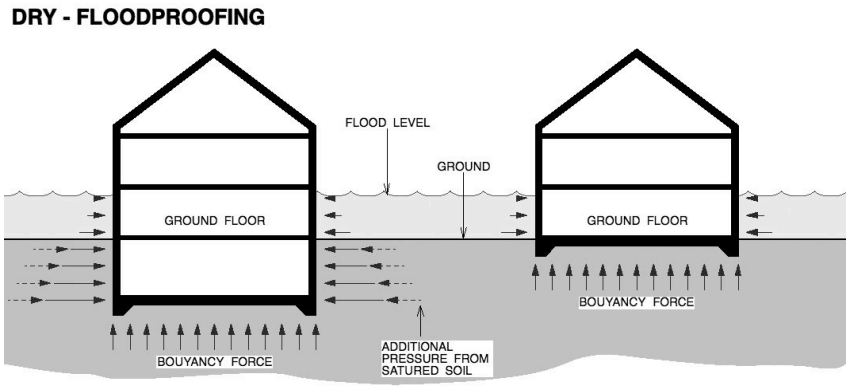
Floodwater-resisting construction methods | A paradigm shift to a re-dynamisation of marshlands, such as controlled temporary flooding, requires floodwater-resisting construction. Representative examples for these typologies still exist but must be modified to match the present-day and prospective demands. For instance dwelling mounds, along causeways arranged buildings with elevated entrances, and houses built on stilts are long-time approved building methods along the Friesian coast (North Germany and the Netherlands). The right interpretation of these mostly rural building and settlement typologies and the integration into dense urban structures will be of importance.

In addition traditional but modified construction methods could involve specified typologies like bridges that are host living and commercial facilities [Ponte Vecchio/Florence, Ponte Rialto/Venice or Kraemerbruecke/Erfurt], buildings on floatable platforms, and houseboats. Fundamental to all new construction in the lowest-lying areas is the reduction of ground-contacted structures such as basements and inhabited ground floors. The design criterion of new developments is the resistance to the most destructive natural flood events, which are expectable for the next hundred years.

Possible solutions for technical water proofing and physical protection of existing nonspecified buildings are approved and available. Established methods are:

1. Dry floodproofing: This is the umbrella term for different construction methods, which make buildings watertight (FEMA, 1995).

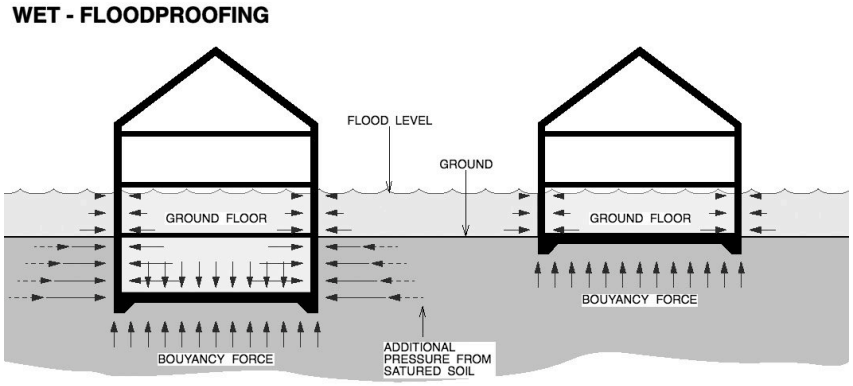
FIGURE 7: DRY-FLOODPROOFING



All measures of Dry-Floodproofing intend to keep flood waters outside of the building constructions (vertical sealing).
Source: Author, unpublished scheme, 2009

2. Wet floodproofing: Wet proofing means the controlled flooding of basements and ground floors in order to release the floodwater pressure from the bearing building structures (FEMA, 1995).

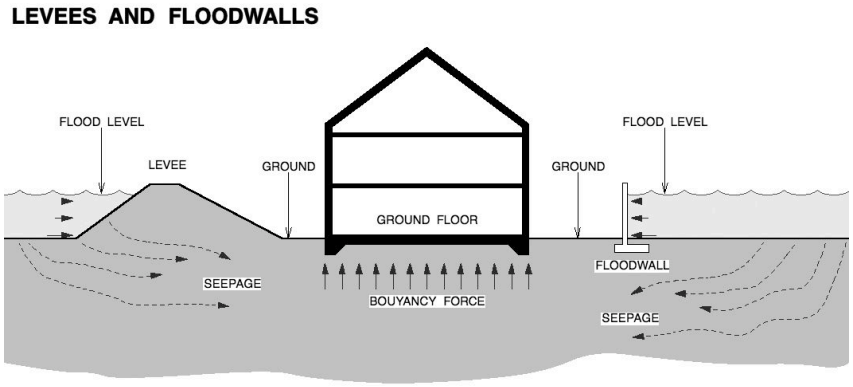
FIGURE 8: WET-FLOODPROOFING



Wet-Floodproofing intends to reduce the water pressure on the construction through flooding the ground floor and basement. To keep the upper floors dry a horizontal sealing above the ground floor is of high importance.
Source: Author, unpublished scheme, 2009

3. Floodwalls: Floodwalls are basically distinguishable into two installations – permanent and temporary positioned barriers. Their intention is to keep floods out of protected areas (FEMA, 1995).

FIGURE 9: LEVEES AND FLOODWALLS



Levees and floodwalls shown here are the most common flood-protection measures. These kinds of solution need much space and lower spatial urban qualities in general.
Source: Author, unpublished scheme, 2009

To decrease the vulnerability of main traffic infrastructure systems like arterial roads, railroad tracks and motorways they should be elevated like causeways and bridges.

Dosed exposure to dwellers | To regain dwellers sensitivity for risks in an urban context and how to elude hazardous damages it is necessary to make them familiar with the specific environmental threats. (Dosed) exposure to extreme natural events is a physiological catalyst to improve the resilience of the dwellers and to decrease their vulnerability. This does not mean to expose dwellers to a "little catastrophe", but every training course will fail in the long-term if they are not substantiated by authentic experiences. The strategy of temporary controlled flood events in addition to adapted living standards is the most promising way to establish a sustainable flood risk perception.

Integrative urban environment | The multiple-coded interspaces between the different elevated urban structures (see above) is the basis layer for the concept of the "Tolerant Landscape". It provides transition areas for renaturation, grassland, flood plains, rainwater infiltration and evaporation, natural ventilation, canals, recreation, and networks for non-motorized modes of mobility. To reduce the flow velocity of incoming floodwaters, small afforested and dwelling mounds can form natural barriers. The integrative urban environment includes an adjustment of interaction between natural and human demands. This highly specified landscape enables a reduction of expensive and difficult adaptable municipal canalization systems by decentralized sump drainage. This measure decreases the probability of technical failure in a significant way.

Local food and energy production | Local food and energy production can be considered as a mitigation aspect to climate change, but it is also an adaptation facet regarding the security of supply. Small networks of decentralized producers and variable methods of production are more stable then one huge institutional solution [security through diversity]. For local / urban food production allotment gardens on top of platform roofs and stacked / multi-storey greenhouses are unusual but thinkable in the future (Sieverts, 2004). The flood plains can be used, if they are not affected by saltwater infiltrations, as cattle meadows or meadow orchards.

Concerning energy production, the "Tolerant Landscape" focuses preferential on renewable energies. Combined heat and power generation (CHP), biomass energy, wind turbines, photovoltaic, solar thermal collector systems and (near-surface) geothermal energy are the most established and applicable renewable energy sources.

A multiple-shift usage of urban facilities for the different needs illustrates the most efficient way to minimize investments and maximize success in the case of emissions reduction (Loeper, 2007).

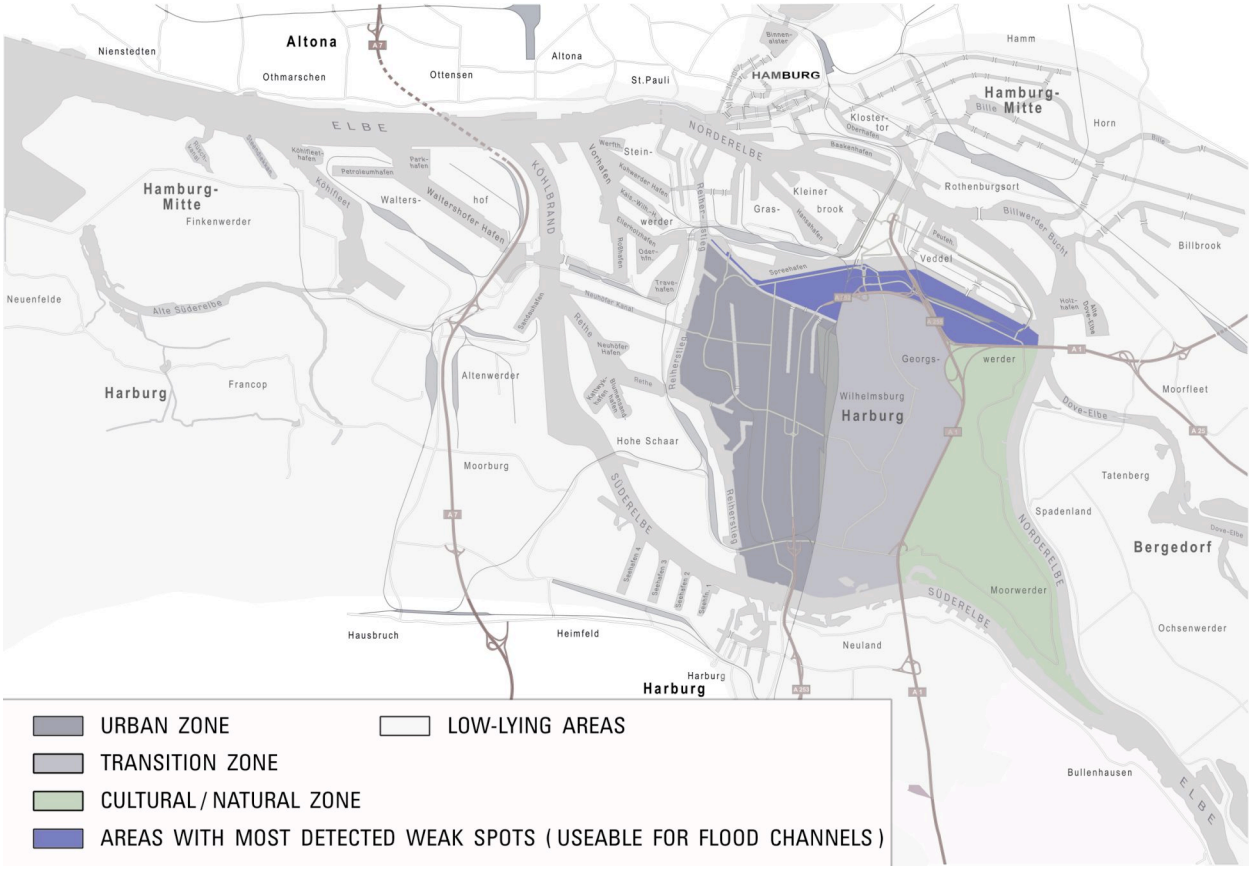
8. Approaches of the IBA-Lab 2009 - Climate Impact Management for the Elbe-Isles

The workshop 1 of the IBA-Lab 2009 concentrated on the development of floodwater risk reduction strategies in urban planning. It was moderated by Prof. Dr.-Ing. Erik Pasche, head of the Institute for River and Coastal Engineering, Technical University Hamburg-Harburg and his team. The compiled results for a long-term strategy (today until 2100) combine the principles of the "Tolerant Landscape" idea and scientific experiments of the Institute for River and Coastal Engineering:

The island is divided in three distinctive zones – western zone, central zone, and eastern zone. These zones are interlinked through diverse land and water connections. Especially in terms of flood management the spatial conditions and divisions are used as multi-scaled "cascading compartments". The macro-scale differentiation of the compartments relates to the three zones. The micro-scale distinction is based on smaller units such as the urban fabric (town blocks for instance), retention basins, or physical farmland separations. The objective is a controlled flooding of the compartments. For the success of this concept it is essential to locate the most (physical) vulnerable spots. These must be fitted with intake structures to release the flood pressure. These intake structures are connected with the macro-compartments through surface bypasses (flood channels). Inside the macro-compartments, the cascading micro-compartments are organized like honeycombs, which fill-up continuously.

The detected weak spots are located in the northwestern and western part of the Elbe isle. They are the "Spreehafen" and the Ernst-August-Channel in the north and some smaller harbour channels in the west.

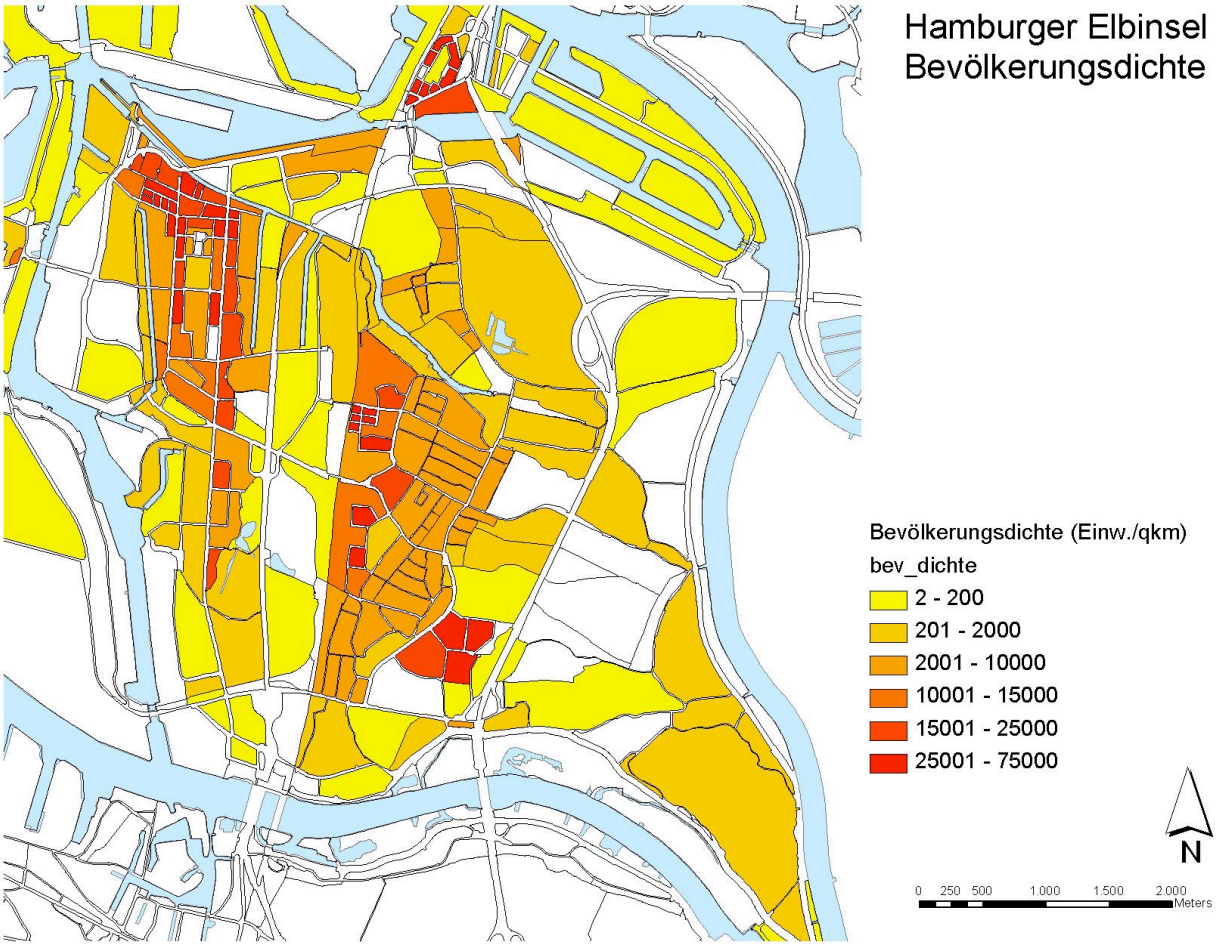
FIGURE 10: ZONING PLAN



The concept of cascading compartments divides the island into three distinctive zones. These zones serve as macro-compartments. Week spot areas (blue) compensate and dispense floodwaters to the macro-compartments through bypass channels (see text).
Source: Author, unpublished map, 2009

Urban zone (west) | The western zone is the most densely populated area of the island. It is located between the downstream relocating port facilities in the west and the track superstructure as its eastern spatial division. The whole water landscape (canals, bypasses, and harbour basins) is affected by dynamic tidal conditions twice a day. This zone is the most physically vulnerable urban structure regarding flood risks. That means that the most intake structures have to be located here. And also, there is a big demand of flood resistant building design. The limited floodwater catchment of this area forces prompt sub-distribution of the incoming water to the other compartments. It is expected that the intention to develop these harbour areas and waterfronts over the next decades in likely. The transformation of this zone opens opportunities to design a flood resistant and distinctive quarter.

FIGURE 11: DENSITY OF POPULATION



This map shows the density of the population on the Elbe Island (inhabitants per square kilometer, coloured clusters compare legend). The red scopes are most densely occupied.
Source: TUHH, unpublished map, 2007

Transition zone (central) | The present-day appearance of this macro-compartment is dominated by suburban developments of the last five decades. This zone must be transformed in the most radical way to a distinctive landscape during this century. In order to save urban developments of the western zone this zone has to absorb huge water volumes. Cascading micro-compartments with causeways and densely attached building structures could fulfill the task.

Cultural / natural zone (east) | This sparsely populated zone should be obtained in its traditional conditions. Because this zone has the largest floodwater catchment capacity, the compartment is of highest significance for worst-case scenarios.

V. CONCLUSION AND FURTHER RESEARCH

All new development must be liable to a consequent concept of specific local mitigation and adaptation measures. To keep the most unlikely anticipated consequences of global climate change at an endurable scale a fundamental shift of the present-day fossil based urban layout to a more efficient, harmonious and resilient post fossil urban design and configuration is demanded.

Furthermore, integrated urban flood management must consider whole urban areas independent of administrative borders. In times of increasing extreme natural threats on coastal cities, town planners and decision makers have to consider a controlled temporary flooding of urban areas in cases of unexpected strong hazards to keep the capacity to act. The concept of cascading compartments demonstrates promising aspects of urban development and design for flood prone urban areas.

In addition all sustainable construction in flood-prone urban regions must withstand temporary flooding. Applicable measures have been developed and are available. The challenges ahead concentrate more on the retrofitting of existing urban structures (especially buildings and places of cultural importance).

Finally, attempts to reduce the vulnerability of inhabitats of a reduction of low-lying areas can still not avoid a catastrophe (in cases of collapsing institutional flood protection) if urban flood management concentrates on physical measures only. Training courses can be successful in the long-term if they are substantiated by authentic flood experiences. The strategy of temporary controlled flood events in addition to an adaptation of living and building standards is the most promising way to establish sustainable flood risk perception and awareness.

VI. BIBLIOGRAPHY

Journals:

Clarke, L., Short Jr., J. F., (1993) "Social Organization and Risk: Some Current Controversies." *Annual Review of Sociology*, 19, 375-399.

Books and Reports:

Alexander, D. (2000) *Confronting Catastrophe – New Perspectives on natural disasters*, Oxfort University Press, New York

APFM – Associated Programme on Flood Management (2006) *Social Aspects and Stakeholder Involvement in Integrated Flood Management*, WMO - World Meteorological Organization, Geneva

Beck, U. (1992) *Risk Society: Towards a New Modernity,* 1st Ed., Sage Publications, London

Beck, U., Giddens A., Lash, S., (1994) *Reflexive Modernization. Politics, Tradition and Aesthetics in the Modern Social Order,* 1st Ed., Stanford University Press, Stanford

Beck, U. (2007) *Weltrisikogesellschaft,* 1st Ed., Suhrkamp Verlag, Frankfurt/Main

Dow, C., Downing, T. E., (2007) *The Atlas of Climate Change: Mapping the World's Greatest Challenge,* Earthscan, London

FEMA – Federal Emergency Management Agency (1995) *Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings*, Mitigation Directorate, Washington, DC

FEMA – Federal Emergency Management Agency (1998) *Homeowner's Guide to Retrofitting: Six Ways to Protect Your House from Flooding*, Mitigation Directorate, Washington, DC

Giddens, A. (1991) *The Consequences of Modernity*, 1st Ed., Stanford University Press, Stanford

Herlin, H., (2005) *Die Sturmflut – Nordseeküste und Hamburg im Februar 1962*, Die Hanse in der europäischen Verlagsanstalt, Hamburg

Hornemann, C., Rechenberg, J., (2006) *Was Sie über vorsorgenden Hochwasserschutz wissen sollten.* Umweltbundesamt, Dessau

IPCC - Intergovernmental Panel on Climate Change (2007) *Climate Change 2007: Impacts, Adaptation and Vulnerability. IPCC Working Group 2 Contribution to the Fourth Assessment Report.* Cambridge University Press, Cambridge

Rahmstorf, S., Schellnhuber, H.J., (2007) *Der Klimawandel: Diagnose, Prognose, Therapie,* Verlag C. H. Beck, München

Sieverts, T., (1999) *Zwischenstadt – Zwischen Ort und Welt, Raum und Zeit*, Birkhäuser – Verlag für Architektur, Basel

SAHSH - Statistisches Amt für Hamburg und Schleswig-Holstein, (2007) *Statistisches Jahrbuch Hamburg 2006/2007,* Statistisches Amt für Hamburg und Schleswig-Holstein, Hamburg

SUL - Studio Urbane Landschaften (2008) *Wasseratlas – WasserLand-Typologien für die Hamburger Elbinsel*, Jovis Verlag, Berlin

Wisner, B., Blaikie, P., Cannon, T., Davis, I., (2004) *At Risk: Natural Hazards, People's Vulnerability and Disasters*, Routledge, London

Chapter in a Book:

Bankoff, G. (2004) *"The Historical Geography of Disaster: Vulnerability and Local Knowledge"* in Bankoff, G., Hilhorst, D., Frerks, G., editors. Mapping Vulnerability: Disasters, Development and People, Earthscan, London, 25-36.

De Vries, D. H., (2007) *"Being Temporal and Vulnerability to Natural Disasters."* In Bohle H.-G., Warner, K., editors. Perspectives on Social Vulnerability. Bonn: UNU Institute for Environment and Human Security, 36-49.

Hilhorst, D., Bankoff, G. (2004) *"Introduction: Mapping Vulnerability"* in Bankoff, G., Hilhorst, D., Frerks, G., editors. Mapping Vulnerability: Disasters, Development and People, Earthscan, London, 25-36.

Loeper, K. A. (2007) *"Sustainability – in context of the City of Limerick"* in von Borries, F., Böttger, M., Heilmeyer, F., editors. Yearbook of Model Projects 2006/2007, Verlag der Bauhaus Universität, Weimar, 231-237.

Schellnhuber, H. J. (2008) *"Am Strand"* in Christ, W., Fladt, M., editors. Better Future? Searching for the Spaces of Tomorrow, Merve Verlag, Berlin, 7-19.

Warner, K., (2007) *"Introduction."* In Bohle H.-G., Warner, K., editors. Perspectives on Social Vulnerability. Bonn: UNU Institute for Environment and Human Security, 14-22.

Web Pages and On-line Material:

BSU - Behörde für Stadtentwicklung und Umwelt (2005) *„Memorandum für die Internationale Bauausstellung Hamburg 2013 – Thematisches Leitbild des Senats der Freien und Hansestadt Hamburg."* BSU.
<http://fhh.hamburg.de/stadt/Aktuell/behoerden/stadtentwicklung-umwelt/stadtplanung/projekte/sprung-ueber-die-elbe/start.html> (April. 14th 2009)

Cutter, S. (2006) "*The Geography of Social Vulnerability: Race, Class, and Catastrophe.*" *SSCR*. <http://understandingkatrina.ssrc.org/Cutter/> (April. 14th 2009)

Sieverts, T., (2004) *„Entwicklung der Metropolen im Zeitalter der Globalisierung im Focus von Siedlungsstruktur und Gesellschaftsentwicklung"* BSU.
<http://fhh.hamburg.de/stadt/Aktuell/behoerden/stadtentwicklung-umwelt/stadtplanung/projekte/sprung-ueber-die-elbe/start.html> (April. 14th 2009)