# Chapter 1
# Introduction: Planning for flood resilient cities

## 1.1 Growing cities, growing flood risks

Cities and water have always had an ambivalent relationship. Many towns have developed close to the seaside or rivers because of the good trade conditions and the sufficient water supplies for citizens and agriculture. Recently, cities like London, Barcelona, Rotterdam and Hamburg have transformed former port areas to new waterfronts emphasizing services, tourism, leisure and housing as a new way to profit economically from its watersides (Schubert, 2011). Access to water has been vital for prosperous development – both in history as well as today. However, the proximity of cities to water also bears risks. Flooding from sea and rivers or inadequate surface water drainage may damage the environment, destroy cultural heritage and hinder economic development. Above all, it takes human lives (White, 2010).

Globally, the number of damaging flood events has increased throughout the last century (White, 2010). Recent flood disasters in England (2007, 2012, 2013/2014), Germany (2002, 2005, 2013) or the US (2005, 2012, 2017) are well-known examples that show the enormous social, economic and environmental consequences a flood event may have. Moreover, they demonstrate that technical measures can never guarantee absolute safety and that there always remains a residual risk that may need to be dealt with. On top of that, two ongoing global processes are expected to increase flood risk in the future: continuous urbanization trends and climate change.

Urbanization has progressed to such a level that the 21st century is also referred to as the 'urban century' (Davoudi, 2014). Since 2007, more than half of the world's population lives in cities, and urban population is yet to grow immensely (United Nations, 2014). Current estimates say that by 2050 three out of four people will be urban dwellers (Davoudi, 2014). Urban growth will particularly take place in urban deltas and coastal areas. Already today, 75% of the large cities are located on coasts (Boyd and Juhola, 2014). By 2030, more than 50% of the global population is expected to live within 100km off the sea (Adger et al., 2005). This is worrying in terms of flooding because more people in coastal cities implies the presence of more human lives, businesses and assets in a potentially flood prone area. The problem grows because new residential areas tend to be developed in particularly vulnerable areas due to a lack of conscientious planning and scarce space in the safer areas of the cities (Zevenbergen et al., 2008). If flooding occurs and cities are ill-prepared, the potential damage can be extremely large.

Climate change is expected to increase the frequency and intensity of flooding (IPCC, 2014). Global warming leads to rising sea levels, an increased intensity and frequency of storms and storm surges, as well as prolonged and more intense

periods of heavy rainfall; all factors contributing to future flood risk (IPCC, 2014; Muller, 2007; Nicholls et al., 2007). The global community is attempting to keep global warming 'well below' 2 °C above pre-industrial levels, and preferably even below 1,5 °C above pre-industrial levels (Paris climate agreement, see UNFCCC, 2015). But there is widespread doubt if these efforts are enough, and if nation states will actually keep to their emission cut targets, particularly because a legal enforcement mechanism is lacking (Clémençon, 2016; Rogelj et al., 2016). Even when global warming is limited to 1-2 °C above pre-industrial levels, major environmental changes and an increase of floods are expected (Maslin, 2009; Susskind, 2010). Therefore, the global debate on climate mitigation has been complemented with climate adaptation (Muller, 2007; Nicholls et al., 2007; White, 2010). Regional and local governments face the particular dilemma that more detailed regional and local climate predictions are highly uncertain (Cooney, 2012). As Susskind (2010: 217) already concluded: "Cities have no choice but to adapt".

This thesis specifically focuses on European cities. In Europe, floods have already proven to be a serious threat to human civilization and their settlements. Between 2000 and 2016, a total number of 376 flood events were registered, leading to 1,751 casualties, 6,500,000 affected people and a total damage of approximately €95,000,000,000 (source: www.emdat.be, International Disaster data base). The European exposure and vulnerability to (flood) disasters has never been higher (Munich Re, 2008, cited in White, 2010). According to the IPCC (2014), climate change and urbanization are also likely to increase flood risk in Europe. Although Europe is expected to have sufficient resources and the expertise to adapt, adaptation is likely to be expensive and lead to conflicts (IPCC, 2014).

Triggered by these growing risks, there are many discussions about adequate ways of climate change adaptation and flood risk management in Europe, manifested among other things in the European Floods Directive (2007/60/EC). England and Germany installed government-independent commissions after they suffered from serious flooding: the Pitt review (2008) evaluated the floods in England from 2007, while the Kirchbach report (Kirchbach et al., 2002) followed the Elbe flood from 2002. Following concerns about climate change and the enormous damage from Hurricane Katrina in 2005, the Netherlands installed a commission even before a flood in the Netherlands actually happened, stimulating a new Delta Programme that is aimed at sustainably protecting the Netherlands from flooding (Deltacommissie, 2008; also known as *Commissie Veerman*).

This thesis contributes to these ongoing debates by evaluating current flood risk management strategies and urban planning practices in three frontrunner cities, namely London, Rotterdam and Hamburg. Such an evaluation is needed,

because cities have initiated strategies and policies to adapt to flood risk; yet, this development is still in the starting phase and the adaptation of cities to climate change and flood risk remains a challenging task (Susskind, 2010; White, 2010). The traditional flood control approach is increasingly being considered to be inadequate to deal with growing risks and uncertainties (Gralepois et al., 2016; Hooijer et al., 2004; White, 2010). Several authors have therefore drawn attention to, and called for, a paradigm shift in dealing with flood risks (e.g. Pahl-Wostl, 2006; Schoeman et al., 2014; Scott, 2013).

## 1.2 A paradigm shift in flood risk management

The paradigm shift in water management is a central theme in this book. The shift has been coined in various ways; 'from flood protection to flood risk management', 'from a predict-and-control regime to an integrated, adaptive regime', 'from fighting the water to living with the water' (Butler and Pidgeon, 2011; Pahl-Wostl, 2006; Vis et al., 2003; Vogt, 2005). While the exact conceptualizations slightly differ from each other, the key message remains the same: there is a need to shift towards a more holistic approach.

The flood protection paradigm used to be driven by civil engineers with high skills to predict flood levels using statistical analysis and modelling. Based on these predictions, technical measures such as dikes, dams and storm surge barriers were designed (Beven and Hall, 2014). The focus was on 'keeping floods away from urban areas' (Meijerink and Dicke, 2008; Oosterberg et al., 2005). Manifestations of this strategy can still be seen in our physical environment in form of dikes and advanced engineering structures. In the Netherlands and in England, for example, the devastating 1953 storm surge led to hard engineering works which are still celebrated today. The Delta Works in the Netherlands, a ring of weirs and storm surge barriers, brought the Dutch worldwide fame and a reputation as 'conqueror of the sea' (van den Brink, 2009: 77; Lintsen, 2002: 565). Similarly, the Thames Barrier in London is appreciated as a masterpiece of engineering, sometimes even labelled as 'the eighth wonder of the world' (New Century Press and Thames Barrier Centre, 1991). The flood protection paradigm has been very successful in protecting the land from sea, forming a crucial condition for the prosperous socio-economic development of coastal areas.

Nonetheless, the traditional flood control approach has become contested (Gralepois et al., 2016; Pahl-Wostl, 2006; Vogt, 2005). First of all, the flood defence strategy is often held to have created a 'control paradox' - a circular reasoning

leading to intensified land use behind the flood defence infrastructure because of a 'false sense of security' (Remmelzwaal and Vroon, 2000; Vis et al., 2003; Wiering and Immink, 2006). Recent flood disasters have increased the fear of technical failures. Climate change and rising sea levels add to this feeling of uncertainty. Moreover, both the technical feasibility as well as economic affordability of the flood defence strategy has been in doubt (Scholten and Hartmann, 2017; Vogt, 2005). The continuous raising of flood defences is costly and requires space which is scarce, especially in densely populated cities. Additionally, flood defence infrastructures have produced changing estuarine and riverine dynamics, resulting in coastal erosion and biodiversity losses, which again can increase the likelihood of a flood event (Giosan et al., 2014).

Flood risk management is increasingly considered to require a more holistic approach to dealing with flood risks (Hall et al., 2003; Meijerink and Dicke, 2008; Schanze, 2002; Scott, 2013; Tunstall et al., 2004). Flood risk is then conceptualised as an outcome of flood probability multiplied by potential impacts of a flood event, and it aims at not only reducing the flood probability, but also the potential consequences of a flood event (Hooijer et al., 2004; Jonkman et al., 2003). This conceptualisation asks for a more diverse set of flood risk management measures (Aerts et al., 2008; Hegger et al., 2014; Mees et al., 2013; Wardekker et al., 2010). Traditional *flood defence* measures (such as dikes, dams and sluices) are complemented with *flood risk prevention* (e.g. keeping vulnerable land-uses out of flood-prone areas, make more space for water), *flood risk mitigation* (adaptations to the built environment, e.g. flood-proofing houses), *flood preparation and response* (e.g. flood warning systems and evacuation plans) and *flood recovery measures* (e.g. flood insurance, reconstruction and rebuilding) (Driessen et al., 2016; Hegger et al., 2014).

The diversification of flood risk management measures also has governance implications. Flood risk management asks for an inclusive governance approach, increasing the number of public and private stakeholders involved. Next to this, it combines centralized and decentralized efforts, i.e. top-down steering and bottom-up initiatives (Johnson and Priest, 2008; Meijerink and Dicke, 2008; Tempels and Hartmann, 2014). The flood risk management agenda is therefore in line with general democratization trends and pleas for an integration of policy fields, for example through area-based development (Boer and Zuidema, 2015; Fischer, 2009; Heeres, 2017). While the flood risk management approach in principle should lead to a safer environment and less flood damages, it also makes things increasingly complex. Mostly because it attempts to fulfil multiple needs and requires the involvement of various actors with diverging interests and backgrounds.

Spatial planning is considered to play a key role in reducing flood risks,

because of its strategic ability to keep vulnerable land uses out of flood prone areas, its regulatory ability to adjust land uses in vulnerable areas, and its communicative ability to bring various stakeholders at one table and stimulate discussions among them (cf. Burby et al., 2000; Pattison and Lane, 2012; Van Ruiten and Hartmann, 2016; Tempels, 2016; White, 2010). The difficulty lies in the integration of the two policy fields, as they have diverging backgrounds (Hartmann and Driessen, 2017; Wiering and Immink, 2006; Woltjer and Al, 2007). Flood risk management typically is rooted in the natural sciences, while spatial planning often belongs to the social sciences. Consequently, flood risk managers are used to base their decisions on physical realities including numbers and facts, whereas spatial planning is a discipline of social interaction including negotiation and consensus-building. Therefore, Hidding and van der Vlist (2014: 11) referred to spatial planning and flood risk management as 'two separated worlds'.

The paradigm shift from flood protection to flood risk management is not taking place abruptly, yet it has been gradually evolving over time. During the 1960s and 70s, the environmental movement brought ecological concerns and pleas for more democracy onto the agenda, leading to an 'ecological turn' in flood risk management (Disco, 2002). The oil crisis in 1973 led to significant cuts in government spending, paving the way for 'New Public Management' as a means to make the public sector more efficient and resulting in a 'managerial turn' in flood risk management (van den Brink, 2009). Since the late 1990s, the importance of spatial planning as a tool to reduce flood risks has increasingly been recognized, which led to a 'spatial turn' in European flood risk management (van Ruiten and Hartmann, 2016). Triggered by two nearly floods in the Netherlands (1993 and 1995), the 'spatial turn' started with the 'Room for the River' project in the Netherlands in 1997 (Wesselink et al., 2007). The idea of giving more space to the rivers as a means to decrease the likelihood of flooding was quickly taken up by other countries; for example, England adopted the 'Making Space for Water' approach in 2004 (DEFRA, 2004).

To sum up, the paradigm shift towards flood risk management is supposed to be more environmentally friendly, financially sustainable, and above all, it should increase the level of security in times of increasing risks and uncertainties. Since the 2000s, this ongoing paradigm shift has been increasingly associated with the term 'resilience'(de Bruijn, 2004; Jakubowski and Kaltenbrunner, 2013; Scholten and Hartmann, 2018; Scott, 2013; Tempels, 2016; Vis et al., 2003; Wardekker et al., 2010; White, 2010). Where this concept comes from and what it entails for flood risk management follows in the next section.

## 1.3 Introducing resilience to the field of flood risk management

The concept of resilience has increasingly been taken up in academic and policy discourses (Wilkinson, 2012). In academia, for example, the amount of articles with the term resilience on Science Direct has increased by factor 16 between 2000 and 2017 (see figure 1.1).

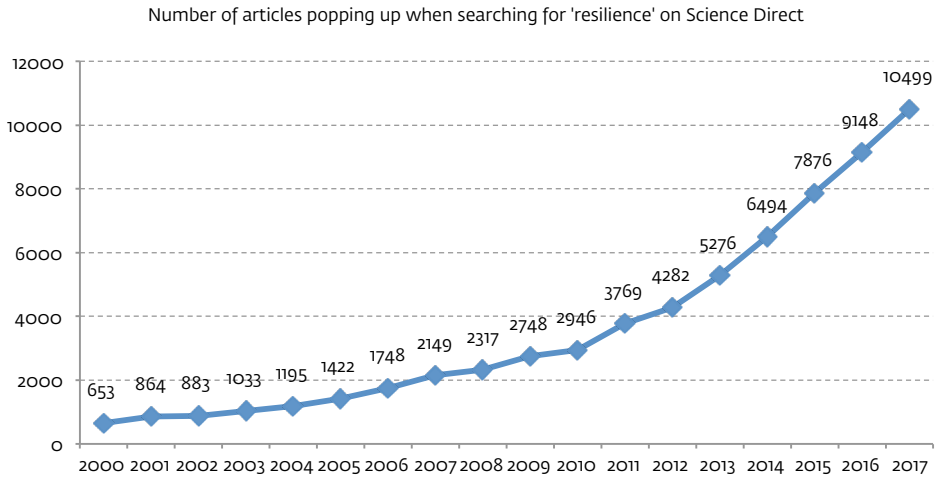


Figure 1.1: Number of articles popping up when searching for 'resilience' on Science Direct; data taken from http://www.sciencedirect.com, query executed by author on Oct 18th, 2017.

Resilience has also entered the policy discourse on disasters. 'Building resilience' seems to be a new mantra inspiring various policy documents, such as the UNISDR report (2012) 'Building Resilience to Disasters in Europe' and the World Bank report (2013) 'Building resilience – Integrating Climate and Disaster Risk into Development'. In 2013, resilience was elected the *Time* magazine's buzzword of the year (Brown, 2014, *cited in* Ashmore et al., 2017). The resilience concept has become so influential that Evans and Reid (2014) even speak of a 'resilience turn' in governmental thinking. In particular, flood risk management has become more and more influenced by the concept and its related way of thinking. This suggests a 'resilience turn' in flood risk management, following the ecological, managerial and spatial turn.

Despite its increasing popularity, the resilience concept is also considered to be 'fuzzy' (Pendall et al., 2010: 80), 'contested' (McEvoy et al., 2013: 291) and difficult to operationalize and implement (Klein et al., 2004). The reasons for this lie in the particular evolution of the resilience concept, which has been introduced to many disciplines (see figure 1.2).

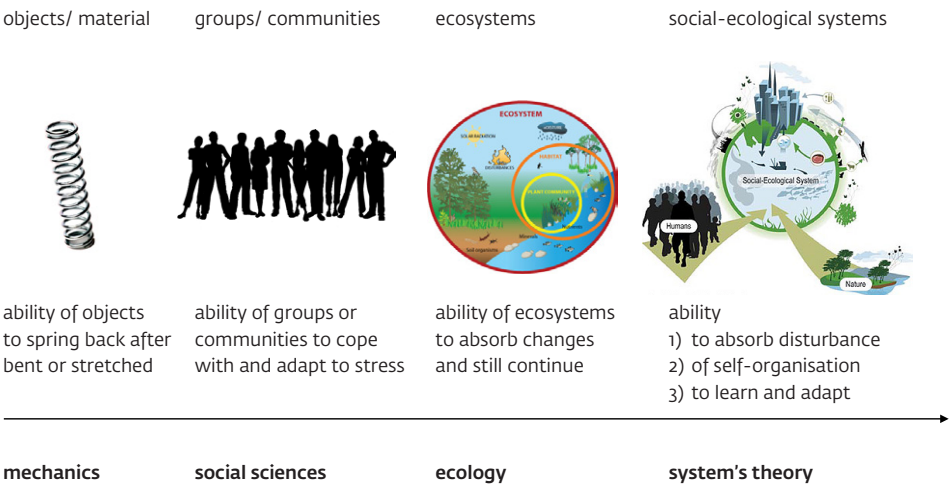


Figure 1.2: Evolution of the resilience concept (designed by author).

The term 'resilience' stems from the Latin word 'resilio' which means 'to jump back' (Klein et al. 2004). Hornby's (1995) Oxford Advanced Learner's Dictionary of current English defines resilience as (*i*) 'the ability of people, animals or plants to recover quickly from shock, damage or injury' or (*ii*) 'the ability of objects to spring back after being bent or stretched' which may also be referred to as elasticity in the original mechanical sense of resilience. Besides mechanics, resilience has been applied to psychology and more generally social sciences to describe behavioural responses of groups and communities to stress (Klein et al., 2004; Manyena, 2006). During the 1960s, the resilience concept was introduced to ecology (Davoudi, 2012). A seminal essay by C.S. Holling (1973) brought the concept forward by defining it as the ability of ecosystems to absorb changes and still continue. He distinguished between stable and resilient systems: stable systems quickly return to normal and have low fluctuation, while resilient systems might be highly fluctuating and unstable but still persist. By acknowledging the dynamics of (eco-)systems, he laid the foundation for the most recent form of resilience, usually referred to as social-ecological or evolutionary resilience.

Different from preceding definitions of resilience, social-ecological resilience goes beyond the idea of equilibria and the idea that there is a stable state that can be returned back to. Social-ecological systems are non-linear, complex and constantly changing, because all parts of the social-ecological system are evolving by themselves, but also through the interaction with each other (Berkes et al., 2000;

Folke et al., 2005). Social-ecological resilience is then seen as a desirable system's characteristic, which has been defined as "(i) the amount of disturbance a system can absorb and still remain within the same state or domain of attraction, (ii) the degree to which the system is capable of self-organization, (iii) the degree to which the system can build and increase the capacity for learning and adaptation" (Folke et al., 2002: 4f.). As the behaviour of social-ecological systems is highly unpredictable, social-ecological resilience thinking rejects a Newtonian worldview and the idea that the world can be predicted and controlled (Chandler, 2014; Davoudi, 2012; Goldstein et al., 2013).

This broader philosophical shift can also be observed in disaster management and, more specifically, flood risk management. In disaster management, a general shift from 'bounce back resilience' to 'bounce forward resilience' has occurred (White, 2010; Davoudi, 2012). The underlying idea is that when a social-ecological system like a city is hit by a flood disaster, recovering to the state prior to the disaster is undesirable, as that would put the city at the same risk. The idea instead is to learn from this experience and to transform to a less vulnerable state. As Davoudi (2012: 302) already noted, "resilience is not conceived of as a return to normality, but rather as the ability of complex socio-ecological systems to change, adapt, and, crucially, transform in response to stresses and strains". The idea of unpredictable system behaviour also underlies the shift from 'predict and control' to 'integrated and adaptive' flood management explained in section 1.2.

In the context of flood risk management and urban planning, social-ecological resilience is therefore increasingly held the most promising strand of resilience thinking. It is considered to offer a potential bridge between natural and social sciences (Davoudi, 2012), which can also be helpful in linking the 'two worlds' of flood risk management and urban planning (see section 1.2). Moreover, social-ecological resilience advocates system thinking, highlighting the interconnectedness of social and ecological systems (Folke et al., 2005; Goldstein et al., 2013). This is manifested in water management in the growing recognition that water does not stop at administrative boundaries, but should be managed catchment-based (Pahl-Wostl, 2006; van Ruiten and Hartmann, 2013). Acknowledging the incompleteness of knowledge and the inevitability of uncertainties has urged the need for more adaptive and dynamic forms of governance (Balducci et al., 2011; Folke et al., 2005; Wilkinson, 2011). Accordingly, flood resilience is about building adaptive capacity in the physical landscape and the social system. As described in section 1.2, adaptive capacity in the physical landscape can be built by a more diverse set of flood risk management measures, targeted at reducing the probability as well as the consequences of flooding. Building adaptive capacity in the social system presents

mainly a governance challenge. In parallel, policy systems should be (re)designed so that these are able to deal with uncertainties and change, while local communities should be empowered to deal with local consequences of flooding. In theory, a flood resilience approach hence provides better protection than traditional flood control.

In practice, however, implementing a multi-interpretable and 'fuzzy' concept (Pendall et al., 2010: 80) like resilience into flood risk management and urban planning practice presents some critical challenges. Two of these will be dealt with in this thesis: the actual meaning-making process of resilience in current flood risk management strategies, and the actual implementation of flood resilience strategies in urban areas.

## 1.4 Towards flood resilience? A strategy-making and implementation challenge

The paradigm shift towards flood resilience, although much discussed and advocated, is neither clear nor evident (van Buuren et al., 2016; Gralepois et al., 2016; Tempels, 2016; Wiering et al., 2015). There has been a long standing academic debate about flood resilience with a growing consensus about *what* should be done. Yet, there is less clarity about how flood resilience can be achieved, often referred to as the 'governance challenge' of flood resilience (Dieperink et al., 2016; Driessen et al., 2016). There seems to be an apparent gap between the resilience concept in theory, and its translation to and implementation in practice. Therefore, this thesis looks at both the meaning-making process and implementation process of resilience in practice. The aim of this thesis is to advance our understanding of how the concept of resilience unfolds in current flood risk management and urban planning practices, with two major building blocks: 1) unpacking the meaning-making process of resilience in current flood risk management strategies; and 2) identifying conditions for implementing flood resilience in urban areas. The main research question of this thesis accordingly is:

> *How does the concept of resilience resonate in current urban planning and flood risk management strategies, and which conditions are conducive for implementing flood resilience strategies in urban areas?*

### Unpacking resilience in current flood risk management strategies

The first building block is about unpacking how the resilience concept is used in current flood risk management strategies. This is interesting because there is a potential friction between the long-standing history of flood risk management, an engineering-based and technocratic policy field, and the new philosophical underpinning of social-ecological resilience rejecting a 'predict and control' paradigm. While social-ecological resilience stresses the idea of transformation and building up transformative capacities, engineering and ecological resilience are much more conservative and less questioning the status quo (White and O'Hare, 2014). However, the fuzziness of the concept and its history with multiple disciplines as a background, can facilitate more engineering and ecological-based resilience thinking, which allows the adoption of a new policy language without actually changing the content of strategies too much. In the context of climate adaptation policies in the UK, Kythreotis and Bristow (2017) have already pointed to the risk of 'rebadging existing strategies' and selling them as new.

For flood risk management, two specific elements of the resilience concept are particularly of interest, i.e. how policy-makers and practitioners make sense of 'uncertainties' and 'adaptability'. Accepting uncertainties is the starting point of social-ecological resilience thinking, and 'adaptive governance' and building adaptive capacity are considered to be key to 'governing the unknown' (Folke et al., 2005; Wilkinson, 2011; Davoudi, 2012). However, accepting uncertainties and being flexible is not a comfortable basis for politicians and civil servants; both urban planners and flood risk managers prefer to provide certainty and have clear rules and guidelines, because that allows for democratic accountability and legitimacy (Biermann and Gupta, 2011; Mees et al., 2013; White and O'Hare, 2014). Although uncertainties are increasingly considered to be 'an unavoidable fact of life' in water management (Brugnach et al., 2008; see also Goytia et al., 2016) and more adaptive modes of governance are called for (Fournier et al., 2016; Huitema et al., 2009; Pahl-Wostl, 2006), there are only few empirical studies yet that examine this meaning-making process in practice.

### Identifying conditions for implementing flood resilience strategies in urban areas

The second building block is about identifying conditions that are conducive, hence favourable, for implementing flood resilience strategies in urban areas. The integration of flood risk into urban planning is considered to be crucial for the

successful implementation of flood resilience strategies in urban areas (White, 2010; Scott, 2013; Tempels, 2016). However, there still is a gap between the *recommendation* and the actual practice of using urban planning as a tool to effectively manage floods (Hutter, 2006). Previous research has shown that flood resilience faces an 'implementation gap' (Clarke, 2015). In general, policy implementation literature hints at a discrepancy between 'policy-on-paper' and 'policy-in-practice' (Hupe and Hill, 2016; Nilsen et al., 2013). The concept of flood resilience is prone to such a discrepancy, because its successful implementation depends on a transformation of long-standing institutions, and enduring societal engagement (Pahl-Wostl et al., 2006; van den Brink et al., 2011; White, 2010; Wiering et al., 2015). Such a transformation is particularly difficult because the primary focus on flood defence within the last century has come along with significant changes in our physical surrounding and institutional path-dependency (Gralepois et al., 2016).

A flood resilience approach is a radical shift in the way flood risks are managed. Besides more governmental authorities being involved, with different backgrounds and ways of working, there is also a need to involve citizens and businesses. Certain measures, such as the adjustment of individual houses or evacuation plans, are only efficient when people are aware of flood risk and willing to take action. Flood resilience therefore is a multi-level and multi-actor governance challenge (Driessen et al., 2016; Mees et al., 2013; Nye et al., 2011; Pahl-Wostl, 2009). The 'what to do' in terms of measures seems to be clear, but 'how to do it', and 'under which contextual circumstances' flood resilience can actually be brought into practice, remains under-researched. This calls for more case studies which examine the implementation of flood resilience measures in practice, and specifically, which conditions lead to, or hinder, the adoption of a flood resilience approach (Leichenko, 2011).

## 1.5 A qualitative case study approach with cases from three cities

To understand how the resilience concept resonates in current flood risk management and urban planning practices, this thesis adopted a qualitative case study approach. The application of the resilience concept in current flood risk management and urban planning practices can be considered a 'complex social phenomenon' in a 'real-life context', in which the researcher has 'no control over behavioural events' (Yin, 2003: 5ff.). The strengths of qualitative case studies are that they can produce concrete, context-dependent knowledge (Flyvbjerg, 2006). Case study research is aimed at particularization instead of generalization (Stake, 1995). Flyvbjerg (2001: 66) has coined case study research as the 'power of example'. Also in

this thesis, the goal is to provide 'thick descriptions' of the cases instead of high-level summaries and abstractions (Mills et al., 2010: 942). By taking into account the rich contextual details of the cases, it is possible to capture the ambiguities and complexities involved in the current meaning-making and implementation process of the flood resilience concept in practice.

## City selection

This thesis discusses cases from three major European port cities. The three cities were chosen for three reasons. First, all three cities face severe challenges because of their geographical location (with longstanding port history as a common denominator), continuous urbanization and climate change. London lies in the Thames Estuary, Rotterdam in the Rhine-Meuse-Scheldt delta and Hamburg is located at the tide-influenced River Elbe. They are all prone to storm surges, sea-level rise and excessive precipitation (Knieling et al., 2009; Lavery and Donovan, 2005; Wardekker et al., 2010). All three cities have a considerable national and international socio-economic significance. Hamburg and Rotterdam have strong global port economies, whereas London functions as a global financial centre. If flooding occurs, all three cities would be very vulnerable.

Second, all three cities have a good reputation in the global debate on climate adaptation and flood risk management, giving them a 'frontrunner' status. London and Rotterdam are part of the 'C40 Cities Climate Leadership Group' (see: http://www.c40.org/) and the '100 Resilient Cities' network (see: http://www.100resilientcities.org/). Hamburg is not part of these global networks, but known for being one of the first to take climate change into account in building design, building the low-lying neighbourhood 'HafenCity' in an adapted way and thereby making it resilient to flooding (Gersonius et al., 2008; Goltermann et al., 2008; Hill, 2012; Mees et al., 2013). Therefore, all three cities can provide insights into good practices.

Third, the three cities come from different institutional and cultural backgrounds, which gives the opportunity to learn from a varied set of cases. The Netherlands are internationally recognized for water management, which is for example expressed in the famous saying 'God made the world, and the Dutch made Holland', referring to the fact that the Dutch have reclaimed big parts of land from sea. Flood risk management is a state responsibility in the Netherlands, with water authorities exerting considerable control (Van den Brink et al., 2011). No major flood damage occurred since the storm surge from 1953, a selling point when the

Dutch are exporting their expertise to other countries. England and Germany have both suffered much from flooding in recent years. Both countries are leading the table when it comes to recent flood damages in Europe (see table 1.1). Flood risk management in Germany is similarly organized to the Netherlands in that respect that it is also mainly a state responsibility (Heinrichs and Grunenberg, 2009; Marg, 2016). However, Germany is a federalized system, giving federal states like the City of Hamburg a big say in flood protection (Heinrich and Grunenberg, 2009). Flood risk management in England is organized very differently. Government has no statutory duty to protect people from flooding (Wiering et al., 2015). Consequently, the responsibility for flood risk management has since long been spread among a variety of public and private stakeholders, which has also resulted in a more diverse set of flood risk management measures in comparison to the Netherlands and Germany.

| Year | Country | Total deaths | Total damage (in 1,000 $) |
|---|---|---|---|
| 2013 | Germany | 4 | 12900000 |
| 2002 | Germany | 27 | 11600000 |
| 2007 | United Kingdom | 14 | 8448000 |
| 2000 | Italy | 46 | 8050000 |
| 2000 | United Kingdom | - | 5918150 |
| 2010 | Poland | 19 | 3080000 |
| 2012 | United Kingdom | 8 | 2946000 |
| 2002 | Austria | 9 | 2400000 |
| 2002 | Czech Republic | 18 | 2400000 |
| 2005 | Switzerland | 6 | 2100000 |

Table 1.1: The ten most damaging flood events in Europe between 2000 and 2016 (data from International Disaster Database www.emdat.be.

## Methodology

Methodologically, the thesis pursues a qualitative case-study approach to study the three cities. While case study research is often accused as being neither rigorous nor objective, methodological triangulation and creating 'thick descriptions' is considered to be a means to reduce bias and to come to trustworthy interpretations (Yin, 2003; Flyvbjerg, 2006). Triangulation implies that a certain phenomenon is studied from

more than one standpoint; methodological triangulation is the most used form (van den Brink, 2009). This implies that the researcher uses two or more sources to validate or reject research findings (Yin, 2003).

Following the idea of methodological triangulation, this thesis uses a mix of qualitative research methods, comprising in-depth interviews, document analysis and participatory observation. In-depth interviews were carried out with stakeholders involved in the strategy-making and implementation processes in the three cities, ranging from representatives of governmental authorities, consultancy agencies and businesses to representatives of civil society. The purpose of the interviews was to understand certain policy choices, and to get a better grip on the struggles in the meaning-making and implementation process of the flood resilience concept in practice.

The policy document analysis comprised primary documents (plans, strategies, legislation, and guidelines) as well as secondary documents (such as Letters to Parliament, articles in professional journals, information from websites and so-called 'grey documents' from interest groups). Primary documents presented the results of preceding negotiation processes, whereas the secondary documents helped to better understand the broader context of the strategy-making and implementation process.

Participatory observation was carried out in Rotterdam and London. In Rotterdam, the analysis involved participation in several work group meetings surrounding the process of making a long-term flood risk management strategy. In London, it was participation in a workshop organized by the Environment Agency for the Local Boroughs of London concerning the implementation of a long-term flood risk management strategy. The level of participatory observation in both cases can be defined as 'moderate' (see Hennink et al., 2011). That means that participants knew about the role of the researcher, but the researcher did not actively participate in the discussions to keep enough distance and ensure objectivity.

The in-depth interviews were fully transcribed and analysed using Atlas.TI. For the policy document analysis, Atlas.TI was used to code particular parts of text. The observation protocols served as additional data source in creating trustworthy interpretations. Specifically for unravelling the meaning-making process of 'uncertainty' and 'adaptability' in current flood risk management strategies, a policy framing perspective was applied. The policy framing perspective emphasises the negotiation and construction of shared meaning, paying particular attention to the language that is being used (van den Brink, 2009). Further details on the process of data collection (what, when, where, with whom) and data analysis (how) are provided in each chapter (see chapters 2-5).

## 1.6 Research design and thesis outline

Based on the identified gaps in the academic literature (see section 1.4), two research questions were designed per building block, drawing on empirical insights from several in-depth case studies (see table 1.2). This resulted in the following four research questions and outline of the thesis.

| Building block | Research questions | Case(s) / object(s) of study | Chapter |
|---|---|---|---|
| 1) Unpacking of resilience in long-term flood risk management strategies | How are 'uncertainty' and 'adaptability' as key notions of the resilience concept framed in long-term flood risk management strategies? | Thames Estuary 2100 Plan in the London region<br>Delta Programme and ADM approach in the Netherlands and the Rotterdam region | Chapter 2 |
| | How can long-term flood risk management strategies be made more adaptive, and which opportunities and challenges do policy-makers involved in these policy processes encounter? | Delta Programme and translation of ADM approach from national level to the Rotterdam region | Chapter 3 |
| 2) Identifying conditions for implementing flood resilience strategies in urban areas | How is the Thames Estuary 2100 Plan translated from the regional to the local level, and which potentials and pitfalls for decentralising the implementation of flood resilience measures are revealed in this process? | Thames Estuary 2100 Plan implementation from regional to local level, with the specific case of the London Borough of Newham and the Royal Docks regeneration project | Chapter 4 |
| | How can flood resilience be operationalized and under which conditions can a flood resilient urban environment be created? | Hamburg Hafen City<br>Hamburg Leap across the Elbe project | Chapter 5 |

Table 1.2: Research design and structure of this thesis.

*How are 'uncertainty' and 'adaptability' as key notions of the resilience concept framed in long-term flood risk management strategies?*

**Chapter 2** introduces the implications of resilience thinking for flood risk management, and argues why a policy framing perspective is particularly useful for studying the meaning-making process of 'uncertainties' and 'adaptability' in flood risk management strategies. The chapter draws on empirical insights from two cases: Rotterdam and London both have developed novel policy strategies.
In London, the Thames Estuary 2100 Plan has been developed to protect London and

its surroundings from tidal flooding. In Rotterdam, the chapter examines how the Adaptive Delta Management approach as part of the national Delta Programme was shaped and implemented in the highly urbanized Rotterdam region. To speak in Yin's words (Yin, 2003), both are 'unique cases' because they aim at planning for the long run (until 2100) and attempt to tackle 'uncertainties' with an 'adaptive' approach. At the same time, both cases are also 'typical' for their planning and management tradition. The TE2100 Plan is a strategic document with guidance but voluntary implementation, typical for UK planning and management. The case of Rotterdam concerns the *Second* Delta Programme; a follow-up of the first Delta Programme that was established after the storm surge of 1953. This chapter forms the starting point, as it makes an inventory how 'uncertainties' and 'adaptability' are framed and actually made sense of in these two cases.

*How can long-term flood risk management strategies be made more adaptive, and which opportunities and challenges do policy-makers involved in these policy processes encounter?*

**Chapter 3** takes a different stance by first theoretically defining three conditions that make long-term flood risk management more adaptive. It then zooms in on the case of the Rotterdam region (the sub-programme *Rijnmond-Drechtsteden*), and tests this case against these theoretically defined conditions. Thereby, this chapter gives further insights into the relation of theory and practice, and specifically the struggle of policy-makers and practitioners of bringing adaptability into practice. The case of Rotterdam is particularly interesting because it is nationally held to be one of the regions that worked most with the idea of Adaptive Delta Management and also puts large emphasis on the integration of spatial planning and flood risk management. Moreover, this chapter profits from the possibility that the strategy-making process in Rotterdam could be studied first hand over a longer period of time, as the researcher was participating in several working sessions as observant.

*How is the Thames Estuary 2100 Plan translated from the regional to the local level, and which potentials and pitfalls for decentralising the implementation of flood resilience measures are revealed in this process?*

**Chapter 4** discusses the translation of a strategic plan like the Thames Estuary 2100 Plan to the local level, thereby providing insights into the potentials and pitfalls of decentralizing the implementation of flood resilience measures in a broader austerity context. Different from the Delta Programme, the strategy-making process of the Thames Estuary 2100 Plan was already completed when this research started. That

gave the possibility to study the implementation process of a so-called 'adaptable plan'. The chapter zooms in on the specific case of the London Borough of Newham and the Royal Docks, as the Royal Docks are one of London's bigger regeneration projects where the Thames Estuary 2100 Plan plays a role due to the geographical location of the Royal Docks next to the river Thames.

*How can flood resilience be operationalized and under which conditions can a flood resilient urban environment be created?*

**Chapter 5** operationalizes the theoretical notion of flood resilience and develops a framework for assessing the flood resilience of cities by linking the concepts of 'resilience' and 'strategy'. Based on this framework, it then compares two urban development projects in Hamburg, the 'HafenCity' and the 'Leap across the Elbe' (in German: *Sprung über die Elbe*). As explained before (see section 1.5), the HafenCity is much praised in academic literature for bringing the concept of resilience into practice through urban design. The Leap across the Elbe project follows much less a flood resilience approach than the HafenCity, although it concerns the same city. Combined these two cases therefore provide insights into the question when, why and how practitioners choose for a flood resilience strategy, and which contextual circumstances are conducive for adopting a flood resilience approach.

Finally, **Chapter 6** brings together the various insights from the previous chapters to draw general conclusions around the main research question. Thereby, it provides a summary of the main findings of this thesis, and gives recommendations for policy-makers which conditions are conducive for implementing flood resilience strategies in urban areas. In addition to this, this chapter contains a theoretical reflection on the resilience concept, and, most notably, provides suggestions for further research.

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