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MUD

Deltas dealing with uncertainty

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Contents

List of Figures .................................................................................................................. vii
List of Tables .................................................................................................................. vii
Acknowledgements........................................................................................................ ix

1. **Introduction** ............................................................................................................. 1
   1.1 Integrating differential equations? ................................................................. 3
   1.2 Ceci n’est pas un delta ............................................................................... 7
   1.3 Multiplicity and fractality ............................................................................. 12
   1.4 Research questions ....................................................................................... 16
   1.5 Methodology ................................................................................................. 17
   1.6 Outline ........................................................................................................... 20

2. **Climate change and ontological politics in the Dutch Delta** ........... 23
   2.1 Introduction .................................................................................................. 25
   2.2 Delta ontologies over time: floods as decisive moments ...... 27
   2.3 Socio-natural dimensions of climate change ............................................ 31
       2.3.1 Mainstreaming climate change ......................................................... 32
       2.3.2 Climate change as a game changer ............................................... 36
   2.4 Conclusion .................................................................................................... 39

3. **Inside matters of facts** ....................................................................................... 41
   3.1 Introduction: control by tolerance ............................................................... 43
       3.1.1 The 1953 aftermath ....................................................................... 45
   3.2 Nature, facts and the nature of facts .......................................................... 48
       3.2.1 The Philipsdam ............................................................................... 49
       3.2.2 Modelling through ......................................................................... 52
   3.3 Radiating effect and complexity .................................................................. 56
       3.3.1 The Oosterschelde storm surge barrier ...................................... 57
6.2.2 Authority of delimitation ..................................................120
6.2.3 Grid of specifications ......................................................120
6.3 Intermezzo: deltas making deltas making... .......................122
6.4 Ontological multiplicity and deltas .....................................123
6.5 Muddy existence .............................................................125
References ...........................................................................129
Summary ..............................................................................145
Funding ..............................................................................149
Short biography .....................................................................151

LIST OF FIGURES
Figure 1: Overview of the delta works .......................................46
Figure 2: Oosterschelde storm surge barrier and compartment dams 49
Figure 3: Oosterschelde, Krammer-Volkerak, Schelde Rijn ..........50
Figure 4: Freshwater routes .....................................................61
Figure 5: Introduction to statistical norms ..................................78
Figure 6: Delta scenarios ..........................................................80
Figure 7: Mekong, Dutch and Balgadesh deltaplans .................108

LIST OF TABLES
Table 1: Problems and plans ......................................................38
Table 2: Delta planning in the Netherlands and their objectives ....75
Table 3: Delta planning and studies in other deltas and objectives ...82
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1. **INTRODUCTION**
1.1 Integrating Differential Equations?

When I was in the second year of my studies, a little more than ten years ago, I did a module called “Introduction to Hydraulics and Hydrometry”. This module was part of the curriculum of the course called “International Land and Water Management”. The studies programme aims to educate what is referred to as “reflexive engineers”. The reflexive engineers are like traditional engineers trained to deal with, or even solve, real life problems. The adjective ‘reflexive’ indicates the ambition of the programme to instil in students the ability to actively think about and reflect on the broader implications of the engineering solutions they might propose. To achieve this, the education programme comprises a variety of disciplines. It includes (development) sociological, legal, economic, natural sciences and design modules. Among my fellow students the Hydraulics/Hydrometry module was notorious for its difficulty. In this module we had to integrate differential equations! The very thought of this was so abstract to some of us, that the module had become controversial for being an obligatory subject in our studies programme. By the time I had to follow the module, it had been replaced by a ‘light’ version. Other, more natural science based studies programmes still had the original, ‘heavy’ version of the module in their curricula, but for the reflexive engineers that we were going to be, a special version was taught.

As a pig-headed second year student I was not amused by this turn of affairs. The fact that some students in the past had difficulties with the course, didn’t have to mean it was too difficult for me? When I articulated my opinion to my studies tutor, he told me I could still do the old, heavy version. And so I did. A choice I often came to regret in the months after. It was difficult, alright! I went to every lecture, noted everything down, and after coming home I had to go through all the examples that had featured in the lecture to understand what steps the lecturer had taken. Never did I study as hard as for that module. I only remember fragments about what we learned, and I passed the module with a mark that I thought did not do justice to my hard labour.

What I do remember sharply is the lecturing professor of the Hydraulics part and especially two moments in which he let his emotions enter the lectures. The first one was an afternoon in which the professor, as usual, filled the three blackboards in the room with all the complicated equations. I had lost
track for quite a while already, but kept taking notes so I could try to retrace his steps after coming home, when he paused for a while, and pointed at a differential equation on the blackboard and said: “If you solve this, you will receive the Nobel prize”. Maybe my memory betrays me a bit here, but if I recall correctly, this was the only time I saw a smile on the professor’s face. He was a rather serious professor. The smile in my view revealed a combination of pride in his profession and the ability to flirt with the boundaries of our knowing.

The second memory had to do with an opposite emotion. In a different lecture, on a different equation, with the familiar incomprehension on my side, the professor slowed down his speaking. With a sad tone he explained how the formula under discussion featured an “empirically determined” coefficient. Up until that moment all formulas had been theoretically grounded – the field of Hydraulics –, but now we had come to a point where a value established empirically in laboratory studies – the field of hydrometry – had to cover the ground that the theories could not.

This write-up of a memory about this stumbling block module in my studies illustrates a fascination that I developed when doing these different disciplinary courses about that all, in one way or another, were about water, land and development. The professor’s enthusiasm and disappointment made me wonder whether the empirical water of hydrometry and the theoretical water of hydraulics are still the same waters. At that time in my studies I was not aware of the existence of a vocabulary that could help me to think about questions of singularity and multiplicity. In retrospect the memory of these lectures was put in a new perspective when I, while working on this PhD thesis, stumbled upon the work of Stefan Helmreich, who states: “Water is not one thing. For natural science, water’s effects depend on its state (solid, liquid, gas), on its scale (from molecular to oceanic), and on whether it is fresh or salty, still or turbulent, deep or shallow. For interpretive social sciences, water can be sacred substance, life, refreshment, contaminant, grave” (Helmreich 2011 p.133). There are so many different ways in which water, land and development can be described, and how their links can be explained, that the question arises: are these different descriptions talking about the same lands, waters and development? Are then, to bring it back to the memory I started with, Hydraulics and Hydrometry still talking about one and the same water?
In a way this is what this PhD thesis is about, an exploration of the consequences and implications of different ways of knowing, different ways of acting, and even different co-existing realities (Law 2015). This means not looking at how in settings where different ways of knowing emerge one way is more true than another, by analysing to what extent these ways of knowing involve a resemblance with what water really is. Instead this means regarding knowing as performative. This mean looking at the practices of knowing, in which different ways of knowing and acting enact different (versions of) objects that sometimes partially overlap. This raises questions about what it is that makes these objects into one? What holds them together? And through which mechanisms (practices and ontologies) are these driven apart? This could be studied in many watery occasions, in irrigation systems, in the field of waste water and sanitation, lakes, rivers, and what more.

In order to be able to study these questions I have turned to deltas. Deltas tend to be dynamic and undetermined in many ways: they mix and separate land and water, they grow in size and height and have a tendency to sink (subside); they are productive (economically) and at the same time they are cruel (through flooding). As such deltas provide a fruitful object for studying the multiple practices that shape and act upon them, as well as the multiple ways in which they are known and how this knowing comes about.

The overall objective of this PhD thesis is to explore how different (versions of) deltas are understood by looking at practices that bring deltas into being as policy objects and by doing so to conceptualise the differences and similarities between these (versions of) deltas.

With this formulation I have deliberately chosen to keep the empirical and conceptual at the same level (Jensen 2013). With this I mean that I do not want to use a conceptual framework to either analyse a certain empirical setting or the other way around, to use an empirical case study to build theoretical propositions. I want to do this following Latour who recognises that “as soon as a divide is made between theories and what they are theories of, the tip of technoscience is immediately shrouded in fog. Theories, now made abstract and autonomous objects, float like flying saucers above the rest of science, which becomes ‘experimental’ or ‘empirical’” (Latour 1987, p.242, see also Bueger 2014). My intention is
therefore to build theoretical propositions using empirical work (Holbraad, Pedersen, and Viveiros de Castro 2014), and recursively at the same time analyse empirical setting using theories (Holbraad and Pedersen 2009).

By levelling the empirical and conceptual I hope that this study also holds a relevance to both the empirical and conceptual discussions. By studying deltas and delta planning my intention is for my accounts to find their ways back into these deltas and delta planning. During the course of this PhD trajectory I have, from a multiple ontologies perspective, given presentations to and have conducted interviews with professionals involved in practices of water management and climate change adaptation. By doing this, my intention is to bring ontological ramifications to light that would otherwise have been invisible. My questions and findings may have been received as disturbing at times, but in general yielded two types of responses. First type of response is that of “I have never thought about it that way”. This is a response I often got when I asked questions about why things are done the way they are done. The thought that there is the possibility of (methodological) alternatives often seemed to be surprisingly alien. In my view this is also the reason why I also stumbled upon scepticism in my encounters with the processes I studied. In these moments I faced responses along the line “I have never thought about it that way, and I want to keep it that way!”. Second type of response that I yielded was “that is exactly what we are struggling with at the moment”, often times supplemented by the addition “but unfortunately we don’t have the time to work on this”.

My engagement with delta planning, water management and climate change has resulted in a doctoral thesis of which two of the chapters have been published in journals aimed at water and climate change focussed professionals and academics. As mentioned, this project aims to also contribute to conceptual discussions. The other two chapters are therefore aimed at different audiences, namely a Science and Technology Studies (STS) and environmental planning studies audiences. Additionally I hope that this thesis can contribute to discussions about what it means to talk about the amphibious (ten Bos 2009; Morita and Jensen, forthcoming) and the indeterminacy (amphibious) nature of deltas as policy objects. This feeds into questions about how to know and plan objects (like deltas) that are intrinsically indeterminate, that are intrinsically muddy.
In this introductory chapter I outline what I have done to reach this objective. I’ll start by briefly exploring the empirical aspect of this study in the section on deltas and delta planning [Ceci n’est pas un Delta]. In the following section [Multiplicity and Fractality] I set out to explain and discuss the conceptualisation on which this thesis is built. In section [Research Questions] I formulate and explain the questions that have informed this research, followed by a section [Methodology] explaining what I have done to arrive at answers. Finally, I briefly discuss [Outline] the content of the other chapters that together with this introduction will serve as my thesis.

1.2 Ceci n’est pas un delta

Deltas are pretty distinct environments on the earth’s surface. Formed by the deposition of sediments at the points where rivers meet the ocean, these environments are by default highly dynamic. In most of the deltas in the world these dynamics are not just geo-morphological phenomena, but they are strongly influenced by human settlements in these regions and subsequent human interventions. Given these dynamics, it becomes quite hard to tell where a delta begins, where it ends, what kind of thing it is. Boundaries in space are difficult to establish and boundaries in time are difficult to trace or fix (see for discussions on the difficulty of pinpointing what a delta is e.g. chapter 2 for the description of confusion over the boundaries of the California delta and whether or not the Bay forms a part of the delta; and also: Lahiri-Dutt & Samanta, 2013; Lund et al., 2007). This is also why the title of this section is referring to the painting by surrealist painter René Magritte “Cece n’est pas une pipe”. Where Margritte painted a pipe and highlighted in that same painting how the painting of the pipe is no longer a pipe, this thesis sketches how the deltas that form the object delta planning activities are enacted through these very practices.

With the rise of the notion of the Anthropocene (Crutzen and Steffen 2003; Baghle 2012), deltas have become notorious victims of climate change (see e.g. Syvitski, 2008; Syvitski et al., 2009). Depending on what delta one happens to look at, the histories of human interactions with their deltaic environments may either date back a long time, like in the Dutch Rhine-Meuse delta (TeBrake 2002) and Egypt’s Nile delta (Hassan 1997) or may be relatively recent, like in Thailand’s Chao Phraya Delta (ten Brummelhuis
2005; Morita 2015; Morita and Jensen forthcoming), California’s Sacramento-San Joaquin Delta (Lund et al. 2007; Norgaard, Kallis, and Kiparsky 2009) and Vietnam’s Mekong Delta (Biggs 2008).

Referring to these environments with a similar term - delta - suggests they have something in common, that there is a sameness. The name delta, originating from Greek, refers to capital letter delta: a letter that has a triangular shape, resembling the way deltas appear when seen from the sky. The recent international attention to climate change adaptation has lent deltas another sameness: they share a vulnerability to the consequences of human induced climate change. Looking at historical accounts of deltas (Iqbal 2010; van Schendel 1991; Lahiri-Dutt and Samanta 2013; Rooijendijk 2009) it becomes clear that though there is no agreement on what the ontological essence of a delta is, they are always simultaneously natural and societal. In that way the term Anthropocene (Crutzen and Steffen 2003; Baghel 2012) doesn’t hold much news for delta in terms of stressing the need to move beyond nature society divides. What probably is new, is the awareness about the indeterminacies imposed on deltas coming from the future: uncertainties. Resultantly deltas form objects par excellence for furthering reflection and debate about uncertainties, interdisciplinarity and socionatures.

In this thesis I have chosen to look at a particular flavour of delta practices, namely those belonging to Dutch delta planning. Why is it so interesting to study particularly Dutch delta planning? The main reason for me can be summarised by looking at the word polder. This Dutch word may very well be the number two on the list of Dutch words that have travelled the world, with the word apartheid undisputedly taking the first place. Unlike apartheid, a word that causes feelings of shame and discomfort, many Dutch people refer to the word polder with pride. Polder refers to dikes (levees) constructed around an area, supported through a variety of technologies like drainage sluices (Van Dam 2002), and iconic and innovative pumping techniques (Rooijendijk 2009; Metz and van den Heuvel 2012). The engineering of these enclosed spaces, in which water is separated from land, went hand in hand with the development of water management institutions (water boards). This physical and organisational co-evolution has become characteristic of the Dutch way of dealing with water in deltas (Wesselink et al. 2007; Woodall and Lund 2009). Even though
typified as uniquely Dutch, and in spite of the problems caused by specific organisational and physical lock-ins (Wesselink et al. 2007), the polder concept did travel to other parts in the world¹.

“The Dutch were responsible for many of the polders in Europe, Asia, Africa and America. In fact polders are still being constructed and the Dutch are still doing most of the work” (Ministerie van Verkeer en Waterstaat, Unknown date, p.3). As this quote from a brochure of the ministry of infrastructure and transport from the early 1980’s stated, destinations of the travels of the Dutch polder concepts are scattered over the world and include the Mekong Delta in Vietnam, and the Ganges-Brahmaputra-Meghna Delta in Bangladesh. Depending on time and space, the incarnations of the traveling polders changed. “Intrigued by the similarity of the Bangladesh Southwest (Khulna Jessore) to the flat and marshy Netherlands landscapes, Professor Wybrand van Ellen of Delft University, together with British flood experts Hugh Brammer and Jim Dampster, developed the idea of compartmentalized polders in the 1980s” (Warner, 2010 p.70). Further to the east, “[i]n the Mekong Delta, historically, the pivotal form of water control and management has been the ‘Dutch dike’ strategy, which involves construction of encircling dikes for settlement, flood control or prevention of sea water intrusion to provide favourable freshwater conditions for agriculture” (Biggs, Miller, Hoanh, & Molle, 2009 p.208). The Dutch polder approach is about making divisions, creating separations. Separations between land and water, between fresh and saline water, between good water (irrigation and drinking water) and bad water (floods), between (agri)culture and (aqua)nature and in the Netherlands specifically and famously also between rivers, land and sea (the Delta Works).

But polder is not only about making divisions and separations. Over time the word polder gained an additional meaning in Dutch, it grew into a verb: to polder. As a verb polder refers to a consensus building style of doing politics and the suggested creation of a “level playing field” (Glasbergen 2002). In

¹ Technological lock-in refers to the path dependency where only ever increasing costs can keep a physical system in place. Because dikes keep out the waters, the lands within the dikes subside, which will result in a need for heightening of these dikes. An instance of organisational lock-in is provided in a situation that “[w]hen safety levels cannot be politically discussed due to a political fear of contradicting the public conception of absolute security, a fundamental revision of flood defence policy is unattainable” (Wesselink et al. 2007 p.205).
the national government poldering has been used to reach agreements with other parties in parliament, but typically also including societal organisations – such as labour and employers’ organisations – in the process. Though the verb to polder itself, to the best of my knowledge, has not travelled as far as it noun-brother, the concept of involving as many parties as possible and aiming for consensus lies at the heart of many of the contemporary attempts to export Dutch delta planning know-how to other countries. In some of the interviews the Dutch delta planning methodology was typified as consisting of two main elements (see chapter 4): looking towards the future and the establishment of a poldering-like dialogue with as much societal organisations as possible. Ironically for polders, the process of poldering has proved to be even capable of de-poldering polders (van Staveren et al. 2014; Warner, Lulofs, and Bressers 2010, see also chapter 5).

This research engages with the middle ground that lies between the polder and poldering. This means that I look at how the legacy of constructing dikes and dams, referred to by Lund et al. (2007) as the Dutch fortress approach, evolved into a more future oriented (adaptive) poldering approach. I consider this change in the light of recent insights into and discussions about the implications of modernity (Latour 2013; Scott 1998), globalization (Tsing 2005; Swyngedouw 1997), the nature of knowledge production and expertise (Jasanoff 2004) in particular when related to nature and the environment (Disco 2002; Latour 2009).

Deltas come and go, they rise and sink, materially and discursively. There is probably not much reason to discuss the ontological essence of a pipe as featured in the painting by Magritte. The fact that the painting has become an icon of surrealist art indicates that there is probably a general agreement about what a pipe is. In the case of deltas this is far less clear cut. A delta is not a pipe. Magritte’s painting is a provocation to think about how the painting of a pipe relates to pipes as things. This thesis is, much less powerful than the painting, attempts to further thinking about shape-shifting objects like deltas and the ways deltas are enacted in delta planning, the practices through which delta’s are done. This is thus not an attempt to arrive at a fixed definition of what a delta is. No. It is an attempt to explore how deltas are made and unmade, an exploration of the political ecology (Latour 2009) of deltas. An exploration of how one specific (Dutch) flavour of delta planning, has come to flourish. A branch of expertise in which I
through my education have become intertwined into. Practices and expertise that through this very PhD thesis have arguably become more real.

The main type of practices studied in this thesis can be captured under the umbrella of “delta planning practices”. Like “delta”, the idea of what constitutes a “plan” is not much more clear cut. In the interviews I did with (Dutch) professionals working on the Mekong Delta, a general frustration that came to the fore was the interpretation of the word plan in the “delta plan”. For the Dutch the word plan refers to the type of strategic planning that is done in the Dutch delta planning exercises. For their Vietnamese counterparts the word plan resonated with the state’s 5-year plan (or master plans). The Vietnamese thought the Dutch plans lacked concrete parameters, where some of the Dutch interviewees suggested that the Vietnamese lacked the ability to “think strategically”. In my view this is not just a confusion of tongues, the frustration is the result of a difference in delta ontologies.

This idea was confirmed when I witnessed a discussion of a draft version of the Vietnamese delta plan between Vietnamese and Dutch experts. The senior Vietnamese government official pointed at one of the maps in the draft report, in which some of the arms of the Mekong River seemed to be closed from the sea. This is very much in line with the way the Dutch changed their own delta through the construction of the delta works. The Vietnamese official warned the Dutch expert that such a map could not be included in the report, that is, if they want it to be taken serious. The Mekong River, with its branches, is referred to by the Vietnamese as the 9 dragon river. Closing off one of the branches of this river equals slaying one of the nine dragons. It has been through experiences with rather essential differences like these that I have become fascinated in ways in which multiplicities play out in delta planning processes, how a need for ontological overlap is accommodated, but also how revealing one reality in the process eclipses other realities (terms as introduced by Strathern, see footnote 12 in Holbraad and Pedersen 2009). In the following section I further explain how I have come to talk about plural ontologies and realities.
1.3 Multiplicity and Fractality

One man’s greed is another man’s pain,
one man’s loss is a another man’s gain,
one man’s pride is another man’s shame,
one man's sorrow is another man's fame

just another day just another day
in another man’s world
in another man’s world
not mine.

Immaculate Fools – Another Man’s world

From California inspiring works are available understanding deltas from a complex socio-ecological systems perspective (Norgaard, Kallis, and Kiparsky 2009b), or deltas can also be considered as sociogeomorphological environments (Ashmore 2015) or as substrata in hydrosocial cycles (Linton and Budds 2013; Boelens 2014). Every way of looking at deltas provides a different picture of the deltas and delta planning. Each option yields/produces materials (Whatmore 2003) that recursively feedback (reflect) on to the theoretical engagements. Every way of seeing is a way of not seeing (Morgan 1997).

My main source of inspiration come from the field (is it really a field?) of Science and Technology Studies (STS), and more specifically from debates around Actor Network Theory (is it really a theory?) and even more so the ideas developed under what some have labelled ‘post-ANT’ (Gad and Jensen 2010; Law 1999). Next to these STS conceptual inspirations, I have also turned to co-evolutionary approaches (Norgaard 1994) and broader environmental historical works (Scott 1998; Biggs 2012), which I introduce and discuss in the relevant chapters.

The central conceptual inspiration for this thesis comes from the ideas developed by Annemarie Mol and John Law about ontological multiplicity and ontological politics. The two main works I draw upon in this respect are Mol’s the body multiple: ontology in medical practice (2002) and Law’s After Method: mess in social science research (2004). Mol’s work shows,
building on ethnographic work in a hospital, how a particular disease (arteriosclerosis) is enacted through multiple ontologies. The body, and the disease, is “more than one - but less than many” (Mol 2002 p.55). This is a further elaboration of the recognition put forward in ANT scholarship (Latour 2005; Law and Singleton 2014) that things, but also facts, are what they are because of their relations. Mol and Law take up this point and argue that reality is, or rather different realities (or a ‘fractiverse’, see Law 2015) are, enacted through different practices. Enactment is coined as an alternative for the similar term “performativity” as used by Judith Butler (1988), which according to Mol has resonances that make the term lack precision. To me an ontological multiplicity perspective, or call it an ontological politics perspective, for studying deltas and delta planning means a study of how delta are concretely made (see Jensen and Morita 2015), it means an interest in how delta planning functions as a platform for different ideas about the delta, about what a delta is, are made to interact, while at the same time pushing a particular ontology of delta planning (e.g. it is a thing that requires a plan).

The use of the term enactment is suggested to enable to move beyond the familiar division between a subject creating knowledge and an object about which knowledge is created. Hence “(i)nstead of talking about subjects knowing objects we may then, as a next step, come to talk about enacting reality in practice” (Mol, 2002 p.50). This could the for example result in talking about the water that is enacted in a hydraulics lecture room and the water that is enacted in a hydrometric laboratory setting, and thus studying the ways in which these waters are the same or different. Is the laboratory water wetter than the water in the lecture room? Such an exercise entails a turn to ontologies, building upon the idea “that ontology is not given in the order of things, but that, instead, ontologies are brought into being, sustained, or allowed to wither away in common, day-to-day-sociomaterial practices” (Mol, 2002 p.6, italics in original). Practices then become the unit of analysis of this study, studied through a praxiographic method which has a strong resemblance with ethnographic methods. Replacing ethno (culture) with praxis (practice) appeals to me for it “suggests studying practices which constitute [these] orders of knowledge” (Bueger 2014, p.386) and for being attentive to the material involved in these practices. Yet, in this thesis, “the study of practice does not necessarily entail to study all of the complexity of practice. As argued by Schatzki
(2005), often it will be meaningful to develop overviews of fields of practice. This does not necessarily or always require tracking and registering ‘the potentially labyrinthine of complexity’ (Schatzki 2005 p.477). In many cases it is desirable and feasible to provide overviews referring not to the details of practice but to larger formations” (Bueger 2014 p.390). In this research I have followed this recommendation to look at such larger formations. Focussing on these rather than the ‘labyrinth of complexities’ has largely been informed by rather mundane considerations about research skills, linguistic capabilities and practical possibilities. The study of the larger formations, delta formations, means a study that examines the ways in which these formations can be conceptualized, and reflecting upon the difficulties that arise from these conceptualizations. This then means that this study, rather than reporting “what actually happens on the ground” (Rottenburg 2009 p.xxxii), will focus on the bigger picture. A bigger (delta) picture for which no single all-encompassing vantage point for description exists. It is for this reason that I will focus on different delta ontologies, thus different descriptions and theories of what a delta is, and the enactment of deltas through different ontologies.

In his After Method, John Law criticises particular practices, conducted under the label of (scientific) methods for removing the option for more than one ontology to exist and therewith for ontologies to clash. They remove the option of a politics of ontologies (Law 2004). Translated to the deltas that are studied in this research, the ontological multiplicity perspective means a study of the enactment of deltas, through the study of delta ontologies (Morita and Jensen forthcoming). Such a turn to ontologies (Escobar, 2007; Holbraad, 2010; Woolgar & Lezaun, 2013), enables a study of the interactions, or intra-actions as Barad (2007) would call these, between deltas as material and discursive objects and the processes engaging (practices) with these deltas. It thus enables a study not only of the ways in which delta plans are dealing with their deltas, but also how deltas are brought into being through these plans, how they are formed as objects.

I will study the formation of deltas as policy objects following the three steps outlined by Foucault in his Archaeology of Knowledge (Foucault 2002): 1) map the surface of emergence; 2) describe the authority of delimitation; and 3) analyse the grid of specification. In the light of the delta ontologies
notion introduced earlier, this means that this PhD thesis first sets out to identify the material and discursive practices that allow deltas to come into being as objects of intervention. Secondly, I trace and examine the authorities that have been influential in shaping the delta as an object of intervention, deciding what is made present and what is (manifestly) absent (Law 2004). A study thus of the mechanisms through which a particular enactment of a delta gains legitimacy, and becomes accepted (see e.g. Barba Lata 2015). This includes an analysis of how authority is linked to debates on the changing role and appreciation of sciences. This is regarded in the light of a call for participation of (non-scientific) voices and appreciation of uncertainties (Petersen 2006) – debates that take place under labels like post-normal science (Funtowicz and Ravetz 1993; Petersen et al. 2011b), integrative science (Lach, Rayner, and Ingram 2005), mode 2 (Nowotny, Scott, and Gibbons 2003) and discursive science (Norgaard, Kallis, and Kiparsky 2009a).

The third and final line of enquiry deals with the mechanisms that come into play in defining which deltas are enacted. This means an examination of the ways through which an overlap between multiple delta ontologies results in the enactments of specific delta realities: how the delta multiple is more than one, but how there is also sameness between different versions. This sameness can be grasped with a term suggested among other by Jensen: fractal (Jensen 2007). “Fractals can be quickly glossed as geometrical images, which can be broken into smaller parts, each of which will retain similarity with the original” (Jensen, 2007 p.836). Following anthropologists Marilyn Strathern (Strathern 1980; Morita 2013) and Roy Wagner (Wagner 1991), Jensen proposes a fractal study of space, society and infrastructure. In this thesis I take up this proposal to explore the implications of thinking about deltas in terms of fractals, or rather to use fractal as a metaphor to study peoples’ dealings with deltas. Following John Law I do this “without worrying too much about the mathematics” (Law 2002 p.3) for two reasons. Firstly to explore whether the term fractal offers a possibility to talk about what happens in deltas beyond the singular–plural vocabulary. In particular, I cherish hopes that the term fractal will be more enthusiastically embraced and understood by non STS scholars than the vocabulary of multiple ontologies. Secondly I aim to see if this fractal metaphor is helpful in understanding deltas that are made in interactions
between human and nonhuman agency, a process that Andrew Pickering refers to as the “dance of agency” (Pickering 2008; Pickering 1993).

The reason why a study of multiplicity and fractality in the case of deltas especially appeals to me, is that it seems to work well in relation to the description of social and physical processes between and within deltas realities. Children playing on the beach might find out how the small water streams on the beach are unstable. These small streams tend to meander in a similar way as large rivers do, though I’m sure any hydrologist, or hydrometrist for that matter, will insist to point out the differences between the two (see for works on fractal hydrology, Tarboton 1996). They are fractal; similar yet different. Looking at the world as manifesting itself as fractally (Wagner 1991), or even as a fractiverse (Law 2015), acknowledges that every way of knowing a delta is, to speak with Haraway, situated and partial (see Haraway 1988). Knowing the delta is situated in the eyes of the viewer. But the viewer in turn, is not alone, and form a part a knowing institutional complex, including agreements about language, methods, metric systems etc.. Knowing a delta is also partial in the sense that it is limited to the “zoom” or “zooms” that is applied. There is no most complete picture.

1.4 Research Questions

In this fluid world of multiple ontologies and fractality, deltas that are enacted by plans rather than the other way around, the main research question [mrq] this research tries to answer is:

[mrq] How can current day practices of dealing with deltas be understood as politics of ontology?

With this question I aim to study how practices enact delta realities. This means a study of presence and absence (Law 2004), of ontological differences and similarities. To operationalize this question into more researchable questions four sub-questions [sq] have been formulated, along the three lines identified in the previous section [surface of emergence; authority of delimitation; grid of specification].
[sq-1] What makes deltas into deltas?

Including: What configurations of practices, discourses and materialities collectively form deltas as objects of interventions? How do different ontologies shape plans that are being made for the delta’s adaptation to anticipated future problems? What are the circumstances that enable deltas to be deltas? What enables deltas to gain (political) momentum?

[sq-2] What holds deltas in place?

Including: What is Dutch about Dutch delta planning. When do decision makers have sufficient knowledge to take a decision? In what form/shape are knowledges represented? How are the knowledges produced? What constitutes a delta planner, authority, and expertise?

[sq-3] In what way does a multiple ontology perspective help to understand, and possibly even contribute to the development of, environmental planning processes?

Including: What does a multiple ontologies perspective makes one see in the deltas? What is the potential use of a fractality approach to study infrastructures, deltas and practices?

[sq-4] What are the deeper implications of the findings of this PhD thesis with regard to understanding about the ways people live in deltas?

Including: Does this thesis provide new insights about the debates about modernity, institutional organisation, and technology in relation to modernity and the moral implications of travelling ontologies?

1.5 METHODOLOGY

Can we know what an empty room looks like? – David Hockney

How to study ontological multiplicity and fractality in delta planning? In this section I will try to explain what I have done to come to answers to my research questions. It may not come as a surprise, given the conceptual framework listed above, that my inspiration for methodologies comes from ethnographically vested STS works, works that study practices. I am trying to
study what deltas and delta planning are, and how this travels the globe, a study of how deltas are made, what Anna Tsing refers to as universals (Tsing 2005). Tsing rightly states that ethnography is traditionally very well equipped for in-depth studies of communities and the local but not so much for the study of universals. “Universals are effective within particular historical conjunctures that give them content and force. We might specify this conjunctural feature on universals in practice by speaking of engagement. Engaged universals travel across difference and are charged and changed by their travels. Through friction, universals become practically effective. Yet they can never fulfil their promises of universality. Even in transcending localities, they don’t take over the world” (Tsing 2005 p.9).

Following Tsing I study how delta planning is made to work in one place (the Netherlands); how this engaged universal is made to travel (to Vietnam and Bangladesh); and how it changes in the process. To study this, I have conducted a multi-sited study in the dynamic and expanding actor network (Latour 2005) of Dutch delta planning. I use the term actor network because this enables the study of both human and non-human actors (Sayes 2014) that together form the network that makes Dutch delta planning, and even deltas for that matter, work. The locally-inflected globally determined problem of applying such an ANT methodology is that the researcher, in this case, me, by describing the network also imposes boundaries on it, she or he inevitably cuts the network (Strathern 1996; Gad and Bruun Jensen 2010). The cutting of the network is a consequence of limitations of time, but very much so in this case also through the limitations in possibilities to connect to the Delta Actor Network under study. Most of the connections I have been able to make have happened through people that I know that know people..., etc.

Studying a fluid field, as deltas turned out to be, requires apart from methodological skills equally as much luck and creativity. Skills required for doing research include the skill to interview, to observe, to report, etc. Luck and creativity are equally important. To contact a busy person like e.g. a (former) minister requires the luck to know somebody that happens to have this person’s email address and is willing to share it. It then requires some creativity to formulate an email that sticks out from the pile of emails this person probably gets. I’ve used watery metaphors, played around with my
identity as engineering/social scientist depending on the situation. There is a certain amount of ad-hoc-ism and coincidence to this type of research. There were two processes that I have been able to participate in that have been crucial for the development of this thesis. The fact that I gained access to ‘closed’ sessions had only very little to do with my research skills. In the one case I gained access because my supervisor was able to squeeze me into the process. In the other it happened that a close colleague during the time of this PhD research happened to evolve into one of the leading players in one of the delta planning processes studied. He was then kind enough to offer me the opportunity to sit in and observe in meetings.

The insights gained in this research are thus partial but they are also inescapably shaped by the normativity imposed in the way I look at things. In the section below I try to explain how I have gone off to generate material (Whatmore 2003) for this thesis in a variety of ways. My aim is not to establish a representative picture or idea of what deltas are and what delta plannings are; I want to describe processes that bring these into being. Similar to how Sarah Whatmore has tried to “examine how environmental disturbances, like flooding or earthquakes, might ‘force thought’ among the people affected by them and, thereby, occasion new political associations and opportunities” (Whatmore 2013, p.2). I have tried to do my examination of deltas, and delta planning responses in dialogue with my “field”. A dialogue that has turned out to be inspiring and deepening the work, yet also at times unexpectedly difficult and even painful. It was painful when a decision had to be taken not to include a particular case and the analysis of this case as part of this thesis because of objections of this field. Though painful, it is a consequence of the type of research I have wanted to do, of working in dialogue. Dialogue also involves appreciating and taking serious objections. Through the use of a variety of methodologies and sites I do try to check what happens to my conclusions when I let the field talk back (Zwarteveen and Boelens 2014).

I started this section with the Hockney quote, not because I want to suggest that deltas or delta planning is like an empty room. I put it there because to study the room you need to enter it, and by entering the room you change it. I have entered my room, or rather rooms, the rooms of Dutch delta planning through the openings that I could find. As with Tsing’s study of ‘her’ Kalimantan forests, my study is patchwork and haphazard. This materialised
in research that consisted of a rather wide variety of practices: in depth interviewing, literature reviewing, visiting public venues of the Delta Programme (annual conferences, working sessions), study of policy documents, participant/ethnographic observations in meetings, workshops and fieldtrips and discussing draft chapters with delta planning professionals. The types of activities varied during the run of my PhD trajectory. In the first years I focussed on getting to know the rooms I studied. I did a literature review and a study on a relative small, confined case (the blue-green algae in a lake). Over time I grew more and more interested in the mechanisms that were at play at what is often referred to as the science–policy interface. While my research interest became slowly more articulated and specific, I also gained access to more entrances into the room. This resulted in extensive in depth interviews with politically high level delta planners, but it also opened up possibilities for me to join and participate in closed sessions. During this what one could call the more methodologically ethnographic phase of my research I grew fascinated with the methodological role that futures and ideas about futures play. I cross checked the lessons I distilled from these participatory research experiences by doing open ended interviews about delta planning and the futures. Apart from these trends in my research practices there has been a base line of continuous conversations with professionals and academics on all aspects of delta planning and trips to and through the deltas when there was an opportunity to do so.

1.6 Outline

In the coming chapters I present four lines along which I have tried to come to answers to my main [mrq] and sub-research questions [sq 1-4]. First up is [chapter 2] ‘Climate change and ontological politics in the Dutch delta’. This chapter applies an ontological politics approach for studying how complexity, uncertainty and ignorance are being dealt with in the Netherlands, looking at how knowledges are produced and incorporated in decision-making on uncertain climate change. On the basis of work done in the Netherlands, this chapter shows two things in particular. First, it illustrates how decision making responses historically have been subject to change under influence of floods and how the emergence of climate change has significantly changed these floods. Second, based on the analysis of
processes of dealing with a blue green algae problem in a lake, it shows that climate change not only changed decision making responses, but also changed the very reality that is being enacted. Consequently, this brings an ethical dimension to the fore, related to the intrinsic tension between the growing awareness that “all is interconnected” on the one hand and the realization not everything can be taken into account.

After this I examine knowledge-policy interfaces more in detail in [chapter 3] ‘Inside matters of facts: reopening dams and debates in the Netherlands’. Both civil engineering and environmentalism strongly influenced the development of water governance in the Netherlands in the 20th century. Much research has focused on these aspects separately. This chapter maps the interaction between governance, technology and ecological systems in the Netherlands, to provide insights into how these are interacting. The analysis is based on a combination of a literature study and an empirical case study on the debates concerning the reopening of the Philipsdam, in the Southwest Delta of the Netherlands. It shows how the negotiations that took place enacted a particular Philipsdam reality, which both increased the complexity of decision-making concerning the dam itself and radiated outwards to affect other parts of the Dutch water system. We conclude that the process of constructing facts and the way these are framed once they have been established as facts are both intrinsically political and reflect the multiplicity of views of how the lake works and what the problem is, and how these views are incompatible at times. As such, ontological complexity is ingrained in what is represented as facts and severely complicates an apparently matter of fact decision to reopen a dam.

Following this chapter [chapter 4] ‘Delta formations: delta planning, the future and ontological multiplicity’, this thesis will start branching out to non-Dutch deltas: In many instances people involved in policy processes are expected to take decisions on matters, while not enough is known about that matter to know what to do. In such cases policy makers often turn to scientific experts. In instances of high uncertainty these scientific experts occupy the difficult intermediary position between having to provide clean cut answers to policy makers’ questions on the one hand while dealing with fluid, unclear and uncertain knowledge of problems on the other hand. Many researches have studied ways to optimize the process of knowledge production at the science-policy interface, predominantly focusing on ways
in which uncertainties are or should be dealt with. In this research, we look at the other side of the same coin: we look at the construction of a consistent object. Drawing on concepts and insights from work done on ontological politics, this chapter explores what happens when in this case a delta is formed as an object, looking at how futures are produced to give body to this object. We describe how the formation of the delta as an object takes place along two lines: partiality and enactment. By doing so we show how the production of futures has functioned as a powerful tool in defining the specifics of the deltas. In the conclusion this chapter discusses some of the implications this finding has for the conceptualization of the role of knowledge-production practices at science-policy interfaces.

Before going into the concluding and discussion chapter of this thesis [chapter 5] ‘The delta diagnosis: on the sociomaterial enactment of the Dutch, Bangladesh and Mekong Deltas’, will apply a fractality approach to the same deltas as discussed in previous chapters. Unlike the other chapters it does not directly look into delta planning processes. Instead it looks in a more environmental historical way at how these deltas have been dealt with (historically). It looks at processes of separation: the separation of waters and lands, good water and bad water. Furthermore it looks at the (geo)political economies that are shaping and get shaped by these separations. Finally it discusses what this means for regarding deltas as fractals, by discussion how the similarities that can be observed in these various attempts to make distinctions in these deltas.

Finally [chapter 6] ‘Mud, muddling through and muddy modernity’ summarizes the lines of argumentation on which this thesis is built. It tries to providing answers to the research questions as they are formulated in this chapter. Additionally it provides a discussion about the limitations and possible wider implications of this work.
2. **Climate change and ontological politics in the Dutch Delta**

This chapter is published in 2015 in the journal *Climatic Change*. The article is part of a special issue of this journal on “Uncertainty and Climate Change Adaptation”.

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2.1 **INTRODUCTION**

In September 2009, the first author of this chapter was present at the launch of the California wing of the Delta Alliance\(^2\) in San Francisco. During this event an exploratory modeling study conducted by a Dutch consortium on the effects of climate change was presented, in which a model made for the Dutch situation was roughly adapted to the Californian situation. After this Dutch perspective on the risks facing the California Delta in the near future, one of the first questions from the audience was “What do you define as a delta?” In the discussion that followed it turned out that the Dutch researchers had used a much broader definition of the California Delta, including the Bay Area, than the Californian researchers and policy makers who were present. This seemed to be more than just a confusion of tongues; it was an incompatibility of technological cultures (Shah 2008), a confusion of what constitutes a delta.

As it turns out, the ways of “knowing” deltas are multiple. This is nicely illustrated by Norgaard et al. (2009), who show how over time the ideas on what the Californian Delta is evolved. Firstly they distinguish what they call the “early vision” of the delta as a vast and open resource, with little to no conflicts between the various interests. Then, from the 1960s onwards, the delta became more and more envisioned as a conduit for water supply, subjected to political and economic constraints. In the eighties environmental constraints were “added”; similar to what in the Netherlands is referred to as the “ecological turn” (Disco 2002). From 2000 onwards there was an increased recognition that little was understood about the functioning of the delta. Consequently, “[a]n awareness of uncertainty, complexity, emerging properties, and the necessity of adaptation began to coexist with a conventional, although contradictory, mandate of achieving specific goals and evaluating performance according to goal achievement” (Norgaard, Kallis, and Kiparsky 2009 p.646). The evolution of these visions over time mutually constituted and recursively shaped management and political approaches. This study builds upon the idea that visions of what the delta is and its enactment not only varies over time, but also depends upon who envisions and for what reasons. Through this

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\(^2\) The Delta Alliance is a Netherlands based initiative that was established for enabling knowledge sharing between various deltas, see http://www.delta-alliance.org.
Deltas, or water bodies more generally, are objects about which knowledge is produced a posteriori. In the domain of water management studies this has most clearly been recognized by Barnes and Alatout “water is not a singular object of epistemology for which abstract knowledge can be produced and circulated in all times and places without interruption” (Barnes and Alatout 2012 p.484). What a delta is, or what a water body is, is ontology dependent. To understand how ontologies develop over time, we need to study how different ontologies interact, to study ontological politics. Ontology, in a broad sense “is the part of philosophy concerned with what there is and what there could be” (Law 2004 p.23). Annemarie Mol developed the idea of ontological politics in her work the body multiple (2002). Following her work, and the work by John Law (2004), this study aims to show the ontological politics of climate change in the context of the Dutch Delta. This means that it tries to show how in this case climate change informs and is informed by practices of Delta governance, and therewith looking at the performative and discursive character of climate change and the Delta. This means a move away from giving the object center stage in the study, but instead looking at how discourses and related practices form and transform the reality of these objects. In this chapter we broadly define delta governance as the combination of problem formulations and the organization of responses to these problems. We will look at delta governance by examining what is considered, and as such what is made real, and through what mechanisms this is subject to change.

In this chapter we focus on two elements of ontological politics: temporal and socio-natural dynamics. For the temporal dynamics, in line with the work by Norgaard et al. (2009) on the Californian situation, we will look at how since the early 1900s visions and approaches of dealing with the Dutch Delta have changed. For the socio-natural dynamics, in line with actor-network theory (e.g. Latour 2005), we will focus on mechanisms through which the delta is being scaled (Blok 2010) by looking at problem formulations, the times and spaces they take into consideration and the publics that are sparked into being (Marres 2005).
We consider the situation in Netherlands, and its “water culture” (Bijker 2012) as a paradigmatic case (Flyvbjerg 2006) in which climate change related uncertainties have a significant impact on the way the Dutch Delta is dealt with. This chapter consists of four sections. After the introduction, the second section will provide an overview of the co-existence and emergence of various ontologies in the Dutch Delta over time. The third section looks at how climate change entered the water management arena in the Netherlands and looks into the related socio-natural dynamics that surround it. The final section sums up the identified temporal and socio-natural particularities of ontological politics in the Dutch Delta and discusses the implications of what we label as an ontological lock-in.

2.2 Delta Ontologies over Time: Floods as Decisive Moments

This section provides a brief review of Dutch water management literature, analyzing ontologies by looking at the histories (Norgaard, Kallis, and Kiparsky 2009) of science, governance and the Dutch Delta. By applying an ontological politics lens to the literature on Dutch water management, it is striking to see the centrality of (near) flooding events as decisive moments; hence this section focuses on four of these moments: the construction of the Afsluitdijk, the 1953 flood, the ecological turn and the second Delta Committee.

Literature on Dutch water management extensively treats technological and societal mechanisms of dealing with water. Nearly all literature emphasizes how the Netherlands have come into being through a constant battle against water, with continuous technological innovations (van Dam 2002) and at the same time the growth of institutional capacities (Disco and van der Vleuten 2002). That the growth of institutions went hand in hand with technological capacities is shown by Kaijser (2002). TeBrake (2002) pinpoints the change from digging ditches for drainage to more codified forms of hydraulic engineering around the 12th century, enforced by the organizational strength of decentralized structures (Water Boards). Petra van Dam poses the thesis that Dutch culture is an amphibious culture with four historical strategies for dealing with floods: compartmentalization, living
on (man-made) elevations (dikes, dam or terps), daily transport over water and the ability to evacuate cows (amphibious cows) (van Dam 2010).

Wesselink et al. (2007) highlight that there is also a down side to the rise of these institutions and technological capacities, namely the problem of a technological lock-in, which refers to the situation “where only ever-increasing efforts can keep the system operational” (Wesselink et al. 2007 p.192-193). Dutch attempts and confidence in its technical and institutional ability to control water culminated in the closing of the Zuiderzee (Southern Sea), by the construction of the Afsluitdijk in the 1920s/1930s. Disco and van den Ende (2003) analyze how this closure dam came about, showing that an institutional void between decentralized Water Boards and little trust in the national level Rijkswaterstaat (executive department of the Ministry of Water Affairs) with centralist ambitions, was bypassed by the installment of a special committee. Foremost the authors show how uncertainties about the consequences of such a dam were “eliminated” by calculations by Nobel laureate Lorentz. These extremely laborious calculations can be seen as the cradle of the flourishing field of hydrological modeling, which really gathered pace around the 1930s through the work by Johannes van Veen. The final push towards closing off the Zuiderzee was given by the sea itself, in the 1916 flood, which “redefined the Zuiderzee as also a dangerous body of water” (Disco and Ende 2003 p.506).

The technological lock-in (Wesselink 2007; Wesselink et al. 2007) came into being especially after the last serious flood event in 1953 when as a response the Delta Works were constructed. Van der Vleuten and Disco see this also happening in river management in the 18th and 19th century: “While the taming of the “Water Wolf” transformed wet nature from [...] a danger to a calculable but ever-present risk, the consequent complacency has become a danger in itself” (van der Vleuten and Disco 2004 p.292). In the 18th century the rivers were tamed first by stabilization of the division of flow over the major branches of the rivers, in the 19th century the rivers were “normalized” through dredging, which facilitated an increasing inland navigation function of the rivers. These river works were mainly executed by Rijkswaterstaat, which slowly grew into a “state within a state” (Disco and van der Vleuten 2002), especially through the canalization of the river Meuse (1918–1928).
The 1953 flood was the decisive moment par excellence for the Dutch. The storm surge, which led to a death toll of close to 1,800 people, left a deep scar in the memories of the people living in the South-western delta (see Leydesdorp 1993). The disaster also marked a radical change in the Dutch (institutional) response to flood risks, though it must be said that the plans implemented after the flood, the Delta Works, had already been drafted before the disaster took place (van der Ham 2006). After the flood the first Delta Committee was established, which formulated a Delta Plan. The Delta Plan basically consisted of closing off all open connections to the sea, except for the Western Scheldt (connecting the harbor of Antwerp, Belgium with the North Sea) and the Nieuwe Waterweg (connecting Rotterdam to the sea), the implementation of flood risk design criteria and the raising of dikes. Delta Plan implementation has been a continuous challenge for “engineering wisdom”; first technologically (construction), later through the ecological turn. This is also reflected in the establishment of the hydrological laboratory in Delft which developed into the current Deltares. The closure of the open sea connection went rather smoothly, until the last hurdle had to be taken: the Oosterschelde.

Where the 1953 flood is generally seen as the start of large scale projects, the Oosterschelde, and the controversy surrounding its planned closure, is often seen as key in the ecological turn in Dutch water management (Disco 2002; Bijker 2005; van der Brugge, Rotmans, and Loorbach 2005b). Wesselink et al. state: “It can be argued that the Oosterschelde dam radically changed the world of water engineering in the Netherlands” (2007 p.196). This ecological turn resulted in a “new” way of setting up projects: “the paradigmatic breakthrough came with the presentation of a vision to combine nature development and flood protection: Plan Stork” (Wesselink et al. 2007 p.197) in 1987. According to some authors this turn also had its foundations in Rijkswaterstaat seeking new legitimacy after the (near) completion of the Delta Works (Hemert 1999; Roth and Warner 2007).

After the controversy over the Oosterschelde was settled with the construction of the Oosterschelde storm surge barrier, the attention shifted to the rivers. Especially after the high water levels in the rivers in 1993 and 1995 (for a history of river flooding in the Netherlands, see Tol and Langen 2000). “Until the (near-) floods in 1993 and 1995, the Dutch felt safe behind ever higher and stronger river dikes” (Roth and Warner 2007 p.519). After this
the Rivers Delta Plan was formulated, which was influenced by the European Water Framework Directive (2000). Dutch water management, according to Wiering and Arts (2006), set course to a more integrated form of water management. This was in line with international trends: “The 1990s saw a rediscovery of the positive aspects of rivers in Western Europe. Rivers had long been seen as a threat (flood risk) and treated as a dumping site for agricultural and industrial waste or an alternative transport route, requiring their channelization for navigation and flood disposal purposes” (Warner, Lulofs, and Bressers 2010 p.138). In the Netherlands this especially materialized in the Room for the River initiative introduced in 2000, aimed at dealing with “residual risk” by means of “calamity polders.”

In 2008, the second Delta Committee presented their water and flood management plans for the Netherlands. This second Delta Committee, while it aimed to “make The Netherlands climate-proof, by reducing both the probability and the potential impacts of flooding, [...] also stated explicitly from the beginning that it would primarily focus on flood prevention, as that has proven to be the most effective strategy in the past” (Brink, Termeer, and Meijerink 2011 p.280). These plans were again influenced by a flooding event, this time not in the Netherlands: the Katrina flood in 2005 in New Orleans (Wesselink et al. 2007). But they were influenced even more by anticipated future flooding events as a result of the changing climate. Building on the report of the second Delta Committee a large policy program has been established, the “Delta Program” (see e.g. Verduijn, Meijerink, and Leroy 2012), headed by the Delta Commissioner.

Van der Vleuten and Disco point at the problem that in the present day “when things do go wrong – as inevitably it seems they will – the losses will be greater and in the same measure the tendency to blame the human network builders and their unruly technology instead of, as in former times, unruly nature” (van der Vleuten and Disco 2004 p.204). In the light of knowledge controversies surrounding climate change impacts, it seems that delta management is much more a matter of dealing with uncertainties, than of building and constructing certainties. Yet it is interesting that the Dutch water management community is communicating the message internationally: “we have everything under control, our land is protected
from flooding by the large engineering structures of the Delta Works (and we’d like to sell you the knowhow)” (Wesselink et al. 2007 p.240).

In all, this brief history shows, maybe not so surprisingly, that decisions are not isolated moments in time and space, but interact with politics, science and technologies. It is more surprising that views on the histories of floods are recursively shaped by decision making processes. Floods function as the stage for the water management community to manifest itself, they discursively shape the way in which water management is thought about and practiced. The most remarkable aspect that comes to light when looking at this history through an ontological politics lens is that this also works the other way around: the water management community constructs flood narratives, e.g. by focusing on floods elsewhere in the world (New Orleans) or even by producing floods in the future (climate change projections). In the following section we will take a closer look at how especially the entrance of climate change has impacted ongoing processes in the Dutch Delta.

2.3 SOCIO-NATURAL DIMENSIONS OF CLIMATE CHANGE IN THE DUTCH DELTA

This section outlines the complexity and circumambulations of climate change adaptation in the Netherlands, by analyzing the Delta Committee report (2008), the annual reports of the Delta Program (Deltaprogramma 2010; 2011; 2012; 2013; 2014; 2015), background documents on Adaptive Delta Management and in depth interviews with the chairman of the Delta Committee and a key advisor to the Delta Program’s head, the Delta Commisioner. This analysis shows that the climate change narrative has changed over time while at the same time attention for uncertainties has been small. Second we will show how climate change has acted as a game changer in the case of the Volkerak-Zoom Lake, by showing how climate change has altered the reality, and therewith changed the issues at stake and the publics involved.
2.3.1 Mainstreaming Climate Change

Anticipating the increased awareness of climate change and its implications, the second Delta Committee, chaired by former minister Cees Veerman, was established by the Dutch government in September 2007 (Verduijn, Meijerink, and Leroy 2012; Boezeman, Vink, and Leroy 2013). The committee’s task was to advise the Secretary of State on:

“expected sea level rise, the interaction between that rise and the discharge in the major rivers in the Netherlands and such other developments, climatological and societal, until 2100–2200 as are important for the coast of the Netherlands;

the consequences of such developments for the Dutch coast

possible strategies for an integral approach leading to sustainable development of the Dutch coast, based on a) and b) and

to indicate the additional value to society of such strategies, in addition to the safety of the hinterland, in both the short and long term” (Deltacommissie 2008 p.101).

The second Delta Committee (2008), also referred to as Veerman Committee, presented its findings Working together with water: A living land builds for its future, which contained twelve key recommendations. The first recommendation states that “The present flood protection levels of all diked areas must be raised by a factor of 10” (Deltacommissie 2008, p.12). Later in the report the committee explains this: “After careful consideration, it is the Committee’s judgement that the flood probability in all diked areas (the amended flood protection standard) must be reduced by at least a factor of 10 below the present standards, i.e. safety levels must be increased by a factor of 10” (ibid., p.43). The last recommendation comprised the installation of a Delta Director, the establishment of a Delta Fund and a so called Delta Program. In November 2011 the Delta Commissioner (who was installed to perform the functions originally envisaged for a “Delta Director”) officially presented the national Delta Program at the first National Delta Conference. “The Delta Program is a national collaborative program of the national government, provinces, municipalities and water boards, with contributions from social organizations. The aim is to protect the Netherlands and its future generations against flooding and to safeguard a sufficient freshwater supply” (Deltaprogramma 2011 p.I).
The Delta Commissioner’s key advisor on strategy and quality explained: “There’s a significant difference between the Delta Committee and the Delta Commissioner. The committee was installed for one year. Smart people, sitting together, taking time to think about what the future of the Netherlands should be. The Delta Commissioner is about sensibleness, now it’s for real, really go and look what needs to happen. Thanks [to the Delta Committee] for the inspiring words, but now it’s getting serious” ³. This pragmatic turn entails that where the Committee puts the year 2100-2200 as its temporal range, the Delta Program talks in a much broader sense about “future generations.” Another difference is the emphasis put on “freshwater supply” by the Delta Program in its mission statement, in line with the recommendation by the Veerman committee to heighten the water level of the Netherlands’ largest freshwater lake, the IJsselmeer by 1.5 meters (Deltacommissie 2008; recommendation 11). This is probably the most controversial recommendation made by the Veerman Committee⁴, that proposed this measure so that “the IJsselmeer lake retains its strategic function as a fresh water reservoir for the Northern Netherlands, North Holland and, in view of the progressive salt water intrusion in the Nieuwe Waterweg, for the western Netherlands” (Deltacommissie 2008 p.13).

When looking at the expressions of climate change and related ontic and epistemic uncertainties (Petersen 2012), it is interesting to note that over time these have moved to the background, have become implicit. Where the Veerman Committee deliberately referred to IPCC reports to strengthen its arguments on the severity of climate change impacts on the Netherlands, the Delta Program makes no reference to the IPCC, but refers to the Veerman Committee instead. Which is remarkable since the Veerman Committee has been criticized for particularly highlighting worst-case scenarios (see e.g. Wesselink and Warner 2010). Veerman sees this as the responsibility of a government:

“What else is a government for? It needs to consider the worst thinkable scenario. [...] After that it’s a political choice to see if you say, well we’re going to account

³ Interview by A.Z. with key advisor on strategy and quality of Delta Commissioner. The Hague 5 March 2013, track 1.
⁴ See e.g. “Waterpeil IJsselmeer niet 1,5 meter omhoog” in Reformatorisch Dagblad 19 September 2012
for e.g. 80% [of that scenario]. [...] Look, professors and research groups need to manifest themselves, and there are always weak spots in an argumentation. That’s how science works.”

The Delta Program made a choice for measurement based climate change estimations supplemented by the projections of the Royal Netherlands Meteorological Institute (KNMI). Whereas the Delta Committee intended to deliver a wake-up call, proposing radical measures based on upper limits of what might happen in terms of sea level rise and changing rainfall patterns and river discharges, the Delta Program over the past years has taken a less extreme view on climate change. In 2008 Cees Veerman wrote: “For us, the second Delta Committee, the threat is not acute, but our mandate is nevertheless urgent. There is absolutely no reason for panic, but we must be concerned for the future. If we are to be well prepared for the expected consequences of climate change, we shall have to strengthen our flood defenses and change the way our country is managed, both physically and administratively” (Deltacommissie 2008 p. 5-7). This urgency to prepare for expected climate change did not vanish over time, but it did become less central. It became one of the elements that underlined the necessity to deal with the Delta now. This happened in two steps. First, climate change is presented as an observable, measurable fact, moving away from predictive models. This is for example explained in the 2012 Delta Program

“This Delta Program […] is starting off with the here and now and heading towards the future, which is why, at the Delta Commissioner’s suggestion, the Cabinet is basing its Delta Program on measurements and the KNMI 2006 scenarios. […] According to observational data, the climate is changing; it has become warmer and wetter, and the sea level has risen” (Delta Program 2012 p.37).

A second step is that of placing climate change alongside other forces of change. This becomes articulate in the 2013 Delta Program publication: “The number of people and the value of what needs to be protected change under the influence of economic and demographic developments. Water and the soil also change over time: the sea level rises and the soil subsides. The climate is also changing, resulting in higher

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5 Interview by A.Z. with Cees Veerman, Groesbeek, 28 January 2013, track 1.
temperatures and more extremes in river discharges and rainfall” (Delta Programme 2013 p.10).

An important factor in the mainstreaming of climate change in the water management policy making domain has been what the Delta Commissioner calls “Adaptive Delta Management”: “After all, solutions should be allowed to develop along with new insights and circumstances. That said, it is advisable to guarantee that the solutions can be implemented in a cost-effective manner when they are needed, and, in the short term, to take the first steps that are worthwhile in every scenario (no regret). In other words, adaptive delta management is not about deferring decisions or measures, but rather about taking the right steps at the right time” (Delta Program 2013 pp.88). With this approach the Delta Program deliberately distances itself from its initiator, the 2008 Delta Committee. The guidance document on Adaptive Delta Management starts with: “The Delta program takes a sensible approach. Sensible here means: interventions not based on worst-case scenarios and not assuming a fixed image for the year 2100”\(^6\). Adaptive Delta Management as it is operationalized in the Delta Program provides a methodology to formulate a “preferred” strategy. To come to this preferred strategy one first needs to determine “tipping point and uncertainties,” construct “development and adaptation pathways” and develop “favorable strategies.” The selection of the “preferred” strategy from the pallet of “favorable” strategies is done through a “real options analysis” (see e.g. van Rhee, Pieters, and van de Voort 2008).

What is interesting about the application of Adaptive Delta Management is that it is presented as an economically rational methodology to formulate and select a preferred strategy, but the determination of tipping points and uncertainties are ontology dependent. The ontological basis is established purely intuitively: AZ: “how do you determine what [type of tipping points and uncertainties] you take on board and what not? What are the criteria?” RE: “There are no objective, a priori determinable [criteria]. It depends on the judgment capacity of the eight people that at that very moment [at the start-up of the process] sit together [...] we make the

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decision to take something into consideration based on implicit criteria. There’s nothing more to it.”

In this sub-section we have highlighted how the performative and discursive character of climate change has changed over time. Whereas the Delta Committee framed climate change as a storm warning from the future, stressing urgency, the Delta Program approaches climate change rather as a long term weather report, which needs to be dealt with in a sensible way. The two responses feature different repertoires, where the Delta Committee used expressions like “raising flood protection levels by a factor 10”, the Delta Program rather talks about “adaptation pathways” and “favorable strategies.”

2.3.2 CLIMATE CHANGE AS A GAME CHANGER
Having introduced how conceptions of climate change and related uncertainties have changed in tandem with institutional set-ups, we will now analyze how climate change has entered a both temporally and spatially bound process dealing with a specific water quality issue in a lake. We will show how climate change has changed the nature of the problem and therewith its “publics,” the socio-natural configuration. The lake we will take a closer look at is the Volkerak-Zoom Lake (VZL), also referred to as Krammer-Volkerak Zoom Lake. The Volkerak-Zoom Lake is an artificial lake that came into being after the completion of the Dutch Delta works in the 1980s. Before the area became a lake it was a part of the Rhine-Meuse estuary. As a result the Volkerak-Zoom Lake has become a fresh water body located in the center of what the Delta Program calls the South West delta. A rather radical transformation, and until recently, never really contested. This was until the early 1990s, by then in summers the bluegreen algae (cyanobacteria) started to appear. By the early 2000s this smelly and poisonous algae was the reason for initiating studies for solving this problem (for more details on the construction of facts in the plan study process see chapter 3). In this section we will show what reality this process enacted, and how over time a climate change ontology, mainstreamed in the Delta Program, marginalized the local reality.

7 Interview by A.Z. with key advisor on strategy and quality of Delta Commissioner. The Hague 5 March 2013, track 4.
In 2008 it appeared to be a matter of fact, that the fresh water Volkerak-Zoom Lake was going to be turned into a salt water lake. The reason for this was that it was the only solution for the lake's bluegreen algae problem. In September 2012 one of the key persons in the process around the Volkerak-Zoom Lake stated that the lake will remain fresh for at least the coming ten years. Apparently something has changed in the meantime. When we asked the same key person why the salt option was being put on hold, the response was twofold: lack of funds and skepticism over the effectiveness of technical solutions for salt leakage problems. We would like to add another explanation for this deadlock from an ontological politics perspective: with the mainstreaming of climate change through the Veerman Committee and the Delta Program a tension has risen between the large scale, generalist ontology related to long term climate change projections on the one hand and the ontology of small scale, local level and relatively short term solutions for the bluegreen algae problem on the other.

After the bluegreen algae had appeared in the Volkerak-Zoom Lake in the 1990s, the responsible Secretary of State commissioned an “exploration study” for the identification of solution directions. By November 2003 the results of this study were presented. The conclusion of the exploration study was that there were eight possible solution directions, of which three were marked as preferred options. These solution directions varied from restoring the estuarine dynamics in the water body, turning the lake into a salt water lake, or maintaining the freshwater lake and flushing the algae out. After the exploration study a plan study continued with the aim to come eventually to a decision that would solve the bluegreen algae problem. This process resulted in the conclusion, in 2008, that the only way to eliminate the bluegreen algae is to turn the lake into a salt water body.

At that same time the Veerman Committee presented its recommendations and especially recommendation eight was particularly relevant for the Volkerak Zoom Lake:

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8 See e.g. de Volkskrant, 8 October 2008: Op een kier tegen te blauwalgen: Deltawerken plan van Rijkswaterstaat om een doorlaat voor zout water te maken in de Philipsdam.
9 Personal communication, 27 September 2012
10 Personal communication, 1 October 2012
“The Krammer-Volkerak Zoommeer, the Grevelingen and possibly also the Eastern Scheldt must be re-arranged to provide temporary storage of excess water from the Rhine and Meuse when discharge to the sea is blocked by closed storm surge barriers. A salinity gradient (a natural transition between fresh and salt water) in this area is a satisfactory solution to the water quality problem and can offer new ecological opportunities. In this case an alternative fresh water supply must be provided”

(Deltacommissie 2008 p.12).

What we see happening here is that the Delta Committee links the lake to neighboring water bodies, namely Grevelingen and the Eastern Scheldt while creating a temporary storage of excess water that may result from expected changing discharge patterns. With this the Volkerak Zoom Lake became part of a new reality, introducing new problems, stretching the boundaries of the system both temporally and in terms of the socio-natural dynamics. Temporally by introducing a 100 to 200 year time frame, while a new socio-natural configuration was brought into being by linking the lake to the surrounding water bodies, eventually forming the Dutch Delta, with the publics that are included in these processes.

<table>
<thead>
<tr>
<th>Year</th>
<th>Institution</th>
<th>Spatiality</th>
<th>Problem</th>
<th>Temporal focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-03</td>
<td>Exploration Study</td>
<td>VZL</td>
<td>Bluegreen algae</td>
<td>15/40 year</td>
</tr>
<tr>
<td>2004-08</td>
<td>Plan Study</td>
<td>VZL</td>
<td>Bluegreen algae/saltwater leakage</td>
<td>2015/2040</td>
</tr>
<tr>
<td>2008</td>
<td>Veerman</td>
<td>The Netherlands</td>
<td>Climate Change (esp. flood risk)</td>
<td>100-200 year</td>
</tr>
<tr>
<td>2008-11</td>
<td>Freshwater-program</td>
<td>ZW-Delta</td>
<td>Especially freshwater provision and distribution</td>
<td>2010-2015 And long term</td>
</tr>
<tr>
<td>2011-15</td>
<td>Delta Program</td>
<td>The Netherlands (Fragmented)</td>
<td>Safety (flooding and freshwater)</td>
<td>Future generations</td>
</tr>
<tr>
<td>2012</td>
<td>National Structure Vision</td>
<td>VZL and Grevelingen</td>
<td>Spatial organization</td>
<td>Short term</td>
</tr>
</tbody>
</table>

As a result of this new situation a freshwater program was initiated which looked at the consequences of a saline Volkerak Zoom Lake for the freshwater availability in the region, but also at the freshwater distribution of the entire South Western Delta region. When the Delta Program with all its sub-programs was launched, the Southwestern Delta was incorporated as one of the six area based sub-programs, while the freshwater component of
the discussion was also incorporated in the generic sub-program on freshwater and with that institutionalizing the generic climate change ontology. What happened to the Volkerak Zoom Lake in the mean time? At the moment a so called National Structure Vision development process has started up for the combined Volkerak Zoom Lake and its neighbor lake Grevelingen. In this vision a decision is to be taken in 2015 on the re-introduction of tidal activity in the Volkerak Zoom Lake.

In this section we have shown how climate change and the uncertainties related to climate change have entered the water management scene in the Netherlands and how its role has changed from an apocalyptic future into a manageable change scenario for which tools are being developed. Subsequently this section explored the consequences of this introduction for the Volkerak Zoom Lake, showing how climate change has changed the reality in terms of spatiality, temporality and audiences involved. Climate change has changed the specifics of the reality, and its subsequent problem, that needs policy action.

2.4 CONCLUSION

In this chapter we have highlighted two mechanisms that we have observed through an ontological politics perspective in the Dutch attempts to deal with climate change and its related uncertainties. First, we have shown how a shift has occurred from delta governance responding to (flooding) events to delta governance constructing future events that in turn require acting upon. We have shown that throughout the 20th century the occurrence of flooding events have been essential in establishing political and societal momentum for significant changes in Delta governance, whether this be decisions to construct large dams, the formulation of a Delta Plan or changing of an attitude towards river dynamics. At the same time, while anticipating climate change something changed about the appearance of floods, floods travelled across oceans, borrowing the floods in New Orleans as a wakeup call for Dutch politicians, and floods are imported from a produced future, sketching an apocalyptic future with regards to sea level rise and river discharges. Floods, apart from their physical character play an important role in determining the characteristics of the object, the delta, that needs to be governed.
Second, we have shown that the process of mainstreaming climate change in the Dutch delta has caused an “expansion of reality”. In the section on the socio-natural dimension of climate change in the Dutch Delta we have analyzed what happened to the responses to a specific local problem situation in the light of the upcoming wave of climate change adaptation in the realms of water governance in the Netherlands. The ontological politics frame enabled us to show how climate change effectively penetrated the Netherlands, and has irrefutably changed the nature of the reality that requires action. Climate change ontologically has stretched the time horizon of policy makers from a 10 to 50 years planning horizon to 100 to 200 years ahead. At the same time the idea about the nature of risks and uncertainties have changed from locally experienced floods to floods elsewhere in the world and in times yet to come. In sum the penetration of climate change and especially the ontic and epistemic uncertainties related to it have radically changed the playing field of water governance in the Dutch Delta. A local problem has become a cog in a machine, namely the complex Delta. As such scales of operation have grown, time has expanded, new publics are sparked into being while others have been moved to the background (e.g. the disappearance of the blue green algae from the political agenda). Reality has grown.

So what are the implications of the ontological politics of climate change in the Dutch Delta? What lessons are there to be learned? The analysis presented in this paper uncovers the fundamental tension between the growing awareness that “all is interconnected” and the practical realization that it is seemingly impossible to take all into account in decision making. While expanding reality one might grow ignorant of localized realities, like some algae in a lake.
3. **INSIDE MATTERS OF FACTS:**

Reopening dams and debates in the Netherlands

This chapter has been published as an article in the journal *Water Alternatives*, and is co-authored by Philippus Wester.

The figures in this chapter are made by Ian Officer.

3.1 INTRODUCTION: CONTROL BY TOLERANCE

The Netherlands is internationally well known for two governance particularities: its drug policy and its ability to fight the sea. The nation’s liberal attitude towards soft drugs has harvested both praise and strong criticism. The basic idea behind the liberal policy is that the spread of narcotics cannot be controlled, but legalising the softer, less harmful varieties breaks the links to harder varieties and to organised criminal activities: better a little controlled tolerance than no control at all.

The other feat for which the Netherlands is known worldwide is the way it has been “fighting against water” since the 12th century. With the dikes, dams and sea barriers (the Delta Works) constructed after the 1953 flood, the Netherlands was thought to be “safe” against flooding in the second half of the 20th century. Based on the proclaimed success of the Delta Works, the Dutch have started an international campaign advocating going Dutch \(^{11}\) in delta management. At first sight, it seems almost paradoxical: a tolerate-in-order-to-control soft-drugs policy on the one hand and an uncompromising water safety policy on the other. However, a closer look at current Dutch water management practices suggests a shift is taking place towards a similar tolerate-in-order-to-control attitude. This chapter explores this shift and what it means in decision-making processes, by providing a brief history of the co-evolution of science, governance and ecological systems in Dutch water management since the 1950s and an empirical case study of the role of models in the debates concerning the possible reopening of the Philipsdam, in the Southwest Delta of the Netherlands.

Analytically, this chapter deploys a co-evolutionary approach, to tease out the interactions between science, governance and ecosystems (Norgaard 1994; Gerrits 2008; Norgaard, Kallis, and Kiparsky 2009b). Studying the co-evolution of these three elements shows how facts are constructed, turned into and used as ‘black boxes’ (Latour 1987) in water governance. Unlike, for example, the work done on complex adaptive systems, this chapter does not show how the co-evolution results in a situation where facts are replaced by ‘better’ facts, thus looking at learning. Instead it builds on the idea developed by Law (2004) and Mol (2002), among others, that

\(^{11}\) The idiom “going Dutch” means sharing expenses equally.
Methodologies help to produce realities and facts and therewith ontological complexities, understood here as the multiplicity of ways of knowing, in this case, a lake, and the multiplicity of understandings and problem definitions underlying proposed actions. Using this lens this chapter aims to show that a “normal” mode of governance (Lach, Rayner, and Ingram 2005), based on the pursuit of consensus, and certainty based on “normal” science (Kuhn 1962), in the case of complex socio-ecological systems, such as deltas, is not able to break through a vicious circle of inertia, or of inaction. This inertia results from the interaction between governance and science, in which the process of constructing facts by “modelling through” is intricately linked with multiplying issue linkages and political and economic interests, resulting in selective strategic orientations that, prima facie, appear as just “muddling through”.

The term muddling through stems from, at the time, provocative work by Charles Lindblom (1959) in which he made a plea for an iterative approach for dealing with complex problems rather than approaches that mechanically try to identify the option that best satisfies pre-set goals. Our phrasing “modelling through” here refers to the remarkable role that hydrodynamic models have played in the case we describe in this paper. In line with Morgan and Morrison (1999) we observe the mediating role that models play with regard to decision-making processes, be it with a serious amount of political agency (King and Kraemer 1993). This means not just staying away from discussions on the ability of models to represent particular realities (Giere 2004), but rather looking at how models play a part in producing certain realities. In this respect Kouw (2012), for example, shows how all sorts of political and institutional considerations are imprinted in models. We will look at the other side of the same coin, to see how modelling practices have influenced the policy process. We thus focus on the use and interpretation of output data (Petersen 2006).

The analysis of the Philipsdam case is based on qualitative research conducted from January to May 2009 and in November 2011 using semi-structured in-depth interviews with ten different representatives of actor groups that were active in the governance process concerning the possible reopening of the Philipsdam.¹² Furthermore, the analysis uses observations from three different meetings: a member meeting of the Northern

¹² For privacy considerations the names of interviewees are withheld.
Horticulture and Agriculture Organization (LTO Noord), a meeting of the project group formed to study the freshwater provision of the southern part of the Zuid-Holland Province, and a roundtable conference of the permanent parliamentary committee on transportation and water management on the future of the Philipsdam. Lastly, this chapter draws on official project documents, reports and newspaper articles.

3.1.1 THE 1953 AFTERMATH: CONCRETE SOLUTIONS FOR CONCRETE PROBLEMS

In Dutch water management the focus has been consistently on keeping the land dry. Over time, the focus has shifted from land reclamation to the 20th century infrastructure-focused safeguarding of Holland’s developed human, agricultural, and industrial landscape. This was followed by the integration of environmental values in the mid-1970s (Disco and van der Vleuten 2002). In recent years, and specifically with regard to projected climate change, we see a return to an emphasis on safety, even if through environmentally friendly processes such as the “Room for the River” policy (van der Brugge, Rotmans, and Loorbach 2005). This policy innovation both appeals to environmental values while in many ways remaining a traditional environmental engineering means to prevent more severe floods (van Hemert 1999). Such floods are expected with climate change-induced increases in seasonal freshwater flows from the Rhine and Meuse rivers.

The Dutch Delta is located where the Meuse and Rhine rivers meet the North Sea. Since the first dikes and sluices were developed around 1100 (Van de Ven 1994), much has happened, especially throughout the 20th century. A crucial turning point in Dutch water management was the 1953 flooding disaster in the Zeeland Province, in which around 1800 people died. This disaster prompted the construction of the Delta Works, including the Oosterschelde Storm Surge Barrier (Figure 1).13 The barrier, completed in

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13 Figure 1 shows, apart from the Oosterschelde storm surge barrier and its compartmentalisation dams, the Philipsdam and the Oesterdam, and the other dams constructed as part of the Delta Works: Grevelingendam (completed in 1965), Volkerakdam (1969), Brouwersdam (1971), and the Haringvlietdam (1971). The figure also shows the location of the Zeelandbridge (1965). This large-scale infrastructural work is not formally part of the Delta Works, but has significantly impacted the accessibility of the Islands.
1986, is 9 kilometers (km) long and has a semi-open character; the barrier can be closed when extreme high water is expected and is open under normal circumstances. This semi-open character is the reason it is known both as a marvel of Dutch civil engineering and as a symbol of Dutch consensus decision-making. The latter is mainly because the semi-open character is the outcome of a political compromise between those who strove for maximum flood protection and nature conservation activists who fought for the protection of the estuary (Bijker 2002). Disco (2002) identifies the construction of the barrier as an important turning point in the appreciation of environmental concerns in the Dutch water management arena, calling it the “ecological turn”.

FIGURE 1: OVERVIEW OF THE DELTA WORKS

Around the time of the completion of the Delta Works in the mid-1980s, the Dutch started to turn towards a more integrative water governance style (Wiering and Arts 2006) which co-evolved with the development of sciences that supported the policymaking process. Disco and van den Ende (2003) illustrate this transition in their account of the history of hydrological modelling and how these provide “strong, invincible arguments” to policy-makers. The development of the modelling sciences co-evolved with the shift in governance style from one of “fighting against
water” to one of “living with water”, which has been taking place since the 1980s (for illustrations see Saeijs 2008). Critics have argued that this shift was less about creating “room for the water”, but rather more about creating “room for the engineer” (van Hemert 1999). The latter argues that in the “fighting against water” mode engineers were mainly concerned with the height of dikes, whereas in the “living with water” mode the playing field of the engineers also came to include all that happens in between the dikes. Van Hemert shows how this shift was supported by changes in hydraulic models.

The recently launched Delta Program14 clearly shows that, despite all the institutional and discursive shifts that have occurred the dominant undertow in Dutch water governance is still “safety,” strengthened by the climate change discourse. This is borne out by the language used in the report by the second Dutch Delta Committee15 which appears to herald a return to post-1953 safety vocabulary in the political arena. This is also the case in some scientific domains, and particularly at the science policy interface. Iconic for this move is the commentary in Nature titled: “Climate Proofing the Netherlands” (Kabat et al. 2005), in which the Dutch leaders of the climate change science program argue for large-scale innovations to help the Netherlands adapt to predicted climate change impacts. Wesselink et al. (2007) argue that the Netherlands is facing both a technical and a political “lock-in”. Technical lock-in refers to the protection by the Delta Works that has created “a false sense of security in the Dutch Delta. Political lock-in refers to the political inability to discuss safety levels: When safety levels cannot be politically discussed due to a political fear of contradicting the public conception of absolute security, a fundamental revision of flood defence policy is unattainable” (Wesselink et al. 2007 p.205).

3.2 Nature, Facts and the Nature of Facts

A key element of Dutch Delta management in the 20th century has been a strong reliance on mathematical predictions of the effects of measures taken in the water system. This started around 1918, when Cornelis Lely was serving his third term as the national minister of water management. Lely, a civil engineer by training, was determined to establish a long dam to close off a large part of the Zuiderzee, a shallow bay located in the centre of the Netherlands, in order to safeguard a large part of the inlands of the Netherlands against flooding, and simultaneously creating the possibility of reclaiming agricultural land from the sea. Politically, there was resistance due to the controversy over the uncertainty about what would happen to the tidal patterns in the Wadden Sea. To settle this controversy, Lely asked Nobel Prize laureate Lorentz to chair a committee to study these patterns (Disco and Ende 2003). Lorentz’s laborious manual calculations were then used to determine the exact location of the dam. When the dam was completed in 1932, Lorentz’s predictions proved to be very accurate. This accuracy was a big step in establishing faith in predictive calculations, which, since then, have evolved into highly technical computerised models that play a crucial role as decision-making support tools.

Disco and van den Ende (2003) provide a historical account on how models grew to being used as water management instruments, showing how tidal models over time have become more and more sophisticated in terms of their computational capacities, and simultaneously have gained importance in the policy domain by determining which measures can and which cannot succeed. Kouw (2012) argues that through the increased sophistication, with their increased complexities, present-day models and simulation exercises have a tendency to become epistemologically opaque. By this he raises an important problem of modellers’ capacities to reflexively conduct their modelling work. This realisation on the work of models and modellers is similar to the emphasis put on the creative, and non-scientific elements (see also Morrison and Morgan 1999) of the work of engineers in general as this has been formulated by Ferguson (1977). With Winsberg (2009) we see models as means that mediate between theories and the world, a mediation that powerfully defines the cognitive boundaries of the system.
3.2.1 THE PHILIPSDAM

The Philipsdam, completed in 1987, is located about 30 km east of the Oosterschelde Storm Surge Barrier, on the border between the provinces of Zuid-Holland, Brabant and Zeeland. The construction of the Philipsdam was a direct consequence of the semi-open character of the Oosterschelde Barrier, which reduced the tidal activity of the Oosterschelde Estuary. To compensate for this reduced tidal activity the area and volume of the Oosterschelde had to be decreased. This was done by compartmentalisation through the construction of the Oesterdam and the Philipsdam. Consequently, east of these dams, a freshwater lake came into being: the Krammer-Volkerak-Zoommeer (see Figures 2 and 3).

FIGURE 2: OOSTERSCHELDE STORM SURGE BARRIER AND COMPARTMENT DAMS

The construction of these compartment dams was contested both locally and internationally (Boermans and Hoeneveld 1984). Belgium was strongly concerned about the Dutch Delta plans as the vitality of its main seaport, Antwerp, was at stake. Though it was clear from the start that the Westerschelde would remain open, Belgium was concerned about its connection with the European network of inland navigation and argued for a stable Schelde – Rijn connection. The Dutch government saw such a
connection as a threat to the commercial competitiveness of the Rotterdam-based inland navigation shipping sector. The dispute was eventually settled, with Belgium paying 85% of the costs for the connection and the Dutch shouldering responsibility for maintenance.

A more local issue was the salinisation of land (Boermans and Hoeneveld 1984). The island of Tholen in the province of Zeeland, which was to be directly connected with both the Oesterdam and the Philipsdam, and the western part of the province of Noord-Brabant, would both benefit from the creation of a freshwater lake on their borders to reduce salinity intrusion. The risk of salt water inflow into this freshwater lake had two sources: the sluices in the Philipsdam and the water coming from Antwerp. This problem was tackled by the ingenious design of a north-to-south flushing system in the Philipsdam sluices, discharging water from the Hollandsch Diep into the Westerschelde. This did not fully resolve salinity intrusion due to the preferential allocation of water from the Hollandsch Diep to the Nieuwe Waterweg (Rotterdam Harbour) in times of limited supply, making it necessary to either keep the sluices closed or to allow for some salinity...
intrusion. In addition, there are tremendous ecological effects of turning tidal water into a stagnant freshwater lake (Boermans and Hoeneveld 1984).

One of these effects was the appearance of the blue-green algae (cyanobacteria predominantly microcystis) in the Krammer-Volkerak-Zoommeer in the early 1990s. This alga, apart from smelling unpleasant, is also poisonous, creating problems for people making use of the lake for recreational purposes and agricultural freshwater supply. In response to these problems Rijkswaterstaat (RWS)\textsuperscript{16} started the project “Exploration of Solution Directions for the Volkerak-Zoommeer” in 2003. The main reason for starting this project was that “since 1994 there has been an increase in inconvenience caused by the blue-green algae and it became clear that the ecological development was not going in the preferred direction.”\textsuperscript{17} During this project eight different possible end-states of the lake were formulated and eventually in November 2003 two options for the “medium term” were formulated: flushing water in the Volkerak-Zoommeer with freshwater or turning the Volkerak-Zoommeer into a saline waterbody.

In December 2004 a planning study was launched that defined the central issue as: “since the early 1990s we are facing severe water quality problems. The ecosystem is not functioning properly causing an annually returning problem with the blooming of the blue-green algae. This bloom of algae can cause other species’ mortality and causes severe inconvenience to the users and the surroundings.”\textsuperscript{18} The goal of the planning study was to develop lasting solutions for the Volkerak-Zoommeer’s problems, which in the long term (2040) would lead to a sustainably functioning ecosystem in the Volkerak-Zoommeer. The planning study explored both directions formulated in the exploration phase. By July 2007 it was concluded that the only feasible direction for the future of the lake were saline solutions, thus turning the freshwater lake salt, and by doing so eliminating the blue-green algae. The following section details how this outcome was achieved. This shows how various ideas on the future of the system, articulated in different modelling outcomes were contested, how, over time, these moved to one

\textsuperscript{16} The executive department of the then Ministry of Transport, Public Works and Water Management, currently the Ministry of Infrastructure and Environment .

\textsuperscript{17} Source: Samenvatting Verkenning Oplossingsrichtingen Volkerak-Zoommeer, November 2003, page 5

\textsuperscript{18} Source: Startnotitie Planstudie Waterkwaliteit Volkerak Zoommeer.
consensual advice and how attempts were made to give this final advice political legitimacy.

3.2.2 MODELLING THROUGH
Looking at the governance process concerning the Volkerak-Zoommeer and the Philipsdam over the last two decades it is striking to see how problem statements have been adapted to new knowledge and vice versa, and how the dam reopening decision process was cognitively bound and specified by the models that were used. In our account of the reopening of the Philipsdam, we give special attention to the production of knowledge by means of hydrodynamic models, to show how water governance in the Netherlands is "modelling through." The debate on the Volkerak-Zoommeer has been, and still is, a debate in which science plays a leading role: first, in establishing a road map for the planning study and, subsequently, in exploring which options would "work." Later on, in the discussion on the freshwater provision of southern Zuid-Holland, the credibility of the established facts was contested.

Contesting facts and the outcomes of studies turn out to be a powerful weapon in discussions. When the Belgians were informed about the Volkerak-Zoommeer planning study they held their cards close to their chest, according to an employee of RWS, while: "at the same time they did come up with various demands on what we should research, and, especially, how we should research this. In turn, we didn't think that was really fair..." The demand on this 'how' was related to methodological issues, whose specifics are unknown to the authors of this chapter, apart from the statement by the RWS employee who explained: "well, they think that we should use all sorts of 3d models and whatsoever. Studies on what the consequences could be. While we think that you can also calculate this in a different way. So that’s what we did, we just calculated it, but not in their way." Though the Belgian attempt to influence the process by contesting the methodologies behind the construction of facts in this case was not very effective, it does show that models in this case did not just mediate, they

19 Interview, 10-2-2009.
20 Interview, 10-2-2009.
were also the grounds of contestation and attempts to stretch and adjust the boundaries of the system.

When taking a closer look at the recent studies done on the possibilities to eliminate the blue-green algae in the Volkerak-Zoommeer we see how credibility in this case is expressed in the number of dimensions used by the model. In 2005, researchers of the University of Amsterdam approached Rijkswaterstaat claiming that flushing 150 m$^3$ of freshwater would solve the blue-green algae problem. Rijkswaterstaat was not sufficiently convinced by this solution, and consequently they turned to Deltares. A representative of Deltares, the key Dutch knowledge institute on deltas, reports on their advice: “in other words, flushing [with freshwater] turned out to be a solution. They had used a confined modelling instrument to reach this conclusion.”

According to this Deltares employee the model used in this case was limited, not in the configuration of the algae modelling, but in the hydrodynamic aspects of this model: “they had made a 1-dimensional, almost 0-dimensional schematization of the basin.” This model resulted in a positive advice for a 150 m$^3$/s freshwater flushing option. With this in mind the planning study project leader asked Delft Hydraulics (now part of Deltares) with the University of Amsterdam as subcontractor, to jointly double-check the figures. The Deltares model showed a negative advice for the 150 m$^3$/s option. The scientists suspected that the difference in outcome was the result of the different ways in which they had modelled the algae bloom. The Deltares employee indicated that: “we have, together with Amsterdam, repeated the calculations, but now with our models. This means a more detailed hydrodynamic model […]. The result was that the horizontal and vertical movement of the water is important for the end result. Even if you make the algae models almost exactly the same, which we have done on statement level, looking at our model and the model of Amsterdam.”

What happened here is that the algae problem, modelled by an algae model, is divided into an algae problem and a freshwater flow problem. Through their hydrodynamic model, Deltares redefined the problem and its boundaries into its own domain. This was confirmed by one of the researchers involved from Amsterdam, who explained how this was done in

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21 Interview, 25-3-2009. See also Verspagen et al. (2006).
22 Interview, 25-3-2009.
23 Interview, 25-3-2009.
practice: “I went to Delft two or three times a week. There I just entered my code, my differential equations into their model. A student did the hydrodynamic part.”  

The models thus form the grounds for the dialogue between pro and against fresh water flushing arguments, (see King and Kraemer 1993) by merging the Amsterdam research and the Deltares modelling study.

But, then, how reliable is this result and the attendant final advice? According to the Deltares interviewee there are various variables which one can influence in a model: “There are some aspects which you just have to think about. In that sense a model is a resource. You can indicate sensitivity, but in fact, only experience, built up in the past 25 years, with algae modelling, not just in waters in Zeeland, but also in the IJsselmeer and the Randmeren, can give you the confidence that your model, under particular circumstances, approximately gives a good description of the situation.” This illustrates the point raised by Morgan and Morrison (1999) about tacit knowledge, skills and judgement being irreducible elements in defining what constitutes a ‘good modeller’, and Kouw’s (2012) idea of the ‘craft’ of modelling.

Despite the 25 years of experience that Deltares has with modelling and predicting effects of measures on water systems making use of models, the uncertainty related to the modelling outcomes does impact the decision-making process. An example of this influence is the uncertainty argument used in the discussion around the freshwater provision of the southern Zuid-Holland Province. At first, southern Zuid-Holland was not really interested in what would happen to the Volkerak-Zoommeer, as long as they would be compensated for the freshwater inlets which they would lose. The problems started when it turned out that there would be backward salinisation over the Volkerak sluices, leaking saline water into the Hollandsch Diep and Haringvliet. This salinisation had been predicted by Rijkswaterstaat, says an employee of one of the water boards, but: “there is quite an uncertainty. (...) Maybe, the vertical component of salinity in water is hard to model,

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24 Interview, 28-11-2011.
25 Dutch for "border lakes."
26 Interview, 25-3-2009.
and therefore it might be overestimated. That could be the entire problem. Then we're having this entire discussion for nothing.”27

This uncertainty also came to light at the meeting of the project group connected to this research on freshwater provision for southern Zuid-Holland. At this meeting a drinking water company requested for more details on this leakage of saline water. A representative of Rijkswaterstaat Zuid-Holland reacted to this: “The numbers that we present all have a bandwidth. Because we're now at the edge of yes or no, complicated or simple measures. It’s just a model. And though people prefer not to hear this, it's just a model of reality. The hardness of numbers is always a seeming hardness...”28 To deal with this uncertainty Rijkswaterstaat decided to start an experiment, testing a “new technology” to limit the mixing of saline water and freshwater.29

Framed in terms of salience, credibility and legitimacy (Cash et al. 2003), the above strategies used by Rijkswaterstaat (increasing the number of dimensions used in the models and doing experiments in the field) served to increase the credibility of the knowledge produced. To increase the legitimacy of the advice Rijkswaterstaat used another strategy: expert judgment. A Rijkswaterstaat employee explains that after Deltares came up with conclusions they were submitted to independent [foreign] experts, for their approval [...] because, the outcome that the fresh option wouldn’t work, that’s not trivial, so we wanted to be sure. [...] They were blue-green algae experts. Two from Finland, since in the Baltic Sea they have similar problems. One from Berlin, from the Humboldt University, who knows a lot about algae. And someone from the NIOO, which is the Dutch Institute [for Ecology]. They were not involved in the plan yet. They were steering the group, as independent experts. They also know a lot about the blue-green

27 Interview, 27-2-2009.
28 Dordrecht, 18-3-2009, meeting project group; Freshwater provision for southern Zuid-Holland.
29 This experiment conducted in the sluices of the Afsluitdijk was completed in June 2011, and according to an employee of Rijkswaterstaat the results are satisfying and the technology seems to sufficiently tackle the salt intrusion problem; source: “Proef Afsluitdijk biedt oplossing zoutlek Volkerak-Haringvliet” http://www.waterforum.net/ (Last visited on 22 June 2011).
algae. And finally a professor from the University of Amsterdam was also involved.\(^{30}\)

In the debates this expert judgment turned out to be an effective form of “closure”; \(^{31}\) after their judgment the option of the freshwater solution basically disappeared from the discussions. Though effective in promoting a single direction for policy-makers, the legitimacy of the international experts was questioned by the Amsterdam researchers: “the funny thing was that I completely didn’t know these experts. Not by name. These were not the people that made me think: ok, these are the top European blue-green algae experts.”\(^{32}\) However, by this time the combined salience, credibility and legitimacy of the studies were sufficiently strong that the choice for a saline future for the Volkerak-Zoommeer could be made. This choice, however, led to a whole set of new “problems”, as the next section shows.

### 3.3 Radiating Effect and Complexity

After the lake’s saline future became a closed “fact” the central problem became that of freshwater distribution, which affected a much larger area, as summarised by the planning study project leader

> Actually, to be honest, it was not really clever to start off the study process by approaching it as a closed system. At first the idea was to flush it or turn it saline, with limited effort, the rest of the world wouldn’t notice a thing. But it turned out that a solution for the system itself was needed. Bit by bit we discovered: Guys! This is impossible! There’s such a radiating effect, so much influence! ”\(^{33}\)

What had started off as quite an isolated problem, a blue-green algae problem in a lake, over time turned out to radiate to many other problems. How this emerging complexity has influenced the science and decision-

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\(^{30}\) Interview, 10-2-2009.

\(^{31}\) Closure here refers to the procedure of stabilising fact or artefacts, as formulated in Pinch and Bijker (1984).

\(^{32}\) Interview, 28-11-2011. In this interview it was also mentioned that the Amsterdam researchers did not entirely agree with the peer-review report, and that they wrote a counter-report. The Amsterdam researchers advocated to try the freshwater flushing option when enough freshwater was available; according to the interviewee this was “too easily disregarded.”

\(^{33}\) Interview, 10-2-2009.
making process concerning the future of the Volkerak-Zoommeer is detailed below showing that the linking of the Volkerak-Zoommeer issue to other issues is a tactic used in many instances. We will briefly discuss how the Volkerak-Zoommeer issue has been linked to the construction of the Oosterschelde storm surge barrier, geese and the brown rot fungi, which is a fungal disease particularly affecting potatoes, to show how for different actors the nature of the problem can vary. After that we will closely look at the already mentioned freshwater distribution issue, also in relation to the possible reopening of the Haringvlietdam and the impacts on the Haringvliet, which is the water body bordering the Volkerak on its north side, to show more in detail how this divergence of the problem takes place.

3.3.1 THE OOSTERSCHELDE STORM SURGE BARRIER
In the planning study process the influence of the Oosterschelde Storm Surge Barrier is that of a bogeyman, with actors stating that the blue-green algae problem in the Volkerak-Zoommeer is a direct consequence of the Oosterschelde Storm Surge Barrier. At the parliamentary committee roundtable conference this link was used in discussions on who is going to cover the costs of the measures that need to be taken now. In this respect it was stated twice during the conference that since it was the national government that had built the dams, it should also cover the costs of its consequences.

3.3.2 GEESE
Farmers, who rely for their freshwater partially on the Volkerak-Zoommeer, frame the problems in quite different terms. At a member meeting of the Northern agricultural organisation, a farmer mentioned that an important aspect is being neglected: geese. One of the really big problems that he and his neighbours are facing is geese. The number of geese increases because of the many nature conservation developments to compensate for disruptions to the ecosystems, which are often combined with changes of the inland water management system. With these new “nature” areas, more geese forage in the neighbourhood, increasing the manure load on

34 Dirksland, 16-3-2009, farmer association meeting.
their lands. A saline Volkerak-Zoommeer would require an alternative freshwater supply system to service the agricultural freshwater needs, which would then be constructed over land by excavating new supply channels, attracting possibly more geese.

3.3.3 **BROWN ROT**

A similar issue that is being linked to the Volkerak-Zoommeer is brown rot. This issue comes up when alternative freshwater supply systems are discussed. One of the options would be to use water from the Wilhelminakanaal, as a freshwater source. The Wilhelminakanaal receives water from the east, all the way from the Meuse. A representative of one of the agricultural organisations explains how the brown rot fungus might pop up in this case: "A disadvantage of the water from the Wilhelminakanaal and the Maas [Meuse] is that it contains the brown rot bacteria, which is an annoying disease in potato cultivation [...] in fact; this [western Noord-Brabant] is one of the areas in the Netherlands which is pretty much ‘clean when it comes to the presence of brown rot.’ By an active inlet of this water this risk will increase."\(^{35}\) The area of the Volkerak-Zoommeer is now suffering from the blue-green algae bacteria. If the Volkerak-Zoommeer is turned saline it might mean that the algae would disappear, but the brown fungus might appear in the region, thus creating an unusual trade-off between smelly waters or rotten potatoes.

3.3.4 **FRESHWATER DISTRIBUTION: JUST A COG IN A COMPLEX MACHINE**

What plays a fundamental role in the background of the entire process is the discharge of more than 1000 m\(^3\)/s of river water flowing through the Nieuwe Waterweg, the open connection of the city of Rotterdam with the North Sea (see Figure 4). This is a substantial fraction of the entire freshwater flow entering the Netherlands by the two large rivers, the Rhine and Meuse.\(^{36}\) Almost every interviewee mentioned the relation between the

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\(^{35}\) Interview, 24-2-2009.

\(^{36}\) Looking at the reference values published online by Rijkswaterstaat.
Volkerak-Zoommeer and the amount of water flowing through the Nieuwe Waterweg. At a meeting with affected farmers, the planning study project leader stated that: “the water from the rivers is needed for keeping out the sea water in the Nieuwe Waterweg (1000 – 1500 m³/s) [...] Using freshwater for the Volkerak-Zoommeer (150 m³/s) will lead to unacceptable salt intrusion in the Rijnmond area.” In this respect, an interesting question was posed at the roundtable conference by a member of parliament, to this project leader:

Well, a solution could be the un-deepening of the Nieuwe Waterweg. Move the shipping activities to the west, which is an autonomous development that we’ll need to accelerate. As a result you’ll need much less water in the north, and you’ve got your water for flushing. What is your response to this?” To which the project leader replied: “Yes, that could be a possible solution, more freshwater available for flushing. My estimation would be that you would need approximately to double the flow size that we’ve tested so far. That’s 300 m³/s. Still that’s a lot of water, which possibly flushes away the blue-green algae. But what you do then is using 300 m³ for a system that eventually uses 30 m³/s for agricultural purposes, and thus you are repeating the trick of the Nieuwe Waterweg, more or less. But ok, it’s possible.

The planning study’s view on the freshwater availability in relation to the possibility of flushing the Volkerak-Zoommeer with freshwater is confirmed by a Deltares employee who was involved with the modelling studies that form part of the planning study. He explains:

we first looked solemnly at the freshwater possibilities. Salt was completely not in the picture yet... we just looked, well, is this 150 correct [solution option as

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37 Dirksland, 16-3-2009, LTO-Noord member meeting.
38 Tholen, 23-3-2009, roundtable conference parliamentary commission, Transportation and Water Management.
suggested by researchers from the University of Amsterdam\textsuperscript{39}: are the residence times needed correct? According to us this 150 m\textsuperscript{3}/s is not sufficient. If you could divert 1000 m\textsuperscript{3}/s through the system all algae will surely disappear. [...] But there is no 1000 m\textsuperscript{3}/s freshwater available [...] 1000 m\textsuperscript{3} is a possible theoretical solution, but in reality this water is not there, so it’s not a practical solution.\textsuperscript{40}

A Water Board representative stated: “it’s a consequence of human action, constantly bigger ships, constantly deeper dredging and constantly more salt intrusion. It’s been a conscious choice to do this, to keep the salt out. Otherwise Gouda will turn saline.”\textsuperscript{41} This led another farmer representative to state: “look again at the entire Dutch water system. And if you do so, and you say, let’s seal off the Rijnmond [Nieuwe Waterweg]... then there’s a lot of water that you don’t need any more.”\textsuperscript{42} Another Water Board representative suggested exploring possibilities of installing, for example, an inflatable barrier in the Nieuwe Waterweg: “Well, look, what the real solution will be is something you’ll have to study. It is possible though, that there are measures that can be taken in the Nieuwe Waterweg, which cost less money, that will provide you with extra water to divert through the Volkerak-Zoommeer.”\textsuperscript{43} The bottom line is that freshwater distribution in the South Western Delta is a fundamental issue that influences other debates like that on the future of the Philipsdam and the Volkerak-Zoommeer. The Volkerak-Zoommeer is just a cog in the machine, albeit a highly complex machine.

\textsuperscript{40} Utrecht, 25-3-2009, interview Deltares.
\textsuperscript{41} Interview, 27-2-2009.
\textsuperscript{42} Interview, 16-3-2009.
\textsuperscript{43} Interview, 11-3-2009.
3.3.5 De Kier

The complexity of the freshwater distribution system in a coastal delta becomes even clearer when we look at another issue that is being linked to the Volkerak-Zoommeer, namely the “Kier” (English: “crack” or “set ajar”). The word “Kier” in this area refers to the initiative to partly open the Haringvlietdam and therewith let seawater into the Haringvliet, particularly aimed at allowing the salmon to migrate from the sea to the rivers as a part of an international agreement. This process has made the word “Kier” somewhat burdened with emotions. A newspaper chapter on the Volkerak-Zoommeer planning study headlined: “On a ‘Kier’ against the blue-green algae.” Rijkswaterstaat was not really happy with this headline, as the project leader said: “The newspaper’s headline maker probably liked it, on

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44 See: de Volkskrant, 8 October 2008. Didde, R: Op een kier tegen de blauwalgen; Deltawerken Plan van Rijkswaterstaat om een doorlaat voor zout water te maken in de Philipsdam.
a ‘Kier,’ but we were not so happy with it, because then you create a link with this [the Haringvliet] which is still quite controversial.”  

During the meeting attended by farmers, the “Kier” issue proved indeed to be controversial. After the presentation by Rijkswaterstaat and the Water Board Hollandse Delta, questions from the audience focused on whether it was possible to reconsider the “Kier” decision, now that this Volkerak-Zoommeer issue also came into play. The person hired as an independent facilitator responded that a “reconsideration of the Kier is not on the [political] agenda.” He continued by stating that though the “Kier” may be a fixed [closed] issue, the compensative measures that are going to be taken for that can be still adjusted to the “new” Volkerak-Zoommeer’s influence.

In 2009, the deputy minister made clear that she wanted to see the Haringvlietdam on a “Kier” by the end of 2010. As a result, this “Kier” decision has been very influential in the process around the Philipsdam. As a Water Board representative stated:

> the same way as it happened back then with the Kier decision in the Haringvliet. There it was decided that the salt could come to a certain fixed point. [...] and consequently we’re going to move the inlets. We’re going to think about a solution for the drinking water supply, all on the expense of the national government. But you notice now, that they’re now much more reticent in that regard.

A farmer representative explained why the “Kier” issue is controversial:

> a study on the Kier is much older. But, devising and execution are two separate things. Well, at a certain moment in time a decision was made, and agriculture said, ok, we will cooperate on this, on two conditions. Firstly we need a guarantee that the current freshwater supply will be untouched. Secondly, if the salt intrusion appears not to stop at ‘Spui’ [which is the fixed, agreed upon point up to which the salt is ‘allowed’ to enter the Haringvliet], but intrudes further, we close the dam immediately. It’s not going to be a matter of open or closed, no we need to have room to manoeuvre. And well, the agricultural organizations have made a big mistake here. The deal was made in a top-down way, with too

45 Interview, 10-2-2009.
46 Dirksland, 16-3-2009, LTO-Noord member meeting: “kier heroverweging staat niet op de agenda” [118]
47 Interview, 11-3-2009.
little communication with their members. As a result, they are very emotional about these issues.\textsuperscript{48}

A Water Board employee put these sentiments in a broader context:

After the Delta Works, the decision on the Kier was made, now the plans regarding the Volkerak-Zoommeer and the new Delta commission... Yes, people feel a threat. These forces are rather big. We are the only ones opposing. What also plays an important role is that Zeeland and Brabant will improve their situation. They'll get a pipeline through western Brabant. [...] They will just receive freshwater, especially Tholen and St. Philipsland will improve their situation.\textsuperscript{49}

Ironically, after having had a tremendous impact in the decision-making process on the future of the Philipsdam, the national coalition cabinet installed in October 2010 decided to cancel the ‘Kier’ decision. In June 2011 this cancellation decision was reversed by the cabinet, in anticipation of financial claims that could be made by neighbouring countries. Wesselink et al. (2007) argue that the Netherlands faces both a technical and political lock-in. The “Kier” decision-making process and its influence on other processes like that of the Philipsdam show how the system is caught in inertia, as decisions depend on projected outcomes of impact studies and projected outcomes depend upon the problem statements (what is taken into account, and what is not?), and therefore they are part of the political decision-making process itself.

So what, in the end, has happened to the Volkerak-Zoommeer? And what does this show us about the governance of such a complex socio-ecological system? Currently, the Volkerak-Zoommeer is still a freshwater lake and the Philipsdam is still closed. What started off as a flood protection problem, “solved” by constructing the Oosterschelde Storm Surge Barrier and the compartment dams (including the Philipsdam), over time became a water-quality problem with the blue-green algae. After this problem was put on the agenda, the “problem” has evolved from a (fresh) water quantity problem, into a situation that, as we have shown, has radiated in many directions and has become gridlocked.

\textsuperscript{48} Interview, 16-3-2009.
\textsuperscript{49} Interview, 27-2-2009.
3.4 Conclusions

The decision by the national cabinet ironically shows how large the impact of decisions can be on the one hand, but also how frustrating the practice of politics can be. Participatory processes have been taking place around the link between the future of the Philipsdam and the “Kier” and one stroke of a pen in a coalition agreement can make these many initiatives appear as a waste of time and money. While this could lead to an increase in political cynicism it also provides insights for conceptualising science-policy-stakeholder interfaces.

The construction of facts has been a strong influence in the whole process, with several Latourian “black boxes” (Latour 1987) being constructed, while on the other hand there are actors trying to open them up, and deconstruct them. Crucial in the different phases of the process has been the use that has been made of these black-boxed facts. The University of Amsterdam, for example, presented the “fact” to Rijkswaterstaat that 150 m$^3$/s of freshwater would make the algae disappear. Rijkswaterstaat decided not to consider this fact “closed,” but instead to ask a second opinion from Deltares. Deltares presented a “no.” Consequently, both boxes were opened up, and Amsterdam and Deltares were assigned the job to construct a new “fact” together. The outcome, as we now know, was: Freshwater flushing cannot do the job!\(^{50}\) Now it would be easy to suggest that Rijkswaterstaat wanted a saline solution from the start, but this does not transpire from the interviews. Rather, these changing insights are a consequence of what Lindblom (1959; 1979) would call “muddling through”, in attempts to grapple with the socio-ecological system’s inertia.

Interestingly, an important tool in the construction of facts has been the number of dimensions of the model used, with consequent alteration of results, as brought out by the dispute and its eventual settling between the Deltares model and the Amsterdam model. By introducing the term ‘modelling through’ we want to emphasise the mediating role that models have played in the process described here. Models function as mediators (Morgan and Morrison 1999), between people and their stands, and between our theories and the world (Winsberg 2009), and they shape our

\(^{50}\) Interestingly this “no” is based on the 150 m$^3$/s which is, according to the planning study leader the politically maximum amount available.
understanding of what the world is like. Apparently, RWS was not sufficiently convinced by the results of the Amsterdam study, and asked Deltares to take a look at the outcomes. The 1-dimensional hydraulic component, they argued was not convincing. After merging Amsterdam’s algae component with Deltares’ 3d hydrodynamic model, the outcomes became undisputed; they became “black boxed” facts, at least for the time being. These facts did not solve the problem, but they became an input in a larger-scale process with shifted problem formulations.

This expansion of the problems has to do with the politics of ontology (Mol 2002a), contestations over what the nature of the problem is. This is illustrated by the nature conservation groups that framed the reopening of the Philipsdam as the first step in a much larger series of interrelated measures that need to be taken. Other actors that are a bit more hesitant about the whole reopening idea, linked it to the entire Dutch water distribution system. Where the planning study frames the problem in terms of a malfunctioning water system, farmers might frame the problem in terms of a problematic ecological turn (with the increased number of geese as the indicator). Models, as we have tried to show in our account, play a particular role in the politics of ontology around the lake. Through their epistemic opacity (Kouw, 2012), they ‘act’ as protagonists of a hydraulic ontology.
4. Delta formations:
Delta planning, the future and ontological multiplicity

This chapter has been submitted in a slightly adapted form to the journal Engaging Science, Technology, and Society for a special issue “Amphibious Worlds: Environments, Infrastructures, Ontologies”. This special issue has been initiated after the panel session “towards an anthropology of the amphibious”, at the IUAES 2015 conference, held in Bangkok, 15-17 July 2015.

This paper is currently in review.

Authors: Arjen Zegwaard, Gerardo van Halsema, Margreet Zwartveeen and Arthur Petersen.

The world we inhabit is abundant beyond our wildest imagination. There are trees, dreams, sunrises; there are thunderstorms, shadows, rivers; there are wars, flea bites, love affairs; there are lives of people, Gods, entire galaxies.

[...] Only a tiny fraction of this abundance affects our minds. This is a blessing, not a drawback.

(Feyerabend, 1999 p.3)
4.1 INTRODUCTION: DELTAS AS DECENTERED OBJECTS

Talk show host: the times are a bit dark when it comes to the government, the economy, politics... you name it. And for that reason it's really nice to have you here. I'm not saying anything new here. Yet, suddenly there is this bright spot, something that we are really good at. So good even, that New York, not completely retarded themselves, need us [the Dutch]. What do they want from us?

Minister: well, we've practiced our battle against water for eight centuries. What you see is that almost all major cities in the world are located in deltas, and they start to experience problems with the rising of water. And then New York comes by and says: how should we deal with this? What knowledge can you bring in? And can you also explain how to do this? Not just how to do this physically, with barriers and dikes, but what we are also really good at is improving the spatial planning to be protected against water.

This excerpt from a prime-time daily talk show on Dutch national television illustrates, in a slightly caricatured way, how the Dutch Water Management sector is branching out to other delta management sectors in the world, partly because of a carefully designed campaign to promote the Dutch as water experts. Recent articulations of efforts to export Dutch water knowledge include a brochure entitled “The Delta Approach”, published by the Dutch government; the existence of an organization called the “Netherlands Water Partnership”; and an article in the journal Natural Hazards entitled “Taming global flood disasters. Lessons learned from Dutch experience” (Zevenbergen et al 2013). The brochure presents “12 building block for a delta approach”, identifying these as “the ‘must-haves’ for sustainable delta management”. The building blocks are the distilled experiences from the Dutch Delta programme, a multi-year policy formulation process in the Netherlands which serves as the iconic and indeed generic model for delta planning. After introducing “delta pressures” (sea level rise; more/extreme storms; more/intense rainfall; etc.) and the building blocks, the brochure illustrates how, with the help of experts, these building blocks have informed the development of strategic plans in 10 deltas elsewhere in the world, including Bangladesh, Myanmar and Vietnam.
Rather similarly, the journal article by Zevenbergen et al (2013) takes the Dutch Delta programme as a successful model that needs to be transferred to other parts in the world to assist them in successfully dealing with their deltas. After characterizing the Dutch approach, the authors draw the attention to how the potential exportability of the Dutch delta programme adds to its attractiveness in the Netherlands itself: “A further factor that has strengthened the political commitment [for the Delta Programme] is the potential for the export of Dutch knowledge and technology to the emerging international market for delta technology” (Zevenbergen et al 2013, p. 1222). It is against the background of the potential exportability of Dutch delta knowledge that the minister of Infrastructure and Environment appeared in the talk show. But what is it that is so special about deltas or about Dutch delta knowledge, and what makes this very Dutch knowledge travel? According to the minister, Melanie Schultz van Haegen, both the Dutchness and the mobility of delta knowledge consists of a specific combination of physical and planning expertise.

This chapter is concerned with the tension in delta plans between Dutchness - or specificity - and mobility. It traces how delta plans move from one delta to another by following Dutch delta planning experts who travel from the Netherlands to elsewhere to formulate, or assist with the formulation of, delta plans. One way of providing an account of these travels of plans and expertise is to look at these in the terms of “policy mobility” (Cook & Ward, 2012), “policy diffusion” (Radaelli, 2005), the travel of ideas (Mukhtarov, 2014) or knowledge transfer (Zevenbergen et al. 2013). These terms, and the studies that make use of them, approach policies or expertise as relatively stable and explain their exportability and mobility by referring to their intrinsic qualities.

The objective of studies belonging to these traditions is to examine the travels of policies and expert knowledges in terms of their effects, assessing for instance how accurately they capture the situation at the place of destiny, or how well they match or can be made to apply to other-than-Dutch institutional contexts or governance cultures. In our account, we approach the travels of delta ideas and expertise from a different vantage point. Rather than assuming that there is some commonality to deltas that translates into and justifies a generic and therefore mobile delta expertise - an assumption that creates deltas as existing prior to the analysis or prior to
the arrival of Dutch planning advice - our starting assumption is that deltas come into being through the very practices in by which they are known and planned. We thus examine deltas as they are “concretely made, conjoined or transformed by the co-evolving relations of multiple agents; people, technologies, materials, spirits, ideas—or what you have” (Jensen & Morita, 2015 p.82). Hence, instead of assuming that deltas are ontologically similar objects or creatures for which a generic delta knowledge can be developed, we look at how deltas come into being and are made through the very practices of delta planning and their travels.

By taking this approach, we do not intend to make any claim about whether or not there exists some form of deltaic materiality that pre-exists delta planning activities. Yet, we do reject the idea of deltas as objects with a single ontological centers (Law, 2002; Mol, 2002), and with it we challenge the possibility to characterize or know a delta before intervening in it. With our approach, we aim to direct the focus on the making, and continuously re-making of deltas; a making that happens in a ‘dance of agency’ (Pickering, 2008) between human and material objects. The study of the coming into being of deltas implies a study of delta ontologies (Morita & Jensen, forthcoming) in the plural. We thus study delta planning practices (Bueger 2013; Miettinen et al 2009) in the Netherlands and elsewhere not so much to provide a description of what “actually happens on the ground” (Rottenburg 2009 p.xxxiii) but to explore how – through which knowledge and planning practices - Dutch deltas are made exportable.

We start our exploration by looking at Dutch delta planning activities in the Netherlands over a longer time period (roughly since the 1950’s) to find out whether it is possible to typify Dutch delta planning, or to establish how Dutch delta plans bring deltas into being. After this we examine Dutch delta planning processes that are taking place in other parts of the world in an effort to establish how they create deltas that are stable and durable enough to warrant similar types of planning expertise – the expertise that comes from the Netherlands.
4.2 Methodology

This chapter draws upon auto-ethnographic and participatory observations carried out since the publication of the second Dutch Delta committee, the Veerman committee, in 2008 (Deltacommissie 2008). These studies are supplemented by five in-depth interviews and an analysis of the written material produced by the Delta plan initiatives in the Netherlands, Vietnam, Bangladesh and Myanmar. The first author’s (AZ) auto-ethnographic observations trace the courses of action following the publication of the Veerman committee. One of those was the establishment of a national Delta Programme (Zegwaard, Petersen, and Wester 2015). In the Netherlands, we carried out observations during visits to annual conferences organized by the Dutch Delta programme and during one of their so-called knowledges conferences. After having set things in motion in the Netherlands, the Veerman committee ventured into the Mekong Delta, where it participated in the formulation of the Mekong Delta plan. Observations of the Mekong delta plan took shape during AZ’s attendance of a workshop in April 2013. This was one of the many occasions in which members of the Dutch delegation met with their Vietnamese counterparts to discuss a draft version of the plan. Less directly this chapter is also informed by the observations and experiences of GvH, who functioned as one of the core authors of, and Dutch experts involved in the formulation of, the Mekong Delta Plan.

In order to get a feel for the materiality of the deltas, AZ undertook and participated in various ‘field’ visits through the Dutch, Vietnamese and Bengal deltas. These visits also provided the occasion for numerous more informal interviews. The more formal in-depth interviews that underpin this chapter were conducted with five prominent Dutch delta-planning professionals who play, or have played, significant roles in the Dutch, Vietnamese and Bengal delta planning processes. These semi-structured, open-ended interviews used observations and experiences from the auto-ethnographic observations as topics of conversation. All interviews were conducted by AZ, recorded, transcribed and labeled.
4.3 THE MAKING OF THE DELTA PROTOTYPE (AND HOW IT CHANGES)

According to the actors involved in the delta planning processes that this chapter talks about, the process of delta planning is typically envisaged as involving three steps. The first step involves the assessment of possible (courses of) events that might take place in the future. The second step involves an assessment of the likelihood that these (courses of) events will actually take place, expressed in terms of probabilities, time frames and related uncertainties. And the third step involves the filtering of intervention possibilities to either accommodate or pro-actively promote certain courses of events. This happens through a prioritization of interventions as less or more desirable, and translating these into action agenda's.

This prototypical delta planning process makes the delta appear as a particular - deltaic - object of planning. In “The Delta Machine,” historian David Biggs and his colleagues draw attention to how the historical specificity of deltas makes the job of planners difficult by highlighting what they call the physical and institutional inertia of deltaic landscapes. With institutional inertia they refer to a situation “where past institutional arrangements [...] have continued to shape the form of state decisions ever since” (Biggs et al., 2009: 221). This is complemented by physical inertia: “the historical built landscape and aging technology that works against propositions to make major changes in water resource strategies” (ibid.). One could read the analysis of Biggs as saying that each delta is formed and defined by its own institutional and physical histories. This makes it difficult to compare deltas across times or places, or indeed to pin-point what precisely makes deltas deltaic. Yet, the idea of delta planning, and indeed the very concept of a delta, does suggest that enough remains similar or identical to warrant a generic procedure or programmatic approach.

In the Netherlands, delta planning was arguably practiced for the first time in the 1950’s. Of course the Dutch had been active in the making and protection of land already for centuries. Yet it was only in 1953, after the Netherlands was hit by a flooding disaster that a concerted effort was made at national level to more effectively deal with flood risks through the
establishment of the first Delta Committee. The committee was assigned the task of determining “which hydraulic engineering works should be undertaken in relation to those areas ravaged by the storm surge, (and) also to consider whether closure of the sea inlets should form one of these works” (Delta Committee 1, 1961: 15, translation taken from Delta committee 2, 2008). The resulting plan proposed the full closure of almost all open river connections to the sea, as well as the heightening of existing sea protection infrastructures (e.g. dikes) to what became known as the ‘Delta Height’. Although the plans were subsequently modified (Bijker, 2002), the constructions made as part of the implementation phase of the first Dutch delta plan radically altered the outline of the Dutch coast.

The excessive high-water levels in the rivers Rhine and Meuse that occurred in the 1990s (in 1993 and 1995) provoked awareness within the Netherlands that flood dangers do not just come from the sea. Accordingly, a process called “delta plan for large rivers” was initiated by the central government. The delta referred to, and indeed created through, this plan resembles yet is also very different from the one of the first delta plan.

Some ten years later, and more than 50 years after the first delta committee, a third delta appeared through the establishment of the second delta committee. This time, the reason for having the committee was not a (near) flooding event. Rather, the need for it stemmed from the growing awareness of climate change in conjunction with the 2005 New Orleans flooding disaster. The assignment of the 2008 committee was to answer the question: “How can we ensure that future generations will continue to find our country an attractive place in which to live and work, to invest in and take their leisure?” (Delta Committee 2, 2008: 7). This assignment was significantly broader than that of the first delta committee, which was formulated in narrow hydraulic engineering terms. Indeed, the difference between the objectives of the first and second Dutch Delta committee is striking (see table 2). Where those of the first were rather narrowly focused on civil engineering, those of the second Committee sound almost esoteric with words like future generations and an attractive place to live. This second committee evolved into a nation-wide Delta Programme that had the task of bringing the committee’s vision down to earth by focusing on the core issue of flooding and the safety of the Netherlands (Boezeman et al., 2013; Verduijn et al., 2012).
Not just the language of the two Dutch delta planning episodes were very different, also the spatial delimitation of the Dutch delta changed. In the 1950s, the delta mainly consisted of the southwestern part of the Netherlands, the provinces of Zeeland and Zuid-Holland, which were the areas affected by the storm surge. In the 2000 plans, instead, the delta covered the entire country.

The Delta Programme, the operationalization of the second Delta Committee, articulates its objectives as follows:

> to ensure sustainable and robust flood risk management and freshwater supplies in 2050, which will allow our country to withstand the (greater) climatic extremes in a resilient manner. In this way, the considerably increased economic values and the higher number of people are well protected. We will ensure that the Netherlands is prepared for various scenarios. We will choose strategies and measures that can give us flexibility in the way we respond to new measurements and insights, by stepping up our efforts if necessary or changing strategy. Everything is at hand. (Deltaprogramma 2014: 6).

The work proposed to realize these objectives has coalesced into what many now refer to as the ‘Dutch Delta Approach’, a packaging and labeling that strategically allows or facilitates exporting Dutch water expertise to other countries:

### TABLE 2: DELTA PLANNING IN THE NETHERLANDS AND THEIR OBJECTIVES

<table>
<thead>
<tr>
<th>Year</th>
<th>Delta</th>
<th>Plan/Process</th>
<th>Goal/Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>Rhine-Meuse-Scheldt, the Netherlands</td>
<td>Delta Committee</td>
<td>To assess “which hydraulic engineering works should be undertaken in relation to those areas ravaged by the storm surge, (and) also to consider whether closure of the sea inlets should form one of these works” (Delta Committee, 1961, p.15)</td>
</tr>
<tr>
<td>2008</td>
<td>Rhine-Meuse-Scheldt, the Netherlands</td>
<td>Delta Committee</td>
<td>“How can we ensure that future generations will continue to find our country an attractive place in which to live and work, to invest and take their leisure?” (Delta Committee, 2008, p.7)</td>
</tr>
<tr>
<td>2009-2015</td>
<td>Rhine-Meuse-Scheldt, the Netherlands</td>
<td>Delta Programme</td>
<td>“The objective is to protect the Netherlands from flooding and to secure a sufficient supply of freshwater for the generations ahead.”</td>
</tr>
</tbody>
</table>

75
“The Delta Programme approach has already become an export product itself: the ‘Dutch Delta Approach’ is drawing considerable attention around the globe. Various countries have called in the assistance of the Dutch government and business community to apply the Delta Programme approach to their own tasking.” (Delta Programme 2015: 8).

What is exportable or generic about the Dutch approach? The head of the second Delta Committee is keen to draw attention to the exportability of the Dutch approach. As he states in an interview:

Let’s us say that in terms of process, we have invented something. How to organize such a process. In that sense a Delta plan is an export product. We are asked to come and do the same thing in Bangladesh. Bangladesh is a democracy, this is quite something different [from Vietnam], a lot more poverty, a different governance culture. Completely different. The art is, like we did in the Netherlands, to create a structure, to de-politicize the problem. It doesn’t matter whether you are left or right wing, you’ll drown if you don’t take measures. It’s about urgency and modality, but eventually a governor will have to face this problem. In that sense it’s an export product, a unique approach (Interview C, Nijmegen, 25 January 2013, 11:00h).

Taking a delta as the object of decision making, under the label of delta planning, means establishing a decision making sphere with is screened off from normal political decision making procedures and structures. The alternative decision making setup that the delta approach seems to entail is expert based, supported by a techno-scientific apparatus.

4.3.1 TRANSLATING HISTORICAL EVENTS INTO NORMS

A traditional and typical way in which the urgency of delta problems and need for specific techno-scientific expertise is formulated is through statistical analysis of past events. Behind Dutch Delta planning, mostly hidden in the everyday practices of the Dutch water management community, sits a sophisticated system of assessing, mapping and quantifying nature to make it legible to managers and policymakers. This system has evolved over the years. The existence of such a system was most vividly articulated in an interview in which the interviewee explained how the high water levels that almost flooded large parts of the Netherlands in 1993 and 1995 had changed the norms of protection along the river Rhine. Stating that at this time, “Nature started to mess with the statistics,” the
interviewee drew a figure (1) to underline the point. He explained that the river Rhine and Meuse each have their own graphs, with the frequency of flood occurrence logarithmically organized on the x-axis, and the water levels on the y-axis.

What happened in the river in 1993 and 1995 was that the linear line was moved up (dotted line in the figure), thereby also changing the water level norms. The interviewee explained how he had experienced the institutional responses to this case of “nature messing with statistics”. Sticking to the statistical methods that were used until 1995 to establish safe water levels would have required a significant heightening (about 50 cm) of the dikes. The enormous investments required to do this would have been very difficult, if not impossible, to mobilize. Instead of heightening the dikes, the response of the responsible committee was therefore to change the equation behind the line that is connecting the plotted events. When he had learned about how objective statistical equations were tampered with because of what he saw as a political reasoning, the interviewee was in shock:

By that time I just started working. And I, after my study in Delft (University), I worked at Rijkswaterstaat (the executive department of the Ministry of Water management) and then you believe in these numbers [...] explaining how he was informed that the statistics were going to change [...] then you fall silent, as an engineer, as an engineer from Delft. Then you wonder: What then is the truth? Is the new 1250 better than the old 1250? That’s a statistical fact! Statistics doesn’t have so much to do with nature. Maybe nature will say at a certain moment: more water is impossible (Interview G, Amersfoort, 18 march 2015, 9:00h.).

This is a clear example of how the delta (at least partly) comes into being – or is enacted – through specific planning practices and delta knowledges. The latter, as we have seen, importantly include the processes and negotiations through which nature is made legible to and manageable by decision-makers. Statistical calculations about the occurrence of floods (water heights, river discharges) provide one of the backbones of Dutch Delta planning, as these provide the figures that inform which and how many interventions are needed to properly protect the country. A specific statistical methodology translates nature, or natural events, into numbers that then become translated into norms that policies rely on.
4.3.2 Future Making and Delta Planning: Apocalypse Now?

Another big difference between the first and the second delta committee is in how the second committee is approaching possible futures. Where the first delta committee predominantly used methods in line with the above described, predicting the probability of events in the future based on the extrapolation of past events, the second supplemented this probability thinking with scenario-thinking.

As a future-making practice, scenario thinking relies on the cultural-political tendency of formulating possible futures as either happy or sad, as either

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51 The water heights are put in the y-axis and logarithmic probability in years on the x-axis. Thus, historical water levels are plotted. Through a statistical analysis of how often water levels occur, the probability of floods is calculated as reflected in the diagonal line. After the high water levels in the 1990s, the curve of this line moved up, indicating that chances of high water levels had become higher. (the dotted diagonal line). This in turn also alters the determined water level that appears in the graph at the 1250 point, which means an occurrence of this water level happens once every 1250 years. This statistically determined water level is legally used as the norm for determining the heights of the dikes.
hopeful or fearful (Bauman 2003), distinguishing between either utopian and dystopian visions (Kitzinger and Williams 2005). In the context of deltas, often being portrayed as the prototypical victims of a changing climate, the sad or dystopian futures meet what Erik Swyngedouw (2010) called a “desire for apocalypse”, a desire that works to powerfully inform present-day actions in terms of where not to go. Hence, delta planning processes are importantly inspired and defined by these less favorable apocalyptic futures, helping identify (and mobilize political support and funds) for actions that either prevent those from happening or create some form of resilience. Hence, once expectations about futures are formulated, for example in the shape of future scenarios, they become an impetus for action. In the case of deltas, this is clearly illustrated by attempts to climate proof the Netherlands, in which “developing a climate-proofing strategy now is likely to be more cost effective then taking drastic actions later” (Kabat et al., 2005: 284).

Ideas about the future thus importantly inform policy and planning processes. They articulate hopes, dreams, expectations and wishes, while simultaneously being loaded with notions about what can or should be done in the present -- in relation to provoke or prevent the changes that these futures might bring.

The turn to future making practices, like the climate scenarios developed by the Delta committee (2008) and the follow-up “delta scenarios” developed by the Delta programme, mark a break from “normal” water management approaches. “In retrospective, water management in the Netherlands has indeed strongly been driven by both floods (e.g. in 1993 and 1995) and drought events (e.g. the summer of 1976), and socio-economic trends (e.g. increasing valuation of nature and cultural heritage).” (Haasnoot and Middelkoop 2012, p.110). With the second Delta Committee a new practice emerged, a future generating practice which (re-)produced the delta as an object in need of planning, slightly changing it in the process.
FIGURE 6 DELTA SCENARIOS AS DEVELOPED AND USED BY THE DELTA PROGRAMMA (SEE E.G. DELTA PROGRAMME 2012)

In conclusion, what we have tried to show in this section on Dutch delta planning in the Netherlands is how it is composed of a set of practices that establish delta as uncertain objects and at as protected spaces. An uncertainty that originates from the possibility of future events establishes an urgency. This urgency in turn is so significant that the delta needs to be regarded as decision making arena that needs to be protected from ordinary political decision making process.
4.4 Dutch Delta Planning Elsewhere.

In the following section we explore what happens when the Dutch delta planning approach starts to travel, along with Dutch delta planning professionals, to other places, in this case Asian Deltas. The brochure “The Delta Approach”, with its twelve building blocks, suggests the existence of a sophisticated delta planning package that can be made to move from the Dutch delta to other deltas. Yet, when we asked the Dutch project leader of an Asian delta planning project what it is that is being exported from the Netherlands, his answer was less straightforward:

“I always think the content of this export is a paper-thin something. [...] This paper-thin something is mainly thinking toward the future, about how these might contain various sorts of futures; and talk to lots and lots of different stakeholders” (Interview G, Amersfoort, 18 March 2015, 9:00 h.).

There is an interesting paradoxical element to this cocktail of “thinking towards the future” and “talking to lots of different stakeholders”. The thinking towards the future, the formulation of future scenarios, is used to create a delta in the present that needs expert attention so urgently that it should not be left to everyday political processes. Planning the delta, is the argument, needs to be screened off from normal political decision making procedures and processes. On the other hand “talking to lots of different stakeholders” is a proposal to bringing politics in. It suggest a particular and perhaps Dutch idea about the political organization of delta planning processes as consisting of forms of inclusive deliberation and forging consensus. In different locations this led to different twists to the setup of delta planning (see Table 3).

An overview of the objectives in Table Two shows how, in the Netherlands, current delta plans have a broader mandate than earlier ones, with a less narrow and predetermined focus on “hydraulic engineering work.” Indeed, as one interviewee insisted, thinking towards the future forms a crucial element of current delta planning exercises, with all involved trying to jointly determine the agenda about the topics that need to be dealt with in these deltas. This has probably something to do with the fact that, as the Dutch Scientific Council for Governmental Policy (WRR) states: “The future is the actual playing field of power [and] policymakers are expected to take responsibility for the future” (van Asselt et al., 2010: 7). Haasnoot and
Middelkoop (2012) argue that a paradigm shift has occurred from predicting to exploring futures. They base this on an extensive review of the use of scenarios in water policy studies in the Netherlands. In the following we will show that in the analyzed project the predictive and explorative role of these futures are far from clear and stable.

### Table 3: DELTAS PLANNING AND STUDIES IN OTHER DELTAS AND THEIR OBJECTIVES

<table>
<thead>
<tr>
<th>Year</th>
<th>Delta</th>
<th>Study Type</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Mekong, Vietnam</td>
<td>Delta Plan</td>
<td>“To contribute to realising and maintaining a prosperous delta, both economically and socially, in which its population can thrive in a vigorous and dynamic economy that is founded on sustainable use of its natural resources, and well adapted to changes in water resources and climate”</td>
</tr>
<tr>
<td>2014</td>
<td>Ayeyarwady, Myanmar</td>
<td>IWRM strategic study</td>
<td>“This study is at a strategic level; it presents an overview of the most important challenges and anticipated changes in water resources management, what measures could be taken and the expected impact of these measures as well as their economic and financial aspects.”</td>
</tr>
<tr>
<td>Ongoing</td>
<td>Ganges-Brahmaputra-Meghna, Bangladesh</td>
<td>Delta Plan</td>
<td>“The Delta Plan will integrate planning from delta-related sectors and from all across the country to come to a holistic plan for the Bangladesh Delta. The Delta Plan will be grounded in a long-term vision of the Delta’s future. This long-term vision, combined with the use of scenarios, allows planning to be adaptive and dynamic by constantly taking into account uncertainties in future developments in e.g. climate change, socio-economic development, population growth and regional cooperation. The Delta Plan is more than just a one-time planning exercise and aims to provide the foundation for permanent delta governance in Bangladesh through the outlining of a delta framework” (<a href="http://www.bandudeltas.org/about/bangladesh-delta-plan-2100-bdp2100/">http://www.bandudeltas.org/about/bangladesh-delta-plan-2100-bdp2100/</a>, visited 14-4-2015)</td>
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4.4.1 PRESENCE AND ABSENCE IN SKETCHING ALTERNATIVE FUTURES

In this section we take a closer look at how, in the process of formulating futures, the deltas become specified and bounded. We examine how specific delta realities become enacted by projects favoring certain developments, while expunging others, or by marking certain developments as “autonomous” and others as “in need of intervention”.

On the face of it, the various Delta planning initiatives in the Netherlands, Vietnam and Bangladesh have the appearance of ‘package-deals’, consisting of a combination of specific delta planning methodologies and delta planning expertise. In the case of the Dutch Delta, the directions to be taken and the languages used to characterize the futures were strongly determined by the assignment given by the minister. One member of the 2008 Delta Committee explained how this assignment co-defined its object: “our original assignment was to focus on the layout of our coast, in relation to climate change. That was our assignment. When we came together for the first time, already after say 2 hours it became clear that we had to look at the water system as a whole” (Interview E, Delft, 19 February, 15:30h.). With this ‘entire water-system’ as its object, a deliberate choice was made to look at a ‘maximum scenario’, because: “if a government wants to protect its citizens, it at least needs to know the worst case scenario” (Interview C, Nijmegen, 25 January 2013, 11:00h.). This maximum scenario included estimates of the magnitude of future sea level rise and changes in river discharge.

After establishing this worst case scenario, designed “to see if we, at all, can maintain living in the Netherlands, which is the crucial question” (Interview E, Delft, 19 February, 15:30h.), climate scientists were assembled and asked to: “put something in [to your models] that is unfavorable, but that you still think of as realistic” (Interview E, Delft, 19 February, 15:30h.). Science thus followed political function, with the climate scientists’ role becoming that of judging whether projections were ‘realistic’ enough to be credible. The Delta Programme, established to follow the Delta Committee, made the attempt to turn the question of future uncertainties (Zegwaard, Petersen, and Wester 2015) into a systematic set of tools and concepts, a methodology referred to as “Adaptive Delta management”. Building upon the work by Haasnoot (see e.g. Haasnoot and Middelkoop, 2012) this
methodology was developed to streamline a “flexibility of measures” with regard to future changes in the various sub-programmes of the Delta Programme.

In the Dutch case this methodology was, so to speak, developed on the fly: it more or less contingently emerged on the basis of the societal and scientific insights, political preferences and alliances of those involved in developing it. To turn it into a programmatic programme that could be exported to other deltas, most notably the Bangladesh Delta plan, it had to somehow ‘fixed’ through an ex-post characterization of its most salient features, making it also somehow seem ‘scientific’, systematic or objective. The pursuit of a delta planning methodology in the case of Bangladesh was explained by one of the involved experts as follows:

“Eventually, this was unclear for a long time, but they now really want to apply an adaptive delta management format [in Bangladesh]. Which means, the classic - well, there is not really a classic... It means a setup with a bunch of scenarios, a so called delta vision, an assessment framework, some strategies, which lead to adaptation tipping points, adaptation pathways, and from there a robust and flexible plan. A strategy for the long term for the entire water management” (Interview F, Delft, 5 march 15:00h.).

As also the following answer reveals, the Dutch Delta Planning approach only achieved a kind of systematicity and reproducibility while traveling. The interviewee involved in the Bangladesh delta plan explained this in the following way:

F: “well, it has been used here [in the Netherlands], partially, for the Delta plan, but not fully, like it is being done now [in Bangladesh] in a, well, scientific way. It originates originally from the UK”.

AZ: “in the Thames 2100 plan?”

F: “yes, that story, they wanted to do something with it in Vietnam, but in the end that turned more into something under the label of adaptive, or flexible. Not much more than that. And now we try to do it rather seriously” (Interview F, Delft, 5 march 15:00h.).

It was thus through its export to Bangladesh that a more stringent methodology was invented – a packaging - to characterize the Dutch approach. This does not mean that the resulting robust and flexible
measures, or consequent delta futures, were produced in an isolated adaptive delta management machine. Rather, the scenarios for the Bangladesh Delta plan were produced in workshops, in which Dutch experts facilitated discussions among Bengali experts to identify relevant external drivers:

Here and there we [the Dutch organizers of the workshop] did steer a bit. We wanted to prevent the traditional reflexes of climate change and socio-economic development, that’s what everybody immediately says. Thus, we suggested that this can also be regarded differently, by asking what is more important, climate change or trans-boundary river management? [...] this turned out to be at least as important as climate change (Interview F, Delft, 5 March 15:00h).

The approach taken in Bangladesh was clearly different from the one in the Netherlands and Vietnam. In the latter, the future was significantly shaped by the evaluative capacities of the (Dutch) experts that happened to be around the table at the right moment. In this sense, the Bangladeshi option was probably methodologically broader. At the same time, the process of creating buy-in and enthusiasm for the delta planning process in Bangladesh followed a specific workshop tradition:

In Bangladesh you need to send out invitations hierarchically. The team leader needs to send a card to the deputy project leader, from the Bangladeshi side, thus the government of Bangladesh, who then send invitations. When this person has signed, everybody will come. When of course a proper DSA (Daily Survival Allowance, financial compensation) is provided. [...] And a lunch. These are seemingly banal boundary conditions that [in the BGD context] are in fact crucial for attracting people (Interview F, Delft, 5 March 15:00h).

Thus, in the reading of this Dutch expert, to create support for the Dutch Delta planning process, it had to be made to fit with Bangladeshi bureaucratic culture. The purpose of the workshops importantly consisted of the Bangladeshi’s becoming acquainted with and convinced of the need for the Dutch way of doing deltas. Such work of mobilizing support for Dutch delta expertise also happened in the Vietnamese context. Institutionally, the Mekong Delta plan initiative was linked to the Vietnamese Ministry of Environment (MONRE), a historical spin-off of the much larger and powerful Ministry of Agriculture (MARD).
MARD deals with land use, MARD deals with water, MONRE makes choices about climate scenario a, b, or c. [laughs] [...] you need to find your support where the most needs to change [...] The people involved in the early stages of the Mekong Delta plan process were too much oriented to the Netherlands (Interview G, Amersfoort, 18 March 2015, 9:00h.)

This quote suggests that deltas, and delta planning processes, are not simply packaged to travel from Netherlands to elsewhere, but happen or come about through the skillful maneuvers of traveling experts who make use of their expertise, intuitions, diplomacy and alliances to mobilize support for considering the delta as an object of planning. The precise definition and contours of the delta and their futures, and the contents or coordinates of delta planning processes, are determined in the process. Hence, in Bangladesh and the Netherlands, deltas became enacted in the planning process as water systems, whereas in the Vietnamese Mekong delta planning process the delta became defines as the interplay between economic development and the water system.

4.4.2 Enacting a Delta through its Futures

As noted, the future is a rather central element in decision-making. In a certain sense, all decisions are about the future, yet the future is inherently unknown. One important way through which Delta planning processes differently enact deltas is in how they approach the question of futures. Where the Netherlands and Bangladesh took so-called autonomous development as a point of reference, the Vietnamese plan deliberately focused on futures that could be influenced by policy. The term autonomous development here refers to those changes that will occur, or are likely to happen, almost irrespective of country policies. These are, in other words, changes that come from ‘outside’ the delta that the delta needs to somehow deal with or accommodate. Examples include rising sea levels and upstream dam development.

Comparing the process in the Netherlands to the process in Vietnam, a senior engineer involved in both the Dutch and Vietnamese delta planning processes observed:

*What I do see, it that it has grown in a certain direction. In Vietnam, the Mekong Delta, there is a much larger gradient of developments to come. The point*
where the Mekong delta is at the moment, compared to the Netherlands, in terms of spatial organization, is very different. In our case [the Netherlands] the spatial layout is the consequence of maybe a 1000 years of dealing with the system. And there [Vietnam] it [...] is much shorter. For that reason I think we have given much more attention [in Vietnam] to the exploration of what directions it might go. In our case many choices have been made, and have led to infrastructures that have influence the development of the land use (Interview E, Delft, 19 February 2015, 15:30h.).

So, where futures are about the times that are yet to come, they are informed by narratives about the delta's socio-environmental history. As the travel of delta expertise demands some comparability of deltas, the suggestion that deltas follow similar evolutions or development pathways is a useful device to bring different delta ‘times' in sync with each other.

“Scenario thinking” was instrumental here. Indeed, a key moment in the Mekong Delta process was the transfer, or rather the translation, of this idea of scenarios to the circles of Vietnamese experts. He articulated the point as follows:

If you ask me, when did the penny drop in Vietnam? This was when we had a good meeting in Vietnam, with people that understood what scenario thinking meant. They could also explain to the Vietnamese agricultural sector and Vietnamese civil engineers: this is real! If we continue like this we will end up in rice-poverty (Interview G, Amersfoort, 18 march 2015, 9:00 h.).

The emphasis on scenarios was also confirmed in another interview with one of the Dutch members of the Mekong Delta plan project. He explained that the level of ‘strategic thinking’ wasn’t understood by the Vietnamese counterpart; the latter assuming that the plan would have to be a master plan:

From the start I’ve said that if we call it a plan, the Vietnamese will have a complete different interpretation of it. [...] they expect a railroad timetable like plan. They looked at us like: Plan? What plan? Man, you’re talking in vague terms. What are the deliverables? And when do we have to deliver? And well, we just don’t know. It took us over a year to adjust our ideas and their expectations of the plan” (Interview C, Nijmegen, 25 January 2013, 11:00h).

As was shown in Table One, each Delta, and each planning process, has its own specific objectives. Combined with the differences in socio-
environmental histories, knowledge frameworks, and engineering and organizational cultures, they lead to different Delta planning practices altogether. For example, in the Vietnamese case there was a deliberate choice to define the future of the Mekong Delta in terms of developments that can be changed. In contrast, the Dutch and Bangladeshi cases elected to define developments as “autonomous.” One of the members of the Mekong Delta plan team compared the Mekong and Dutch planning process, emphasizing the strength of the former:

> What I really liked [about the Mekong DP process] is that we analyzed how the economy works, what does it do? What are the elements that influence each other? And how can we change that in a positive way?, [...] but also, what does this mean for my water situation? [...] I find that one of the major weaknesses of the Dutch Delta Programme, that does not include a vision on how the Netherlands will develop the coming 40 years (Interview G, Amersfoort, 18 march 2015, 9:00 h.).

The Vietnamese approach was also quite different from the one taken in Bangladesh. In the latter, an expert explained:

> “we didn’t per definition look for extremes. The use of scenarios is more a methodological story, they need independent drivers, it’s about changes in the external world” (Interview F, Delft, 5 march 15:00h).

As these differences suggest, deltas are as much the effect of different planning cultures, trajectories and objectives, as they are their cause. Aiming to “contribute to realizing and maintaining a prosperous delta, both economically and socially [...] and well adapted to changes in water resources and climate” (see table 1), the Vietnamese plan deliberately delimited its delta as an object within the reach of intervention of policies. On the other hand, by aiming to “integrate planning from delta-related sectors and from all across the country to come to a holistic plan for the Bangladesh Delta,” the Bangladeshi plan enacts the delta as an object that should be able to accommodate or deal with drivers from ‘the external world.’

Where Dutch experts were involved in facilitating delta planning processes, paving the way for future sales of Dutch knowledge clearly also played a role in their considerations. During the Workshop of the Mekong Delta Plan, the Dutch wanted to discuss a draft version of the plan with the Vietnamese
It was around this time that the agro-economic scenario had come to be the ‘preferred’ scenario. From the perspective of Delta planning methodology this was surprisingly inconsistent. Whereas, in deltas elsewhere, future scenarios were used to assess the robustness of measures, in Vietnam a particular scenario was translated as the preferred direction of development. When the agribusiness development scenario was chosen as the preferred option for the development of the Mekong delta, this caused some of the Dutch team members to speculate over lunch about the potential for Dutch agri-business knowledge to be exported to Vietnam.

In Bangladesh, in contrast, the methodology of the delta planning process itself became the primary “export product”:

> We hope to bring the Delta-plan further as a product. Of course we also hope that the Delta plan will yield work for our [Dutch] dredgers, or adaptive constructions, or building dikes (Interview F, Delft, 5 March 15:00h).

However, interviewees suggested that in Bangladesh, too, there were less visible, or hidden, agendas: “I think there are all sorts of motives [for the Bangladeshi parties] to use the Delta plan for short or longer term goals. That’s inevitable. You need to be aware of that” (Interview F, Delft, 5 March 15:00h).

In all cases, the way the Deltas and their futures were defined was the joint product of international relations, the accommodation of local requirements and to a lesser extent trade agendas with a complicated dynamic on its own (Jensen and Winthereik 2013). The Vietnamese and Bangladeshi cases show ad hoc and rather opportunistic considerations with regard to the identifying trade opportunities for specific sectors. Delta planning processes might, thus, involve changes of methodology and particular choices of specific futures, shaped by local demands. It appears that one sees the future one is trained to see, but also that the future one believes to have been asked to see.
4.5 CONCLUSION AND DISCUSSION: SINGULARITY + MOBILITY = STABILITY

Deltas change over time and over place, which makes it difficult to unequivocally characterize their ontological essence – or indeed to know them. In this article we have used this difficulty as the starting point for questioning the rationale and workings of the travels of Dutch delta expertise to other countries. Our exploration suggests that deltas are as much the effects as the causes of particular expert and planning cultures and processes.

The construction of the delta as a more or less stable, singular and coherent object of knowing and planning is an important pre-condition for the exportability of Dutch delta knowledge. Our analysis has shown that imagined futures – scenarios - play an important role in providing such coherence: futures are operative in turning deltas into singular coherent objects of intervention. Hence, delta sameness is importantly the result of the construction of deltas as similarly vulnerable to the effects of climate change. Deltas also become similar through a mapping of their development on more or less logical or unavoidable evolutionary pathways; an imagination of all deltas as having to undergo similar phases or stages. In this imagination, the implicit positing as the Dutch delta as the more or even most advanced in terms of development reinforces the idea of Dutch expertise as superior, which of course helps exporting it.

Our analysis has also shown that this exportability or mobility of Dutch delta knowledge goes accompanied with, or happens through, the active invention, introduction and use of a specific delta language. This is a language of flexible measures, robust measures, adaptation pathways and maneuvering around tipping points. Talking the right delta language is not sufficient, for with it goes a required way of thinking. To plan a delta, to prepare it for its futures, decision makers need to master scenarios. As we have shown, these scenarios are themselves embedded in a package of ideas about the steps, or trajectories, that delta development must take. Consequently a community of Delta experts is brought into being, consisting predominantly of Dutch experts capable of preparing the deltas for those futures that are made visible.
As we reflect upon what happens when one delta ontology is made to prevail over others through a methodological turn to futures, it is tempting to be critical. Such criticism might find inspiration in John Law’s (2004) critique of scientific methods, which centers on the ways in which methods effectively cover the multiplicity of ontologies at play in practice. Such covering over is an important aspect of the travelling delta planning practices we have examined, and the futures they produce.

Yet, there is another side to this story. For through the construction of a more singular delta, delta plans also do succeed in formulating actions for regions that are typically muddy. Muddy, in the sense of places where water and land continuously mix, but also in the sense that their futures are neither quite fixed nor quite liquid. The enactment of delta futures through planning processes that help to hold the delta steady, as a place and as an object of intervention -- at least for a while.
5. **THE DELTA DIAGNOSIS:**

**ON THE SOCIOMATERIAL ENACTMENT OF THE DUTCH, BANGLADESH AND MEKONG DELTAS**

Previous incarnations of this paper have been presented and discussed at the workshop on Bruno Latour and Environmental Governance, organised by STEaPP, University College London, on 18-19 May 2015, and at the workshop on Water Matters organised by the Eating Bodies group, University of Amsterdam, on 11 June 2015. The paper has benefitted greatly from the comments and suggestions made in these inspiring sessions.

Arjen Zegwaard
Target journal: *Environment and Planning D: Society and Space*
5.1 The rise of sinking deltas

Deltas are sinking! In deltas, rivers deposit silt and sand at their intersection with seas and oceans, forming highly fertile lands which in turn attract human populations who turn these wetlands into their habitats. In many deltas around the world, and in geological terms incredibly rapidly, “wetland natures” are thus being transformed into agri-cultural and urban cultural spaces. In the recent past, such transformations typically took place as part of engineering projects (Scott 1998; 2006), projects that involved several techniques and technologies. The scientific and engineering knowledge informing these were and are anchored in a modernist distinction between nature and society/culture, and crucially based on normative separations: between good or useful water and bad or damaging, useless water; and between water and land. Good water typically includes fresh water for domestic and agricultural uses, whereas bad water is water that causes flooding or that is too saline for human uses. In addition, the divorcing of the category of water from the category of land that the creation of wetland natures also entails is one that forcefully renders mixings and mud impossible.

Separations happen and happened through engineered things, non-humans: dikes, dams and sluices. Yet, the construction of these non-humans did not just produce the desired separations, but also yielded consequences that were not foreseen in design and planning processes. These include biodiversity loss and accelerated land subsidence (Syvitski et al. 2009b), partly endangering the fertile characteristics that made deltas interesting places to live in the first place. These unexpected effects of engineering wetland natures have sparked debate about the ways in which vulnerable environments like deltas can and are to be known and dealt with (Disco 2002), also prompting more fundamental questions about the modern (Western) tendency in science to consider nature and culture as separate categories (Latour 1993; Latour 2009) with the one open to control by the other (Strathern 1980).

Deltas are on the rise! Since the start of this century the topic of climate change has fundamentally altered many global, regional and local policy agendas. The label “anthropocene” (Crutzen and Steffen 2003) is frequently used to denote this, both to mark humans as the main culprits, and to highlight that societal action is needed to reverse or slow down the trend.
The foreseen effects of climate change have not just altered policy discourses, but also sparked new archetypical objects into being, such as declining artic poles, polar bears and melting glaciers. One prominent new policy object that climate change has produced is drowning deltas. As deltas happen to be located at the intersection of two narratives through which the apocalyptic message of climate change (Erik Swyngedouw 2010) tends to be expressed - sea level rise and changing river discharges - they indeed provide iconic spaces for climate change advocacy, activism and action. This has put policy makers responsible for, or at least involved in, delta regions that are threatened by the rising of the seas and changing river discharges in the spotlight, forcing them to initiate processes to prepare for the uncertain futures that lay ahead.

In this playing field of the sinking of deltas and the rise of deltas as a globalized object of policy intervention, one deltaic community has been particularly active: that of Dutch delta planners. Dutch delta planners are not only actively engaged in processes of “climate proofing” their own Rhine-Meuse-Scheldt delta, but also energetically interfere in other deltas in the world, like the Mekong delta in Vietnam, the Mississippi delta in New Orleans and the Ganges-Brahmaputra-Meghna delta in Bangladesh. This happens because of the international appreciation of Dutch delta and water management expertise, an appreciation that is rooted in the fame of the nationwide infrastructure development project the Dutch initiated after the 1953 flooding disaster, the so called “delta works”. These delta works comprise, among others, large closure dams and barriers that have turned most of the Dutch estuaries, the open river connections to the sea, into stagnant lakes. This is not to say that the Delta Works have become a fixed blue print for a specific Dutch way of dealing with deltas. Dutch approaches have been subject to change as is for instance reflected in how Dutch water management thinking regarding the role of, and attitude towards, nature has altered considerably since, during, and probably even because of the construction of these closure dams, something that is often referred to as the ecological turn in Dutch water management (van der Brugge, Rotmans, and Loorbach 2005; Disco 2002; Zegwaard, Petersen, and Wester 2015).

The relatively sudden rise of sinking deltas as objects of climate change adaptation and the ecological turn in Dutch water management are
prompting questions about the mechanisms through which deltas are formed as policy objects, about deltas as emergent phenomena. These are questions about what it is that makes a delta into a generic thing through time, and about what it is that allows delta knowledge or delta plans to travel. What is it that allows different locations across the world to be diagnosed as cases of a delta? The most familiar way of answering this question would be to point at similarities in the physical processes that explain the formation of deltas. In this chapter, I take a different approach: in trying to understand the flow of Dutch delta planning knowledges and tools to other places, I do not make any assumption about an intrinsic physical sameness of deltas, but instead consider deltas as objects that come into being in or are enacted through planning practices. Looking at deltas and delta planning from this point of departure would regard the Dutch Delta as being brought into existence (enacted) through for example the Delta Committees. In the enactment of the Dutch Delta the Netherlands is transformed from collection of rivers and land into a deltaic whole. Consequently I thus examine how sameness comes about in and through delta planning processes, examining how geographically different locations become similar problem arenas.

In earlier explorations I have looked at the content of Dutch delta planning when taking place in the Dutch Delta, the Ganges-Brahmaputra-Meghna Delta in Bangladesh and the Mekong Delta in Vietnam. These forays, conducted in collaboration with various colleagues, have highlighted the powerful role of hydrological modelling (Zegwaard and Wester 2014) in such planning processes. They also illustrated that and how trade-offs are made in moving from visionary strategic planning to pragmatic proposals for action (Zegwaard, Petersen, and Wester 2015); and identified mechanisms of future-making that facilitate Dutch Delta Plan processes to travel to other deltas (see chapter 4).

In this chapter I am particularly interested in exploring the interrelation between delta materialities and the performativity of deltas, looking at how deltas are brought into being in interactions between human and non-human agency. This means looking at the question: how do deltas come into being? This means looking at the sociomaterial aspects of the enactment of deltas, looking at the divisions made (between socio and material, between human and non-human, between nature and society,
etc) in the processes of enactment. In order to answer this question, I will look at the practices (including the material involved in these practices) that make connectedness (Mol 2002; Bueger 2014), a connectedness between the different things a delta can be, between different ontologies. With this I will engage with two puzzles: the puzzle of how they remain stable or durable over time [5.3]; and the puzzle of how deltas obtain mobility [5.4].

The metaphor that I use in this chapter to investigate and make sense of connectedness between various enacted deltas is that of fractal. Fractal, as I explain in the following section, provides a potentially fruitful way to capture the idea that deltas are neither singular nor endlessly plural; to talk about modes of ordering (Law 1994) rather than about given orders of things (Wester 2008; Zwarteveen 2015); or to express that deltas are spatially fluid, rather than fixed objects defined in an Euclidean space (Law and Mol 2001), and temporally dynamic in often unpredictable and unexpected ways In the following section [Multiple Deltas Multiple?] I explain what I mean with this material and performative character of deltas and how I want to approach this from a multiple ontologies perspective. After this section I present two closer looks into deltas and practices that enact deltas. In these, I provide descriptions about how modes of ordering affect, or have taken place, in their contexts. The first description provides a closer look at the concept of “polder” as a practice of turning “natural”, amphibious spaces into “agricultural” (Morita 2015) lands; the description zoom will look at the political implications of living in/on spaces that are neither land nor water, that are amphibious (Morita and Jensen forthcoming), and look at the impact of geopolitical struggles on the enactment of deltas.

The deltas that are featuring in this section are all currently engaged in “delta plans”, and in all three deltas Dutch delta planning professionals are involved in helping design and implement these plans. By invoking the metaphor of fractality to describe how deltas become enacted, I hope to show how sameness across different locations is constructed. I use the concluding section [Deltas as muddy fractal] for a further reflection upon sameness and differences between the two descriptions in an attempt to assess the usefulness and appropriateness of a fractality perspective for explaining delta travels. In this section I will also reflect upon some of the
differences between the diagnosis of a particular disease in a hospital setting and looking at a delta as a diagnosis of a socioenvironmental phenomenon.

5.2 **MULTIPLE DELTAS MULTIPLE?**

Studying deltas and delta planning means embarking on a study of what Tsing would call *global connection*; a study on how deltas and their vulnerabilities gain urgency and political momentum and travel the world on the waves of climate change. How deltas thus are or become at the same time global and local. A fundamental question in such an analysis has to do with how to make sense of the existence of different (ideas about) (delta) realities (see also Verzijl and Dominguez 2015):

“Is it simply that people believe different things about reality? Or is it that there are different realities being done in different practices? If the first of these positions is right, then we are in the business of beliefs, perspectives, and epistemologies. We may, we do, have different views of – for instance – the environment, what it is, and what there is in it. If, on the other hand, the second position is right, then we are being backed into issues of ontology. This alternative position is analytically radical because it treats reals as effects of contingent and heterogeneous enactments, performances or sets of relations. Categories such as ‘nature’ and ‘culture’ may or may not carry into these alternative worlds. (Law 2015 p.2).

If we would engage with what Law called the epistemological line of trying to understand the differences and similarities within and between deltas, the analysis would revolve around establishing “truer” facts about deltas, for instance translated into comparative tables (Bucx et al. 2010); vulnerability maps (Syvitski 2008); or normative narratives about what ought to be done (Anna Wesselink et al. 2015). Such explanations may also take the form of predictions about the (distributed) impacts of climate change (e.g. sea level rise), positing the delta as a spatial entity that is increasingly vulnerable to flooding due to sea level rise. The latter type of explanations helps set (policy) priorities and prompts the exploration of possibilities for technological and institutional (governance) interventions to reduce the vulnerabilities of the respective deltas. Yet, such studies make it difficult if
not impossible to ask the question how the deltas referred to are at all similar or comparable even though they form part of very different cultural, political, ecological and historical contexts.

When nature is no longer the objectifying anchor of truth - which in the case of deltas is difficult to maintain precisely because they always are socionatural - then what is? In this light the second line, a turn to ontologies (Woolgar and Lezaun 2013), or applying ontography (Lynch 2013) potentially enables a quite different set of explanations about what it is that makes allows the connectedness between the regions to be diagnosed as deltas. This means an analysis that sets out to map/identify the ways in which multiple ontologies enact different deltas, the delta multiple (cf. Mol, 2002), so to speak. The delta multiple referring to how (1) it is possible for one and the same spatial region to be denoted/enacted as deltaic in many different ways; (2) for different spatial regions to be denoted/enacted as deltaic in similar, but many, ways; (3) for different spatial regions to be denoted/enacted as deltaic in many different ways. This chapter not an attempt to analytically explore parallel universes, or a pluriverse “to use James’ term for a world freed from being defined by only one mode” (Latour 2010 p.604) that houses different deltas; I leave that to the Murakami’s of this world (in his wonderful 1q84). Rather, it is an attempt to analyze deltas as parts of a fractiverse (Law 2015). By looking at the universe, world or delta with the metaphor of fractal I intend to follow the proposal by Jensen for a fractal approach for studying space, society and infrastructure (Casper B. Jensen 2007). Following this proposal provides the possibility to talk and think about deltas that are (1) more than one, and less than many (Mol 2002; Wagner 1991); and (2) that come into being in a ‘dance’ of human and nonhuman agency (Law 2002; Pickering 2008).

The idea of fractal is borrowed from the field of mathematics. Fractals are never ending patterns, created by an ongoing feedback loop in a formula. Resultantly images, like the famous Mandelbrot fractal, appear to which one can infinitely zoom in to, yielding images with equal complexity showing similar patterns, clearly also looking different from each other. To use a fractal metaphor to think about a delta means to think about a delta that has no single ontological centre, it is multiple. The multiple deltas do not live their separate lives, the relate to each other, as John Law in his Aircraft Stories say about the multiplicity of aircrafts “[...] and yet these various
versions also interfere with another and shuffle themselves together to make a single aircraft. They make what I call singularities, or singular objects out of their multiplicity. In short, they make objects that cohere” (Law 2002 p.3). But how to think about an object that is neither multiple nor singular? John Law also opts for fractionality: “If we take this [fractal] as a metaphor without worrying too much about the mathematics, then we may imagine that fractal coherences are coherences that cannot be caught with or reduced to a single dimension. In this way of thinking, a fractionally coherent subject or object is one that balances between plurality and singularity” (Law 2002 p.3).

In the following sections I will provide two explorations of (sets of) practices that are typically delta. I look at the multiple practices that shape, enact, deltas and by doing so I want to pay attention to what Andrew Pickering has labelled “the dance of agency”. In his chapter “New Ontologies” (2008) Pickering provides an account of the attempts by the US Army Corps of Engineers to bring the Mississippi river under control, while in turn the river “wants to move”. For Pickering the dance of agency between the river and humans acting upon this river is the “flow becoming” (see also Lavau 2013 and Jensen forthcoming -editorial-). In Pickering’s account the river, or in our story the delta, becomes, or to use the Mol/Law wordings is enacted as a fractionally coherent object in a dance of agency. I will use the two sets of practices presented below to illustrate the dance of agency of deltas, a dance between people and the muddy substance they happen to live on.

5.3 ON THE PUZZLE OF OBTAINING STABILITY

The first set of practices that I will take a closer look into is the concept of polder. Polder is typically linked to land and water management practices taking place in the Netherlands, which as a concept has started to travel the world:

“The fact that nearly half of the Netherlands consists of polders may be common knowledge. The word ‘polder’ has even crept into the English language. What might be ‘news’ to many people is that there are thousands of polders scattered all over the world. The Dutch were responsible for many of the polders in Europe, Asia, Africa and America. In
fact polders are still being constructed in many parts of the world and the Dutch are still doing much of the work. This is hardly surprising, considering that the Netherlands is the one place in the world where polders are essential for its survival.”

This excerpt is taken from the introduction section of a brochure called “Polders of the World” published by the Dutch Ministry of Transport and Public works. The exact date of publication is not known to me, but it was probably published in the early eighties. It clearly shows a sense of Dutch pride over its water management accomplishments. The brochure provides a history of Dutch land reclamation accomplishments, highlighting the different types of polders that exist and how these are constructed. The central part of the brochure highlights how Dutch knowledge on “water control” was disseminated over the world, from Japan to Thailand, and also to the “third world” countries like Bangladesh and Guinea-Bissau. “The water control problems which they are confronted with may be illustrated by the situation in Bangladesh, which is fairly typical of much of the third World” (Ministerie van Verkeer en Waterstaat unknown date, p.19).

The brochure is quite up-front in its efforts to highlight the sameness of and similarities between many regions in world, in current days mostly referred to as deltas, emphasizing the appropriateness of Dutch polder knowledge and techniques for enabling a prosperous life in these regions: “The solution would be to build barrier dams and dikes on the scale of the Dutch Delta Project, but the country cannot afford this” (Ministerie van Verkeer en Waterstaat Unknown date, p.19).

So what is a polder? Polder typically refers to the practices of building a dike around a low lying piece of land and the construction of a drainage system. Or, in the words of a Dutch civil engineer in the early 1980’s: “a polder is a level area which was originally subject to a high water-level, either permanently or seasonally and due to either ground- water or surface water. It becomes a polder when it is separated from the surrounding hydrological regime so that its water-level can be controlled independently of the surrounding regime” (Segeren 1983 p.51), thus turning low lying swampy wetlands into dry lands that are suitable for domestication. This is an approach which Lund et al. (2007) refer to as the “Dutch fortress” approach. A fortress of which the walls are formed by dikes, and “a polder without a dike is like a house without walls” (Ministerie van Verkeer en
Waterstaat unknown date, p.28). Through the construction of thousands of
polders (Steenbergen et al. 2009) the Netherlands has become a country
that is composed of thousands of independently controllable hydrological
regimes, and institutional capacities to control these regimes (TeBrake
2002).

This very fragmented institutional landscape of water boards was partially
blamed for the 1953 flooding disaster, which took the lives of more than
1800 people (van der Ham 2006). The disaster thus came to play an
important role in a shift towards more centralized water management,
towards what Lintsen refers to as the techno-scientific period (Lintsen 2002;
Disco and van der Vleuten 2002) in Dutch water management. This period
resulted in the Dutch delta works (above referred to as the Dutch Delta
project by the ministerial brochure) which did not so much focus on the
construction of polder sized controllable hydrological regimes, but on
keeping the sea at bay. This happened through the construction of a large
network of infrastructures (delta works), like dams, barriers and dikes. It is
through both the development of the polder concept and the delta works
that the Dutch have gained an international fame when it comes to its
water management know how.

5.3.1 DELTAS WANT TO MOVE

Yet, living in a country that is built on separations of lands and waters, and
of ‘good’ and ‘bad’ water, over time turned out to be not quite as
straightforward as was assumed in the modernistic, techno-scientific
attempts to control (“tame” is also often used in this respect, see e.g. Lach,
Rayner, and Ingram 2005) the water. Separations turned out to have messy
consequences. Before addressing Dutch examples I first turn to the account
that Gerrits provides on the deepening of the Unterelbe (North Germany),
which he concludes with a section titled “A disappointingly large amount of
mud”. He explains how the deepening of the waterway resulted in a
situation where the accumulation of sediments in the harbour basin
doubled after the dredging was completed. Drawing on this example
Gerrits states “One must always bear in mind that the authorities do not
make policy decisions on passive physical systems; such systems respond
dynamically and unpredictably to policy decisions, which could yield
unfavourable results. Such as a very large amount of mud in the middle of a port” (Gerrits 2008, p.2).

In the Netherlands we find many examples of unforeseen things that happened after policy implementations, such as the construction of the delta works. These delta works resulted in the closing off of nearly all the open connections of the rivers to the sea, with the exception of two waterways that form the connection between two major harbours, being Antwerp and Rotterdam, and the North Sea – and that form, through the North Sea, the connection with the rest of the world. After some time all the deltaic waters that came to be closed off from the sea though the construction of dams faced problems. All waters over time started to suffer from losses of biodiversity. The Oosterschelde (Eastern Scheldt) additionally faced a problem referred to as sand-hunger. Sand-hunger refers to the phenomenon that tidal plains of the Oosterschelde after the completion of the Oosterschelde storm surge barrier started to erode into the depths of the former estuary. Explanations over why happened suggest that the barrier caused a reduction in the inflow of sediments into Oosterschelde basin, which tweaked the basins’ internal sediment balance. The basin became hungry for sand.

Bordering the Oosterschelde, the delta works created a fresh water lake called the Volkerak Zoom Lake. Where the Oosterschelde kept its tidal activity (be it reduced), and remained saline, the Volkerak Zoom Lake more radically shifted from being (part of an) estuary into being a stagnant fresh water lake. In this lake, the main unexpected phenomenon is not sand-hunger, though the same phenomenon also occurs here. In the early 90’s the lake at times turned green and smelly. This shift is attributed to the blooming of a blue-green algae (cyanobacteria), yet another unwanted and unplanned reaction of nature to the interventions of men in the waters. It triggered various policy and research projects since the early 1990’s (see Zegwaard and Wester 2014), projects and processes that are currently still ongoing. These have not (yet) resulted in material changes in the lake, at least, so it seems. Yet, in recent years, while processes to combat the blue-green algae were ongoing, the Quagga mussel made its appearance in the lake. This is linked to the waterway connection between the Rhine and Danube, which made it possible for the mussel to travel to the Netherlands, where it became a new “invasive species”. Somewhat miraculously, this
invasive mussel happens to be feeding on blue-green algae, thereby possibly solving a problem that planned measures until today could not. “Nature” seems to be responding faster than the Dutch policy and planning processes.

In a response to these unanticipated material consequences of techno-scientific interventions, human and non-human elements that once were absent to use the terms of Law (2004) have become present, also helping spark new human publics into being (Marres 1997) which in turn resulted in the so-called deliberative turn in water management (Warner and van Buuren 2009; Van Bommel et al. 2009). Appreciation of nonhuman elements and considerations like ‘biodiversity’ resulted in an ecological turn (Disco 2002; van der Brugge, Rotmans, and Loorbach 2005) in Dutch water management approaches. The combination of both set the scene for new large scale projects under the label of “Room for the River”. In Room for the River projects the rivers are not controlled by continuously raising dikes along the river, but instead are given space to meander and move. There is no consensus over the question how deeply these deliberative and ecological turns have institutionalized new ways of thinking and doing, or of whether they resulted in (paradigmatic) changes or just are strategic refrairings of the same old approaches (van Hemert 1999; Wiering and Arts 2006). Yet it is interesting to see how there appears to be something like a material feedback: the river but also new publics (including human efforts to represent nature) talk back to the designs made. Like Pickerings Mississippi that “wants to move”, the delta seems to be talking back.

In this light it’s interesting to look at the case of the Noordwaard, as described by van Staveren et al. (2014). The Noordwaard is an agricultural polder located right in the heart of the Dutch delta. As a part of the Room for the River project, this polder is currently in the process of being depoldered. This means that the polder is changed to accommodate occasional river floods. The authors refer to this depoldering as controlled flooding. This means that different parts of the polder will have different design flooding frequencies, varying from once every year to once in every thousand years. To let the waters enter the polder, creeks have been dug, in patterns that are based on historical maps which date back to 1905. Although the water is welcomed back into the polder to mix with the lands, the sediments involved in such flows are considered a threat: “Although
considered as a natural process well in line with historic land and water dynamics, sedimentation in the case of the Noordwaard, ‘needs to be kept within an acceptable range in order not to affect the hydraulic discharge capacity of the area’” (van Staveren et al. 2014 p.696). This exemplary case of the ecological turn in Dutch water management shows that control is still a central design principle, but what is controlled and where this is done have changed. Water is now allowed to become present within the polder, be it within designed intervals. The sediments that these waters might bring along are problematic. Water and land (sediment) remain separate categories.

The examples of muds, sediments, algae and mussels support Latour’s ideas that the distinction between nature and society is not per se very helpful for understanding the environments (or deltas) that we are contained in (see also the "amodern disposition" in Casper Bruun Jensen 2010). The delta and its waters are hybrids. Humans and non-humans align at some instances (like mussels and people) and collide with each other (like algae and people). In his historical account on the modifications of the Western Scheldt, the connection that remained open to link the harbour of Antwerp with the world, Gerrits shows the ways through which the nature–society distinction is reiterated through policy. This distinction is remarkably influencing the situation in the Western Scheldt. Gerrits shows how the idea of nature compensation entered the scene with regard to the deepening of the waterway of the Western Scheldt. Nature compensation, as a principle that affects the Western Scheldt region through European legislation, implies that when harm is done to a water basin through, and for the benefit of society (e.g. through dredging), the damage needs to be compensated to nature through the development of ‘new nature’ elsewhere.

In sum, Dutch approaches towards deltas have a history of making separations. Separations between water and land, and between fresh and saline water. These separations have in turn resulted in what Stephanie Lavau (2013) referred to as specific ontological cleavings, splitting between what Atsuro Morita and Casper Bruun Jensen refer to as terrestrial and aquatic ontologies (Morita and Jensen, forthcoming). The brief exploration of separations above on the other hand also seems to suggest that this ontological cleavage is not stable. Instability that emerges from the
continuous interactions between modes of ordering and a dynamic delta, that wants to move.

5.4 ON THE PUZZLE OF OBTAINING MOBILITY

Where the previous section looked at the complicated situations that emerge when certain ordering are imposed on deltas, this section will look at what happens when similar orderings are interacting with other deltas in the world. As a result of the travels of concepts like polders, polder like situations can be found in many places in the world (Segeren 1983). Interestingly in all the cases in the world that I am aware of, ideas are formed or are being formed about (re-)introducing controlled flooding and depoldering. In Vietnam this is called controlled flooding (MDP 2013), Californians refer to this as environmental and storage levels (Lund et al. 2007) and in Bangladesh this is called tidal river management (Imam Ibne Amir et al. 2013). Where in the eighties the Dutch water management focused attention to the export of polder knowhow, since the publication of the report of the second Dutch delta committee the focus has been on the dissemination of delta planning know how.

The geographically different locations that I deal with in this chapter, are enacted as deltas through delta planning activities that these are currently engaged in. In all of these, Dutch delta planning professionals and concepts play, and historically have played, significant roles. As such these deltas form interesting sites for studying the universal aspect, the sameness’s, of deltas that make delta professionals and concepts travel. Such travel includes the travelling of polders in the eighties and before, but also other not (exclusively) Dutch concepts and ideas like the travels of Integrated Water Resources Management concepts (Allan 2003; Molle 2008) and a Water for all policy (Goldman 2007), the Tennessee Valley Authority model (Scott 2006; Ekbladh 2002).

For the Dutch delta a five-year Deltaprogramme has resulted in the formulation of five national “delta decisions” that together form “a new delta plan” for the Netherlands (Deltaprogramma 2010; 2011; 2012; 2013; 2014; 2015). It is referred to as the “new” delta plan because after the 1953 flooding disaster the “first” delta plan has been formulated, resulting in the
construction of the Dutch Delta works. While the formulation of this new delta plan was ongoing, Dutch delta planners set sail to the Mekong delta in Vietnam and the Ganges-Brahmaputra-Meghna Delta in Bangladesh. In the Mekong Delta with its turbulent colonial and post-colonial geopolitical history, Dutch experts have contributed to the formulation of the Mekong Delta plan (MDP 2013). For the Bangladeshi part of the Ganges-Brahmaputra-Meghna Delta a process is currently ongoing aiming at the formulation of a Bangladesh Delta plan, supported by a consortium of Dutch Delta planning experts.

**FIGURE 7 MEKONG, DUTCH AND BANGLADESH DELTAPLANS**
In the following subsections I analyze the works of separations that have been happening in these two destinations of Dutch delta planners overseas. The works on the Vietnamese Mekong Delta that I draw upon is the works of historian David Biggs (2008; 2012 and Biggs et al 2009). In these works Biggs and his colleagues describe, among other things, the not so successful attempts to “export” an IWRM approach, as was developed and implemented in the US by the development of the Tennessee Valley Authority (TVA). In the Bengal Delta “export” of the TVA concept has taken shape in the establishment of the Damodar Valley Coorperation (DVC), as described in the second line of work that I will draw from: Dancing with the River by Kuntala Lahiri-Dutt and Gopa Samanta (2013).

Lahiri-Dutt and Samanata argue that both spatially and temporally it is not as easy to define a delta as this may appear. “Geographers and geologists have argued over the exact boundaries of the Bengal delta” (Lahiri-Dutt and Samantha 2013). Dancing with the River discusses and debates about definitions of the Bengal delta, about whether or not to include the sundarbans (Mangrove forest), whether to express the delta as a geological unit, defining it in terms of its river based origin, tectonic history, or position relative to the level of the sea. Definitions of deltas can be expressed in the language of the (scientific) disciplines describing them; alternatively it could be argued for the Dutch case that the Netherlands became, or rather, was enacted as a delta after the 1953 flooding disaster, through the instalment of the first Delta Committee. This committee predominantly, in coastal and civil engineering terms, focussed on reducing the risk caused by storm surges coming from the sea (Deltacommissie 1961). The second Delta Committee in the Netherlands broadened its assignment to the entire water system of the Netherlands, focussing on both flood risks and fresh water supply for agriculture. The Mekong Delta is different from the Bengal and Dutch deltas, not only because of its violent geopolitical history, but also because of the related, “nation building activities” (Biggs 2008) in the delta preceding and following the war.

5.4.1 TURNING INVISIBLE

Dancing with the River deals with the lives of the people in the Chars in West Bengal. They introduce the chars by quoting Amitav Ghosh’s wonderful novel “The Hungry Tide” about an Indian American scientist doing research
in the char regions. This novel in itself is almost a Latourian act of following a
scientist into her laboratory, showing all the tricky moral and ethical
dilemmas that research on “nature” and the iconic river dolphin more in
specific bring along (Anand 2008). The following quote used in Dancing
with the River nicely illustrates what the chars are:

“Interposed between the sea and the plains of Bengal lies an immense
archipelago of islands... There are no borders here to divide fresh water from salt,
river from sea. The tides reach as far as three hundred kilometres inland and
every day thousands of acres of forests disappear under water only to re-emerge
hours later.... The currents are so powerful as to reshape the islands almost daily--
some days the water tears away entire promontories and peninsulas, at other
times it throws up new shelter and sandbanks where there were none before”

Ghosh’s novel, and Dancing with the River in a much more systematic way,
show how life at the char regions is a complex struggle in which
international politics (border between Bangladesh and India), ethnic
clashes, religion and consequences of global environmental protection for
local populations all play a role, in terms of exclusion and control. In the
second chapter of their book Lahiri-Dutt and Samatha show convincingly
how human interactions with the rivers, the attempts to control these rivers,
have impacted the life in the char regions. These attempts to control the
water have been undertaken from colonial times onwards, and most
significantly under the establishment of the Damodar Valley Corporation
(DVC) in 1948, modelled after, and assisted by the Tennessee Valley
Authority (TVA) in the US. Following the TVA model the goal of the DVC was
to make “multipurpose” use of the river. The DVC included the planning
and construction of large hydroelectric, multipurpose dams. The chapter in
Dancing with the River shows that:

“Colonial land systems not only left their imprint on Bengali social and economic
lives, but made far-reaching impacts on the ecology. The separation of land and
water as two separate physical elements, the valuation of land for its revenue-
yielding qualities, and the perception that rivers in Bengal were in need of control
were colonial contributions. [...] [B]y changing the way lands and waters were
valued by those who lived in Bengal, these factors prepared not just the context
but the intellectual atmosphere in which interventions in the river’s system could
be legitimized. Therefore, one might say that what happened during the colonial
period was critical to understanding the production of an environmental
discourse that was also part of the Bengali milieu. Environmental changes created and were created by a mind-set that legitimated and encouraged rivers to be controlled in riverine Bengal, and in the midst of all the focus on the river and their floods, the chars turned invisible.” (Lahiri-Dutt and Samantha 2013, p.77).

Such analysis shows how practices under the umbrella of modernistic progress have resulted in the separation of land and water which are only valid and make sense within a specific paradigm and vision of development, but become less useful in others. Ironically, and arguably not accidentally it is generally the poorest people that live in the regions that fall off the map. Similar to what poldering did to the Dutch Delta, the Bengal Delta has been transformed. In Dutch polder works the hydrological regime of levelled areas are separated from its surrounding regime, in order to be able to control the waters' effects on land. Lahiri-Dutt and Samantha show that, in a similar attempt to bring a hydrological system under control, elements that do not strictly fit the categoric label ‘water’ or ‘land’ become othered, with all the political consequences this brings along.

5.4.2 NORMAL DELTA ONTOLOGY

Separations in deltas do not only take place between land and water. Historian David Biggs has shown how in the Mekong Delta a purification of waters has taken place, through the separation of fresh and saline water: “In the Mekong Delta, historically, the pivotal form of water control and management has been the ‘Dutch dike’ strategy, which involves construction of encircling dikes for settlement, flood control or prevention of seawater intrusion to provide the favourable freshwater conditions for agriculture” (Biggs et al. 2009, p. 208). The interventions, as Biggs shows in his article on Water Engineering in the Mekong Delta, are connected to French, American and later Vietnamese ‘nation building projects’. “Such a perspective draws attention to the wide variety of actors – human and nonhuman—that played important roles in either constraining or enabling specific actions” (Biggs 2008, p.622). Actions, in turn, that were strongly informed by economic (French), war time political (American, including also an attempt to export the TVA concept) and national food security (Vietnamese: Doi Moi) politics and policies.
The work of Biggs show that, even stronger than in the Bengal situation, interventions and practices are strongly shaped by international and national political agendas, resulting in what Biggs et al. call institutional inertia that is, “[w]here past institutional arrangements [...] have continued to shape the form of state decisions ever since” (Biggs et al. 2009, p.221). Apart from this they also observe a physical inertia: “in terms of the historical built landscape and aging technology that works against propositions to make major changes in water resource strategies” (Ibid.). Where lands and water are separated through infrastructures, this separation is also translated into the institutional setting. Ministries of agriculture deal with the lands, ministries of water and environment with the waters. Biggs and colleagues show, through what they call the physical and institutional inertia, that deltas seems to be enacted through what we following Thomas Kuhns Normal Science (Kuhn 1962) and Robert Chambers’ Normal Professionalism (Chambers 1986) could call Normal Delta Ontology. This referring to a standard set of understandings, practices and materialities that shape how deltas are understood. A normal delta ontology, or simply delta ontology (Morita and Jensen forthcoming) that tends to be conservative. Normalcy here also means a blackboxing - and the difficulty to question or interrogate it. Normalcy gets to look natural - and politics and histories disappear and (Dutch) delta expertise gets continuously reified).

5.5 Delta as a Diagnosis

Through the exploration of delta (management) practices this chapter has tried to explore deltas as enacted and decentered objects. This exploration navigated from Dutch poldering attempts, aimed at separating waters and lands, and building on ideas of control to obtain deltas as stable (policy) objects. In the process of doing so a ‘hydrological regime’ is chopped up in smaller, controllable hydrological regimes. The initial Dutch idea of a delta was one of fragmented hydrological regimes. This was until the deltas started talking back. There appeared to be difficulties with the specific separations that brought the delta landscapes into being. Separating land and water was very promising at first for new land is created, but over time, land without the water started to sink. Keeping the sea out of the delta by constructing dams, dikes and barriers may have been effective in safety terms, but over time the waters became “hungry” for sediments. The deltas
indeed started to talk back, with unexpected interactions between people, rivers, sand and mud crumbling normal and taken-for-granted ontological definitions and leading to clashes with the knowledges, technologies and institutions that hold on to 'old' definitions.

As the controlled flooding case of van Staveren et al showed, institutional capacities and technologies have co-evolved with and are based on separating water and land. As a consequence, they are not equipped to deal with mixings, or with the delta’s hybridity. Dutch institutions have, to speak with Lahiri-Dutt and Samantha, lost their capacities to dance with the river. Their book shows that the Dutch control attempts do not stand in isolation internationally, but also that separations that have taken shape under high modernist (Scott 2006) control works form all part of a specific ontological ordering, and can indeed be rendered as fractal. Compared to one particular patterned ontological order in the Dutch case, where sediments and algae where invisible, the Bengal case in dancing with the river shows how entire livelihoods become invisible to policy makers. Livelihoods that happened to be located on, and exist thanks to, the muddy places in the delta. Expanding our look to the Mekong delta, we see again similar high-modernist control works of separations taking place. A diagnoses of areas or situations as delta thus emerges based on specific fragmentations and separations. Such a diagnosis enables mobility the mobility of delta concepts and expertise. At the same time, the delta becomes, and is made durable in a dance of agency between human and nonhuman elements that they contain. Which is a dance between a history of fragmented, localizing practices and a future that is unifying and globalizing. The dance that brings deltas into being is also a dance between local politics and global geo-politics.

Deltas are brought into being as (policy) objects at locations where the global, universal, science based and a-political climate change intersects with the local, muddy, political practices of trying to make a living in these locations. The deltas provide clear examples of the limitations of high modernist approaches to control the waters: the deltas talk back. Through this talking back the deltas in a way hint at the limitations of a post-modernistic, or liquid modernity (Bauman 2000) attitude towards the environment, in which supposedly anything goes. Through the similarities in the ways in which deltas respond to human interventions, there appears to
be a sameness between them. Land cannot go without water, there needs to be a certain level of mud. This seems to resonate with how philosopher Peter Sloterdijk refers to the crisis with the image of foam. As ten Bos summarizes his diagnosis: “Politically, foam is uncontrollable and unruly; we live our lives in what can best be described as a morphological anarchy” (ten Bos 2009 p.85). Maybe, as Latour has argued, we indeed have never been modern (Latour 1993) in the sense that nature and culture were separated. The dance takes place on the muddy grounds (/waters) that are located somewhere between the rationalities of (high) modernity and post or liquid modernities.
6. Mud, Muddling Through and Muddy Modernity
6.1 Multiplicities and Deltas

According to Bakker, building on the distinction between H$_2$O and Water as coined by Ivan Illich (1986), water is at the same time part of physical (as H$_2$O) and of social flows (as water) (see Bakker 2002). Helmreich also recognizes a multiplicity of water, but points to ways of knowing water as an explanation for its plurality: “Water is not one thing. For natural science, water’s effects depend on its state (solid, liquid, gas), on its scale (from molecular to oceanic), and on whether it is fresh or salty, still or turbulent, deep or shallow. For interpretative social sciences, water can be sacred substance, life, refreshment, contaminant, grave” (2011 p.133). Barnes and Alatout point at the different roles that water can play in societies when they state that: “Water is not a singular object... Rather, water reveals its complex, multi-layered biophysical identities for particular enactments, depending on assemblages that are in place or still in the making. As a result of the assemblages in which it finds itself, water can be and become a border, a resource for regeneration, a foundation for empire, a means of nation building, and a material linkage between past and present” (Barnes and Alatout 2012 p.484-485). In this thesis I have looked at not only the multiplicity of water (see also Linton 2010; Steinberg and Peters 2015), but the multiplicities of waters mixing with and being separated from land. Or, to return to the way I formulated it in the introduction chapter, the overall objective of this PhD study is to explore how different (versions of) deltas are understood by looking at practices that bring deltas into being as policy objects and by doing so conceptualize the differences and similarities between these (versions of) deltas. A study into the making and unmaking of mud which I conducted in four steps.

The first step [chapter 2] dealt with historical and current day dealings with the Dutch Delta. This chapter gave an insight into what we could refer to as a Dutch delta ontology. The synchronicity between the way in which the Delta Committee embraced a flooding event to establish political urgency and the way in which Dutch history is made to tell how flooding events in the past triggered decision making is apparent. The chapter also showed how, in a way, with the rise of a globalizing climate change awareness the Dutch Delta has been stretched. Timelines for policymaking are expanded to longer time scales, and floods that occurred elsewhere in the world impacted delta (policy agendas).
The second step [chapter 3] took a closer look at a seemingly confined and tamed problem: the bloom of blue-green algae in a lake. This chapter showed that the longer the process took, the bigger it became: the spatiality of the problem, its temporality, the publics involved and the number of dimensions in the hydrological modelling studies. The latter, the hydrological modelling, played in various ways a crucial role in the process. These models formed the basis for truth claims, determining what is and what is not possible. Yet they also formed the experimental grounds for interactions between different scientific disciplines that remain limited to a presumably rationalistic scientific ontology.

Building upon the ramifications of the study of the Dutch Delta and the policy processes, step three [chapter 4] looked at what happens when Dutch delta planning travels to other deltas, other contexts. Where in the Dutch context [chapter 2] delta planning and the delta as an object of policy making is actively building upon a particular history, a history of flood, in the Vietnamese and Bangladeshi contexts emphasis is put on the future. The respective deltas are enacted through the formulation of futures scenarios. This process, as is argued in this chapter, actively influences the agendas about what the delta is, determining what trends are relevant. The travel of Dutch delta planners and their methodologies and technologies is above all a travelling of a Dutch flavoured delta ontology.

For the fourth step of this endeavour [chapter 5] I took a bit of a different take on the deltas. In this chapter I tried to look for a vocabulary that engages with the various enactments of deltas in terms that stay away from the singular/plural terminology and that appreciates the influences of social/human and material/nonhuman agency. Looking at separations in the context of the three deltas that are featured in this thesis, with the fractal metaphor, the thesis grapples with the implications of a performative understanding of what deltas are. Understanding deltas as objects that are brought into existence though continuous interactions between human and nonhuman agency. Over time ontological definitions start to crumble when they are interacting with the material. Deltas are ontologically dynamic, they flow but with a high viscosity, when it is interacted with it tends to talk back.
6.2 THE MAKING OF DELTAS

How did these steps help to come to answer the questions raised at the start [chapter 1] of this thesis? I will use the coming sections to first discuss the ways that I would answers the sub-questions of this research, before discussing and reflecting upon the main research question: How can current day practices of dealing with deltas be understood as politics of ontology?

This section will now first deal with [sq-1] What makes deltas into deltas? and [sq-2] What holds deltas in place? Following the steps of studying the formation of objects as identified by Foucault [chapter 1], it makes sense to describe the processes of delta formation that have featured in this thesis along these lines: 1) mapping the surface of emergence; 2) describing the authority of delimitation; 3) analysing the grid of specification (Foucault 2002).

6.2.1 MAPPING THE SURFACE OF EMERGENCE

The Mississippi delta

Was shining like a national guitar

Paul Simon - Graceland

There is quite obviously a materiality to the surfaces on which deltas emerge. Deltas appear where rivers meet oceans, where they dispose sediments, and where sediments turn into land. But this is, as this thesis has highlighted, only part of the story that make deltas. Deltas are as much discursive. As the excerpt from Paul Simon’s Graceland makes us see: to name a delta a delta it is not enough to have an area the shape of which resembles that of the Greek letter delta (Δ) when looked at from the sky. The deltas discussed in this thesis emerge when certain elements align. Firstly, deltas emerge where there is an urgency. Climate change has arguably created the discursive and political space for deltas to emerge, for the message of climate change is often expressed in terms of changing waters. A second element that helps deltas come into being is the dominance and authority of a specific ‘western’ techno-scientific delta ontology. As is shown in the chapter on the production of futures [chapter 4] in delta planning, deltas are promoted as objects of strategic policy.
making. ‘Strategic’ here means thinking about the delta ‘as a whole’, regarding and anticipating the effects of actions in one part of the delta on other parts, taking into account the longer time scale (100 years plus). Strategic thinking thus performs the delta as having its own logic of long-term existence, something that is contrasted with ‘local’ delta ontologies that enact deltas as consisting of relatively short-lived (5-year) composites of different fragments which at times compete, (e.g. in agricultural production and flood protection).

6.2.2 Authority of Delimitation
Who has the authority to decide what is and what is not part of a delta? Part of the answer to this question is “experts”, and given the focus of this thesis the experts studied happen to be Dutch experts. The authority of the Dutch experts is supported by two mechanisms: its water governance history and a methodology. The Dutch watery history is actively highlighted when Dutch water professional are promoting their work overseas. In this light it is interesting to note that one of the Dutch engineers involved the Mekong Delta Plan that I interviewed for “Delta formations” [chapter 4] became involved in the process largely because of this track-record on dike construction and affinity with the Vietnamese context. In the interview he explained to me in detail about his extensive career while at the same time the interview was a lecture in the science of dike constructions. The Mekong Delta Plan played a rather formative role in this long professional and personal history. The process, he explained, had opened his eyes to the capabilities that are enabled when one starts to turn to future scenarios. Turning to futures, and formulating these one way or another provides a powerful means for defining the deltas as an object. But it also provides a powerful means for defining the directions of this object, normatively setting policy and funding agendas about which developments are considered relevant and desirable in and outside the delta.

6.2.3 Grid of Specifications
It seems that it takes a delta to know a delta. In this thesis the knowing of the deltas happened through the Dutch delta experts building on their water history of dealing with and preventing floods, and their more recently
acquired skill of future scenario building. This brings with it also two elements that are crucial in defining the content of the deltas, their grid of specifications. First, what the three deltas and associated delta planning studied in this thesis have shown is that in the end deltas are first and foremost engineering systems. All three delta planning activities aim at intervening in these systems. This is done to a greater or lesser extent building on ideas that the deltas are heading towards their futures while walking over (adaptive) pathways, activating a history of partially successful interventions in these systems. The Delta Works in the Netherlands have radically changed the Dutch landscape, and have increased the safety of the Netherlands. These same Delta Works have also taught a lesson about unforeseen ecological consequences of interventions in such a system. The Delta Works thus, by intervening in the water system redefined the system as a watery eco-system. And the embankments constructed in the upper delta in the Mekong Delta have boosted rise production significantly, and with that contributed to food security in Vietnam. In the process these embankments have ‘accidentally’ created the fragmented institutional soils that seem fertile for a call for integration, which is argued for in the Mekong delta plan.

A second element in defining the specifics of the deltas is that deltas have become geologically ephemeral. With the rise of climate change [chapter 2] and through the definition of future scenarios [chapter 4] temporal horizons of deltas have been stretched sometimes up to ranges of 200 years. These more geological temporal ranges differ significantly from the usual policy making time frames. It has been partially due to the dangers that appear on these longer time frames that deltas have started to appear on international and national agendas, for it is on these timelines that deltas gain a policy making urgency.
6.3 INTERMEZZO: DELTAS MAKING DELTAS MAKING...

In this section I reflect upon the conditions that make it possible for delta plans to travel from one place to another. Though I haven’t explicitly done research that directly aimed at providing a full explanation, since I only scratched the surfaces of the context on which the delta plans land, I do think my work allows me to reflect upon this. What particularly helped me in this regard is a book chapter by anthropologist Rebecca Empson on the travels of medical expertise from western countries to Mongolia (Empson 2012). In this chapter Empson provides a history of the first successful organ transplantation ever conducted in Mongolia. This history is told along two lines. The first line provides an account of national pride, linking the activities of the transplant doctor to the history of Chinggis Haan (‘Ghenggis Khan’), links to international donors, skills and technologies involved and links to legislation. The second line provides a rather different frame for the same practice of transplanting an organ. Building upon the insights from a Swiss doctor involved in the development of Mongolian medicine for over a decade this line raises international dimensions that are not visible in the first line. The Mongolian act of transplanting turned out to be more hybrid (including Chinese influences) than it seemed in from a Mongolian perspective. From this perspective there appeared to be a story of personal economic gain and ethical concern that could be told about the very same act of transplanting organs. Reading this chapter resonated with a lot of the things I have witnessed in my research.

Like the travels of an organ transplanting practice from western medicine to a Mongolian context, the travels of delta plans to other deltas find their way to the destinations through the linking of agendas – whether these are agendas of global development aid, nature conservation and climate change adaptation networks or national politics. Both the Mekong and the Bangladesh delta plan actively construct ‘sameness’ between agendas. Climate change in that sense has been rather instrumental in establishing divergent deltas as similar in the sense that these are all highly vulnerable to it impacts. Comparative histories of flooding events, interventions and past collaborations are discursively shaping the circumstances for experts to travel from one delta to another. This includes a significant number of Vietnamese and Bangladeshi delta experts and politicians who come to visit e.g. conferences called Deltas in Times of Climate Change hosted in
the city of Rotterdam in 2010 and 2014. Whether the delta plans find grounds to land in the deltas depends on the partial overlapping of (policy) agendas. This does not mean that these have to be fully aligned, or coincide. Like the Mongolian example, practices in the delta may play part in multiple lines, multiple ontologies. De-poldering in the Netherlands form part of the bottom-up implementation of room for the river. In Bangladesh similar practices, under the label of Tidal River Management, form ‘indigenous’ practices of dealing with drainage congestions, which became heavily politicized after these had been adopted by national policy circles (de Die 2013).

Delta plans, and deltas as objects for that matter, travel when there is a sufficient level of resonance. Resonance that takes place in terms of discourses, materialities and practices.

6.4 ONTOLOGICAL MULTIPLICITY AND DELTAS

Spiral out,
Keep going
Tool - Laterarus

By now this last chapter of this PhD thesis has arrived at the more reflexive questions that were formulated in the introductory chapter. This section deals with a discussion of the conceptual framework used in this thesis: [sq-3] In what way does an multiple ontology perspective help to understand, and possibly even contribute to the development of, environmental planning processes? The multiple, yet connected, strands of my research have made me see how different ontologies are politically enacted, evaluated and determined or, indeed, eclipsed by others. The multiple ontologies perspective provides the analytical means for studying the ways deltas are brought into being through practices. It provides the tool for coming to different understandings about the practices of delta planning. Different in the sense that it does not come to normative statements about what ought to be. This is a difficulty of many studies done under the umbrella of Science and Technology Studies (STS). Studying the
performative character of practices results in an analysis that is hard to translate back into these very practices.

Looking back at the various strands of this research I must say that probably more than highlighting and documenting differences between various ontologies this research has been about the ways in which one ontology is prevailing. As such I have been able to show how a Dutch flavoured delta reality has been able to land in other locations, showing how this happens through a combination of linking up with international networks and discourses, local policy agendas, and (re-)formulations of the socio-material spaces. The latter might sound a little cryptic, but with this I refer to the aspect that from a multiple ontologies perspective deltas as objects (of intervention) are the outcome of these processes rather than the source, the matter of delta planning. The turn in this study to look at the prevalence of a certain ontology has resulted in the need for a language to talk about sameness rather than difference. It is for this reason that I ended up experimenting with the fractal metaphor for thinking about the delta [chapter 5].

There is a fundamental difficulty about doing research on (multiple) ontologies that in this research surfaced in two ways. First, there is the problem that for one to do research on ontologies, the study of practices, one needs to engage with these practices. This in itself is not a difficulty, it’s the opposite, it’s a very exciting learning experience. Many times this engaging made me feel like the first time I drove a car. I had been inside a car many times before I drove it for the first time, I had seen all the buttons and switches, I had learned what they are for, but setting a car in motion opens new perspectives on what a car is, what a car does. The same happened when I had the opportunity to engage with delta planning processes. There is quite a difference between studying delta planning as it ends up on paper and studying delta planning in the making. Engaged research, which in this case means collaborating with and participating in sessions with the experts involved in these processes, is a useful way to gain a deeper understanding of these processes. The difficulty about this engaged research is that in analysing these moments of interaction you inevitably create a certain analytical distance between the experience, the people involved in these processes and the interpretation of these
moments. These reflective interpretations are not always welcomed, though most of the time they were, by the people involved processes.

It takes continuous effort to make sure the conceptually laden interpretation of events does not come across as a hostile meta-perspective. This methodological difficulty is therefore closely related to the second, more conceptual difficulty that I came to face. A difficulty that could be summarized as the scratch on the record effect that is involved in the ontology of studying multiple ontologies. Describing how particular practices enact delta reality or realities while (partially) eclipsing others requires a sort of container ontology. This results in a reverse Droste effect, but this is what this study has tried to accomplish, adding reality.

This research has tried to add reality to the realities that are sparked into being in delta planning activities in two ways: methodology and context. In terms of methodology I have tried to work in dialogue with the people involved in delta planning processes. By explaining the type of research I do, reflecting as a relative outsider on the events that I became part of, explaining types of conclusion that I draw and discussing draft chapters I have, I think, contributed to a reflexivity of the experts involved. In many instances the questions that I asked in interviews caused reactions like: I have never looked at it that way. As such, though not in these very term, I have tried to discuss the limitations and situatedness of the delta realities enacted in policy and delta planning processes. In terms of context I hope to have contributed to an awareness about the ontological implications of the actions by Dutch delta planning professionals working in other deltas by linking forms of understanding that would otherwise remain disconnected.

6.5 Muddy Existence

What does it mean to live in a delta at the start of the twenty-first century? This is, a bit grotesquely, a reformulation of the last sub-research question of this PhD research: [sq-4] What are the deeper implications of the findings of this PhD with regard to understanding about the ways people live in deltas? While this is a question that is far too ambitious to answer in the last section of a PhD thesis, I do think this is a relevant question and I want to use this possibility to share my reflections that are the product of the four years that I
have attempted to make sense of deltas and what people do to make deltas into liveable places. In The Delta Diagnosis [chapter 5] I have proposed to look at deltas as muddy fractals, or rather fractals made of mud. This included highlighting the muddiness of the separations that shape human actions in deltas. Separations of water and land, separations of waters, separations of nature and culture, etc. The division that are made are continuously altered, unmade and remade. This is because of waterbodies’ hunger for sand, invasive species changing the nature of the problems, changing knowledge frameworks, fluctuating temporal horizons and spatial orientations and changing geo-political playing fields. Muddy deltas tend to flow.

It is for this reason that, in that same chapter, an argument was made for taking a renewed look at the 1950’s notion of policy making and decision making as the science (or art?) of muddling through (Lindblom 1979; Lindblom 1959). Muddling through as adaptive delta management avant la lettre. An adaptive approach that is not just sensitive to uncertainties in understanding, but an approach that is sensitive to the idea that underlying ontologies are also subject to change, realities and what they are composed of also flow.

Apart from the above mentioned aspects of muddy existence referring to deltaic materialities and the governance of deltas there is a third aspect that comes to the fore in this research, which relates to the way in which we look at modernity. We may never have been modern (Latour 1993) and we have come to see the problematic nature of high modernist projects (Scott 1998; Scott 2006), especially the ways these separate nature from culture (Latour 2009). We are in an individualistic state of liquid modernity, as Zygmund Bauman coined it (Bauman 2007; Bauman 2000), characterized by an increasing feeling of uncertainty in the individual. Looking at the ways in which people relate to deltas such a perspective indeed makes sense. Reflecting on my PhD work I would like to add that next to these experiences of uncertainties, there also seem to be patterns, there seems to be fractality. Water needs the land and vice versa, nature and culture are intertwined, and similar sociomaterial delta-practices (like e.g. depoldering) seem to be happening in many deltas around the world. Next to the liquidity and uncertainty there also appears to be some viscosity and
stability. Maybe it is time to consider modernity not as solid or liquid, but as muddy.

Thinking about the experiences gained through this research, trying to come to an understanding about the ways in which humans relate to their (material) surroundings and the ways in which these surroundings respond to interventions made me wonder if there is potential for regarding these relations as muddy. For me this provides the shortest answer to my [mrq] How can current day practices of dealing with deltas be understood as politics of ontology?, namely to consider these practices as muddy.
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SUMMARY

Deltas are dynamic environments to live in. They provide favourable conditions for the production of food through their fertile soils and the transportation of goods over the rivers and to the sea. Quite paradoxically these favourable conditions at the same time house severe threats for life in these regions: rivers tend to flood, sea levels rise and lands tend to subside. The productive yet cruel nature of deltas has gained renewed consideration through the international attention for the effects of climate change. It are these circumstances under which Dutch delta planners have been particularly active, resulting in the formulation of delta plans not only for their own Dutch Rhine-Meuse-Scheldt Delta, but also others around the globe including the Mekong Delta in Vietnam and the Ganges-Brahmaputra-Meghna Delta in Bangladesh. Though deltas are iconic and stereotypical victims of climate change, there are no pre-set boundaries as to where they begin and end. In this setting it is the objective of this PhD thesis to explore how different (versions of) deltas are understood by looking at practices that bring deltas into being as policy objects and through this analysis conceptualizing the differences and similarities between these (versions of) deltas.

Looking at the interactions between deltas as objects of policy intervention on the one hand and the ways in which these deltas are understood on the other, this thesis sets out to treat the conceptual and the empirical on the same level. Drawing upon a post-Actor Network Theory analytical vocabulary, in particular the works of John Law and Annemarie Mol, this study examines the enactment of deltas through multiple ontologies. Understanding deltas as performative, enacted entities, the study explores how deltas emerge as objects of policy intervention, how this emergence is related to particular ideas of expertise and authority, and in what terms deltas are defined and understood. The overall research question of this dissertation is: How to understand current day practices of dealing with deltas as politics of ontology? In order to come to an answer four subsequent chapters have been devised to explore the topic from four different perspective, consequently with four different audiences. These audiences are broadly: interdisciplinary climate change scholars; water studies scholars; scholar with an interest in science and technology studies; and environmental planning scholars.
The first chapter is titled ‘climate change and ontological politics in the Dutch delta’. This chapter describes how complexity, uncertainty and ignorance are being dealt with in the Netherlands, looking at how knowledges are produced and incorporated in decision-making on uncertain climate change. On the basis of work done in the Netherlands, this chapter shows two things in particular. First, it illustrates how decision making responses historically have been subject to change under influence of floods and how the emergence of climate change has significantly altered these floods. Second, based on the analysis of processes of dealing with a blue green algae problem in a lake, it shows that climate change not only influenced decision making responses, but also impacted the very reality that is being enacted. Consequently, this brings an ethical dimension to the fore, related to the intrinsic tension between the growing awareness that “all is interconnected” on the one hand and the realization not everything can be taken into account on the other.

After this exploration, the knowledge-policy interfaces are examined more in detail in the chapter ‘inside matters of facts: reopening dams and debates in the Netherlands’. Both civil engineering and environmentalism strongly influenced the development of water governance in the Netherlands in the 20th century. Most research on the topic has focused on these aspects separately. This chapter maps the interaction between governance, technology and ecological systems in the Netherlands, to provide insights into how these are interacting. The analysis is based on a combination of a literature study and an empirical case study on the debates concerning the reopening of the Philipsdam, in the Southwest Delta of the Netherlands. It shows how the negotiations that took place enacted a particular Philipsdam reality, which both increased the complexity of decision-making concerning the dam itself and radiated outwards to affect other parts of the Dutch water system. It concludes that the process of constructing facts and the way these are framed once they have been established as facts are both intrinsically political and reflect the multiplicity of views of how the lake works and what the problem is, and how these views are incompatible at times. As such, ontological complexity is ingrained in what is represented as facts and severely complicates an apparently matter of fact decision to reopen a dam.

Following this the chapter ‘delta formations: delta planning, the future and ontological multiplicity’, will start branching out to non-Dutch deltas. In
instances of high uncertainty scientific experts occupy the difficult intermediary position between having to provide clean cut answers to policy makers’ questions on the one hand while dealing with fluid, unclear and uncertain knowledge of problems on the other hand. Many researches have studied ways to optimize the process of knowledge production at the science-policy interface, predominantly focusing on ways in which uncertainties are or should be dealt with. This chapter looks at the other side of the same coin, it looks at the construction of a consistent object, exploring what happens when in this case a delta is formed as an object, looking at how futures are produced to give body to this object. It describes how the formation of the delta as an object takes place along two lines: partiality and enactment. The production of futures has functioned as a powerful tool in defining the specifics of the deltas.

The last building block that will enable this thesis to formulate an answer to its main research question is presented in a chapter titled ‘the delta diagnosis: on the sociomaterial enactment of the Dutch, Bangladesh and Mekong Deltas’. This chapters applies a fractality approach to the same deltas as discussed in previous chapters. Unlike the other chapters it does not directly look into delta planning processes. Instead it looks in a more environmental historical way at how these deltas have been dealt with. It looks at processes of separation: the separation of waters and lands, good water and bad water. Furthermore, it looks at the (geo)political economies that are shaping and get shaped by these separations. Finally, it discusses what this means for regarding deltas as fractals, by discussion how the similarities that can be observed in these various attempts to make distinctions in these deltas.

Returning to its main research question on how to understand current day practices of dealing with deltas as politics of ontology, this thesis concludes by opting to think about deltas as multiple nor singular, but as fractal. Fractal not in the mathematical sense of the word, but as environments that simultaneously have strong resemblances and differences. Similarities and differences not only over time and space, but temporal and spatial properties of deltas understood as enacted. The thesis concludes that Deltas are to be understood as muddy. Muddy not just in the sense of physically being composed of a mixture of land and water, but also as mouldable policy objects, as moving targets.
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SHORT BIOGRAPHY

Born in Sneek, Arjen spent his childhood in the water rich environment which is typical for the Friesland province in the north of the Netherlands. It was only when he left this province after graduating his VWO at Bogerman to engage in the study “International land and water management” that he started to realize the deltaic and manmade character of the landscape that he sailed and skated through in his youth. While studying for his BSc and MSc degree in Wageningen, he specialized in irrigation and water engineering. Particularly through is experiences that formed part of his internship and thesis fieldwork, in Pondicherry, India (2004) and Urgench, Uzbekistan (2006) respectively, he developed a fascination for the ways in which water and environments are understood. It is this interest that inspired him to continue at the Irrigation and Water Engineering (now Water Resources Management) group of Wageningen University, first as junior researcher and later as PhD researcher in the NWO/WOTRO funded project “Communities and institutions for flood resilience: enhancing knowledge and capacity to manage flood risk in the Bangladeshi and Dutch Deltas”. This resulted eventually in the defence of the PhD thesis entitle “Mud: deltas dealing with uncertainties” at the Institute for Environmental Studies (IVM) of the VU University.

After completion of his PhD Arjen continued his academic journey as a postdoc at the University of Amsterdam, as part of the DoUbT – Deltas dealing with uncertainties, project. This project endeavours to combine insights from Science and Technology Studies, Development Anthropology and Philosophical pragmatism to study the travels on knowledges and expertise.
And inside every turning leaf
Is the pattern of an older tree
The shape of our future
The shape of all our history

And out of the confusion
Where the river meets the sea
Came things I’d never seen
Things I’d never seen

Sting – I was brought to my senses