

## On the waterline

Maarten Kleinhans, May 2020

Look at the map. The lowlands and the deltas border on the sea. The blue sea borders sharply on the green and yellow land. The coastline is a line and lines have no width. Rivers are blue lines too, drawn in a sea of land. But this is an illusion. It is only true when we see the whole country at a single glance, on a single page, in an instant. And that instant idea is a thought that not even brain researchers can locate anywhere. Your hands already knew better when you were a child on the beach.

When you dig a hole in the beach or on the river bank, it rapidly fills with water. The sea is down into the sand, right under our feet. If you tried to freeze the river and lift it up to look at the empty channel floor, you would find the river rock-solid attached to the banks. The ice continues deep into the floodplains. The water is everywhere in the pores of the soil. The soil and the water go down very deep. Some of the tap water we drink, has been underground for thousands of years.

In the horizontal plane, the water does not stay in line either. Every few seconds, the surf waves smear out the beaches. Every day the tides seesaw over tens of kilometers, in and out of bays and sea arms. Every year the rivers flow over their banks and flood the adjoining land. Over the decades, sand bars off the coast emerged and submerged. Over past centuries, the rivers carved new channels during floods and abandoned others. Sea arms formed while others silted up. In thousands of years the coast and the rivers went hither, thither and everywhither. The lines are as static as the clouds in the sky. The web of lines through space and time is a water landscape in itself.

The longer we look, the larger the coastal zone. Since about eleven thousand years ago, two-thirds of the polar ice caps melted and the oceans expanded. All over the planet, the margins of the land were flooded. The sea flooded Morton Bay, Australia, Chesapeake Bay, Virginia, and the Netherlands on the North Sea. Before the great melt of the glaciers, people and other animals walked between Europe and England on dry land. The waves lapped up the old river sands and formed the beaches. Storms blew up the sand and shaped the dunes. Barrier islands grew together and protected an embayment from storms. Rain and rivers fed fertile mud and freshwater to the plants. And the plants did the rest. Landward of the dunes, a spongy swamp raised the land from the sea as dead plants accumulated into a sopping wet, pitch-black peat.

So the water flows all over and all through the landscape. This is the story of the lowlands to the east of the Southern Bight of the North Sea. Its inhabitants have a long history of map making of their turf. They call the land they walk on the Netherlands and they call the dunes their coastal defense. But their story is really about waterscapes.

### *Space and time*

*I see the infinite line between the steel-gray sky and the slate-gray sea. The sky and the sea bend together like two railway rails that never touch. The line does not exist. It takes an infinite distance for the air and the sea to weld together. And yet I only see a line. I cannot behold the infinite space.*

*Time is easier. Infinite time does not exist. Time is an upward curved line, like a cable going up the mountain. I compress the time just by looking further. The longer ago, the more it curves up and the more I can see at a single glance. The further back I step in history, the larger the steps. Up to a point. The further I look forward into the future, the larger the steps. Up to a point.*

*The beach under my feet washed up today. The beach is new, but the sand remains old. I look back towards the land. The dunes formed before the steam engine was invented. The swamp behind it grew before Stonehenge was built. The hills in the east were left by a glacier before people made fire. The further back I look from the waterline, the older the land. I turn back to the sea, which is the*

*oldest now. Wavelets weakly slop over my feet on the waterline. The sea has no interest in toes. A hot spot welds the sky to the earth. It only touches the sea once per day, when it is already extinguished. The name of our planet should not be Earth, but Water.*

## From 11000 to 8000 years ago: archipelago

The last ice age lasted until about eleven thousand years ago. There were only dry polar deserts south of Denmark, but no ice. The North Sea was dry land too. Around the current location of the city of Dordrecht, the Rhine and Meuse rivers left their valley and flowed to the south onto the present North Sea floor. They were joined by the Thames and Seine rivers and many smaller streams. A great and turgid river reached the ocean south of Calais<sup>1</sup>.

The ice age ended rather abruptly, and the sea rose rapidly. The air warmed and icebergs calved from the polar icecaps, splashing into the ocean to shatter and melt. Each century, the sea rose many meters. The Earth is a rather flat place and a sea level rise of 120 meters in the vertical is equal to a great expanse of lowlands in the horizontal. But it was not only the meltwater that made the sea level rise. Kilometers of icecap had weighed down the underlying crust of the continents. It had pulled the ocean waters to the south and they bounced back north. The crust bounced up over a few thousands of years after it was released of the weight. Scandinavia went up when the ice had melted, but the land further south went down while the sea went up. About eight thousand years ago the sea had flooded most of the North Sea and reached what is now called the Netherlands<sup>2</sup>.

The lowlands drowned fast. The waterscapes became the playground of tides and storms. Waves swept up sand from the seafloor and gradually worked it landwards. An archipelago of sandy islands grew out of the surf. The tides dragged the sand back and forth, but pushed more sand onto the coast than out to sea. The tidal wave steepened and toppled over a little bit in the shallow North Sea. The waters sped a little faster, but briefer, during the incoming flood than during the ebb. Slightly faster flow carries a lot more sand. So it was the sea that built the land from the sand that was left behind by the ice age rivers.

But there was no clash between the sea and the rivers. No grand delta was thrown up such as in the wrangle between the Nile river and the Mediterranean. The ebb and flood seesawed through the gaps between the islands. Behind the islands was neither land nor sea. Every day it flooded and dried, while storm waves already broke on the island shores. The sea brushed the sand towards the coast, and the river brushed sand and mud towards the sea. A low-relief picture was painted in water colours wherein both forces of nature had lost the power to dominate.

The land under water began to rise faster than the sea. But even the sand of the islands was yet barely land. It was a place to land, to keep looking over your shoulder, and to fly away from when the water came back. The islands washed over during storms. But they collected more sand and merged. And wader birds have very long collective memories. They rerun the waterlines and forage forever.

### 8021 BC

*Waves flush over the island. The air is dense when I steer towards the sea. I rest and float and plunge and leap back up. The sea breathes out and foams in fury. The island are on the move again.*

*The gale rushes the foam towards the lagoon, and unveils the sand. No worm or shellfish would be down there; they all burrowed down or turned to rotting squish. There will be shelter in the marsh.*

*I will come back when the wind abates. There will be Islands, and muddy flats that dry when the sea goes out. Then I will land and eat. It will even be cool while the reedy land is sultry.*

### From 8000 to 5000 years ago: land level rise

Then something special happened: the floodplains and the tidal flats filled up. The chief engineers were the marsh plants. They made the land creep out of the sea. They grew in shallow areas on the margins of the tidal flats. The sedge slowed the flowing water down, and wind waves were dampened too. The mud, suspended in the turbulent waters, settled down between the plants. The land level rose at the margins of the tidal flats. The sea had not stopped rising but the land rose faster<sup>3</sup>. But it was a soft and vulnerable land.

The barrier islands grew. But gaps between barrier islands were seesawed open by the tides. The tidal currents and the waves and the wind blew sand into the gaps but they would not close. Whole barrier islands moved slowly northward, but still the gaps did not close. The tidal inlets just moved along with the islands. The waters, stored in the inland seas during flood and released during ebb, were too voluminous. But the plants on the margins of the inland seas kept capturing mud. The land raised further and thus the plants pushed the waters out.

Tidal flats were replaced by saltmarsh and that left no room for the water. But not everywhere along the coast. Until this day it remains somewhat mysterious why the waterscape rose up in the west of the Netherlands, but not so much in the northern Wadden Sea.

The tidal currents lost their power and the gates of the sea silted up. The waterscape of the western lowlands had filled up with mud, armored and overgrown by plants. Plants piled up further to form peat that was watered by rain and occasional river floods. The rivers changed their courses tens of times. Today, ribbons of abandoned sandy channels still crisscross the delta plain like craquelure, sprinkled with orchards and villages.

The Dutch often boast that God created the world, but the Dutch created the Netherlands. But around four or five thousand years ago, the vegetated lowlands had grown larger than ever since. You may wonder how many engineering heroes hid amongst the Neolithic Dutchmen at the time the Dutch waterscape transformed to land. They ingeniously must have covered all their traces.

Hunter-gatherers occasionally foraged into the lowlands. One of them could have experienced the area around present-day Dordrecht as follows.

#### *4121 BC*

*Yesterday the river carried me. It smelt like iron with whiffs of moldy leaves. The river hardly noticed me with all the driftwood. The trees shoaled on the bars and stayed behind. I slid onto the slippery bank and there are reeds as far as I can see. The reeds bow in waves like rabbit fur when I stroke it. Ragged lines of brown banks are the bare-skinned seams.*

*Later that day the water nearly disappeared but instead the air was filled with birds. I could hear them trilling and yipping out above the susurrus of swishing reeds and humming bugs. The air is fat now. It tastes of shellfish. The birds poke into the mud like woodpeckers into the trees but I hear no tapping, only yips and trilling squeals. They show me where the crabs burrow that will do well on the cooking fire. The ground is soft and sounds like my hand in the belly of a deer after the hunt. The soil had not let all the water go.*

*Today I floated where the water went. Suddenly the plant fur broke up. Sand flats stretched out and turned white where the horizon could be. The sand was rippled like the carved wood of my canoe. Gullies remained where the water had rushed out. The cliffs looked as harsh as the valley walls of the river of a moon ago, but crumbled when I touched it with the paddle.*

*Wading birds hurry along the waterline. They fly up like clouds of mosquitos, but they go somewhere. I wonder how far their wings can carry them up. The water is too dark for my eyes to go down and see the fish. I am caught between the air and the water. My mouth is dry and salty. Waves begin to nibble at the canoe. The water turns back to the land and I follow, relieved.*

## From 5000 years ago to the early Middle Ages: shifting waterlines

The landscape greened. Thick layers of dead roots, stems and seeds collected. Peat domes arose. Rainwater fed the living plants. It was as densely vegetated as a tropical rainforest. The Rhine river changed its course occasionally. The sea rose a few meters, but much slower than before. The ice was long gone and the crust flexed but little in the afterthought. Yet the groundwater water rose and large inland lakes formed north of the hills that kept the rivers in their valley. The peat-covered land bridge between the Wadden Sea and the Almere lake broke open around two thousand years ago. The peat around the lake collapsed, the waves ate away the soft banks and the lake enlarged to a brackish inland sea. The north-east and south-west of the lowlands also flooded. Large sea arms opened up. The genesis of the Netherlands is a history of drowning.

But this is a riddle. Why would plants, that outgrew the fast rising sea of the early Holocene, suddenly desist when things quietened down? An invasive species began to make changes. It carried a different idea about what land should look like. It had no idea of its indirect effects. It inadvertently caused changes that were understood only thousands of years later.

The natural Dutch riverscape has been topped by fertile mud because of Neolithic hillslope dwellers. Forests were cut down, and no longer kept the mud on the hillslopes. It flushed down to the rivers. Since about three thousand years ago it arrived on the river floodplains, smothered the plants, buried and compacted the peat<sup>4</sup>. It wasn't a bad thing. The first civilizations were founded on the fertile fluvial waterscapes of the rivers Nile, Indus, Euphrates, Tigris and the Rhine.

Ditches purged the swamps of water and a drier, farmable land emerged. But water carried part of the weight of overlying mud and peat. Water inflated the soil like air inflates the lungs. Now the soil compacted. The peat dried out and disappeared into thin air. The land went down, slowly but irreversibly. The Romans drained large bogs along their northern border. With this prominence removed, the floods found the gap and the Rhine displaced again to fill it.

But farming people preferred not to be flooded. They threw up mounds to elevate their houses, and dikes to keep out river floods. Around 1100 AD, nine hundred years ago, a monumental plan transformed the land. Polders were enclosed entirely by dikes. Water authorities emerged, appropriately named 'Waterscapes' in Dutch, and exist until today. Nearly-abandoned river branches were closed off, and canals were dug to drain the swamps.

A brilliant mind had invented a one-way conduit which closed during flood and opened during ebb as to let out the drainage water. It was made from reused parts of a canoe<sup>5</sup>. This lowered the groundwater to the level of the ebb tide. At a meter lower than the natural groundwater level, it sped up the compaction of mud and the death of the peat. No new mud or sand arrived from rivers or the sea, but water seeped in. The conduits and ditches required maintenance.

## 70 AD

*The conduit broke again. The tide was high outside the dike. Water flushed in and nearly flooded the fields. The grain had just been sown. We had to block the conduit with hides and clay. When the water lowered we had five hours to repair it. The broken gate had to be unfixed and a spare put in.*

*The three of us stood in the ditch up to our hips and dived in turns. The pin in the pivot broke off and needed to be carved out. We rubbed our hands and clapped them on our backs to return the hot*

*blood. I had to pull my brother out when his legs went numb. The fat won't stick to him and he thinks too much.*

*The grain is safe again. Care and worry will go on as ever, but no need to walk on water yet.*

FIGURE one-way conduit Vlaardingen?

### The late Middle Ages: culture landscapes

The dikes and ditches with the one-way conduits became civilization's backbone. But, with the flooding's kiss of life smothered, they were also their bane. When you built the ring dike on the beach and the flood came in, the dike got soggy from the groundwater going through its toes before the collapse, long before it could have been overtopped. Wet feet happened and the dike did little to prevent it. In many places people took the material for the dike from the toe of the dikes. There was nothing to stop the groundwater from rushing in. They could only rush out themselves as much as the low tide allowed, and repair the dikes later. Maintaining dikes is a fight against gravity and time.

The city of Dordrecht was supplied by grain from the Groote Waard polder. People were required by their lords to maintain their stretch of dike. Thumbs or hands were cut off if they failed. But in the early fifteenth century there was also a civil war going on. Dordrecht was besieged and skirmishes took their toll. The dikes were not maintained well as imminent threats were looming. It was a disaster waiting to happen.

It happened four times<sup>6</sup>. In November 1421 a storm pushed up the North Sea against the Dutch coast. The storm surge breached the western dikes between the Haringvliet sea arm and the Groote Waard, and many other places in the lowlands. Later that same winter, the flooding river Rhine breached the northern dike of the Groote Waard. Now the people had a war on their hands between two lords and a war to fight against the river and the sea. The damage to the dikes was repaired, as it was on previous occasions. The river breached the northern dikes again in the winter of 1423. A second storm surge breached the western dikes again in 1424.

Many survived, but the luckless could not even run away on land and lost their bearings and lives in knee-deep water. The DRIELUIK painting in Dordrecht depicts people loading their goods into boats. There was time to save people, rescue cattle and salvage goods. There was even time to dismantle the churches in the villages to salvage the stone for use elsewhere.

The flooding river and the perpetual tides forged a connection through the polder. The tides seesawed in and out and carved deep channels. After the floods, the dikes could perhaps have been repaired again. But it did not happen and after a delay the gaps in the dikes had deepened. How does one repair a dike if the water is deeper than a man's height and rushes through at running speed?

The area was lost and the people left. The last person to leave may have looked out over the flooded polder from a church tower. He would perhaps have observed the following.

#### 1424 AD

*Halfway up the stairs are still wet. I twist further up the dank tower. My back aches and my feet are sore from this dismal day's work. I scan the horizon for the landmarks and ignore the stinging blisters of my hands on the wall. There is no sun. The wind has abated but clouds still rush to the east.*

*There is no land. There are only treetops, some rooftops, and the church towers of the other villages. The water shrouds the village. Gray roofs are sinking in gray water like overturned boats. There is no smoke anywhere. They say the dikes breached down by the sea arm this time. That is too far away to see or hear the tides surging through the breach. In the flood two winters ago the river scoured such an abysmal hole that it washed up the buried shells from the great deluge. The fish must be perplexed.*

*A carcass floats against a roof. I can hear the wind sigh through the tower. I hear the waves slopping against the church wall. I look down and smell the death of brackish waters. Somewhere below, the drowned were buried side by side with victims of the warring lords. My heart was buried twice.*

*The last rowing boat is waiting for me. It bobs on the water like Moses' basket in the Nile. The men beckon and I hold up my hand briefly. We saved the tools from the smithy and the silver cross from the church but the stores left behind will not last another day. We must catch the tide now and count the hands later. We must fish for food in the low tide tomorrow. Next week the lords might wage their wars over fishing grounds.*

FIGURE historic map Biesbosch Sgrooten

### Modern times: the highs and lows of the waterscape

A century after the area was abandoned, the Count of Holland and the Prince of Orange divided the fishing grounds in the area. The river was also a source of tax income. War vessels guarded the entrance at the location near Werkendam where the dikes had breached in 1424. Ships were forced to take the old river channel to Dordrecht for taxing. The Dutch trade and tax everything, even disasters. Tens of villages were lost and there were perhaps thousands of casualties. Many others survived. Paintings were painted to remember the flood as an unfortunate natural disaster. There was a baby floating around in a basket on the painting.

The river Rhine coursed through the former Groote Waard. The old branch silted up in decades. To this day, dredging ships suck out the sand so that other ships can pass. But most of the sand carried by the river bled into the former polder. The polder was wide and deep and the flow lost its power to carry the sand. A miniature delta formed within the Dutch delta. The delta spread out in a quarter circle like batter in a square baking tin. Within a century bars began to emerge during ebb when the river was low. In two centuries, the northeastern third of the former Groote Waard was filled by the sandy delta. The southwestern area filled with mud at a slower pace. The land level rose meters above that of the surrounding polders. But so did the river floods.

Nature ran its usual course. Plants settled on the Biesbosch delta. They were useful plants. 'Bies' refers to the reeds that were used for roofs of houses and chairs with rush seats. On higher grounds, willow, poplar and elder trees grew. Perhaps this is where the name 'bosch' comes from, which means bush or wood. While the trees had their uses too, they caused new flooding disasters. The trees on the Biesbosch delta not only captured more sand and mud. They also trapped the drift ice from the river. In cold winters drift ice piled up higher than the dikes. It dammed the river. Flood waters piled up and breached the upstream dikes. The storm surges and spring tides have continued to flood the land. In 1953 thousands of people drowned. Survivors of floods have to survive their nightmares for life.

Delta laws were made for dams and dikes. But rivers adhere to their own laws. The Law of Conservation of Trouble supersedes all others. The law works in downstream and upstream directions and onto the adjacent floodplains. The Dutch were good at drawing lines on maps<sup>7</sup>, but dikes are only soft lines in the sand of the real river. The trees on the delta in the Biesbosch were removed by hand once the upstream people found out about the law. A newly invented steam

engine dredged a canal through the Biesbosch to convey the river into the wide estuary. Crops grew again in the polder, but the old villages remain buried.

Dikes were built and rebuilt, but the river needed more room<sup>8</sup>. A hinterland covered in concrete and a river squeezed between dikes make for higher floods. The dikes in the Biesbosch were lowered again and houses were put on dwelling mounds as the Dutch had done in the early Middle Ages. The bloodletting lets the highest peak of the river leak out. The downstream cities are safe. Guaranteed by legal law until 2050. Nothing is certain in life, but experts now say that climate change is a higher certainty<sup>9</sup>. The people do not want to hear this. Had the Biesbosch been in the province of Zeeland, the costly dikes would have been reinforced and would be flooded anyway. Is there really a choice?<sup>10 11</sup>

2024

*Four choices, they said. Four choices they gave us. While they were safe behind the highest dikes and on the dunes, they dared suggest that we let the sea back in.*

*The dikes are safe. The dams are safe. We survived the great flood. My brother and father drowned when they tried to save the neighbors. We sat on the roof for two eternal days and nights until they came and got us. Those in the city did not lose anyone and they owe us.*

*They say the sea will rise. The polar caps are melting. But that is lies. The sea isn't rising. Astronauts saw that the Earth is getting greener. The plants take up the CO2 and grow faster. The creation is in equilibrium. We keep it in equilibrium, we begot children to populate the planet and we were promised to have no more floods.*

*Four plans they showed us. Two with dikes and that is fine. One to make the country greater and put a superdike in the North Sea. That won't happen. The ships need to come into port and the fish needs bringing in. Our dikes are fine. And then there is the devil's plan. Controlled retreat they call it. Giving up the land and all to become German. Did our families drown for nothing? It's a scam. They want to walk away from their responsibilities. They want to turn their back on us. But we survived before. They owe us.*

FIGURE four perspectives Delta committee

## The collapse of the icecaps

Troubled waters lie ahead. Floods enlarged as people smoothed the courses of the upstream rivers in the hinterland. Bad weather intensifies as people pump up the atmosphere with greenhouse gases. Heavy rains in future winters threaten to collapse the dikes again. And the sea will rise again. The ice caps did not melt entirely after the last ice age. Gargantuan flood waters have been kept in store. Tens of meters the seas would rise. The icecap of Greenland is already collapsing. If Antarctica goes down too, the sea may rise faster than it did after the ice age. It will take its time, but the rivers rise up with the sea and the Dutch will feel it from west to east and north to south.

Most people made their lines in the sand higher and stronger. In all the polders, chances of fatalities are specified in human laws<sup>12</sup>. Some offered the river another way out. The dikes of the Biesbosch were removed and farms were rebuilt on dwelling mounds. The river is allowed to flood between new and wider lines. It has to avoid the cities. The river obeys another law, without lines and fatality quota. One hopes it recognizes the compromise. This century, the river is the greatest enemy. But the sea will rise and will not go another way. The only way out of the sea is up the land. The land of the natural waterscape that has been compartmentalized by dikes and dams. These lines are high and strong as mountains and we feel safe. Their foundation is the soft and leaky waterscape.

Every child with experience on the beach knows what happens next<sup>13</sup>. Briny water will creep under the dikes and uphill through the rivers to poison the land and the drinking water. The lines we drew in the sand will breach one by one. Each event will be a sudden and unexpected major flooding disaster. The cause was forged by long dead ancestors with your names and mine. We put our lives on the line. Perhaps an heir of the Groote Waard villagers will stand on the ice-pushed hill and witness the wiping out of lines.

#### *2241 AD*

*The water is dark but near the horizon the little waves reflect a brittle blinding light. The sun sets as if it drifts to the end of the shimmering path on the water. I cannot fathom the depth. I really should go and find drinking water. And food. And shelter. The mosquitoes are drinking my boiling blood. But I am dazed and cannot look away.*

*The water just came and kept coming and never went. It filled the ditches and canals. It pushed the rivers out of their channels. It came out of the ground. It boiled and foamed over the roads. Roofs seemed to race on the water like boats keeled over, but it was the water going east. It looks calm now, but to the south tiny ships struggle against the ebb current.*

*I know the river is down there because of the beacons. I see the sea down there because I would have to turn my head around to see the land. I know it was my home down there. Dark towers, concrete silhouettes and hairy trees are scratched in the sky above the horizon. Below the skyline the earth is wiped out.*

*But the city center was often flooded before. We learned to live upstairs. Water came through the doors and out of the sewers but the stone and concrete buildings kept standing. So did we. Life went on after the cleaning. Either that or become climate refugees.*

*There is nothing concrete now. The sun is gone and the sky is overcast. The contours are washed out. Somewhere the air turns into water but there is no line. The cathedral tower looks sunken. I remember the beautiful bells and the banal songs they were made to chime. I wonder in what tongue our songs shall sound a lifetime away from here.*



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- <sup>7</sup> Paul van den Brink (1998) In een opslag van het oog: de Hollandse rivierkartografie en waterstaatszorg in opkomst, 1725-1754. Canaletto
- <sup>8</sup> Ruimte voor de Rivier maatregelen: <https://www.rijkswaterstaat.nl/water/waterbeheer/bescherming-tegen-het-water/maatregelen-om-overstromingen-te-voorkomen/ruimte-voor-de-rivieren/index.aspx>, zie ook <https://www.waterschaprivierenland.nl/noordwaard-stroomt-mee-ruimte-voor-rivier-verlicht-druk-op-dijk>
- <sup>9</sup> <https://www.ipcc.ch/>
- <sup>10</sup> Marjolijn Haasnoot, Ferdinand Diermanse, Jaap Kwadijk, Renske de Winter, Gundula Winter (2019), Strategieën voor adaptatie aan hoge en versnelde zeespiegelstijging. Een verkenning. Deltares rapport 11203724-004, [http://publications.deltares.nl/11203724\\_004.pdf](http://publications.deltares.nl/11203724_004.pdf)
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- <sup>12</sup> Staatsblad van het Koninkrijk der Nederlanden, Wet van 2 november 2016 tot wijziging van de Waterwet en enkele andere wetten (nieuwe normering primaire waterkeringen)
- <sup>13</sup> Rolf Schuttelhelm, Vrij Nederland 7 februari 2019, De zeespiegelstijging is een groter probleem dan we denken. En Nederland heeft geen plan B. <https://www.vn.nl/zeespiegelstijging-plan-b/>