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European Regional Development Fund

SARCC

Middelkerke Pilot Study: Report in Support of the Maritime Atlas

Middelkerke Pilot Study

Report in Support of the Maritime Atlas

Contents

1. Introduction

The Middlekerke scheme to install a soft sea wall in the form of a grass embankment (controlled dune) is one of seven pilot sites within the SARCC project that are developing Nature Based Solutions to coastal management in urban settings along the 2Seas coasts. Full details of the Middlekerke scheme are provided on the SARCC Website: https://www.sarcc.eu/pilots/middelkerke

This report concentrates on presenting details in support of the Maritime Atlas which considers how data from archaeology, paleoenvironmental material, historical sources, art, charts, maps and photographs can provide vital information on long term coastal change. This, in combination with datasets on storms, flooding patterns and sea-level changes, ensures schemes incorporating Nature Based Solutions for coastal management have the full benefit of hind-sight when planning for future changes.

Humans have interacted with the environment and landscape for thousands of years during which time the coastline has changed and evolved. The coast has been attractive for human use due to a wide range of social and economic reasons which include trade and defence, and in the last few centuries tourism and leisure activities. The resulting construction of settlements which have grown into urban centres and conurbations and their shoreside harbours, facilities and buildings have then required the establishment of coastal defences to prevent flooding and damage.

This report introduces the pilot area with Section 1 providing data on geomorphology, coastal processes and environmental impacts. The results of the results of the archaeological and palaeoenvironmental study and scoring are then presented (Section 2), followed by the maps and charts (Section 3) and then the pictorial resources – art and historic photographs (Section 4). The analysis of these results in combination as applied to the Middelkerke frontage then demonstrates the scale and rate of coastal change and is presented in Section 5.

1.1 Introduction to Pilot Study Area

The Middelkerke case study area is located in the central Belgian coastal region, it is between the urban areas of Middlekerke and Niewport (Figure 1). A study area of 1.5km around the extents of the pilot works (red area indicated in Figure 1) has been used for this study to assess a range of resources related to the history of coastal change. The Belgian coast is largely marked by a rigid coastline, consisting of a small strip of beaches, directly bordered by human reinforcements, sometimes intersected by dune sections. This rigid coastline only came into existence after the Early Middle Ages, due to human embankment activities. In the Holocene pre-medieval period, the coastline was characterised by barrier beaches with tidal flats extending landward. Successive human populations in the area have lived with and adapted to changing coastal circumstances.

In current times the coastal area to the west of Middlekerke requires the coastal defences to be strengthened again the 1,000 year storm possibility and due to sea level rise. The objective of the pilot is to replace the existing measures of beach nourishment with permanent investments. Based in a key tourist area there will be expansion of wave dampening measures, which will be a nature based solution to the threats faced. Between the surf club and the Noordzeelaan, a soft sea wall in the form of a grass embankment (controlled dune) will be constructed. With the controlled dune, it means that it height and visual impact can be designed.

The advantage of this nature-based solution is that its construction is cheaper than the traditional (hard structure) coastal protection. Through the grass dike, more greenery is added. The slope of the beach is extended and the zone closest to the current sea dike level is given a sustainable, controllable vegetation with marram grass and other retained species. It can also grow with future higher protection needs (sea level rise) and can provide much added value in terms of experience for tourists, nature and biodiversity.

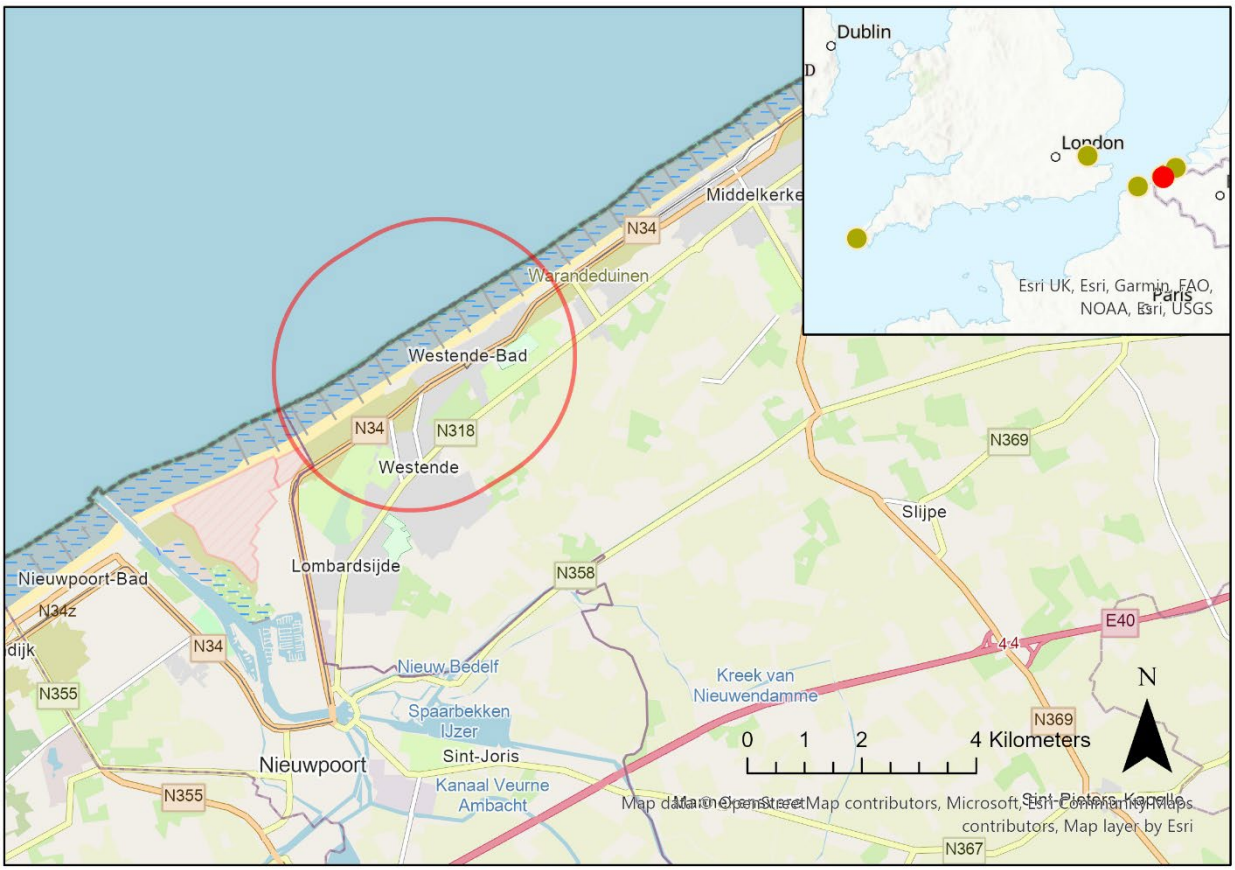


Figure 1: The location of the Middelkerke Pilot Study area, inset map shows Middelkerke (red) and the other SARCC Pilot Sites (green).

1.2 Geology, Geomorphology and Topography of the Pilot Area

Understanding the geology which underlies and influences the form of the coast and the geomorphological processes that have, and continue to, play a part in shaping the coast is important for providing context to the human use of the area and its long-durée. The summary presented below draws on previous work undertaken as part of the Arch-Manche project (https://archmanche.maritimearchaeologytrust.org/) with additional detail in relation to Middelkerke. Similar background information is also presented in the SARCC case study reports for Oostende and Blankenberg as they share comparative geology and geomorphology.

The pre-Holocene evolution of the Belgian coastal plain is highly intertwined with 4 major palaeovalleys: the IJzer, Ostend, Coastal and Flemish valleys. An overview map of these valley systems and the surrounding top-Pleistocene (i.e pre-Quaternary or top-Paleogene) surface of the Belgian continental shelf and coastal area is shown in Figure 2, with the position of the Middelkerke pilot area being indicated by the red circle on the left.

The shallow sediments of the area are made up of a highly variable (laterally and vertically) sequence of sand, peat, silt and clay layers that reflect the complex history of the Holocene during which marsh-like environments, sandy dunes, and intertidal mud- and sandflats alternated.

At that time the North Sea was dry land and large rivers incised the landscape. Gradually, river sediments were deposited in the valley. When temperatures started to rise at the end of the Saale ice age, the permafrost melted and the river started to incise even further. During the warmer Eem period (ca. 130,000 - 116,000 yrs BP) sea level rose again and the Ostend valley transformed into a tidally influenced estuarine area. It is then that it obtained its typical funnel shape.

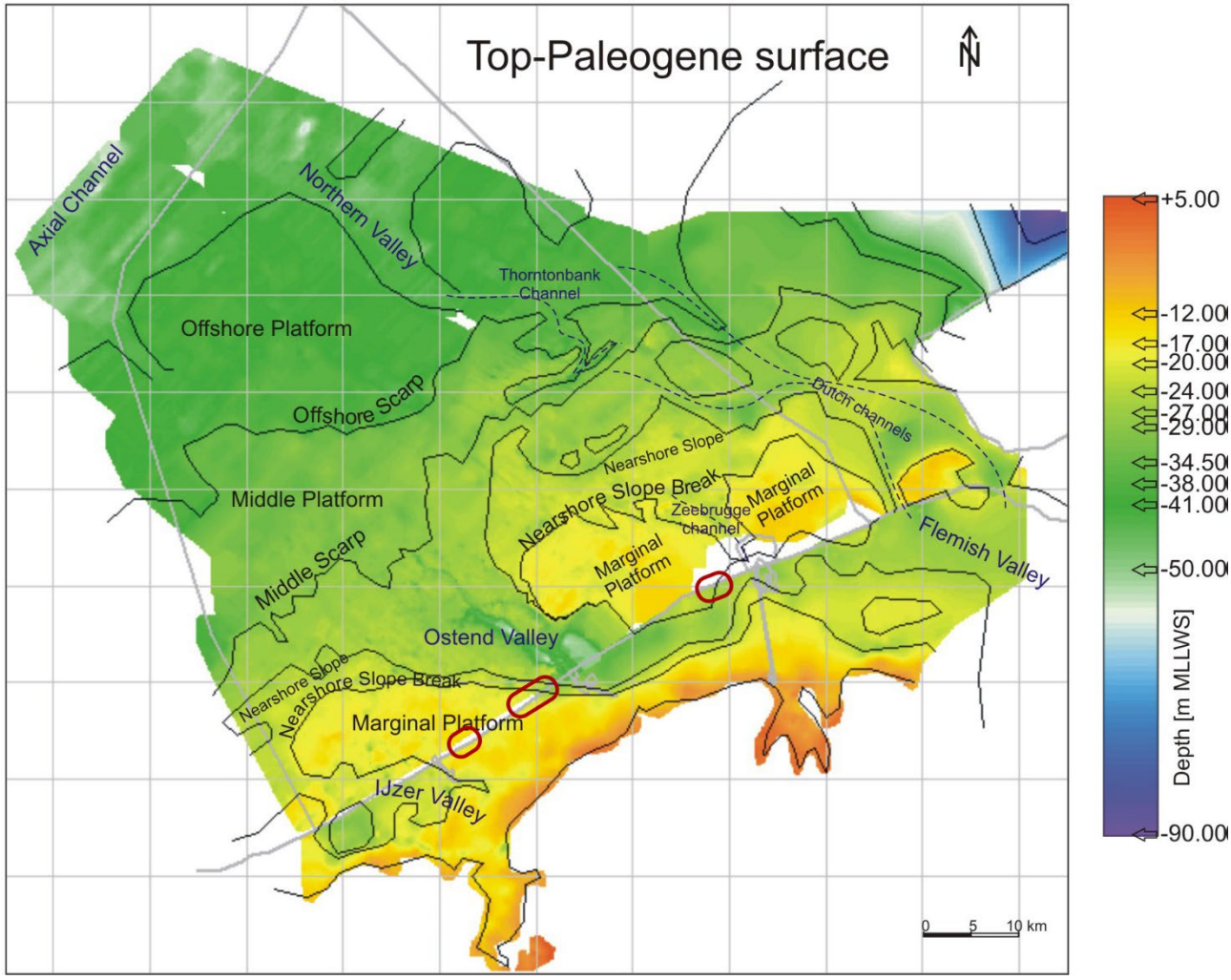


Figure 2: Belgian coast showing major palaeovalleys (the three Belgian SARCC case study sites are indicated in red).

During the Early Holocene sea level rose very fast and a large part of the Belgian continental shelf was already inundated. A large coastal plain came into existence, roughly 20-30 km offshore from the present coastline (See Figure 3). Because of the increasing wave action a large dune barrier system developed in front of the coastal plain. Behind the dune barrier, the coastal plain most likely consisted of a large (inter)tidal flat environment marked by constantly changing tidal channels, tidal flats and marshes. The landward part was most likely cut my numerous rivers that flowed towards the sea. Together with sea level rise also the groundwater level started to rise, and coastal peatland started to develop for the first time (so-called 'basal peat') (Baeteman, 2007) (see Figure 4 for a tentative reconstruction of changes to the coastal morphology over time).

Over the next 2000 years, sea level kept on rising fast and the coastline shifted further towards the land (green line in Figure 3). This caused considerable infilling of the tidal gullies with marine sand and clay. In the western part the sea intruded far inland. Around 7,000 yrs BP sea level rise started to slow down and the dune barrier system stabilised. This finally resulted in rising of the intertidal area to a level that prevented frequent flooding. For the second time, a fresh water marsh developed and peat growth was started (so-called 'surface peat') (Figure 4) (Baeteman, 2007; Mathys, 2009).

Around 5500 BP sea level rise slowed down even further, causing a constant accumulation and growth of peat. An extensive coastal marsh, characterised by reed vegetation, started to cover almost the entire coastal plain (Figure 4:c). In the west, in the area of the Middelkerke pilot, by this time the coastline was in a similar position to that of current day, having moved slightly seaward since 7,500PB.

The process was replicated along the Belgium coast, where by the middle of the 2nd millennium BC, modelling by De Clercq shows how the land at the mouth of the Ostend valley extended a further 10km out to sea when compared with the contemporary coastline, while, coastal peat marsh stretched almost 20km inland (Ervynck et al 1999; De Clercq et al 2013; Baeteman 2013). Progradation of the coastal zone in the region continued until the end of the first millennia BC when a stable equilibrium might then have been established if it were not for human influence.

Over the next 2000 years peat growth expanded over a vast area. Around 2,500 yrs BP peat growth started to slow down. Tidal channels cutting through the marsh were now becoming eroded by enlarged precipitation run off from the hinterland (due to climate change and deforestation). At the fringes of the tidal channels, the peat eroded completely, causing drainage of the peat layer and subsequent lowering of the surface (ca. 1 to 1.5 meters). Due to this compaction, the fresh water marsh was converted to an intertidal area again. By 1,500 BP the peat growth comes to a definitive halt (Baeteman, 2007).

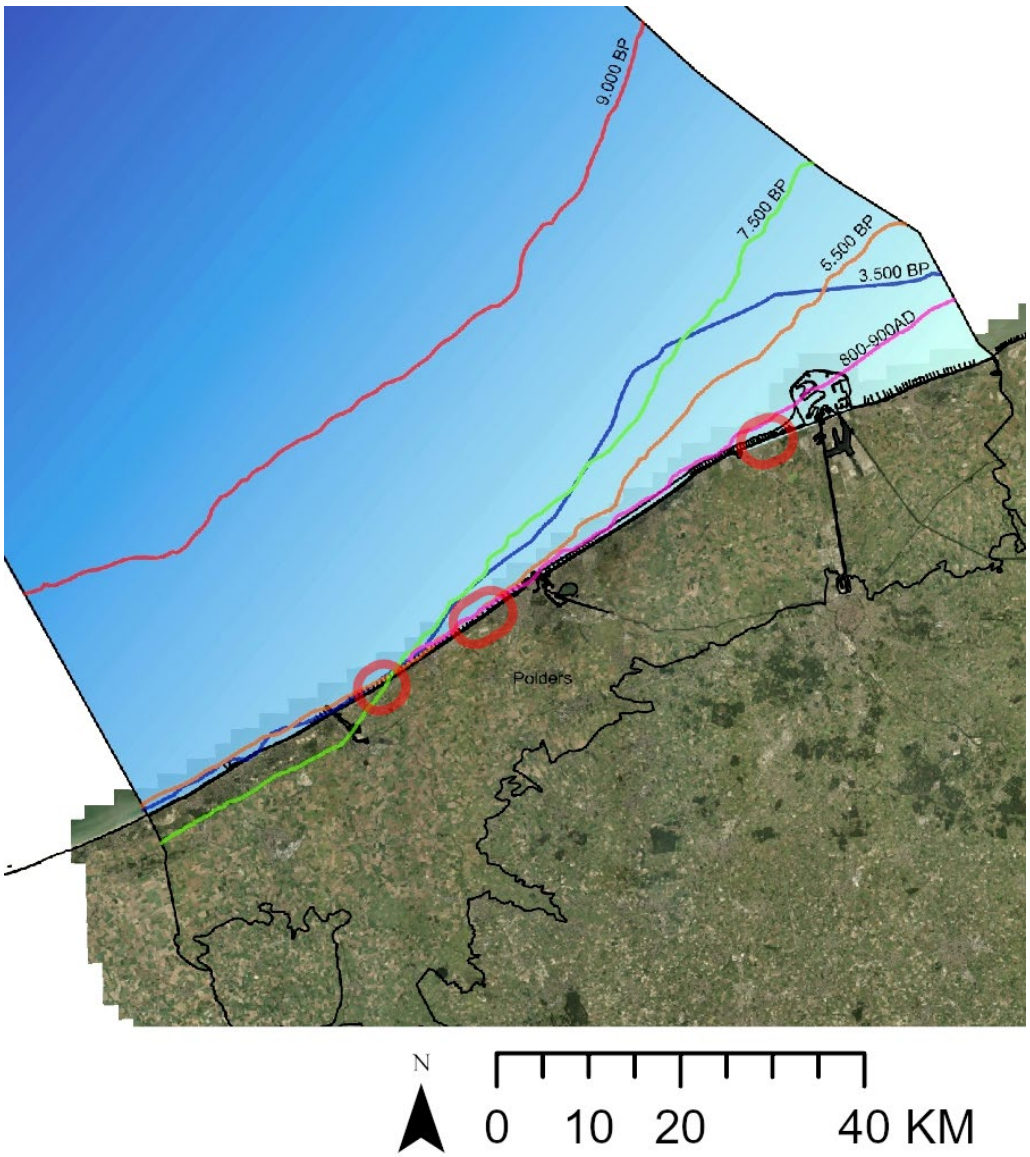


Figure 1: Schematic evolution of the Belgian coastline during the Holocene (De Clercq, 2013, after: Mathys, 2009). The red circles mark the position of the SARCC pilot areas.

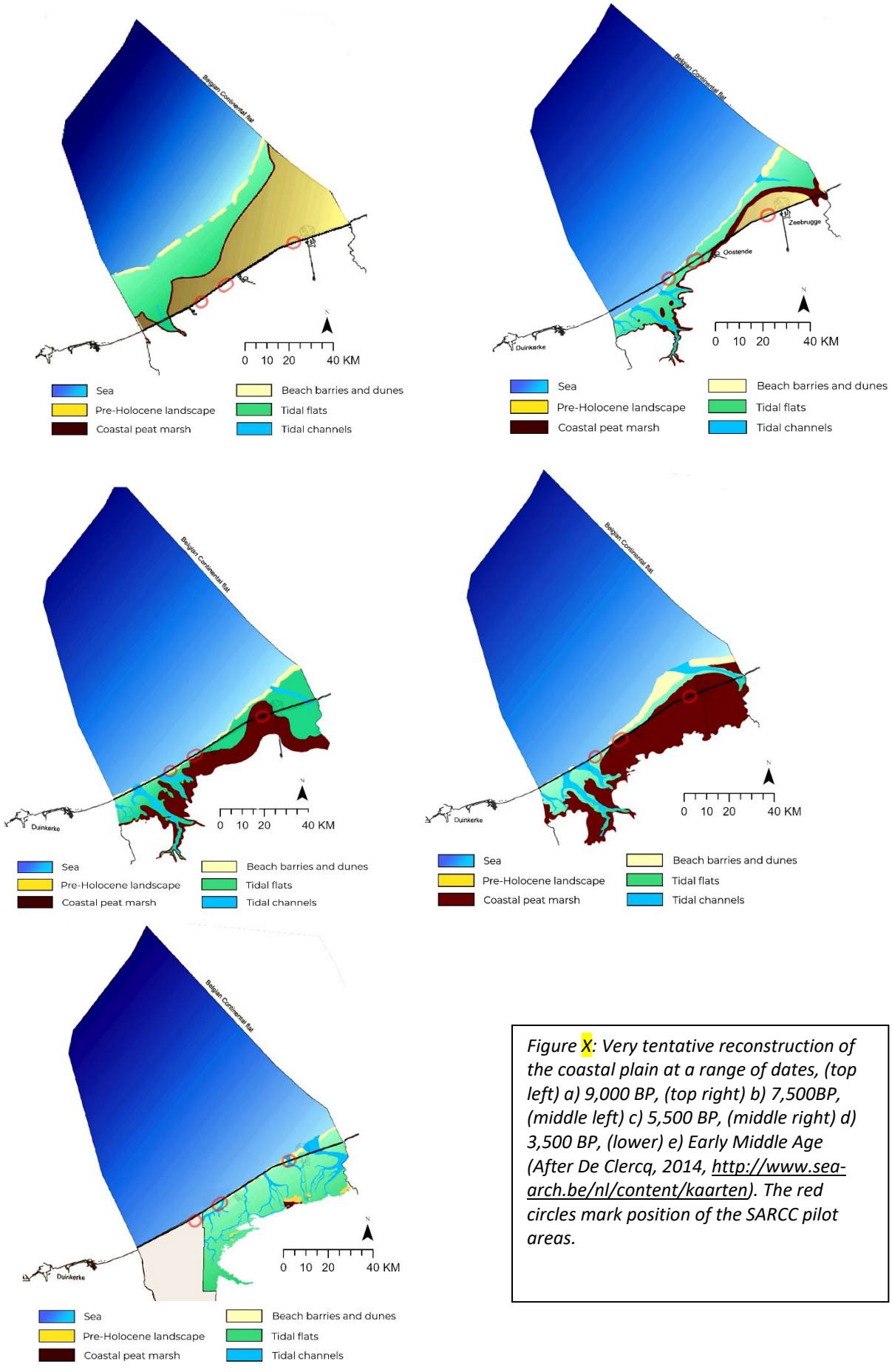


Figure X: Very tentative reconstruction of the coastal plain at a range of dates, (top left) a) 9,000 BP, (top right) b) 7,500BP, (middle left) c) 5,500 BP, (middle right) d) 3,500 BP, (lower) e) Early Middle Age (After De Clercq, 2014, http://www.sea-arch.be/nl/content/kaarten). The red circles mark position of the SARCC pilot areas.

During the Iron Age and Roman era, to the east of Middelkerke, the sea was located a few miles offshore from today's coastline and an area of sandy dunes formed the border between sea and land. The area behind the dunes was marsh-like and crossed by numerous creeks and tidal gullies.

From the Roman period onwards the coastal plain noticed a growing human influence. Drainage and peat extraction further caused the surface to be lowered. After the Roman period the sea slowly progressed more inland, and a tidal flat was again installed in almost the entire coastal plain (Baeteman, 2007). It has been suggested that this increased tidal activity was possibly the result of increasing neglect of the water management systems during the late Roman period (Ervynck et al., 1999).

Although coastal changes have been more stable from the Early Middle Age, from Figure 4:e, it is clear to see that Middlekerke is situated on an area of the coast that continues to be influenced by tidal channel systems as well as marine conditions. Evidence of human occupation and use of the coast helps understand these changes at a micro scale as it can reveal the specific topographic and environmental conditions at a particular time, which can be attributed through scientific dating techniques.

1.3 Storms and Flooding Patterns

The relationship of humans to the coastline and their use of the area, whether as seasonal areas, or for more permanent occupation and building is influenced and impacted by storms and flooding patterns. A review of the patterns of these over time from known historical sources provides a useful background to understanding both the impacts on human populations and damage to associated structures, and on the morphology of the coastline.

Middelkerke is situated in a low-lying coastal basin plain. Flooding along the Flanders coast is commonly caused by storm surges, the result of storm winds above the North Sea, or by the overwhelming of its dense network of rivers following periods of heavy and prolonged rain. Between 200-650 AD, three periods of marine transgression (see Figure 5) made large parts of the low countries uninhabitable. The worst, Dunkirk II 350-700 AD, submerged northern France, Belgium, the Netherlands and parts of Denmark. Evidence from soil surveys together with the lack of archaeological artefacts suggests that these areas were underwater between the mid-third-century and c.1050.

The following significant storms and flood events in Flanders have been recorded:

- 1375, 8th October, a storm caused widespread flooding in Zeeland and Flanders.
- 1394 The St Vincentius storm surge destroyed many settlements along the Flanders coast, including Middlekerke, Ostende and Walraversijde.
- 1404, St Elisabeth's Day Storm (19th November) caused catastrophic flooding in Flanders, Zeeland and Holland. In Flanders all the coastal islands in the mouth of the Westerschelde were washed away. The Duke of Burgandy, John the Fearless, ordered that all the existing dikes were linked to create one long dike running the length of the county, creating the straight Belgian coastline we know today.
- The weather during the 16th century was particularly stormy. At least seven storm surges were recorded: 1509, 1511, 1530,1532, 1552, 1570, 1594.
- 1570 All Saints Flood (1st November) - despite the first ever flood warning being issued, little could be done to prevent the national disaster caused by the All Saints Day flood on the 1st November, 1570. The collapse of numerous dikes resulted in flooding of the entire coast between Flanders and Groningen, up to the northwest of Germany. The Duke of Alva informed King Phillip II that 'no less than five sixths of Holland were underwater'. Thousands of people died, tens of thousands were left homeless and livestock and winter supplies were destroyed.
- 1703 The Great Storm, the famous windstorm which began on the 26th November and was recorded by William Defoe, caused flooding and destruction throughout Belgium, Netherlands, Germany, Denmark and UK.
- In 1714, three storms in quick succession 26th February, and the 2nd and 7th March, caused damage and flooding along the coast of Flanders and Zeeland.

- 1715, 3rd March, a major storm surge hit the same area causing widespread flooding, one of the severest storm surges of the 18th century.
- 1808, 15th January, a storm surge combined with a severe gale hit the Flanders– Zeeland area, causing flooding in many areas.
- 1906 A large storm surge on the 12th March caused considerable damage in Zeeland and Flanders.
- 1953 The North Sea Flood. A storm on the 31st January combined with high spring tides, developed along the coasts of the UK, Belgium and the Netherlands. Photos exist showing Middelkerke underwater.

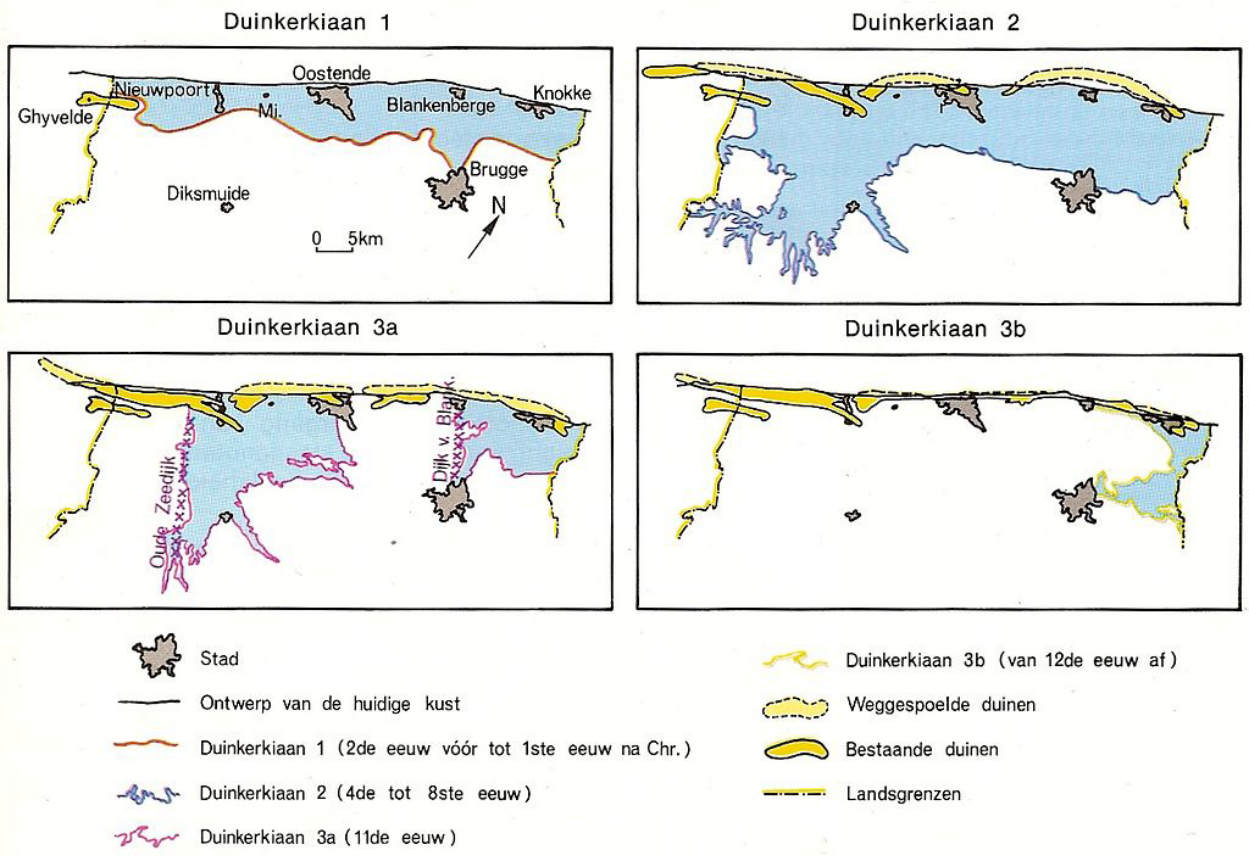


Figure 5: The three phases of Marine Transgression by J. Amerijckx en F. Depuydt - Fysische Bouwstenen voor de mens, Taken Aardrijkskunde 5, CC BY 3.0 nl, Source: https://commons.wikimedia.org/w/index.php?curid=5078044 Accessed 07/07/2021

In recent decades, the frequency of flooding in Belgium has increased. Major floods occurred in 1995, 1998, 2002, 2003, 2005, 2007, 2013, 2016 and 2020.

- 2007 - The North Sea flood of the 8th November 2007 was caused by the remnants of Hurricane Noel combining with a storm surge, affecting the coastlines of northern and western Europe.
- 2016 - In late May and early June 2016 flooding began after several days of heavy rain in Europe. In Belgium four days of torrential rain caused the rivers to flood.
- 2010 in November, Belgium experienced its worst flooding and mudslides in fifty years as extratropical Cyclone Carmen hit.
- 2013 A storm caused major damage to the beaches and flooding in the port, many houses were flooded as the drainage systems could not cope.
- 2020, In September, Storm Odette hit West Flanders. In Middelkerke, cars parked near the beach were buried in sand, the tramline could not run due to the rails being buried and beach huts were blown over on the beach.

1.4 Current Environmental Impacts/ Threats & Management Approaches

The Belgian coast is one of the regions directly impacted by climate change. The sea defense is formed by only a small strip of land, which is in most areas strengthened by sea dikes and other "hard" structures, leaving little space for natural responses to, for instance, storms or sea level rise. The Flemish government is aware of these threats and in the early 1970's breakwaters were constructed at regular intervals along the coast to protect the beach from erosion.

The Flemish Government approved the Master Plan for Coastal Safety in June 2011. That proposes a series of measures to protect the 67-kilometre-long coast against a 1000-year storm surge. In the Master Plan, all flood risks are established and the risk zones charted. For each risk zone, measures and possible alternatives are studied. The emphasis is primarily put on the realisation of the chosen measures necessary to ensure the coastal safety until 2050. Thereby the expected rise in sea level is being taken into consideration.

Flood risk calculations of the Coastal Safety Master Plan show that there are major risks for victims and damage caused by flooding from the sea in Middelkerke. Tackling these risks is therefore a priority. This weak zone extends from Westende, part of Middelkerke, to Middelkerke.

2. Archaeology & Palaeoenvironmental Resource Scoring

This section provides initial background to the palaeoenvironmental, archaeological and historic development of the area surrounding the Pilot Project to put its development into longer term context. It then presents the results of the scoring of a range of sites, buildings and features within the pilot study area to identify those which provide the most potential for informing on the scale and pace of coastal change.

2.1 Archaeology and History of the Pilot Study Area

Evidence from prehistoric periods through to modern day includes a wide range of traces of the environmental changes through preserved deposits and land surfaces in addition to the many finds, traces of buildings and burials through to historic development of coastal hamlets then towns. This evidence provides the long-duree of human use and occupation at the shore, including how people have both influenced coastal change through structures and have themselves been impacted through storms and coastal changes.

Prehistory

The first mention of Middelkerke occurs in 1218. Prior to this, occupation in the area centred around nearby Raversijde (4km north-east), where archaeological findings on the beach date back from the final-Palaeolithicum (14,000-12,000 yrs BP) to the Neolithicum/Early Bronze Age (around 4000 yrs BP). In the surface peat layer a wooden paddle, dating back to 5000-2800 BP was found (Demerre et al., 2013; Pieters, 1992). Numerous artefacts found at the Raversijde site date back to the Roman period. Next to pottery, waste pits, and ploughing traces there were also traces of peat and salt exploitation found (Demerre et al., 2013; Thoen, 1978; Pieters et al., 2010).

The remains of a Roman dike were discovered (Figure 6 Pieters et al. (2013)). The dike is mainly built of stacked clay blocks, on its western side reinforced with peat blocks. The dike is oriented roughly perpendicular to the present coastline, which suggests that its purpose was most likely to embank a tidal gully that stretched further inland. Until the 1970's these intertidal remains were still visible on the beach, but beach suppletion works and groin construction has resulted in them being buried several metres by sand.

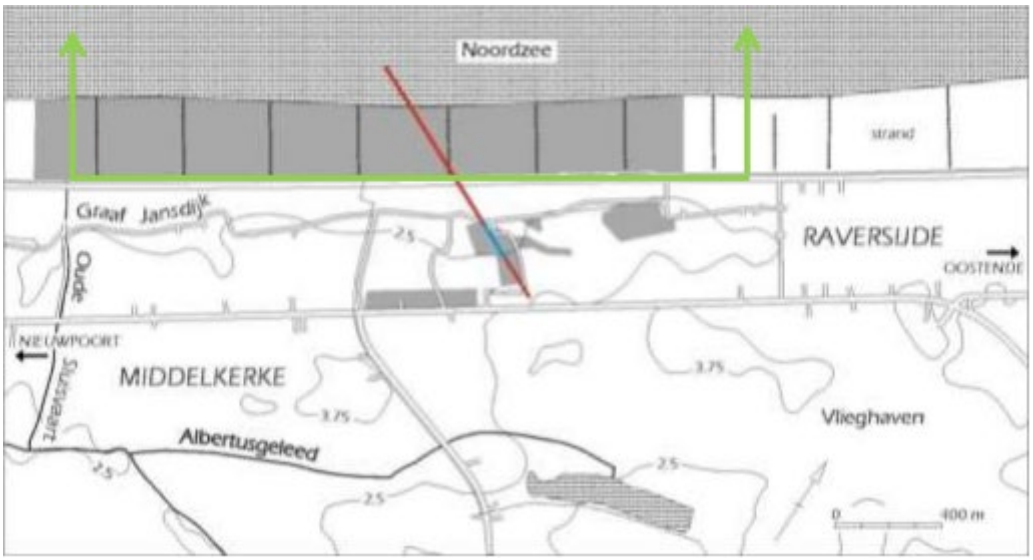


Figure 6: Map of present-day Raversijde. The blue line marks the remnants of the Roman dike that was excavated, the red line represents the possible continuation of the dike (Pieters et al., 2013).

Roman

As the first marine transgression began to displace people early in the first century AD, Germanic tribes invaded Flanders, where they settled as farmers and began to trade with the Mediterranean. Julius Casear referred to the inhabitants of Belgium, North Western France and the German Rhineland as the Belgae and considered them part of Northern Gaul. There is relatively little evidence of Roman activity in Belgium, the only Roman administrative capital was at Tongeren, 190km east of Middelkerke.

At nearby Oudenburg (15km east of Middelkerke), a roman vicus developed in the middle of the first century, but was submerged during the second Dunkirk marine transgression in the second half of the third century. The remains of wooden houses, pottery and other artefacts have been found during excavations. As the waters regressed, leaving the new coastline north of the old vicus, a castellum was built on top of the ruins, part of the Litus Saxonicum defence system. The remains of three successive castella have been discovered. A roman road linked Oudenburg to Blicquy and Bavai, and other roads probably led to Cassel and to Bruges and Aardenburg. Soil analysis revealed that at the end of the third century, the castellum was located on a slightly raised sandy strip, surrounded by a lagoon. Other small fortifications and watch towers were likely to have been constructed all along the coast. Today, Oudenburg is 8km inland.

Middle Ages

The first mention of Middelkerke occurs in 1218. A that time, Middelkerke was in the middle of the Testerep, a coastal island (see Figure 7). Fishing villages at either end, Westende and Ostende, are mentioned earlier in 1087. Written sources indicate that villagers along the coast fished, traded salted fish and other goods. Peat was extracted to produce the salt.

Testerep was a salt marsh spit, naturally created by tidal action in the fifth and sixth centuries. The island was owned by the Counts of Flanders and rented to the Saint Pieters Abbey of Ghent. The island was separated from the mainland by a tidal gully (the Testerepvliet) that was completely submerged at high tide. In the tenth century, a natural dune belt developed that protected the island from the sea and encouraged settlement. Shepherds and fisherman moved onto the island, and the town of Middelkerke began to develop. By the twelfth century, the Testerepvliet had been reclaimed and Testerep was part of the mainland.

Figure 7: Map of the medieval island "Testerep", with the most likely location of Walraversijde indicated in red (http://www.oostende.be, 5/8/2014)

Peat extraction, land reclamation and the creation of dikes adversely resulted in rising flood levels. The grant of city rights in 1266 further added to the problems. The resulting expansion included a systematic flattening of the natural dune belt and the widening of the tidal channel in 1284. As a direct result, parts of settlements were destroyed by the Christmas Eve flood in 1330, and three years later in 1334, the whole island was inundated following the St Clements storm. The St Vincentius storm surge in 1394 wiped out all the settlements on the Testerep including Middlekerke, Ostende and Walraversijde. Storm surges in the fourteenth and fifteenth century completely submerged the northern half of Testerep as the coastline retreated more than 1km. the coastline has remained in more or less its present position since the 16th century.

Towards the end of the fifteenth century, the region became politically unstable and mercenaries plundered the coast. Combined with increased stormy weather and flooding, much of this area became uninhabitable. By 1598 sources record how wasted the area had become.

Since 1992 detailed archaeological investigations have been carried out in the polder area behind the present dike. Excavations revealed two phases of occupation. The earliest site on the beach inhabited between 1200-1400 and the new village built on a polder inhabited between 1400-1600. The final abandoning of the village in the 15th century was a gradual process, induced by flooding and war (Tys 2013). The Walraversijde Museum houses the artefacts recovered and has many reconstructed buildings and scenes depicting life in the medieval fishing village, that would also have been typical of life in Middelkerke and Westende (Figure 8).

Figure 8: Reconstructed buildings at Walraversijde 1465 (Source creative commons https://commons.m.wikimedia.org/wiki/File:Walraversijde_1465_-_368372_-_onroerenderfgoed.jpg)

Modern

Flanders experienced a Golden Age of prosperity in the sixteenth century. During this time, canals and dykes were built to join Testerep to the West Flanders mainland. However, until 1876, Middlekerke remained primarily a farming settlement.

Towards the end of the nineteenth century, the area of Middelkerke-Bad developed as a seaside resort, with the majority of tourists arriving from England on the Dover to Ostende ferry. Between 1875 and 1910, the population increased fourfold. In 1875, the first temporary Zeedijk was built. The seawall at Westende-Bad was built in 1898. Between 1904-1911, the Zeedijke at Middelkerke was rebuilt and hotels were constructed all along The Strand (Figure 9).

The First World War was catastrophic for both Middelkerke and Westende-Bad. Middelkerke fell under German occupation, with the Western Front only a few kilometres away. The inhabitants fled the city. Trench maps record the locations of trenches, observation posts and gun emplacements. Only the 1909 Belle-Vue hotel (De Rotonde), designed by the famous art-nouveau architect Octave Van Rysselberghe, survived (Figure 10). Every house was damaged. Post-war, Middelkerke and Westende were reconstructed and once again attracted tourists. The royal family and their court frequently stayed at the Belle-Vue Hotel during the Interbellum. The Villa Les Zéphyrs in Henri Jasparlaan street are a surviving example of an opulent holiday home of the Belle Epoch, built in 1922 and in use until 1940. A number of photos available from the online the Image Bank Kusterfgoed record the war damage inflicted (Figure 11).

Figure 9: View of the beach and the Koning Ridderdijk with the Westend'Hôtel in Westende. Sent on July 29, 1911. Source https://www.beeldbankkusterfgoed.be Accessed 12/06/2021 no rights known.

Figure 10: La Rotond, the only building in Middelkerke to survive the First World War unscathed (Source: Google maps)

Figure 11: Corner of the Zeedijk and the Jean van Hinsberghstraat in Middelkerke after the First World War (Source: https://www.beeldbankkusterfgoed.be No rights known).

During the Second World War, Middelkerke was on the defensive line of the Atlantic Wall. Gun batteries were built along the coast from Raversijde to Zwin, including at Middelkerke, interconnected by trenches and barbed wire. Most above ground structures have since been removed, although some are preserved and postcards dating from both wars exist as a record (Figure 12). A subterranean German bunker was recently discovered during the construction of the new casino.

Periods of reconstruction after both wars, saw the towns expand, with much new construction and increasingly higher buildings appeared and spread further along the coast in both directions. The height of tourism occurred between 1945-1960. Post war reconstruction set the foundations for the seafronts as they exist today, as popular areas for recreation and tourism.

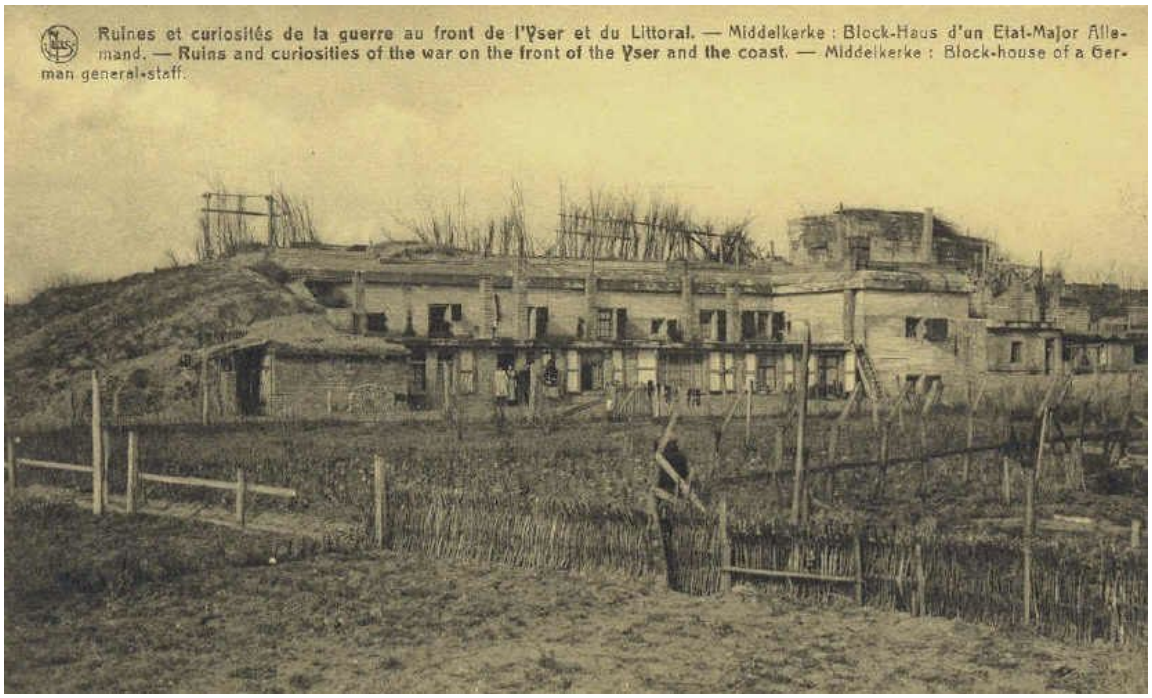


Figure 12: Postcard of the 'Ruins and Curiosities of war' (Source: https://www.greatwarforum.org/topic/46815-middelkerke-flandersbelgium/)

2.2 Results of Archaeology scoring

This section outlines the results of the archaeological and palaeoenvironmental scoring from the Middelkerke study area, followed by a discussion of the results. The scoring methodology applied is detailed in *SARCC Maritime Atlas: Methodology Report* (MAT 2022). It should be noted that the scoring is not providing any measurement of historic or cultural significance of a site, only its potential to inform on coastal change.

Within the pilot area data was obtained from Belgian online heritage databases and available reports and publications. Where data indicated there were sites with potential to inform on past change then further research was required in order to understand the full nature and extent of the site. A total of 51 sites were assessed and scored.

The highest combined scoring sites are shown in Figure 13 and listed in the table below, the total score has been normalised to give each site a score out of 100. It is possible for a site to score highly in one of the three scoring categories and still be important for informing on coastal change over time. The combined approach identifies those scoring highly across the scoring categories.

ID	Site Name	Period	Score-Sea Level	Score – Enivronmental	Score – Temporal Continuity	Total Score	Coastal Context
4864	IJzermonding en Sint-Laureinsduinen (Yser Estuary and Sint-Laureinsduinen (Covers some of pilot area)	Early Middle Ages	High	High	High	100	Above high water
3710	Middelkerke borehole information	Middle Ages - Modern	Medium	Medium	Medium	66	Above high water
4998	Steunpunt Seydlitz (Support center Seydiltz)	Modern	Medium	Medium	Medium	66	Above high water
3712	Site of moat Middelkerke	Early Middle Ages	Medium	Medium	Low	55	Above high water
3715	Guard House	Modern	Medium	Low	Low	44	Above high water
5046	Duitse observatiebunker/vuurleidingspost (German observation bunker/fire control post)	Modern	Medium	Low	Low	44	Above high water
5210	Kinderhome	Modern	Low	Medium	Low	44	Above high water
5256	Dorpskom Westende-Bad (Village District Westende-Bad) https://inventaris.onroerenderfgoed.be/erfgoedobjecten/302298	Modern	Medium	Low	Low	44	Above high water

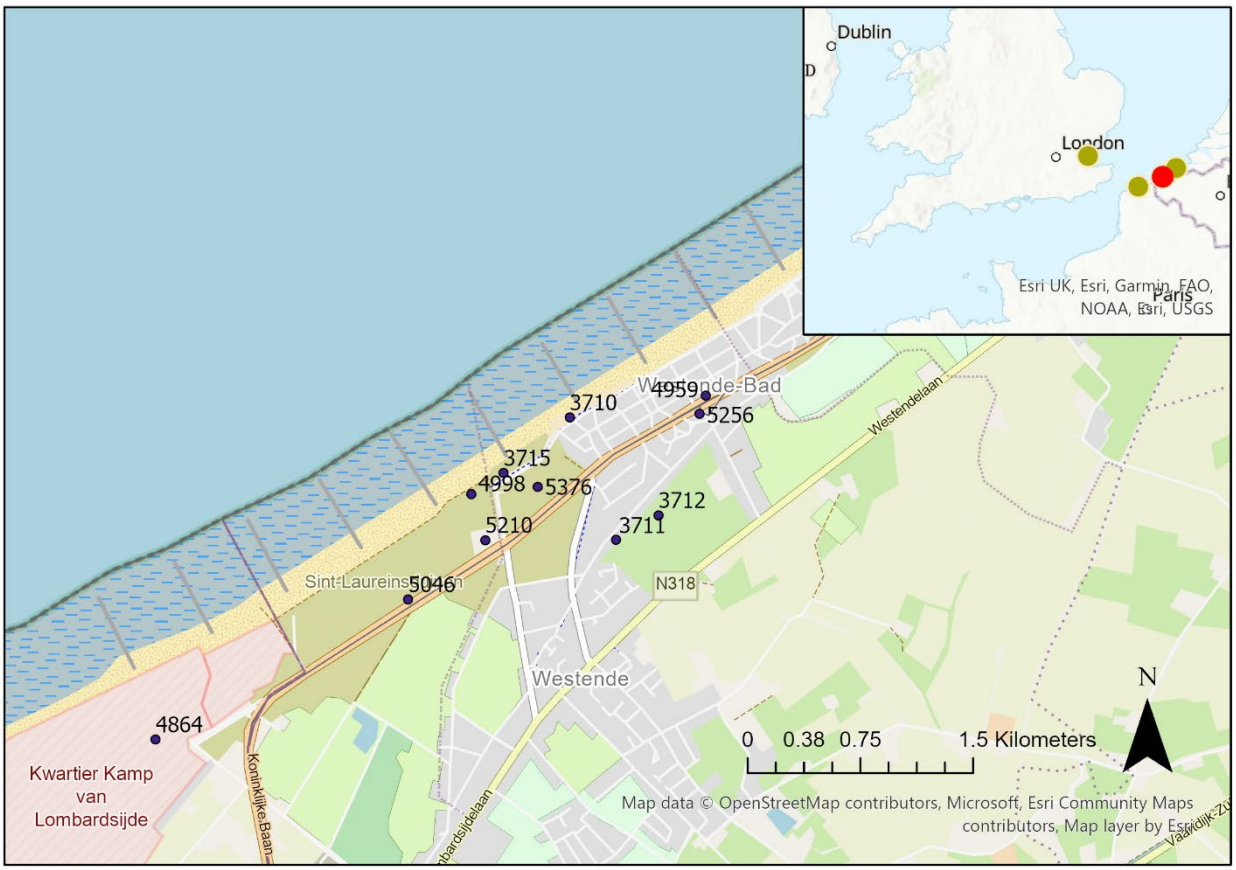


Figure 13: Position of high scoring archaeology sites within the Middlekerke pilot study area.

2.3 Discussion of scoring results

The majority of the top scoring archaeological and palaeoenvironmental sites are located in the dunes/former dune area. The top scoring site, the Yser Estuary and Sint Laureinsduinen (ID 4864) (Figure 14) marks the former Terestep, an island separated from the mainland by a creek. Before the 12th century, a dune front developed on this salt marsh area, making habitation possible. This anchorage contains the complete sequence, from beach and dunes to polder and a mud flat and salt marsh near the mouth of the Yser and is representative of how the whole coastline from Ostende to Nieuwpoort was before development.

The natural geomorphological flooding processes here are hindered by human interventions such as land reclamation, dikes and buildings. The trench map of 1917 shows the military impact of defences built into the dunes during the First World War. These defences were extended in the Second World War with the construction of the Atlantic Wall defences running the length of the coast. This is clear to see in the 1937-1942 map (both maps are held by the National Library of Scotland). During the Second World War, a low dike was built to separate the beach from the dunes as part of the Atlantic Wall. This remains today, as do a number of other military structures built into the dunes such as Support Centre Seydlitz (ID 4998) (Figure 15) and a German observation bunker/fire control post (ID 5046). These military remains have been preserved, but many others were demolished in the early 1980's.

Figure 14: (ID 4864) Mud flats and salt marshes at the Yser estuary. (Source: https://id.erfgoed.net/images/223754)

Left Figure 15: (ID 4998) Support centre Seydlitz (Source https://id.erfgoed.net/images/17959 Vandevorst, Kris op 01-01-2004 free reuse, Attribution 4.0 International.)
Right Figure 16: ID 5046 German observation bunker/fire control post. (Source: https://id.erfgoed.net/images/17961 Vandevorst, Kris 2004 free reuse, Attribution 4.0 International.)

ID 3710 refers to borehole data and archaeological excavations in this area in 2016 which uncovered the remains of a mill and a moat (ID 3712), together with traces of a trench, bomb craters, guardhouses (ID 3715) and a crashed German WW2 fighter plane (The Archaeological Evaluation of Soil Archive Middelkirke Report, Centrale Archeologische Inventaris).

Other non-military buildings were also constructed in the dunes. In 1887 an Entrepeneur from Brussels, Mr Edouard Otlet, bought the dunes at Middelkerke and Westende with the intention of creating an elite holiday resort (ID 5256). ID 5210 records the presence of a former children's home built into the dunes in 1900.

2.4 Photographic Survey of High Scoring Features

Some of the sites and features that scored highly are in existence today and can be viewed/ visited. A site visit was undertaken to capture current day images of the coastal frontage, examples are included below (Figures 17 – 20). These can now be used to directly compare with other available resources to demonstrate the extent to which there have been changes to the coastal frontage.

Figure 17: The modern day coastal frontage where buildings directly boarder the coastal frontage.

Figure 18: Buildings and paving have replaced the dunes along the sea front. MAT 2021.

Figure 19: Small sections of dunes remain in breaks between the buildings.

Figure 20: A larger section of dunes remain to the east of the Middelkerke pilot area.

3. Maps and Charts

This section provides a background to the development of maps and charts over time which have relevance for the area surrounding the Pilot Project. It then presents the results of the scoring of a range of maps and charts which cover the pilot study area with details that allow them to help demonstrate changes to the coastline over time.

3.1 Maps and Charts Background

Prior to the Middle Ages, early maps were little more than a sketch of a small area, accompanied by a more detailed written report. In the fifteenth and sixteenth centuries, more traditional maps began to appear, but were usually drawn by artists and were of a pictorial nature. Focusing on the location of towns, castles and fortifications, rivers, lakes and woods, these large works were commissioned to be displayed in palaces and

castles. It wasn't until the mid-sixteenth century when systems of survey and measurement were introduced, that the potential of maps as reliable tools for a variety of purposes was realised. Local surveying and map making developed in the Southern Provinces a century earlier than in the Northern Provinces. The oldest surviving property map of a piece of land in Flanders dates to 1307.

Very few historical maps specifically of Middelkerke exist, but it is depicted (not named) by a church on this early pictorial map by Pieter van der Beke dated 1538 (Figure 21). Ostende and Nieuwpoort are shown as harbours. This map reflects the defiant independence of the Flemish cities against Spanish rule, containing heraldic shields, a genealogical log and the four bears representing the oldest families. The map was produced on four wooden sheets.

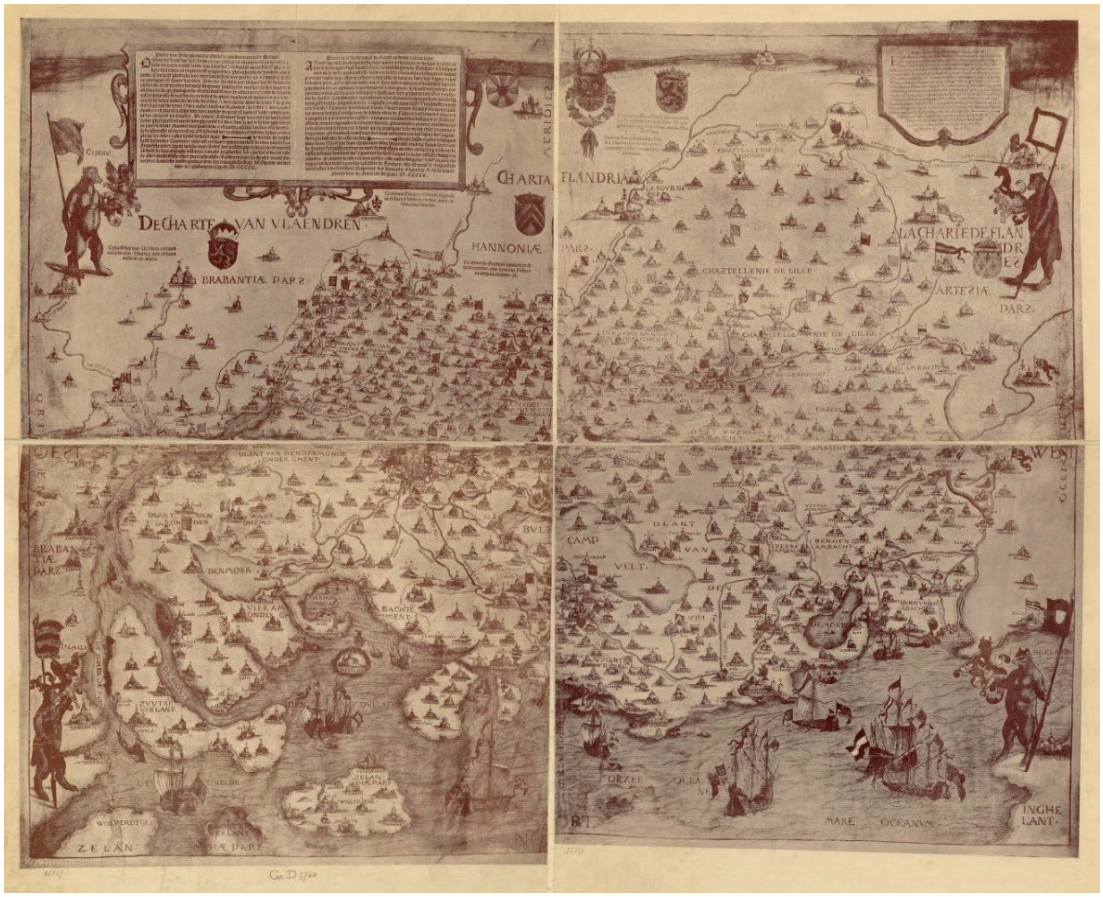


Figure 21: Pieter van der Beke dated 1538 (Source: public domain)

In 1540, Gerard Mercator, a Flemish pioneer of cartography was commissioned by the Merchants of Ghent to produce a map of the county of Flanders. The merchants hoped a more respectful portrayal of the county would replace the 1538 map and appease the Spanish Emperor Charles, following their rebellion. Mercator signed the map "Dedicated to Charles V most Holy Roman Emperor by the most devoted Gerardus Mercator of Rupelmonde." Middelkerke is again depicted by a church (Figure 22).

The accuracy of Mercator's map is attributed to triangulation already carried out by Jacob van Deventer. The nine copper engravings together form a wall chart measuring 96 x 125cm. The map is on display in the Museum Plantin-Moretus. The museum in Antwerp is the original residence and workshop of the Plantin and Moretus publishers and is a UNESCO world heritage site. Mercator's map was included in the Theatrum Orbis Terrarum by Abraham Ortelius. Printed in 1570, considered to be the first true modern atlas.

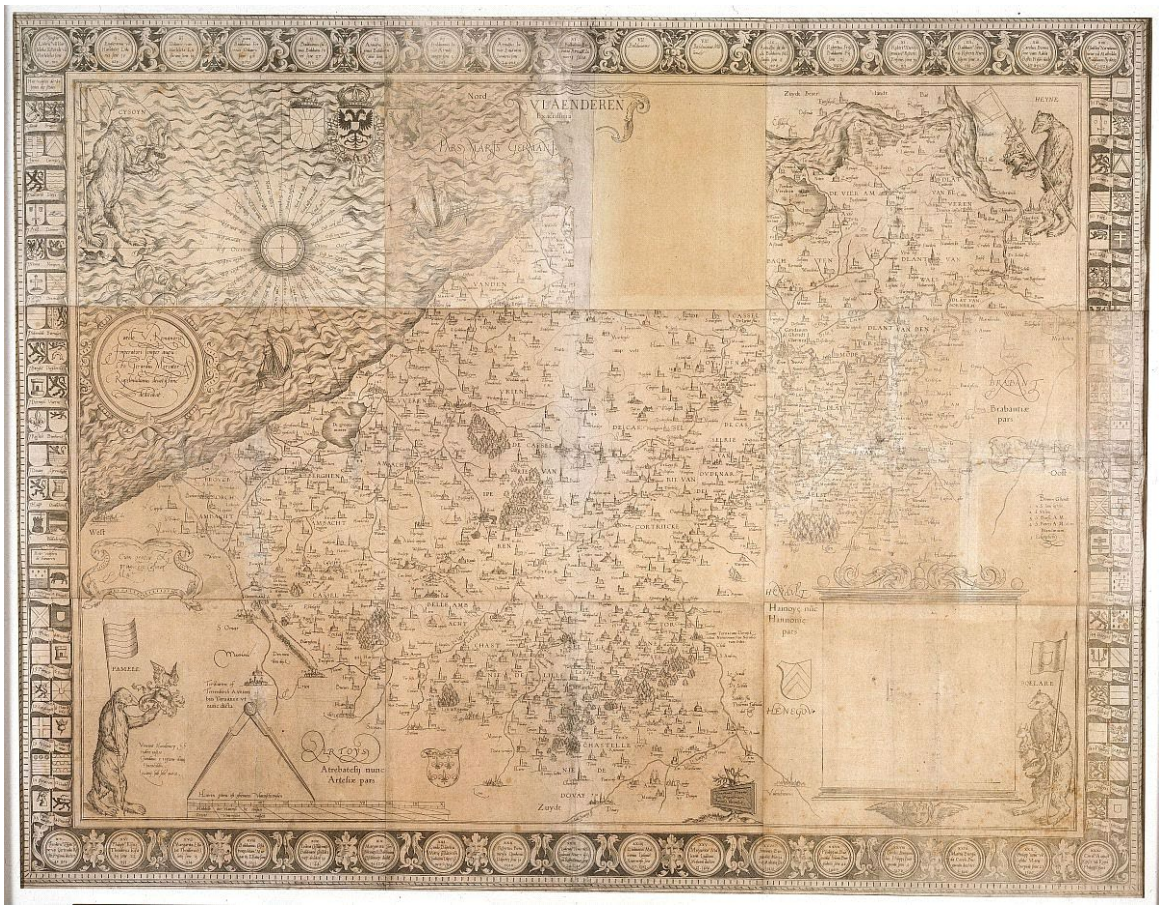


Figure 22: Map of 1540 by Gerard Mercator

Jacob van Deventer, a leading Dutch Renaissance Cartographer, was commissioned first by the Emperor Charles V and then in 1559 by King Philip II to create manuscript topographical plans for all of the cities of the low countries. This was to be his life's work. By the time of his death in 1575, he had created over 250 city maps. King Philip II required these maps to suppress the cities that revolted against him. Deventer pioneered triangulation to produce accurate scale maps. Drawn in plan, buildings were drawn side on for easy recognition by the soldiers. Important buildings, roads, rivers and fortifications were all mapped in water coloured detail. These plans were not published due to their secret military nature and were only rediscovered in the late nineteenth century. Middlekerke does not seem to have been mapped at this time, it was probably too small and not considered a threat. Nearby Ostende was mapped by Deventer in 1562.

Meanwhile, topographical maps were produced at provincial levels, rising from the desire for self-representation. Printed province maps were produced in almost all the countries of Europe between 1575-1700, many of these maps clearly show Middelkerke as a named town, such as this example by CJ Visscher, 1621 (Figure 23).

Figure 23: Map by CJ Visscher, 1621.

In 1638, Henricus Hondius in Amsterdam and Alexander Serhanders in Ghent, published a multi-sheet map of Flanders that superseded Mercator's map (Figure 24). This was the basis of Blaeu's six sheet wall map of Flanders published in 1643 (Figure 25).

Other topographical maps of Flanders were produced by: Seutter (1678) (Figure 26), Jalliot (1695), Mortier (1700), Masse (1729) (Figure 27), Visscher (1730), Bodenehr (1740), Frickx (1744) and Ferraris (1777) (Figure 28). These maps name Middelkerke and Westende.

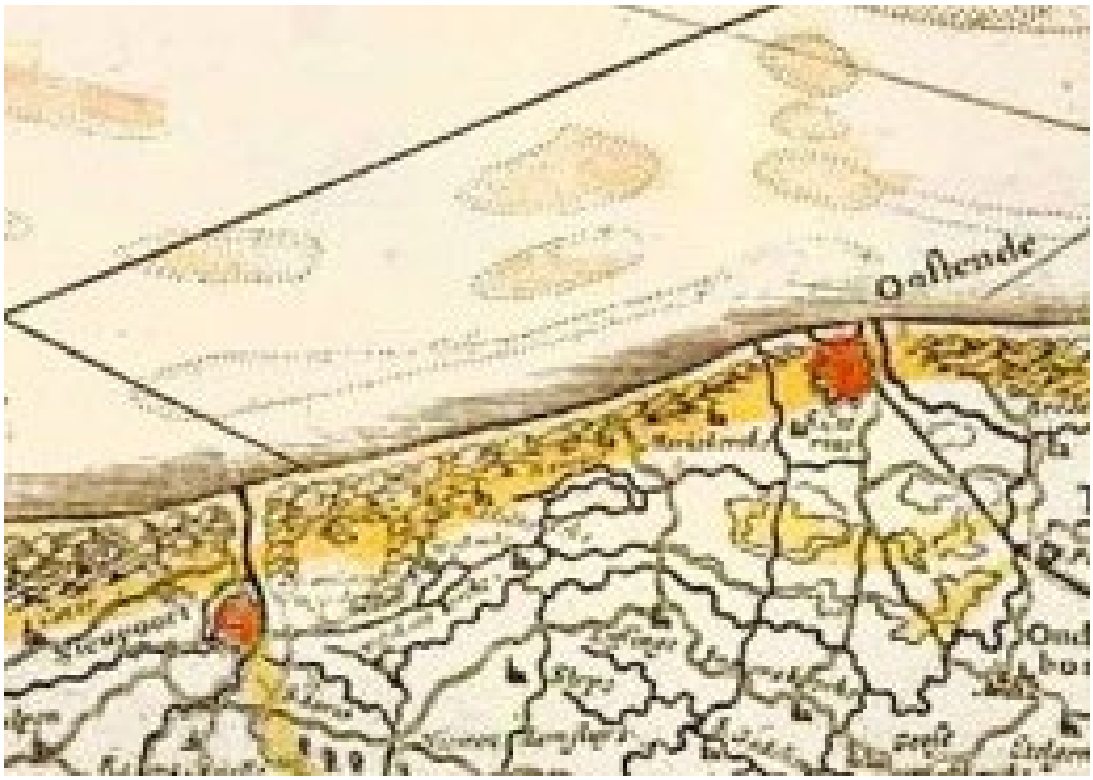


Figure 24: Map by Henricus Hondius 1638.

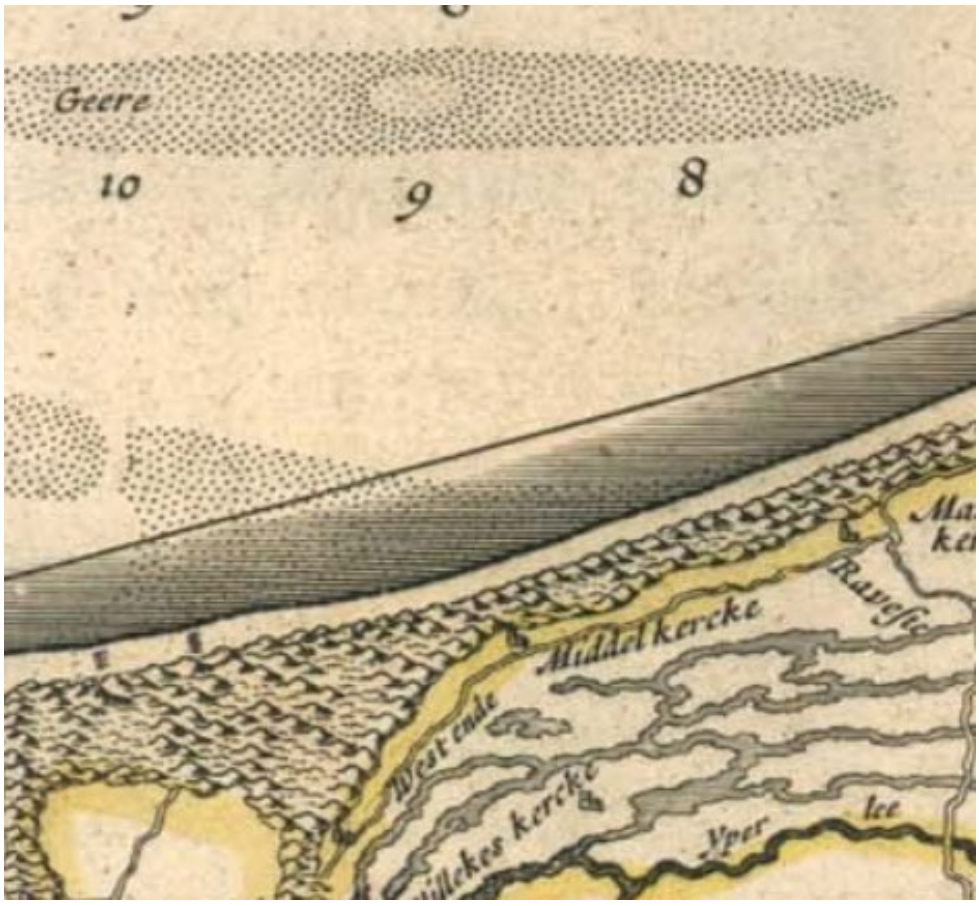


Figure 25: Northwest Flanders, by Willem & Joan Blaeu 1643 (ID 803).

Figure 26: Map by Seutter, 1678.

From the 1700's maps start to be produced on a smaller scale and contain much more detail. Good examples for Middelkerke and Westende include Masse (1729) (Figure 27) and Ferraris (1770's) (Figure 28).

Figure 27: Map produced by Masse in 1729 (Source Geopunt)

Figure 28: Joseph de Ferraris Map Source Joseph de Ferraris (1726 – 1814), Public domain, via Wikimedia Commons

A land registry map of Middelkerke was produced by Philippe-Christian Popp in 1845.

Middelkerke, Westende and Westende Bad feature on British First World War Trench Maps. Accurate spatial positioning was essential for both defensive and offensive operations. These maps were produced using the British Trench Map Grid System, based on existing maps and aerial photography which was being pioneered at this time. The maps show the changing front line and the location of enemy positions, detailing the position of communications trenches, gun emplacements, obstacles, observation posts. Between 1914-1918, the Ordnance Survey printed over 34 million maps. The originals are held in the National Archives and the Imperial War Museum. Scanned copies can be viewed online at the Royal Library of Scotland (ID 810). The War Office also produced maps and Middelkerke is annotated on the Map of Water Supply Ostend, dated 1916, held by the British Library. Extensive additions made during the second world war are visible on the 1937-1942 maps (ID 811 National Library of Scotland).

Charts have also been produced over the years to map the changing Flemish coastal geomorphology. The Historical Maps Coastal Zone website http://www.vliz.be/hisgiskust/en/image-library?p=search&term=oostende&search.x=3&search.y=1 hosts these charts for the years 1866 (Figure 29), 1966 (Figure 30), 1968, 1971, 1973, 1974, 1980, 1982, 1984, 1985, 1998, 1991 and 1996 (Figure 31). The earliest, latest and a middle example are shown below.

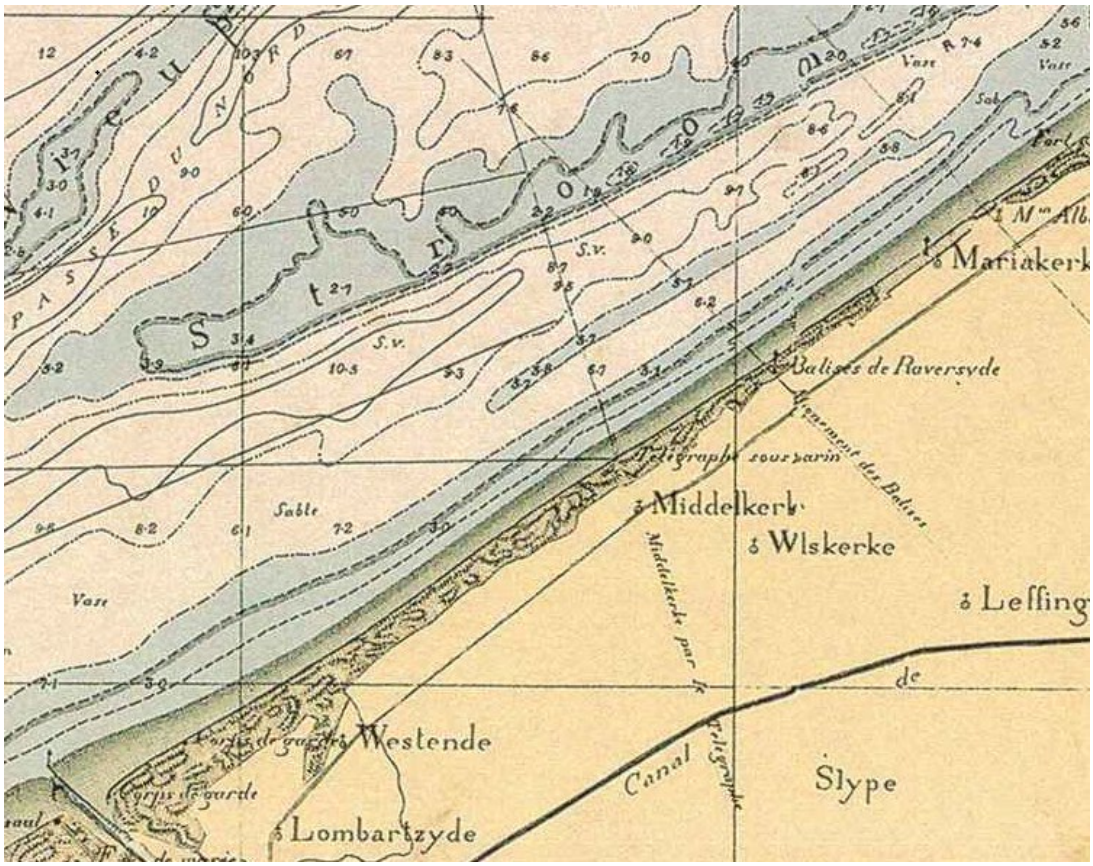


Figure 29: Vlaamse Banken (1866) http://www.vliz.be/hisgiskust/en/image-library?album=4904&pic=15526

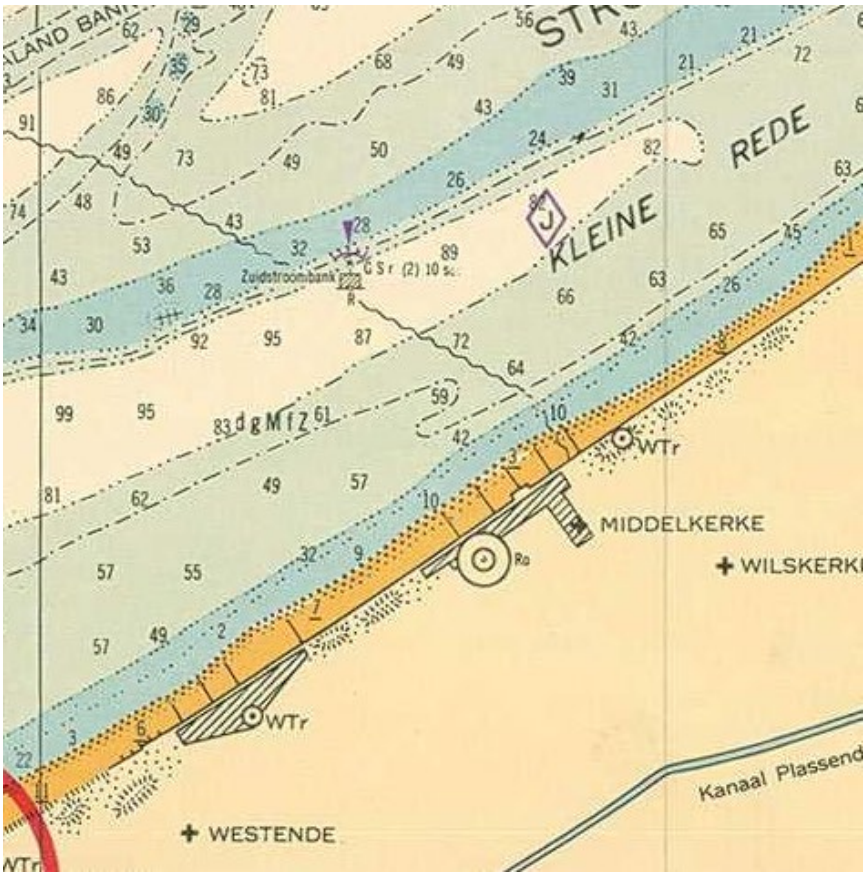


Figure 30: Vlaamse Banken (1966) Hydrografische Dienst der Kust http://www.vliz.be/hisgiskust/en/image-library?album=4905&pic=15527

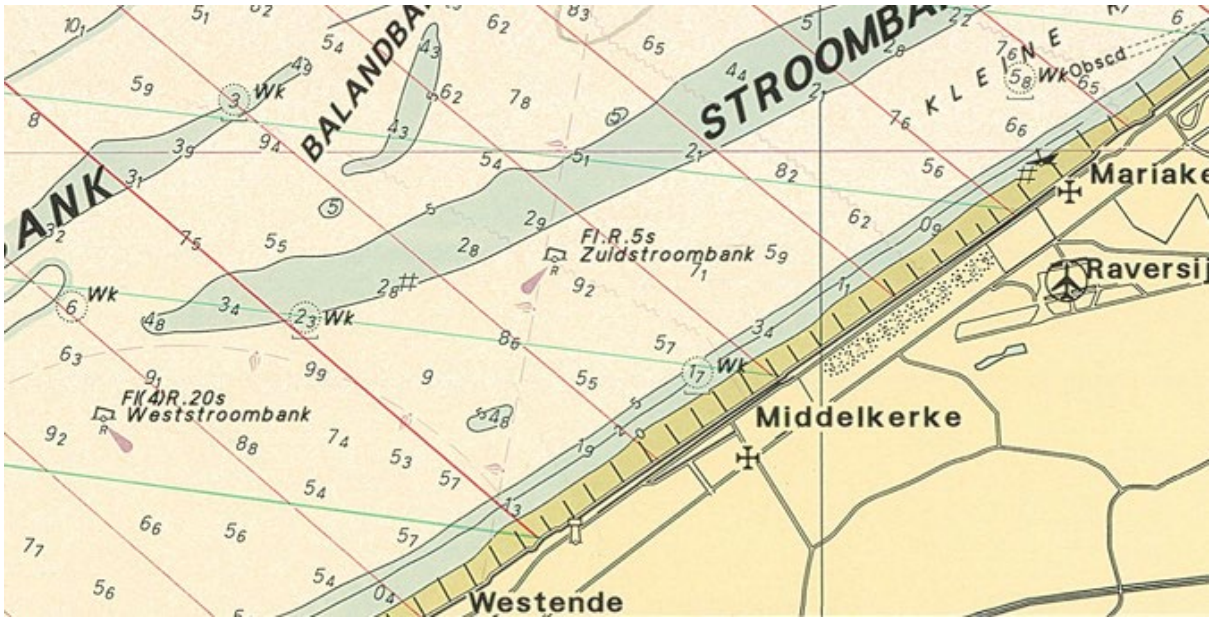


Figure 31: Vlaamse Banken (1996) Hydrografische Dienst Oostende, Afdeling Waterwegen Kust http://www.vliz.be/hisgiskust/en/image-library?album=4905&pic=111861

3.2 Results of scoring

The ranking system for maps and sea charts as set out in *SARCC Maritime Atlas: Methodology Report* (MAT forthcoming) and has been applied within the Middelkerke pilot area. A range of historical maps and charts of the area were assessed as part of the project, with some dating back over 500 years.

The study of maps and charts has utilised a range of online resources, it has been designed to show the potential of this type of resource for coastal change, but it is not an exhaustive study as other examples exist within archives, museums, libraries and galleries that is has not been possible to access due to Covid-19 restrictions. 18 maps and charts were analysed through the scoring system, the top 10 scoring examples are detailed below and in Figure 32:

MAP_ UID	Title	Year	Score Chronometric Accuracy	Score Topographic Accuracy	Score Detail in non-coastal area	Score Geometrical Accuracy	Total Map Score
381	Oostende and Middelkerke 1913.	1913	100.00	44.44	66.67	66.67	69.44
413	Nieuport 1952.	1952	100.00	33.33	66.67	66.67	66.67
231	Orthophoto mosaic 1971	1971	100.00	33.33	66.67	66.67	66.67
414	Dunkirk to Niueport C18.	18th century	100.00	33.33	66.67	66.67	66.67
415	Middelkerke 1888.	1888	100.00	33.33	66.67	66.67	66.67
416	Middelkerke to Dunkirk C19.		100.00	33.33	66.67	66.67	66.67
345	Blaeu 1645 - Eastern part of German Flanders	1645	100.00	52.78	66.67	33.33	63.19
309	Belgium 1584	1584	100.00	44.44	66.67	33.33	61.11
315	Map of the flemish coast 17th century	17th Century	100.00	41.67	33.33	66.67	60.42
337	Vlaamse-banken-1966	1966	100.00	41.67	33.33	66.67	60.42

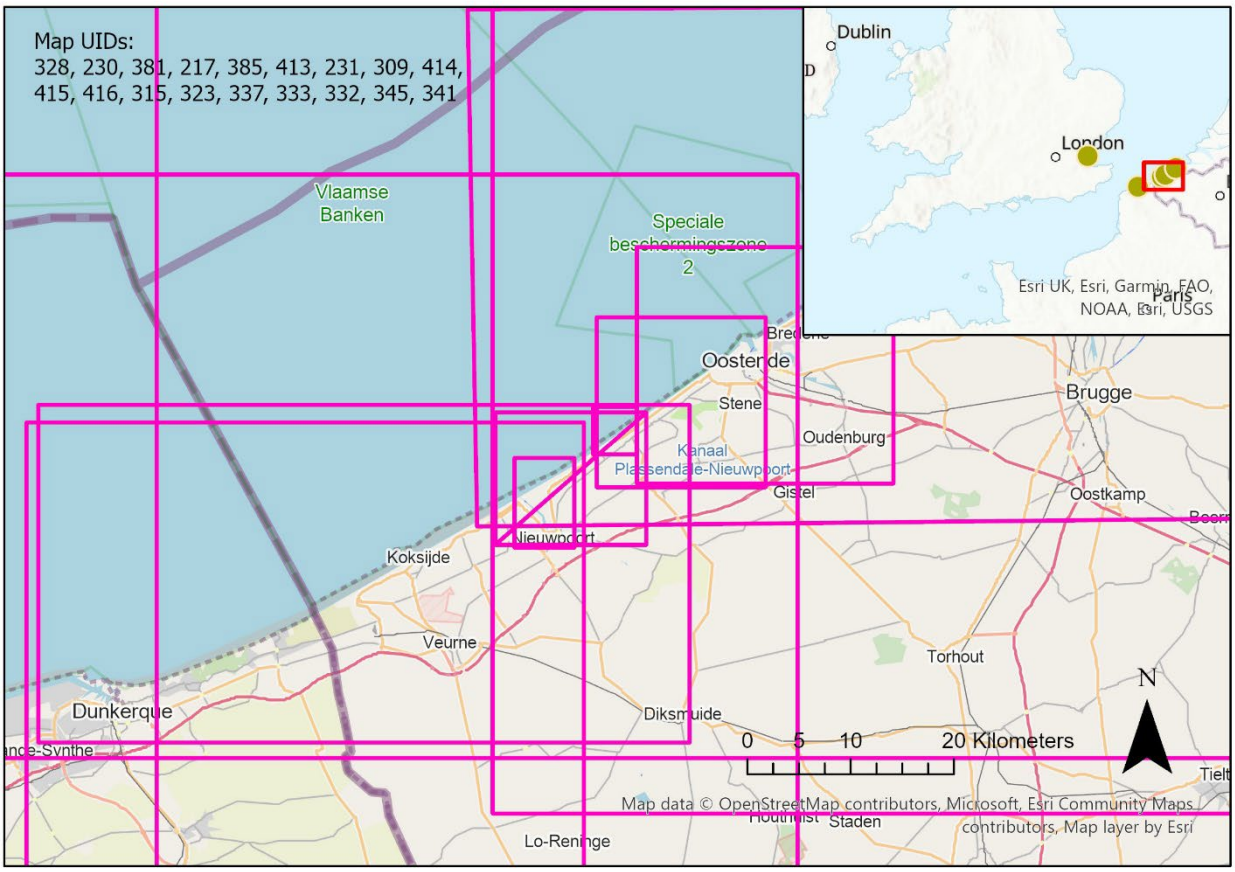


Figure 32: Distribution of the highest scoring map and charts for the Middelkerke area

3.3 Discussion of scoring results

The top scoring maps range in date from 1584 to 1971 and cover the pilot area and the area either side. Through study of these maps it is possible to see the progression of Middelkerke and Westende as seaside resorts. As in the other Belgian case studies, Blaeu's map of 1645 (ID 345) is one of the top scoring maps, recording the natural dune frontage long before development began. By the late 19th century, buildings began to be constructed behind the dunes (ID 415). By the early 20th century, development started to encroach into the dunes. The top scoring map (ID 381) dated 1913, shows clearly how the emerging resort is cutting into and starting to replace the dunes along the seafront. An orthophoto mosaic taken in 1971 (ID 231), shows the extent of post-war re-development and expansion, and was taken approximately ten years after the peak of tourism was reached around 1960. The individual buildings are clear to see and large areas of the dune front have been lost, though some still survives either side of the resort.

4. Pictorial Resources Scoring

This section presents the results of the research, scoring and analysis of artistic images and historic photographs. The scoring approach for these resources has been developed to take account of the various styles, approaches and potential subjectivity (particularly of art images), and the potential of the resources to provide information on coastal change.

Artistic resources provide a similar time-depth to maps and charts in terms of the periods over which they have been produced, with photography being available for periods from the mid – late 19th century. Whereas maps and charts were designed to be as accurate as possible in producing 'plan views' which include the coast, art and photography provide a range of landscape and oblique views which give a different type of evidence of coastal change.

4.1 Artistic Images

The use of artistic images to help understand coastal processes, measure coastal change and inform approaches to coastal management has been developed over the past 20 years. Initial reports focused on the use of art resources to demonstrate coastal change in relation to issues for life and for economic assets (McInnes & Stubbings 2010, 2011; McInnes & Benstead, 2013, 2013, 2015). They demonstrated the potential for the resource to provide more data on other aspects of coastal management. The use of art images alongside archaeology and heritage data was further developed through the Arch-Manche project (https://archmanche.maritimearchaeologytrust.org/) which focused on long-term coastal change and included the assessment of artwork, cartography and photograph for more recent periods.

This section outlines the art history relevant for the Middelkerke Pilot Area before looking in detail at the high scoring art works, what these examples show us and how modern photos can be compared to the artistic views.

4.1.1 Summary of Art History of the Channel Coast

The development of coastal artistic representations across the area of the SARCC Pilots has a common history which reflects broader trends in social and economic development and their impacts on art and artists. This brief review of developing trends draws on the work of Professor Robin McInnes within the Arch-Manche Project and is a summary of the background to the art of the Channel-Southern North Sea Region from the Arch Manche Technical Report https://archmanche.maritimearchaeologytrust.org/uploads/images/Documents/Technical_Report_Section_One.pdf. It provides a review of the development of coastal art applicable across the Channel coast SARCC pilot areas, with additional detail on further research related to the specific pilot area.

The beginnings of coastal art

It wasn't until the early 17th century that the work 'landscape' started to be used in English to describe scenery, it came from the Dutch word 'landschap' (an area of cultivated land). But the origins of landscape painting date back to the 15th century when scenery was included in paintings of early artists such as Leonardo de Vinci. In the 16th century in the Netherlands Pieter Brueghel the Elder (1525/30-1569) painted scenes which included the countryside and coast. However, for much of the 16th and 17th centuries portrait painting was the most common work produced.

During the fifteenth to seventeenth centuries Flanders produced some of Europe's leading artists.
"Artists from the Netherlands, Flanders and Belgium played a significant role in the development of landscape art, particularly in relation to the coastal and marine environments", these included Pieter Bruegel the Elder, Rubens and Van Dyck. This encouraged other European artists to their centre of activity and Flemish Baroque painting flourished, particularly in the Antwerp School, but also in Brussels and Ghent. Following the Siege of Antwerp in 1584-85, Flanders became separated from the Dutch Republic and many artists fled to Holland, leading to the development of the 'Dutch Golden Age' of painting, which spanned the 17th century. A more naturalistic style of painting developed which included landscape depictions, with important artists being Esias Van De Velde (1587-1630), who painted landscape, genre and shipping subjects and Hendrick Avercamp (1585-1634) who painted some of the first Dutch landscape paintings. Seascapes became more popular with Hendrik Vroom (1566-1640) being one of the earliest seascape painters.

The Dutch economy was heavily based on maritime trade which was captured through paintings, as was naval conflict and dangerous sea condition. Many of these paintings included detail of the coast, beaches and harbours.

Strong European trading networks meant Dutch and Flemish painters and paintings were exported, including the famous Willem Van De Velde (c.1611-1693) and his son, also Willem (1633-1707), who moved to London in 1672. Their expertise in depicting ship and the sea dominated marine painting in England and inspired a

generation of English marine painters. Dutch art was particularly influential on the 'Norwich School of artists' (1803-33).

"The influential role of Dutch, Flemish and Belgian artists on the development of land and seascape paintings cannot be underestimated. In particular, the prosperity of the Dutch Republic created an opportunity for strong trade links with the rest of Europe and this in turn enabled works of art, and, therefore, artistic styles, to permeate into Great Britain".

The fashion for monied young men to take the 'Grand Tour' in the late 17th and 18th centuries developed appreciation for classical remains and Renaissance art, particularly of Italy and Greece. Those returning often commissioned art work and were particularly impressed by the landscape paintings. While 'on tour' they were able to purchase engravings and paintings of coastal scenes that had been painting for the 'tourist trade'. Some travellers were accompanied by their own artists and later photographers to capture their sights while on tour.

Throughout the 18th century there was growing appreciation of landscape and subsequent interest in landscape painting including through watercolour drawings and through publication of richly illustrated aquatinted plates. Some of the dedicated topographical artists, such as Turner, Rowlandson, William Daniell and Richard Ayton, travelled extensively to inaccessible places to develop their works. This often-included areas of coastline and their paintings have left a legacy which are an important record of the state of the British coastline.

19th Century Developments

In the 19th century artists continued to follow the Dutch tradition of creating very detailed depictions of the coast capturing developing coastal settlements which developed into resorts. "This era of coastal landscape painting relied not just on the skills of the original artists in the field, but also a number of remarkably fine craftsmen, engravers and colourists, who produced illustrations through a range of techniques such as aquatint and lithography".

In particular the mid-19th century Pre-Raphaelite Brotherhood became influential in landscape painting – they wished to capture nature in its precise detail and beauty and they painted the smallest of details in their quest for realism. Their works and those of their followers coincided with developing interest in the natural and earth sciences and the development of geology. Many important geological exposures have been painted by Pre-Raphaelite artists and their attention to detail means these works can be of particular importance for studying the chronology of physical, environmental and social change around the coast.

The influence of the Pre-Raphaelites was felt throughout the art world, and many artists were inspired by their methodical approach to depicting the natural world. Although there are many examples of Pre-Raphaelite coastal paintings from Britain, many artists worked in a range of countries. For example, Edward William Cooke RA (1811-1880) took a keen interest in depicting the geology of the coastline with great accuracy and precision and produced works of the English, French and Dutch coastlines.

Coastal Art Colonies

A number of 'artistic schools' developed around the coastline in the 19th century and thrived until the early 20th century. They often centred on particularly aesthetic locations where artists worked together developing particular styles. In the post Napoleonic War years and after the European-wide revolutions of the early 1800s there began a gradual movement of artists towards the coastal towns of Europe. This trend continued until the outbreak of the First World War.

Art colonies grew in size throughout the 1800s. There were over eighty art communities around the Channel-Southern North Sea coasts of different types including villages with transient and fluctuating artist populations, for example Honfleur on the French coast and Katwijk on the Dutch coast; villages with semi-

permanent visiting and residing artists, for example, Concarneau in France, St Ives on the Cornish coast and Bonchurch, Isle of Wight; and villages with mainly stable groups of artists in residence, for example, Egmond on the Dutch coast and Newlyn in Cornwall and Walberswick in Suffolk, East Anglia.

Painting by the coast was seen as a means of reverting to a simpler way of life away from the industrialisation of many European cities. The artists of the colonies shared a common aspiration to paint en plein-air (i.e. out of doors), they embraced descriptive realism and were eager to paint out of doors in front of the subject and capture the subject in its natural setting.

The presence of a coastal art colony often means there is a large legacy of paintings for the surrounding coast, many of which can contribute to understanding of changes to the coast over time.

Art and the Development of Tourism

From the mid 18th century visitors were drawn to the coast for health and leisure. In the 19th century with the expansion of the railway network and road building the numbers visiting developing seaside resorts from growing urban centres increased rapidly. The building of promenades, piers and hotels followed and fuelled this demand on both sides of the Channel coast.

Visitors wanted a record of the areas of the coast they had visited and before photography this was achieved through artworks, or copies of these. Even after the invention of photography works of art were still high in demand as they provided colour views when photographs were still black and white. For this reason, paintings of the coast continue to be important for records of coastal change into the 20th century.

Early guide book publications were highly illustrated with engravings, however, in the mid 19th century they could not be printed in large enough numbers to meet demand. However, the invention of chromolithography and colour plate reproduction allowed larger print runs to be developed. Artists were commissioned to write and illustrate books which covered all part of the European coast to meet the demands of travellers and tourists. From the 1890s onwards postcards became popular with tourists, many of them featured coastal scenes. Artists were commissioned to create paintings for use as postcards.

The position of the Middelkerke Pilot Area between the main tourist centres of Middelkerke and Nieuport mean there is not a high number of available images showing the specific area.

4.1.2 Results of scoring Art

The development of the scoring system for works of art is described in SARCC Maritime Atlas: Methodology Report (MAT, 2022). Details of each artwork have been entered into the project database, including information on artwork type, medium, subject matter, time period and other parameters, the database was then able to calculate the scores for works of art from the pilot study site. Seven artworks were scored and analysed for the project, the highest scoring art works were:

Art UID	Source Title	Artist	Date	Scored - Medium	Score - Period	Score - Style	Score heritage	Score environ	Total Score
440	Westende (Belgium)	Hermaan Struck	1912	Etching	1880-1920	Picturesque landscapes	Maritime heritage suggests...	General view of the beach...	74

404	Surf on the shore	Henri-Cassiers-Middelkerke	1858	Watercolour	1880-1920	Topographical/beach & coastal scenery	Maritime heritage suggests...	General coastal view	70
439	The Dunes in Middelkerke	Thomas Deputter	1925	Oil paintings	Modern	Topographical/beach & coastal scenery	Maritime heritage suggests...	General view of the beach...	70
500	Nieuport C17.	Unknown		Litho/fine pencil/watercolour drawings	Before 1770	Topographical/beach & coastal scenery	Maritime heritage suggests...	General coastal view	70
403	Middelkerke promanade 1900	Unknown	1900	Watercolour	1880-1920	Caricaturist/Genre subjects	Maritime heritage suggests...	General view of the beach...	66
438	Westende 1905	Charles Guillox	1905	Oil paintings	1880-1920	Picturesque landscapes	Maritime heritage suggests...	Riverside scene	66
441	Plage de Westende	Gustave-Max Stevens	1898	Litho/fine pencil/watercolour drawings	1880-1920	Caricaturist/Genre subjects	Maritime heritage suggests...	General view of the beach	59

Table: The highest scoring artworks within the Middelkerke Pilot Study Area

4.1.3 Discussion of scoring results

Far fewer art works than photographs were found for this area. Most of these top scoring art works have near equivalent views and scenes of similar dates amongst the top scoring photographs. The art works feature dunes and the seafront. The only exception is ID 441, a travel poster advertising that Westende is only 30 mins by train from Ostende. The scene shows a family enjoying the beach.

4.1.4 Field Survey of Art Locations

Following scoring of the artworks a number of examples have been the subject of more detailed analysis involving a site visit. Where it was practical to gain access and relevant to the study, present day photographs were taken in the field to try, as far as possible, to match the views painted by the nineteenth and early twentieth century artists. It also provided the opportunity to assess the conditions of the shore to note changes that may have taken place over time. This ensured that thorough comparison could be made between the situation depicted in the artwork and the present-day situation.

Figure 33: (left) [ID 404] Henri-Cassiers Surf on the Shore 1880-1920, and (right) comparative equivalent image from 2021.

Figure 34: (left) [ID 403] Middlekerke Promenade 1900, and (right) comparative equivalent image from 2021.

4.2 Photographs

Photographs are an invaluable resource to support coastal change studies because they represent true depictions of the landscape; there is not the need to rank them in the same way as artworks (where views may be susceptible to interpretation and variation). For photographs to be used to assess how they can support studies of coastal change the two key issues are the content (in terms of what the image tells us) and the quality of the image. Because of the dynamic nature of this coastline historic photographs can be a particularly valuable resource with many historic photos containing depictions of the shore and sea front with recognisable heritage features nearby, including buildings, quays and bridges. These can be compared to the modern situation and from this an accurate idea of the rate of erosion since the date of the photograph can be gained.

A total of 15 historic photos were assessed as part of the project, images include those from locations within the pilot area where historic paintings and archaeological sites were also known. The photographs were collected and then scored using the methodology outlined in SARCC Maritime Atlas: Methodology Report (MAT, 2022). The study and scoring of historic photographs highlight the potential for historic photos to provide information on coastal change. Sources and archives used included a range of national, regional and locally based resources that are available online.

4.2.1 Results of scoring

This pilot area has a limited number of available historic photographs and postcards many of which are of a tourist nature. 15 photographs were entered into the project database, all scored over 55 and so have been included below within the 'high scoring' results. The Figure 35 shows the distribution of the images and the table has the detail of their subjects and scores.

Image ID	Title	Year	Purpose	Score Heritage View	Physical Image State	Total Score
1346	Westende-Middelkerke-Promenade-Strand-1912	1912	2	3	3	100
1341	Westende Panorama from the road	1914	4	2	3	77
1343	The ruins of Westende from the dunes	1914	4	2	3	77
1347	The beach on a stormy day	1911	4	2	3	77
1348	Westende Dutch Villa Colony 1911	1911	4	2	3	77
1349	Westende-Middelkerke-Badeleben-Strand-1911	1911	2	2	3	77
1350	Westende Villa of Marcunvins 1911	1911	4	2	3	77
1351	Middelkirke Strand and Dijk	1890	2	2	3	77
1372	Middelkerke Le Plasir de la plage	1917	4	2	3	77
1373	Westende Beach 1911	1911	4	2	3	77
1374	Middelkirke Dunes		4	2	3	77
1378	WWI shelters and damage to dunes at Middelkerke	1914	4	2	3	77
1375	Middlekirke Tempete - Storm		4	1	3	55
1376	Middelkerke-Westflandern-Les-Dunes-de-Groenendyck	1915	4	1	3	55
1377	Middelkerke-Dan-les-Dunes	1908	4	1	3	55

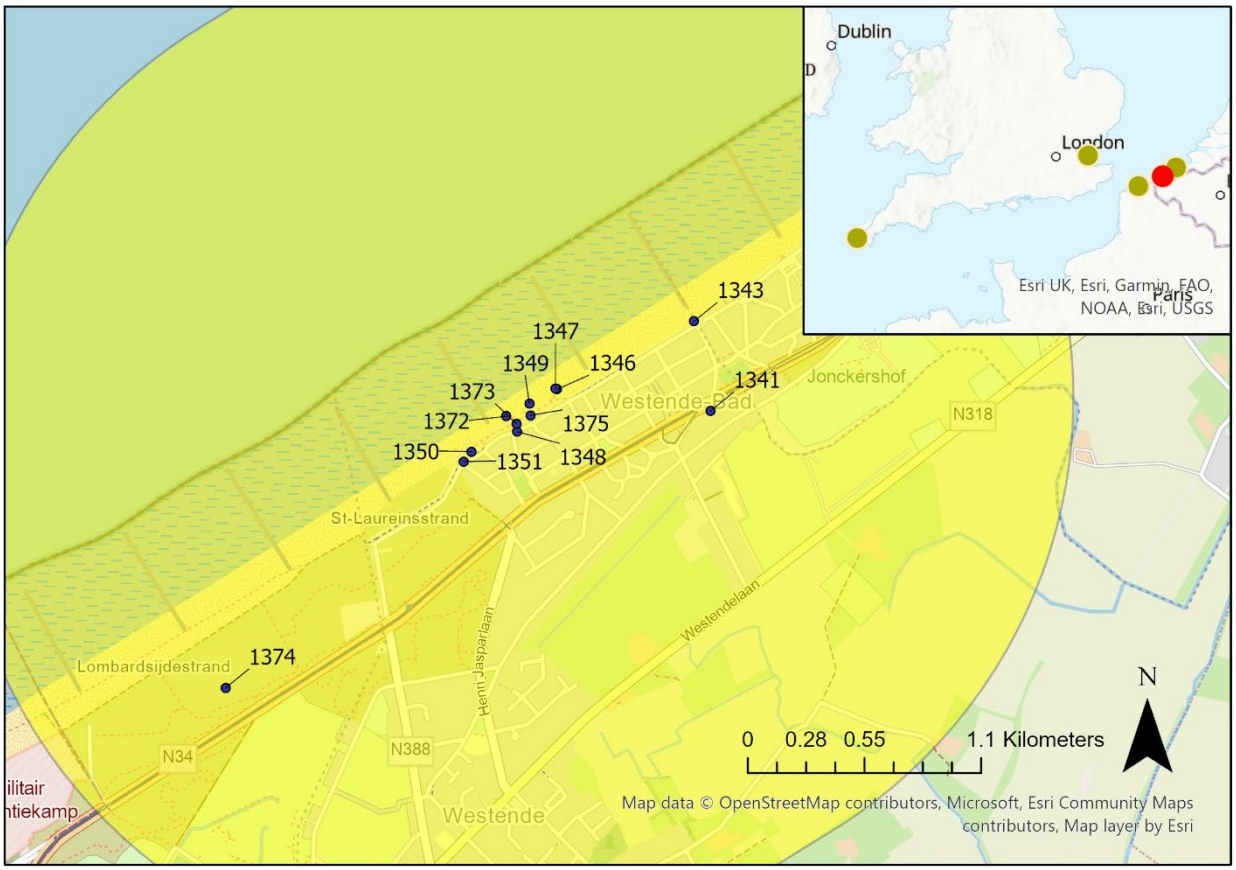


Figure 35: Distribution of high scoring historic photographs within the Middelkerke pilot study area.

4.2.2 Discussion of scoring results

The majority of photographs/postcards of Middelkerke are of a tourist nature showing people on the beach with beach huts and the promenade and the hotels behind. Seven such photographs make the top scoring table ID 1346, 1349, 1351, 1372 and 1373. Two photographs feature these locations during stormy weather, ID 1348 and 1375. The beach huts have been blown over and waves break over the sea wall.

Five photographs feature the undisturbed dunes at Middelkere and Westende ID 1374, 1376 and 1377. Two, both dated 1911, show buildings starting to encroach on the dune area in ID 1348 and 1350.

The remaining three photos (ID 1341, 1343 and 1378) dated 1914-1918 record military buildings built into the dunes and WW1 damage.

4.2.3 Field Survey of Photograph Locations

Following scoring of the photographs a number were the subject of more detailed analysis involving a site visit. Where it was practical to gain access and relevant to the study, present day photographs were taken in the field to try, as far as possible, to match the views. It also provided the opportunity to assess the conditions of the shore and to note changes that may have taken place over time through comparison of the features shown in historic photographs and the present-day situation. Examples are included below (Figures 36 – 38), with further examples in Section 5.

Figure 36: (ID 1351) Middelkerke Strand and Dijk in 1890 with the comparative modern day image (right).

Figure 37: (ID 1347) The beach at Middelkerke on a stormy day in 1911, with the comparative modern day image (right).

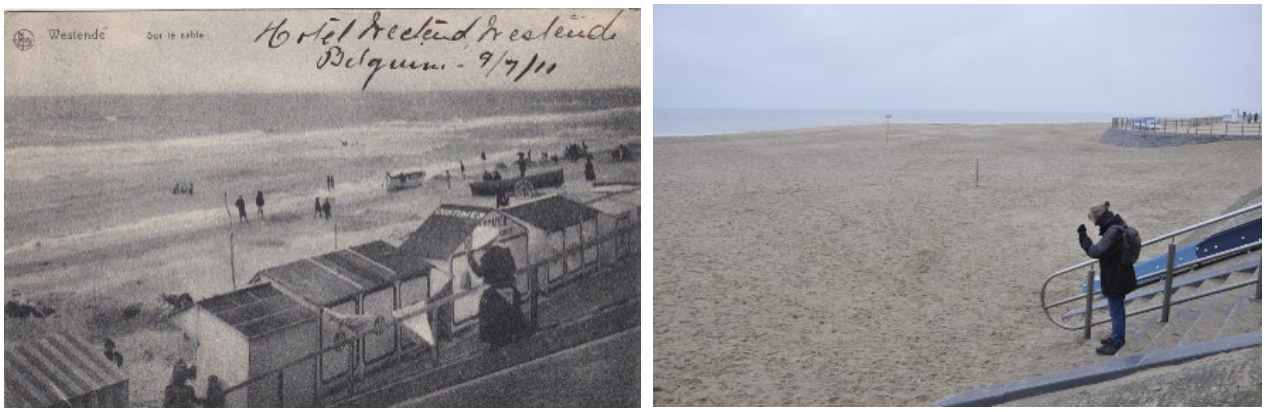


Figure 38: (ID 1373) Westende Beach in 1911, with the comparative modern day image (right).

5. Combined Application for Analysis of Change at the Coastal Frontage

The above sections have demonstrated the potential of each type of resource – archaeological, palaeoenvironmental, artistic, maps and charts and photographs – to be assessed and analysed to inform on the scale and pace of coastal change. When these resources are utilised together to look at particular areas or features this provides an exceptionally powerful set of data to be able to understand the long-durée of the coastline.

Analysis of the available resources to show the long-term changes and development of the area of the coastal frontage adjacent to the Pilot Project shows the long-term changes and development of the area.

Detail from scoring of available resources:

The Middelkerke seafront is closely linked to the development of the town and appears across the range of scored resources. Figure 39 includes a combination of these resources to show changes over time.

- Archaeology – All of the top scoring archaeological and palaeoenvironmental sites are associated with the original dune frontage and the impact of human intervention upon them.
- Maps/ Charts – The Blaeu Map of 1645 shows the natural dune frontage at Middelkerke intact. Through time, maps chart the development of Middelkerke as a tourist resort resulting in the dunes being replaced with buildings.
- Art – Only 7 artworks were found, including one travel poster.
- Photographs – The majority of photos that exist of the Middelkerke frontage are taken from a tourist point of view, or focus on the WW1/WW2 impact.

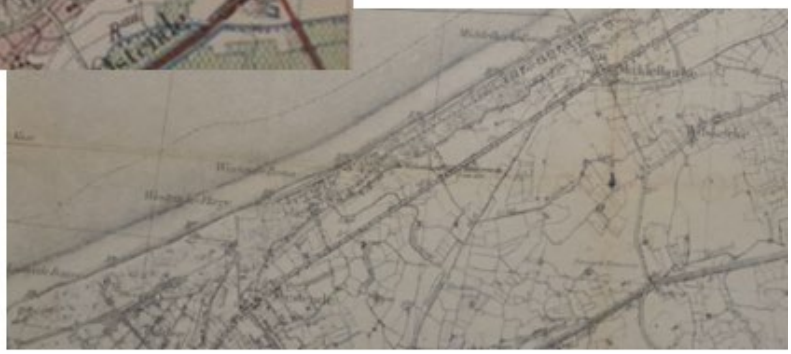
How the combined resources inform on coastal change:

In 1887 an Entrepeneur from Brussels, Mr Edouard Otlet, bought the dunes at Middelkerke and Westende with the intention of creating an elite holiday resort (ID 5256). Maps and photographs capture the transformation of the seafront from a natural dune landscape to a built landscape. The first villas were built in the dunes at Westende in 1896. The first hotels were built on the seawall in 1898, and the Grand Hotel on the Stand in 1909. A children's home (ID 5210) was built in 1900. 250 villas quickly followed (see ID 1348 and ID 1350). During both World Wars, the dune front was fortified with the addition of bunkers and other military installations built into the dunes, some of these still remain. These defences are visible on map ID 351 and ID 352. Shell damage during the First World War reduced every building, with the exception of the Belle-Vue Hotel, to ruins (ID (ID 1341, 1343 and 1378). All were quickly rebuilt, only to be damaged again in the Second World War. Tourism peaked between 1945 and 1960 resulting in further expansion and development along the coastline in both directions.

The Blaeu Map of 1645 shows the natural dune frontage intact. As Middelkerke began to develop as a seaside tourist resort, buildings encroach into the dunes. The 1888 map shows the addition of The Strand and buildings replacing dunes along the seafront in Middlekerke and the 1913 map shows further development towards Westende. A 1971 aerial photograph (ID ID359 restricted) shows almost the entire dune frontage replaced by buildings. This development is captured in historic images, which also show that with no dune protection, storms break over the seawall (ID 1347).

Middelkerke Coastal Frontage

Maps showing changes to the frontage: Far left (ID 803) Blaeu Map of 1645.
Left: (ID 415) Middelkerke 1888.
Below: (ID 380) map from 1913.
(Courtesy of Stadsarchief–De Benne, Blankenberge).



Left: Postcard showing frontage with no dune protection (ID 1347).

Historic Postcards showing the dune systems and built up frontage (IDs 374, 497, 1349)

Historic photos showing World War One fortifications in the dunes (Left ID 355, Right ID 499)

Figure 39: Combined resources used to understand changes in the dune frontage over time

6. Conclusions/ recommendations

Although the number of resources available for the specific study area of 1.5 kilometer radius from the pilot work isn't as great as some of the other SARCC pilots which are often closer to the main urban centre, there are still a good variety to be able to demonstrate the potential of the SARCC scoring approach that has been applied to identify those resources of particular importance for understanding the long-durée of the coast.

Evidence from archaeological and historical sites provide evidence from early historic periods through to the Second World War. Combining the archaeological and historic data with artistic resources, including historic maps, charts, photographs and artworks allows us to understand change from prehistory up to the present day. Through a better understanding of how the Middelkerke/ Westende area developed, and in particular how the frontage and dune system became what it is today, coastal managers will be better placed in planning for the future.

The combination of the various available sources of data have provided detail on the form and scale of change over time – particularly with the building of structures further out into and eventually across the dune frontage. This information is of importance to the coastal scientist.

In many coastal locations detailed monitoring has taken place for less than twenty years. This pilot study helps explain the rate of change over past centuries as a result of sea level changes, human construction and the relationship of this with apparent periods of increased storm frequency. These data can supplement existing and future monitoring of trends and can support predictions for the future.

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