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North Sea's Capricious Anthropocenic Shores

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ABSTRACT

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On the North Sea and Channel shores the Southeastern coast of England holds perhaps the record for the number of towns gobbled up during recent—historic—times. The relative level of the sea to the land has varied over the centuries: in the late Roman period, and again from about 1250 onwards. Protective dykes were constructed but were repeatedly destroyed by the sea. There were periods of accretion that resulted for instance in the creation of the salt marshes of Essex and the Wash. Once flourishing settlements on the eastern coast of England have been completely destroyed, some before, some during the Middle Ages. Some prospering settlements disappeared under the sea in the 14th century, when major flooding occurred several times, with the worst floods in the 15th century. The coast of Flanders—Belgian area and Netherlandish Zeeland—has been the theatre of both silting and erosion. The paper provides a review of physical changes, loss of land, and their economic consequences.

ADITIONAL INDEX WORDS: *Flemish coast, sea level rise, flooding*.

INTRODUCTION

The phenomenon of reshaping coastlines has impacted for a great many years the shores of Northern France, Belgium, The Netherlands up all the way to Denmark and, across the Channel, to the British Isles. Occasional storms of exceptional virulence threaten or invade the adjoining coastal plain. A major purpose of the paper is to describe the situation for the Belgian segment of the North Sea littoral in order to devise a sustainable approach to continued beach loss and preventive methods against coastal plain flooding. Current literature emphasizes the problem, particularly in the light of sea-level rise.

The Flemish coastal plain, also known as the maritime plain, is protected from inroads by the North Sea by a string of dunes of varying width. Of the original dunes very little remains—near La Panne (De Panne) shreds subsist—due to continuous and often irresponsible encroachment by Man. Younger dunes are still in place here and there, in between some of the shore resorts. Once estuaries, *e.g.* the Gravelines estuary, and inlets pierced the string, draining a marshy interior land, but they have shrank of even disappeared completely due to the development of littoral barriers and accumulation of natural deposits but considerably because of human occupancy.

The shoreline has been continuously redrawn, towns have been swallowed up on both sides of the Channel and Dover Straits, islands have been formed and were the site of thriving towns, such as Wulpen, to disappear completely, offshore banks have formed, disappeared, shifted geographical positions, inlets have appeared, then filled up, *e.g.* the Schipgat, the Zwin.

The modifications through the Quaternary have been the subject of a rather abundant literature—see among others contributions by Baeteman, De Moor, Paepe and others-- and the human geography is still the subject of many papers. The latter explained by a predominant role of the Cistercian Order (Roman Catholic Church) that established numerous abbeys and tilled the land, is being rewritten by certain authors who allocate a much larger share in the development to lay settlement. Studies by Verhulst, among others, occupy a prominent place.

In the 20th century the North Sea caused renewed concern, especially during the serious flooding of 1953 which led to large expenditures for coastal defenses (Crowther, 2006). Affected by severe erosion—a persisting phenomenon not withstanding man's intervention with hard and soft means, and various new approaches such as "let nature have its way" The Netherlands, Belgium, France monitor permanently the situation. A similar approach is followed in the United States (Boruff, Emrich, and Cutter, 2005; Crowell *et al*., 2007; Tol, Klein, and Nicholls, 2008; van Koningsveld *et al*., 2008).

The Atlantic coast of France, for the last decades also subject to retreat, has been rather a site for accretion leading to disappearance of ports, even of islands now found well inland. This does not hold true for the northwestern segment which, to the contrary has to cope with the same marine erosional action as the southeast of England and the Belgian (Flanders) and Netherlands (Zeeland) coasts.

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paper provides a review of physical changes, loss of land, and their economic consequences.

The coastal areas of Flanders and Zeeland were repeatedly covered, in proto-, pre- and historic times, by the North Sea waters. The storm of the 13th century broke through continental barriers, opening a channel whose draught allowed ships to sail up to such towns as Sluis, Damme and Hoek, sites that became, for several centuries outer-harbors of Bruges. The trade thus generated is at the origin of Bruges wealth, leading to the Zwin inlet's nickname of "Golden Inlet". But, silting set in and occlusion of the inlet progressed inexorably to Antwerp's benefit. The Zwin inlet is today merely a natural swimming pool and at high tide a rivulet of water allows some canoes to maneuver. On the other hand the region became a world celebrated bird- and plant-natural refuge. Yet, Bruges, re-emerged thanks to sea-canals, linking it to the sea and an artificial harbor (Zeebrugge), is again a ranking port .On the shoreline erosion and sedimentation have brought about new modifications, some of which impact faunal presence.

Mention of the coastline changes and the hardships of life close to its shores had been already stressed by the Latin author Plinius the Elder who described the Frisians as wretched creatures eking out a meager living and searching on "terpen" refuge from the surges of the North Sea. The arts did not ignore the North Sea's anger fits: a Breton legend maintains that the sea gobbled up in the 4th or 5th century the island of Ys which is purported to have been in the Bay of Douarnenez—also known as the Baie des Trépassés—and inspired the late romantic composer Edouard Lalo (1823-1892) for his opera Le roi d'Ys. And even Dante Alighieri (1265-1321) was familiar with the dreaded floods of the North Sea as, in his Divina Commedia, the Italian poet refers to the Zwin, Bruges and floods of the North Sea: "Like the Flemings, between Cadzand and Bruges, fearing the flood that passes over them and construct a dike to tame the sea".

On the other end of the short Belgian coast one finds an unusual variety of dunes, pannes and möers (in Flemish moeren), and silted-in sea channels. The west coast is also the site of a natural reserve that include the oldest dunes of Flanders

At the limit between Oostduinkerke (a name that could translate into East Dunkirk) and Coxyde (in Flemish, Koksijde) a break in the dunes girdle indicates where through the Doornduinen (popular denomination meaning thorn dunes) the Schipgat (translates into "ship's hole" or "passage") North Sea channel led, in historical times, to Dixmude (in Flemish, Diksmuide) then a thriving inland harbor for the cloth trade.

The eventual construction of groins and dikes aimed at the protection against recurrent floods of the below sea level laying polders. Of course these polders were flooded more than once voluntarily. Best known openings of the sea-locks include 1383 when the bishop of Norwich, who had sworn allegiance to the Avignon seated papacy, laid siege to Blankenberge, Ostend and Newport; in his war with these cities which had chosen allegiance to the Rome seated pope. In 1600 the Spanish defenders of Newport opened the locks to stop the Dutch invaders while the Gueux opened an inlet in the dunes near Ostend which they had captured from the Spaniards. And once again the locks were opened, this time at Furnes (in Flemish, Veurne); on the orders of King Albert I to stem the German advance in World War I, thereby drowning the Flemish plain of the Yser River mouth. A renewed version of this scenarion was vetoed by King Leopold III in World War II, because of the thousands of refugees jamming the roads of Flanders.

Yet, according to a Manifesto, released in late February 2004, signed by sixty American scientists, the dikes and protection works undertaken in The Netherlands will not suffice to protect the land beyond and the sea will break through between 2006 and 2013, unless measures proposed by the Kyoto Protocol are enforced. The document charges President Georges W. Bush's American administration with falsification of reports to hide the actual situation (cf. Gordon Orsian of the National [US]Academy of Sciences and the University of Washington, quoted in La Libre Belgique [Brussels, Belgium], Feb. 20th, 2004). True, on February 16th 2004, a presidential advisor, on the Columbia Broadcasting System's [CBS] program Meet the Press, stated that enforcing the Protocol is unconceivable because of its consequences for the country's [USA] economy.

About 6km to the east lies the estuary of the Yser (in Flemish, IJzer), incidentally the front line between German and Allied forces in World War I. Once a major waterway, the only river entering the North Sea from Belgian territory, has lost much of its commercial significance due to silting but has acquired biological reputation with the return of seals who often come to rest and sun themselves on sandbanks and groins. Along the North Sea and the Atlantic other harbors located on the coast or not far inland had their hour of glory. On the Yser River, Dixmude (in Flemish, Diksmuide) was a thriving port—on a far smaller scale than Bruges, however--in medieval times. This ranking export harbor for cloth and a large urban settlement benefitted from its vicinity with Ypres (in Flemish, Ieper), then a world famous trading place for cloth. Gradual silting of the river sounded the death toll for Dixmude, which with Ypres got practically raised during World War I.

CAPRICIOUS FLEMISH COAST

The coast and offshore area of Belgium have undergone numerous changes during the Anthropocene. The events involving the Zwin Inlet are but one. Channels have been filled in, such as the Sincfal, towns have been "swallowed up" by the North Sea, such as Harendyke and Walraverside, but there have also been "readjustments" at relatively short distance from today's coastline on the continental shelf. The Sincfal, was made up during the middle ages, of river estuaries, schorres, sandbanks, islands-- Wulpen (that gradually disappeared between 1377 and 1513), Koezand (totally disappeared by 1570), Zuidzande, Cadzand (now a small coastal harbor and resort), Schoneveld)—spread out where the mouth of the Westernscheldt is located nowadays. Originally an inlet, the Westernscheldt became an estuary between the ninth and twelfth centuries. The Sincfal is sometimes referred to as the early link between the coast and Bruges.

Peat layers, the retrieval of coins and artifacts, *inter alia*, witness that the area has undergone several very recent sea level changes. The peat layers continue under the present sea surface for quite a distance and reappear near the English coast.

Storm floods periodically affected the Rhine, Meuse and Scheldt estuaries, with effects on the coastal land of Flandrian Zeeland. Dunes protect only the western sides of the islands while the inlets- and outlets on the coastline are protected artificially by dikes; dunes development seems contemporary with the implantation of human built sea defenses (12th -13th century). The hard structure approach has not yielded all but benefits. Larger in- and out-lets have been closed by dams, as part of the Dutch Delta Plan, implemented after the disastrous and murderous storm and flood of 1953. Studies have been recently conducted to ascertain the possibility of assessing, predicting an possibly remediating the shifts of coastlines. The shoreline change rate is one of the most significant parameters in analyzing sandy shore behavior with time. This parameter can be

monitored by means of low- and high-resolution survey methods, depending on the objectives of the monitoring program. Survey efficiency is also very important for achieving high resolution in both space and time (Baptista *et al*., 2011).

Coastal barriers and dunes lined the coast during the Holocene; indeed, young tidal and lagoon deposits are overlain by Younger Dunes, that occasionally top Older Dunes, and barriers were destroyed when, after the Gallo-Roman historical period, the shoreline migrated seawards and the peat deposits were either eroded or covered by tidal flat sedimentary deposits.

This study, and especially the monitoring, of the regions bordering the North Sea, is of primary importance because of the economic implications, but also because of the future of large harbors of world significance and of the fate of large populations. The American press stressed a few decades ago that Charleston in North Carolina could end up 5 m below sea-level, though at the time not below such sea-level. Reason to worry, indeed, but with its territory for a good deal below sea-level and protected by a network of dykes, the threat is the more harrowing for The Netherlands, the adjoining territories, perhaps for large portions for Northwestern Europe.

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