Natural filling of macrotidal estuaries in the North of France (Opal Coast)

Environmental consequences and possible human interventions to mitigate them

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The three main Picard estuaries
(from F. Verger, 2009)

- Canche
- Authie
- Somme
Summary:

- The environmental context of the study area
- Recent data on current and past sedimentation: the process of sediment filling of the estuaries
- Environmental consequences of the filling process
- Is it necessary or even useful to reduce (or slow down) the filling process? What could be the best practices to do that?
Hydrodynamics and sediment sources of the study area

Somme Bay - tidal marshes of the south edge
Calculated swell propagation and significant wave height

27th February 1990 during a storm

Tide range in the eastern Channel and southern North Sea

Source: CETMEF/SHOM 2008
in SOGREAH, 2009
### Some hydrological characteristics

<table>
<thead>
<tr>
<th></th>
<th>Mean annual discharge close to the estuary</th>
<th>Extreme flood discharge</th>
<th>Mean suspended load</th>
<th>Catchment area</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Somme</strong></td>
<td>33 m³/sec</td>
<td>100 m³/sec</td>
<td>20 mg/l</td>
<td>6 550 km²</td>
<td>The river is nearly wholly channelized since 1770-1843 with several locks Slope of 1⁰/₀₀ Wide parts of the valley are frequently inundated especially at high tide</td>
</tr>
<tr>
<td><strong>Authie</strong></td>
<td>10 m³/sec</td>
<td>30 m³/sec</td>
<td>30 mg/l</td>
<td>1 305 km²</td>
<td></td>
</tr>
<tr>
<td><strong>Canche</strong></td>
<td>12 m³/sec</td>
<td>41 m³/sec</td>
<td>10-40 mg/l</td>
<td>1 274 km²</td>
<td>The river flow is not much disturbed by human works. A small dam in Hesdin was dismantled in 2005</td>
</tr>
</tbody>
</table>
A great quantity of sand available nearshore

A powerful longshore drift controlled both by prevailing winds and propagation of the tidal wave from the Channel to the North Sea
A simple model of « Picard » estuary development after Briquet (1930)

It explains the asymmetry of both edges and the shifting of the whole system to the north.

F: prevailing longshore current
V₁ V₂: flood current entering the estuary
M₁ M₂: retreating north bank shoreline
P₁ P₂: successive spits formed on the south bank
p₁ p₂: internal spits

The reality is more complicated...
Canche, Authie, Somme: some common points, but also major differences

Canche Bay: 10 km²

Authie Bay: 17 km²

Somme Bay: 70 km² (86 km² a century ago)

Source: Ppige (orthophotoplan, 2012-13)
The process of sediment filling

Authie Bay – seals on a sand bar close to Berck
© Y. Battiau-Queney
Flood and ebb tidal currents in the Authie Bay (spring tide)

Figure 2.18 - Champs de courants de marée en baie d’Authie

The Canche Bay: a typical « Picard » estuary?

Source: Ppige Orthophotoplan 2005
The Canche Bay: main flood current (in red) and wave refraction (in blue)

Contrasted situation along both edges of the estuary

central north bank

north bank (Lornel Head):
roof of a German bunker
At the rear embryo
dunes in front of older
dunes (July 2013) © photos YBQ
Canche Bay north bank in 2013
After a strong retreat since the last war the shoreline is currently advancing (embryo dunes and massive sand deposit in the intertidal area)
Elevation change in the outer Canche Bay 2011-2013 from airborne LiDAR surveys

Figure 3.1 - Evolutions anciennes de la baie d’Authie

Source : Jacques Beauchamp, La côte sableuse nord et la baie d’Authie, Internet http://www.u-picardie.fr/beauchamp/bds/inter_5.htm
Authie Bay: altitudinal and volumetric change from 1997 to 2008

Figure 5.9 - Evolution des fonds de 1997 à 2008
Stability of the north edge of the Somme bay, 1671-1970, compared to the northwards shifting of the Authie Bay (after Dobroniak, 2000)

Advance of the north edge of the Somme Bay (black line in 1947, yellow line in 2007)
Somme Bay: aerial view

St Quentin Head

Ilette bank

Maye R. delta

Crotoy Head

Hourdel Head

St Valéry

Sedimentology of eastern Channel (Anthony, 2002)

Somme Bay bathymetric change 1835-1993

Average input of sediment in the bay = 700,000 m³ / y
Elevation of the tidal area = 1.8 cm / y

Source: B. Latteux, 1998
Geomorphology of the Somme Bay

source: F. Verger, 2009

railway dyke

(high marsh)  (peat)  (hunting ponds)  (lock)
Environmental consequences of the filling process

Somme Bay - view to the south-east
Shrinkage of the tidal area and shoreline change from 2007 to 2013 in the Canche Bay

source: EDEN 62, Plan de gestion de la Réserve Naturelle Nationale de la baie de Canche, 2015
Inner Canche Bay: accretion and expansion of high tidal marsh (schorre) from 1947 to 2013

source: Julien Gosset, 2015, University of Lille
Authie Bay: surface area of high tidal marsh (schorre) along the north bank from 1971 to 2004
Somme Bay: expansion of high tidal marshes and retreat of the front of the ebb delta (1878-1997)

source: F. Verger, 2009
Is it useful to reduce (or slow down) the filling process? What could be the best practices to do that?

Authy Bay – high salt marsh (mollière) -inner part of the estuary, north bank
How to conserve biodiversity and accept economic development?

_Salicornia europea_ is present in the high « slikke » in the three estuaries, but especially in the Somme Bay. The picking is controled.
Somme Bay: different ways to keep the maritime character of the area

- Re-estuarisation of the small Dien River (1)
- Eradication of Spartina (2)
- Flush basins (3)
- De-polderization (4)
Thank you for your attention