

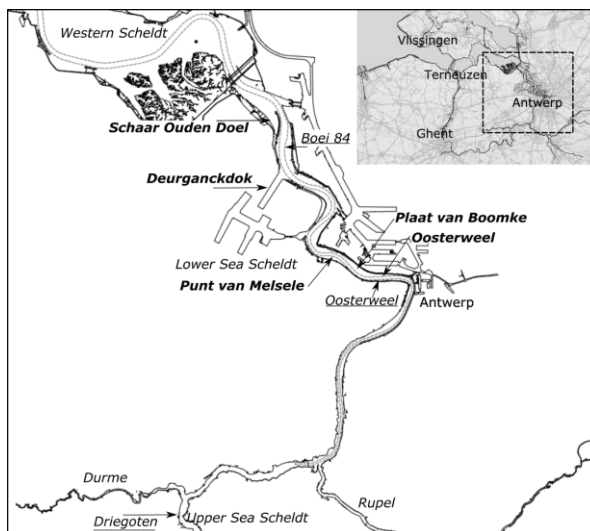
Mud disposal and suspended sediment concentrations in the Lower Scheldt

D. Depreiter, Lanckriet T., Van Holland G. (IMDC)
Vanlede J. (FHR), Beirinckx K. (AMT), Maris, T. (UA)

IAHR World Congress, The Hague, NL



Setting



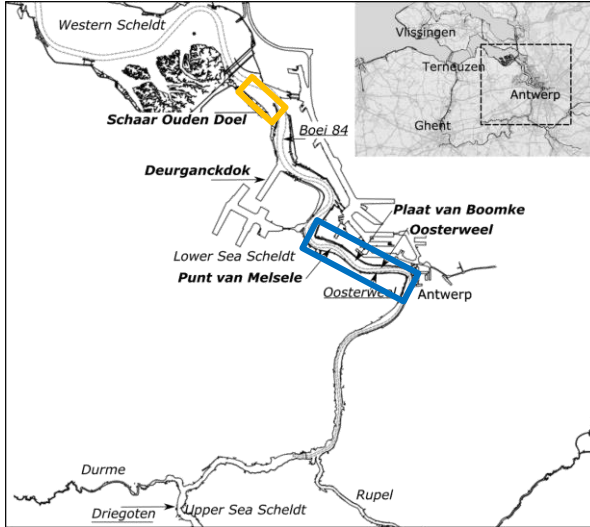
Seascheldt

- Belgian part of Scheldt estuary
- Single channel system
- Port of Antwerp
- Docks, locks, terminals
- Mudflats

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Sediment dredging & disposal



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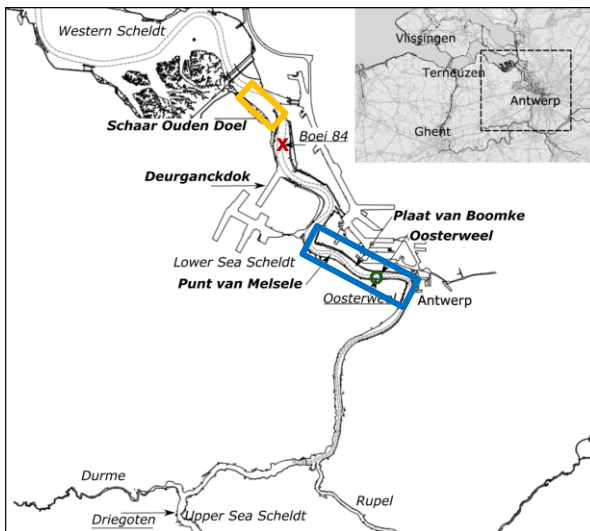
Dredging and disposal

Dredging: shoals, sills

Disposal separate locations for mud and sand disposal



Continuous turbidity measurements



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Dredging and disposal

Dredging: shoals, sills

Disposal separate locations for mud and sand disposal

Continuous turbidity meters 2 sites in lower Seascheldt:

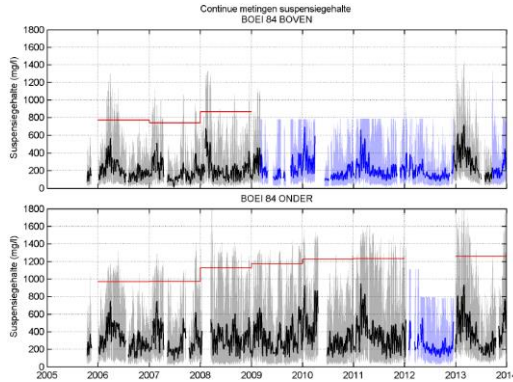
Boei 84 (x)

Oosterweel (o)



SSC data

- “Boei 84”
 - Measurements 0,8 m and 3,3 m above the river bed
 - Saturation: statistical model for estimation of ‘true’ average SSC

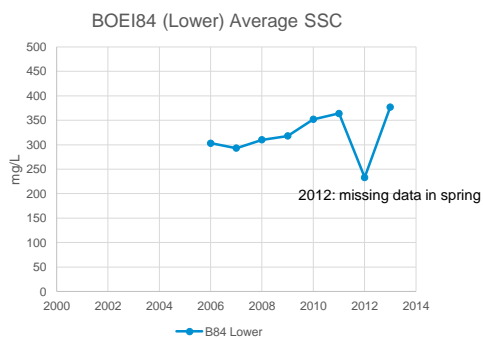
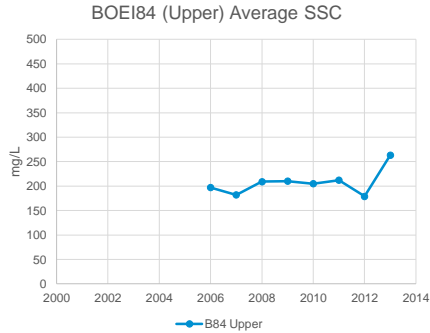
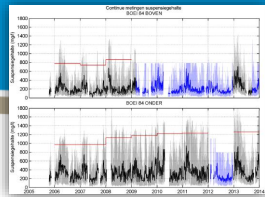


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SSC data

- “Boei 84”
 - Average SSC

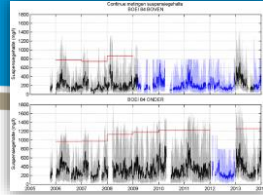


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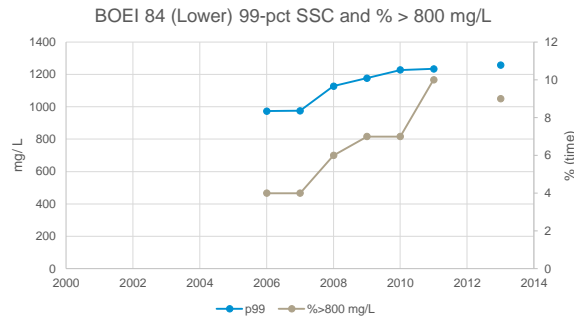


SSC data

- “Boei 84”



- Peak sediment concentrations: 99-pct and time > 800 mg/L

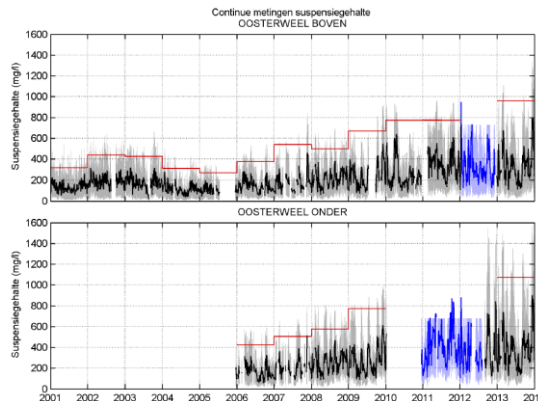


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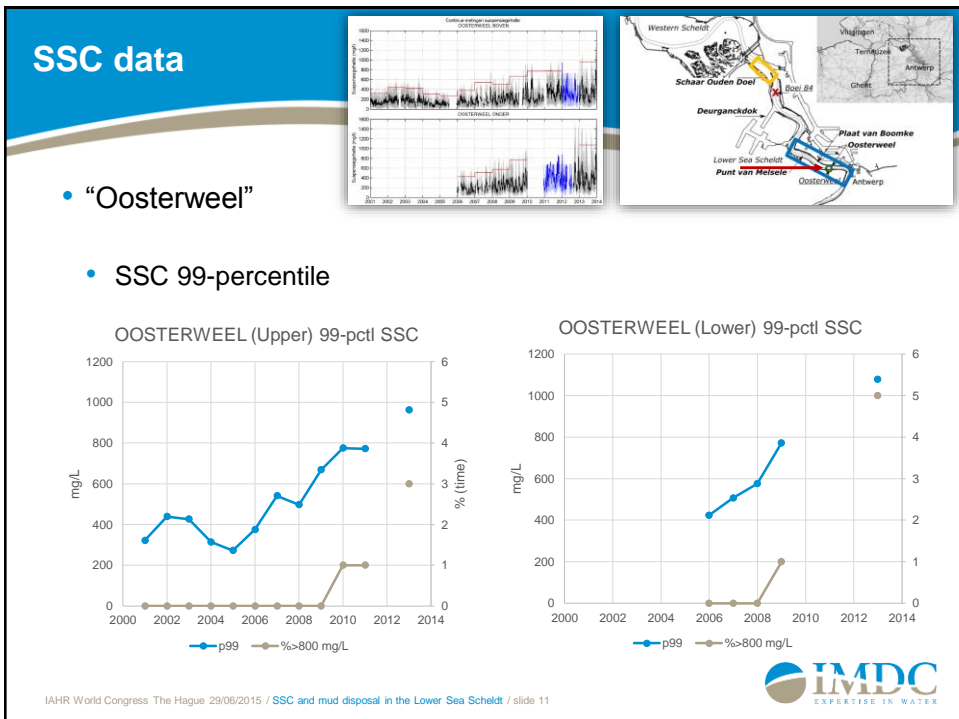
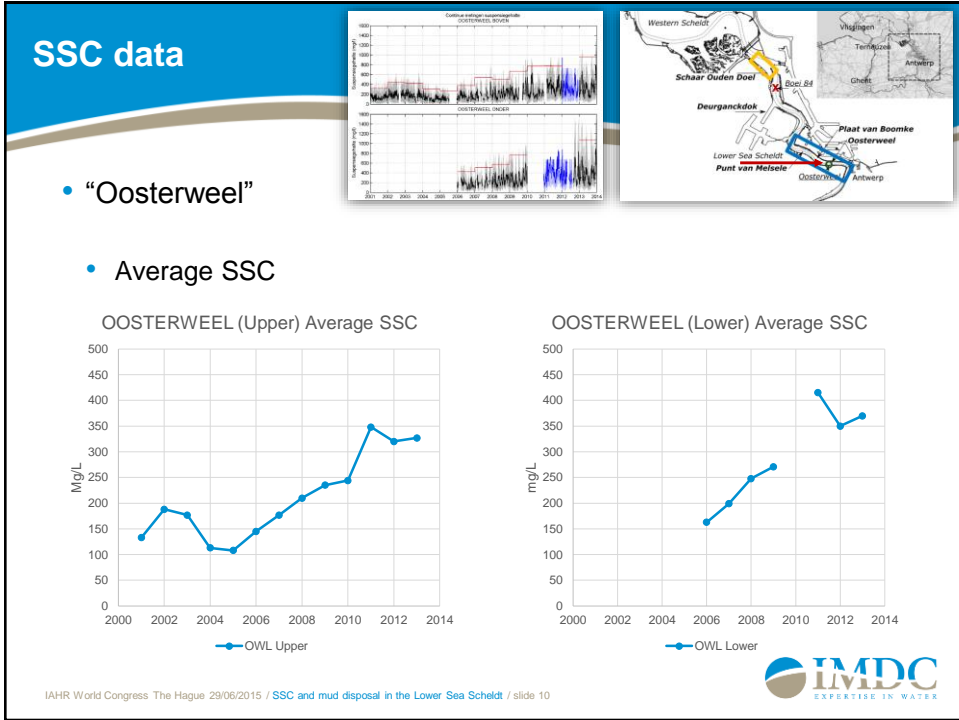
SSC data

- “Oosterweel” location
 - Measurements 1 m and 4,5 m above the river bed
 - Saturation: statistical model for estimation of true average SSC



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SSC data



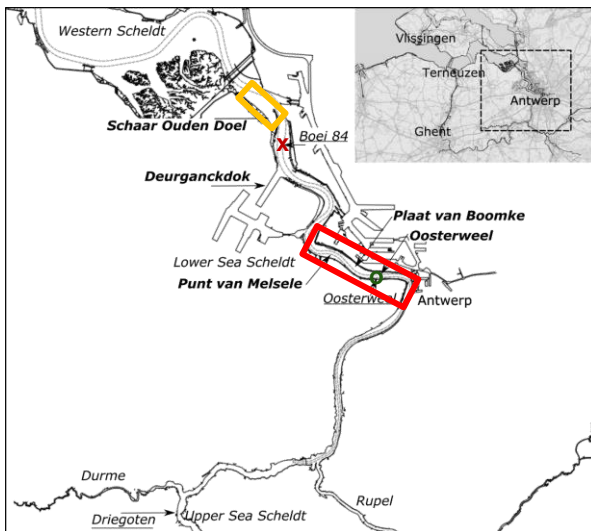
- Summary

	Average SSC	Max yr avg	99-pctl SSC	Max yr p99
B84 Upper	↗ 2007-2013	2013 (263 mg/L)		
B84 Lower	↗ 2007-2013	2013 (377 mg/L)	↗ 2006-2013	2013 (1258 mg/L)
OWL Upper	↗ 2005-2013	2011 (348 mg/L)	↗ 2005-2013	2013 (962 mg/L)
OWL Lower	↗ 2006-2013	2011 (415 mg/L)		
Driegoten		2011 (377 mg/L)		

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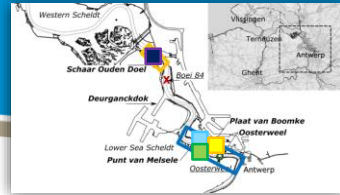
Sediment disposal



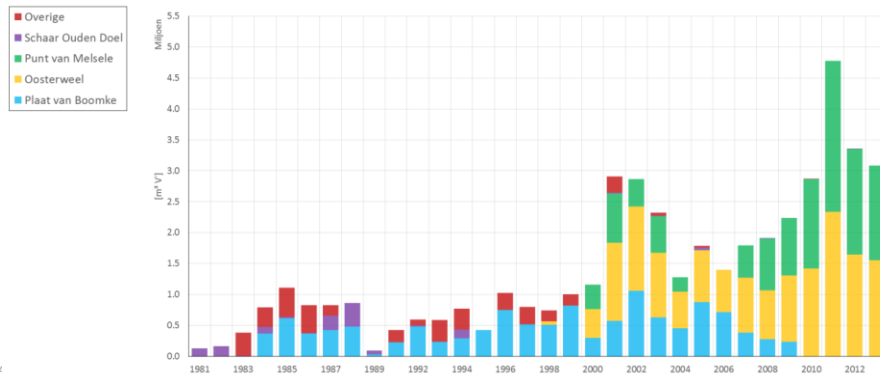
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Disposal data

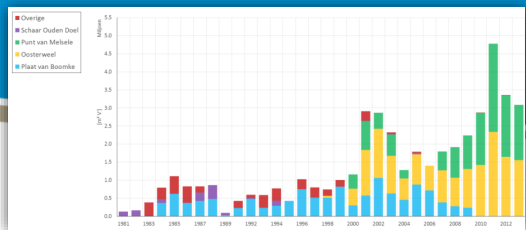


- Evolution of mud disposal volumes



1/

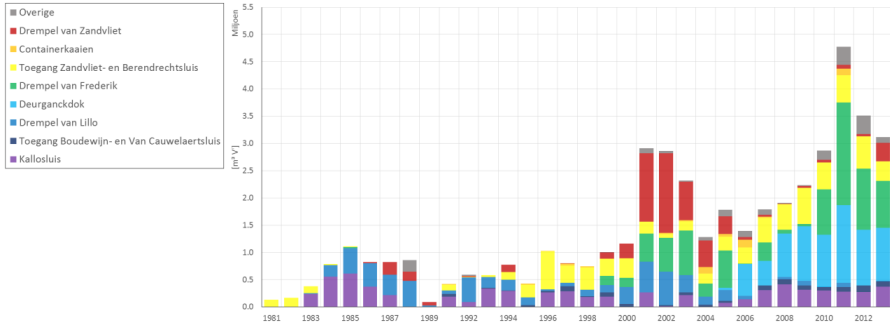
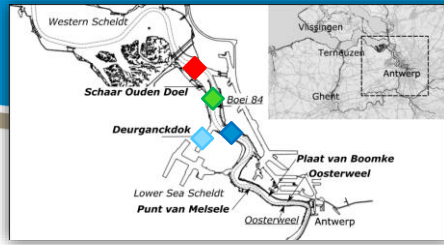
Disposal data



- Mud disposal volumes
 - Peak in 2001-2003
 - Deepening of Dremfels Zandvliet & Frederik (preparation for Deurganckdock activation)
 - Increase since 2007
 - Main increase: maintenance of Dremfel Frederik + Deurganckdock
 - Max volume in 2011
 - Deurganckdok: dredging depth -> design depth (less deep before)
 - 2012, 2013 lower than 2011; but still higher than <2010

Disposal data

- Mud disposal volumes
- Main mud dredging locations

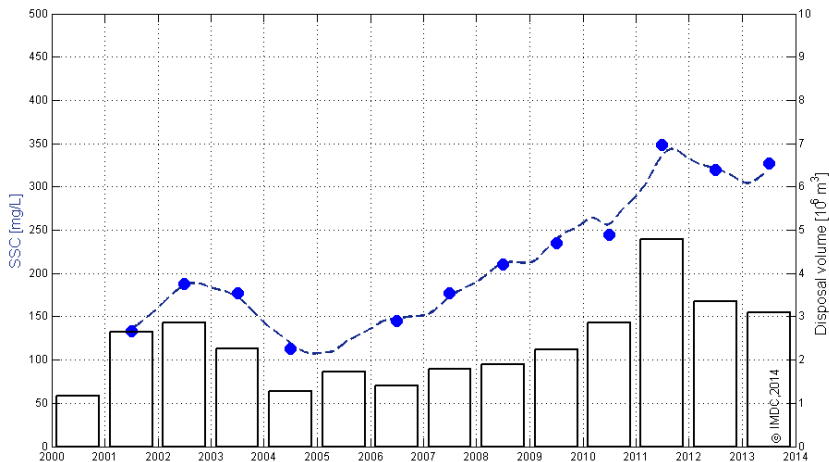
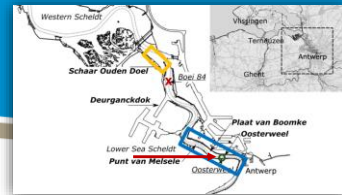


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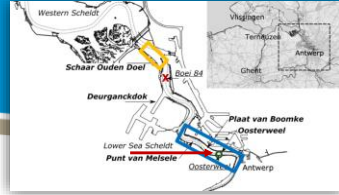


Relation mud disposal - SSC

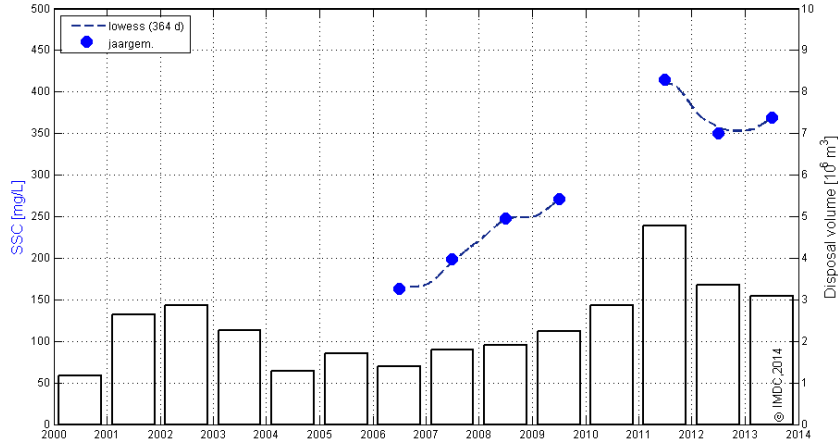
Oosterweel Top sensor
(= near disposal location)



Relation mud disposal - SSC



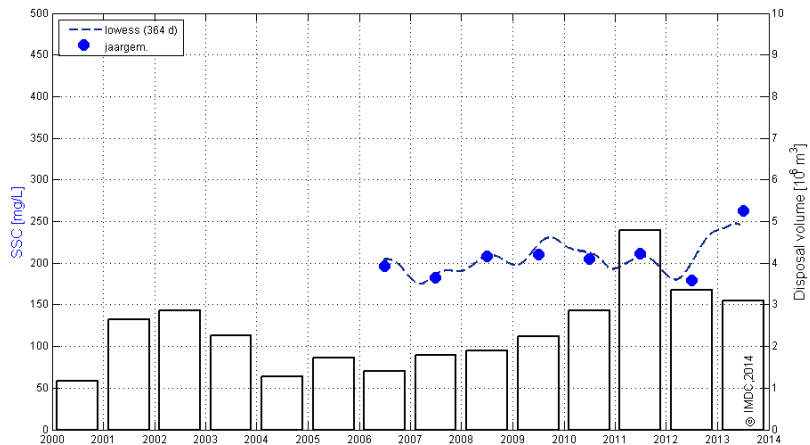
Oosterweel Lower sensor
(= near disposal location)



Relation mud disposal - SSC



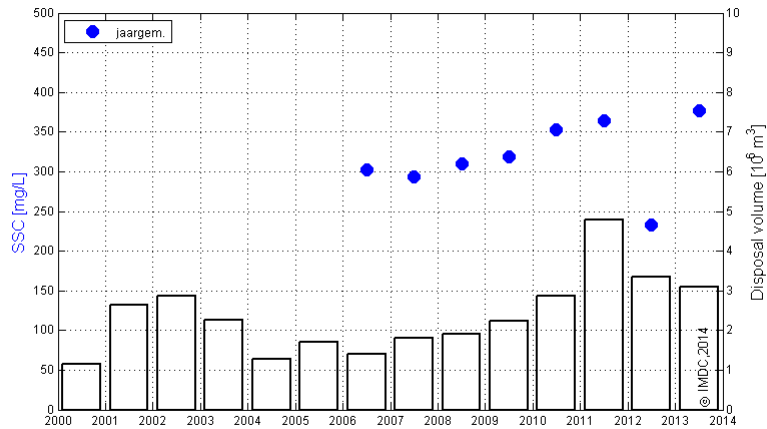
Boei 84 top sensor



Relation mud disposal - SSC

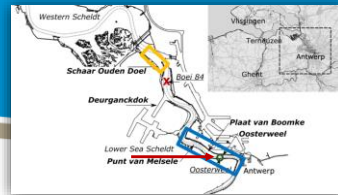


Boei 84 Lower sensor



IAHR

Multivariate regression



Oosterweel upper sensor

- Main explanatory variables:
 - Weekly mud disposal volume (45%)
 - Autoregressive component (45%)
 - Neap-spring cycle (36%)

Measured SSC is strongly depending on disposed mud volume and average SSC of the week before.

Vicinity of disposal locations!

Multivariate regression



Boei 84 lower sensor

- Main explanatory variables:
 - Autoregressive component (39%)
 - Neap-spring cycle (36%)
 - Weekly mud disposal volume (34%)

Measured SSC is depending on the autoregressive component and the neap-spring cycle signal. The weekly mud disposal volume is still an important factor, even at the greater distance. This was not obvious from the 'visual' trend in the signal.

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Discussion

Role of upstream discharge/sediment load?

Upper Seascheldt: discharge conditions control SSC
Relation not observed in Lower Seascheldt

Long term trend?

Biweekly-monthly sampling of surface since mid '90s
shows no significant avg-SSC trend in Seascheldt

→ presentations by W. Vandenbruwaene (*next presentation*)

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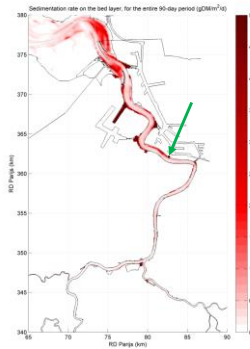


Discussion



Role of disposal location?

- Current maintenance and disposal has a net SCC increasing effect in the Lower Sea Scheldt
- "Recirculation" between Deurganckdok and disposal site
 - Effect of disposal at 'Oosterweel' site on sedimentation rate
 - Sedimentation mainly occurs in DGD and lock entrances

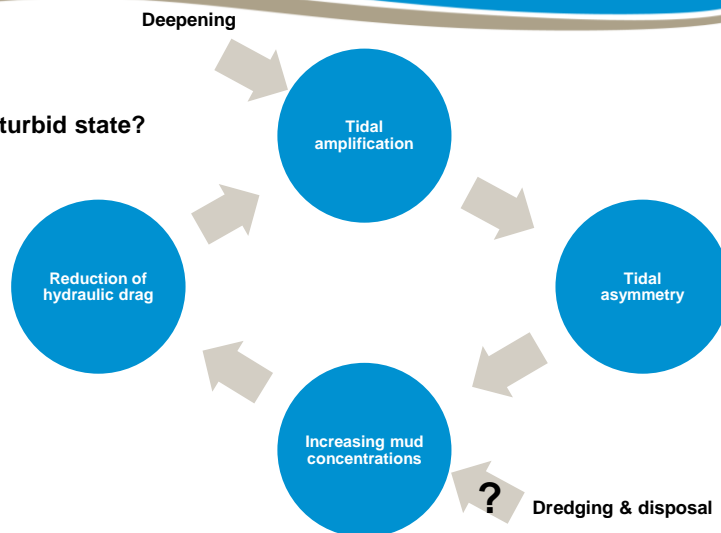


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Discussion

Towards a hyperturbid state?



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Conclusions and outlook

- Yearly average continuous SSC shows increase since ~2007 and peaks in 2011/2013
- 99-pct SSC concentrations increase as well and peak in 2013
- SSC > 800 mg/L occurs more frequently since 2007-2008
- Mud disposal has increased in volume in 2001-2003 and again since 2007
- A peak in mud disposal occurred in 2011
- This activity is related to
 - deepening of sills (2001-2003) and
 - maintenance depth of the Deurganckdok dredging and nearby sill
- Influence of disposal at Oosterweel is important in nearby measurements and still significant at further locations (Boei 84)
- How does this compare to long term SSC evolution?
- Does it pose a risk for a system state transition towards hyperturbidity ?

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