

Modelling the fate and transport of suspended sediments and contaminants in the Scheldt River and Estuary with the finite element model SLIM

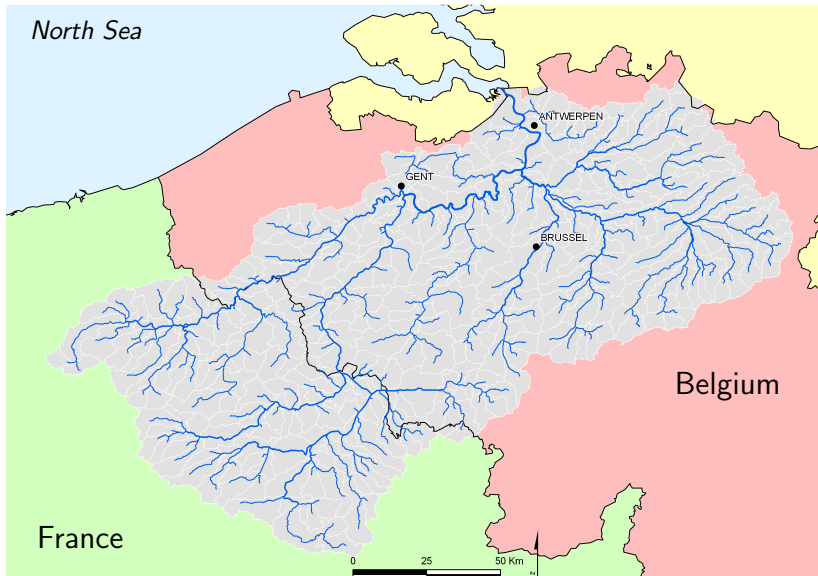
O. Gourgue, A. de Brauwere, B. de Brye, E. Deleersnijder

Université catholique de Louvain (UCL), Belgium

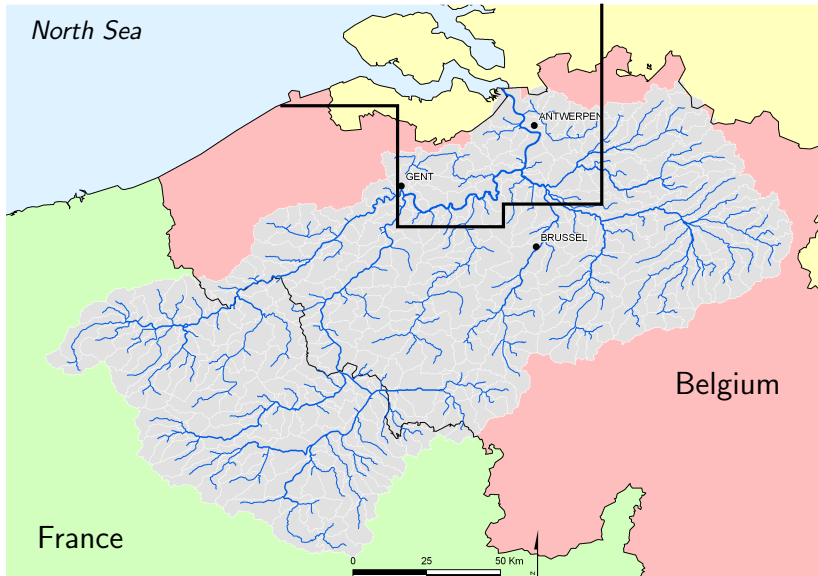
May 21, 2012



The Scheldt watershed



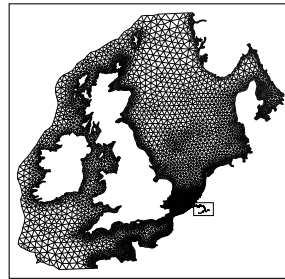
The Scheldt watershed



Modelling the Scheldt using SLIM

SLIM

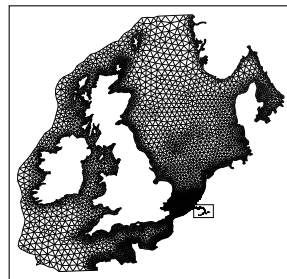
Deleersnijder *et al.*, Monday 5.00 pm



Modelling the Scheldt using SLIM

SLIM

Deleersnijder *et al.*, Monday 5.00 pm



Hydrodynamics

de Brye *et al.*, JONSMOD 2010

Dissolved transport

de Brye *et al.*, Wednesday 10.00 am

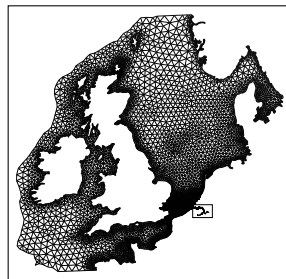
Particulate transport

This presentation

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SLIM

Deleersnijder *et al.*, Monday 5.00 pm



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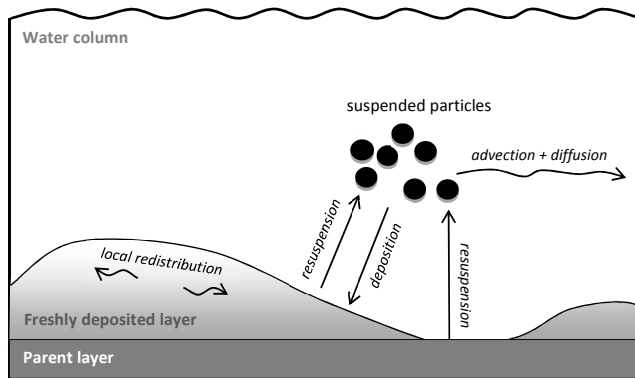
Particulate transport

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Objectives

1. Building a simple deposition/resuspension sediment module
2. Studying long term environmental pollution problems:
 - *E. coli* concentration
 - trace metal concentration
 - ...

Sediment module: processes and parameters



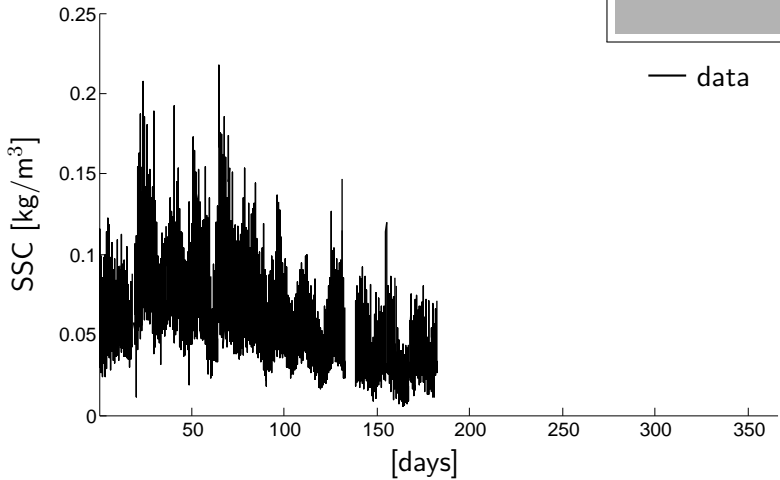
Resuspension:

- M : erosion rate
- τ_e : critical shear stress

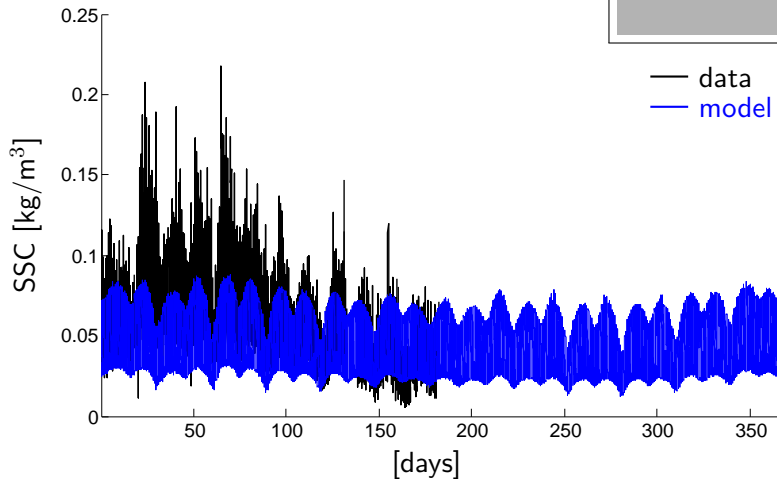
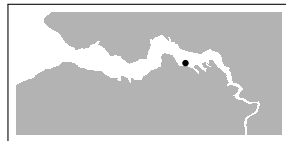
Deposition:

- w_s : settling velocity

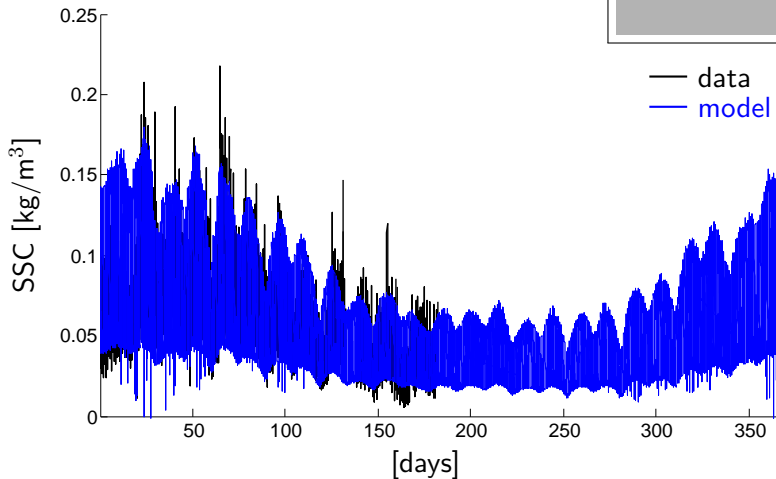
Time series close to Baalhoek (2000)



Using constant parameters



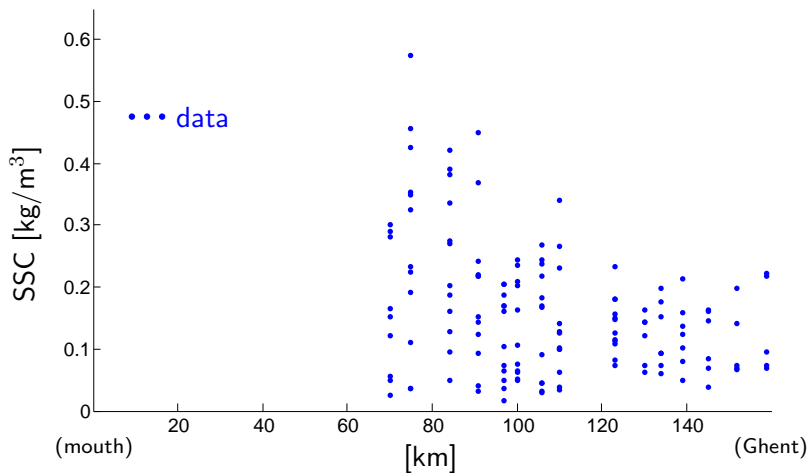
Taking biological activity into account



τ_e and w_s increase with temperature
(due to the increase of biological activity)

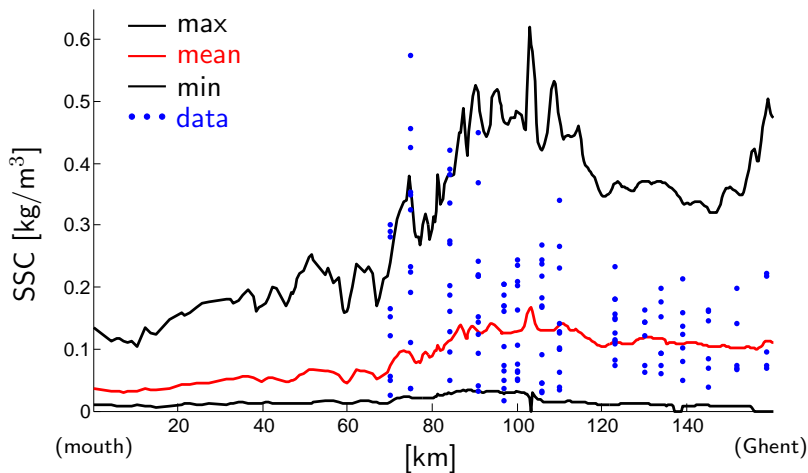
Reproducing the main estuarine maximum of turbidity

Comparison with field measurements (2002)



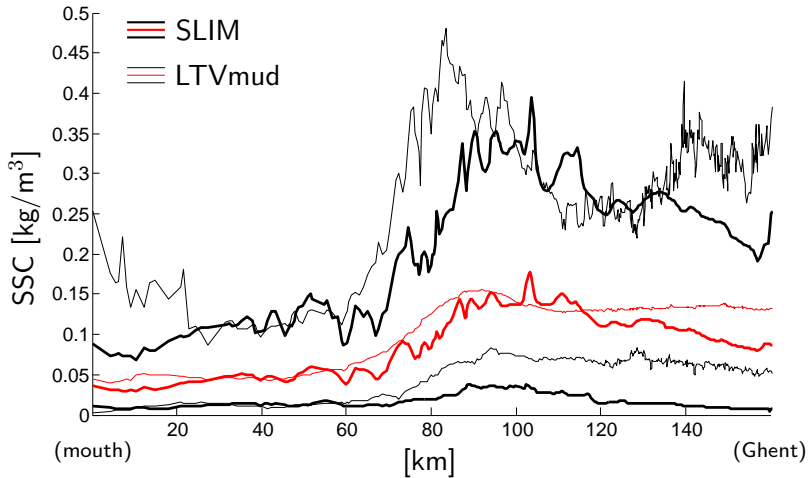
Reproducing the main estuarine maximum of turbidity

Comparison with field measurements (2002)



Reproducing the main estuarine maximum of turbidity

Comparison with the results of the 3D LTVmud model (Fall 2006)



Processes taken into account

Version 1.0 (submitted to JMS)

- settling velocity increases with suspended sediment concentration, salinity and temperature (flocculation)
- critical shear stress increases with temperature (biostabilization)

Version 1.1 (JMS paper in revision)

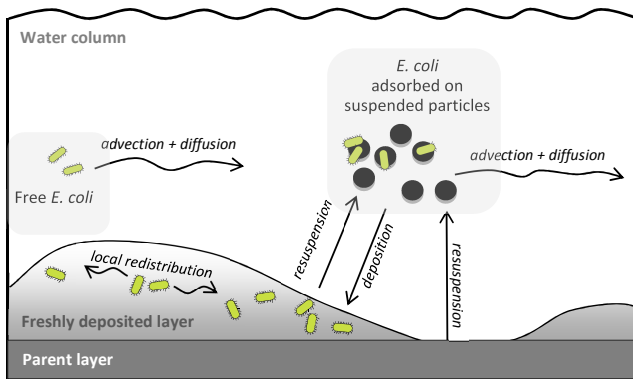
- effect of salinity on flocculation limited to small salinity values
- critical shear stress increases with mud proportion on the bottom

Version 2.0 (future developments)

- several sediment classes
- 3D component of SLIM
- influence of turbulence on flocculation
- ...

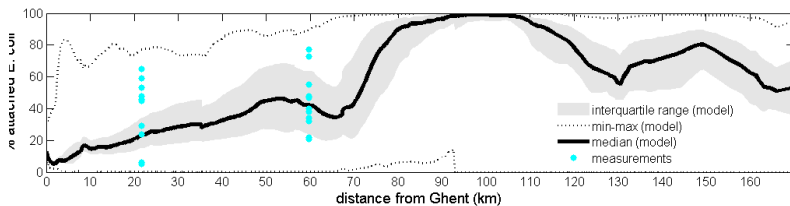
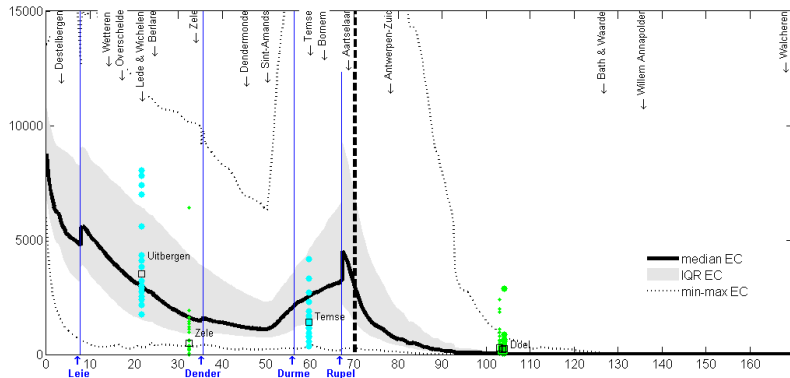
A first environmental application

E. coli concentration

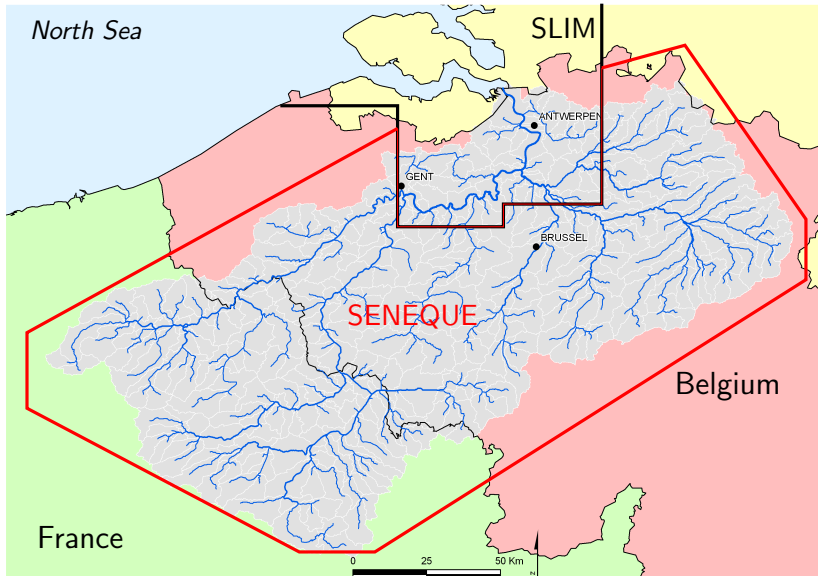


Model results vs. field measurements

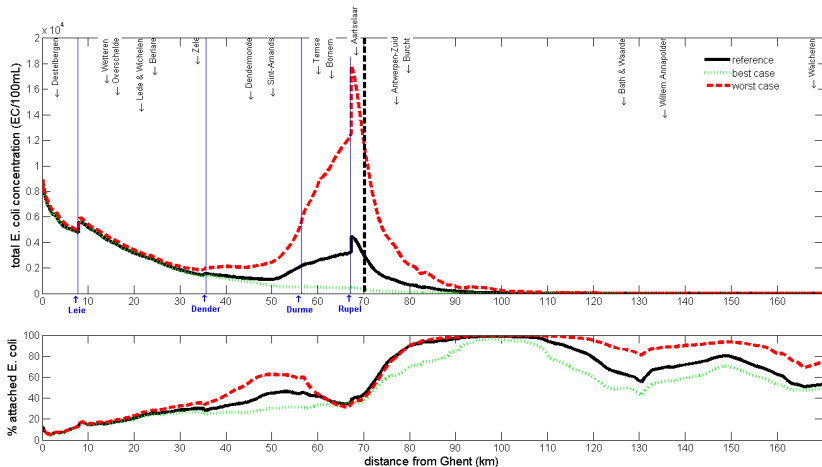
March 2007 - June 2008



Coupling tidal (SLIM) and catchment (SENEQUE) model

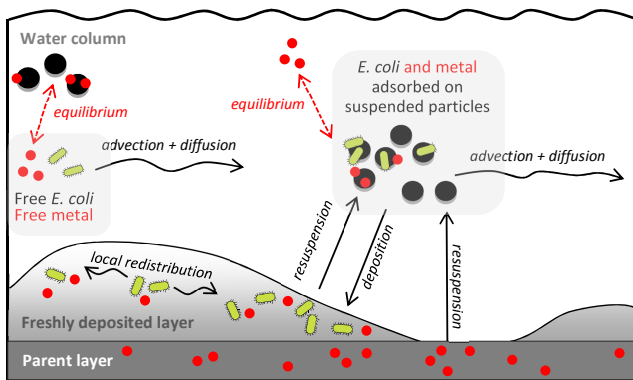


Comparing different wastewater management scenarios

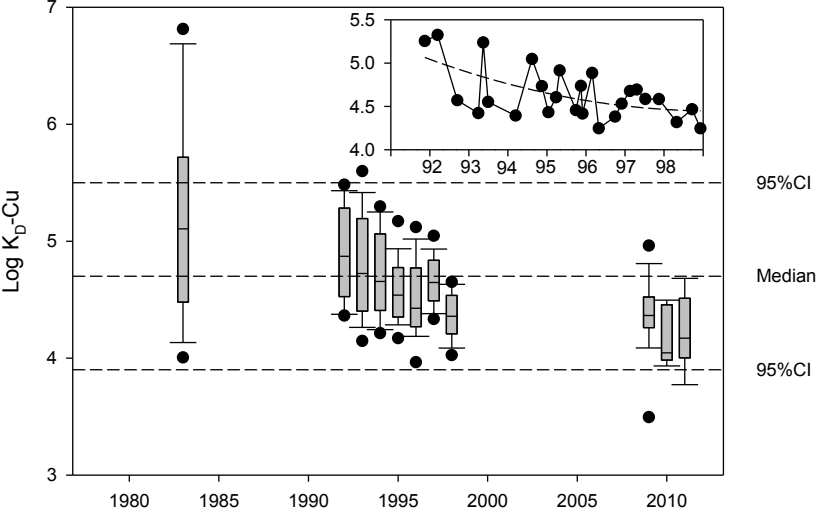


A second environmental application

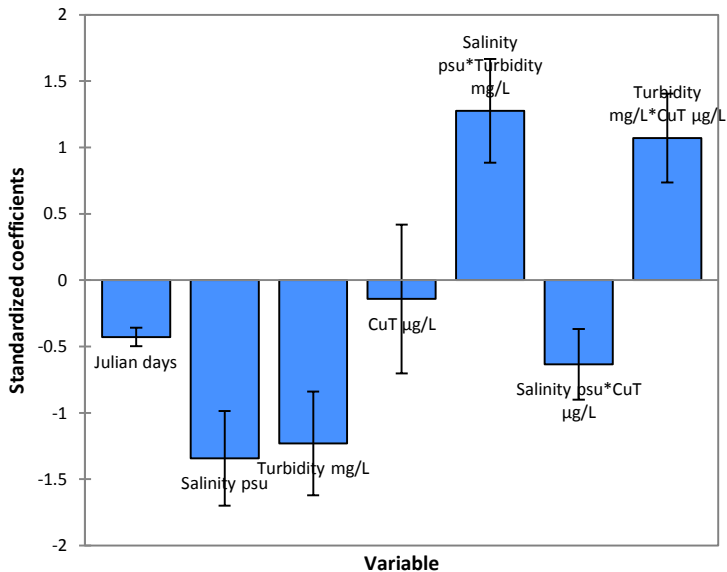
Trace metal concentration



Evolution of the partition coefficient K_D (copper)

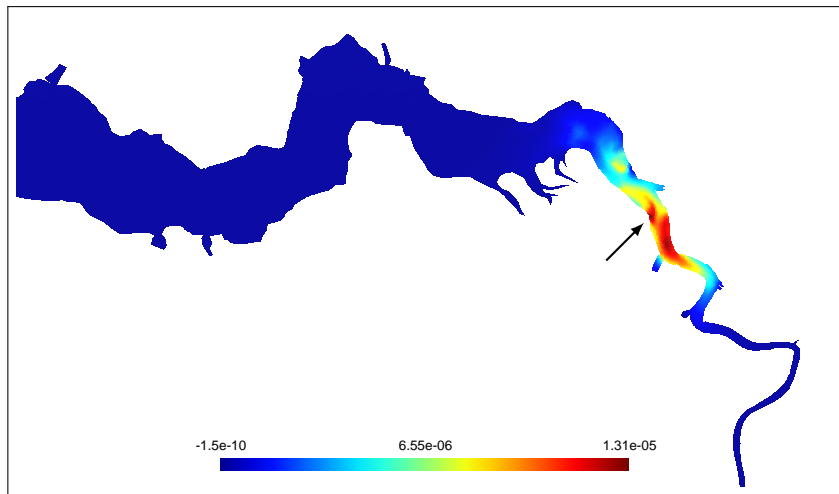


Variables influencing the partition coefficient K_d (copper)



First test case: accidental release of cadmium

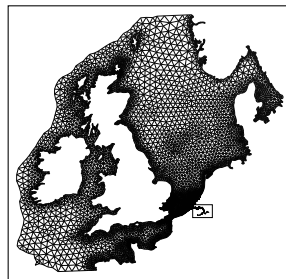
Total concentration in water [kg/m^3]



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Environmental applications

JONSMOD 2014 ?