Odour nuisance in Scheldt branch Gentbrugge-Melle

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Introduction and objective

The tidal branch of the Sea Scheldt between the lock of Gentbrugge and Melle – part of the complex Ringvaart system around Gent – has not received any upstream discharge since 1981. As a consequence ebb velocities were reduced while flood velocities were left unaffected, causing sedimentation in the branch. At some locations along the branch, odour nuisance was regularly reported.

In order to address this problem, Division Sea Scheldt of the Flemish Government proposed to dredge the associated muddy material. Flanders Hydraulics Research was asked to conduct a study about the necessary upstream discharge at the lock of Gentbrugge needed to ensure the river branch's self-erosiveness.

Geographical situation

The tidal branch between Gentbrugge and Melle is located at the upstream end of the tidal zone of the river Scheldt. The limits of the tidal zone are a combination of a weir and sluice at Gentbrugge, a weir and sluice at Merelbeke and a sluice at Zwijnaarde. This locations are shown in **Figure 1**.

The tidal branch between Gentbrugge and Melle is the original meander of the river Scheldt. In 1969 the Ringvaart around Gent was constructed: ever since navigation to the river Leie occurred via the sluice of Merelbeke. As a consequence of the construction of the Ringvaart, the discharge through the branch of Gentbrugge - Melle diminished. From 1981 no more upstream discharge was released through this branch.

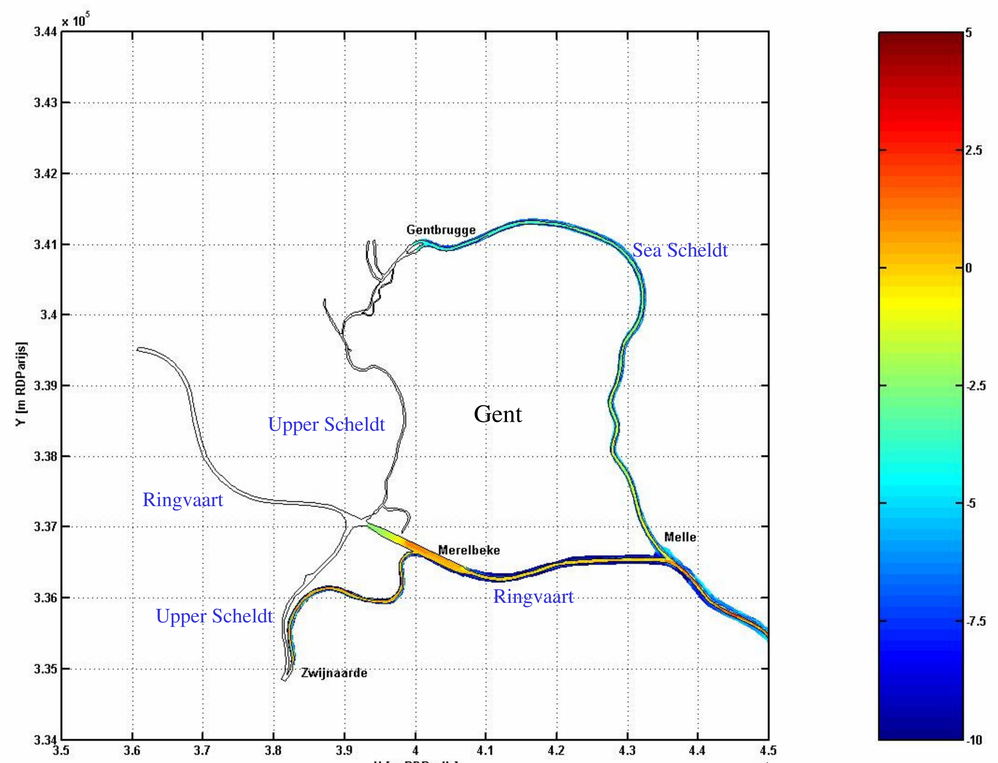

Figure 1. Geographical situation of the tidal branch between Gentbrugge and Melle. Bathymetric reference plane in m TAW.

Methodology

Numerical model

In order to study this problem, a 2D numerical model of a part of the Sea Scheldt was constructed by Flanders Hydraulics Research. The domain of this model is extended from Driegoten at the downstream end up to Gentbrugge, Merelbeke and Melle at the upstream end, as shown in **Figure 2**. The software Delft3D was used to carry out the simulations.

To run the numerical model, monitored data were to be combined with state of the art modelling know-how. The data from the extensive measurement network of Flanders Hydraulics Research – as well as measurement data from AOSO and AMINAL – were used to deliver this boundary conditions. At the downstream boundary a water level was imposed, at the upstream boundary yearly averaged discharges. To take into account the effect of the river Dender, a discharge at Dendermonde was imposed as well. Besides from the hydrological data, sediment parameters (particle characteristics, concentrations) were to be imposed as well.

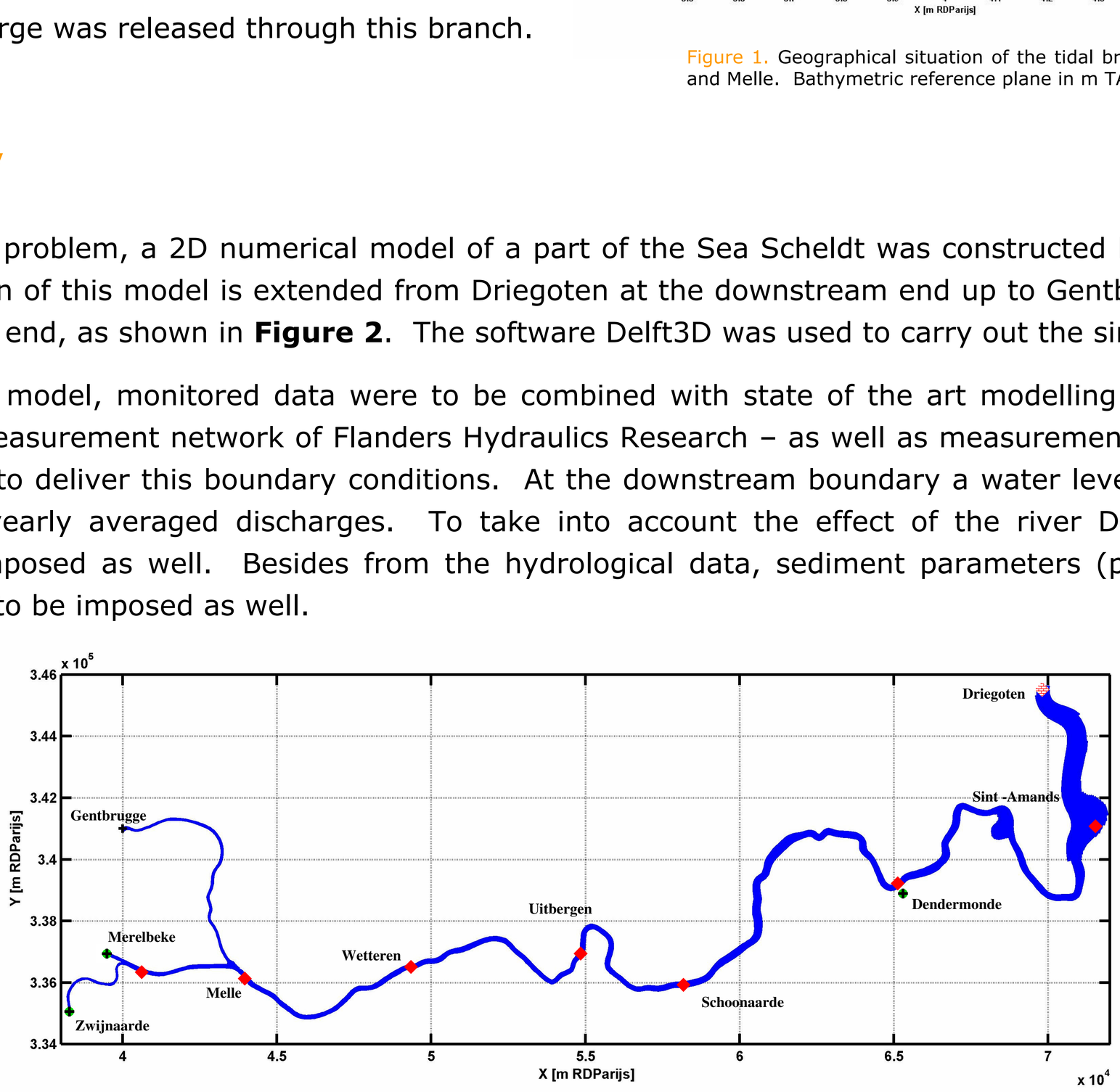

Figure 2. Overview of the numerical model and measurement stations.
- water level station
- interpollated water level from water level station Tielrode, Temse and Sint-Amands
- discharge location
- discharge and sediment flux measurement

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Methodology (continued)

Model calibration and validation

After the numerical model was set up, hydrodynamics were to be calibrated. By adaptation of some model parameters (bottom roughness, water viscosity and algorithm for drying and flooding) the evolution of the water level at different stations shown in **Figure 2** was optimized. One of the results of the calibrated model is shown in **Figure 3:** observed and modelled water level at station Melle.

Afterwards the calibrated and validated hydrodynamic model was extended to become a morphological model. By carrying out a hindcast and adapting some of the parameters (inflow sediment concentration, critical shear stress, density) this morphological model was also calibrated.

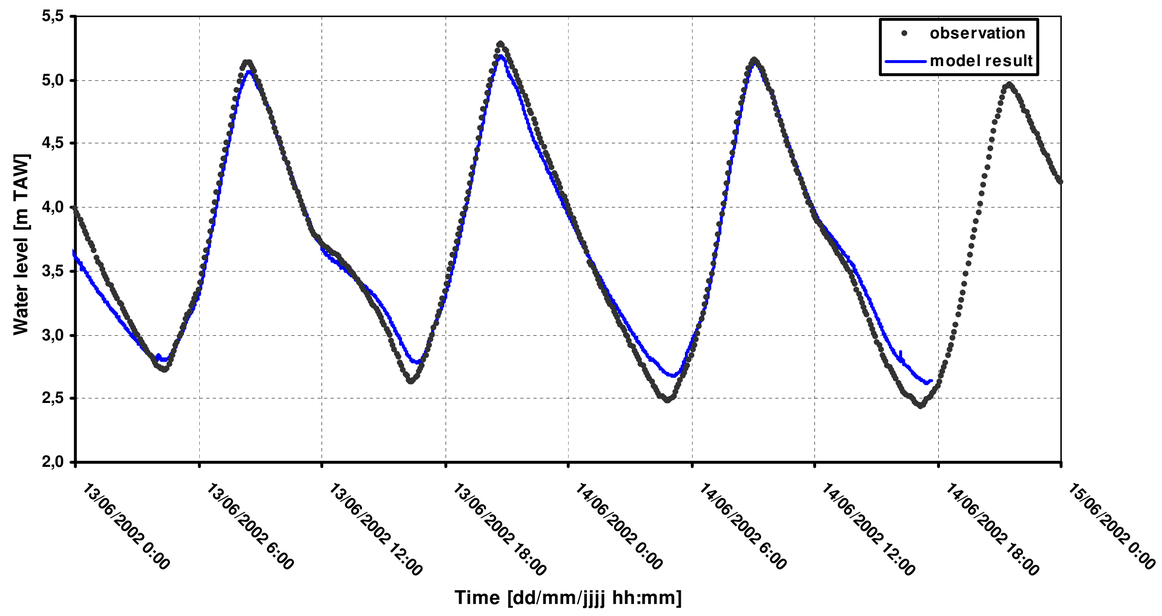

Figure 3. Water level at Melle: observation versus model result.

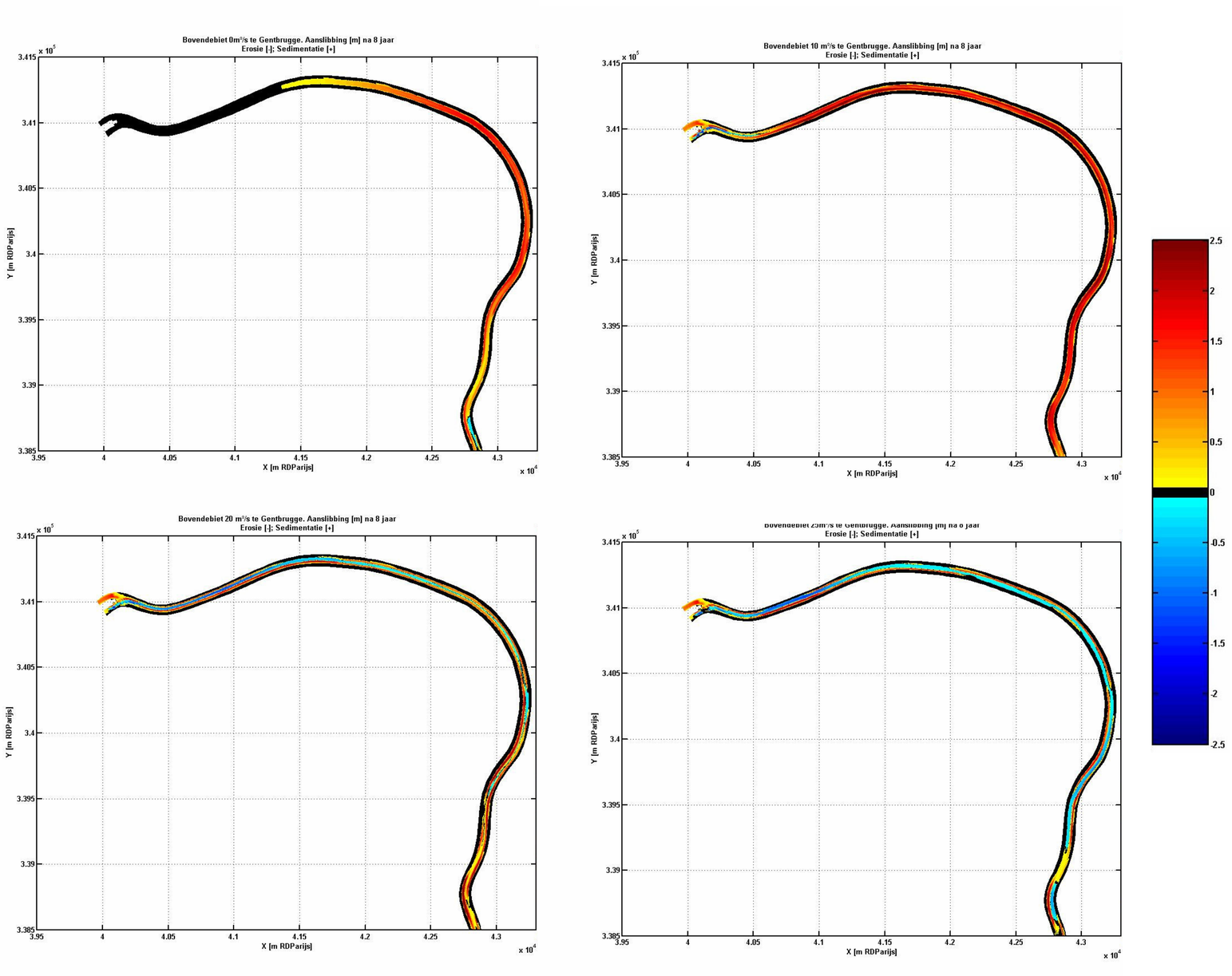

Figure 4. Erosion-sedimentation patterns at the tidal branch of Gentbrugge-Melle for different upstream discharges. Blue = erosion, red = sedimentation.

Scenarios

In order to determine the discharge at the weir of Gentbrugge needed to ensure the river branch's self-erosiveness, different scenarios were carried out. The upstream discharge at this weir was varied in the different scenarios from 0 to 25 m³/s.

In **Figure 4** the erosion and sedimentation pattern of a 8 year simulation is shown for some of the scenarios. It was concluded that a strong sedimentation of the tidal branch occurs at discharges smaller then 10 m³/s. Sedimentation reduces significant at discharges between 10 and 25 m³/s, reaching a minimum around 20 to 25 m³/s.

As a remark it needs to be mentioned that the different scenarios were carried out with a constant discharge, which will never be the case in reality.

Conclusion

Since 1981 the tidal branch of the Sea Scheldt between the lock of Gentbrugge and Melle has not received any upstream discharge. As a consequence sedimentation occurred, causing odour nuisance at some locations. In order to address the problem, Division Sea Scheldt of the Flemish Government proposed to dredge the associated muddy material. Flanders Hydraulics Research conducted a study about the necessary upstream discharge at the lock of Gentbrugge needed to ensure the river branch's self-erosiveness.

After numerous numerical scenarios, it can be concluded that the discharge required lies between 20 and 25 m³/s. However, as a mean discharge of only 70 m³/s is discharged into the entire water system around Gent and as the other waterways within this system require sufficient discharge as well, this discharge is not available in the tidal branch in normal circumstances. Currently Flanders Hydraulics Research is investigating the possibilities of a lower discharge at the weir of Gentbrugge that would allow to maintain the branch with a limited dredging. In this study the effect of a variable discharge is also taken into account.