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A COMPREHENSIVE GIS APPROACH TO DREDGING-RELATED STUDIES AND DATASETS FOR THE BELGIAN COASTAL WATERS AND THE SCHELDT ESTUARY

Natasha Blommaert[1], Frederik Roose[1], Chantal Martens[1], Kenneth Cools[2]

[1] *afdeling Maritieme Toegang, E-mail: natasha.blommaert@mow.vlaanderen.be, frederik.roose@mow.vlaanderen.be, chantal.martens@mow.vlaanderen.be*
[2] *Geo Solutions NV, kenneth.cools@geosolutions.be*

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ABSTRACT

The web application 'Data Viewer', developed by the Flemish Maritime Access division of the Flemish Ministry of Mobility and Public Works, supports the operation of dredging and environment-related activities in the access channels to the Flemish harbours. This application enables the geographical visualisation and a limited analysis of various complex dataset types. The present database contains dredging intensity data, various hydrodynamic measurements and density profiles on silt accretion locations. The advantages of the Data Viewer are numerous: data in this central database is accessible, easy to consult and to interpret, in relation to various dredging monitoring and reporting activities.

Currently, the Data Viewer is only internally accessible because of security reasons. As soon as the security issue is solved external third parties can register in order to log on to this site.

The Environment and Information Portal is a JAVA based web application connected with an Oracle 11g database and an Arc SDE 10 GIS database engine. The GIS data are published in the form of web map services (WMS) and web feature services (WFS) through an Arc GIS server 10. The visualisation of the geographic data is implemented by an Openlayers javascript library.

Dredging Intensity data

The accessibility of the Flemish harbours requires continuous maintenance dredging activities in the navigation channels in the Belgian coastal waters and in the Scheldt estuary. The dredged sediment is transported to allocated relocations sites by trailer suction hopper dredgers. A Dredging Information System stores all information related to the dredging and relocation process, which allows the retrieval of intensity maps of the dredging and relocation sites. The intensity maps, showing the spatial distribution of weight and volume of dredged sediment, are very useful for morphological analysis in the framework of optimisation of the dredging and relocation process, environmental monitoring and environmental impact assessment.

The user interface allows querying on time and space. The cumulated intensity map is visualised over the requested time period from 1 week up to several years and multiple dredging or relocation sites in a standard colour legend.

The web based GIS viewer offers standard viewing facilities, an identify tool, multiple background layers and export features.
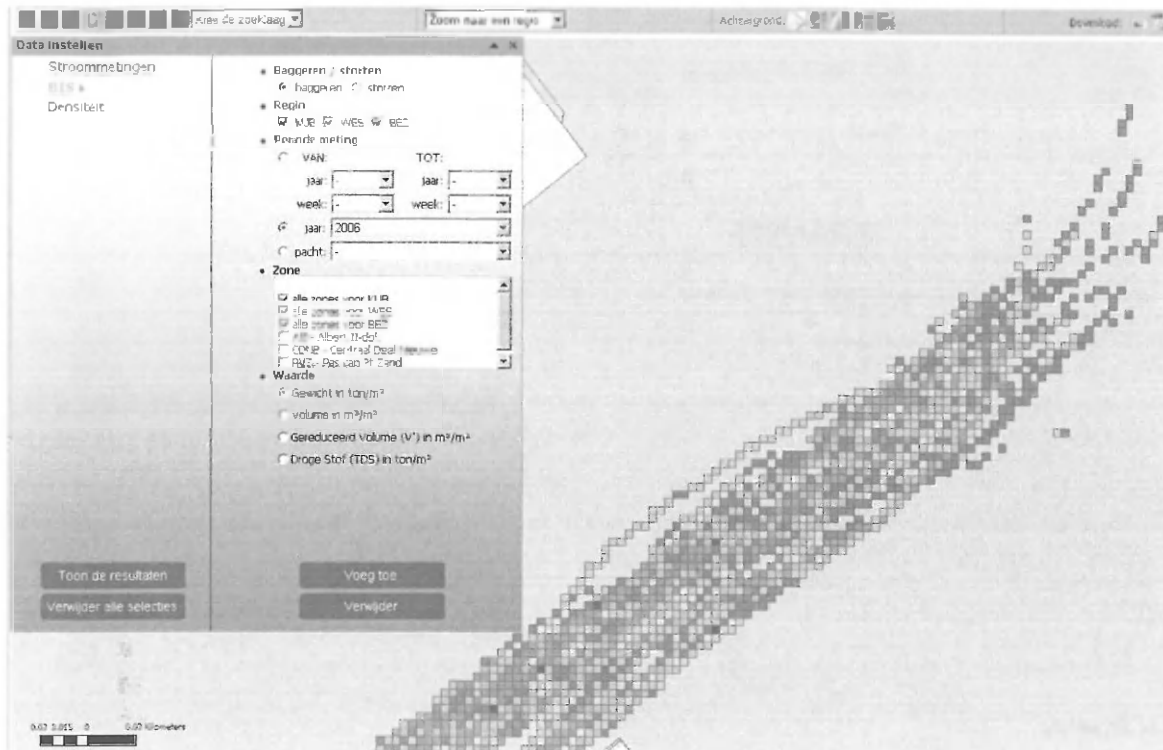
Fig. 1. Visualisation of Dredging Intensity data. The pop up window allows the user to make a search query in the dredging intensity database.

Cross-sectional current velocity measurements

The Belgian Coastal waters and the Scheldt estuary are subject to a tidal regime. Cross-sectional hydrodynamic measurements during a tidal cycle are executed regularly within the framework of the monitoring programs along a series of predefined transects or at request during additional research surveys. The cross-sectional hydrodynamic measurements consist of a set of consecutive acoustic recordings along a transect of current velocity and suspended sediment concentration, of which discharge, and sediment flux through the transect can be deduced. The data obtained during the cross sectional hydrodynamic measurements are imported in the ArcSDE 10 database by a customised Python® script.

The user interface allows querying on time period, the location of a cross section and on the measured time interval during the cycle. The queried sectional hydrodynamic measurements are visualised as current velocity vectors on the geographic map, indicating the current velocity and current direction at a chosen depth. The Data Viewer is not designed to show suspended sediment concentrations.

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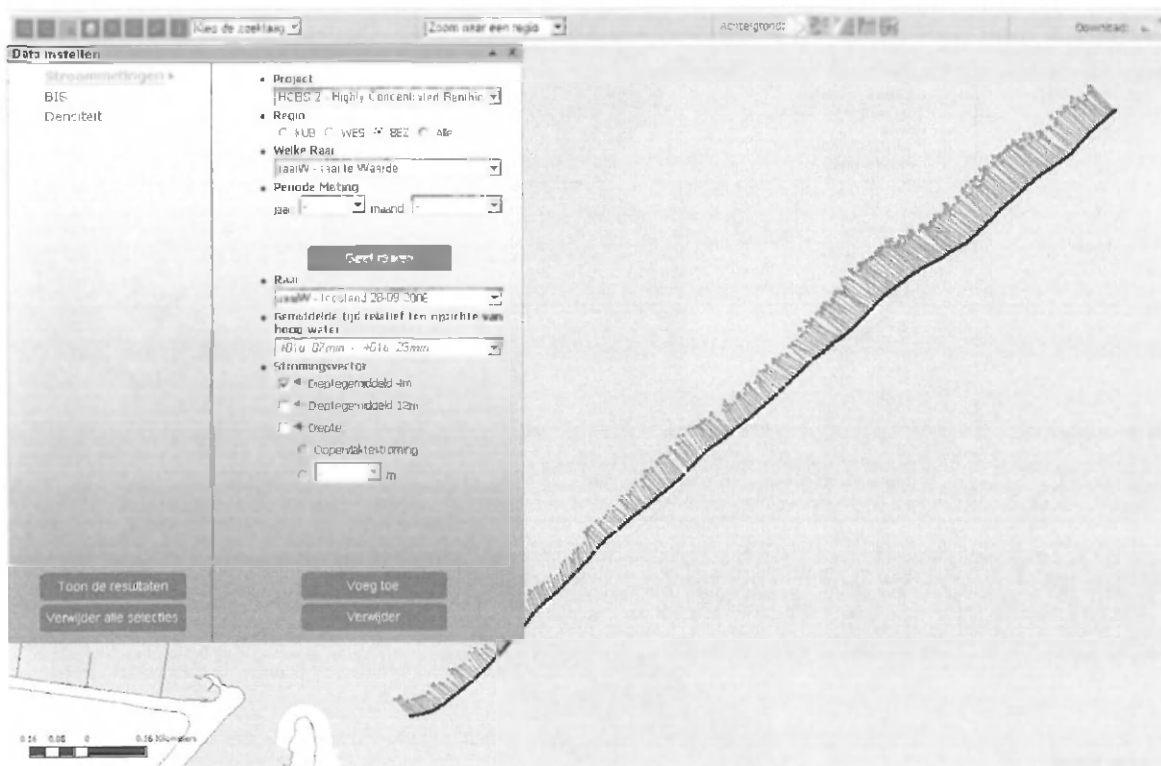
Fig. 2. Visualisation of cross- sectional current velocity measurements. The pop up window allows the user to make a search query in the cross section current velocity measurement database.

Density profiles in silt layers

The neighbourhood of the harbour of Zeebrugge at the Belgian coast and the harbour of Antwerp in the Scheldt estuary are characterised by the presence of a turbidity maximum of fine cohesive sediments. These sediments accumulate in harbour basins, resulting in the formation of cohesive silt layers.

The cohesive silt layers are surveyed by a dual-frequency echo sounder (210 and 33 kHz) and by density profiles of which the depth of equal density layers and the nautical depth (defined as the 1.2 t/m³ density) can be determined in a certain area of interest.

The survey results are visualised on the geographic map of the application. All points are labelled with the depth value of the selected density values and the dual-frequency soundings.

At the moment of writing, the functionality to visualise isobaths between the selected data, was still in a developing phase. The solution for the visualisation of the interpolation or other geospatial processes could be delivered by the implementation of so called Web Processing services (WPS). A WPS allows the user to request a certain image processing algorithm on the available data. The execution of this algorithm delivers an output which could be directly returned to the client or could be saved as resource data at the server side of the web application.
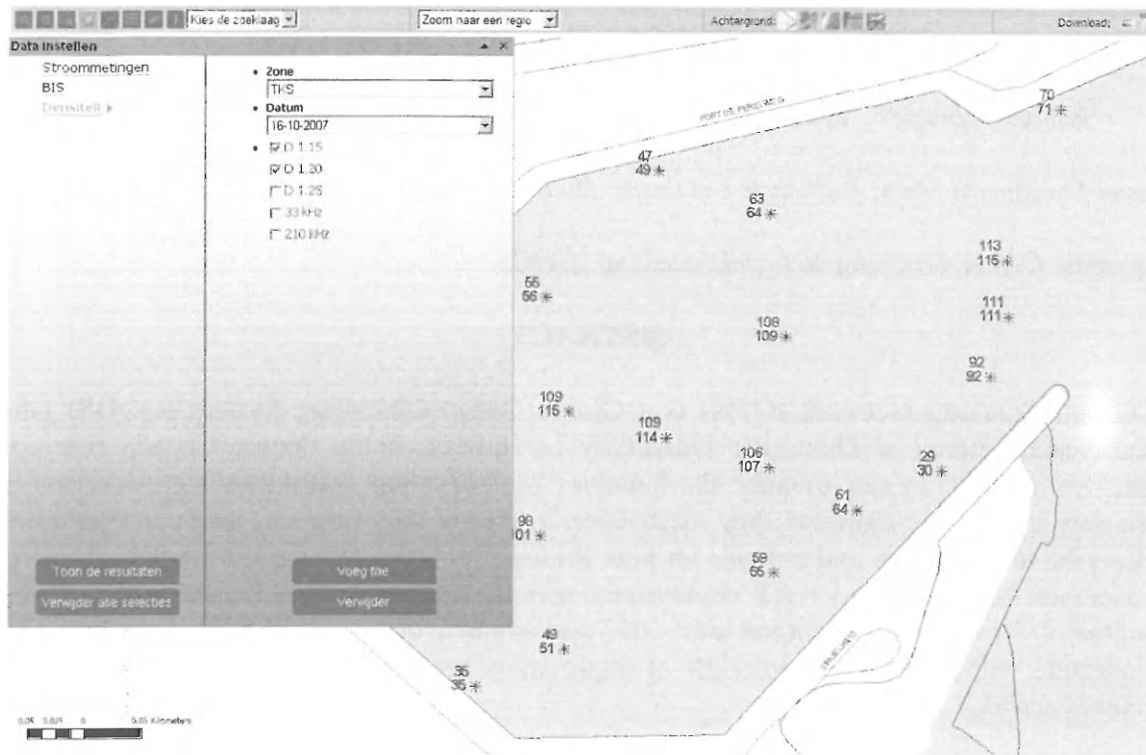
Fig. 3. Visualisation of density measurements. The pop up window allows the user to make a search query in the density measurement database.

Conclusion

The Data Viewer provides the possibility to manage coastal (and estuarine) information in an easy accessible and clarifying manner. Maritime Access established a viewing portal for various dataset types with GIS tools such as standard viewing facilities, an identify tool, multiple background layers and map export features.

The Openlayers JavaScript library, which supports the common Open Geospatial Consortium (OGC) standards, gives a powerful geographic map visualisation which is independent of the implemented client and server.

The scalability and maintainability of this web based GIS viewer is optimized by using a REST architecture in the application code. The separation between server and client allows to develop both independently. Other Maritime Access applications, such as Matador (a search-, view- and metadata managing- portal of GIS related data available at Maritime Access) and the Grid database (a search and viewing portal of Bathymetric data), can be integrated with the Data Viewer.

All this features makes the Data Viewer an efficient tool for various dredging monitoring and reporting activities. Because of its scalable characteristics, the Data Viewer has also the potential to become a powerful module for the implementation of different analyses.