STUDY OF SAND DYNAMICS AT SMALL SCALE ON THE BELGIAN CONTINENTAL SHELF TO EVALUATE THE RISK OF MINE BURIAL

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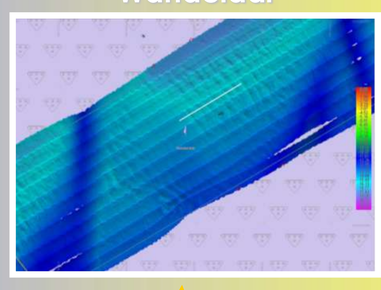
The Belgian Continental Shelf is affected by sea mines from the World Wars. It is not uncommon that fishermen carry one of them with their net, sometimes with heavy consequences.
The Belgian Navy makes an effort to solve this problem. It supports several researches involved in this topic and this project is one of them.
After years of researches considering and improving the best methodology to find and pick them up from the sea bottom without consequences, the Belgian Navy wanted also better understand the environments surrounding these objects and the causes-effects due to their interaction.
More over, the Belgian Navy wishes to develop a method to evaluate the most appropriate techniques usable considering different geo-morfological scenario.

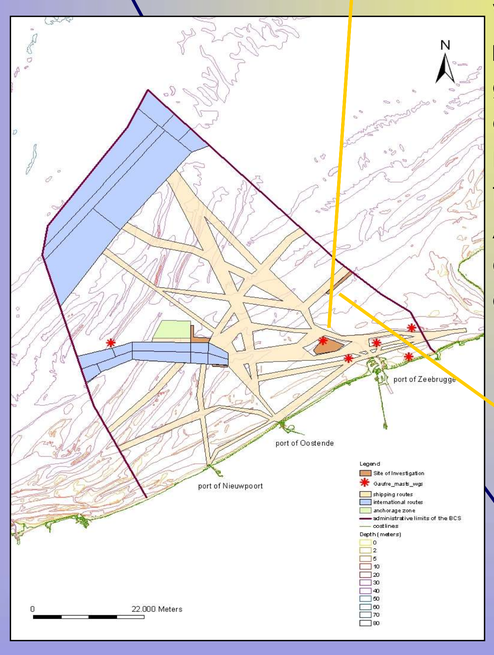
Based on previous studies (Wever, Th.F.(2003), FWG Report 50), the bedforms named "**megaripples**" with a height up to 1.5 meters and a cross section up to 10 meters are considered as the most important bedforms for episodic mine burial on operational time scales.
Areas where these bedforms can be formed and where they have a certain dynamics are selected for the investigation.

Areas of analysis

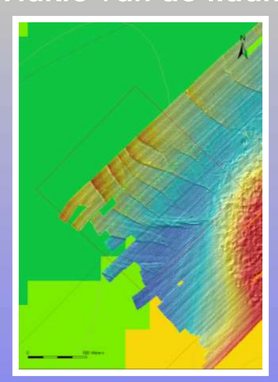
Wandelaar



The Wandelaar and the Vlakte van de Raan regions show this geomorfological characterization and moreover they are areas frequently crossed by ships. As a consequence, these areas are of a high economical value.



Vlakte van de Raan



Box cores

Sediment analysis of samples sediment sampled in Wandelaar regio.

Medium grey-yellow sand with entire shells and shell fragments.

Differences in the sediments distribution are due to the vicinity or not to the recording instruments.

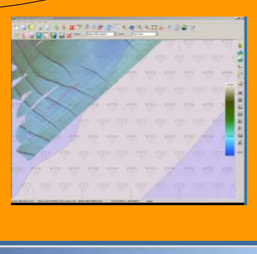
For very detailed sediment analysis at the experimental site.

Date-Name	D50	Mode	Skewness	Kurtosis
7 Feb 2008- BC15	313 µm	277µm	2.1	4.8
15 Jan 2009	474 µm	469 µm	0.85	0.27
28 May 2009	514 µm	507 µm	0.88	0.46

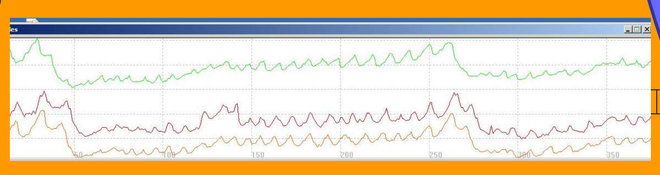
Techniques

MWU[1] system:
Kongsberg EM 3002

Bathymetrical maps and time series analysis.



Raw data profiles of 3 different MB recordings on the Vlakte van de Raan regio.

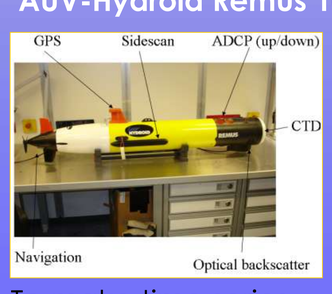


In green data measurements from 5th November 2009, in red from 29th March 2010 and in orange from 30th March 2010

BRMs[2]

To investigate small-scale variability of sand dynamics over long periods.

VSW[3] system:
AUV-Hydroid Remus 100

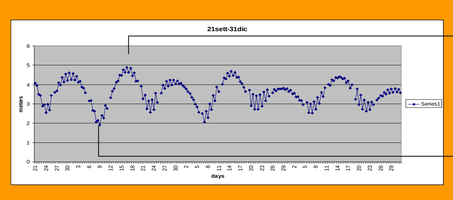


To make time series measurements and monitoring the BRMs.

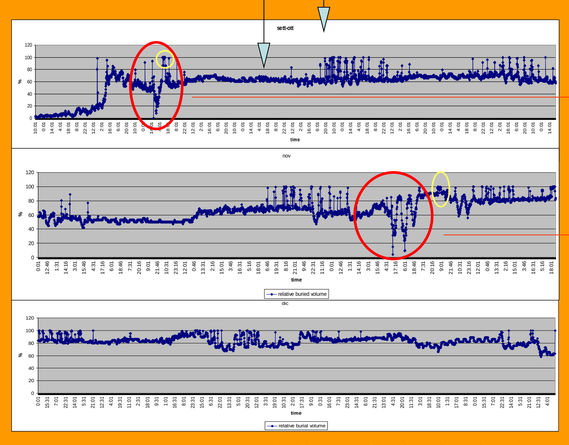
[1]. Mine Warfare Unit (Belgian Navy)
[2]. Burial Recording Mines (FWG-German Research Institute)
[3]. Very Shallow Water (Belgian Navy)

Results

Some results from the BRM "Seestern" recording; it has recorded every 15 minutes for 104 days, between 25 September and 6 January.



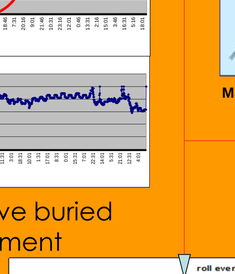
Variation between spring and neap tide ; every single dot represents the variation berween HW-LW; the concave parts of the curve represents period of spring tide and the convex parts represents periods of neap tide.
Period of neap and spring tide are well recognisable on the data curve.



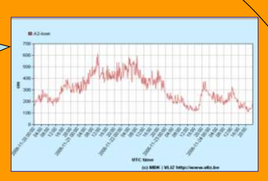
The curve represents the relative buried volume of the mine in the sediment during the recording period .

BRM is an experimental Instrument able to record measures of the sediment height surrounding itself once it is deployed on the sea-bottom. It has a cylindrical shape and it is 1.7m long with a diameter of 47cm; 3 rings of 24 led bridges equally spaced are collocated on its sides and its centre. The led bridges detect the presence of sediment at programmed time recording. From the data it is possible to evaluate the Interaction object-environment in extreme details.
The object starts to be buried for 60% of its volume after 5 days from the deployment and it stayed in equilibrium with this condition till the storms of the 21th November. Neap and spring tide regularly influence the distribution of the sediment around the object. Storms event depending on their magnitude can unbury completely the object and can cause scouring around it causing roll events. It is recorded a roll event of almost 90 degrees during the storm of November. After storms, period of complete burial are detected and the averaged volume of sediment surrounding the object can increase.

Maximal wave height during 3rd October.

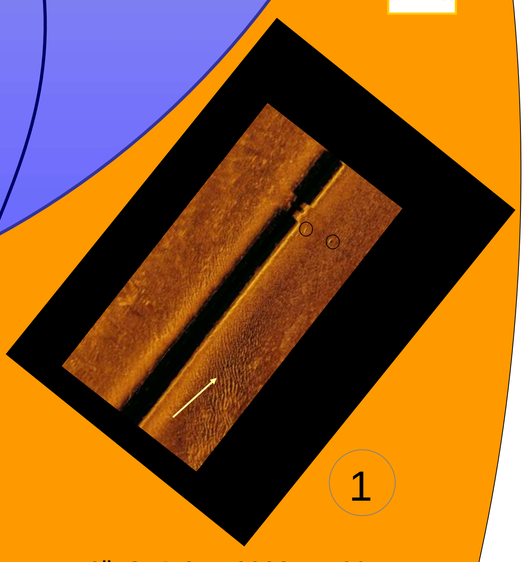


Roll event during the storm of the 21th-22th November 2008



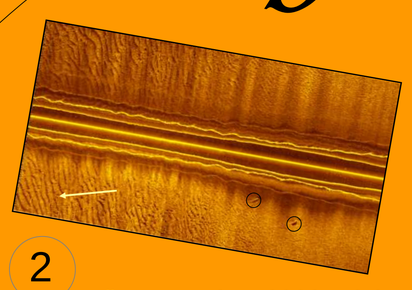
SSS measurements on contact on the Wandelaar regio:

Evidences of the evolution of the sea-bottom along 3 months.



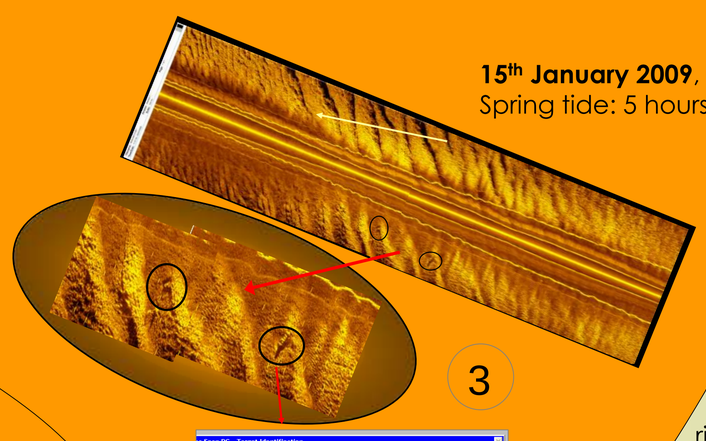
1

13th October 2008, 11.30 a.m.;
Spring tide: 1.3 hours before HW



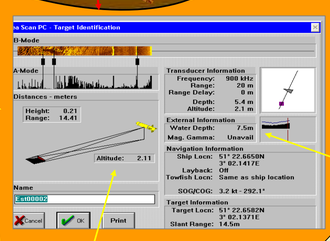
2

17th November 2008, 12.37 a.m.;
Spring tide: 4 hours before HW



3

15th January 2009, 09.45 a.m.;
Spring tide: 5 hours after HW



On the **first image** the 2 objects are well visible and quite far from the group of ripples. The ripples have a wavelength between 1.5m to 2.0m[1].
On the **second image** the objects are still visible even if both are buried for 30cm of their diameter. The ripples are between 6 to 10 cm high and they have a wavelength between 1.0m to 1.5m; the direction of the ripples follows the direction of the current. The sub-bottom around the objects is flat suggesting turbulence occurred previously then the SSS recording. Meteorological measurements confirm a turbulence in the environment occurred during the afternoon of the 16th with the peak during the night of the 17th.
On the **third image**, the objects are not anymore clearly visible. One is for half side completely buried and for the rest it is only 10 cm out of the sand; the other one is buried of 26 cm and it shows the presence of a scour around itself.

[1]. Measures calculated considering the object shadows visible on the SSS image with the Sea Scan PC software package by Hydroid.

Acknowledgements

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