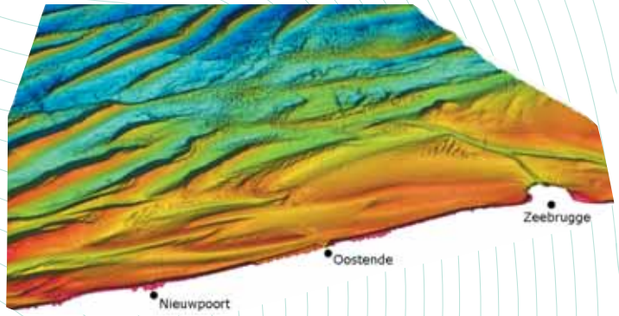
INTRODUCTION

QUEST4D *(a BELSPO-funded project)* targets the Belgian Part of the North Sea (BPNS), to reconstruct seabed ecosystem changes over the past 100 years.
This approach becomes feasible, since extensive data have become available on the seabed nature and processes.
The datasets are unique in Europe.



3D image of the Belgian Part of the North Sea

Throughout the reconstruction, Case Studies will be established and impacts will be modelled, relating seabed changes to both naturally- and anthropogenically-induced sediment dynamics. Furthermore, climate change scenarios will be modelled and their consequences on the management of the seabed estimated. Thus, a significant increase in knowledge on the sediment and sediment transport system is expected. This is the key to any ecosystem or impact study. The final results will contribute to the development of more sustainable exploitation strategies for non-living seabed resources.

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http://www.belspo.be/ssd
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http://www.vliz.be/projects/quest4D

quest4D

QUantification of
Erosion and
Sedimentation patterns to
trace the natural versus
anthropogenic sediment dynamics

quest4D

Seabed, living and non-living resources are exploited increasingly: Sand and gravel is required for beach nourishment and construction purposes. The accessibility of harbours requires regular dredging and dumping operations. Offshore windmills contribute to our future energy supply. Pipelines and cables transport gas and electricity to the mainland.

The interaction of such activities, together with the nature of the seabed and the acting processes, need careful consideration. However, present-day impact studies remain often inconclusive because of: the lack of a 'non-disturbed' reference situation; the interference of both naturally- and anthropogenically-induced changes and the, hitherto unknown, role of climate change on seabed processes. Moreover, the range in human activities may result in cumulative effects, affecting the magnitude and extent of the impact on the seabed. Therefore, a sustainable management plan, based upon an overall marine environmental status and its possible degradation, is needed. Setting-up environmental targets and well-balanced monitoring programs are now timely.
These will assist in protecting and preserving the marine environment and safeguarding our seas for future generations.

Need for marine aggregates

Implantation of windmill parks

1 Belgian part of the North Sea, in its 4 dimensions

Multiple datasets are available in the space, depth and time domain (i.e. 4D). The key to the research undertaken is the optimisation of advanced modelling approaches, validated with experiments and targeted observations/samplings. **Geographic Information Systems** and **databases,** relating to the seabed of the BPNS, will be further developed.

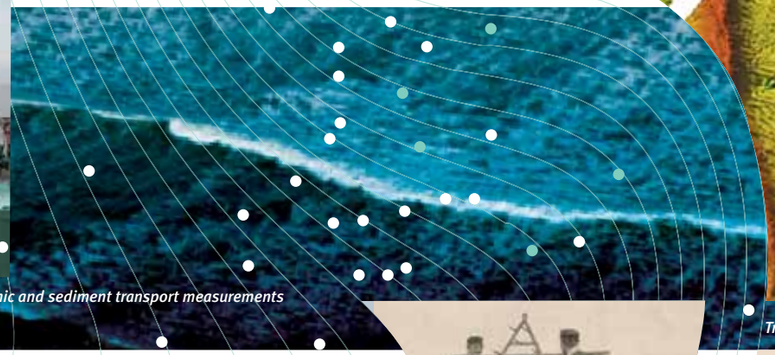
SEAFLOOR OBSERVATIONS AND SAMPLING

Multidisciplinary seafloor observations will be undertaken, with the aim of quantifying seabed erosion/sedimentation patterns and rates. Erodibility of the sediments will be measured, based upon *in-situ* and laboratory experiments. This parameter is missing often in impact and modelling studies. The analysis of vibrocores permits the long-term impact of dumping activities to be studied. Existing time series of seabed evolution (i.e. monitoring of depth changes and sediment nature) will be extended.

Taking samples to determine the sediment erodibility

FURTHER DEVELOPMENT OF HYDRODYNAMIC AND SEDIMENT TRANSPORT MODELS

Integrated sand/mud models are developed, with boundary conditions being generated from models focusing on the Scheldt estuary and the coast. Current and wave models are coupled dynamically and will support the studies undertaken on the impact of climate change. The sediment transport models will simulate historical situations, in order to quantify human pressure on the environment.



Multisensor tripod for hydrodynamic and sediment transport measurements

SETUP OF A HISTORICAL REFERENCE FRAMEWORK

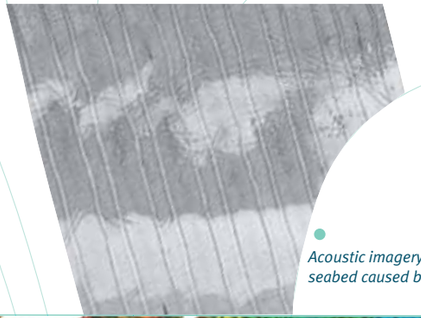
The sediment and macrobenthos dataset of Gilson (~1900) is an unique historic dataset, that can be used as a reference for the further analysis of long-term physical and ecological changes. Historic sediment and benthos samples of G. Gilson were gathered with standardized and documented methods.

Gilson dredge

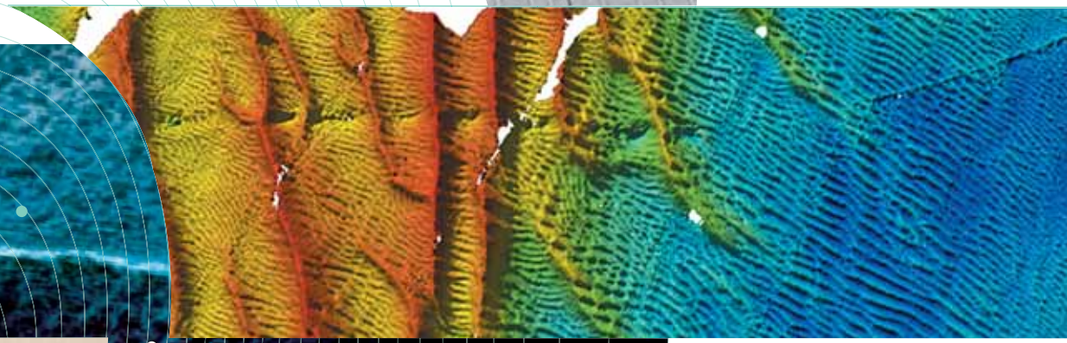
Gilson ground-collector

2 Natural versus anthropogenic

The natural evolution of the seabed will be studied, particularly sandbank areas, and **changes due to storms** will be estimated. Different **climate change scenarios** will be investigated and related to seabed erosion. Subsequently, natural evolution will be compared against the occurrence and intensity of human activities. Multidisciplinary Case Studies will be performed, using the newly-developed integrated models and datasets. The sites will be selected according to their socio-economic relevance.



Acoustic imagery shows trawl marks on the seabed caused by extensive beam trawling



Trench of a pipeline crossing the Oosthinder sandbank

3 Management issues

The quantification of erosion/sedimentation patterns is important, to develop **criteria** and **monitoring strategies** and to optimise **sustainable exploitation and management practices**. Quest^{4}D will focus upon the allocation of more efficient dumping grounds, aggregate extraction and the development of more sustainable coastal protection schemes.