Project Information

1. Project Basics

Project Title	Digital hydromorphological twin of the Trilateral Wadden Sea
Project Partners	Federal Waterways Engineering and Research Institute (lead partner) smile consult GmbH Wadden Sea Forum e. V. planGIS GmbH
Summary	TrilaWatt develops an innovative digital geodata and analysis infrastructure for the Trilateral Wadden Sea (The Netherlands, Germany, and Denmark). It supports the planning and maintenance of transport infrastructure with harmonized, quality-assured data on geomorphology, sedimentology, and hydrodynamics. Geodata, analysis and documentation methods are linked via web portals and services to form an assistance system.
Challenges and Innovation	The Wadden Sea World Heritage Site lacks a consistent harmonized database and appropriate tools to navigate efficiently on such mass data and to evaluate them for different purposes. Planning and decision-making processes for detailed and comprehensive assessment of mutual interactions between sustainable use and minimization or avoidance of harmful environmental impacts require robust knowledge of hydromorphology and sediment transport processes.
Project Aim	A digital twin (counterpart) of the Trilateral Wadden Sea will be developed as a service-based assistance system for planning tasks and reporting. Finally, the Marine Data Infrastructure Germany (MDI-DE) will be expanded technically and in terms of content to include new analysis and access methods for Big Data applications. Quality-assured geodata of geomorphology, sedimentology and hydrodynamics as well as specific analysis methods applicable to mass data support the processing of maintenance and planning tasks of the marine transport infrastructure.
Main Activities	The new digital database homogenizes field and simulation data from the Netherlands, Germany and Denmark in the area of the Trilateral Wadden Sea. For this purpose, generic analysis procedures and reporting methods are developed and linked as services with an assistance system. Preliminary work from the *mFUND* project EasyGSH-DB and MDI-DE will be used and further developed. The functionality of this infrastructure is demonstrated applying case studies.
Expected results and further Impact	The consistent geodatabase created together with the innovative analysis infrastructure establishes workflows for merging, harmonizing and presenting heterogeneous data from different source systems. The data is made available via a geoportal to be used in various target systems such as transport and environmental management for the classification of Outstanding Universal Values (OUV) in the Wadden Sea World Heritage Site or for detailed scientific studies.

2. Starting point

A new call of the *mFUND* program was published on12 February 2021 by the Federal Ministry for Digital and Transport (BMDV). Possible proposals could focus on cooperation on cross-border data innovations, the provision of data or harmonization with other European partners.

Different demands, requirements and restrictive environmental legislation pose major challenges for the planning and maintenance of transport infrastructure in the marine environment. At the same time, the natural marine system is changing due to climate change and morphodynamics, and use thereof by e.g. offshore wind turbines or green hydrogen. Area-wide geodata can be obtained from numerical long-term simulations in the German Bight (e.g. project EasyGSH-DB) for hydrography and hydromorphology. These are freely available via Geoportals (like MDI-DE). However, there is not yet a flexible processing infrastructure existing to address current issues in marine transportation and environmental assessment by evaluating consistent data.

3. Challenges

Provision of a sound and consistent database for the Wadden Sea is one of the major current challenges. Such a harmonized background is necessary for detailed and comprehensive assessment of the mutual interactions in the conflict between sustainable use of marine waters on the one hand and minimizing or even avoiding harmful climate and environmental impacts on the other hand. Resilient data is essential for decision-making processes that affect the Wadden Sea, which was inscribed as UNESCO world heritage in 2009 for its ecological richness and unspoiled natural dynamics.

High-resolution hydrographic data series are locally available for the German Bight. These can be combined into area-wide models. Area-wide morphological and especially sedimentological surveys can only be produced at intervals of several years or decades due to the high mapping effort. However, they are needed in much higher temporal resolution for the analysis and assessment of environmental impacts in a system like the Wadden Sea and adjacent marine waters. Only in this way the pressures, as addressed in the MSFD Annex III for the descriptors "seabed integrity" (D6) and "hydrographic alterations" (D7), can be correctly classified as physical loss or physical disturbance. The distinction between these two types of impacts is crucial for the approval of new transport and infrastructure projects.

Today, the costs of maintaining the transport infrastructure are very high. A solid and consistent database can help to find optimization potentials. Partially competing goals such as economic efficiency, environmental interests, navigability, acceptance, etc. could be evaluated by a digital planning assistance system based on comprehensive processed data and documented by meaningful metadata.

Maintenance of seaport approaches and port facilities is strongly determined by the seaward sediment input. Therefore, it is important to be able to describe the hydromorphology accurately and to acquire knowledge about sources, sinks, and transport paths of sediment. From this point of view, it is advantageous to consider the adjacent parts of the German Bight in detail for a heuristic and synoptic modelling set up, since neighboring regions are affected and must be evaluated. This leads to the fact that planning and assessment for the southern North Sea should be done on a transnational basis.

Reproducing the complex physical processes in coastal and especially in tidal mudflat regions, such as large-scale sediment transport, depends on an accurate data situation, which unfortunately is often heterogeneous, patchy and not harmonized across borders. In the previous research project EasyGSH-DB, areal data of geomorphology, hydrodynamic and extensive analyses were obtained for the first time from long-term numerical simulation (1996-2015) with focus on the German Bight!
They are freely available via Geoportals such as MDI-DE (see mdi-de.baw.de/easygsh/EasyEN), *mCLOUD* (www.mcloud.de) and GOVDATA (www.govdata.de). This data, the analyses and documentation are already being used as part of the EU reporting obligations for the **W**ater **F**ramework **D**irective (WFD) and the **M**arine **S**trategy **F**ramework **D**irective (MSFD).

Finally, TrilaWatt aims at developing and implementing a powerful spatial data and analysis infrastructure on a homogenized database comprising the Trilateral Wadden Sea area of the Netherlands, Germany and Denmark.

4. Project objective

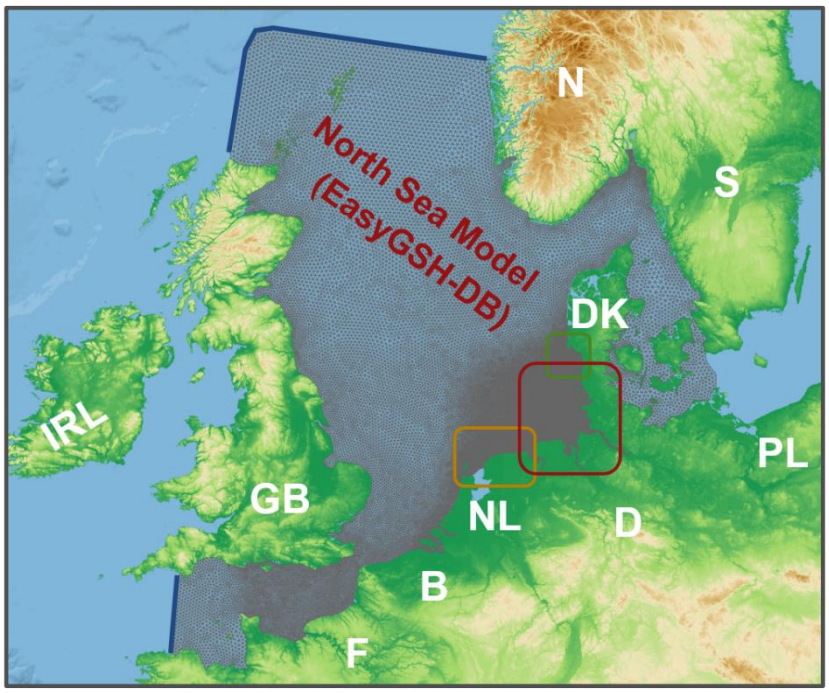

Figure 1: Model area of the entire North Sea Modell used for EasyGSH-DB including refinements in NL and DK for TrilaWatt

The main objective of the project is to build up a powerful high-performance geodata and analysis infrastructure in combination with enlarged data of geomorphology and hydrodynamic for the Trilateral Wadden Sea (see Figure 2 and Figure 1). The previous work in MDI-DE, the model set-up and data workflow of EasyGSH-DB form the basis for this project (the entire model area is shown in Figure 3). This geodata and analysis infra-structure will be established for the entire Trilateral Wadden Sea area as a service-based assistance system for planning and reporting. It will be integrated into the existing web portal and interface of MDI-DE, which manages quality-assured geo-data for geomorphology, sedimentology, and hydrodynamics. It also provides analysis methods and generic documentation components in a wizard-based manner. For a limited number of years, the extended data will be compared with those of EasyGSH-DB, which focuses on the German Bight and in which nothing is changed.

For this purpose, the following milestones are foreseen:

- Extension and completion of the database
- Extension and completion of the geomorphological products for the area of NL and DK
- Development and prototypical operation of a hierarchical and distributed data management system
- Implementation and prototypical operational use of documentation and analysis components
- Integration into the MDI-DE as a user interface and the provision of web services
- Stakeholder participation process from NL, DK, and DE

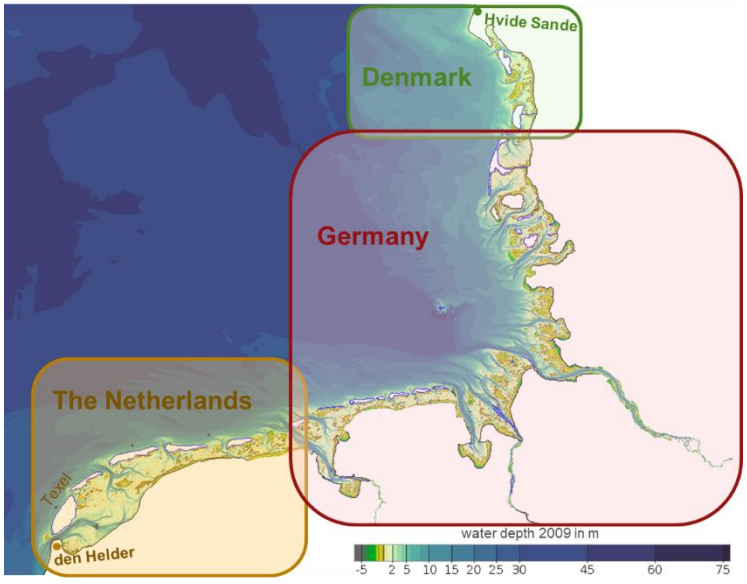

Figure 2: Area of concern for the TrilaWatt project. The existing database, simulation model and analysis tools for the German part will be extended to the Dutch and Danish part.

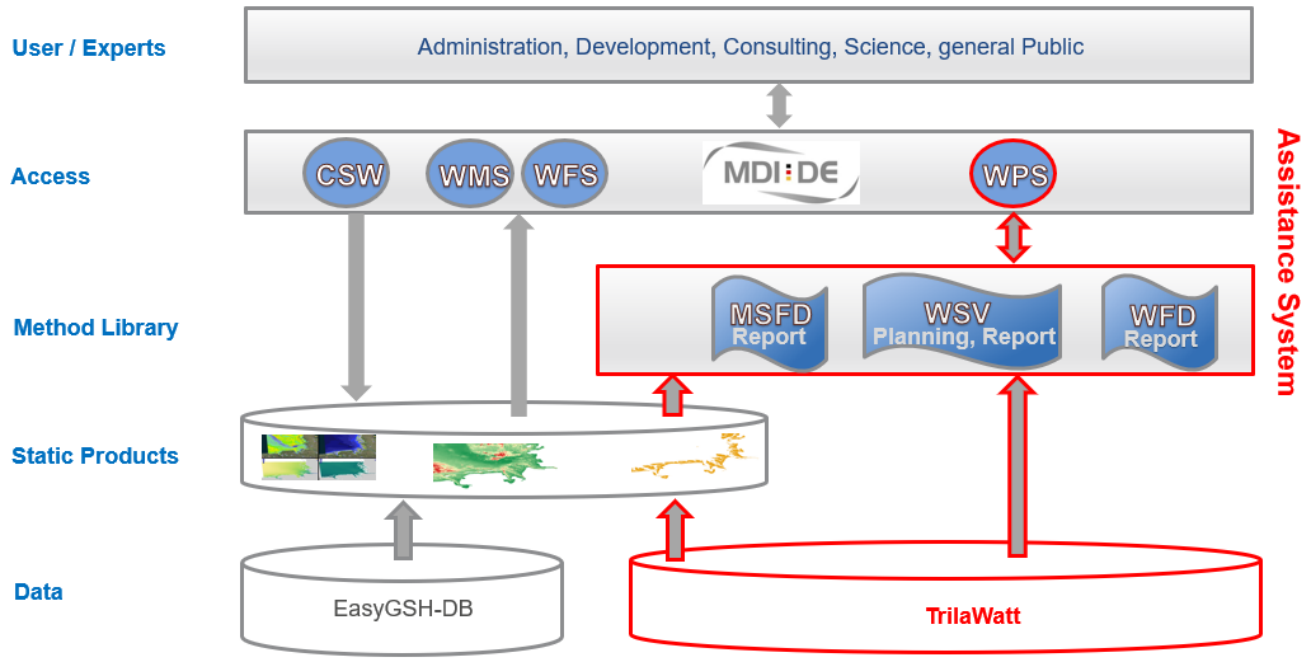

Figure 3: TrilaWatt-Infrastructure

5. TrilaWatt Project Partner

BAW Federal Waterways Engineering and Research Institute

WADDEN SEA FORUM

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6. Get involved!

The TrilaWatt project consortium would be happy to welcome you on board. If you are interested as data user or as data provider, please get in touch with us:

BAW Federal Waterways Engineering and Research Institute

WADDEN SEA FORUM

Main Project Lead

Dr.-Ing. Andreas Plüß
Federal Waterways Engineering and Research Institute
E-Mail: andreas.pluess@baw.de
Phone: +49 (0)40 81908 417

Stakeholder Involvement

Dr. Frank Ahlhorn
Wadden Sea Forum e.V.
E-Mail: ahlhorn@waddensea-forum.org
Phone: +49 (0)4421 9108 18
Mobile: +49 (0)151 1215 8443