Supported by:

Federal Ministry
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by the German Bundestag

mFUND
Das Startkapital für die Mobilität 4.0

TrilaWatt

Digital hydromorphological twin of the Trilateral Wadden Sea

TrilaWatt

Kick-Off-Meeting

A. Ullwer (BMDV)

A. Plüß, F. Ahlhorn, P. Milbradt, F. Simmering, R. Lehfeldt

16.02.2022

Source: BAW

Agenda

1. Welcome by the BMDV, introduction of participants
2. Overview of mFUND and integration of the project into the funding program (BMDV)
3. Presentation of the project consortium
4. Presentation of the project
5. Discussion and questions from participants

Introduction

Overview of *mFUND*

- Status of *mFUND*
- Funding target
- Cooperation of the mFUND projects

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by the German Bundestag

Integration of the project into the funding program of BMDV

- Funding line
- Requirements
  - Data innovation
  - Big-Data
- Publications

Introduction of participants

- Federal Waterways Engineering and Research Institute – Hamburg (BAW)
- smile consult GmbH – Hannover
- planGIS - Leer
- Wadden Sea Forum – Wilhelmshaven

Introduction of the speakers

- BAW: Andreas Plüß, Rainer Lehfeldt
- smile consult: Peter Milbradt
- planGIS: Frank Simmering
- Wadden Sea Forum: Frank Ahlhorn

Presentation of the associated partners

- **Stakeholders from the Netherlands, Denmark and Germany**
  - Rijkswaterstaat
  - Danish Coastal Authority
  - Common Wadden Sea Secretariat

- **German institutions**
  - State Office for Coastal Protection, National Park and Marine Protection – Schleswig-Holstein (LKN-SH)
  - State Office for Agriculture, Environment and Rural Areas – Schleswig-Holstein (LLUR)
  - Lower Saxony State Agency for Water Management, Coastal Defense and Nature Conservation (NLWKN)
  - Federal/State working group North and Baltic Sea (BLANO, hydromorphology)

Source: BAW (Fedderwarder Priel)

Initial problem / genesis

- The **Wadden Sea World Heritage Site** forms the largest tidal flat system in the world, in which **dynamic processes** occur largely undisturbed. It stretches along the Danish, German and Dutch coasts of the North Sea.

- Very **different user interests** (maritime and energy industries, fisheries and, last but not least, tourism) require
  - **integrated monitoring** and **understanding** of the system
  - coordinated efforts and **planning**.

- There are large amounts of data in the trilateral Wadden Sea that are
  - distributed or dispersed,
  - not homogenized and
  - difficult to be researched.

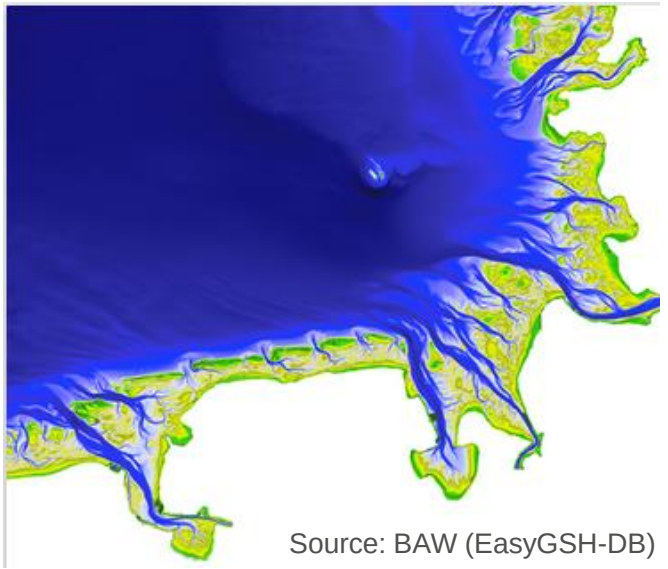
- There is a lack of **suitable tools** for navigation, interdisciplinary overlay as well as analyses for different purposes.

[www.waddensea-worldheritage.org]

Product catalog from the previous project EasyGSH-DB (I)

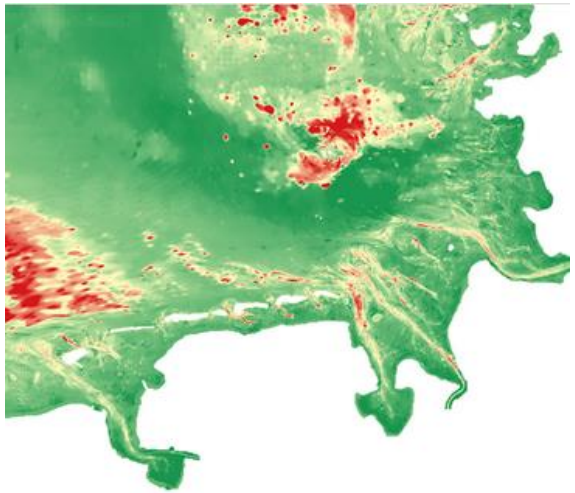
Available standard products 1996-2016

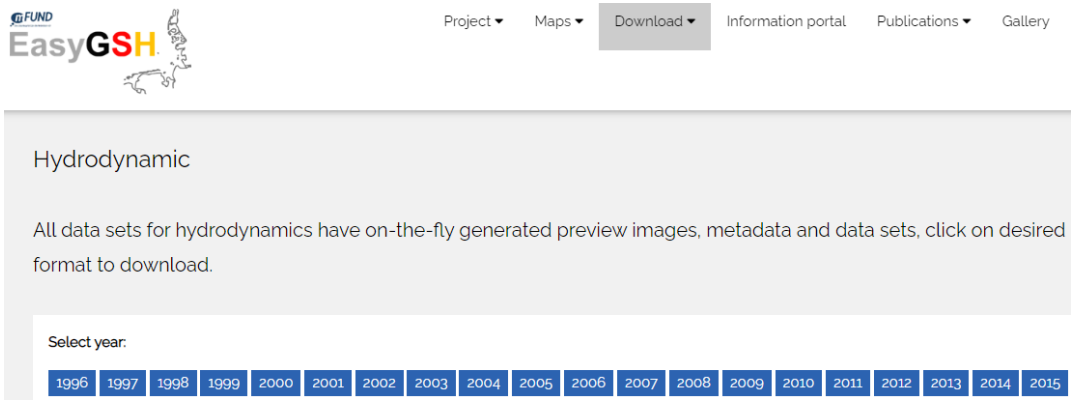
- **Geomorphology: (https://mdi-de.baw.de/easygsh/EasyEN_DownloadG)**
  - Bathymetry (over a wide area)
  - Morphological drive
  - Morphological space
  - Bathymetric contour lines



Source: BAW (EasyGSH-DB)

- **Sedimentology: (https://mdi-de.baw.de/easygsh/EasyEN_DownloadS)**
  - Petrographic maps
  - D50-grids /-contour lines
  - Sorting
  - Inclination/skeweness
  - Porosity
  - Sedimentology (CSV)

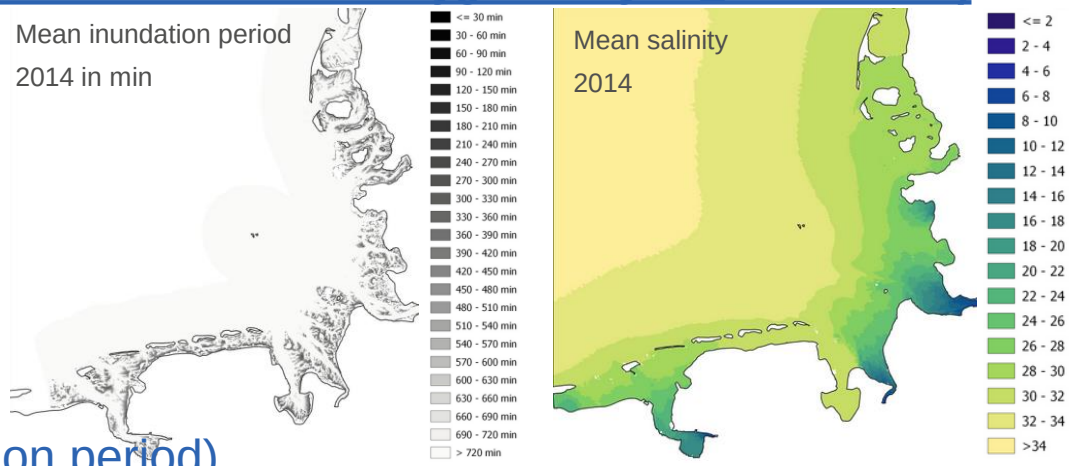




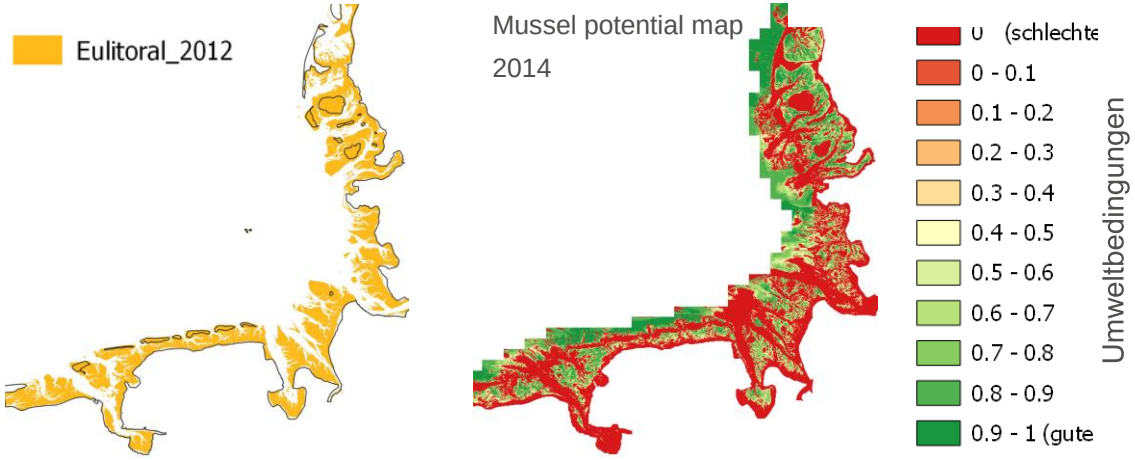
Product catalog from the previous project EasyGSH-DB (II)

Available standard products 1996-2016 (https://mdi-de.baw.de/easygsh/EasyEN_DownloadS)

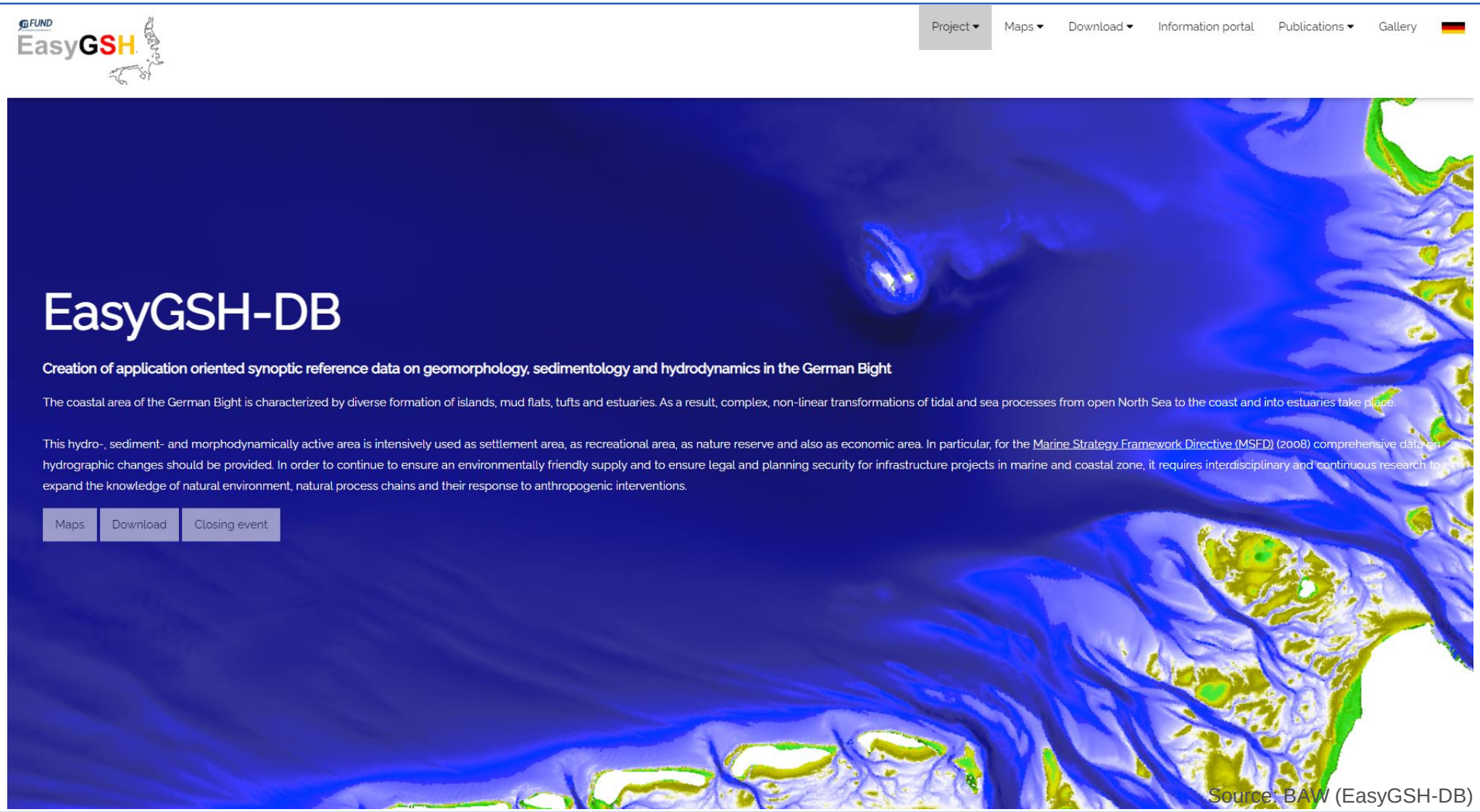
- **Hydrodynamics**
  - Tidal characteristics of the water level
  - Tidal characteristics of current speed
  - Tidal characteristics of salinity
  - Tidal characteristics of bottom shear stress
  - Long-term parameters of salinity
  - Long-term characteristics of the water level (inundation period)
  - Harmonic analyses of the water level
  - Characteristic values of the sea state
  - Long-term characteristic values of the sea state
- **Prototype Products**
  - Eulitoral (2002, 2012)
  - Tidal flats (2004, 2014)
  - Mussel potential map (2012)



Source: BAW (EasyGSH-DB)

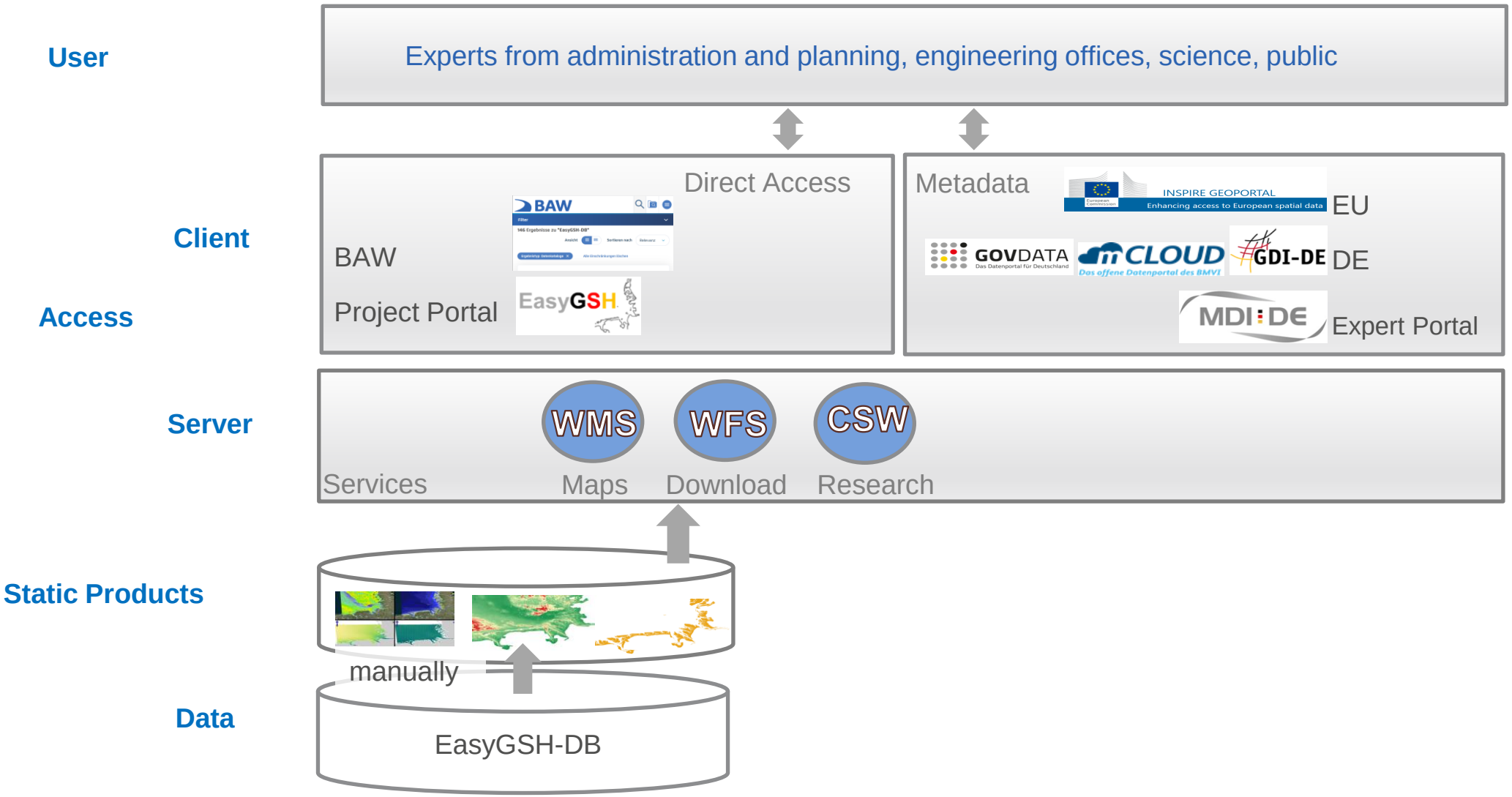


EasyGSH-DB data access



Source: BAW (EasyGSH-DB)

Existing infrastructure



TrilaWatt initial situation

Climate impact monitoring: Morphology

- Monitoring of changes in the morphology of the coasts of Schleswig-Holstein caused by climate change and relevant for coastal protection, recurrent reporting obligation
- Design of specification sheets
- **Data** compilation, quality assurance, .. (field data, tidal characteristics, ..)
- Performing **analyses** on the base data
- **Presentation of results** and visualization
- Periodic **reporting**

Source: BAW (Wattbefliegung)

Application of climate impact monitoring

Klimafolgenmonitoring
Berichtskennblatt

LKN.SH Landesbetrieb für Küstenschutz Nationalpark und Meeresschutz Schleswig-Holstein

Jährliche Änderung der mittleren Geländehöhe des Intertidals

Norderhever - Heverstrom mit Tümlauer Bucht, Nordsee
2013 - 2019

I. Herkunft	
1. Verfasser	
2. Organisation	Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein (LKN.SH)
3. Anschrift	Herzog-Adolf-Straße 1 25813 Husum

II. Einordnung	
1. Gebiet	Nordsee
2. Messstation-/Bereich	Norderhever - Heverstrom mit Tümlauer Bucht
 Hintergrundkarte © OpenStreetMap-Mitwirkende	
3. Teilgebiete/-profile	-
4. Bezugspegel	Pellworm-Anleger
5. Zeitliche Einordnung	2013 (Referenz) 2019 (Auswertung)
6. Parameter	Watteinzugsgebiete
7. Bedeutung	Das Wattenmeer sorgt durch die Verringerung der Wassertiefe für eine Reduzierung der Wellenhöhen und damit auch der Wellenenergie, die bei Sturmflut auf die Deiche einwirkt und besitzt somit eine Schutzfunktion für die Deiche.

III. Eingangsdaten	
1. Profil-/Gebietsdatensatz	7320_pol_Flaechenmessungen_KFM.shp

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Klimafolgenmonitoring
Berichtskennblatt

LKN.SH Landesbetrieb für Küstenschutz Nationalpark und Meeresschutz Schleswig-Holstein

Jährliche Änderung der mittleren Geländehöhe des Intertidals

Norderhever - Heverstrom mit Tümlauer Bucht, Nordsee
2013 - 2019

2. Höhenmodell-Datenbasis	DGM_10x10m_2013.grd (2013) DGM_10x10m_2019.grd (2019)
3. Tidekennwerte (10-jährige gltd. Mittel)	MTnw (2013): -1,6640 m NHN MTnw (2019): -1,6560 m NHN MThw (2013): 1,4890 m NHN MThw (2019): 1,5120 m NHN

IV. Hauptindikator		
1. Definition	Jährliche Änderung der mittleren Geländehöhe des Intertidals in den Grenzen von 2013 und 2019	
2. Methodenbeschreibung	In zusammengefassten Watteinzugsgebieten werden die Intertidalbereiche beider Jahre in den Grenzen definiert durch die Tidekennwerte je von Auswerte- und Referenzjahr ermittelt. Die Änderung der mittleren Geländehöhe wird jahresnormiert als Hauptindikator ausgewertet. Eine positive Änderung bedeutet eine Vergrößerung der mittleren Watthöhe innerhalb der jeweiligen Bezugsgrenzen.	
3. Auswertung	Intertidalgrenzen 2013	Intertidalgrenzen 2019
	0,3996 mm/a	0,5175 mm/a
4. Darstellung		
 Intertidal 2019, Hintergrundkarte © OpenStreetMap-Mitwirkende		
5. Beschreibung der Entwicklung		

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Klimafolgenmonitoring
Berichtskennblatt

LKN.SH Landesbetrieb für Küstenschutz Nationalpark und Meeresschutz Schleswig-Holstein

Jährliche Änderung der mittleren Geländehöhe des Intertidals

Norderhever - Heverstrom mit Tümlauer Bucht, Nordsee
2013 - 2019

V. Nebenindikatoren			
Definition	Wert	Einheit	Ort
Mittlere Höhe des Intertidals (Grenzen von 2019)	-0,1066	m	Norderhever - Heverstrom mit Tümlauer Bucht
Mittlere Höhe des Subtidals (Grenzen von 2019)	-7,7881	m	Norderhever - Heverstrom mit Tümlauer Bucht
Fläche des Intertidals (Grenzen von 2019)	265.093.800	m²	Norderhever - Heverstrom mit Tümlauer Bucht
Fläche des Subtidals (Grenzen von 2019)	332.174.500	m²	Norderhever - Heverstrom mit Tümlauer Bucht

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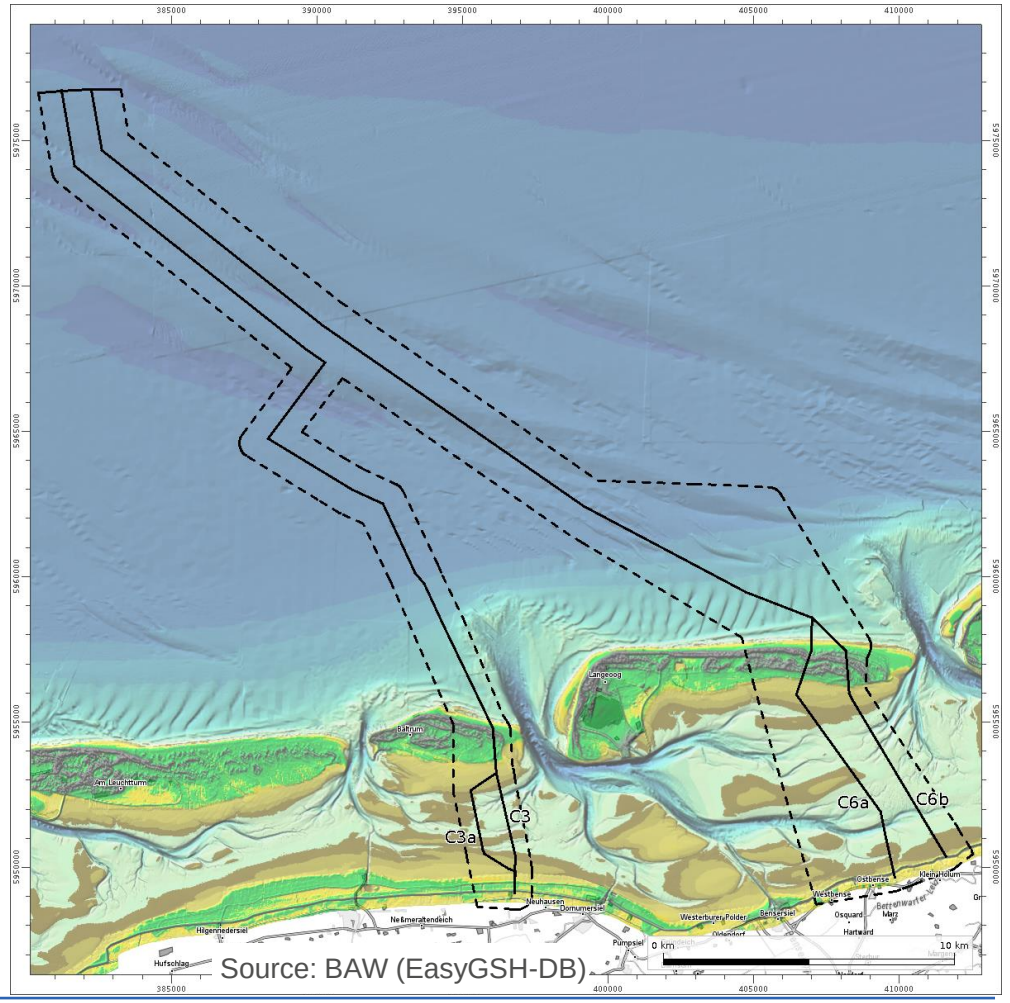
Reporting specification sheets
Morphology:
6 for the North Sea
3 for the Baltic Sea

TrilaWatt initial situation

Route finding and optimization

- Development and morphodynamics of the route corridors Baltrum and Langeoog for the “Seetrassen 2030” project
- Compile **Data**, quality assurance, (survey data,..)
- Perform **analysis** on the base data
- **Optimization** of the route depth
- **Presentation** of results and visualization
- **Reporting**



Study area
and
preferred routes

Source: BAW (EasyGSH-DB)

Route finding and optimization

Route position with regard to depth

- Determination of **morphological stability map** (space between smallest and largest measured depth z)

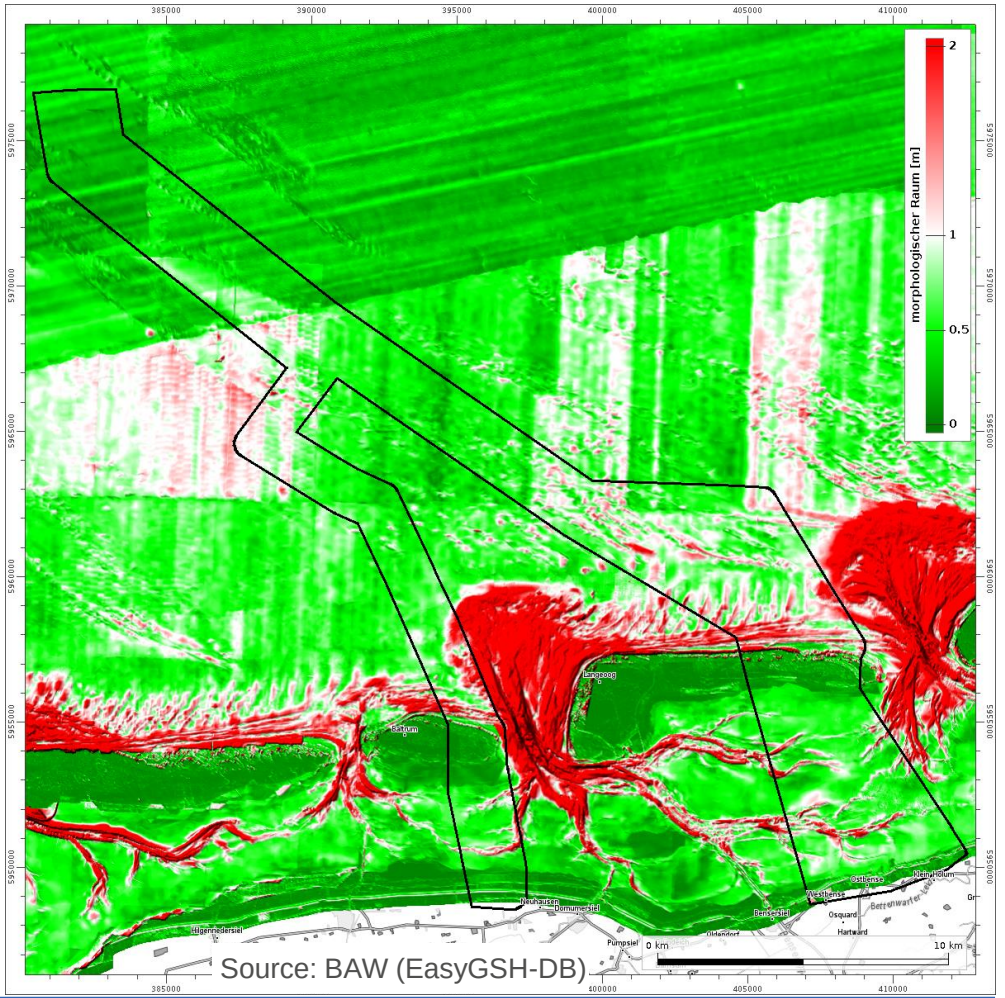
  Stable to Unstable

- Determination of **minimal z**
- **Safe installation** depth results from minimal z

  and

  required coverage
- Consider the **allowed curvature radii** of the cables
- Determination of **necessary excavation** to the current position of the water bottom

Study area
and
preferred routes



Source: BAW (EasyGSH-DB)

Examples: Operators and users - Trilateral Wadden Sea area (enumeration)

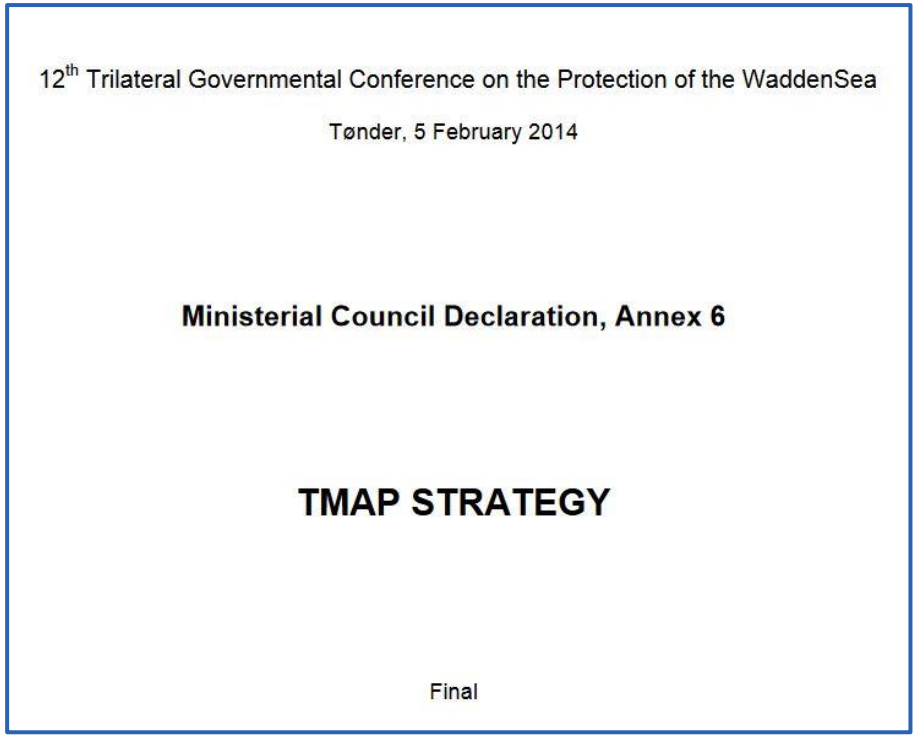
- Administrative units at different levels related to the Wadden Sea and the sea in general
- Research, e.g. Coastal Engineering
- Private economy, e.g. service providers for water and coastal water construction, energy network operators
- Concrete examples:
  - National Park Administrations/LKN.SH
  - Office for Regional State Development/LLUR
  - TenneT/Amprion
  - Waterways and Shipping Authority
  - Danish Coastal Authority
  - Rijkswaterstaat
  - Deltares
  - Trilateral Wadden Sea Cooperation

(Source: Herman Verheij)

Target groups

Specification: Data producer/handler and users - Trilateral Wadden Sea Cooperation

- Trilateral Monitoring and Assessment Programme (TMAP) should ...
  - ... support reporting for the EU and for World Heritage status
  - ... enable an integrative assessment for the application of the ecosystem approach in Wadden Sea protection



12th Trilateral Governmental Conference on the Protection of the WaddenSea

Tønder, 5 February 2014

Ministerial Council Declaration, Annex 6

TMAP STRATEGY

Final

Target groups

Specification: Data producer/handler and users - Trilateral Wadden Sea Cooperation

- Trilateral Monitoring and Assessment Program (TMAP)

- Quality Status Report (2017)
  -> „update in progress“

- Trilateral Initiative:
  "Wadden Sea Sediment solutions – Community of Understanding"

Photo: Rijkswaterstaat, NL (https://beeldbank.rws.nl). Zuiderduin 2011.

Target groups

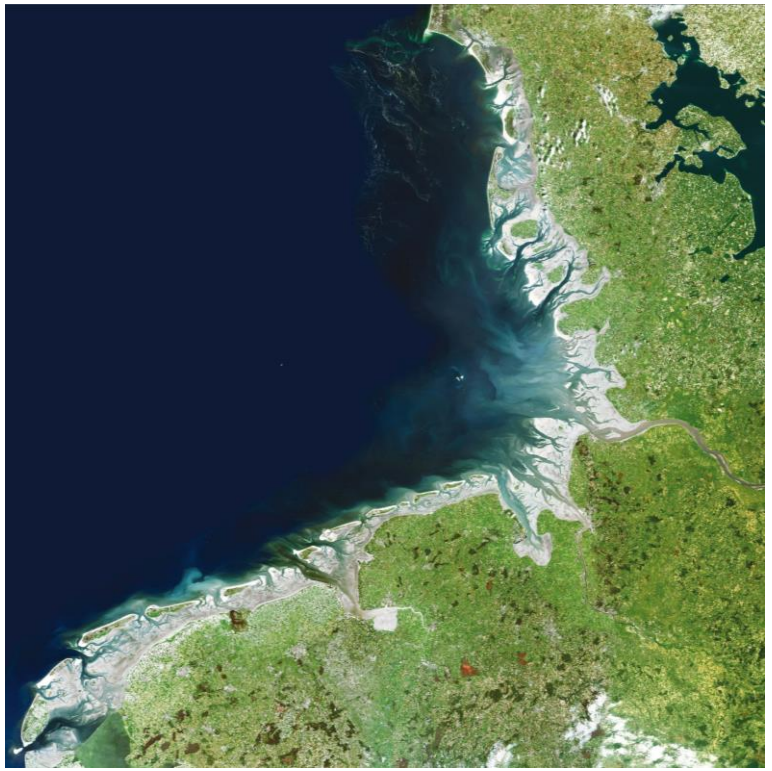
Specification: Data producer/handler and users - Trilateral Wadden Sea Cooperation

- Trilateral Monitoring and Assessment Programme (TMAP)
- Quality Status Report (2017)
  -> „update in progress“
- Trilateral Initiative:
  „Wadden Sea Sediment solutions - Community of Understanding”

Specification: Data producer/handler and users - Trilateral Wadden Sea Cooperation

- Trilateral Monitoring and Assessment Programme (TMAP)
- Quality Status Report
- Trilaterale Initiative -> „Community of Understanding – Sediment Solutions“

- Digital Twin of Biology of the Wadden Sea -> NIOZ (NL)



Source: CWSS

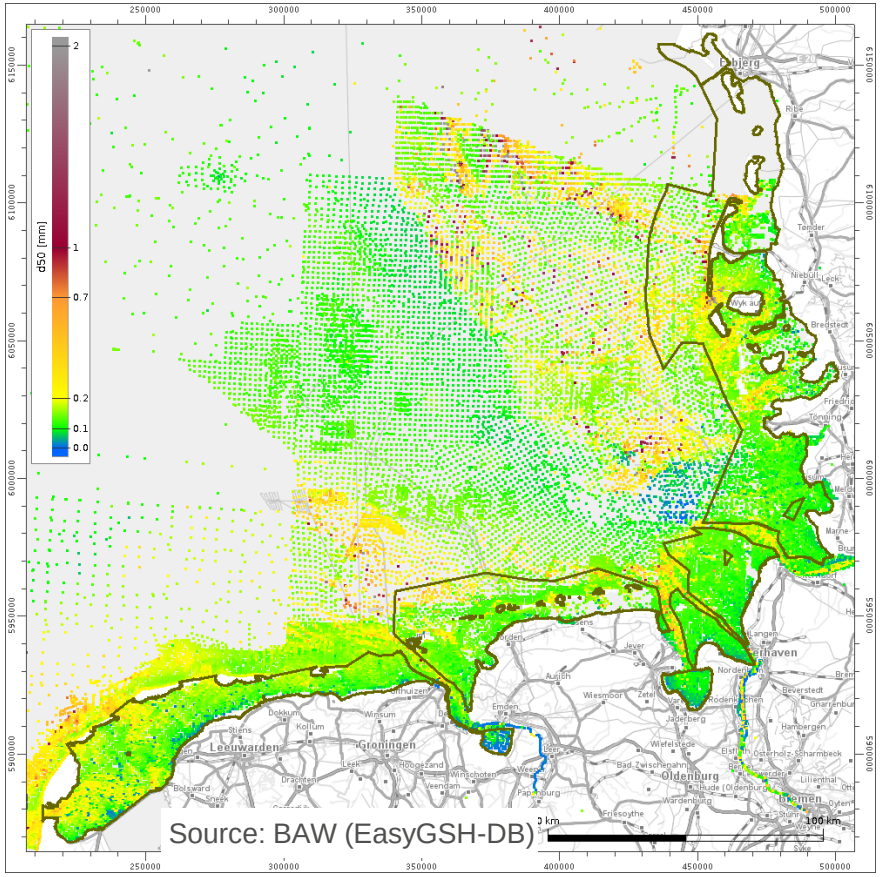
Data and services

Homogenization and expansion of the data and product database

- Expansion and updating of the data and product database
- Optimization of data management using Big Data technology
- Quality management and assessment
- Hight reference and position systems

Homogenization and extension of services

- Partial automation through services
- Expanding and updating the services, including
  integration of Dutch & Danish services



Surface sediment samples
Status at project start

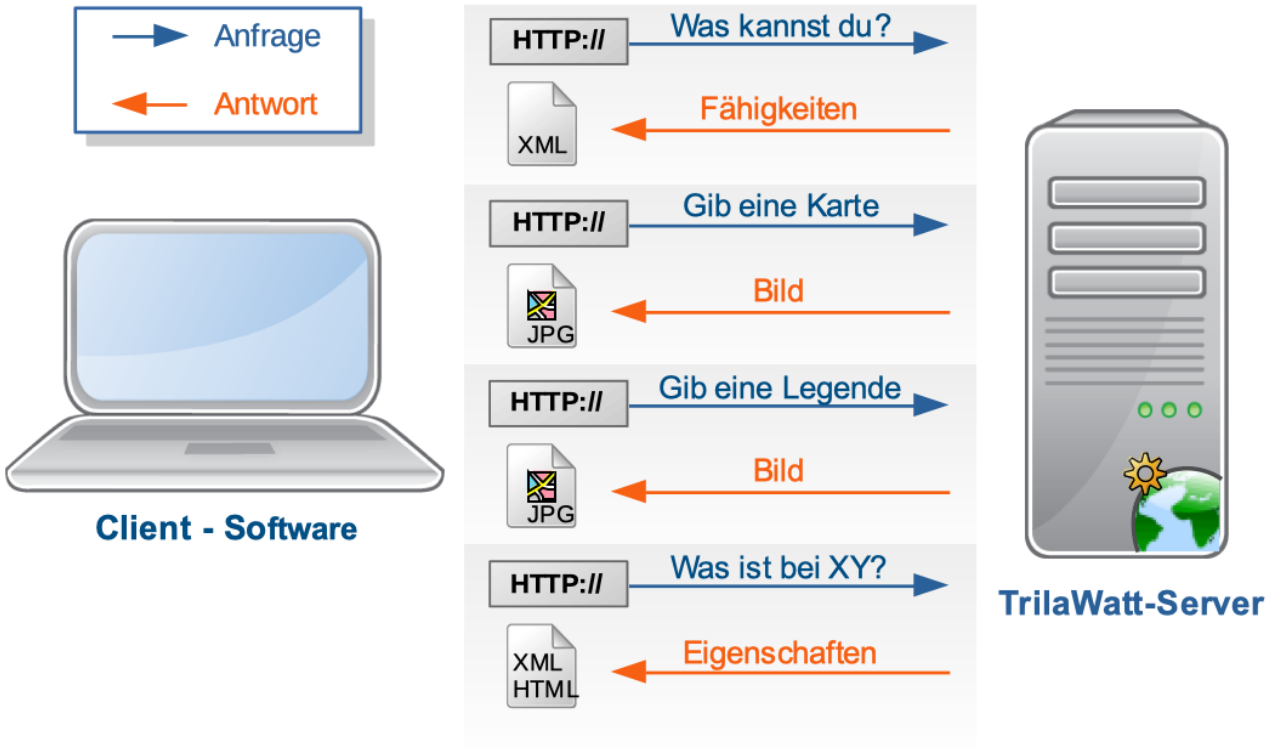
Methods and workflows

Method Library

- Directly on the basic and product data
- Web Map Service (WMS)
- Indirect via Web Processing Service (WPS)
- Templates and software components
- Development of process chains

WPS - Workflow

- Specification of interface definitions
- Development of templates and schemes
- Prototype realization of WPS process chains



Communication scheme of an OGC Web service

Server software

GeoServer

+ Widespread
+ WPS request builder
+ WPS process chaining

RichWPS

+ WPS processing with reporting
+ Prototype: macrophyte assessment

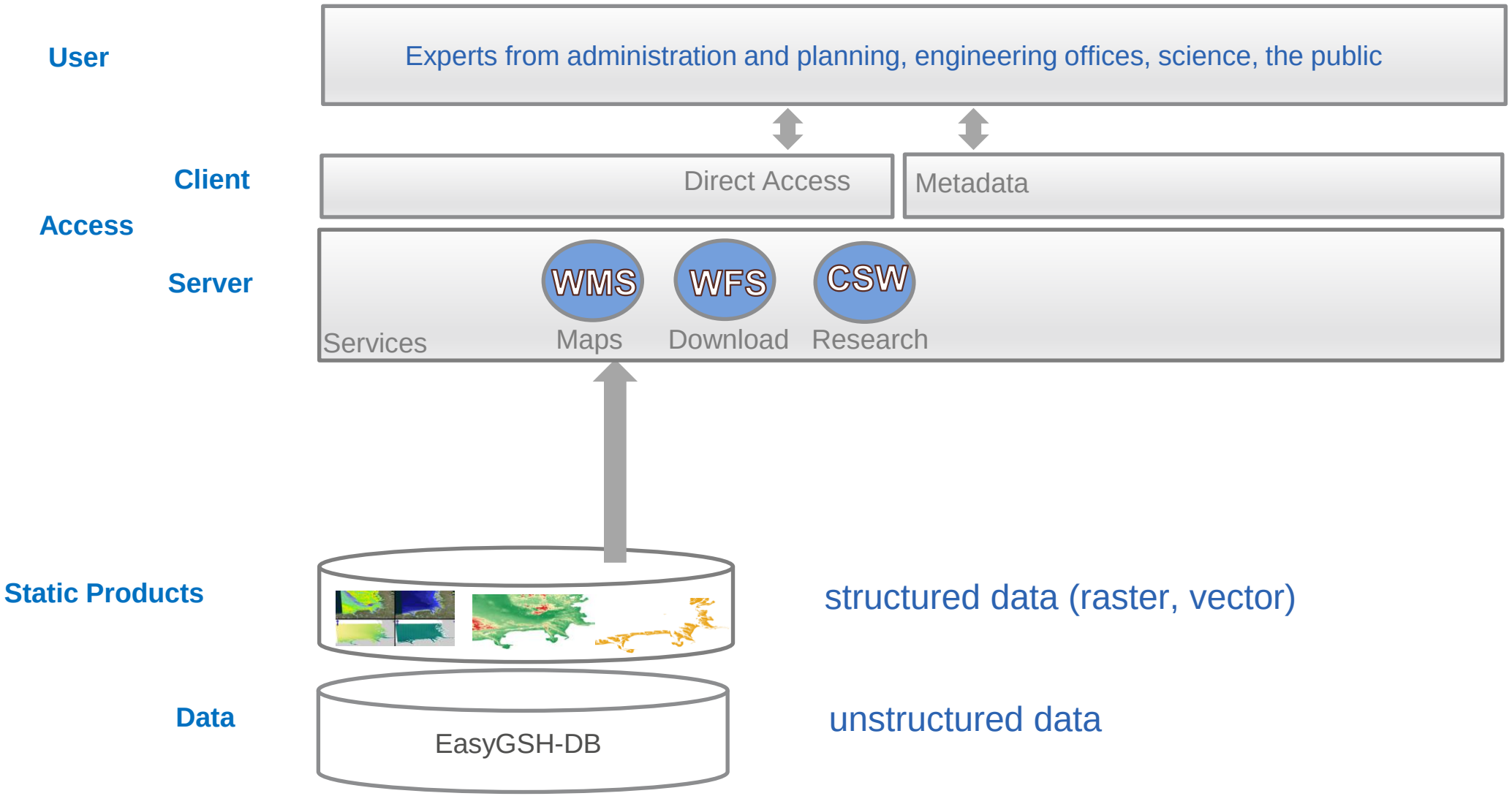
terria

+ NetCDF support
+ Time series analysis with map selection
+ CSV download

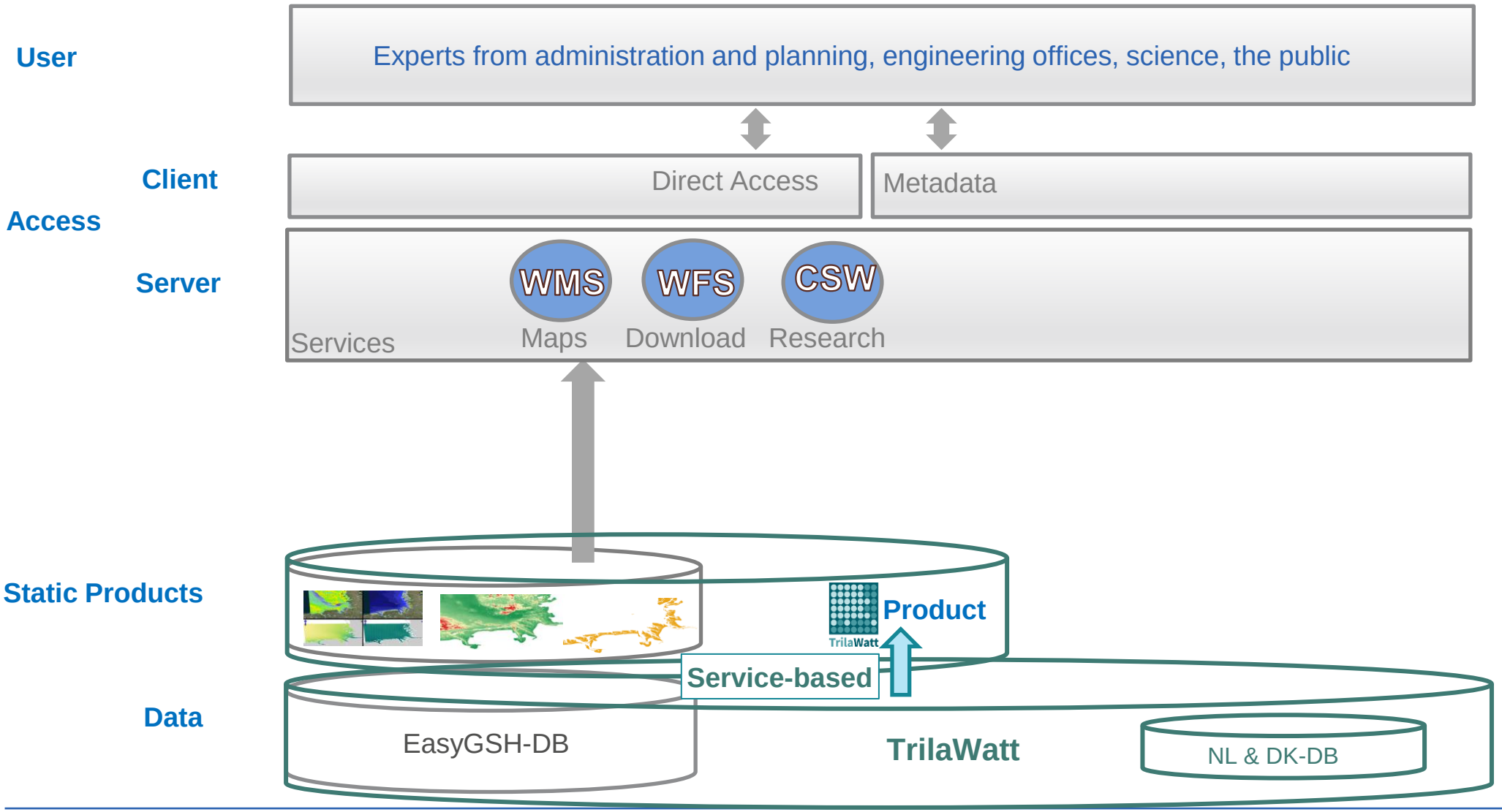
rasdaman
raster data manager

+ Big data handling
+ Extensive WPS operations
+ Datacubes / NetCDF

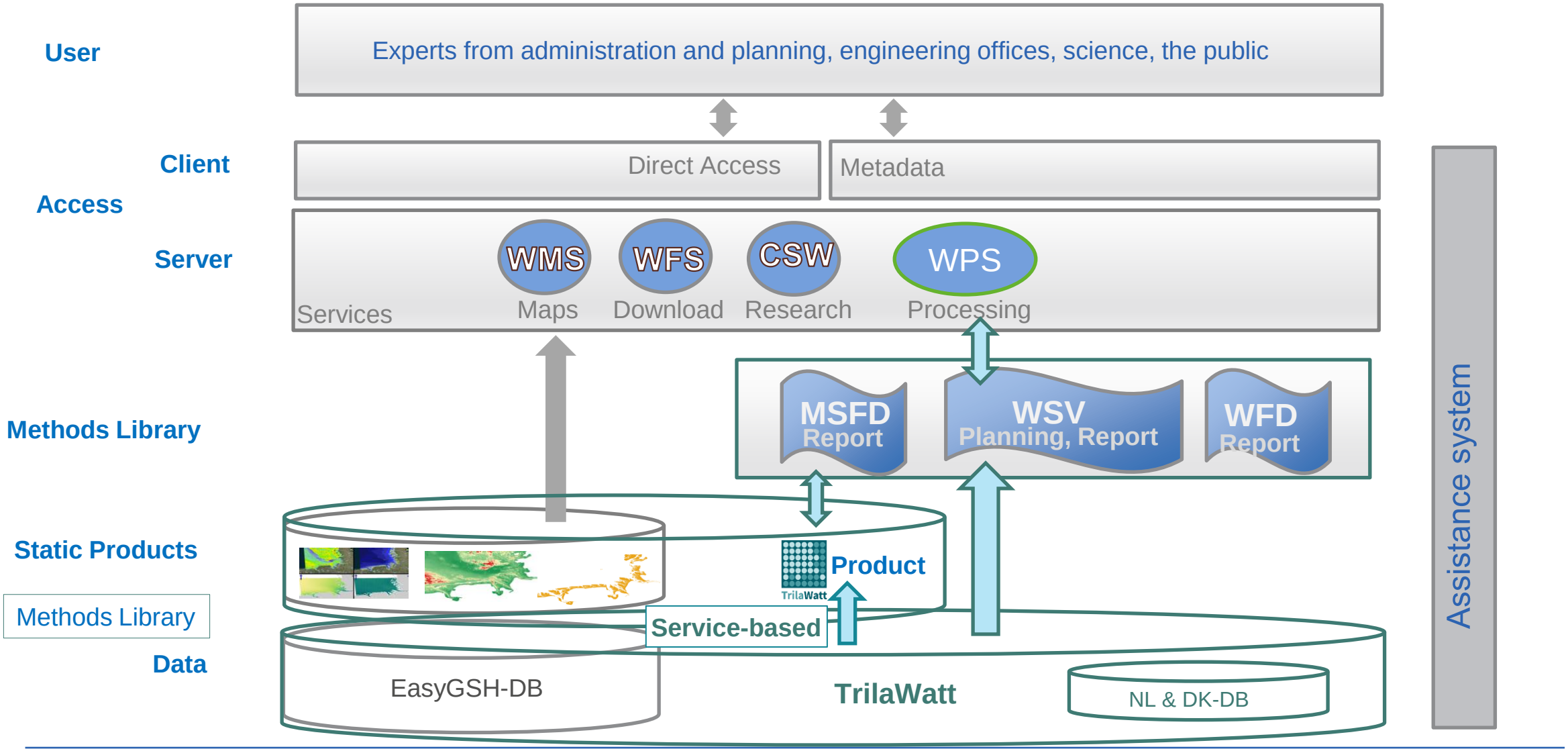
Existing infrastructure



TrilaWatt infrastructure: Database



TrilaWatt infrastructure: Methods



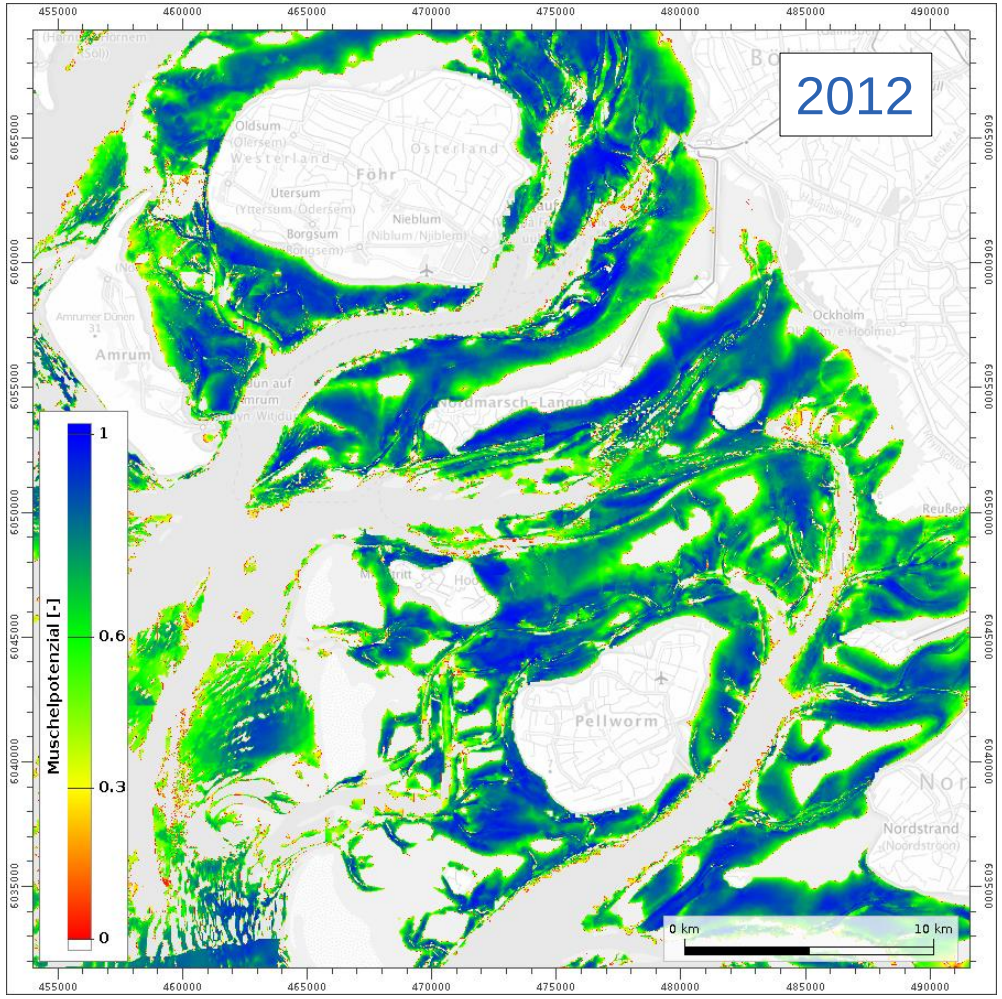
Application: Risk and potential analysis

Risk maps

- Erosion
- Siltation

Potential maps

- Shell Settlement
- Seagrass Settlement



Shell potential map
[EasyGSH-DB / BIWA-WATT]

Methodology: Process automation

Use of Web Processing Services (WPS)

Sample mussel potential map

* Salinity limits: ~19-28 ‰

	Eulitorale Muschelvorkommen		
Umweltparameter	*Minimum*	*Maximum*	*Median*
Erosions- / Sedimentationsrate [m / Jahr]	**-0,2**	**0,7**	–
Sedimentverteilung d50 [mm]	**0,079**	0,652	0,175
rel. Trockenfalldauer / Tide [%]	0	**42,210**	14,163
mittl. Ebbestrom [m/s]	**0,025**	**0,311**	0,155
mittl. Flutstrom [m/s]	**0,023**	**0,317**	0,153
Orbitalgeschwindigkeit [m/s]	**0,074**	**0,504**	0,290
Bodenschubspannung Ebbe [N/m²]	**0,026**	**0,979**	0,259
Bodenschubspannung Flut [N/m²]	**0,026**	**1,309**	0,213
Wellenintensität / -brechen [W/m²]	0	**0,21**	0,001
Salinität [°/₀₀]	**18,676**	27,717	24,379

WPS to assess salt concentration

Sample mussel potential map

* Salinity limits: ~19-28 ‰

	Eulitorale Muschelvorkommen		
Umweltparameter	*Minimum*	*Maximum*	*Median*
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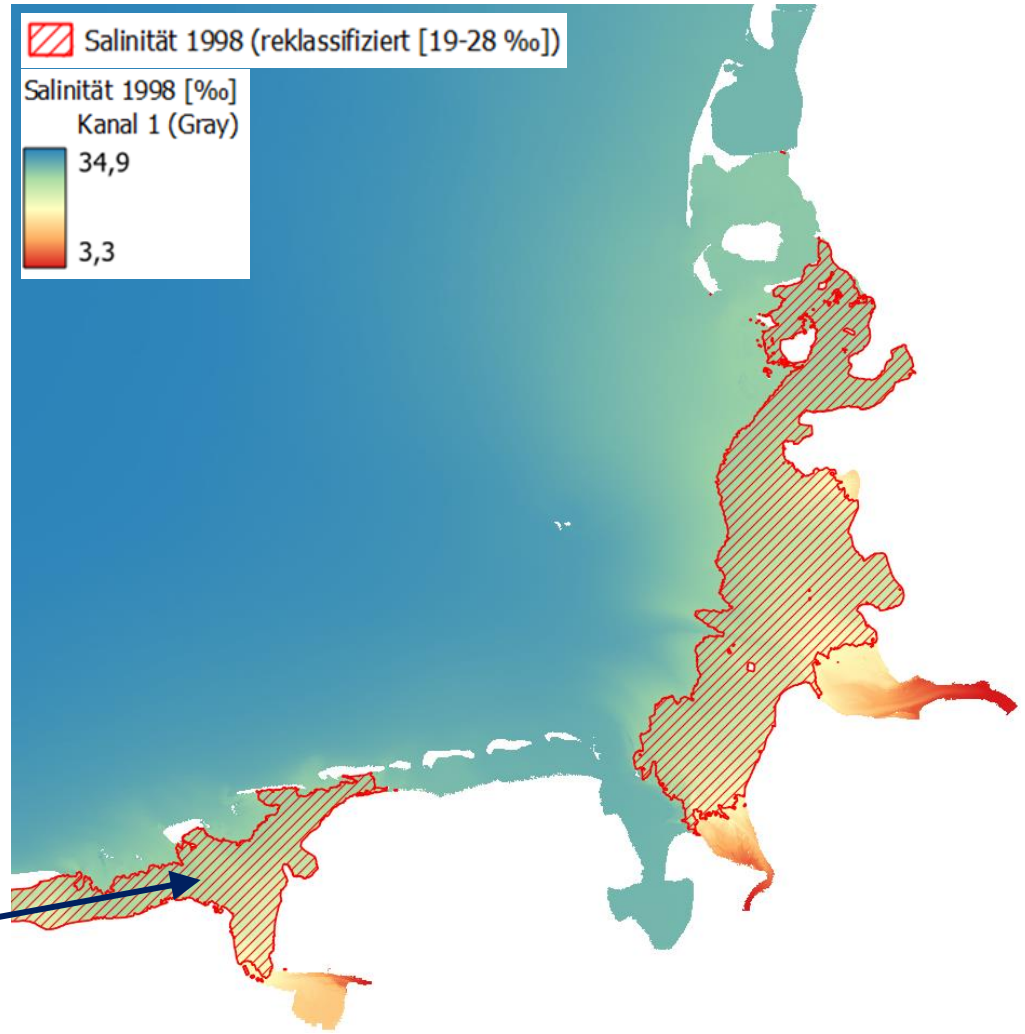
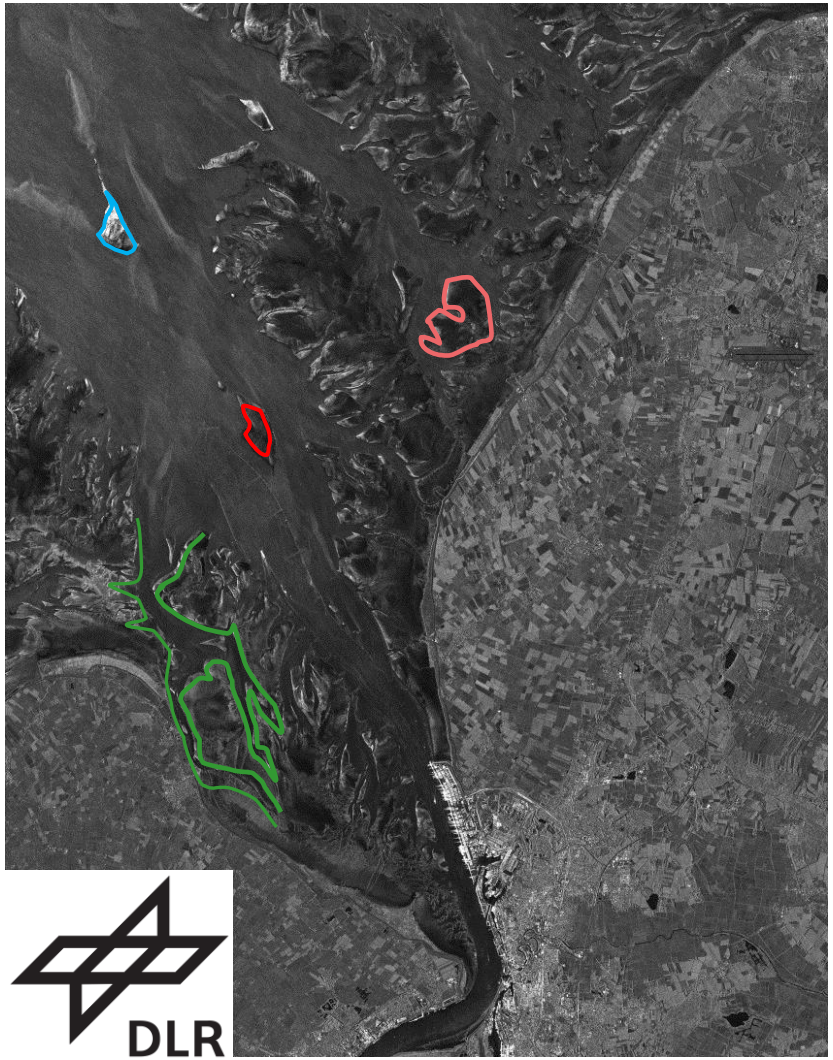
Result WPS processing



Application of mudflat edges from satellite imaging



Wurster Watt

Tegeler Plate

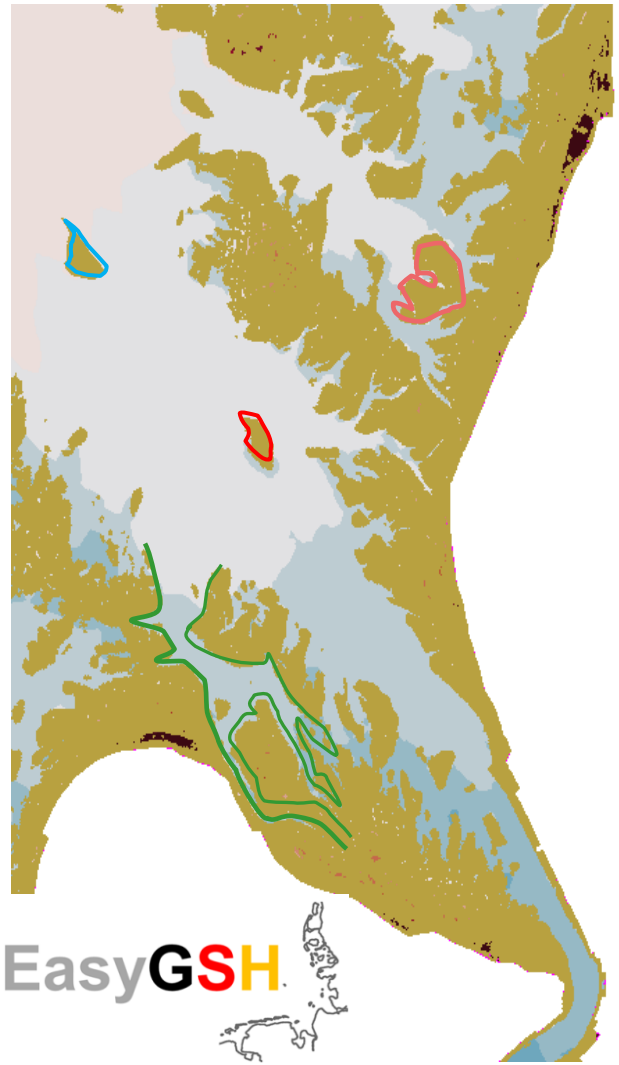
Robbenplate

Fedderwarder Priel

DLR-image:

3.8.2013 - 17^{02} UTC

Pixel resolution: 3 m



HN-Simulation:

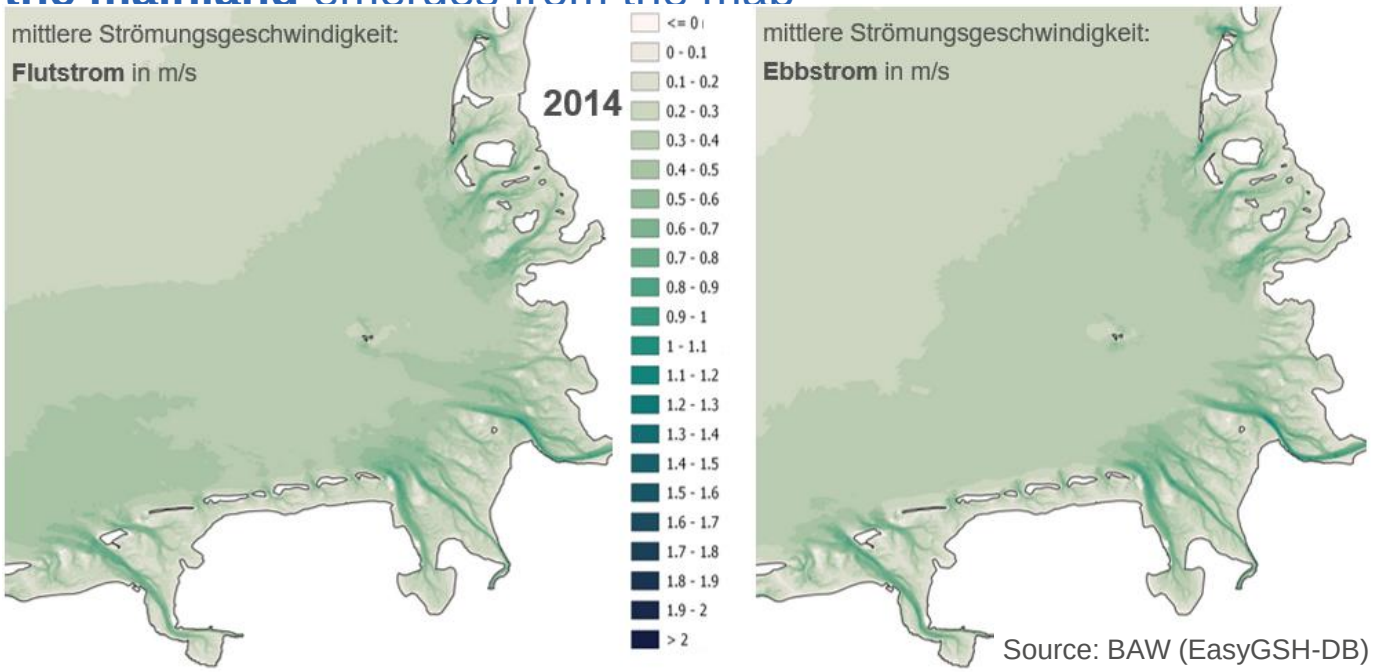
3.8.2013-17^{00} UTC

Grid resolution: 400 - 500 m, with SubGrid ≈ 30 m

Application: Green Energy

Site search for tidal energy plants

- Finding the necessary tidal current intensity: **Analyses (V_{Fm}, V_{Em}, V_{Fmx}, V_{Emx})**
- **Safe Installation depth: Morphological Stability map** (Difference smallest/largest depth z)
- Determination of minimum water depth **(Tlw, min z)**
- **Site selection** concerning **distance to the mainland** emerges from the map

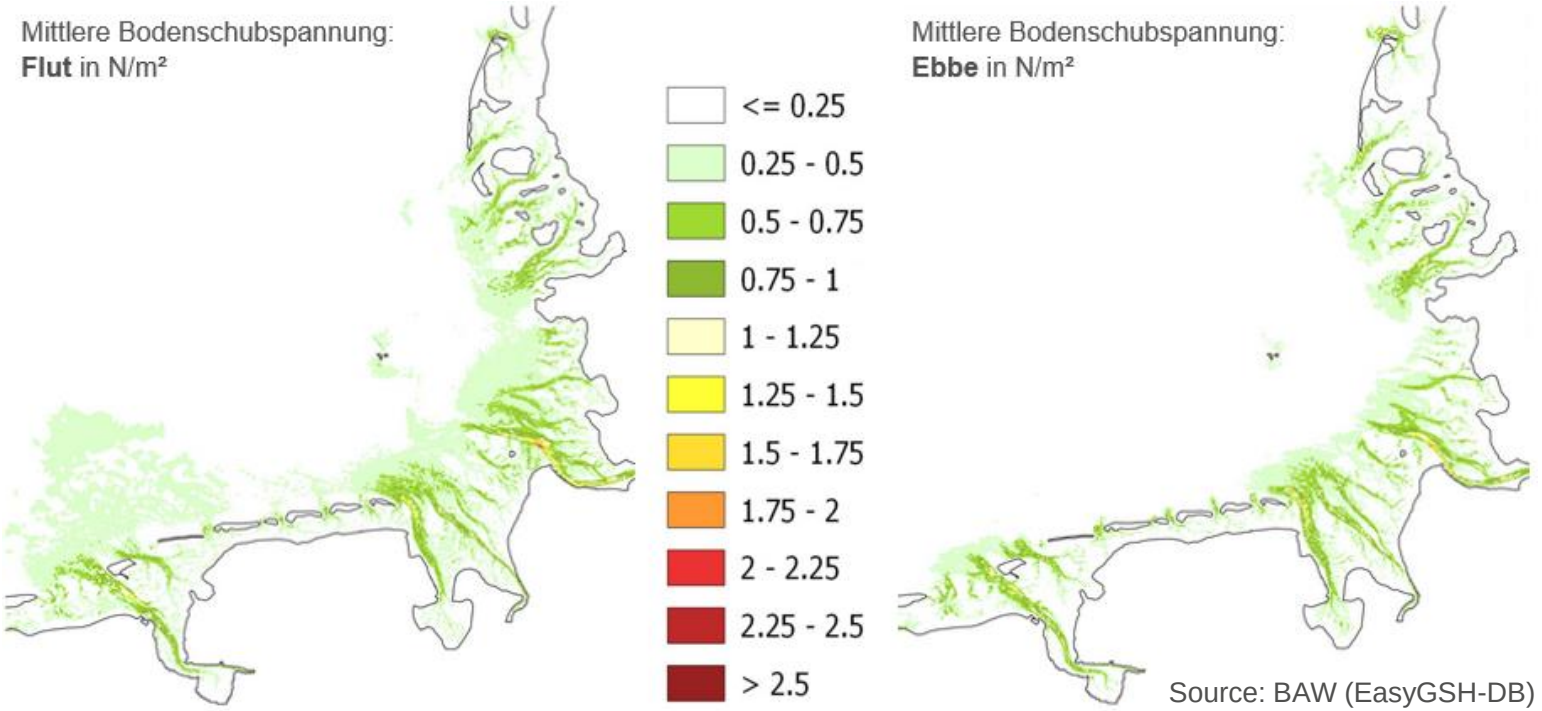


Source: BAW (EasyGSH-DB)

Application: Habitat types

Mussel beds: **Occurrence** and **population**

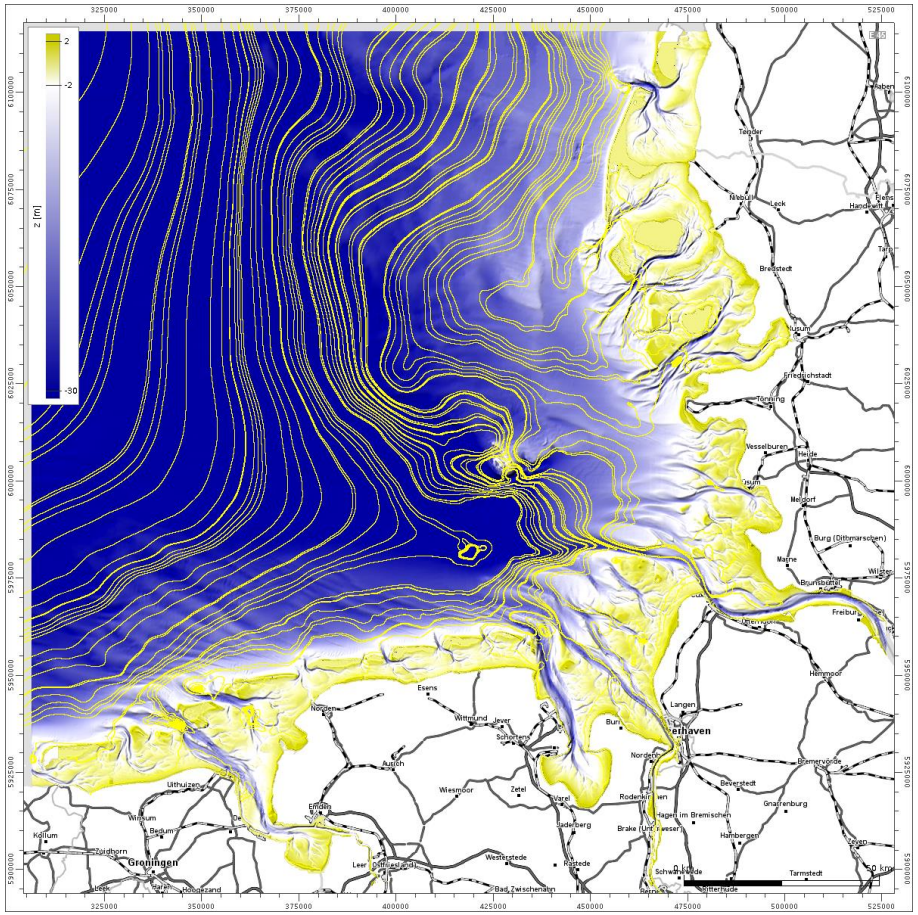
- Flow velocities and bottom shear stresses: **analyses (V_{Fm}, V_{Em}, V_{Fmx}, $V_{emx,}$ tau_B)**
- **Morphological stability map** (difference smallest/largest depth z)
- Determination of **minimum water depth (Tlw, min z)**



Source: BAW (EasyGSH-DB)

Expected project results

- Synoptic, QS - secured and freely available data base
  - geodata + simulations + analyses
  - bilingual metadata and services
- Data innovation
  - Big-Data-/Smart-Data-management
- Assistance system
  - schemata processing
  - semi-automatic product generation
- Generic infrastructure
  - networked
  - interdisciplinary
- Practice-oriented application
  - material for reporting requirements



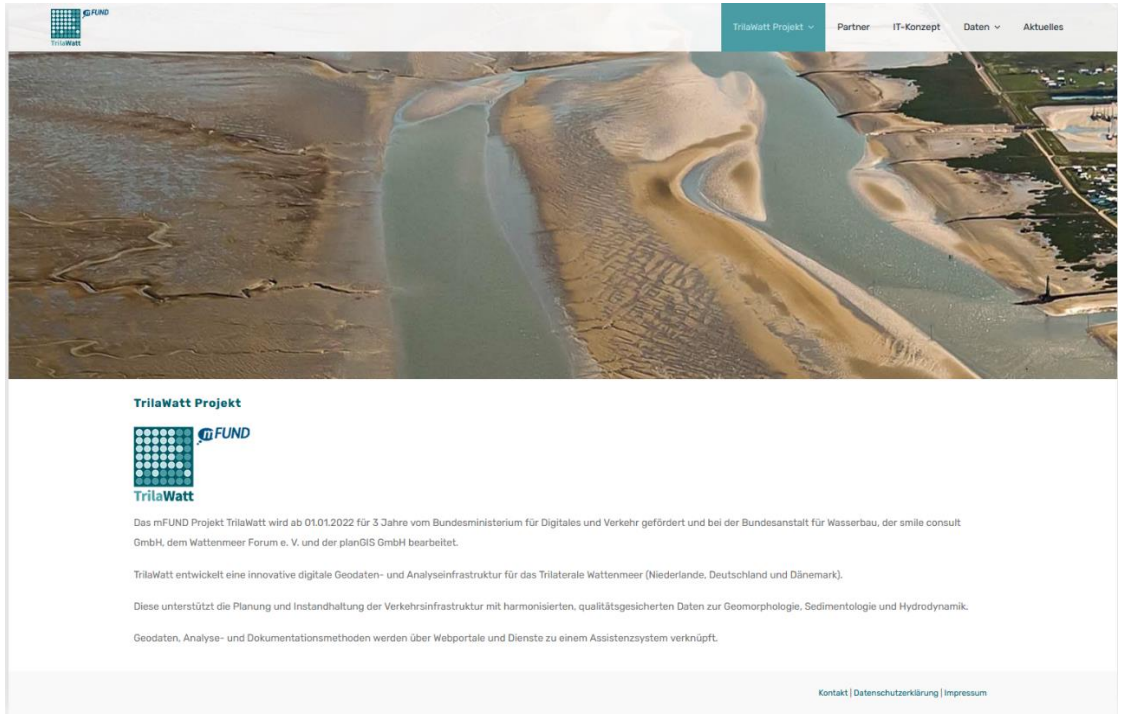
resultling streamlines 2006 [EasyGSH-DB]

Technical networking

- TrilaWatt web portal
  - Project details
  - direct access to dababase and data products
  - TrilaWatt cloud

- Marine Data Infrastructure Germany MDI-DE
  - Metadata for data and services
  - Catalog search (Catalog Service Web)
  - Map-viewer (Web Map Service)
  - Download (Web Feature Service)
  - Processing (Web Processing Service)
  - MDI-DE working groups

- Trilateral Wadden Sea cooperation



https://trilawatt.eu/

Integration into the Marine Data Infrastructure Germany

Search for data and services
by harvesting of standardized metadata

International

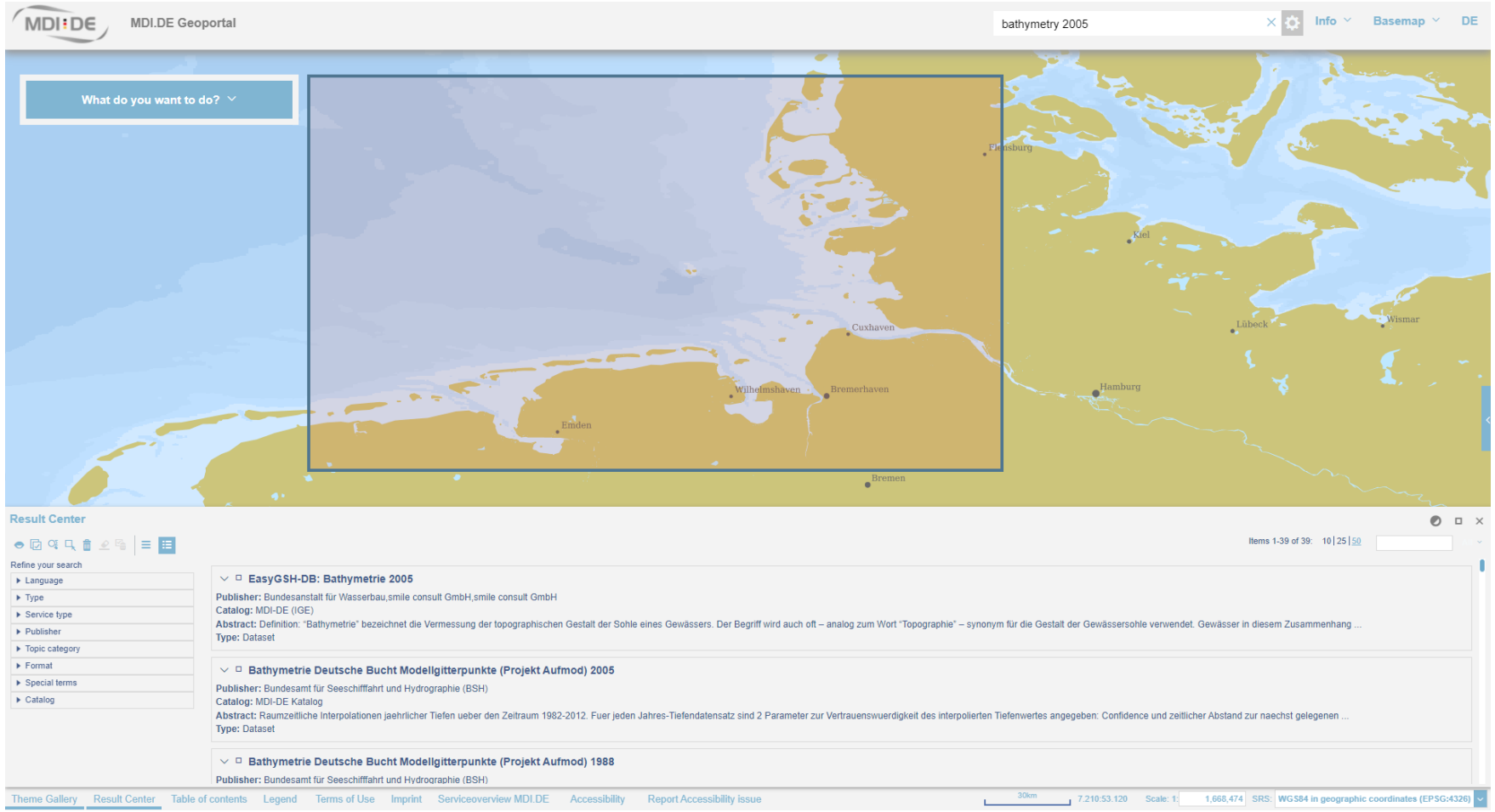
National

Subject / Expert Portal

Project Portal

Search and find data in the MDI-DE

Using EasyGSH-DB as an example



https://mdi-de.org

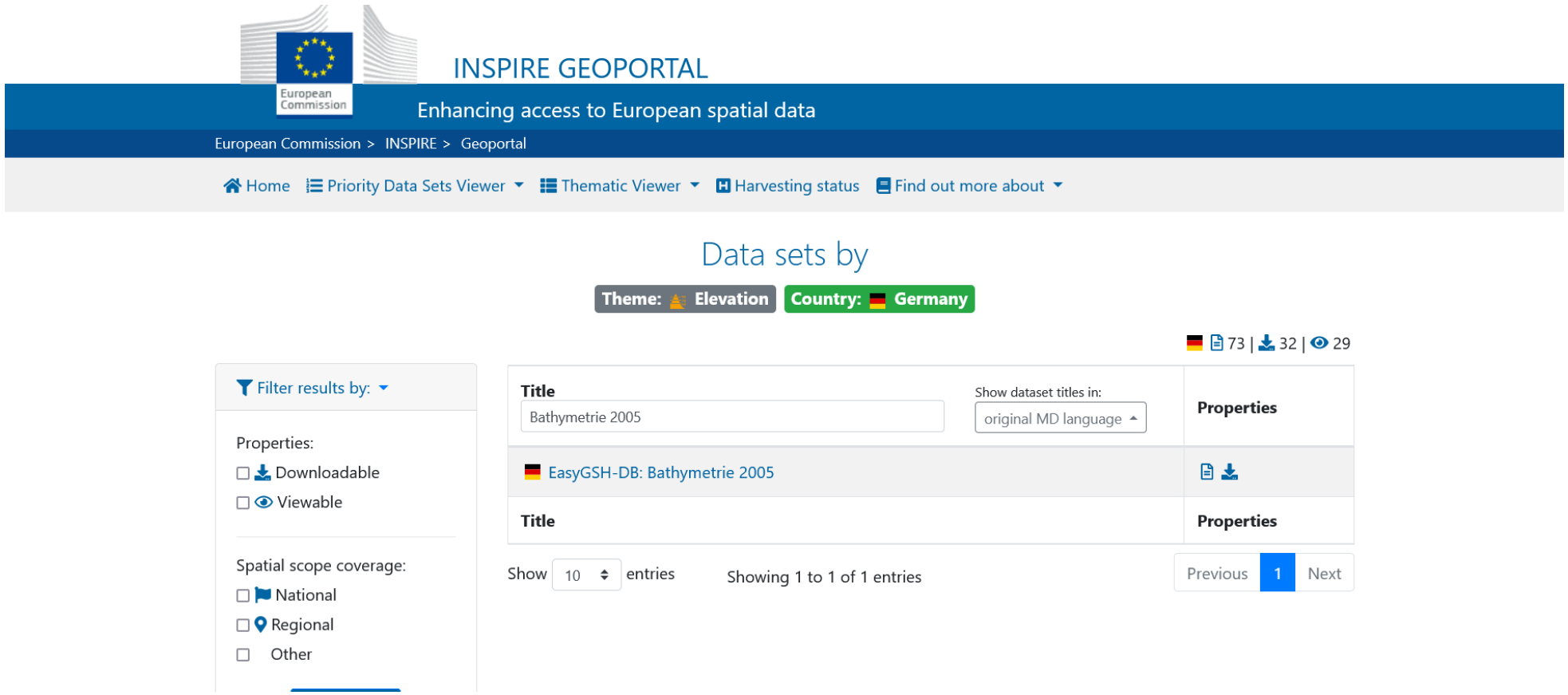
Search and find data in the *mCLOUD*

Using EasyGSH-DB as an example

https://www.mcloud.de

Search and find data in the INSPIRE Geoportal

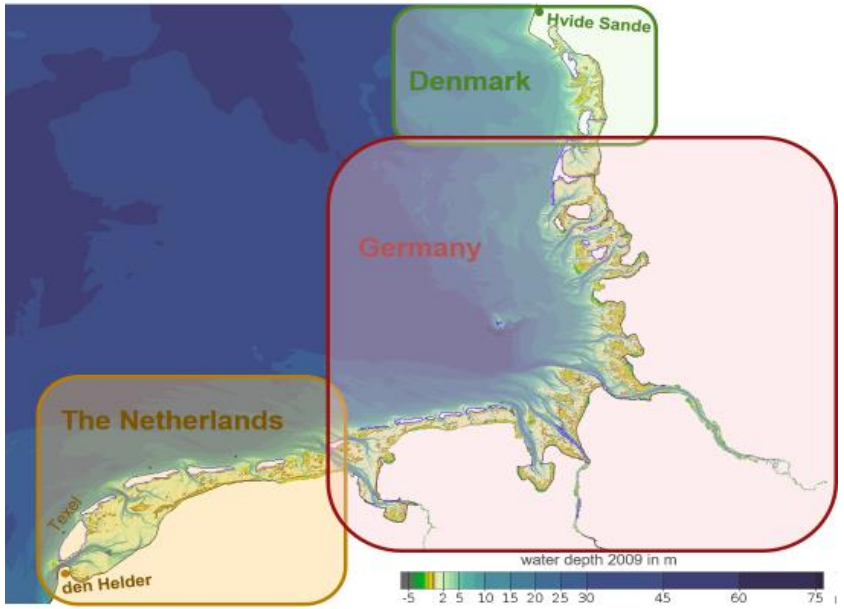
Using EasyGSH-DB as an example



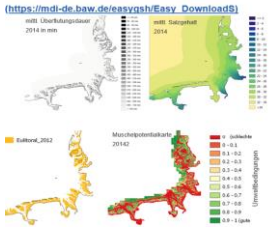
https://inspire.ec.europa.eu

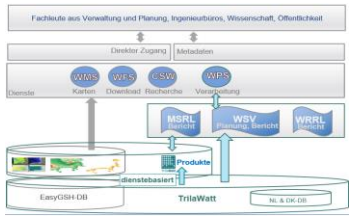
Next Steps

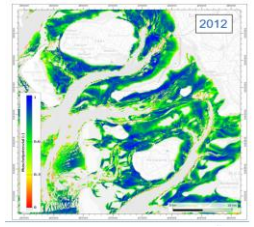
- Trilateral **stakeholder analysis** - Identification of potential data users, data holders and other users
- Questions and tasks - Identification of **pilot applications** together with the stakeholders
- Involvement of **interested users** in the joint processing of the respective question/task
- Data retrieval and database extension
- Data **harmonization**
- Establish data **interoperability**

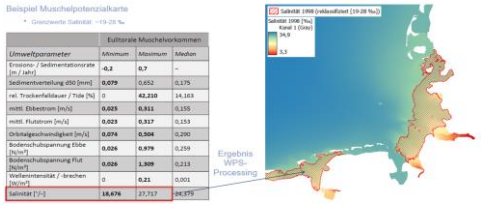


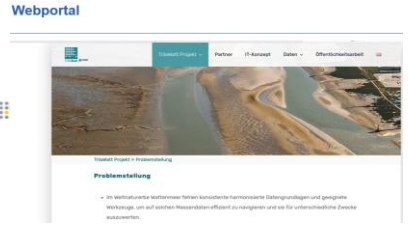
- works on **international** level on a **coherent database** for the **Trilateral Wadden Sea Cooperation**
- creates **consistent**, **quality-assured data** records
- develops services-based **methods** for **automated reporting**
- makes the developed **results** and **products** available via **known data portals**
- would like to encourage **users** from different sectors to become "problem owners" and to seek **cooperation with the TrilaWatt consortium**
- offers the opportunity to work on **selected issues concerning the trilateral Wadden Sea Area**











Discussion and questions in the group of participants

Discussion (All)

- Form
- Goals
- Content
- Communication
- Deployment
- Usage
- Perspectives

Please scan and enter here

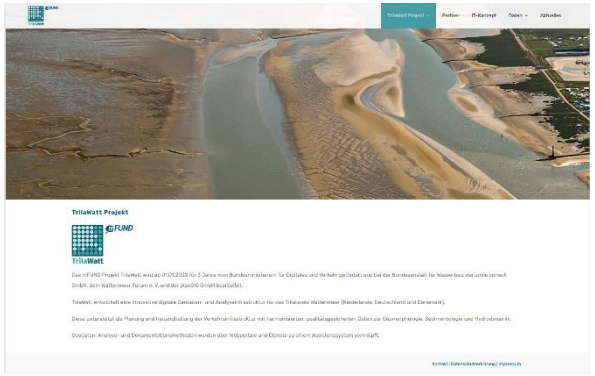
Supported by:

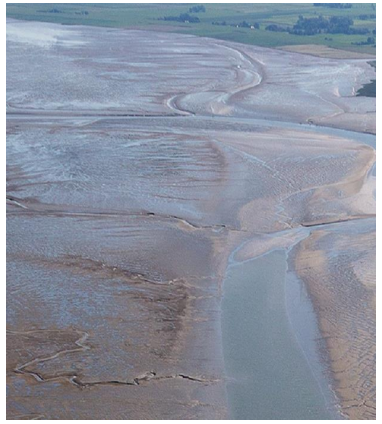
Federal Ministry of Transport and Digital Infrastructure

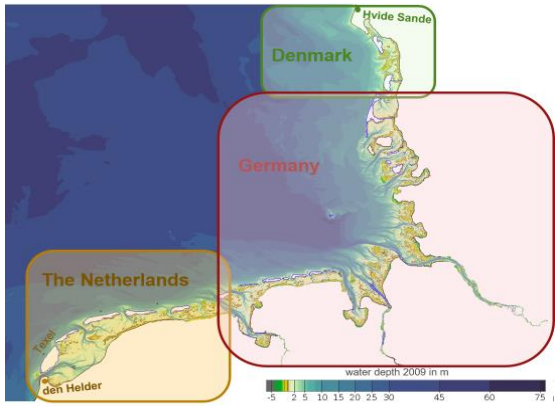
mFUND – Das Startkapital für die Mobilität 4.0

on the basic of a decision by the German Bundestag

TrilaWatt







Source: TrilaWatt

Thank you for your interest and attention!

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Bundesanstalt für Wasserbau
22559 Hamburg

www.baw.de

thank you!

hartelijk dank!

mange tak!