The EMODNET-Geology project – delivering harmonized geological maps of the European seas

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and EMODnet – Geology partners

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EASME/EMFF/2016/1.3.1.2 – lot 1 - geology

International Scientific Forum
"Gulf of Finland - natural dynamics and anthropogenic impact“
//St Petersburg, Russia// October 17-18, 2018

EMODnet

What is EMODnet?

(European Marine Observation and Data Network)

- Established in 2008 by the European Commission
  - As part of the Integrated Maritime Policy Action Plan
  - To support 'Marine Knowledge 2020'
  - To support the aims of the Marine Strategy Framework Directive to achieve good environmental status in European waters by 2020
  - Two first phases accomplished by end of 2016 and the third phase has now six months left.

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EMODnet mission

To assemble scattered marine data into harmonized maps of the European seas.

Who are we - EMODnet Geology Consortium

Totally 39 organizations, mainly European geological surveys - 34 partners and 5 subcontractors

Project coordination by the Geological Survey of Finland (GTK)

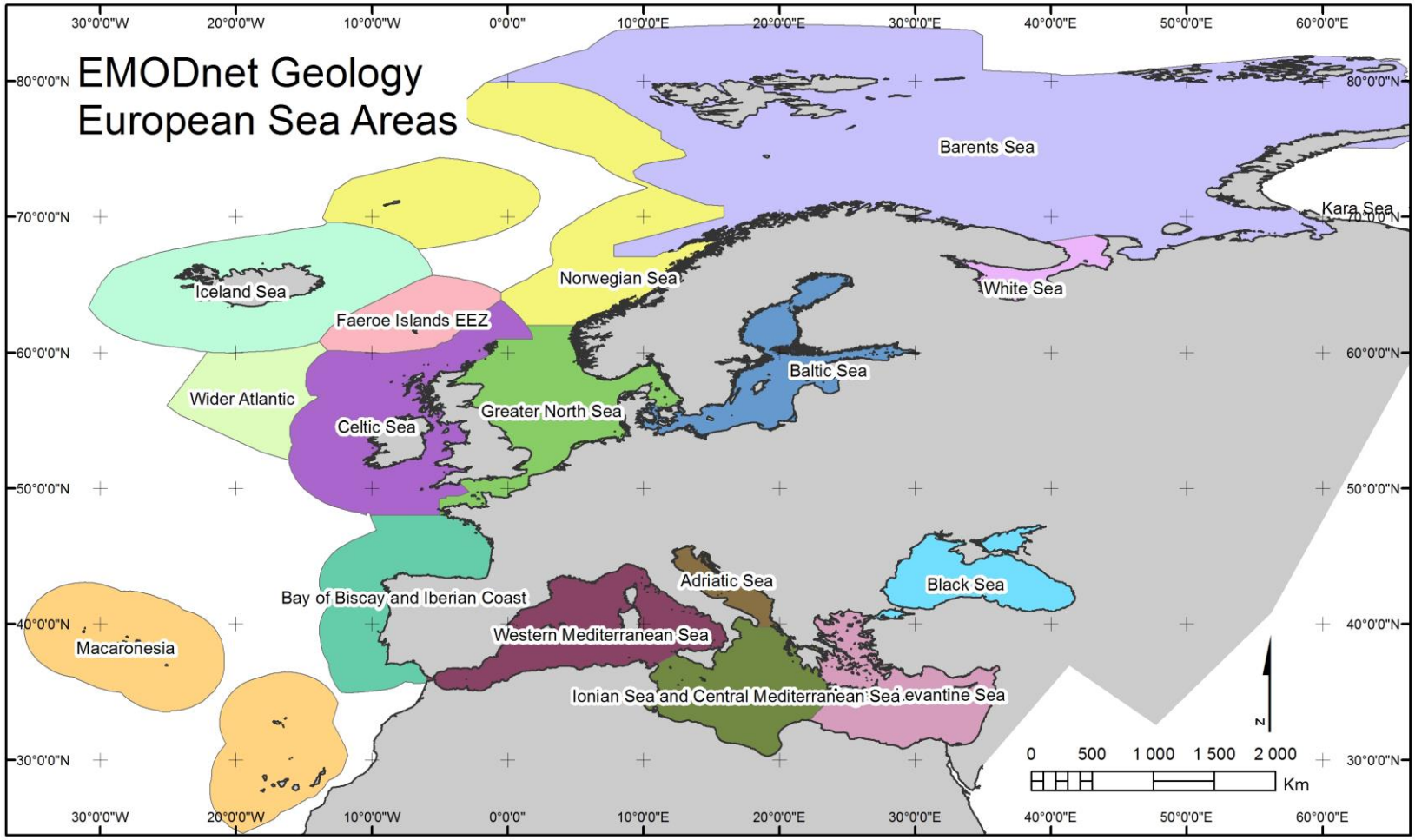
What do we do?

Collect data from all European seas and assemble data products, mainly maps

EMODnet ‘EMODnet design principles’

- **collect data once** and use it many times
  - EMODnet only collects available data
- develop **standards** across and within disciplines
- process and **validate data** at different levels
- provide **sustainable financing** at an EU level so as to extract maximum value from the efforts of individual Member States
- **build on existing efforts** where data communities have already organised themselves, such as the network of European Geological Surveys (Eurogeosurveys)
- accompany data with statements on **ownership, accuracy and precision**
- recognise that marine data is a **public good** and discourage cost-recovery pricing from public bodies

Sea areas covered by EMODnet



Data: European Sea areas VLIZ (2014). EMODnet Regions v1.
Coastline: EEA, upload 4th July 2013,
Both datasets modified in EMODnet geology
based on seabed substrate data
(e.g. Faeroe EEZ, Wider Atlantic Sea included in sea areas)
Coordinates: WGS84

EuroGeoSurveys
European Geoscience for Society
The Geological Surveys of Europe

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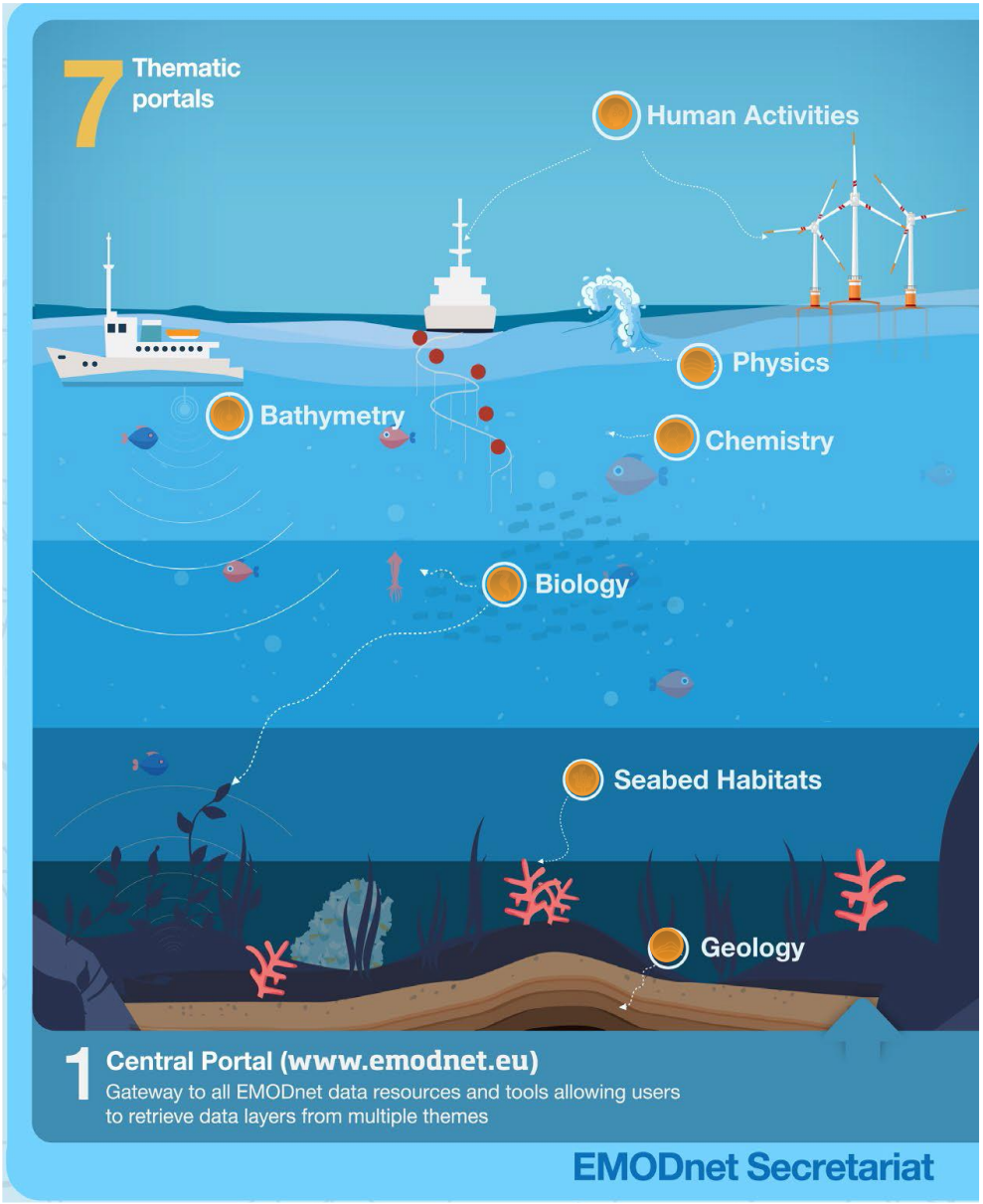
EMODnet Programme = 7 thematic EMODnet projects

EMODnet thematic portals:

- **Lot 1 - Geology**
  Geological Survey of Finland (GTK) + 34 partners + 5 subcontractors
- **Lot 2 - Seabed Habitats**
  JNCC Support Co + 11 partners
- **Lot 3 - Physics**
  ETT SpA + 3 partners + 5 subcontractors
- **Lot 4 - Chemistry**
  Istituto Nazionale di Oceanografía e di Geofisica Sperimentale (OGS) + 26 partners + 18 subcontractors
- **Lot 5 - Biology**
  Vlaams Instituut voor de Zee VZW (VLIZ) + 21 partners + 2 subcontractors
- **Lot 6 - Human Activities**
  COGEA Consulenti per la gestione aziendale SRL (COGEA SRL) + 5 partners
- **# 7 - Bathymetry**
  SHOM + 49 partners + 6 associated partners
- **+ Central portal and Data Ingestion project**



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EMODnet-Geology project

- Two earlier phases:
  - First phase July 2009 – July 2012,
  - Second phase; October 2013 – October 2016
- Third phase; from 12th April 2017 to 12th April 2019, with an option of two additional years
- The third phase is building on the second phase, but with more details than before, *The resolution shall be at 1:100,000 all over but finer where the underlying data permit = multi-scale approach* (EC, tender specifications)
- Added information - **NEW WP!** = Reconstructions of the submerged landscapes of the European continental shelf at various time-frames

EMODnet Deliverables according to the service contract

Lot 1 Geology

- **seabed substrate**
- **sediment accumulation rate**
- **sea-floor (bedrock) lithology and stratigraphy**
- **coastal behaviour**
  - **migration direction, rate and volume, resilience**
  - **geological events and probabilities (e.g. earthquakes, submarine landslides, volcanic centres)**
- **geological events and probabilities (e.g. earthquakes, submarine landslides, volcanic centres)**
- **mineral occurrences (e.g. oil and gas, aggregates, metallic minerals)**
- **reconstructions of the submerged landscapes of the European continental shelf at various time-frames**

Additionally: Geomorphology and Quaternary geology

All map outputs shall be added to the EMODnet-geology web portal

Workpackages

- WP1. Project management. GTK, Finland
- WP2. Geological data specification and sourcing. GTK, Finland
- **WP3. Sea-bed substrate. GTK, Finland**
- **WP4. Sea-floor geology. BGR, Germany.**
- **WP5. Coastal behaviour. TNO, the Netherlands.**
- **WP6. Geological events and probabilities. ISPRA, Italy.**
- **WP7. Minerals. GSI, Ireland.**
- **WP8. Submerged landscapes. BGS, UK.**
- **WP9. Data management, web portal and services. GEUS, Denmark.**
- WP10. Dissemination. GTK, Finland
- WP11. EMODnet collaboration. GTK, Finland
- WP12. Project analysis and sustainability. GTK, Finland and GEUS, Denmark.

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Let's take a look at the different work packages and their products:

WP3: Seabed substrate

EMODnet Multinational substrate data challenges

- Collected by institutions around the European Seas (30 nations)
- Year ranges (1970's →)
- Different:
  - Field techniques
  - Scales (1: 1 500 → 1: 1 000 000)
  - Interpretation methods
  - Terminologies
  - (Grain-size) Classifications (>30 different classifications)

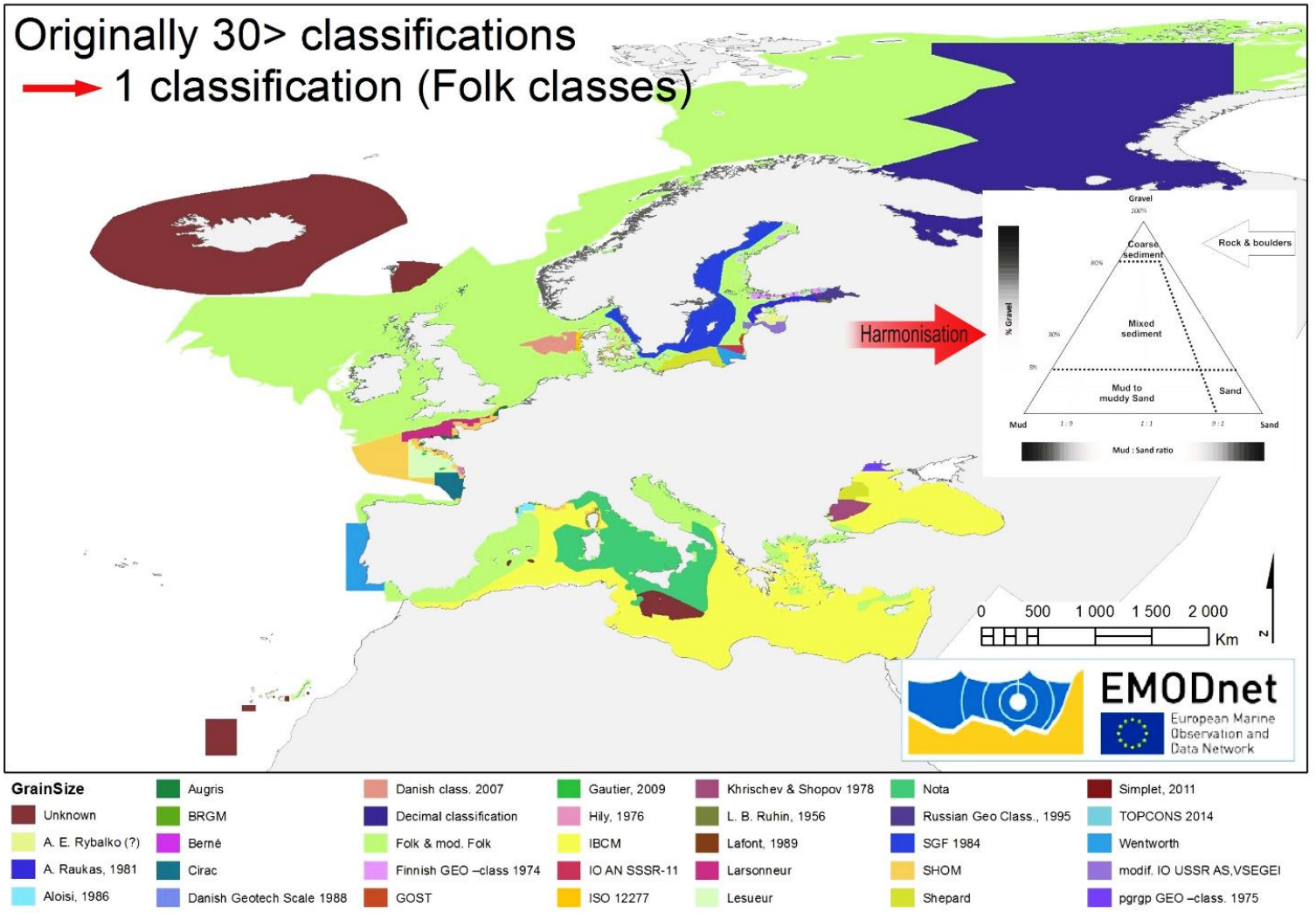
EMODnet Many classification schemes

Table 1. The Grain size limits in different classification systems.

Grain size Mm > Ø	EMODnet FOLK	MNCR	Udden - Wenthworth	GTK & SGU	GEUS	YSEGEI	EGK Raukas 1981	Lithuania	Ukraine	Romania	SHOM	Larsonneur (1979) modif	Aloisi	Augris (1990-2013	Simplet (2011)	Gautier (2009)	Laffont (1989)	Berné (1986-1987)	BRGM	Hilg (1976)	Grain size Mm > Ø	EMODnet FOLK	Comments
> 600	Boulders (> 256)	Boulder (> 256)	Boulder (> 256)	Boulder (> 600)	Boulder (> 200)	Boulders (> 100)	Boulders > 1000	Boulder (> 100)	Boulders > 10	No information	Cailloutis (“pebble, >200)	Cailloutis (pebble), Coquilles (Shell), (>200)	No information	Blocs (boulder, >600)	Galets (cobble, >64)	Galets (cobble, >64)	No information	Galets, graviers (gravel to cobble, > 2)	Galets, >64	Graviers(gravel, >2)	> 600	Boulders (> 256)	All defined boulder categories fall into this group. Overlap with large stones. Some national classifications include smaller particles in category Boulders (GTK, GEUS,
-600				Large Stones			Cobbles (100-1000)							Galets (cobble, >64)							-600		
-256	Gravel (2– 256)	Cobble (64 - 256)	Cobble (64 - 256)	(200 - 600)																	-256	Gravel (2– 256)	Almost all gravels belong here. Also stones, cobbles and pebble sizes fit to gravel grain sizes. Large stones overlap with boulder sizes. Some boulder sizes (GEUS, YSEGEI, Ukraine) overlap with gravel category.
-200				Small stones (60 - 200)	Stone (20 - 200)						Graviers, (gravel, 2-200)	Graviers, (gravel, 2-200)									-200		
-100						Cobbles (10 - 100)	Pebble (10-100)	Cobbles (10 - 100)													-100		
-64		Pebble (16 - 64)	Pebble (4 - 64)											Cailloutis (pebble, 20-64)	Cailloutis (pebble, 16-64)	Cailloutis (pebble, 16-64)			Graviers (gravel, 4-64)		-64		
-60				Gravel (2 - 60)																	-60		
-20					Gravel (2 - 20)									Graviers (gravel, 2-20)							-20		
-16		Gravel (4 - 16)							Gravel (1-10)						Graviers (gravel, 2-16)	Graviers (gravel, 2-16)					-16		
-10						Gravel (2 - 10)	Granule (1-10)	Gravel (1-10)													-10		
-4		Coarse Sand (1 - 4)	Granule (2 - 4)																Granules (gravel, 2-4)		-4		
-2	Sand (0.0625-2)		Very coarse sand (1 - 2)	Coarse sand (0.06 - 2)	Sand (0.06 - 2)	Sand (0.05 - 2)				Sand (0.0625-2)	Sables (Sand, 0.5-2)	Sables grossiers (coarse sand, 0.5-2)	Sables grossiers (coarse sand, 0.5-2)	Sables grossiers (coarse sand, 0.5-2)	Sables grossiers (coarse sand, 0.5-2)	Sables grossiers (coarse sand, 0.5-2)		Sables grossiers (coarse sand, 0.5-2)	Sables grossiers (coarse sand, 0.5-2)	Sables grossiers (coarse sand, 0.5-2)	-2	Sand (0.0625-2)	Quite allright. Some problems with fine sand grain sizes as with MNCR Coarse sand grains. YSEGEI sand includes smaller particles.
-1		Medium Sand (0.25 - 1)	Coarse sand (0.5 - 1.0)				Sand (0.1-1)	Coarse sand (0.5-1)	Sand (0.1-1)												-1		
-0,6				Medium sand (0.2 - 0.6)																	-0,6		
-0,5			Medium sand (0.25 -					Medium sand (0.25-0.5)			Sables fin (Fine sand, 0.05-0.5)	Sables fines (fine sand, 0.2-0.5)	Sables fins à moyens (fine to med sand, 0.2-0.5)	Sables moyens	Sables moyens	Sables moyens		Sables moyens	Sables moyens (medium sand, 0.25-	Sables fine (fine sand, 0.0625-0.5)	-0,5		
-0,25		Fine Sand (0.0625 - 0.25)	Fine sand (0.125 - 0.25)					Fine sand (0.1-0.25)						Sables fine (fine sand, 0.25-0.125)	Sables fine (fine sand, 0.25-0.125)	Sables fine (fine sand, 0.25-0.125)		Sables fine (fine sand, 0.25-0.0625)			-0,25		
-0,2				Fine sand (0.06 - 0.2)								Sablon (Very fine sand,	Sablon (very fine sand 0.04-0.2)						Sablon, 0.02-0.2 (“very fine sand	Sables très fine (very fine sand,	-0,2		
-0,125			Very fine sand					Coarse silt (0.05-0.1)	Silt (0.01-0.1)					Sables très fines (very	Sables très fine (very	Sables très fine (very					-0,125		
-0,0625	Mud (< 0.0625)	Mud (< 0.0625)	Mud (< 0.0625)				Silt (0.005-0.1)			Silt (0.0033-0.0625)	Silts, <0.0625	0.05-0.2)		Silts (0.002-0.0625)	Silts (0.002-0.0625)	Silts (0.002-0.0625)		Silts (0.002-0.0625)		Vases (Mud, 0.0625)	-0,0625	Mud (< 0.0625)	All mud, silt and clay grain sizes belong here. Part of the fine sands (GTK, SGU, GEUS = difference only 0.0025 mm, YSEGEI= difference 0.0125mm) overlap here. EGK and Ukrainian silt classes overlap with sand and mud categories.
-0,06				Silt (0.002 - 0.06)	Silt (0.002 - 0.06)																-0,06		
-0,05						Silt (0.005 - 0.05)		Fine silt (0.01-0.05)			Argiles (Clay, <0.05)	Lutites (lutite, <0.05)									-0,05		
-0,04													Vases (mud, <0.04)								-0,04		
-0,02																					-0,02		
-0,01								Clay (< 0.01)	Clay (< 0.01)												-0,01		
-0,005						Clay (< 0.005)															-0,005		
-0,0039										Clay (< 0.0039)											-0,0039		
-0,002				Clay (< 0.002)	Clay (< 0.002)		Clay (<0.005)							Argiles (clay, <0.002)	Argiles (clay, <0.002)	Argiles (clay, <0.002)		Argiles (clay, <0.002)	Argiles (clay, <0.002)	Argiles (clay, <0.002)	-0,002		
				Baltic and North Sea					Black Sea		French classifications												

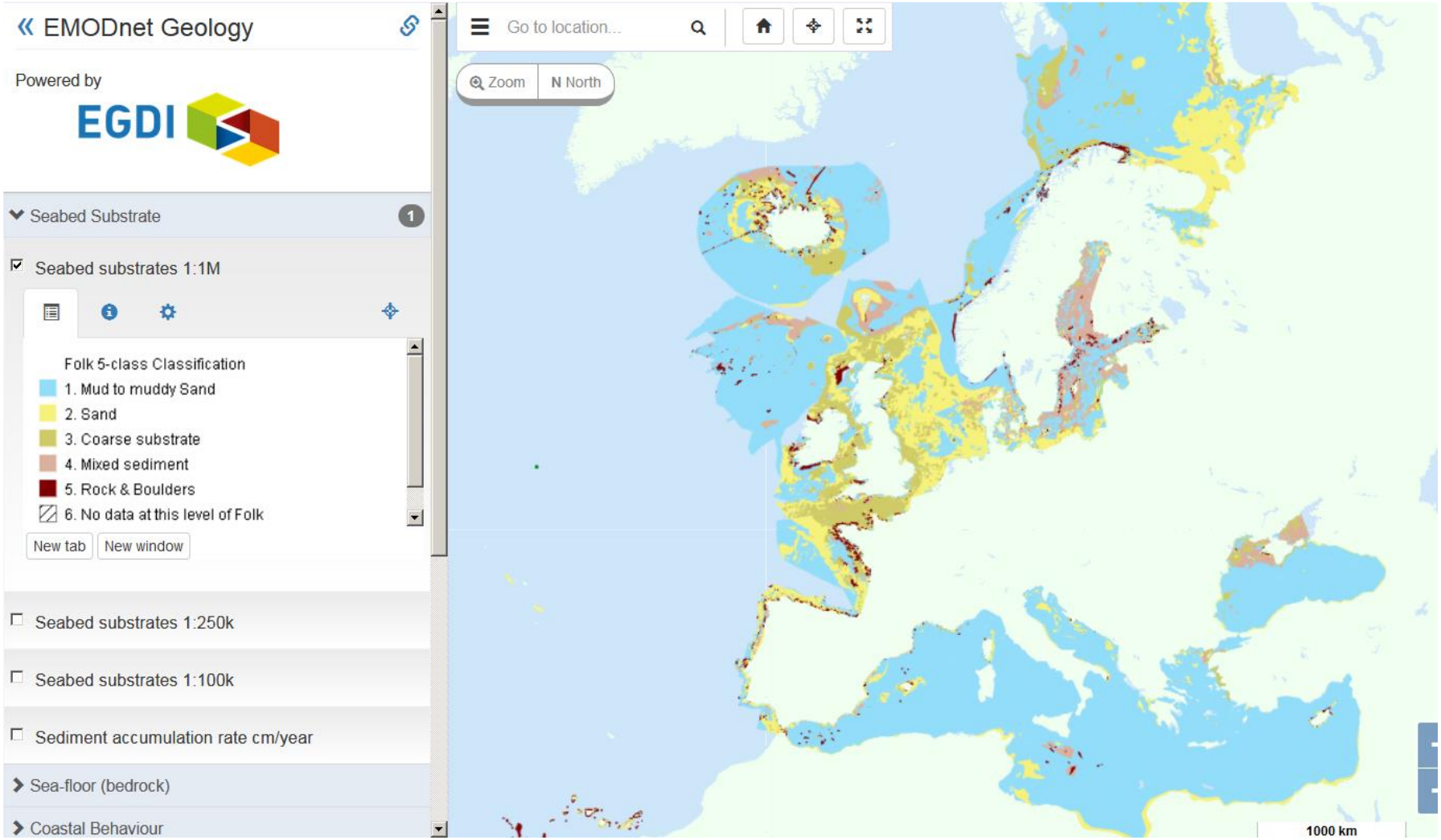
EMODnet Sediment substrate

Harmonisation



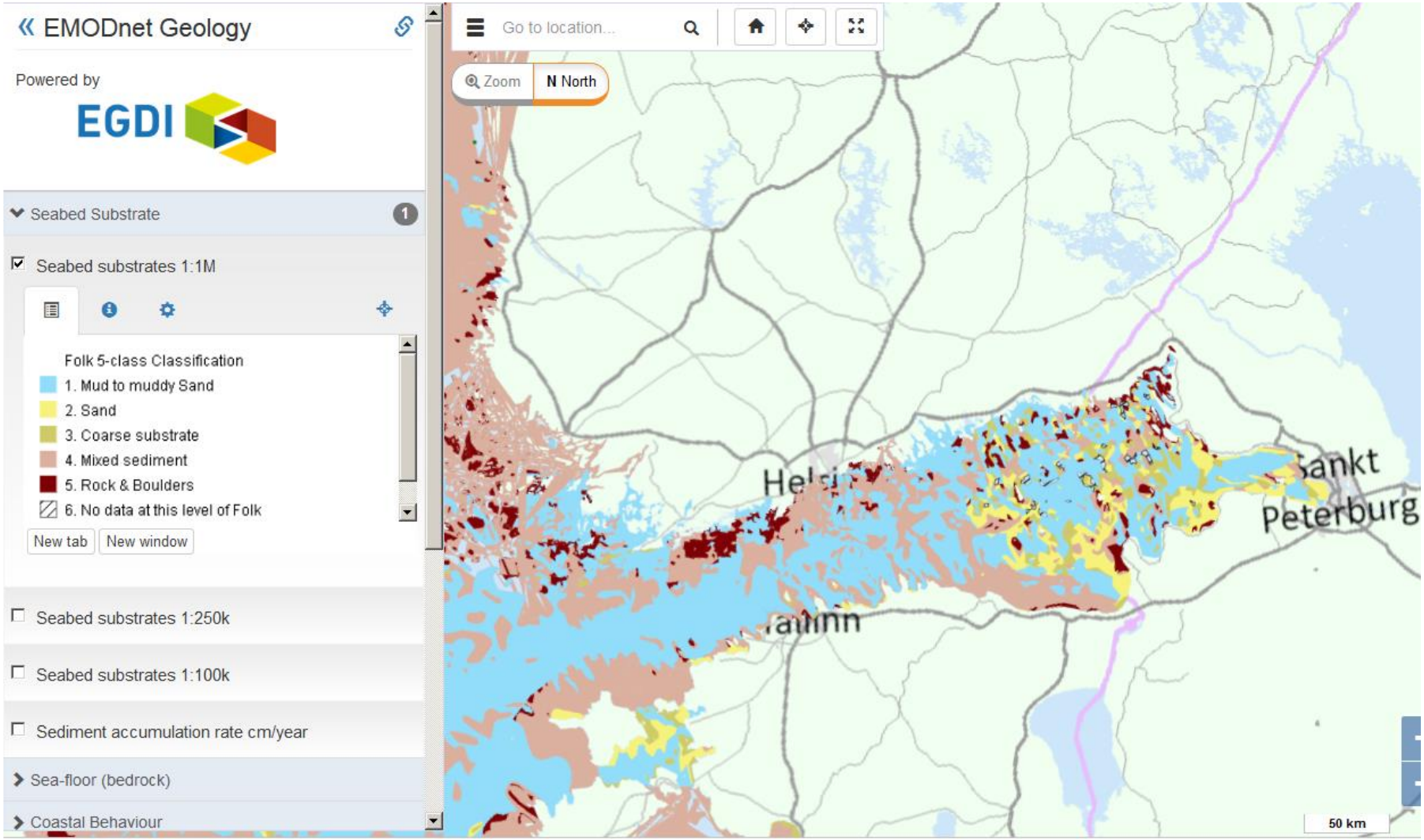
EMODnet WP3:Sediment substrate

Seabed surface sediment substrate 1:1.000.000



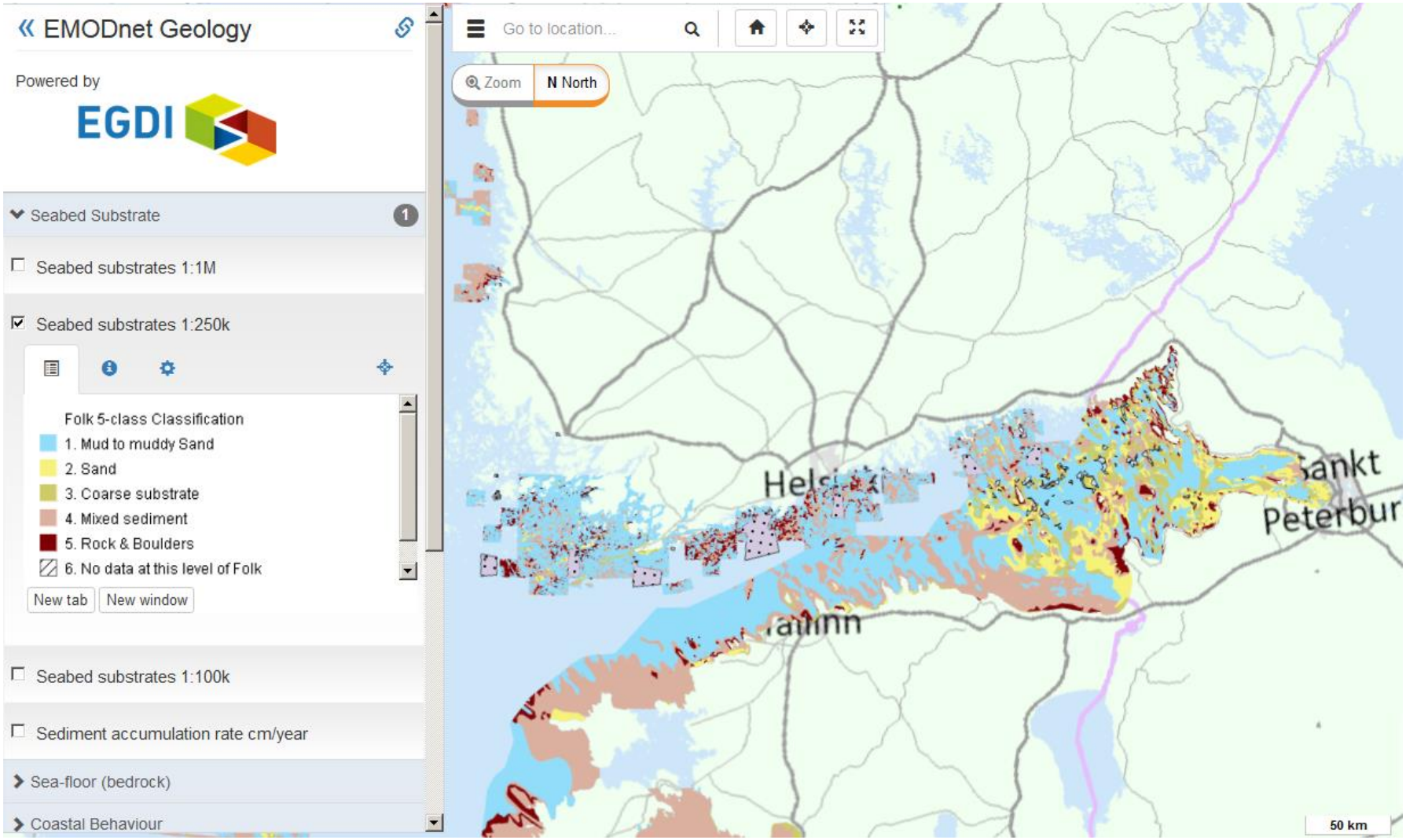
EMODnet WP3:Sediment substrate

Seabed surface sediment substrate 1:1.000.000



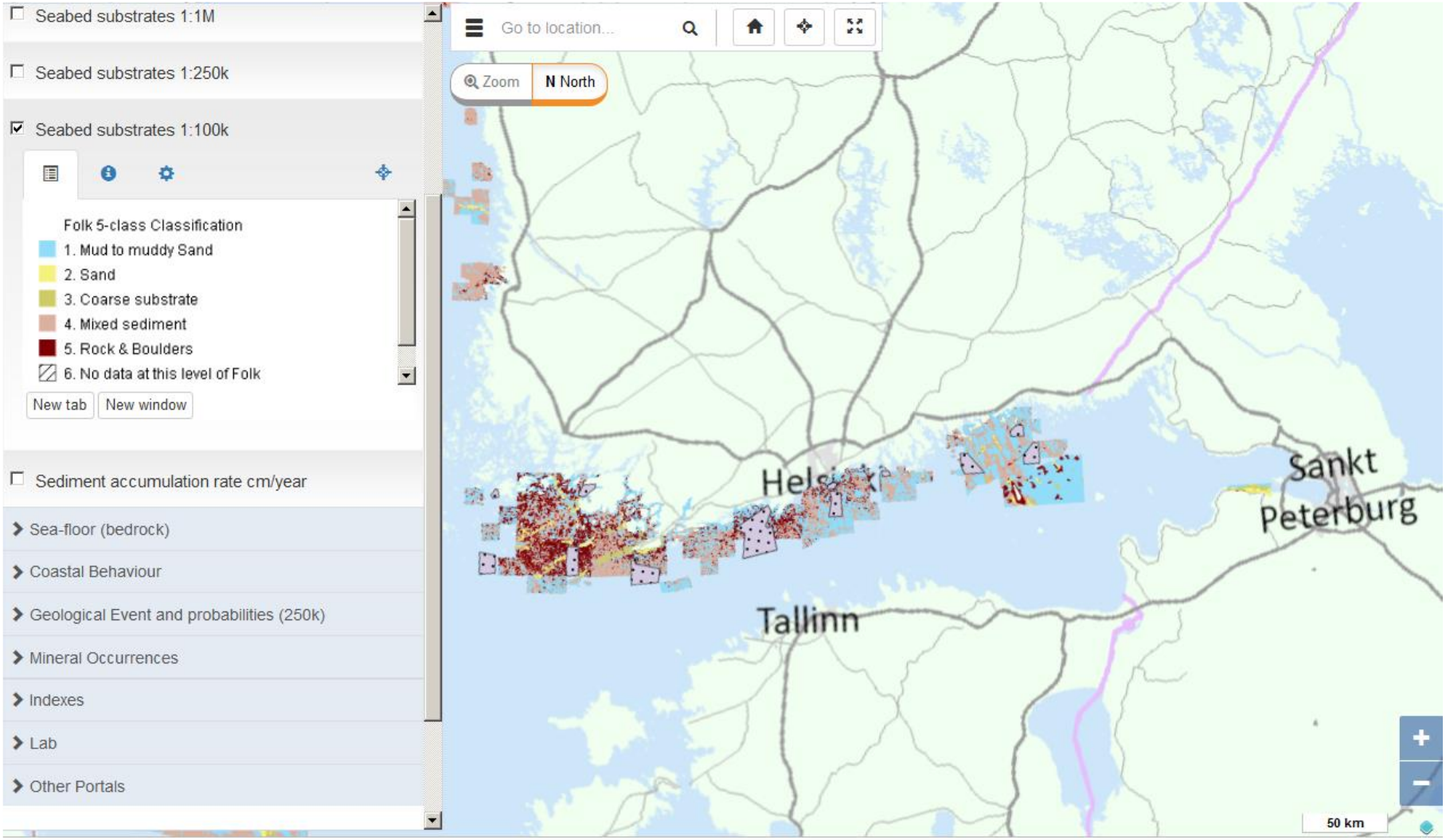
EMODnet WP3:Sediment substrate

Seabed surface sediment substrate 1:250.000



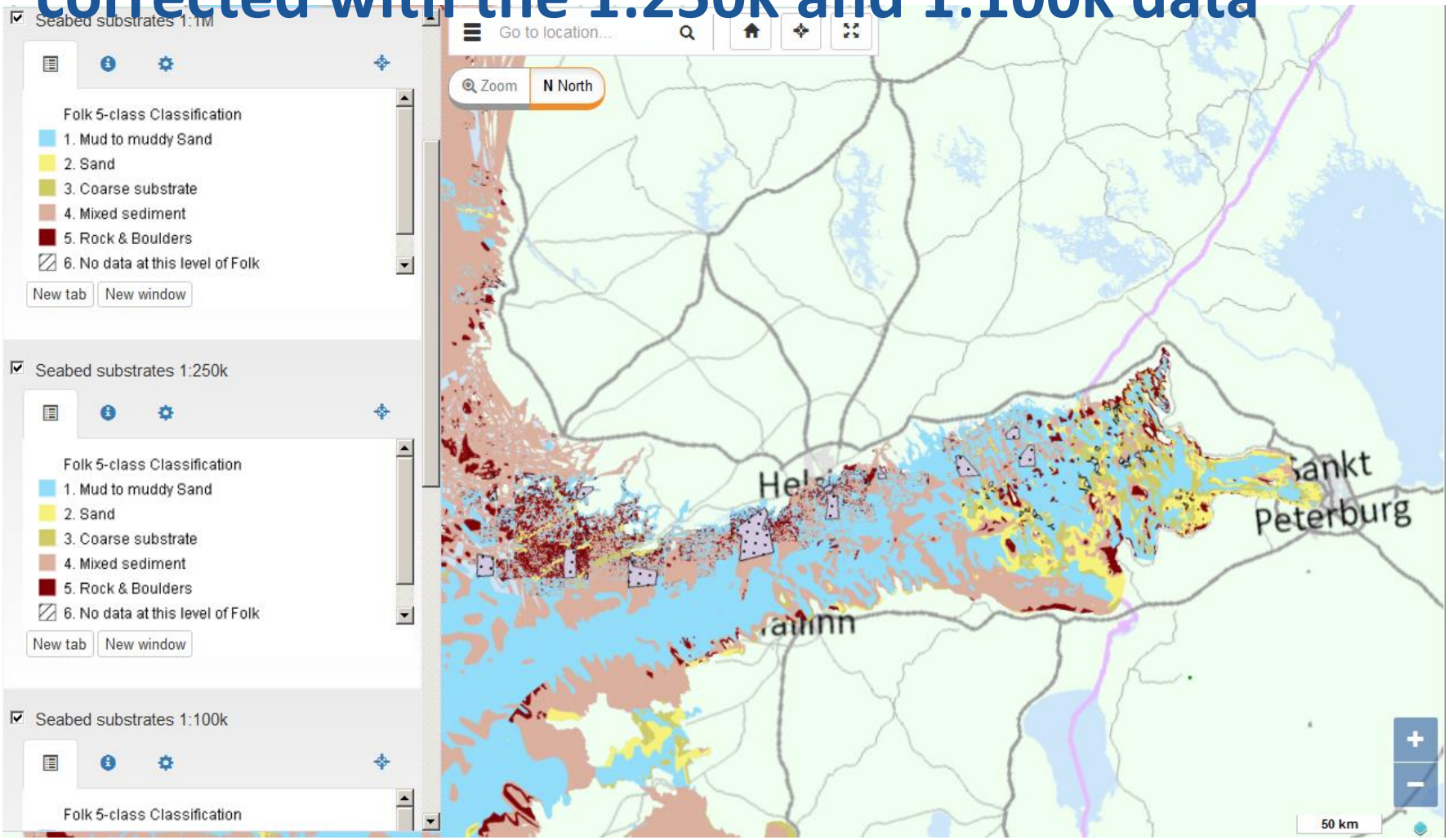
EMODnet WP3:Sediment substrate

Seabed surface sediment substrate 1:100.000



EMODnet WP3:Sediment substrate

Seabed surface sediment substrate 1:1M corrected with the 1:250k and 1:100k data



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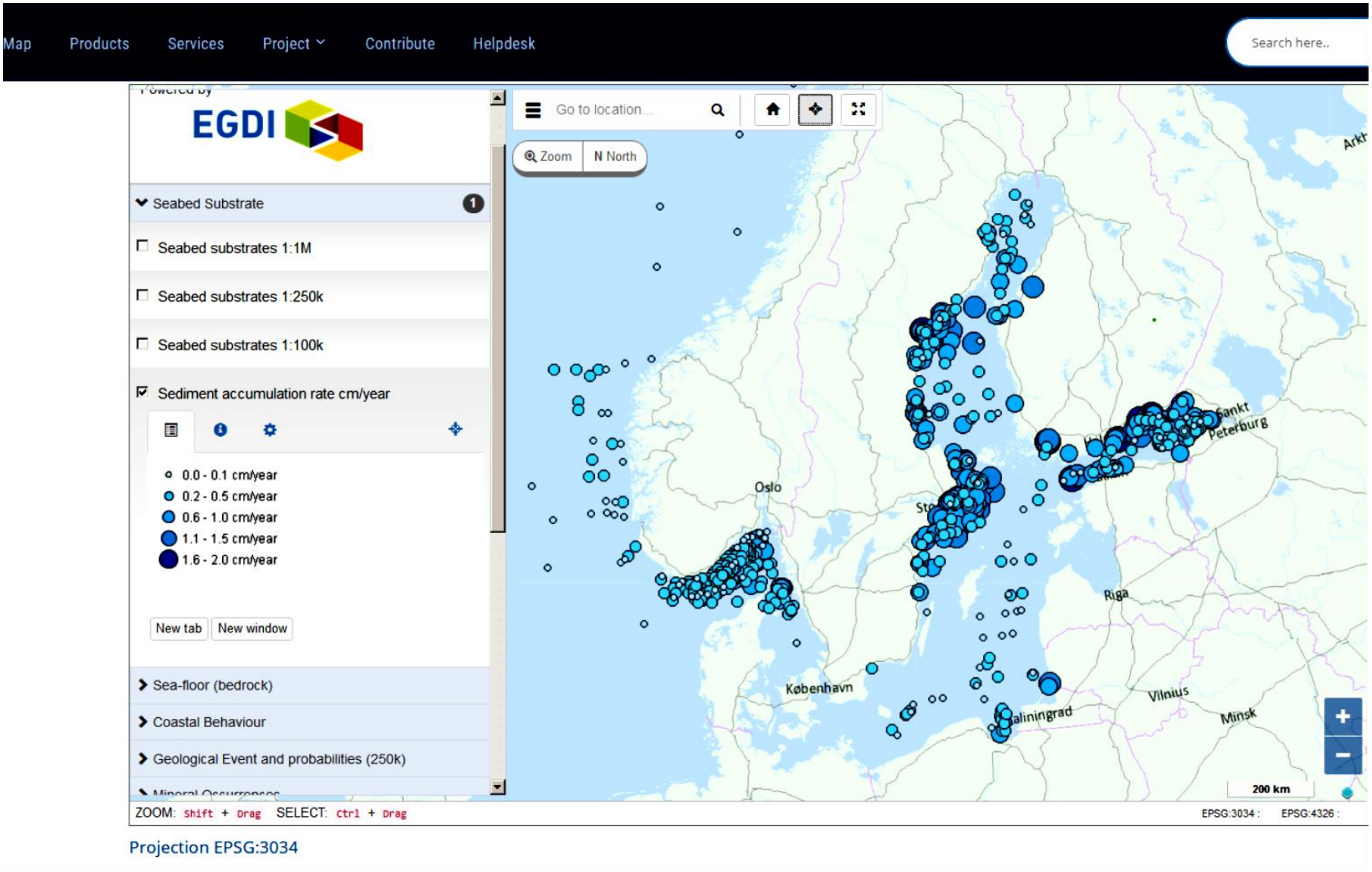
WP3: Sediment accumulation

EMODnet WP3:Sediment accumulation rate



Projection EPSG:3034

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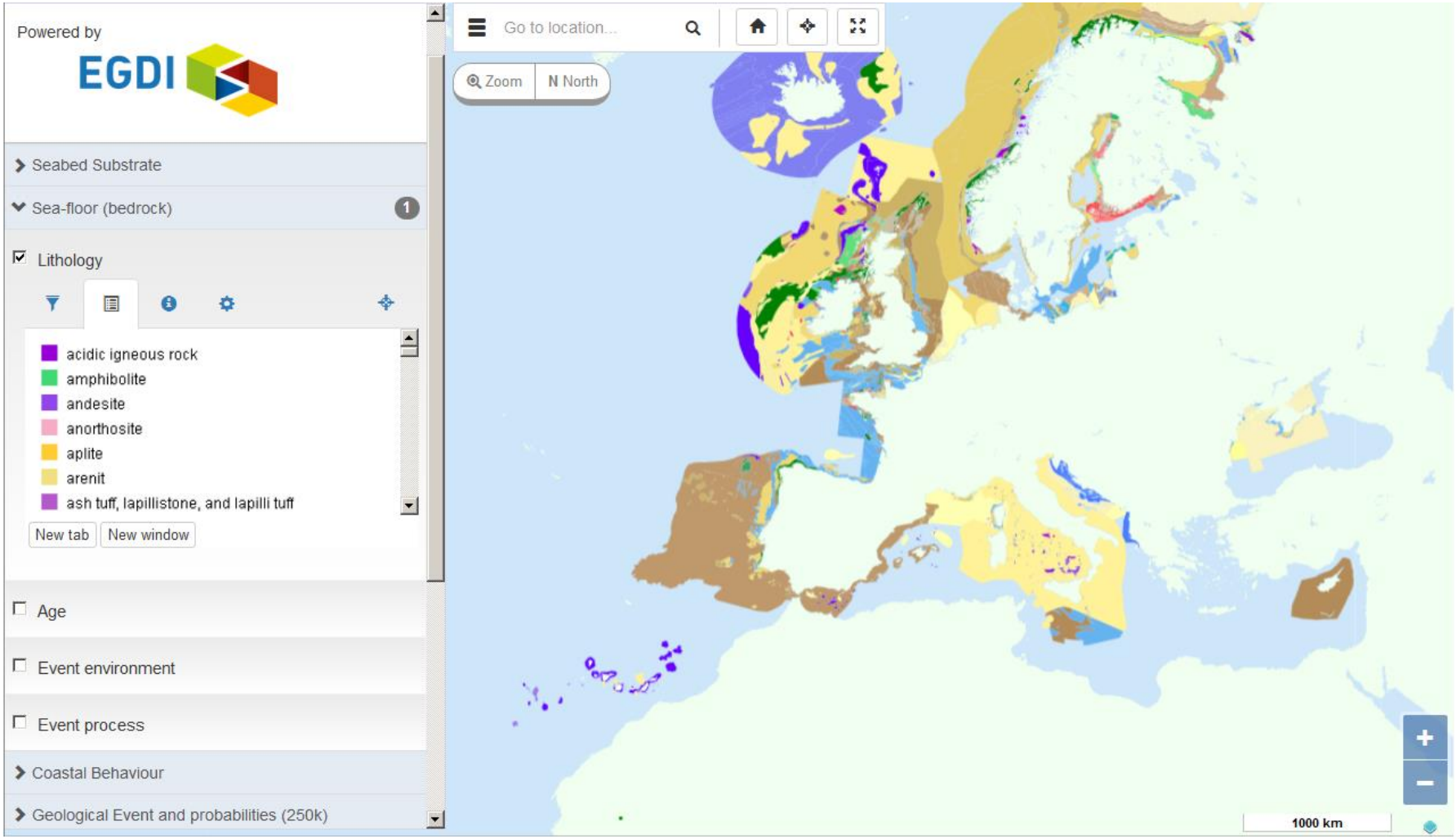
WP4: Sea-floor geology = hard rock

WP4: Sea-floor geology = hard rock

Sea-floor Pre-Quaternary lithology of European seas



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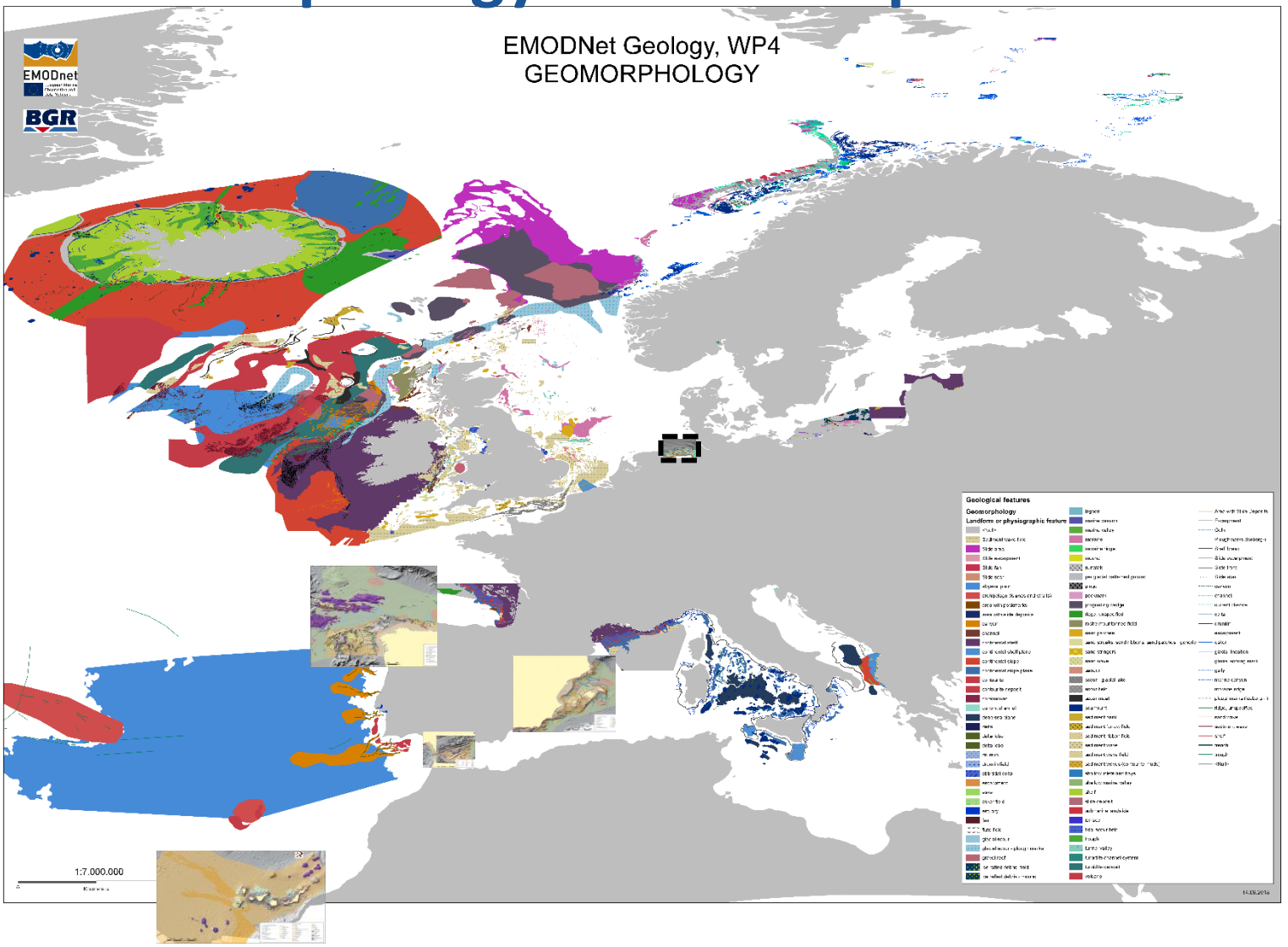
Geomorphology of the European seas



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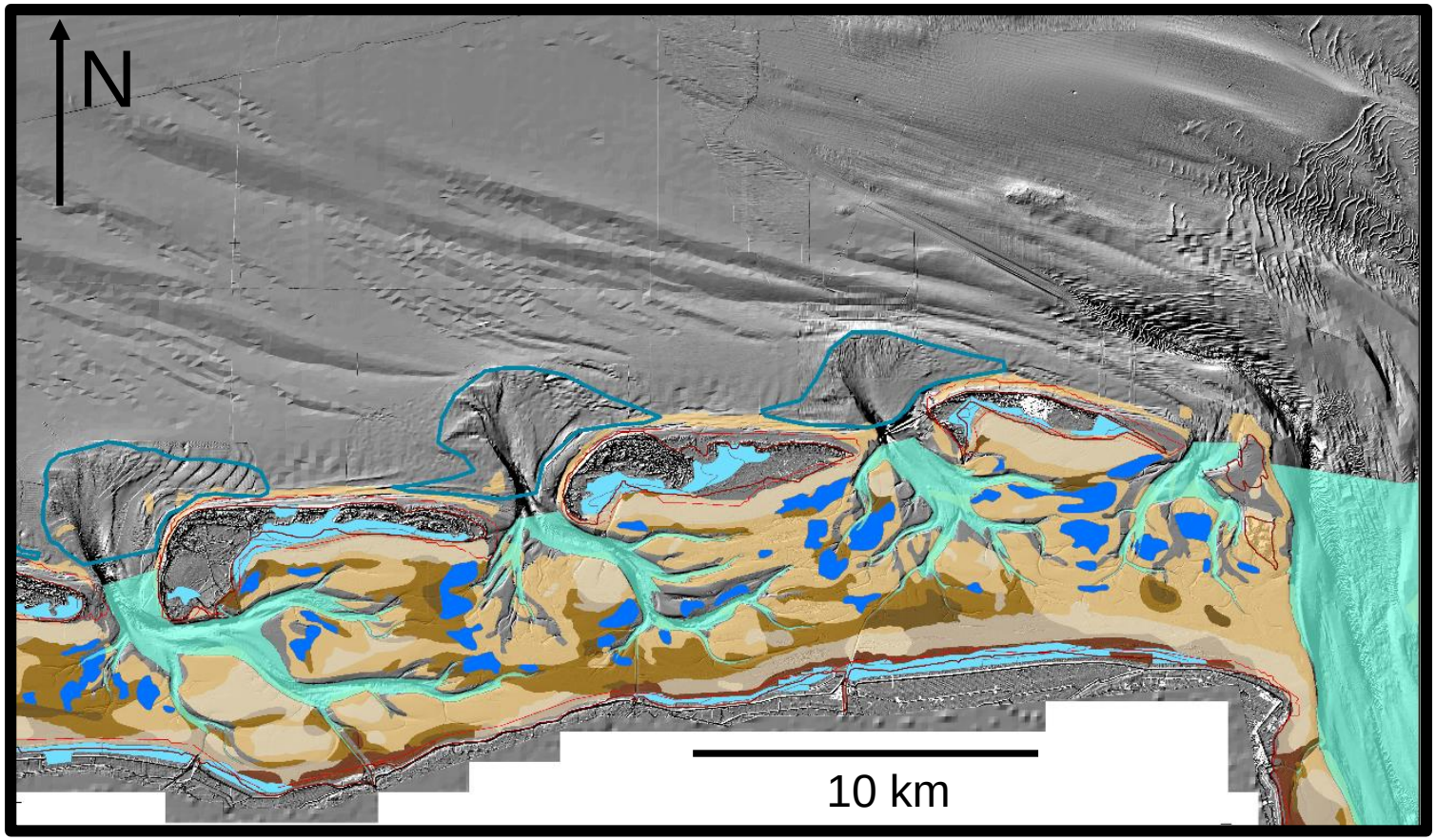
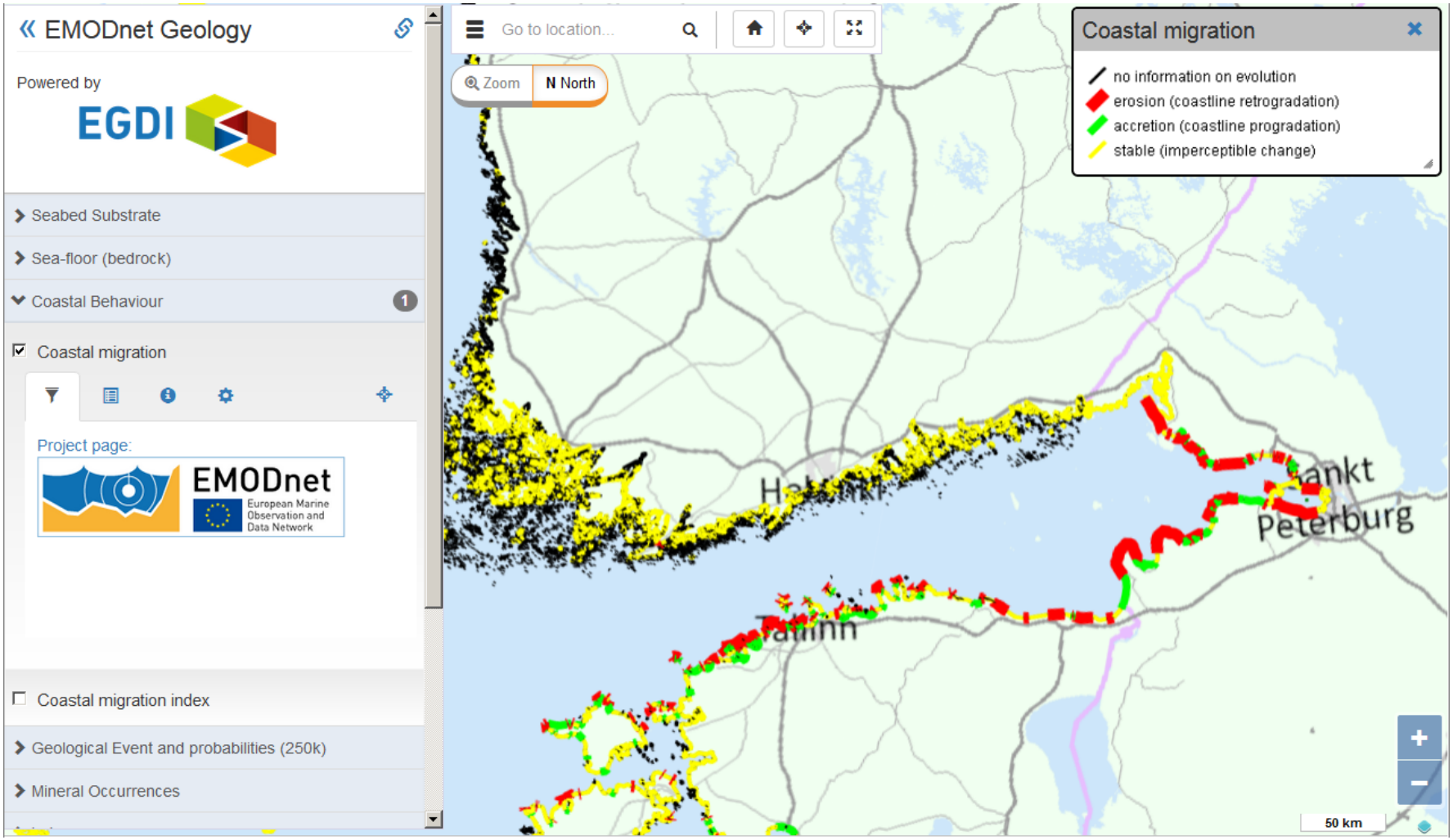
Detailed geomorphology from northern German coast



Through geological interpretation pure seafloor topography (bathymetry) changes into geomorphology (landforms and physiographic features).

WP5: Coastal behaviour

Coastal migration



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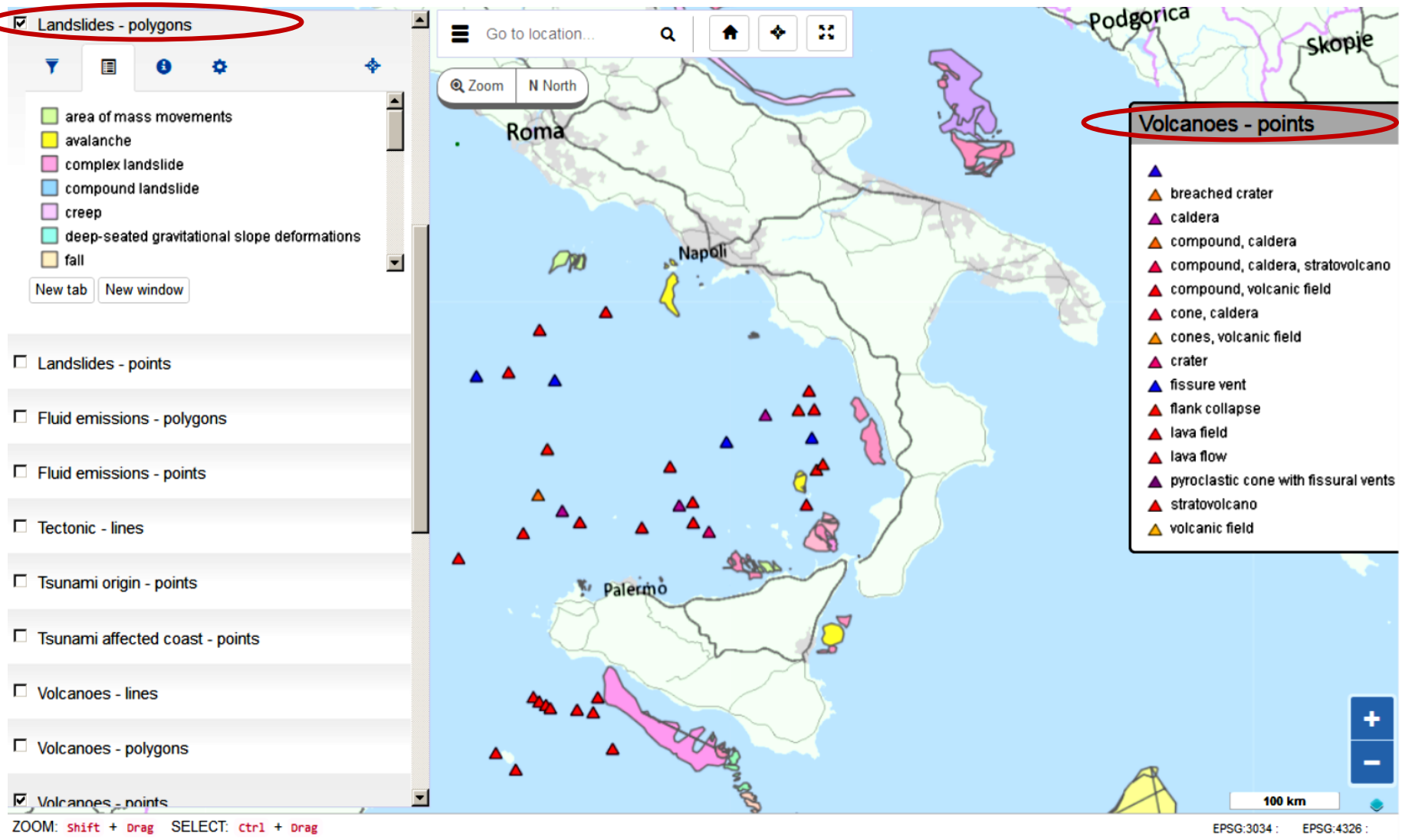
WP6: Geological events and probabilities

EMODnet WP6: Geol. events and probabilities



WP7: Marine minerals

WP7 Marine minerals

Marine minerals

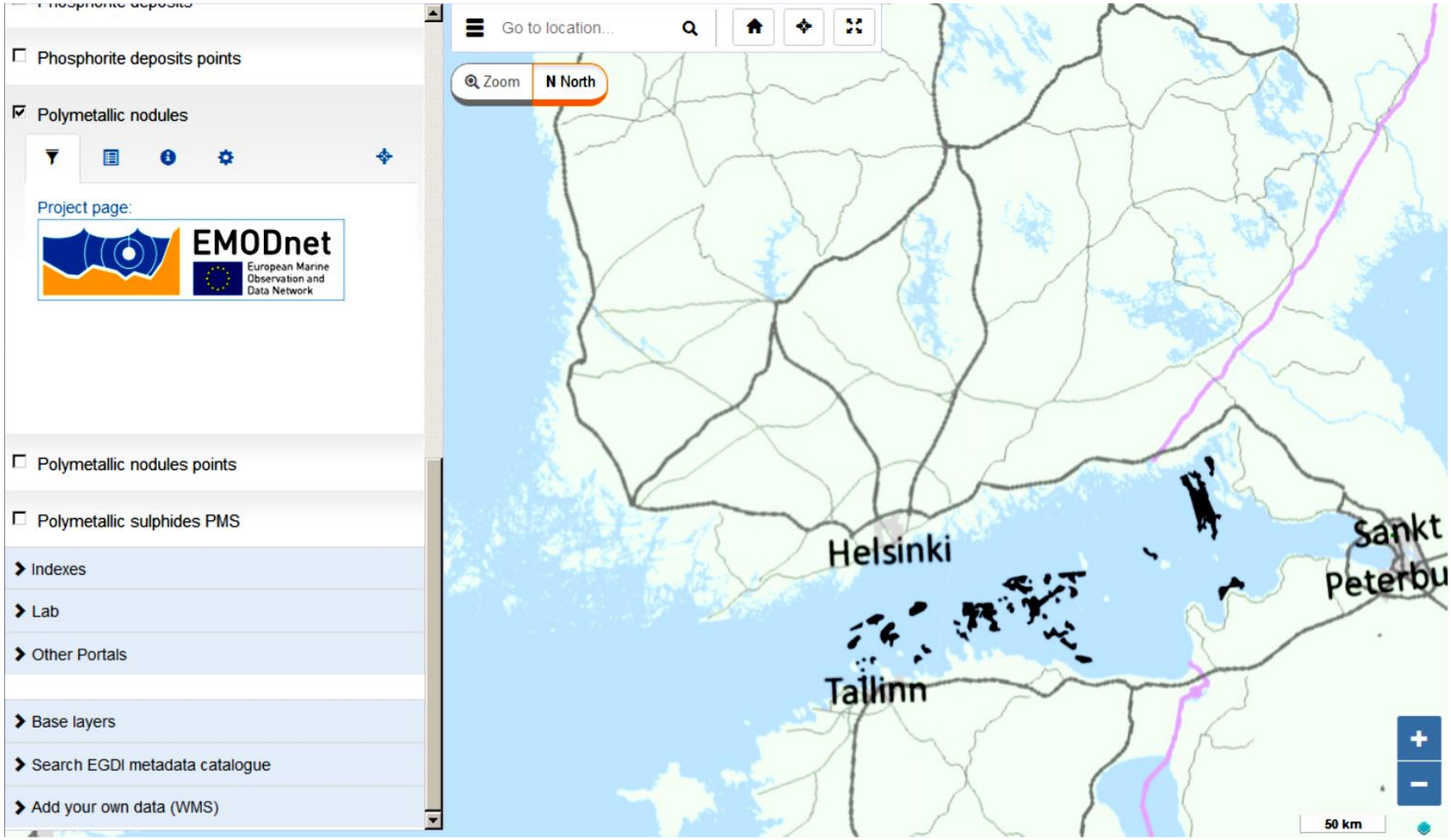
- Aggregates
- Cobalt rich ferromanganese crust
- Evaporites
- Gas Hydrates
- Hydrocarbons
- Marine placers
- Metal rich sediment
- Outcrop, pegmatite and vein hosted mineralisation
- Polymetallic Nodules
- Polymetallic Sulphides
- Phosphorites
- Sapropel

Example of attributes reflecting key components for each mineral

Field Alias
OBJECTID
Feature shape
Country Code
Deposit Type
Setting
Depth to deposit (m)
Morphology
Primary minerals/elements
Other minerals/elements
Area Name
Area Number
Area Extent
Status
Operator
Units
Comments
References
Data Provider
Data Provider Contact
Shape area
Shape length

Above template of parameters to describe occurrence of Polymetalic Nodules

Polymetallic nodules



WP8: Submerged Landscapes

EMODnet WP8: Submerged Lanscapes

Reconstructions of the submerged landscapes of the European continental shelf at various time-frames (e.g. Last Glacial Maximum (LGM) and older low sea-level stages), with particular focus on:

1. Shorelines and coastal environments and deposits (lagoons, dunes, estuaries etc., marine terraces, beachrocks);
2. Valleys and riverbeds, terraces and associated deposits;
3. River-deltas and delta-clinoforms;
4. Submerged water points, e.g. Submarine Groundwater Discharges (=submerged springs), and freshwater lakes;
5. Thickness of Holocene deposits above LGM landscape;
6. Flora and fauna on the submerged landscapes.

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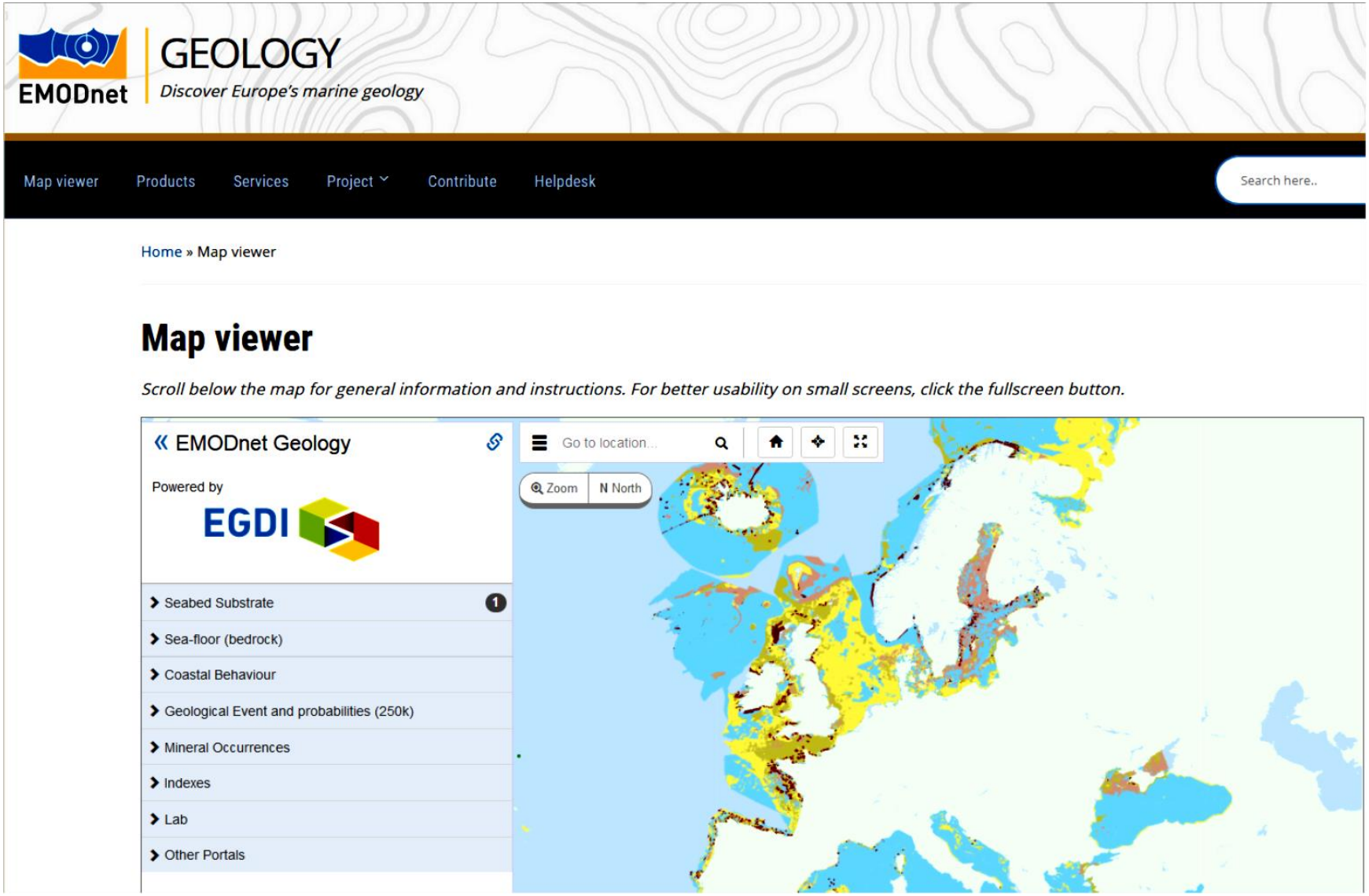
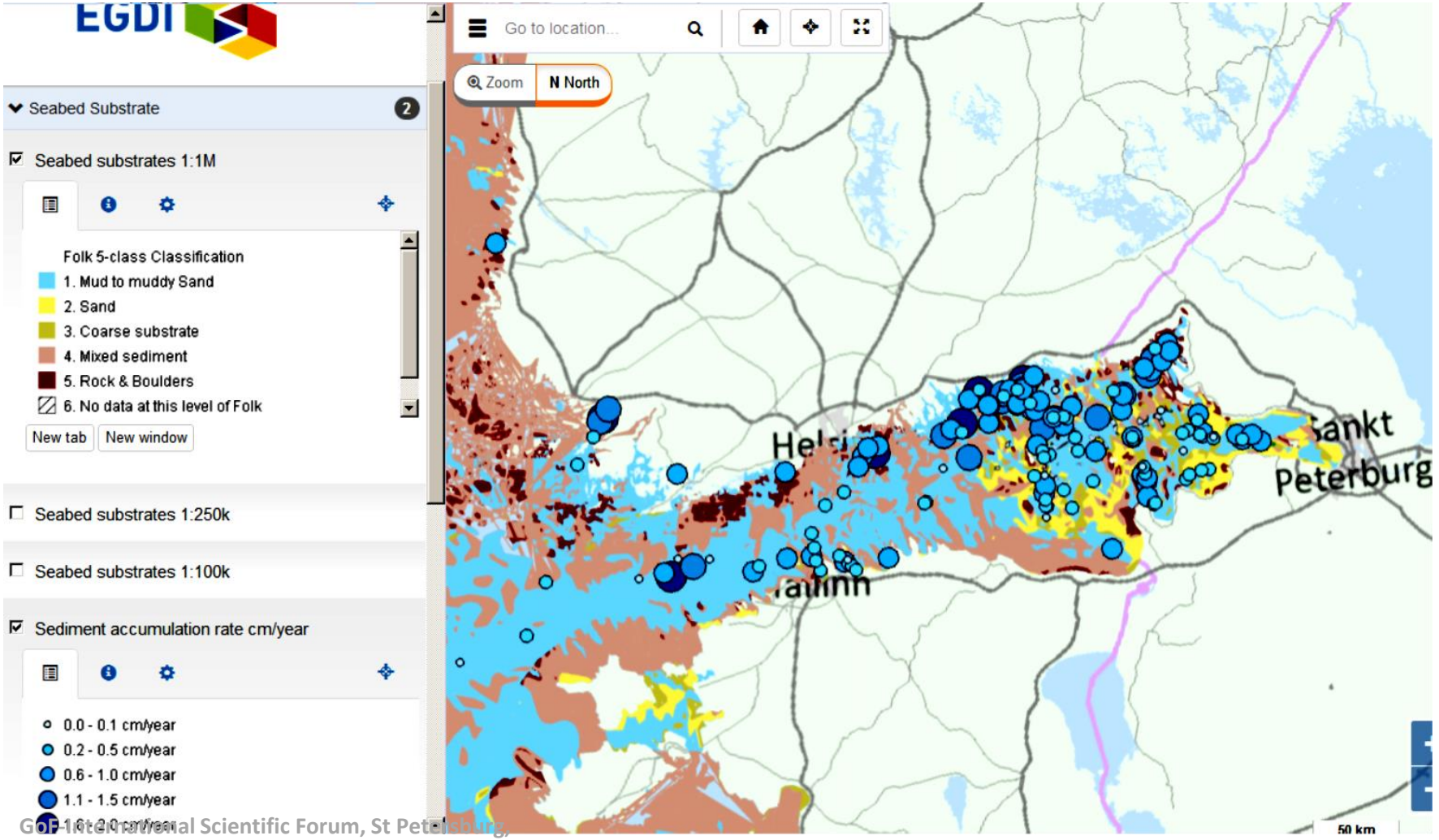
WP9. Data management, web portal and services.

EMODnet Geology portal: https://www.emodnet-geology.eu/



Possibility to combine layers of chosen area



Use cases

5.2. EMODnet supporting marine environmental monitoring and management

Swedish Agency for Marine and Water Management

'SYMPHONY' AND MARINE SPATIAL PLANNING IN SWEDISH GEOLOGY

Portal:
EMODnet Bathymetry and Geology

About SwAM

SwAM is the Swedish Agency for Marine and Water Management responsible for managing the use and preventing the overuse of Sweden's marine and freshwater environments.

Symphony is a tool used by the Swedish Agency for Marine and Water Management (SwAM) to assess the cumulative impact of human activity in Swedish waters.

Symphony is a multicriteria decision support tool that is based on the method developed in 2008 by Ben Halpern. It works to predict areas of

data) for countries bordering Sweden were combined with the best available map products within Swedish waters from the Geological Survey of Sweden (SGU). Transboundary data were important as the impact does not stop at national borders. This data was collated by SGU, then modelled with various other physical data to create 'risk'

Acknowledgement

EMODnet Geology partners:

2 Geologian tutkimuskeskus (GTK) - **Geological Survey of Finland** – Coordinator, 3 Natural Environment Research Council – **British Geological Survey** (NERC-BGS United Kingdom), 4 **Geological Survey of Sweden** (SGU), 5 **Geological Survey of Norway** (NGU), 6 **Geological Survey of Denmark and Greenland** (GEUS), 7 **Jardfeingi** (Faroe Islands), 8 **Iceland GeoSurvey** (ISOR), 9 **Geological Survey of Estonia** (EGK), 10 **Latvian Environment, Geology and Meteorology Centre** (LEGMC) , 11 **Lithuanian Geological Survey** (LGT), 12 **Polish Geological Institute** - Natural Research Institute (PGI-NRI), 13 TNO –**Geological Survey of the Netherlands,** 14 **Royal Belgian Institute of Natural Sciences** (RBINS), 15 Bureau de Recherches Géologiques et Minieres (**BRGM**, France), 16 I**FREMER** (France), 17 **Geological Survey of Ireland** (GSI), 18 Instituto Geológico y Minero de España (IGME), 19 Instituto Português do Mar e da Atmosfera (**IPMA**, Portugal), 20 Istitituto Superiore per la Protezione e la Ricerca Ambientale. Servizio Geologico d'Italia (**ISPRA**), 21 **Geological Survey of Slovenia** (GeoZs), 22 **Croatian Geological Survey** (HGI), 23 **Geological Survey of Montenegro** (GEOZAVOD), 24 **Geological Survey of Albania** (GSA), 25 **Institute of Geology and Mineral Exploration** (IGME) (Greece), 26 **Hellenic Center for Marine Research**, Greece (HCMR), 27 **Institute of Oceanology – Bulgarian Academy of Science** (IO-BAS), 28 National Research and Development Institute for Marine Geology and Geoecology (**GeoEcoMar**, Romania), 29 **Geological Survey of Cyprus**, 30 **Continental Shelf Department of the Office of the Prime Minister** (**Malta**), 31 Centre for Environment Fisheries and Aquaculture Science (**CEFAS**, United Kingdom), 32 **University of Sussex** (United Kingdom), 33 Dipartimento Scienze della Terra Università La Sapienza, Roma (**UNIROMA**, Italy), 34 **Department of Geology, University of Tartu** (Estonia), 35 **Foundation for Research and Technology Hellas - Institute of Computer Science** (Greece), 36 **Prichornomorske State Regional Geological Enterprise** (Ukraine), 37 IMST, **Dokuz Eylul University** (Turkey), 38 A.P Karpinsky Russian Geological Institute (**VSEGEI**), 39 Federal Institute for Geosciences and Natural Resources (**BGR**, Germany), 40 EMCOL Research Centre, **Istanbul Technical University** (ITU, EMCOL, Turkey)

Thank You!

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https://www.emodnet-geology.eu/