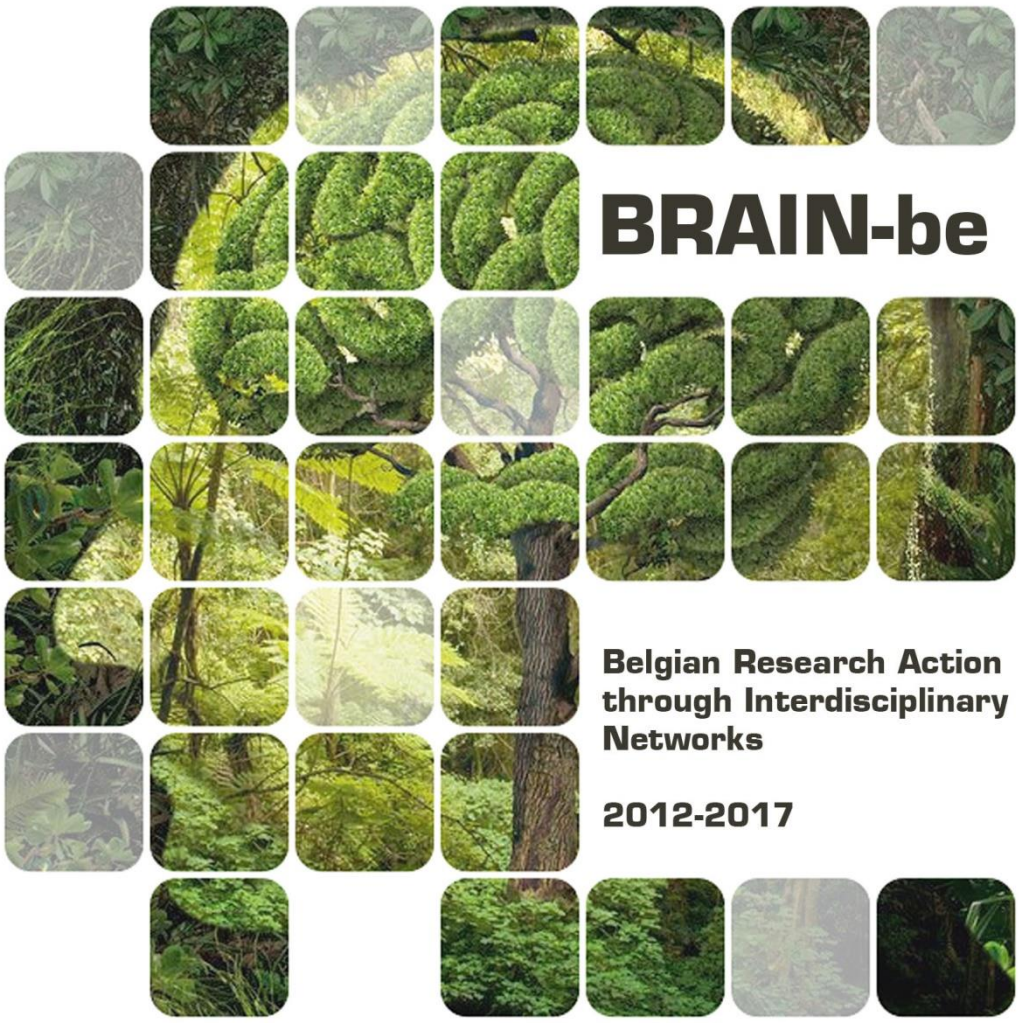

VALORISATION PROJECT

Seabed4U

Seabed CommUnity Initiative: communicating sustainability challenges of marine sand use in a changing world

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VALORISATION PROJECT

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FINAL REPORT

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1. SUMMARY

Seabed4U is a community initiative aiming at synthesising available seabed-related data and information supporting long-term (sub)surface seabed resource management. It builds on the legacy of the Belspo TILES project on Transnational and Integrated Long-term marine Exploitation Strategies of sand resources (Van Lancker et al., 2019[1]).

In the aftermath of TILES, the debate on sand accelerated, stimulated by new initiatives of the United Nations Environment Programme. With sand resource governance being one of the greatest sustainability challenges of the 21st century (UNEP, 2022[2]), the stakes are indeed high. Sand was put on the agenda of the United Nations Environmental Assembly (UNEA), with UNEA-4 and -5 calling for action. In anticipation, UNEP Grid Geneva has set-up the Global Sand Observatory Initiative and coordinated the extensive 2022 report on Sand and Sustainability: 10 strategic recommendations to avert a crisis. In this broad international debate the qualitative and quantitative resource mapping approach of TILES was widely recognised.

Community awareness on sustainable use of sand further built upon the UNEP initiatives and this was expressed via press releases, interviews, social media, but also during invited talks and dedicated demonstrations to the public at large and to the diverse stakeholders involved with sand use. Secondary school children and students were addressed also.

Several research pathways were explored that are key for the long-term use and management of marine sand resources. Slowly, but increasingly, the value of sand as a strategic resource is recognised. Demands are increasing unprecedently with growing populations, coastal and offshore land reclamation and infrastructure works, as well as coastal safety measures. Also, in Belgium, new research is now granted to study more widely marine ecosystem impacts, as well as alternative sand sourcing. With respect to the management and exploitation of subsurface data and models, of which contents are diversifying and numbers increasing, the need emerged to handle multidimensional data and bringing knowledge management at higher levels. Within the Horizon Europe coordination and support action 'Geological Service for Europe' this will be attempted, with the TILES subsurface models being integrated and linked to other models and datasets.

The multitude of information is synthesised in the Seabed4U on-line community platform, purposely built for long-term use and allowing further integration of information and knowledge.

[1] Van Lancker V, Francken F, Kapel M, Kint L, Terseleer N, Van den Eynde D, Hademenos V, Missiaen T, De Mol R, De Tré G, Appleton R, van Heteren S, van Maanen PP, Stafleu J, Stam J, Degrendele K, Roche M. (2018). Transnational and Integrated Long-term Marine Exploitation Strategies (TILES). Final Report. Brussels: Belgian Science Policy 2018 – 82 p. (BRAIN-be - Belgian Research Action through Interdisciplinary Networks).

[2] United Nations Environment Programme (UNEP) (2022). Sand and Sustainability: 10 strategic recommendations to avert a crisis.

2. INITIAL OBJECTIVES AND VALORISATION FOCUS

Seabed4U had three main objectives:

(1) Foresight on research pathways, securing the long-term use of marine sands;
(2) Raising community awareness on the use and management of a finite aggregate resource;
(3) Building an online community platform on *#SeabedMatters.*

A broad target audience of the valorisation trajectory was envisaged: from school children, students and public at large, to scientists and stakeholders involved with sand use.

Three main work packages were foreseen to meet the objectives: (1) Discussion on major sustainability challenges of marine sand use; (2) Increasing community awareness; and (3) Building a community information platform.

Focus of the valorisation was communicating sustainability challenges of marine sand use, and building pathways to continue expanding the knowledge base.

Generally, goals were met (see achievements below). Difficulties encountered was the phasing out of the on-line aggregate resource decision support tool for which longer term solutions are needed.

3. OVERVIEW EXTERNAL COLLABORATION(S)

National to global initiatives are listed in which actions were undertaken. Via the networks of the TILES consortium (also via social media, and Linkedin in particular), the project outcome gained an important visibility. With TILES, Belgium is regarded a pioneer in its aggregate resource management, and this was confirmed as well at the global level via UNEP. With involvement in UNEP initiatives, networking on sand and sustainability intensified resulting in spin-off activities. A major deliverable was UNEP's report 'Sand and Sustainability providing 10 strategic recommendations to avert a crisis'. A wide group of experts was involved that agreed to continue activities.

Main external collaborations were set-up via:

Data and information exchange with stakeholders

TILES products were used externally to support various applications, e.g.,: (1) science: sediment distribution underpinning seabed suitability maps (e.g., habitats, gravel beds); (2) applied projects (e.g., aggregate resource estimation (government, industry, NGOs), in relation to wind farm development, sustainability analyses (e.g., VLAIO SUMES); (3) marine spatial planning; (4) education and valorisation at large (e.g., via European portals).

Contributions to reports

- United Nations Environment Programma (UNEP), 2019. Sand and sustainability : finding new solutions for environmental governance of global sand resources, 54 pp. (contribution of V. Van Lancker as reviewer).

Conferences and debates (with promotion of TILES and/or resource mapping)

- Invited speaker at the 'Conference Sand and the Sandbank: is sand extraction a sustainable business?'. The Geological Society and Royal Geographical Society. London (UK), 30/1/2019. Bringing together stakeholders from universities, governments, NGO's, industries, UNEP. (V. Van Lancker: '*New approaches to sand resource management in a constrained environment*')
- Keynote speaker at the international conference 'From the North Sea lowlands to the Celtic Shelf Edge', Utrecht (NL), 18-20/11/2019. (V. Van Lancker: '*Transnational seabed mapping and subsurface modelling'*)
- Invited moderator of the debates '*Availability'* and '*Responsible Sourcing'* during the International Symposium "Future of Sand"[3] organised by the Royal Geological and Mining Society of the Netherlands (KNGMG) and Rijkswaterstaat, 30/11/2020. Stakeholders from universities, governments, NGO's, industries, UNEP. (V. Van Lancker)

[3] https://www.kngmg.nl/the-future-of-sand-a-video-impression-of-the-symposium-organised-by-kngmg-de-lichtkogel-and-rijkswaterstaat-on-30-november-2020/

- Invited speaker and interview at the occasion of 10 years of EMODnet, and the related EMODnet Open Conference – From open data to societal applications. Hybrid. (V. Van Lancker: '*EMODnet's contribution to Research'*)
- Invited expert and moderator on resource mapping during the UNEP expert round table on 'Sand and Sustainability: Principles on Policy for the Just and Responsible Governance and Management of Sand'. Hybrid meeting at UNEP Grid Geneva, 12/10/2021 (V. Van Lancker)
- Invited speaker during the launch meeting of UNEP's Sand and Sustainability report. Environment House, Geneva, 26/4/2022. (V. Van Lancker on the topic of '*Resource Mapping'*)
- Invited speaker at the inauguration of Geo-Ocean, the multi-approach Joint Research Unit in Marine Geosciences (geo-ocean.fr) in Brest, 8/6/2022 (V. Van Lancker: '*Sustainable use of Geo-Resources*')

Valorising TILES in other projects and initiatives

- ✓ **Continuous monitoring programme on the impact evaluation of sand and gravel extraction** (ZAGRI and related MOZ4 project), the main aggregate resource monitoring programme in Belgium (FPS Economy, RBINS, ILVO).
- ✓ **Marine Strategy Framework Directive (MSFD)**. Assessment of Seafloor Integrity: Seabed change assessments require evaluation of the natural extent of seabed types for which the TILES outcome provides the framework. This was illustrated in the ICES working groups related to physical loss and disturbances, as well as in the Technical Group Seabed coordinated by the European Commission.
- ✓ **European Marine Data and Observation Network (EMODnet)**: Outcome of TILES is incorporated into the European Marine Data and Observation Network (EMODnet) via the Geology Lot. EMODnet products are widely used throughout Europe with the seabed-related products being further valorised into EMODnet Seabed Habitats. Via MSFD, the European Commission promotes the use of the resulting habitat maps in the assessments of Good Environmental Status. Finalisation of a next mapping phase is 2023.
- ✓ **Fisheries measures. Federal Public Service Health and Environment**: To scientifically underpin new fisheries measures in Belgian waters, up-to-date habitat suitability maps were requested. This allowed a significant update of the seabed sediments parameterisation that was aligned with the TILES models.

Project development (2019-2022)

From a long-term perspective, work plans were made for intensified cooperation with the Belgian Geological Survey (**RBINS-GSB**), stimulated by **RBINS Research Strategy** (see 6). Via GSB and its European umbrella organisation EuroGeoSurveys (EGS), future developments of the TILES aggregate research were fed into the EGS coordinated projects Geo-ERA and the Horizon Europe CSA **Geological Service for Europe** (GSEU). Whilst aggregate resource research *s.s.* is not yet regarded a priority for direct incorporation into such projects, and proposals(*) were not taken forward, GSEU does allow further valorisation of the TILES models. This will be done via the set-up of Geological Structural Frameworks in which GSB is pioneering in Europe. A first target application will be

directed to wind energy, and is embedded in GSEU that started in November 2022. **EMODnet-Geology** also mainly builds upon EGS partners and is doing so since 2009. Via EGS and EMODnet wide collaborative networks are established.

With increasing recognition of the many knowledge gaps that come with increasing sand demands, as exemplified in UNEP's Sand and Sustainability report, increased funding opportunities are expected in relation to aggregate resource research. In (6) the newly granted projects are discussed that were developed after 2019. Other research pathways were also developed and new networks built, though were not yet granted[4].

[4] 1) SUSTRAIN – SUSTainable development through integRAted INtelligent decision technology. H2020-MSCA-ETN-2020 Application (Lead: Prof Luis Martinez. University of Jaén (ESP), Department of Computer Science) (together with UGent DDCM and TNO); (2) Aggre-grade, a proposal on land-sea aggregates in the framework of Geo-ERA (*) (3) Promoting sustainable sand mining in developing countries, taking into account transparency, governance and due diligence. Federal Public Service (FPS) Foreign Affairs, Foreign Trade and Development Cooperation. Directorate-General for Development Cooperation and Humanitarian Aid (DGD). Antwerp University. Institute for Environment and Sustainable Development (IMDO) and Royal Belgian Institute of Natural Sciences; and (4) A devoted aggregate resource workpackage in the HEurope CSA GSEU (*).

4. GENERATED PRODUCTS AND IMPLEMENTED APPROACHES

A tiered approach was adopted to further promote a sustainable management of marine aggregate resources on the long-term.

Websites

Seabed4U portal: https://odnature.naturalsciences.be/seabed4u/ including sections on:

- Science for Sustainability
- Milestones
- Code of Sand Storymap
- Seabed data and information (e.g., with links to FPS Economy, managing sand resources in the Belgian part of the North Sea (https://economie.fgov.be/nl/themas/ondernemingen/specifieke-sectoren/zand-en-grindwinning-op-de); TILES data portal (https://www.bmdc.be/tiles-dataportal/), EMODnet.eu, the European Geological Data Infrastructure (EGDI). For main data products, guidelines were made.
- Contributions
- Highlights with information on sand-related initiatives

The data portal is a living portal, with contents being updated when relevant. It will also flag new data products, such as an updated seabed sediment map that will be published in 2023.

Databases

Lithological descriptions of marine sediments in the Belgian part of the North Sea, SediLITHO@SEA: https://metadata.naturalsciences.be/geonetwork/srv/eng/catalog.search#/metadata/bmdc.be:dataset:2161

The coring data can be easily integrated into Geographical Information Systems via RBINS Geonetwork: https://spatial.naturalsciences.be/geoserver/ows?version=2.0.0
In the list the TILES products are listed.

The TILES subsurface models are downloadable:

- Aggregate resource 3D voxel model of the Belgian Continental Shelf (resolution 200*200*1m): https://metadata.naturalsciences.be/geonetwork/srv/eng/catalog.search#/metadata/bmdc.be:dataset:2721
- Aggregate resource 3D voxel model of the Hinder Banks (resolution 100*100*0.5m): https://metadata.naturalsciences.be/geonetwork/srv/eng/catalog.search#/metadata/bmdc.be:dataset:2720
- Aggregate resource 3D voxel model of the Belgian and Dutch Continental Shelf (resolution 200*200*1m): https://metadata.naturalsciences.be/geonetwork/srv/eng/catalog.search#/metadata/bmdc.be:dataset:2722

Publications (since 2019) (integration of TILES outcome)

Public at large

Invited by the Dutch Geological Organisation, a broad valorisation article was written on sand: van Heteren, S., van der Klugt, P.. & Van Lancker, V. (2020). Met zulk mooi zand kan je alleen maar winnen. Grondboor en Hamer 74(4).

Stakeholders

In 2022, an update was published of the Chapter 'Sand and Gravel extraction' in the Knowledge Guide Coast and Sea. This chapter provides an overview of all relevant data, information and research programmes in relation to sand extraction in Belgium.

Van Lancker, V., Vandenreyken, H., De Backer, A., Lauwaert, B., Lescroart, J., De Raedemaecker, F. (2022). Sand and gravel extraction. In: Dauwe, S. et al. (Eds). Knowledge Guide Coast and Sea 2022 - Compendium for Coast and Sea. p. 67-78.

Peer-reviewed (international)

Kint, L., Hademenos, V., De Mol, R., Stafleu, J., van Heteren, S., & Van Lancker, V. (2021). Uncertainty assessment applied to marine subsurface datasets. Quarterly Journal of Engineering Geology and Hydrogeology, 54(1).

Wyns, L., Roche, M., Barette, F., Van Lancker, V., Degrendele, K., Hostens, K., & De Backer, A. (2021). Near-field changes in the seabed and associated macrobenthic communities due to marine aggregate extraction on tidal sandbanks: A spatially explicit bio-physical approach considering geological context and extraction regimes. Continental Shelf Research, 229, 104546.

Reports with global outreach

Since 2019 contributions were made to UNEP reports related to sand and sustainability:

United Nations Environment Programme (UNEP) (2019). Sand and sustainability: finding new solutions for environmental governance of global sand resources, 54 pp. (V. Van Lancker, reviewer)

United Nations Environment Programme /GRID-Geneva (2022). What is Sand - Results from a UNEP/GRID-Geneva expert discussion. (V. Van Lancker, contribution)

United Nations Environment Programme (UNEP) (2022). Sand and Sustainability: 10 strategic recommendations to avert a crisis. (V. Van Lancker, invited lead author on the chapter on Resource Mapping). Downloadable via: https://www.unep.org/resources/report/sand-and-sustainability-10-strategic-recommendations-avert-crisis

Demonstration posters and booth

A series of posters on the TILES Code of Sand (https://www.wur.nl/en/Education-Programmes/Studium-Generale/Show/Photo-exhibition-Code-of-Sand.htm) were produced with a narrative on sand and sustainability. The posters were made in collaboration with Wageningen University and were first used during a **week symposium 'The World of Sand'** organised by Studium Generale, University of Wageningen (https://www.wur.nl/nl/show/programmaflyer-the-world-of-sand.htm), 21-28 May 2019.

Next a selection of the series was showcased during the 3-yearly **study day on sand, edition "A 360° perspective on sea sand"**, organised by FPS Economy on 19/11/2021. During the **demonstration days of the new RV Belgica**, 23-26/6/2022, the science hangar proved the ideal forum for the posters. During the two latter a booth on sand resources, using a large screen, was arranged using the Seabed4U platform as knowledge exchange medium.

Press and social media

Topical information on sand-related activities was shared with the press (# 22 contributions). In the aftermath of the TILES project, most attention was raised upon release of the UNEP reports on Sand and Sustainability (2019, and 2022) for which RBINS made press releases. Via #SeabedMatters information is shared on Social Media (LinkedIn, Twitter and Facebook).

Educational material

For the public at large, more educational presentations have been prepared (V. Van Lancker): on 'Zandbanken' at the Provinciaal Bezoekerscentrum Duinpanne (28/11/2019); on related measurements and models during the Day of Sea, organized by UPV (Uitstraling Permanente Vorming), an institute dedicated to science valorisation (23/5/2019); on 'Zandbanken binnenste buiten gekeerd' at the Pier in Blankenberge, organized by ZeeUitzicht, 22/01/2020. In 2023, an afternoon class is foreseen at secondary school level (14/2/2023). Nathan Terseleer was invited to present 'Sand' to school children during the 'Atelier Sable', an RBINS Museum event (13/12/2019).

As guest professor at Ghent University, V. Van Lancker teaches since 2021 the Coastal and Marine part of the Hydrography B course Geology and Geophysics (Interuniversity programme between UGent and the Antwerp Maritime Academy). One of the modules is on Aggregate Resources.

5. IMPACT AND ADDED VALUE OF THE VALORISATION ACTION

Main impact of the different valorisation activities (√: Impact; ○: added value)

- ✓ Raised awareness on the challenges of marine sand use
  - ○ Better informed citizens
- ✓ Portfolio of open-access data and information, nationally and internationally
  - ○ Better planning of suitable sites (e.g., aggregate extraction, wind energy)
  - ○ Better development of projects having sand as a fundament
- ✓ Recognised implementation realities of sand use, given the limited sand resources
  - ○ More realistic plans of sand use (quantity and quality)
  - ○ Minimisation of environmental impacts
- ✓ Extended community working on sand-related issues, internationally and globally
  - ○ More effective knowledge exchange
  - ○ Accessibility to a broad knowledge base
- ✓ New research and development activities
  - ○ Joint discussion of research pathways
  - ○ Sharing innovation trajectories
- ✓ Educational and training spin-off
  - ○ Training next generation marine stewards (also via RV Belgica)
- ✓ Broadened view on what Sand and Sustainability entails on the long term
  - ○ Sharing roadmaps addressing sustainability challenges

Through participation to the UNEP initiatives on Sand and Sustainability, data and information also contribute to three resolutions from the UN Environment Assembly:

- UNEA 4, on Mineral Resource Governance (sand is the most extracted material in volume)
- UNEA 4, on Sustainable and Resilient Infrastructure (infrastructure requires sand as a building material).
- UNEA 5, Environmental aspects of minerals and metals management (requesting to raise our environmental standards on how to manage these resources).

And the IUCN[5] motion « For the urgent global management of marine and coastal sand resources ».

[5] IUCN is a membership union that brings government and civil society organisations together with a global network of experts

6. MEASURES TO MAINTAIN THE COLLABORATION(S)

Main measures relate to various initiatives that were taken from the national to global level, and comprise:

Committing to further digitization and expansion of the geological knowledge base of Belgium's marine aggregate resources

Under the umbrella of the **continuous monitoring programme on marine sand extraction**, both the Federal Public Service Economy and the Royal Belgian Institute of Natural Sciences continue building the geological knowledge base of its marine aggregate resources. Using state-of-the-art survey and sampling techniques, FPS Economy, together with Flanders Marine Institute (VLIZ), aims to update and refine the available geological information of available sand resources in concession/exploration zones.

Recognizing the **importance of the geological substrate in environmental monitoring** (e.g., Wyns et al., 2021), RBINS now incorporates subsurface data acquisition in its impact monitoring related to extraction, but also for the **MSFD monitoring of Good Environmental Status** for which seabed change assessments are made every six years. Sedimentological parametrisation of all monitoring programmes is reintegrated in seabed sediment maps. These maps are further available, for example to support the Federal Public Service Health and Environment, e.g., in relation to fisheries measures, future updates of biological valuation (see 3) and/or to support restoration projects.

Significant updating of marine aggregate resource information is also undertaken elsewhere. Exemplary are TNO, Geological Survey of the Netherlands and the Geological Survey of Denmark and Greenland, updating aggregate resource databases, maps and models, combining both land and sea databases optimising resource allocation, fit-for-purpose.

Clearly, there are **many and diverse challenges that come with increased resource demands, calling for a bigger support base and alignment of initiatives**. Uptake of results and joint development in wider organisations are regarded essential to ensure the longevity of tools beyond project level and to expand the knowledge base most efficiently. Recognising the need for long-term solutions, several steps have been undertaken, and are listed below.

Embedding aggregate resources in RBINS Research Strategy and collaborating more structurally with the Geological Survey of Belgium

Aggregate resources are taken up in **RBINS 2023-2027 Research Strategy** under the research theme **'Geological sciences for a sustainable Society'**, and more specifically 'Sustainable supply of raw materials', under the general coordination of the **Geological Survey of Belgium** (GSB). Central to this research theme is the creation of geological knowledge and services in view of using natural resources responsibly, managing environmental change and being resilient to hazards. This is done in partnership with European and regional geological surveys, universities, scientific institutes, governments, companies and Federal Research Institutes; within a national (Belgium), European (partnership EuroGeoSurveys) and global context. For marine aggregate resources, this theme will also link to actions under the research theme **'Sustainable management of marine waters'**.

Linking aggregate resource research to EuroGeoSurveys' Strategic Research & Innovation Agenda

EuroGeoSurveys is the vehicle to promote geosciences in Europe and is further strongly connected to geoscientific organisations in the world. One of the central pillars is harmonization and sharing of pan-European geological data and research, embedded in the **European Geological Data Infrastructure** (EGDI). In EGS' latest **Strategic Research & Innovation Agenda** (EGS, 2021), 'Resourcing Europe' is a key goal and includes the research priority 'Diversifying sourcing (on- & offshore; in Europe & beyond). The need for natural construction material, including sand and gravel, is recognised, calling for investigations addressing the geological, environmental and technological dimensions. Transversal research themes that are of direct relevance for aggregate resources relate to Inventory (e.g., 'Intelligent decision support', 'Land-sea connection'), and Impact and Hazards. The Horizon Europe CSA **'Geological Service for Europe'** will give impetus to these topics and is a trajectory for the further development of the TILES research legacy. As an invited talk, a prospective view on marine resource mapping will be given at the **European Marine Sand and Gravel** (EMSAGG) Conference in Hamburg in 2023. Further actions are envisaged as well via EGS' **Marine Geology Expert Group**. With the new momentum for aggregate resource related research in the aftermath of UNEP's initiatives on Sand and Sustainability, joint actions will be discussed.

Levelling-up the harmonisation of marine geological and resource maps via EMODnet-Geology

With increasing mapping phases within **EMODnet**, also the Geology Lot, intensifies and diversifies its mapping products, anticipating on the needs of Europe's Green Deal (Hollis et al., 2022[6]). A subgroup North Sea specifically addresses regional harmonisation of geological data (L. Kint coordination). Also collaborations intensify to increase information on aggregate resources (e.g., on volumes). Further uptake is also expected via the **EMODnet for Ocean Decade coordination group** (V. Van Lancker member).

Exchanging knowledge and information via UNEP's Global Sand Observatory Initiative

UNEP Grid Geneva continues coordinating the actions on sand and sustainability globally, e.g., via the **Global Sand Observatory Initiative**. UNEP is raising further awareness on Member State level, and are open to contributions.

Developing new research pathways aligned with the finite nature of sand resources

Whilst increasingly the finite nature of sand resources is recognised, sand remains the fundament for many project developments including coastal safety. Nature-based solutions for increased coastal protection (e.g., building dunes for dykes) is an example requiring vast amounts of sand. Starting in 2023, the feasibility of such initiatives will be assessed within an ecosystem services balancing project, and will also investigate alternative sand sourcing (SUSANA: **Sustainable use of sand in nature-based solutions**, VLAIO cSBO funding 2023-2026; University of Antwerp, UGent, KUL, ILVO, RBINS; wide stakeholder involvement).

[6] Hollis, J., Bricker, S., Čápová, D., Hinsby, K., Krenmayr, H. G., Negrel, P., ... & Venvik, G. (2022). Pan-European geological data, information, and knowledge for a resilient, sustainable, and collaborative future. European Geologist, 53, 6-19.

Under the coordination of Twente University (NL), a project proposal is developed on '**Understanding Tidal Sandbank Dynamics and Impacts of Sand Extraction in Sediment-Scarce Environments**' (BANX). Main goal is to understand the behaviour of sandbanks, and wider seabed dynamics, under decreasing sand volumes. In consent with a diversified user committee, knowledge and tools will be developed to mitigate impacts.

From a research perspective, the Dutch NWO project OR ELSE (**Operational Recommendations for Ecosystem-based Large-scale Sand Extraction**) (2022-2027) will research on how to minimise the ecological effects of sand extraction. Governmental organisations, the fisheries sector, the dredging industry, nature organisations, and a wide research consortium will work together to ecologically optimise sand extraction (V. Van Lancker advisory board).