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# D5.1
# BoSS geospatial platform (limited functionality)

Carola Hein; Michael Rodrigues

# Bauhaus of the Seas Sails

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### Contributor(s)

| | |
|---|---|
| Main Contributor(s) | Carola Hein, Michael Rodrigues |
| Contributor(s) | Luisa M Seixas, Mariana Pestana |

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# 1. Executive Summary

The BoSS geospatial platform aims to create an open online system that seamlessly integrates four types of data: open access geospatial data, spatial information on port city territories, dynamic data on sustainability, aesthetics, and inclusiveness, and narratives and storytelling about the project's pilots. This platform enables efficient analysis, visualization, and sharing of data and project-generated information within the BoSS initiative. Users can explore and analyze geospatial information, engage with multiple layers of data, and share their own experiences. The platform utilizes open-source tools and libraries for frontend and backend development, ensuring efficient data management and retrieval. Currently, the platform is in an early stage of development and offers limited functionality and visualization. It will be tested and improved based on feedback from the BoSS community and co-design processes in various localities. To facilitate the multiple tasks, we have brought together a number of open-source tools. The platform's front end combines HTML, JavaScript, and CSS for its design and functionality. No commercial software is used in both the front end and back end of the application.

The BoSS geospatial platform is available with limited functionality and visualization and in an early stage of development at the following address: *bossatlas.online*

At the present stage, the platform is still under development and therefore does not accurately reflect the final platform. During the project, the platform will be tested through interaction with the BoSS community, in order to improve its functionalities in line with the consortium objectives and the co-design processes being undertaken in several localities. For such reason, anyone accessing the current experimental platform must take this into consideration.

# 2. Introduction

The Bauhaus of the Seas Sails WP5 - Impact Assessment, intends to evaluate the effects of pilot projects in a three-fold way. Firstly, the geospatial platform will be used to compare locations in terms of sustainability, aesthetics, and inclusiveness in line with NEB's principles. Secondly, it will evaluate the systemic implications of various stakeholders involved in WP2 and WP3. This assessment will involve the documentation of the project's drops and ripples on the narrative layer of the platform, enabling stakeholders to document the effectiveness and impact of BoSS pilots. The platform's narrative layer expands on the three core principles that define NEB way of working: participatory process, multi-level engagement and a transdisciplinary approach. Lastly, the geospatial platform will provide interactive visualization tools that serve both project partners and the wider audience, facilitating outreach efforts. The geospatial platform enables the mapping of heterogeneous spatial, socioeconomic, and cultural data integrating narratives for and from the pilots and follower cities in a standardized manner. This platform will serve to study the impact of the drops (pilot actions) and ripples (pilot demonstrators) in the diverse BoSS locations undergoing similar water-related transformations. Through its tools and functionality, the platform seeks to create a connection between science, technology, education, art, and culture, based on the ideals of the New European Bauhaus (NEB). The overarching goal is to engage stakeholders and facilitate value-based discussions through interactive visualizations.

The BoSS geospatial platform is built on three core pillars. Firstly, the platform allows users to create visually appealing maps, charts, graphs, and various visual representations. These visualizations serve as a foundation for informed discussions and to contextualize the work done in WP2 and WP3 in various locations. The visualization tools provided enable users to analyze patterns, relationships and trends within geospatial data. Secondly, the platform offers a comprehensive suite of analytical methods for performing complex spatial analysis. These powerful analytical tools enable users to gain valuable insights based on geographic patterns and relationships. Lastly, through the narrative layer, the platform facilitates sharing of information generated within the BoSS project, acting as a repository and allowing stakeholders to publicly share the effectiveness and impact of drops and ripples.

The BoSS platform will not only present stories and narratives but also provide the option to do so in multiple languages. Visualizations will play a pivotal role in facilitating continuous exchange among pilot stakeholders throughout the project, allowing them to discuss achievements and challenges.

# 3. Infrastructure

Within the BoSS geospatial platform, a multitude of components come together to provide comprehensive support for storage, processing, and analysis. These components work harmoniously to ensure efficient data management, analysis, and delivery of geospatial information to end-users. Issues related to the use and production of data are also included in the Data Management Plan (D1.2).

## 3.1 Data storage

The platform adopts a robust and scalable approach for storing geospatial data, utilizing a combination of file-based storage and a relational database management system. This data storage infrastructure is designed to efficiently handle large volumes of geospatial data, spanning from continent-level datasets to street-level details, while keeping the costs as low as possible.

### 3.1.1 File-based storage (GeoJSON)

GeoJSON serves a crucial role within the platform by facilitating the representation, storage, and exchange of geospatial data in a standardized and lightweight format. GeoJSON utilizes the widely adopted JavaScript Object Notation (JSON) to encode geospatial information[1]. By utilizing GeoJSON, the platform can store and manipulate geospatial data in a structured format that is easily comprehensible and manageable.

In line with web mapping applications, GeoJSON plays a significant role within the BoSS geospatial platform. This integration allows the platform to display geospatial data as interactive map layers,

[1] Horbiński, T., & Lorek, D. (2022). The use of Leaflet and GeoJSON files for creating the interactive web map of the preindustrial state of the natural environment. Journal of Spatial Science, 67(1), 61-77.

allowing users to visualize and explore the data directly within the user interface of the geospatial platform.

### 3.1.2 Relational database management system (MariaDB)

MariaDB plays a pivotal role in the storage of data within the geospatial platform. As a widely used open-source relational database management system, MariaDB offers a structured and efficient approach to data storage[2]. It encompasses essential features such as data indexing, query optimization, data integrity, and transaction management, ensuring the reliability and consistency of stored information.

Crucially, MariaDB natively supports geospatial data types, including points, lines and polygons. These specialized data types enable the storage and management of spatial objects alongside their associated attributes. Moreover, MariaDB facilitates the creation of spatial indexes, leading to improved performance in spatial queries. The spatial indexing structure optimizes spatial search operations, enabling efficient spatial filters, proximity searches, and spatial joins. Consequently, the retrieval and analysis of geospatial data within the platform benefit from enhanced overall performance.

MariaDB provides an extensive collection of built-in spatial functions and operators specifically designed for geospatial analysis. By leveraging these spatial functions and query operators, users can perform complex spatial queries and analysis directly within the database. This integration streamlines the process of retrieving and analyzing geospatial data based on spatial relationships.

## 3.2 Data processing

In the BoSS geospatial platform, processing and analysis are essential for deriving valuable insights. This involves executing complex computations, spatial algorithms, and data transformations in real-time. To optimize efficiency, the platform adopts an optimized client-server approach that does not rely on high-performance computing resources, distributed processing frameworks, or cloud-based

[2] Wood, W. (2018). Migrating to MariaDB: Toward an Open Source Database Solution. Apress.

processing services. By avoiding these resource-intensive options, the platform is designed to keep operating costs as low as possible.

An important aspect of the adopted approach is to exclude data acquisition and integration processes from the platform itself. Instead, data ingestion, cleansing, preprocessing, and transformation are conducted offline using dedicated GIS software. This ensures that the data is prepared and refined before it is integrated into the platform. By handling these data preparation tasks externally, the platform can focus on providing efficient processing and analysis capabilities to users without the need for additional resources or costly data integration procedures.

### 3.3 Spatial analysis

Spatial analysis is a critical component of the platform, providing users with geospatial processing capabilities. Turf.js plays a pivotal role in enabling this functionality. The library incorporates a wide range of spatial analysis algorithms and methods, allowing users to perform complex operations and calculations on geospatial data[3]. This includes tasks such as geometry manipulation, spatial queries, overlay analysis, clustering, buffering, and network analysis that are essential in allowing to compare locations and spatially analyse of variables related to sustainability, aesthetics, and inclusiveness in line with NEB's principles. By integrating Turf.js in the platform, users can extract valuable insights, facilitating accurate quantitative analysis and improving their understanding of the spatial characteristics inherent within the data.

One of the key advantages of Turf.js is its ability to operate on the client-side, directly within the user's web browser. This real-time and interactive spatial analysis capability is seamlessly integrated into the geospatial platform. By performing some of the analysis on the client-side, there is reduced reliance on server-side processing, resulting in faster feedback and an enhanced exploration experience with the data.

[3] Środa, K., Łabuz, M., & Ernst, S. (2019). Improving the Responsiveness of Geospatial Web Applications through Client-Side Processing. In Multimedia and Network Information Systems: Proceedings of the 11th International Conference MISSI 2018 11 (pp. 142-150). Springer International Publishing.

## 3.4 Visualization

Visualization within the platform harnesses the power of D3 (Data-Driven Documents), a JavaScript library renowned for its data visualization capabilities[4]. D3 specializes in crafting interactive and dynamic visualizations of data, making it an ideal choice for the geospatial platform. Leveraging D3, users can seamlessly create charts, graphs, and various visual representations to effectively explore geospatial information within an intuitive and interactive environment.

D3 enables the platform to establish dynamic connections between data and visual elements, automatically updating the visualizations in response to changes in the underlying data. Within the geospatial platform, this means real-time visualization of geospatial data that adapts in real-time to user interactions or updates in the data itself. This dynamic nature allows for a responsive and immersive exploration of geospatial information within the platform.

## 3.5 Access control

The platform has been designed to be open and accessible to users from any location, and thus does not include any specific security measures or access control mechanisms to protect data confidentiality or prevent unauthorized access. The platform will solely use publicly available open data found in the public domain. Authors and institutions contributing to the narrative layer must provide copyright permissions for their work, as it will be publicly available. We envision a function where users can upload data analysis films to be shared with other users, including in living lab settings. This will be moderated.

Preliminary discussions on the approaches and access of specific data-sets have already been addressed with the consortium, and will respect the Open Access and Fair principles. Any ethical and privacy issues will also respect the project's Data Management Plan.

[4] Bostock, M., Ogievetsky, V., & Heer, J. (2011). D³ data-driven documents. IEEE transactions on visualization and computer graphics, 17(12), 2301-2309.

# 4. Scalability and Performance

For the BoSS geospatial platform to deliver efficient performance and rapid response times, it must effectively handle large datasets and support high-performance processing. This capability becomes crucial when dealing with real-time complex spatial analyses or accommodating multiple concurrent users. The platform achieves this by employing a custom-built geospatial indexing approach that partitions geographical space into highly regular cells. In order to enhance data query operations, a geographical search engine was developed using PHP, a server-side scripting language primarily utilized in web development.

A hierarchical grid system serves as a fundamental tool in many web-based applications for indexing and retrieving spatial data based on geographic location[5]. A grid structure systematically organizes geospatial data into a hierarchy of nested cells, with each level representing a distinct level of detail or granularity. This hierarchical organization enhances the efficiency of spatial queries across various scales, enabling seamless exploration from country regions to localized areas.

The platform addresses scalability and performance by implementing a custom-built hierarchical grid system. This data structure serves as a powerful mechanism for organizing and conducting efficient spatial queries on geospatial data. By partitioning geographic space into a hierarchical tessellation of highly regular cells, the method significantly accelerates spatial queries and effectively narrows down the search space. The hierarchical structure enables queries to swiftly identify and retrieve relevant data that are within the desired spatial area without the need to examine every single data point on the database. This optimization substantially reduces computational costs and greatly enhances query performance.

The grid-based approach within the BoSS platform plays a crucial role in efficiently organizing and querying geospatial data. It offers numerous optimizations for spatial queries, enabling fast and

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[5] Shimizu, C., Zhu, R., Mai, G., Fisher, C., Cai, L., Schildhauer, M., ... & Stephen, S. (2021, December). A Pattern for Features on a Hierarchical Spatial Grid. In The 10th International Joint Conference on Knowledge Graphs (pp. 108-114).

accurate retrieval of data. Additionally, the method facilitates zooming and Level-of-Detail (LOD) capabilities, allowing users to visualize and analyze data at varying levels of detail. The grid-based method also supports aggregation and summarization operations on-the-fly, providing valuable insights from geospatial data in a concise manner. One of the key advantages of hierarchical grid systems is their ability to facilitate aggregation and summarization operations[6]. The structured hierarchy allows for efficient summarization of data by aggregating information at higher levels of the structure. Moreover, the hierarchical grid system enhances data compression and storage efficiency, thereby optimizing resource utilization on the server-side. Overall, this method is an essential component within the BoSS geospatial platform, effectively addressing scalability and performance concerns. Before uploading data to the server, data preprocessing must be done to create the grid-based approach. This is a time-consuming process.

By leveraging the hierarchical grid system in the platform, users gain the ability to efficiently retrieve and analyze geospatial data across different scales. From broad overviews to detailed analyses, this structure allows users to explore and summarize geospatial data in an organized and scalable manner within the platform.

The BoSS platform's grid-based approach facilitates visualization and analysis of geospatial data by enabling users to zoom and take advantage of LOD capabilities. Without requiring extensive manual input, the platform automatically selects the appropriate level within the data hierarchy for analysis predicated on user interactions. This way the BoSS geospatial platform provides users with a streamlined visualization experience. Its custom-built geographical search engine seamlessly retrieves and displays data with varying levels of detail, dynamically adjusting resolution to match the user's chosen zoom level or area of interest.

Using a regular grid aids in providing smooth gradients and making it easier to measure differences between cells. It is important to choose the right kind of cell shape for the grid system. To ensure

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[6] Wang, W., Yang, J., & Muntz, R. (1997, August). STING: A statistical information grid approach to spatial data mining. In Vldb (Vol. 97, pp. 186-195).

ease of use, polygons like triangles, squares, or hexagons are typically preferred since they tile easily. Taking performance into account, the BoSS platform employs square cells.

The BoSS geospatial platform not only requires real-time data processing but also emphasizes real-time visualization capabilities. Handling data streams in real-time introduces additional challenges such as data synchronization and enabling near-instantaneous processing. Network latency can impact the speed of data access and processing, thereby affecting overall performance. To address these challenges and guarantee optimal performance, consistent monitoring, testing, and performance tuning will play a vital role in ongoing development. These practices will enable the identification of bottlenecks, optimization of resource utilization, and maintenance of seamless operations as the platform expands.

# 5. The Port City Atlas Layer

The platform will incorporate, and present data extracted from the Port City Atlas book, which was created within the Leiden-Delft-Erasmus PortCityFutures research group and the Faculty of Architecture TU Delft. The Port City Atlas stands as a comprehensive cartographic representation of European port cities, delving deep into the intricate relationships that exist between water and land. It sheds light on the built environment within port city regions, offering valuable insights into their unique characteristics.

By focusing specifically on the presence and influence of ports, the Port City Atlas Layer establishes a foundation for understanding and analyzing the vital challenges faced within these dynamic regions. It explores the multifaceted aspects of infrastructure, built structures, and institutions situated at the intersection of sea and land. This perspective allows for a holistic comprehension of the complexities involved in the development and sustainability of port city territories while acting as a base layer for other data that will be made available on the platform.

The project's pilots encompass a diverse range of five distinct water bodies: lagoon, river, strait, delta, and coast. Each of these bodies possesses its own set of geographic and topographic features that exert a significant influence on numerous aspects of spatial development, socio-economic networks, and, ultimately, the overall sustainability of the respective areas. By recognizing and considering these unique characteristics, a deeper understanding can be gained regarding the factors that shape these regions. The platform will act as a gateway, offering a multidimensional exploration of the Port City Atlas data, allowing users to understand the unique characteristics and dynamics of the territories and fostering further research, planning, and sustainable development initiatives.

# 6. The Flow Layer

The flow layer represents dynamic data on population, health, and other variables related to sustainability, aesthetics, and inclusiveness in line with NEB's principles. To understand spatial development we need insight into a diverse range of data sources. By accessing and analyzing this multifaceted data, we can obtain a more nuanced and comprehensive understanding of the socio-spatial transformations occurring within the targeted areas. However, it is worth noting that these datasets are often available only at the national or regional level. This limitation poses a challenge to researchers and practitioners seeking a granular understanding of the complexities and local nuances that shape spatial development. Consequently, the platform aims to bridge this gap by striving to uncover and integrate data that illuminates the historical, cultural, economic, and environmental dimensions defining the pilots participating in the project.

By delving into the historical context of the pilots, the platform seeks to unearth valuable insights into the factors that have shaped their growth and development over time. This historical perspective helps shed light on the trajectory of spatial transformations and provides a foundation for understanding the current state and potential future trajectories of these areas. Furthermore, the platform recognizes the significant influence of cultural dynamics on spatial development. By exploring the cultural aspects embedded within the pilot areas, such as traditions, heritage, and identities, a more holistic understanding of their socio-spatial fabric can be achieved. This cultural dimension contributes to the unique character of each area and helps shape their economic and social landscapes.

By integrating data from diverse dimensions — historical, cultural, economic, and environmental — the platform aspires to provide a multidimensional understanding of the pilots' spatial development while allowing them to compare locations in terms of sustainability, aesthetics, and inclusiveness. However the BoSS project does not have a human-focused approach, therefore we will attempt to include the more-than-human dimension and evaluate which variables can relate to this specific dimension. These dimensions and their dynamic nature can be effectively captured and depicted through the use of temporal data. By examining the temporal patterns within these areas, we can gain valuable insights into the evolving dynamics of spatial development, socio-economic networks, and the overall sustainability of these regions. As we place pilot drops across the territory, our aim is to observe and analyze the potential impact and reach on specific locations, as well as the overall flows within and between these diverse water bodies. This approach allows for a comprehensive understanding of the interconnectedness and interdependencies that exist within and between these port city regions, ultimately contributing to the broader knowledge and sustainable development of these vital areas.

# 7. The Narrative Layer

One of the cornerstones of the geospatial platform is the narrative layer. This layer is based on our understanding that cultural interventions are key to spatial transformation. Users can interact with this layer, where clickable dots provide contextualized stories or themes in relation to a place on the map. It connects the user to a specific location and provides a medium for deeper understanding. Furthermore, the narrative layer can provide a better understanding of trends, history, and priorities that can be used to guide the user to gain a deeper insight about the cities taking part in the project. The narrative layer provides a tool to share stories and perspectives of local stakeholders and create a sense of place for the user. Moreover, the narrative layer will track data associated with BoSS drops (pilot actions) and ripples (pilot demonstrators).

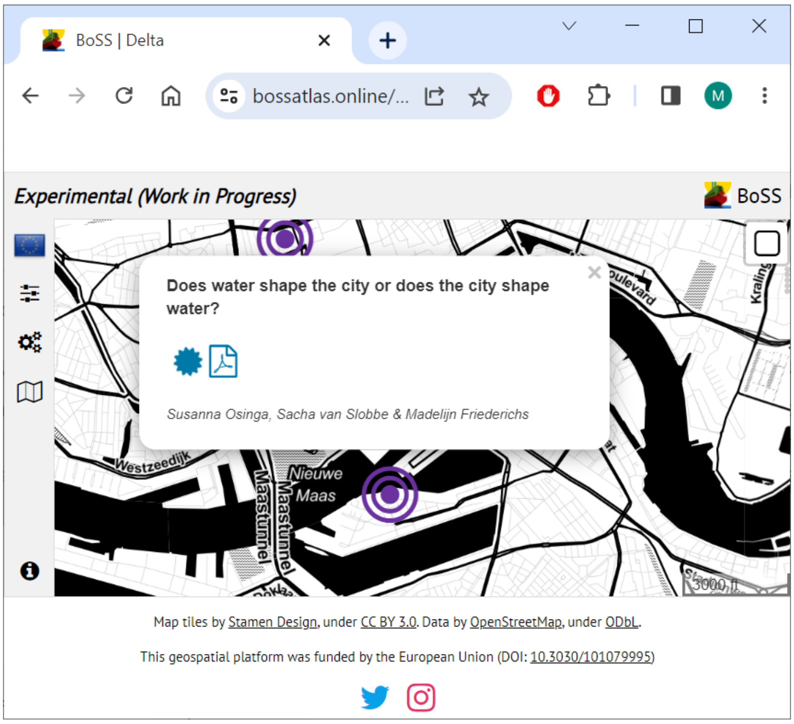


Figure 1. The narrative layer (bossatlas.online).

Overall, the narrative layer serves as a tool for communicating information. Through the narrative layer, stakeholders can tell stories that are connected to a specific place. This layer allows for the quick communication of complex ideas, context, motivations and actions. It also allows users to gain insight and understanding about the environment and other geographical features. The narrative layer can help organize and present information in a way that is engaging.

Ultimately, the narrative layer can act as a repository for the findings of the BoSS project by storing the relevant information to be shared publicly in an organized and centralized location. Not only does using a narrative layer facilitate efficient management of research data, it also enables easier sharing and referencing of the research results. Furthermore, it helps users to quickly explore the data and draw their own conclusions in an interactive, engaging way without having to read long, drawn-out reports.

# 8. User Interface

The BoSS geospatial platform is designed as a responsive, single-page web application that enhances user experience through dynamic rewriting of the current web page with updated data from the web server. Rather than loading entire new pages when transitioning, the platform selectively loads and adds the necessary resources to the page in response to user actions. This approach ensures faster transitions, creating a seamless and app-like experience for users.

The user interface is optimized for mobile devices, ensuring a mobile-friendly experience. Users can access and perform all functionalities using a desktop, smartphone, or tablet. The platform aims to provide an intuitive and efficient environment for users to interact with geospatial data, conduct analysis, and derive valuable insights. Regardless of the device used, the platform's user interface delivers a consistent and user-friendly experience, encouraging users to efficiently explore and analyze geospatial data. Color selection and appearance will be further refined.

### 8.1 Map view

At the core of the interface lies the map view, which serves as the central component. It allows users to visualize geospatial data and interact with the map. Within this view there is the display of various layers, including a base map and additional data layers. The interactive capabilities of the map enable users to navigate through different locations by panning and zooming, effectively exploring and examining the desired areas of interest.

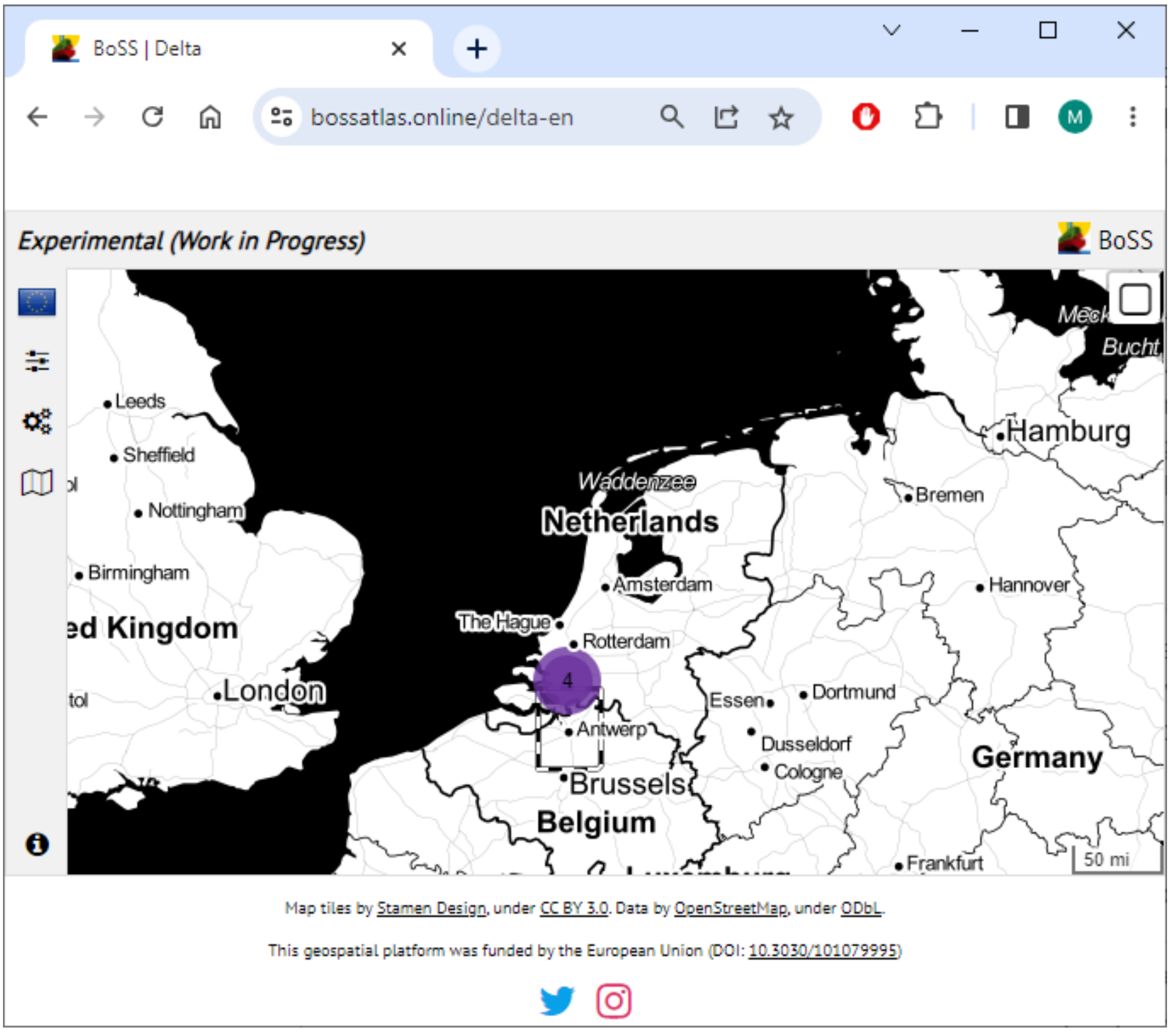


Figure 2. Map view (bossatlas.online).

## 8.2 Toolbars and menus

The left sidebar of the interface houses the toolbars and menus, providing users with a diverse set of tools and functionalities. These options enable users to customize their preferences, such as language selection and system of measurement. Additionally, users can utilize these tools to query specific data, enabling them to retrieve and analyze the information they require.

### 8.2.1 Settings

The Delta region shared between Netherlands and Belgium currently has some data available, and users can select their language preferences and choose their preferred system of measure for the platform. This is all managed by the location setting, which defines the geographical scope for the platform.

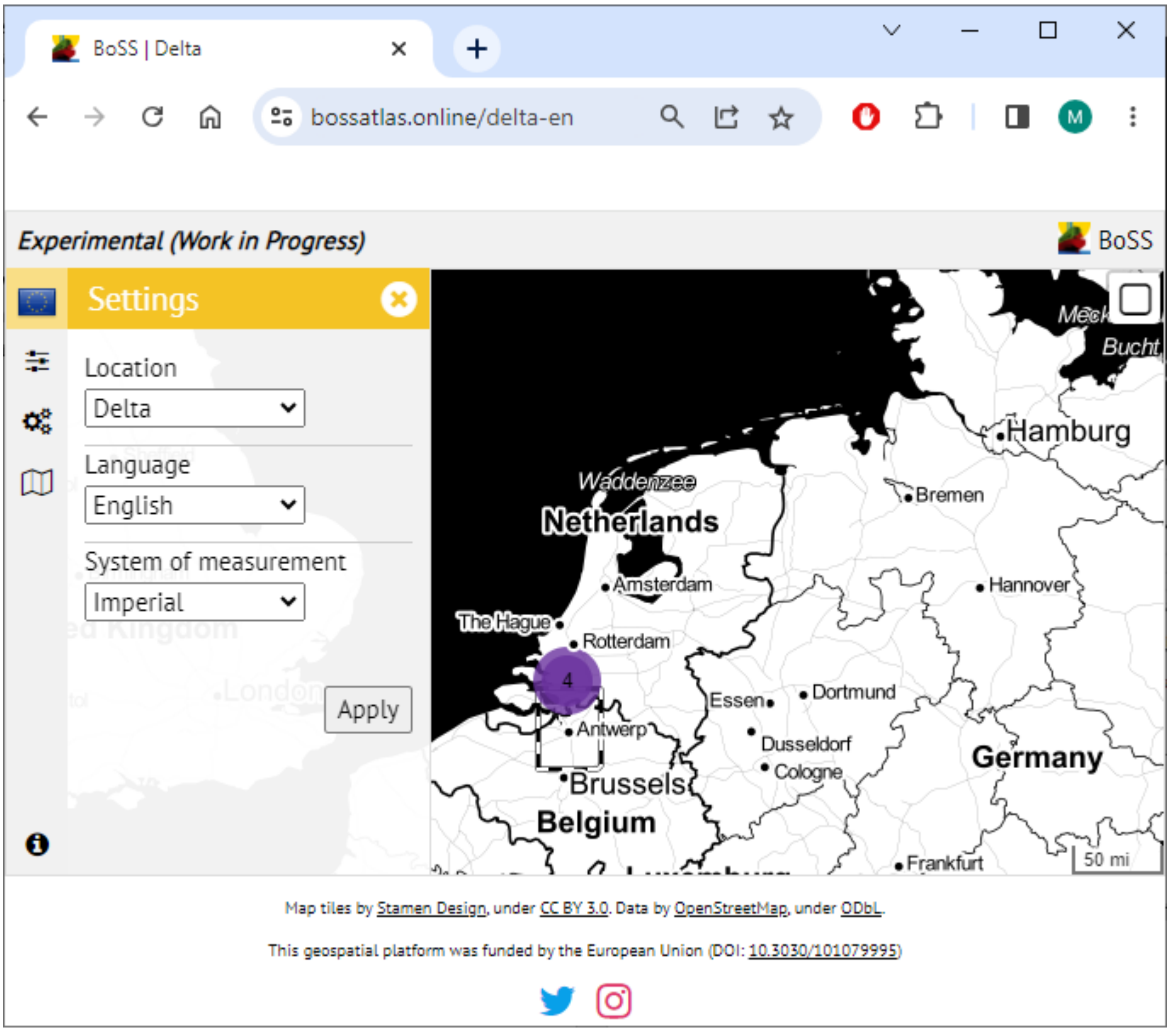


Figure 3. Settings (bossatlas.online).

### 8.2.2 Data dimensions

The platform organizes its data by dividing it into separate dimensions. Each dimension is a category of related data, and selecting it gives users access to its respective variables. This structure makes it easy to navigate and examine the different data sets, allowing users to explore the platform and focus on aspects that interest them. The Delta region shared between Netherlands and Belgium currently has three variables available: elevation, land use/cover, and number of residents.

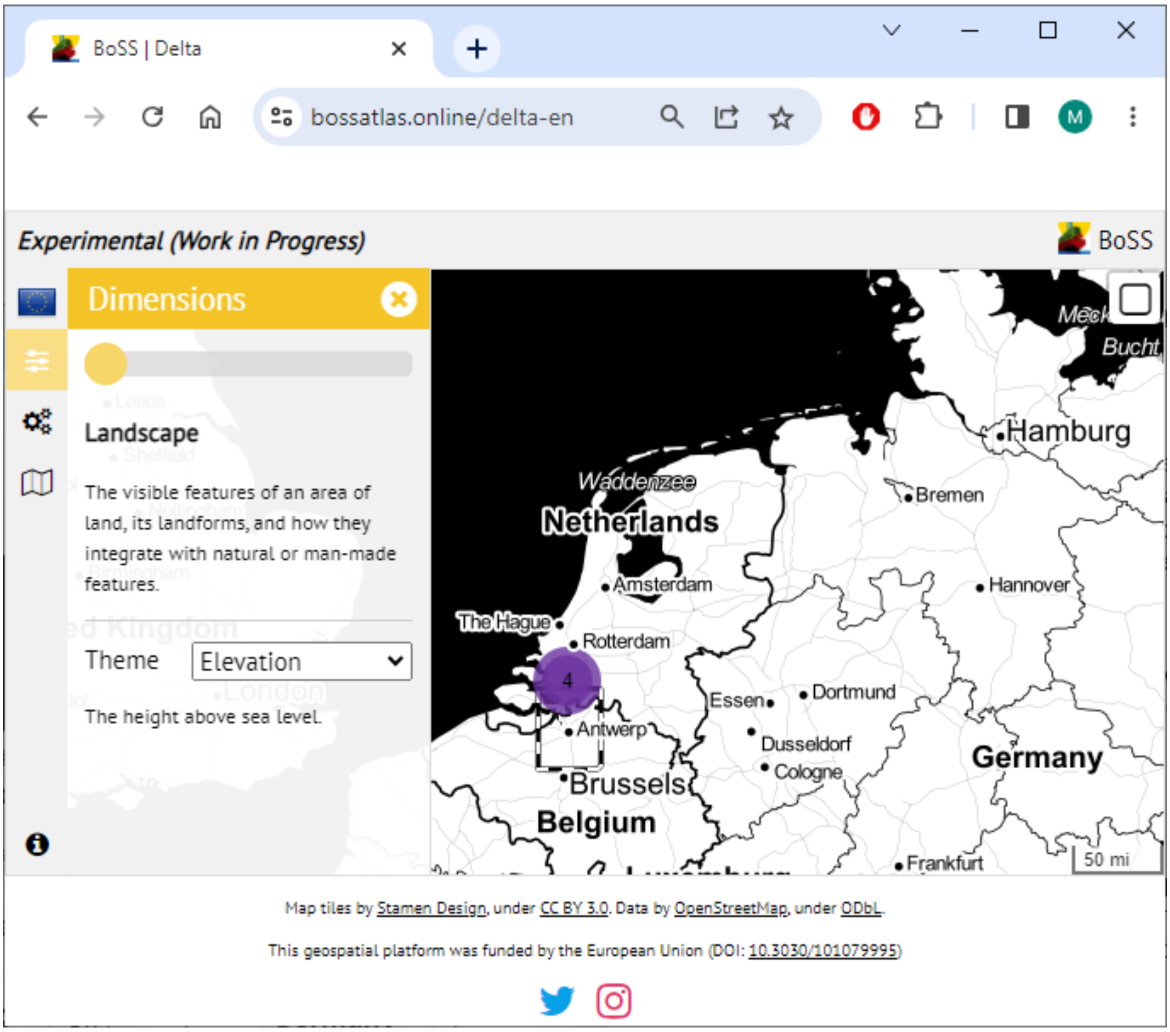


Figure 4. Data dimensions (bossatlas.online).

### 8.2.3 Spatial analysis

Within the user interface, users can access a selection of spatial analysis tools that allow them to carry out geoprocessing operations. They are given the ability to customize input parameters, and then, with a single click on the top right icon, the analysis is executed.

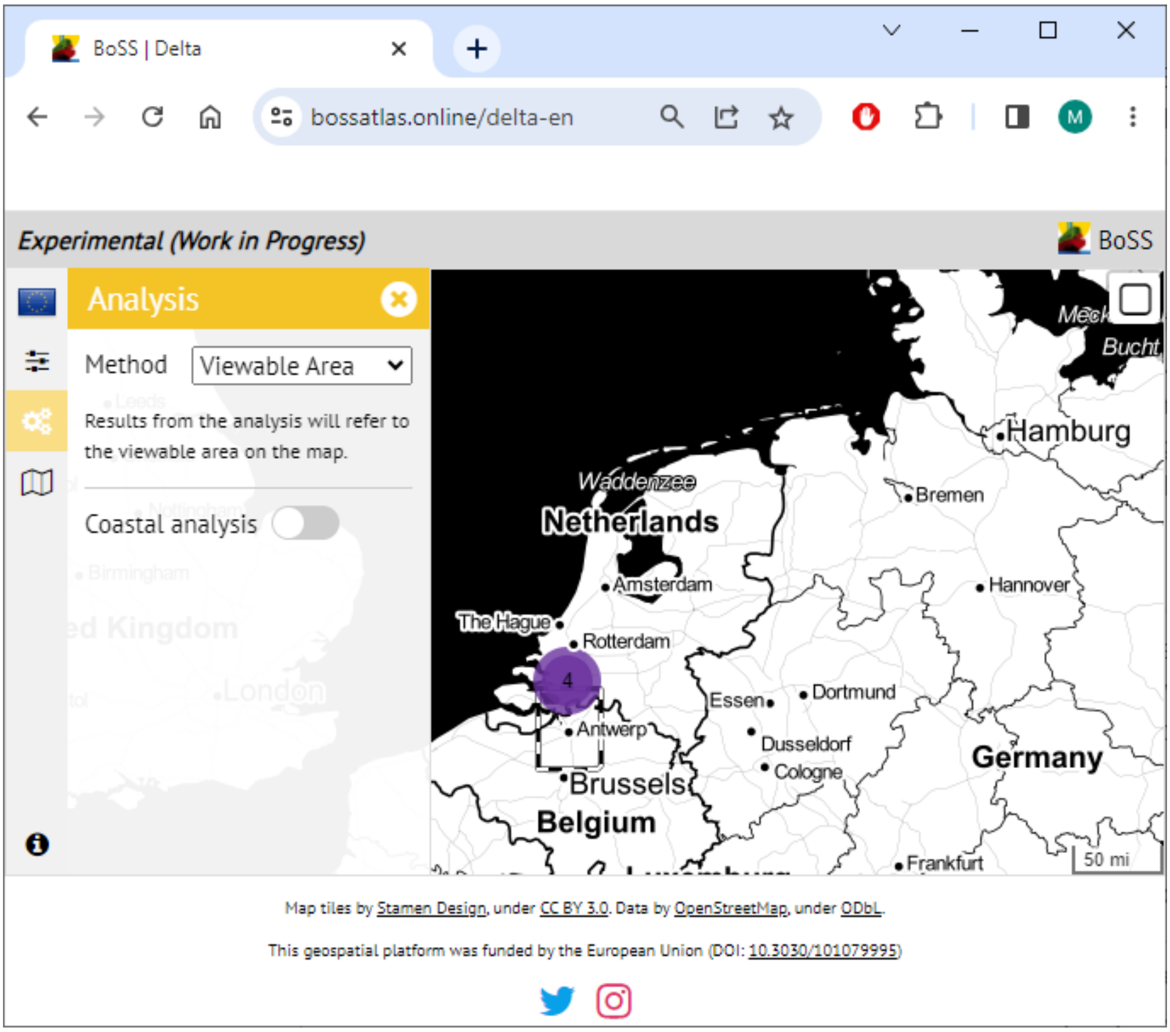


Figure 5. Spatial analysis (bossatlas.online).

### 8.2.4 Port City Atlas

The platform will feature data from the Port City Atlas book, which was created within the LDE PortCityFutures research group and the Faculty of Architecture TU Delft. The platform allows users to control the visibility of specific map layers related to port cities territories. The Port City Atlas control panel in the user interface enables users to turn on or off specific layers.

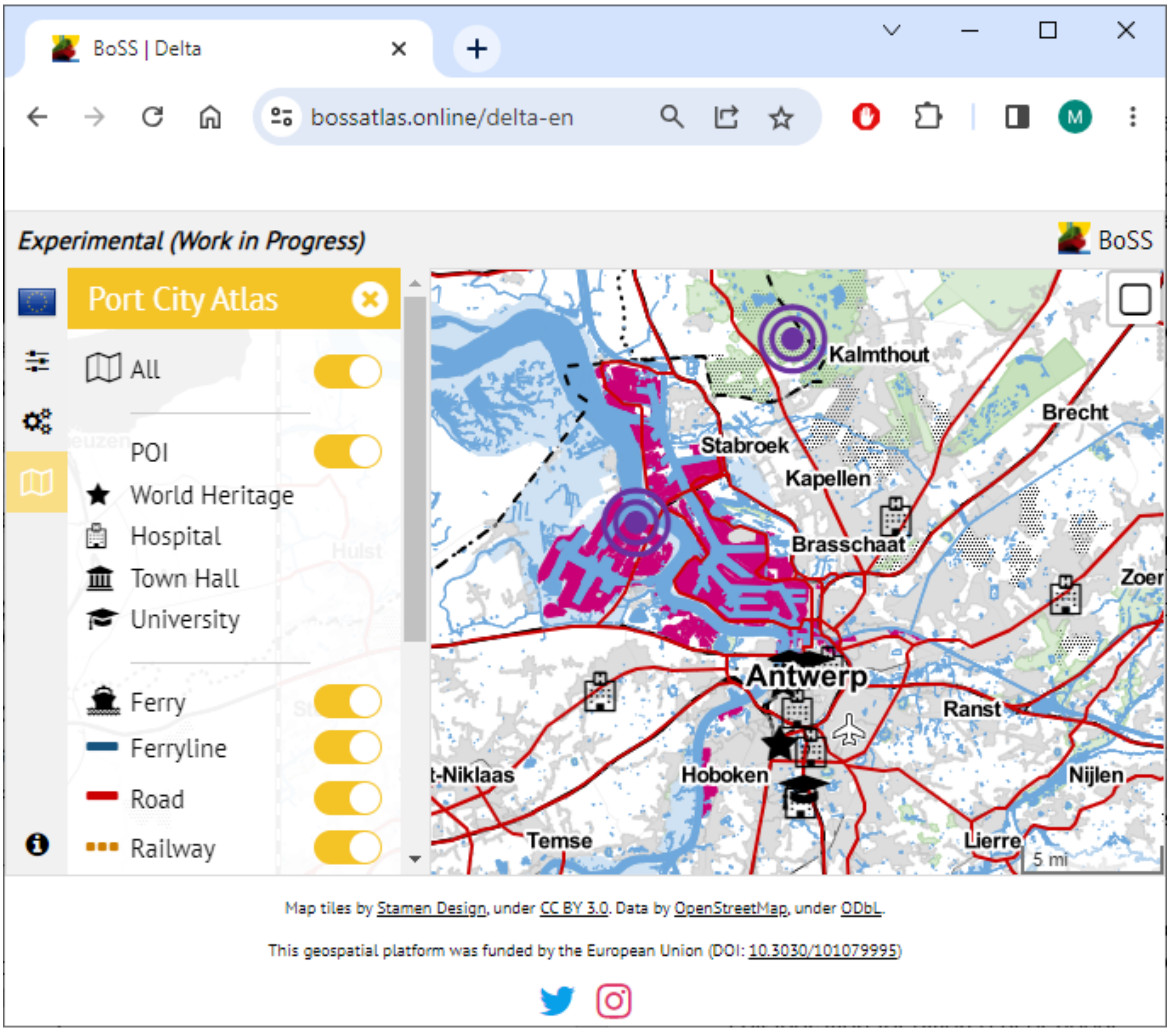


Figure 6. Port City Atlas (bossatlas.online).

# 9. Impact Assessment: Gaining Insight

Currently, the platform has a limited amount of data and functionalities. Nevertheless, it is already capable of demonstrating certain features, such as analyzing population trends over time to gain insights into patterns of population growth or decline. Despite its current limitations, the platform showcases its potential and provides a glimpse into the possibilities of conducting meaningful analyses using the available data.

An example of impact assessment utilizing the geospatial platform involves analyzing resident population figures within a specific geographic area covered by one of the project's drops (pilot actions). This type of analysis aims to answer crucial questions, such as understanding the dynamics of change and determining the population affected by drops (pilot actions) and ripples (pilot demonstrators) across a given area. By leveraging the platform's capabilities, any user can gain insights into population trends, patterns, and the reach of targeted interventions within a designated geographic area.

Below is a step-by-step scenario outlining the process of assessing population figures and dynamics using the geospatial platform available at: [bossatlas.online](bossatlas.online)

To begin, we utilize the platform's settings to define the geographical scope, language, and system of measurements (figure 7).

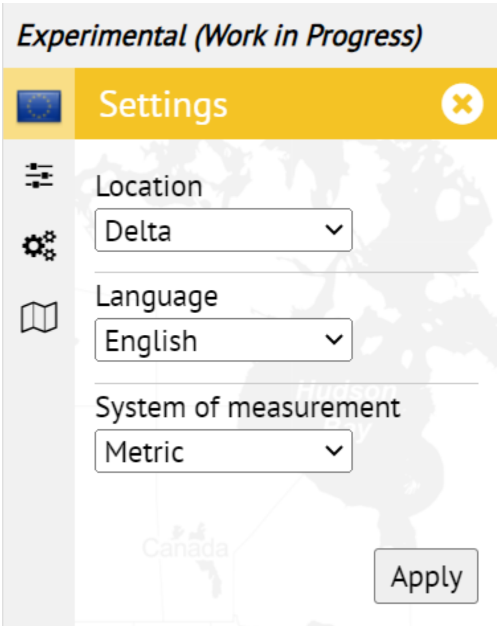


Figure 7. The settings options.

Subsequently, we zoom in on the map to the desired area (figure 8). In this instance, we will use the example of Drop 8 from the BoSS project and choose an iconic area within the Delta region: Verdronken Land van Saeftinghe (Drowned Land of Saeftinghe). By zooming in, we narrow our geographic view to concentrate on this particular region of interest within the larger context of the Delta. This allows us to analyze and explore the specific characteristics and dynamics of the selected area using the geospatial platform.

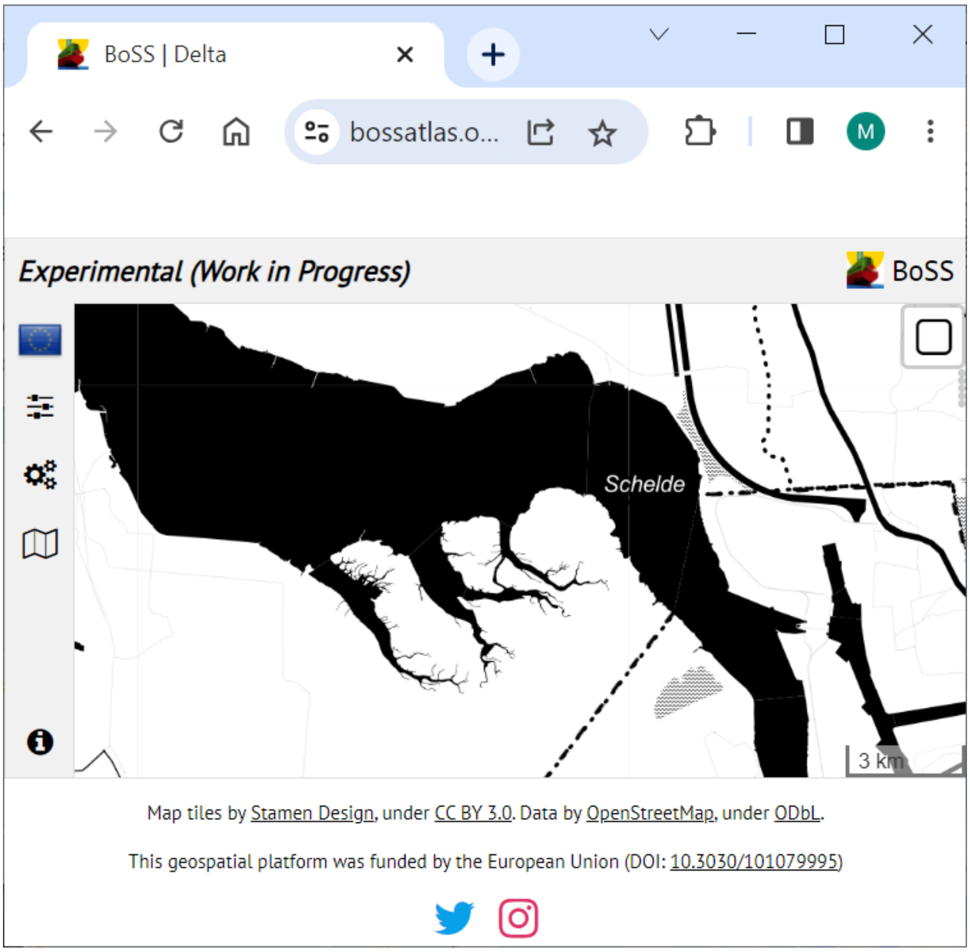


Figure 8. Map zoomed to Verdronken Land van Saeftinghe.

By clicking on the second icon located on the toolbar, we access the data dimensions feature. Within this feature, we proceed to select the "Human Population" category, specifically focusing on the "Residents" theme (figure 9). This selection allows us to retrieve specific data related to the resident population within the chosen geographic area.

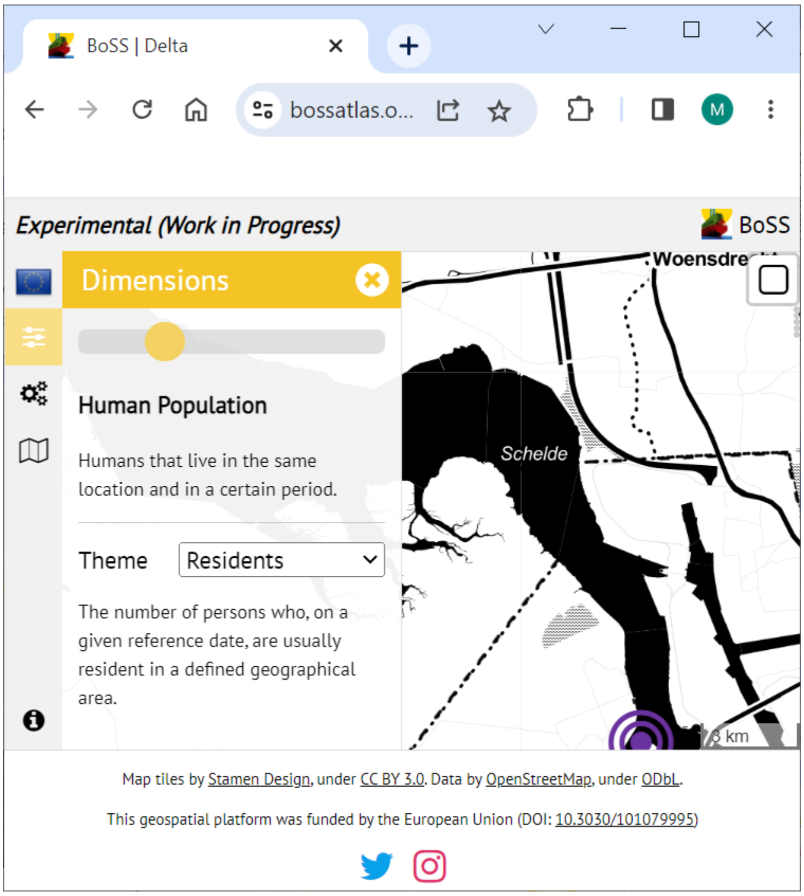


Figure 9. The data dimensions.

For this example, we aim to determine the population residing within a 5 km radius of a hypothetical location in the Verdronken Land van Saeftinghe. It's important to note that this radius can be adjusted and customized based on the specific requirements of the user (figure 10).

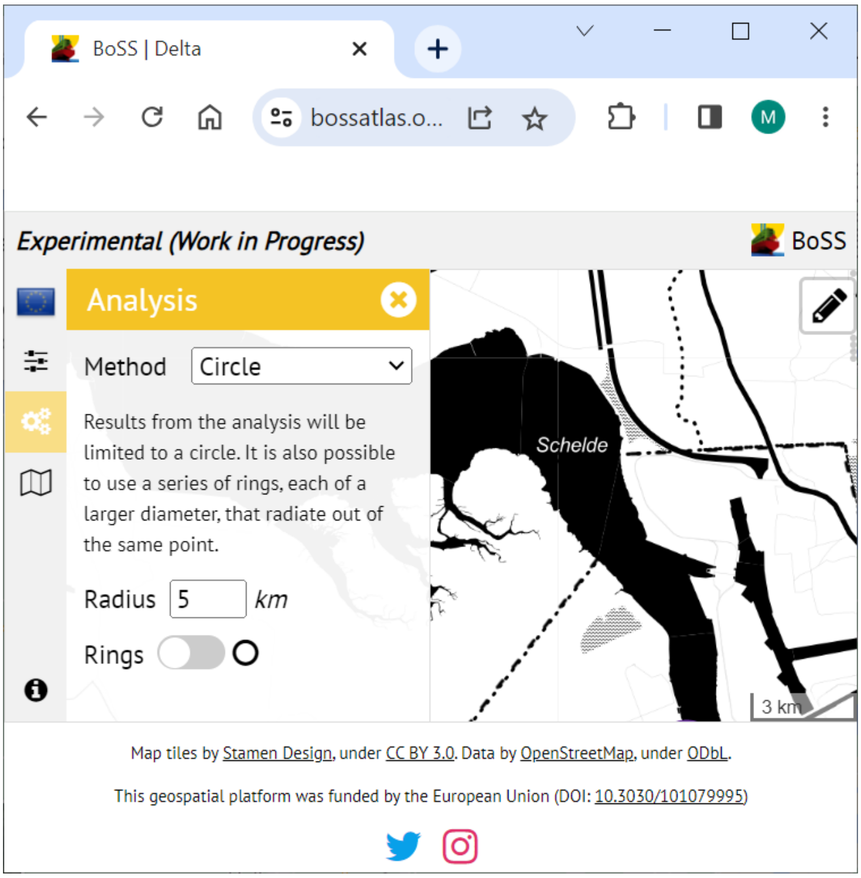


Figure 10. Defining the analysis parameters.

In the end, we only have to click on the pencil icon located in the top right corner of the interface. This allows us to define the center of our 5 km radius circle, which serves as the focal point for our analysis. The geospatial platform then promptly calculates and provides results in real-time (figure 11).

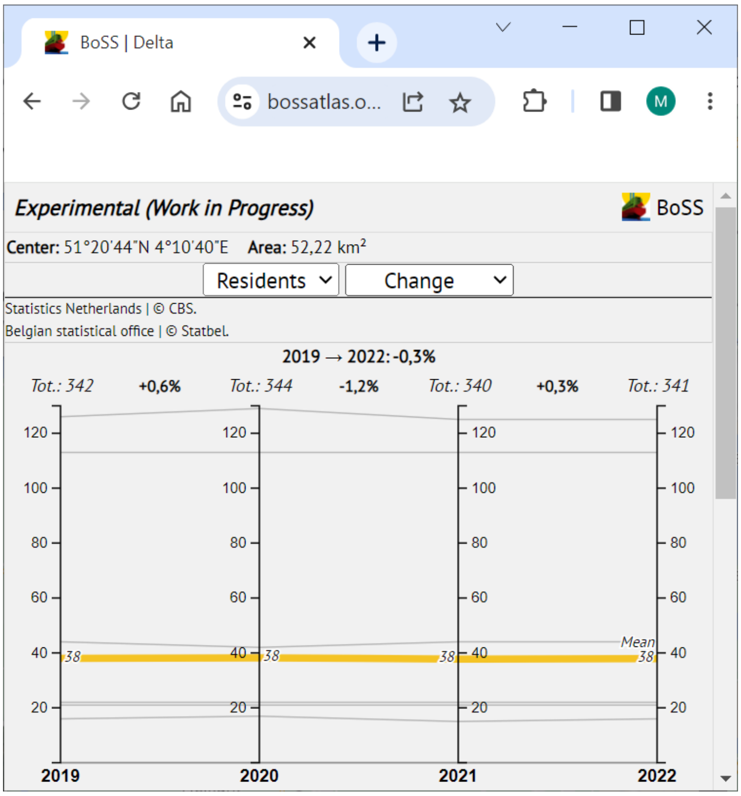


Figure 11. Results for the analysis.

Based on the analysis (figure 11), it reveals that within a 5 km radius from the selected location, there was a total of 341 residents as of 2022. The results also indicate stability in population dynamics within this radius between 2019 and 2022. The chart displays lines representing the number of residents on each street within the area, providing a visual representation of the population distribution. On average, each street accommodates approximately 38 residents.

It is worth noting that this analysis is already readily accessible for any area within Belgium and the Netherlands. The geospatial platform already allows for seamless exploration and assessment of population figures across various regions, providing valuable insights and comparisons.

# 10. Development

During the initial six-month period, the focus was on conceptualizing the geospatial platform. This involved creating a framework that encompassed the overall architecture and system components. Additionally, emphasis was placed on designing an intuitive user interface to facilitate seamless interactions. Defining the data model and database structure was also a crucial aspect, along with implementing efficient data integration strategies for handling geospatial data. Furthermore, integration of both frontend and backend components of the platform was performed. For an overview of the expected future development, please refer to Table 1.

| Task | Description | Timeline |
|---|---|---|
| **Backend Development** | Gather, process and ingest the curated set of open source data that will be available on the platform. | Jul 2023 – Dec 2024 |
| | Populate the narrative layer. | Sep 2023 – Dec 2025 |
| | Create additional services to handle geospatial queries, spatial analysis, and data processing. | Jul 2023 – Dec 2024 |
| **Frontend Development** | Design and develop the user interface for data visualization, search functionalities, and user interactions. | Jul 2023 – Dec 2024 |
| | Optimize the platform's performance and responsiveness. | Sep – Dec 2023 |
| **Integration and Testing** | Conduct user testing and gather feedback for iterative improvements. | Jan – Jun 2024 |
| | Address any identified issues from user testing and fine-tune the platform's performance and stability. | Jul – Dec 2024 |
| **Deployment and Launch** | Conduct a final round of testing and quality assurance checks. | Jan 2025 |
| | Launch the geospatial platform. | Jan 2025 |
| **Workshops** | Workshops for WP2-4 and for Ambassadors to use the geospatial platform as one of their tools in their interventions and outreach. | Jan – Mar 2025 |
| **Conceptualize Digital Twins for Coastal Cultural Heritage** | Report on the feasibility study of the application of Digital Twins of coastal cultural heritage. | Sep 2025 |

Table 1. Future Development.

# 11. Conclusion

In conclusion, the BoSS geospatial platform is a comprehensive tool that aims to provide a multidimensional understanding of spatial development in port city regions.

By integrating data from diverse dimensions such as historical, cultural, economic, and environmental, the platform allows for a holistic assessment of sustainability, aesthetics, and inclusiveness. Additionally, the platform incorporates temporal data to capture the dynamic nature of these regions and gain valuable insights into evolving dynamics, socio-economic networks, and overall sustainability.

At the present moment, the geospatial platform (accessible at bossatlas.online), offers limited functionality but serves as a valuable resource for stakeholders involved in the Bauhaus of the Seas Sails project. It provides a structure that allows for efficient summarization of data by aggregating information at higher levels, enabling users to analyze and compare locations in terms of various dimensions. One of the key features of the platform is the narrative layer, which serves as a tool for communicating information and telling stories connected to specific places. This layer facilitates the quick communication of complex ideas, context, motivations, and actions while providing insight and understanding about the environment and geographical features. Moreover, the narrative layer acts as a repository for the findings of the BoSS project, storing relevant information in an organized and centralized location. This facilitates efficient management of research data and enables easier sharing and referencing of research results.

Overall, the BoSS geospatial platform, with its multidimensional approach, temporal analysis, and narrative layer, contributes to the broader knowledge and sustainable development of coastal regions. It allows for a comprehensive understanding of interconnectedness and interdependencies within and between these vital areas. By providing a user-friendly interface and interactive features, the platform empowers users to explore the data, draw their own conclusions, and actively engage with the project's results.

Furthermore, the BoSS geospatial platform plays a crucial role in the impact assessment of the pilot projects undertaken in the BoSS locations. Work Package 5 (Impact Assessment) aims to evaluate the effects of pilot projects in a standardized manner, using the platform to map heterogeneous spatial, socioeconomic, and cultural data. The platform's analytical tools enable users to gain valuable insights based on geographic patterns and relationships, while the narrative layer facilitates the documentation of the effectiveness and impact of the pilot projects. By comparing locations in terms of sustainability, aesthetics, and inclusiveness, the platform provides a comprehensive understanding of the systemic implications of various stakeholders involved in the project. Through its interactive visualization tools, the platform also facilitates outreach efforts, enabling project partners and the wider audience to engage in value-based discussions and participate in the project's participatory process, multi-level engagement, and transdisciplinary approach.

The continued development and utilization of the geospatial platform will allow BoSS to foster knowledge exchange, informed decision-making, and inclusive development practices for the benefit of present and future generations.

The BoSS geospatial platform is available with limited functionality and is in an early stage of development at the following address:

*bossatlas.online*

# 12. Acknowledgments

Use of open-source software libraries in the development of the BoSS platform is acknowledged below. We would like to express our gratitude to all the authors and contributors.

DataTables - Tables plug-in for jQuery. Copyright (C) 2008-2020, SpryMedia Ltd.

D3: Data-Driven Documents. Copyright 2010-2021 Mike Bostock.

Font Awesome 4 - SVG, font, and CSS toolkit. Copyright (c) 2017, Dave Gandy.

jQuery JavaScript Library. Copyright OpenJS Foundation and other contributors.

Leaflet - JavaScript library for mobile-friendly interactive maps. Copyright (c) 2010-2019, Vladimir Agafonkin. Copyright (c) 2010-2011, CloudMade.

Leaflet Contextmenu. Copyright (c) 2017, Adam Ratcliffe.

Leaflet Control Search. Copyright (c) 2013-2020, Stefano Cudini.

Leaflet Markercluster. Copyright 2012 David Leaver.

Turf - JavaScript library for spatial analysis. Copyright (c) 2019 Morgan Herlocker.