Tua Nylén, Harri Tolvanen, Anne Erkkilä-Välimäki and Meeli Roose

Deliverable D.T3.4.1 Guidelines for visualising spatial MSP information effectively on maps

Cross-border case

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CONTENTS

BACKGROUND

Spatial information and maps are one of the cornerstones of Maritime Spatial Planning. They are present at every step of the planning process and maps play an important role in involving stakeholders and the public in the process. Successful evaluation, collection, management, analysis and visualisation of spatial information are the key for making evidence-based planning decisions.

Member states of the European Union plan the use of sea space within their own territories. However, spatial data from the other side of administrative borders is needed, since the planning processes require awareness of human uses and the nature beyond borders. In addition, spatial information of economic, cultural and nature aspects need to be fitted together in the planning process. Compared to land use planning, spatial data utilisation in Maritime Spatial Planning (MSP) faces many additional challenges. Therefore, the different practices in the management of spatial information across geographical and thematic boundaries must be carefully dealt with.

This report forms the last part of the new **guide for cross-border spatial data analysis in Maritime Spatial Planning** (Nylén et al. 2019). The guide is targeted at regional planners and spatial data officers involved in national and cross-border MSP. It aims at helping the regional planner understand and evaluate maps and other outputs of spatial data analysis. In addition, it seeks to assist the GIS specialist in understanding Maritime Spatial Planning and designing spatial data analysis workflows in a goal-oriented way.

The guide (Nylén et al. 2019) presents a step-by-step approach to utilising spatial data in MSP. It seeks to complement existing MSP guides in a concise and practice-oriented way, instead of forming a comprehensive manual. The steps of this guide may be linked to the general MSP workflow presented in UNESCO IOC's guide "Marine Spatial Planning – A step-by-step approach to ecosystem-based management" (Ehler & Douvere 2009). This guide introduces each step of the MSP spatial data process in a general way and includes practical tips, arising from a literature review and Plan4Blue experiences. The guide has been prepared in four parts that represent the usually steps in MSP spatial data analysis:

- Guidelines for identifying and sharing relevant spatial data in MSP (Plan4Blue report, April 2017)
- Guidelines for harmonising, producing and managing cross-border spatial data (Plan4Blue report, July 2017)
- Guidelines for spatial modelling and analysis to produce data and identify interactions of interests (Plan4Blue report, January 2019)
- Guidelines for visualising spatial MSP information effectively on maps (this Plan4Blue report, June 2019)

Please note that the numbering of steps (e.g. Step 12), sub-steps (such as 12.1) and figures in this report follows the structure of the guide (Nylén et al. 2019). Since the content of the first three reports has been refined for the guide book, the numbering does not match that of the previous reports.

The guide is prepared as part of the MSP development project Plan4Blue - Maritime Spatial Planning for Sustainable Blue Economies (2016-2019; http://www.syke.fi/projects/plan4blue) co-funded by the EU European Regional Development Fund (Interreg).

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Available online: syke.fi/projects/plan4blue

FREQUENTLY USED TERMS

CRS – Coordinate reference system.

Guidance document – A document accepted by the MSP coordinating group, and consisting of a review of criteria for spatial data inclusion, spatial data analysis goals, results of the data inventory, spatial data evaluation and spatial data harmonisation guidelines.

Metadata catalogue – A catalogue holding detailed metadata of all data created and used in the MSP spatial data analysis process.

MSP – Maritime/Marine spatial planning.

GUIDELINES FOR VISUALISING SPATIAL MSP INFORMATION EFFECTIVELY ON MAPS

The last phase of the MSP spatial data analysis consists of the visualisation of the spatial analysis results on maps. Visualisation of spatial data is as important as the data itself. Through careful visualisation, it is possible to communicate spatial information objectively and clearly, avoid misunderstandings and enable justified evaluation of the data and the MSP results. An inseparable part of the presentation of the MSP results is reporting the utilised spatial data and analysis methods.

Finally, the spatial results (maps, spatial data and metadata) of the MSP process are stored and distributed to a wider public. Cross-border interaction is facilitated by taking into account common frameworks and practices in visualisation choices and metadata. Moreover, the structure and languages of both spatial data and metadata influence the usability of the results across borders.

Step 12. Visualise spatial information

In this step, the results of the MSP process (either intermediate or final) are visualised for communicating them to planners, authorities, stakeholders and the general public. Visualisation of the MSP background information, scenarios and spatial plans on maps is much more effective in communicating the information than narratives.

12.1 Create visualisation plan: identify aims for spatial data visualisation

To design best possible maps, make a *visualisation plan*. In the plan, list the spatial outputs of the MSP process and determine their aims. The plan should conform to the overall goals of the MSP process and follow the *guidance document*. The visualisation choices depend on following aspects:

- Phase of the MSP process, e.g.: stage-setting phase, intermediate phase, final stage, monitoring/evaluation stage
- Content of the map: current conditions and their dynamics, spatial interactions, future conditions, scenarios, maritime spatial plan
- Target group of the visualisation, e.g.: internal use (planners), authorities, stakeholders, general public
- Publication type, e.g.: physical maps, static digital maps, three-dimensional views, spatial animations, interactive map views
- Context: stand-alone map, illustration in report, atlas

Each type has different potential and preconditions. For example:

- Maps of final maritime spatial plans for the wide public should be as plain, clear and visually well designed as possible
- Drafts with large amounts of information and unpolished symbology may be acceptable for internal use
- Interactive map views, such as in MSP spatial data portals, use predefined symbology to visualise data. Since the map view can be zoomed and data layers turned off and on, the portals have different (and less strict) requirements for visualisation than static maps
- The vertical dimension and temporal dimension can be incorporated into visual outputs using three-dimensional views and animations

Maps are powerful ways of communicating information and easily redistributed. Thus, they are also easily used out of their context and their message misinterpreted or misused. Intermediate analysis results and intermediate versions of spatial plans should be handled carefully.

Practical tips

- Generally, precise numbers and detailed borders should only be used when communicating final official results. To highlight their intermediate nature, values in maps can be reclassified into non-numeric scales and resampled to mask spatial details. The maps can also be clearly labelled as

"drafts", "demos", "scenarios", "options", "illustrations" etc. (preferably on top of the map image itself so that it cannot be cropped out; Figure 7).

- Non-figurative (scenario) maps (Milestad et al. 2014) can be used for communicating scenarios and other types of intermediate information. Generally, they aim at illustrating the main characteristics of spatial phenomena "at a glance" instead of being accurate maps. This is done for example by avoiding numeric values and precise borders.

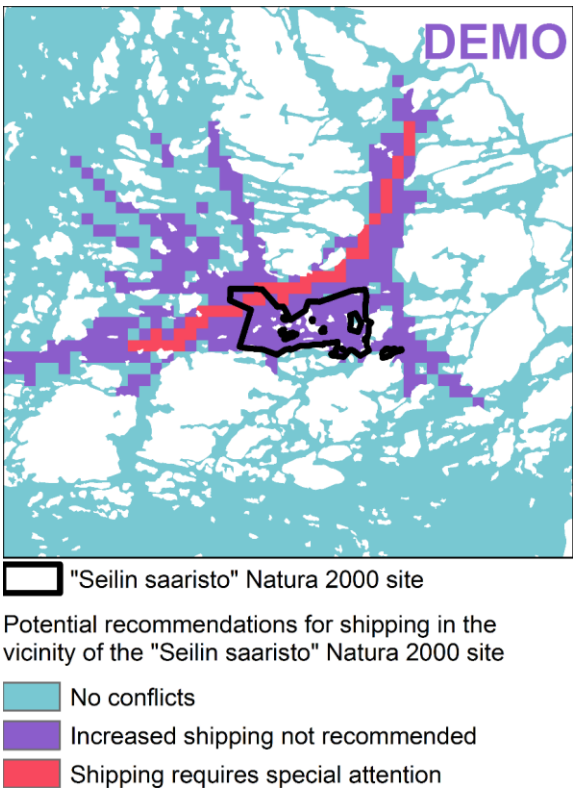

Figure 7. Example of a map visualisation of analysis results that are intended as an example, not actual MSP information. Note the "DEMO" label as well as the missing north arrow, scale bar and place names.

12.2 Determine uniform guidelines for spatial data visualisation

Determine guidelines for creating harmonious visualisations of the spatial results. The following aspects may be considered to improve visual impression and comparability of spatial outputs (choosing one option or a selection of them):

- Uniform formats of published maps (web page, digital document, printed report, static or interactive)
- Uniform image sizes and spatial extents for map layouts
- Uniform spatial scales for map layouts
- Uniform CRS for map layouts
- Uniform colour and symbol selections for map layouts
- Logos and their placement

Each visualisation is unique and has unique requirements for visual design. The guidelines must therefore be flexible and allow exceptions.

12.3 Prepare visualisations considering best practices

When working with each visualisation, follow best practices in cartography. They outline for example general principles for the content, elements, use of colours, shapes, patterns, text and other types of information in maps. In addition, they guide the selection of metadata to be included in the visualisations.

Practical tips

- There are a few extensive and clear guides, for example those of Peterson (2009) and Brewer (2015).

12.4 Visualise uncertainty and data gaps

Visualise uncertainty and data gaps on maps. Including this information on maps (in addition to metadata and e.g. report text) can be used to improve the transparency of the spatial data process and facilitate the evaluation of the results. For example, areas with missing information can be shown on the map and uncertain observations can be labelled with specific symbols.

Practical tips

- For example, one of the input layers used for calculating an aggregate spatial data layer may have covered only one part of the plan area / analysis area. Thus, the result must be examined acknowledging this input data gap. The result can be visualised on a map where e.g. a transparent layer on top of the aggregate data layer signals the extent of the input data gap.

12.5 Explore visualisation tricks

Use geoprocessing methods to improve map visualisations. Report analyses clearly in the map metadata.

Practical tips

- Report for example the name of the method, applied radius and weight field (depending on the method) in the metadata.
- For example, add jitter to point data to visualise many observations with identical coordinates. Utilise density analysis for visualizing (point and line) data.
- For another example, large point data of oil spills with many overlapping observations can be visualised using heat map symbology (Figure 8). This method visualises the density of points as a continuous colour gradient, which may easier to interpret than the original point data.

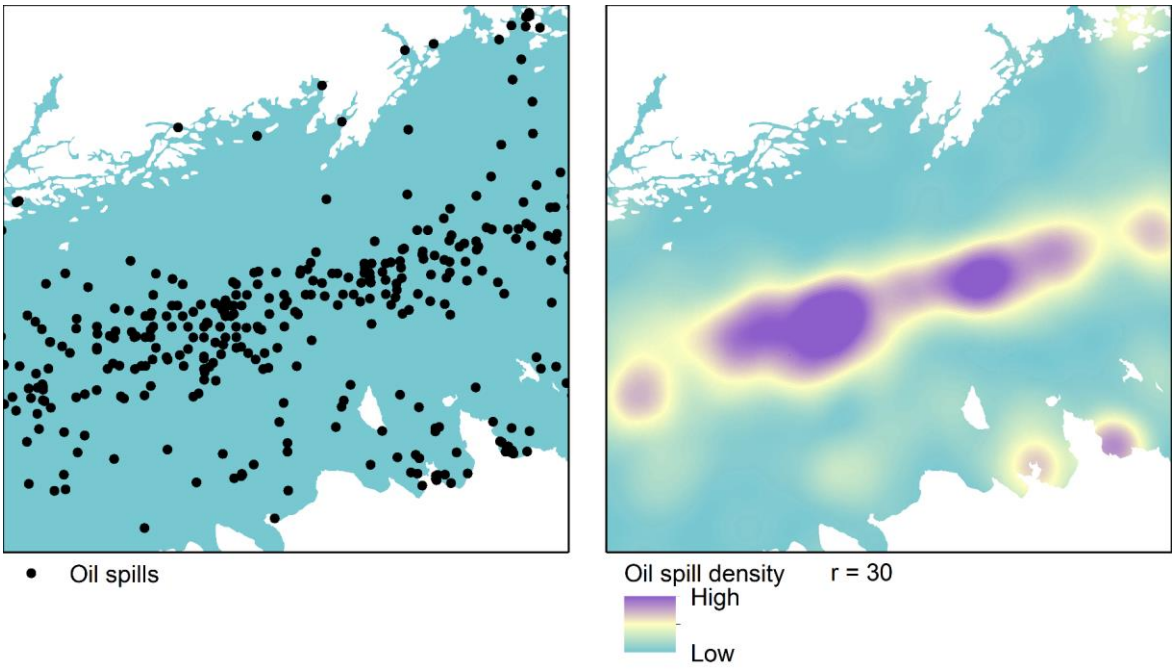

Figure 8. A heat map visualisation of marine oil spill point data (with Kernel density search radius r = 30). The original point data has a large number of overlapping observations, making it challenging to visualise.

12.6 Evaluate maps

A map is never perfect and map visualisation should be an iterative process. Peer or public evaluation are useful for improving map design and removing errors. Cross-border comparison of MSP maps may be useful and facilitate international cooperation.

Step 13. Report spatial data and analyses

In this step, the maps and spatial data products are supplied with appropriate metadata. They will allow evaluation and examination of the input data, methods and results and their limitations. In addition, they will enhance transferability of the workflows across sectoral and administrative borders and reproduction of the analyses during successive MSP rounds.

13.1 Finalise metadata catalogue

Check and update the *metadata catalogue* (Step 5.1) for all spatial data created and used in the MSP process.

13.2 Include citations to input data

Cite all input data and methodology so that it can be evaluated and accessed easily. Include the citations for example in reports, metadata and map captions.

13.3 Prepare metadata summaries for maps and spatial datasets

Write summaries of the most fundamental information for each spatial data visualisation and dataset. The information includes input data and its quality, used analysis methods and their restrictions. These summaries should be used in map captions and/or layouts and in the general descriptions of digital data products.

Although metadata sheets are available, they may not be read through by users of maps and spatial data. The short descriptions are therefore important for communicating the most essential information.

Step 14. Store and distribute MSP data

In this last step, the intermediate and final outputs of the spatial data analyses in MSP are stored and distributed to a wider public. It allows planners, authorities, stakeholders and the general public across sectoral and administrative borders to access, examine and evaluate the key results that form the basis for MSP. Public distribution of the data enhances transparency of the planning process, stakeholder involvement in the process, communication of plans and transferring ideas to other areas.

14.1 Identify essential MSP spatial data for distribution

Identify those spatial data that are relevant for distributing to a wider public. These may include key data on the current environmental conditions and human activities, scenarios or planning options and maps of final spatial plans.

Practical tips

- Make a distinction between new datasets created in the MSP process and input data created by other providers.
- It may be advisable to only distribute original data created in the MSP process. Providing adequate citations for background data gives end-users the possibility to access these data through original providers' databases, which is in many cases most appropriate and practical (e.g. Fowler et al. 2010).

- Identify data layers relevant for stakeholders. These may include a raster layer of the maritime spatial plan, vector layers for sea use “zoning”, spatial interaction data for marine activities (conflict areas etc.) and layers indicating the potential areas for different activities (based on analyses).

14.2 Identify ways to distribute data

Identify a practical way for distributing MSP spatial data to the wider public. MSP spatial data portals (interactive web-based services for viewing and downloading spatial data) or marine atlases (web-based services and/or printed atlases of static cartographic visualisations of selected data) are two of the most common ways of distributing spatial MSP data and maps.

Consider whether or not viewing, downloading and interactive analysis and visualisation capabilities are all needed and if you have the resources to implement them. The user needs to be able to browse metadata in the data portal before making a decision on downloading the spatial data.

Practical tips

- In addition to detailed metadata, the key information (e.g. major disclaimers) should be summarized and visible for all users without opening a separate metadata file.
- Identify the best way to store and distribute spatial data. Consider data origin, rights, open access possibilities, data layer size, format, CRS, version information and metadata.
- For example, the distribution of MSP spatial data may require a database including original and background data. In addition, an online map application would be needed to give users the possibility to view these data. Original data could then be downloaded in spatial format through the application, while background data would be merely visualised and described. This service can be incorporated into existing spatial data applications.
- The simplest way to distribute (a limited amount of) spatial MSP data would be to publish map visualisations as images on a web page and provide download links for the most important spatial data and metadata.

14.3 Prepare spatial data for publication

Triple-check spatial data files and metadata. Extract up-to-date metadata from the *metadata catalogue* for each spatial dataset to be published. Create a metadata sheet for each dataset and ensure that it is published with the data.

Pack the spatial data files and their metadata sheet together in order to ensure that the end-users have convenient and automatic access to the metadata. In addition, use the metadata summary (13.3) for a general description of the spatial data, its origin and quality in the data portal.

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