



Baltic Sea Information on the Acoustic Soundscape

Concepts of the BIAS GIS-based planning tool for underwater ambient noise

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Below follows a description of the content and function of the BIAS GIS-based planning tool.

Our way of putting the “tool-package” together follows the general items below:

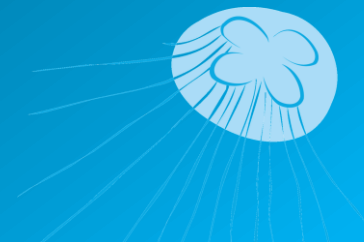
- Which are the targeted users?
- Which answers does the tool need to supply?
- Which BIAS data do we want and are possible to include?
- Which data will be possible to include from future field surveys, or perhaps even modelling?
- What functions should be incorporated in order to meet the needs of the managers?

Remember that the tool will only deal with AMBIENT noise, since this is the pure scope of BIAS.



BIAS GIS-based planning tool: background

- Target user group:
 - National managers; focus on MSFD and Regional management >> management of national waters, usually country by country
- The tool is aimed to present ambient noise "products" that help answer questions raised by the user group. Examples of such questions may be:
 1. How is the noise pressure in my regions?
 2. What are the monthly percentiles of ambient noise in my regions at 63Hz, 125Hz, 2kHz and broadband 10Hz-10kHz?
 3. What are the fluctuations in noise levels inside a year?
 4. How good/uncertain is the noise level assessment?



BIAS GIS-based planning tool: concepts of the interface

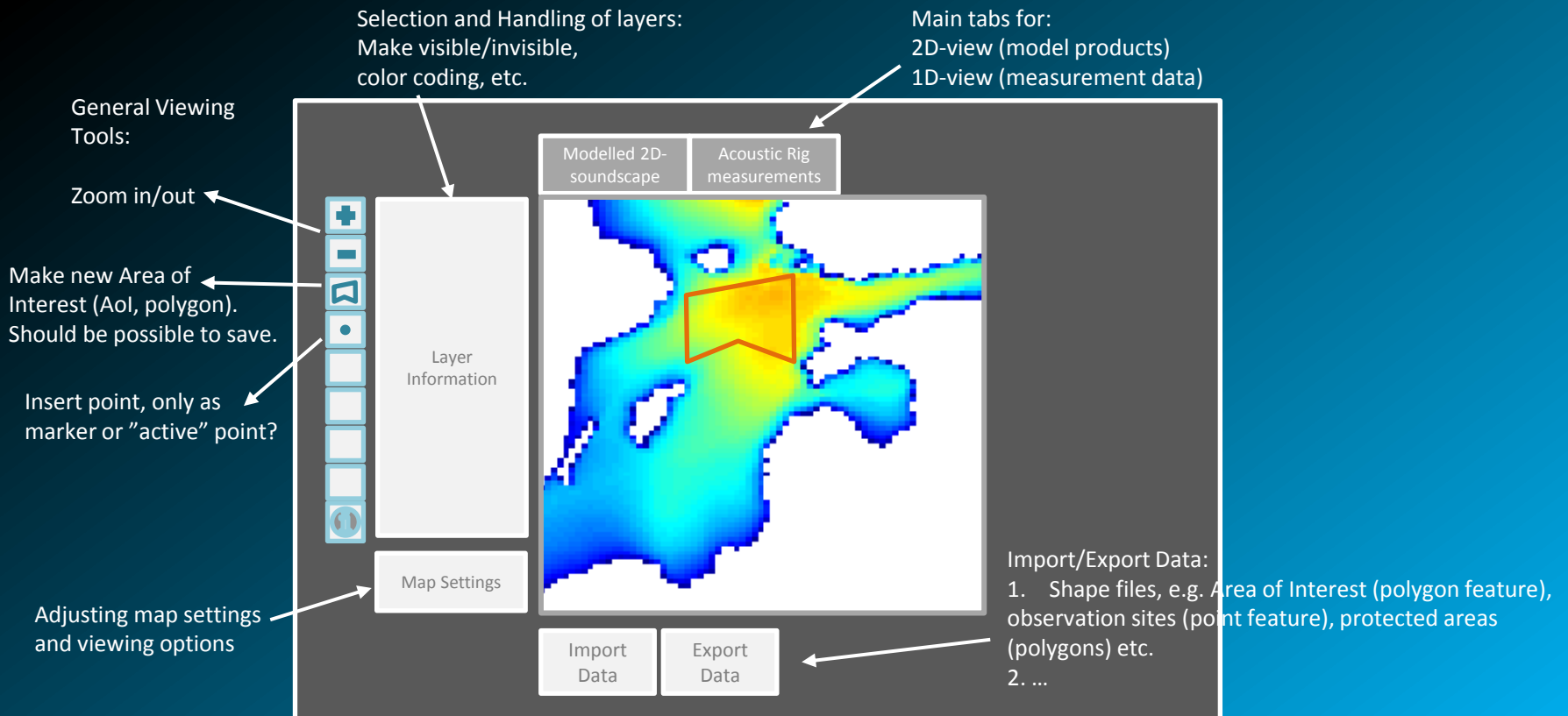
The tool consists of viewing interfaces for two types of “products”:

Maps/layers (2D)

- BIAS modelled soundscape maps
- BIAS environmental layers
- BIAS shipping information (AIS statistics)
- External GIS-layers (protected areas etc.)

Rig measurements (1D)

- BIAS acoustic measurement data



BIAS GIS-based planning tool: 2D-interface features

- Selection of:
 - Frequency (63Hz, 125Hz, 2000Hz and broadband 10-10 000Hz)
 - Time Period (months and years)
 - Depth Level (surface level, “midlevel”, “bottom level”) [TBD]
 - Statistics (arithmetic mean, median, 90th percentile, 10th percentile) [TBD]
- Selection/Definition of Area of interest (red polygon); import or draw in tool
- Application of a number of functions/calculations for one or all model pixels within area of interest

The screenshot displays the main interface of the BIAS GIS-based planning tool. At the top, there are two tabs: "Modelled 2D-soundscape" (selected) and "Acoustic Rig measurements". Below the tabs is a navigation bar with options: "Frequency | Statistics | Depth Level | Time Period | ...". The main map area shows a heatmap of a coastal region with a red polygon highlighting an area of interest. To the left of the map is a vertical toolbar with icons for map operations. Below the toolbar is a list of layers: ".Soundscape map", ".Environmental raster", ".Environmental polygon", ".Environmental point", and ".AIS layer". At the bottom left is a "Map Settings" button. At the bottom center are "Import Data" and "Export Data" buttons. On the right side, there are three buttons labeled "2D-Function 1", "2D-Function 2", and "2D-Function 3".

The screenshot displays the same interface as the previous one, but with the results of a 2D-function calculation. The navigation bar now shows "125 Hz | 90th-perc. | Midlevel | March 2014 | ...". The main map area is replaced by a large white box containing the text "Graph of 2D-Function 1". To the right of this box is a small thumbnail of the map with the red polygon. The "2D-Function 1" button is now highlighted in blue, while the other function buttons are grey. The "Import Data" and "Export Data" buttons are at the bottom, and the "Map Settings" button is on the left.

2D-interface layers: BIAS soundscape modelling results

per frequency 63Hz, 125Hz, 2kHz, 10Hz-10kHz and depth level:

- SPL monthly average (arithmetic mean)
- SPL monthly median
- SPL monthly 90th percentile
- SPL monthly 10th percentile
- ...
- SPL annual average (arithmetic mean)
- SPL annual median
- SPL annual 90th percentile
- SPL annual 10th percentile
- ...

2D-interface layers: BIAS environmental layers

- Bathymetry
- Seabed sediments
- Monthly + Annual mean
 - Hydrography: Temperature/Salinity
 - Wave Height
 - Wind Speed **or** Sea State measure
 - Ice thickness/cover

2D-interface layers: BIAS shipping information

- Monthly and annual ship traffic density maps
 - Possibly divided into ship types/classes

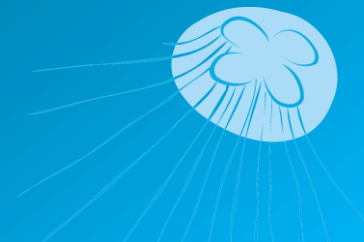
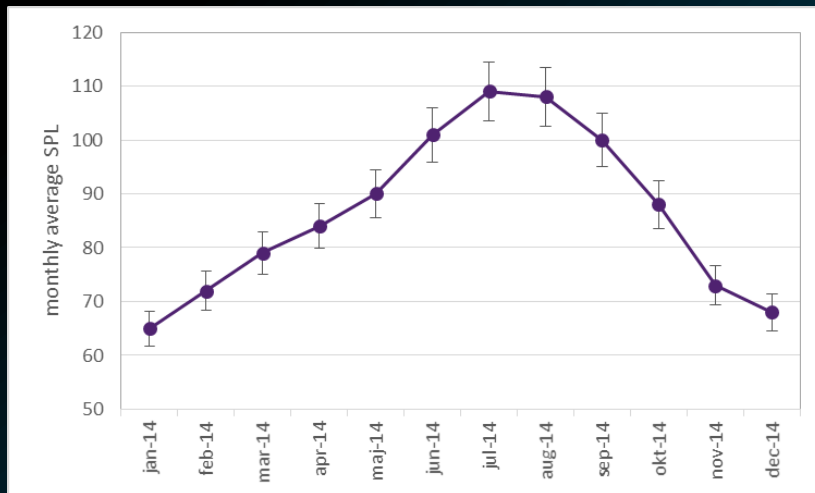


2D-interface functions (modelling data)

Graph2D-1: SPL vs time

For the selected frequency, depth level and statistical measure:

→ Time series of SPL, for one model pixel or the spatial average (and max) of all pixels within the area of interest.

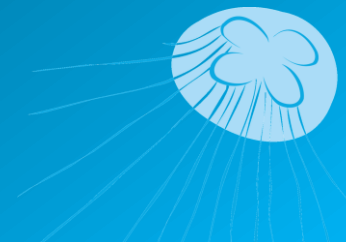
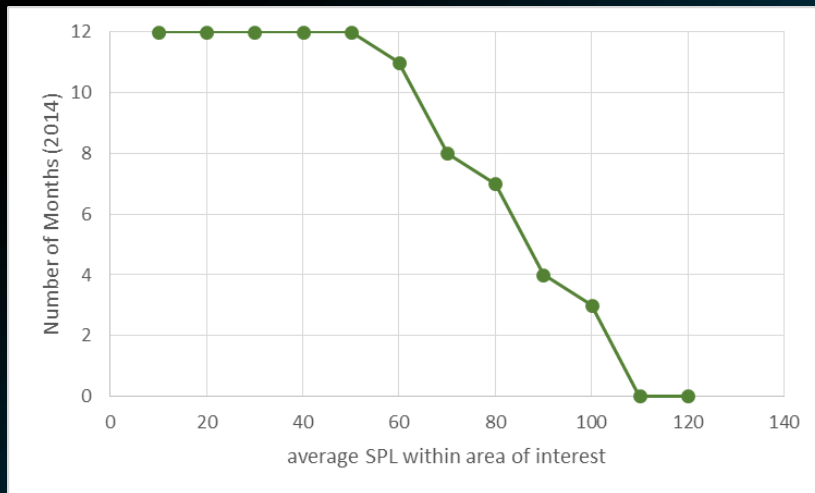


2D-interface functions (modelling data)

Graph2D-2: Time vs SPL for area of interest

For the selected frequency, depth level and statistical measure:

→ Number of months vs SPL exceeded, for one model pixel or the spatial average (or max) of all pixels within the area of interest.

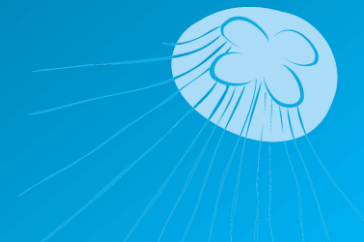
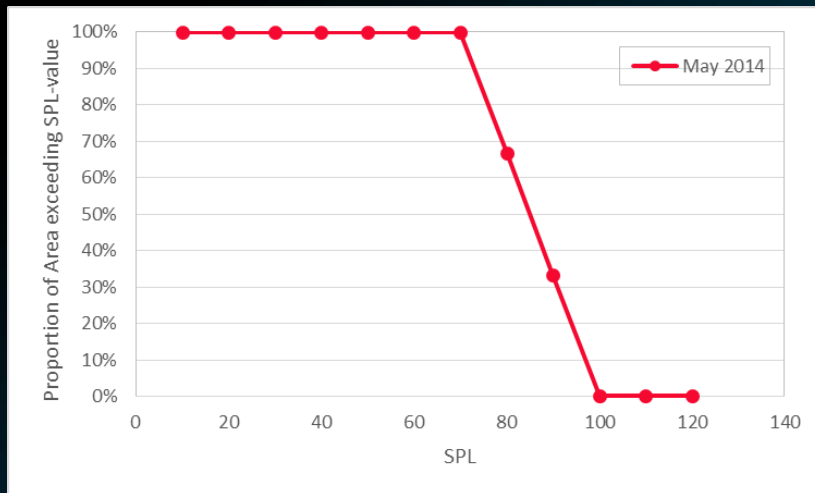


2D-interface functions (modelling data)

Graph2D-3: Area vs SPL, for one selected time period

For the selected frequency, depth level, statistical measure, and month(s)

→ Number of model pixels within the area of interest vs SPL exceeded, for one or more months.



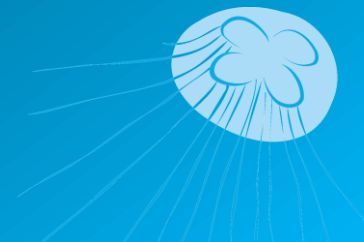
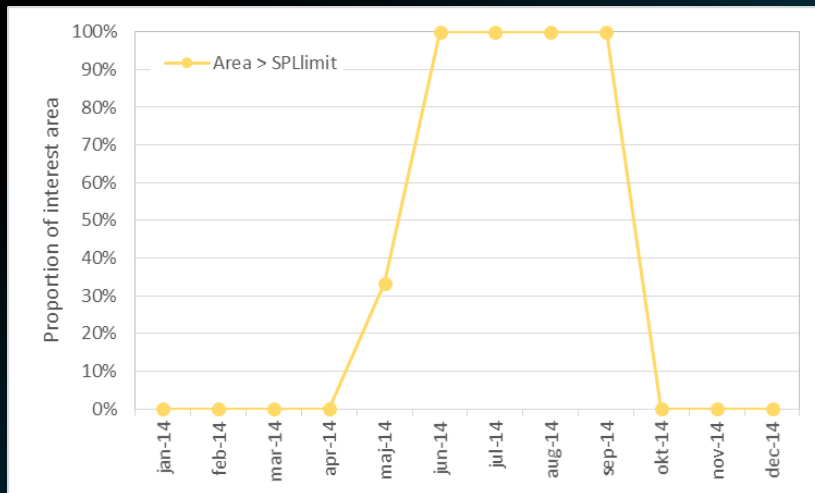
2D-interface function (modelling data)

Graph2D-4: Area exceeding SPL limit, vs time

For the selected frequency, depth level, statistical measure, SPL-limit

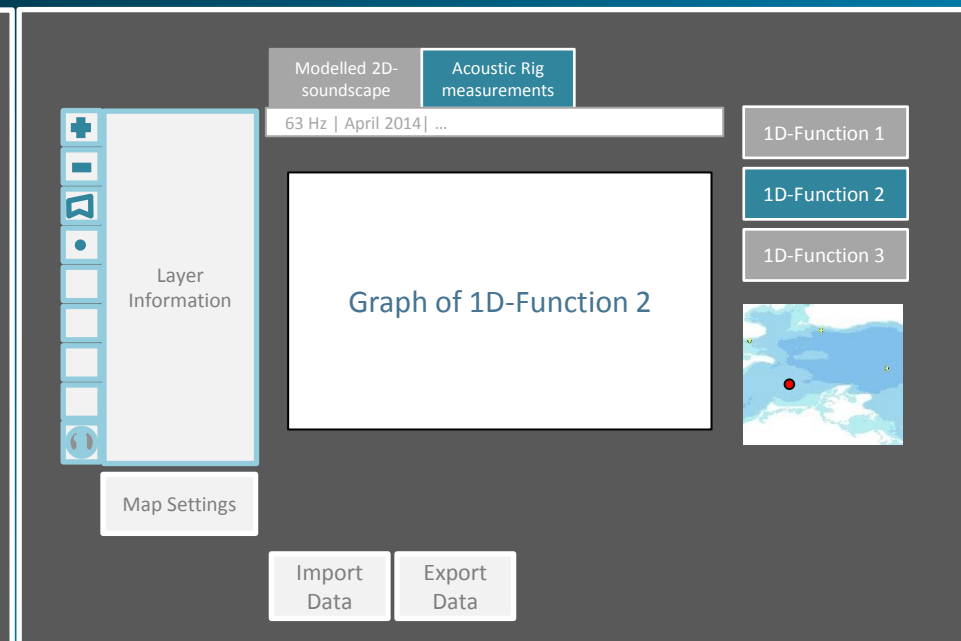
→ Areal percentage (or number of model pixels) within the area of interest, exceeding a certain SPL-limit, per month.

Needs SPL-limit to be specified by user/selected from species table (of hearing range, GES-level, etc)



BIAS GIS-based planning tool: 1D-interface features

- Selection of:
 - Rig Location
 - Frequency (63, 125, 2000Hz)
 - Time Period (months or years)
 - Statistics (arithmetic mean, median, 90th percentile, 10th percentile)
- Application of predefined functions/calculations for the data of the specified rig
- Acoustic measurement data should be provided, the least, as monthly and annual values (average + other statistical measures). Since the 20-sec “raw data” do not require so much space, we would also like to propose the use of measured 20-sec values



1D-interface functions (measurement data)

Graph1D-1: monthly averages of SPL vs time

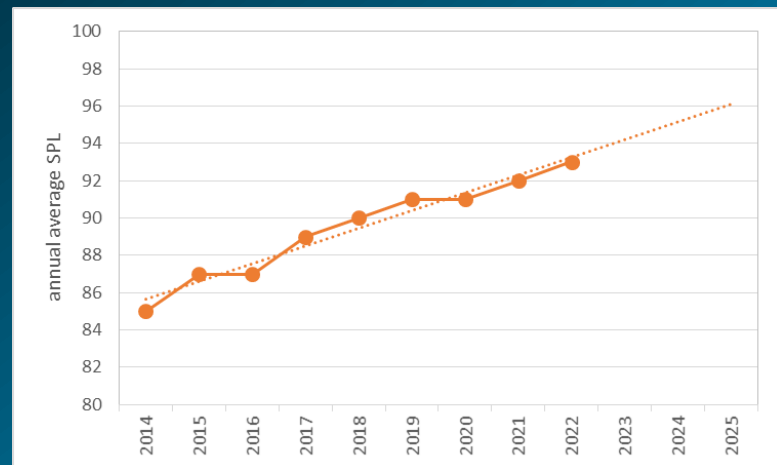
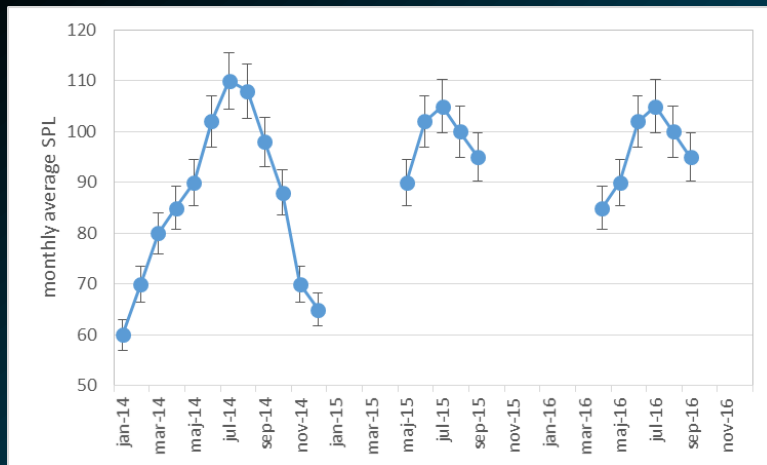
For the selected frequency

→ Time series with monthly values for the measurement point of interest. **Statistical measures (percentiles, 1-2 σ , etc) possible to add?**

Graph1D-2: annual averages of SPL vs time

For the selected frequency

→ Time series with annual values for the measurement point of interest. **Statistical measures (percentiles, 1-2 σ , etc) possible to add?**

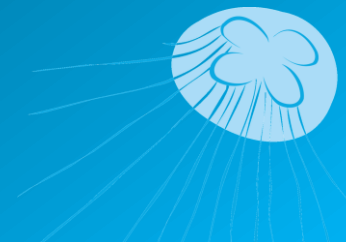
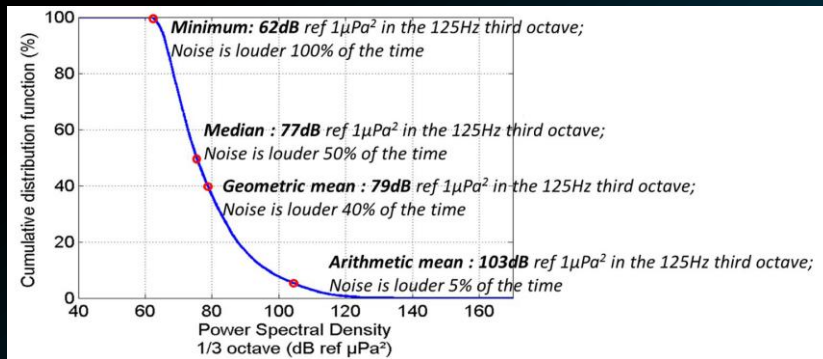


1D-interface functions (measurement data)

Graph1D-3 : monthly or annual exceedence SPL vs time

For the selected frequency, and time period (individual month or full year)

→ Cumulative distribution function based on 20-s averages at the measurement point of interest. Possible as long as 20-s averaged acoustic “raw” data are provided

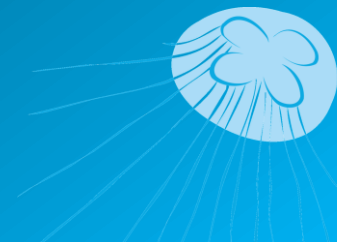


Summary: To what degree does the tool fulfil the forecasted needs of the managers?

The table below describes which of the above shown graphs that addresses each formulated management issue

Management Issue:	Tool graph/function:	G2D-1	G2D-2	G2D-3	G2D-4	G1D-1	G1D-2	G1D-3
A1. Annual average of noise levels at 63 and 125 Hz							X	
A2. Fluctuation in annual average of noise levels at 63 and 125 Hz								X
B1. Noise pressure in region of interest		X	X	X	X	(X)	(X)	(X)
B2. Monthly percentiles of ambient noise (63, 125, 2000 Hz) in regions of interest		X				(X)		
B3. Fluctuation in noise levels inside a year			X			X		
B4. Uncertainties is the noise level assessment						X	X	X

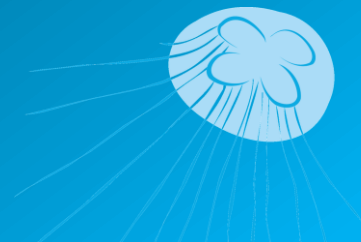
() : if rig available in region of interest



B4. Uncertainties of the noise level assessment

What do we mean with this? Should we consider:

- Time aspects (is the measurement period/duration representative of current conditions?),
- Spatial aspects (is the rig location appropriately chosen?)
- What are the measurement errors and precision?
- How well does the model resemble the measurements? Is there any kind of "automatic" values which are produced during modelling and which can be visualized in the tool?



BIAS GIS-based planning tool: uploading features

There are also a number of things to set for the process of uploading future data:

- Upload new rig measurement acoustic data (monthly and annual values): [Possible to what extent?]
 - Specifications of data formats and “products” possible to upload
 - Quality requirements and control
 - Metadata requirements and templates
 - Upload data to an existing position
 - Upload data for 63, 125, and 2000Hz
 - Upload data for new frequency
 - Upload data to a new position [define when a new position should be initiated]
 - Upload data for 63, 125, and 2000Hz
 - Upload data for new frequency
 - ...
 - ...
- Upload new soundscape modelling data [Future development (low priority for now?)]



Examples of similar existing tools or database interfaces:

- **HELCOM Data & Maps:** <http://helcom.fi/baltic-sea-trends/data-maps>
- **ESME;** Effects of Sound on the Marine Environment: <https://esme.bu.edu/index.shtml>
- **SeaGIS;** Ekosystembaserad planering av havsmiljön m h a GIS: <http://seagis.org/about/gis-baserad-kunskapsplattform/>
- **NordGIS;** A geographic metadata information system for high-latitude environments:
<http://www.nordgis.org/sites/about/about.php>

