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MSI

Underwater noise – knowledge base and pilot study results

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Background

MSFD GES Descriptor 11: introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment

Sound is a dominant feature of the underwater marine environment as a result of natural and anthropogenic sound sources

Anthropogenic sound sources of primary concern in underwater noise impact assessments are the activities that overlap in the frequencies with the hearing range of marine organisms

The organisms mainly affected are marine mammals and many fish species that use sounds for communication, foraging, avoiding predators and orientation

Background

The effects of noise in marine mammals depend on the distance from the source, species-specific sensitivity, sound exposure level, duration, work cycle and other factors

Anthropogenic sounds may be of short duration (e.g. impulsive) or be long lasting (e.g. continuous)

High amplitude, low and mid-frequency impulsive anthropogenic sounds include those from offshore constructions such as pile driving, seismic surveys, some sonar systems and explosions

Continuous low frequency sound is introduced into the marine environment mainly by shipping

Indicators

Impulsive sounds

The proportion of days and their distribution within a calendar year, over geographical locations whose shape and area are to be determined, and their spatial distribution in which source level or suitable proxy of anthropogenic sound sources, measured over the frequency band 10 Hz to 10 kHz, exceeds a value that is likely to entail significant impact on marine animals (11.1.1).

Ambient noise

Trends in the annual average of the squared sound pressure associated with ambient noise in each of two third octave bands, one centred at 63 Hz and the other at 125 Hz, expressed as a level in decibels, in units of dB re 1 µPa, either measured directly at observation stations, or inferred from a model used to interpolate between or extrapolate from measurements at observation stations (11.2.1)

Methodologies

Impulsive sounds

Spatial scales – 20 x 20 km blocks (should be harmonized between the neighbouring countries)

Temporal scales – days

Sound levels – should be agreed what are the most relevant type of loud sources that should be included; e.g. seismic sources, pile-driving, low and mid-frequency sonar and explosives; minimum treshold could be set, e.g. for sonars SL > 176 dB re 1 µPa m; for expolsions m_{TNTeq} > 8 g.

A registry has to be created where the information about the mentioned activities will be collected.

In order to calculate the number of days that in an area (block) a certain threshold (pulse) is exceeded the following information has to be collected: pulse-generating activity; day; location; source level.

Methodologies

Impulsive sounds

Once a register is set up, it should be possible to determine the spatial and temporal distribution of impulsive sound sources; e.g. Number of days when an area with a certain size is affected, e.g. from which animals may be displaced.

There is at the time insufficient knowledge to determine the amount of disturbance that would compromise GES. There are several options proposed:

* A target on the maximum allowable number of pulse-block days in an assessment area;
* A no-deterioration (i.e. stable or negative trends) target on the number of pulse-block days in an assessment area;
* A percentage target on the assessment area that is affected due to noise disturbance (i.e. at any given day less than x% of the assessment area is lost due to noise disturbance).

Methodologies

Ambient noise

There is still insufficient knowledge on the effects of (increased) ambient noise levels in the ocean to determine whether existing levels are too high or where GES is being achieved with respect to ambient noise.

To describe both GES and to determine trends in these sounds, actual levels are needed, and understanding of the spatial and temporal variations in levels is needed to identify an underlying trend.

The combined use of measurements and models (and possibly sound maps) is the best way to ascertain levels and trends of ambient noise in the relevant frequency bands.

Methodologies

Ambient noise

A limited set of monitoring stations per region/basin should be sufficient to satisfy the requirements of the indicator.

The monitoring should focus on shipping noise and individual ship noise assessment. A set of measurements from a point at an appropriate distance from a shipping lane can be combined with data on individual vessels (from a vessel monitoring system such as AIS) to provide data on source levels of vessels, which could then be used as input to models.

The averaging method for annually averaged noise level is the arithmetic mean of the squared sound pressure samples

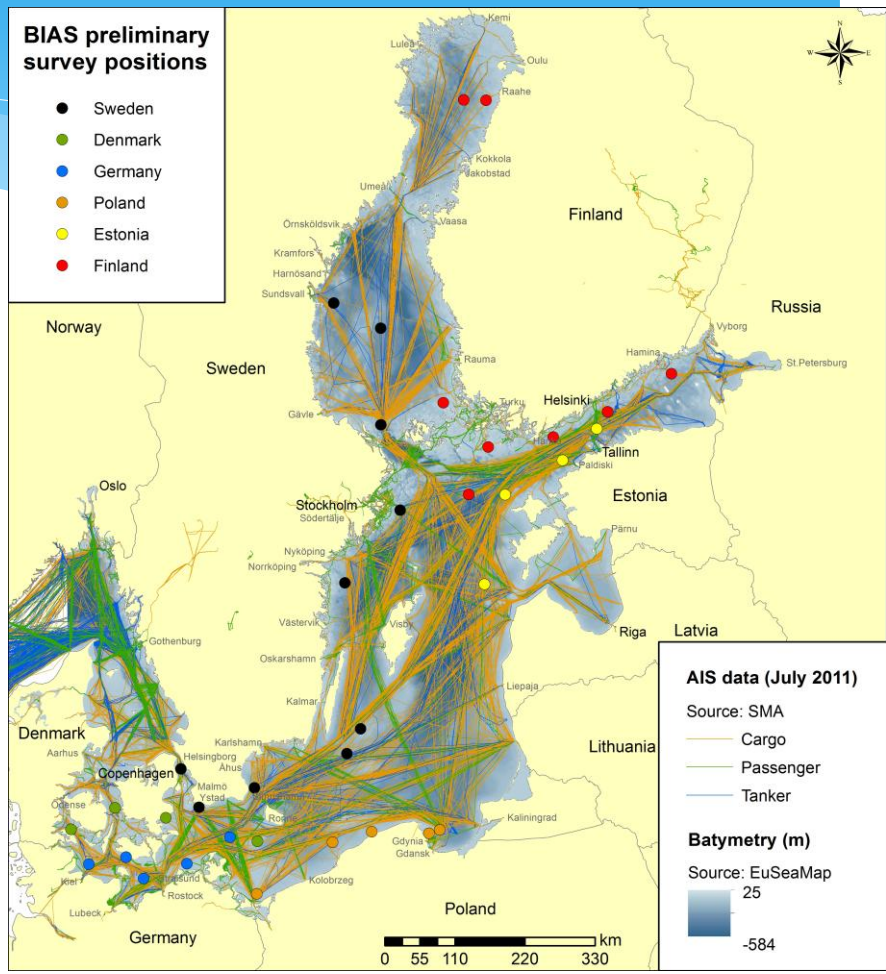
Methodologies

Ambient noise

It is suggested to start and conduct ambient noise measurements in 2014, as much as possible taking into account the BIAS project activities

In GES-REG area Gulf of Riga and Narva Bay, as well as arcipelago areas could be relevant

There exist certain recommendations for measurements sites, equipment; necessary calibrations etc have to be conducted



Aim of the pilot study

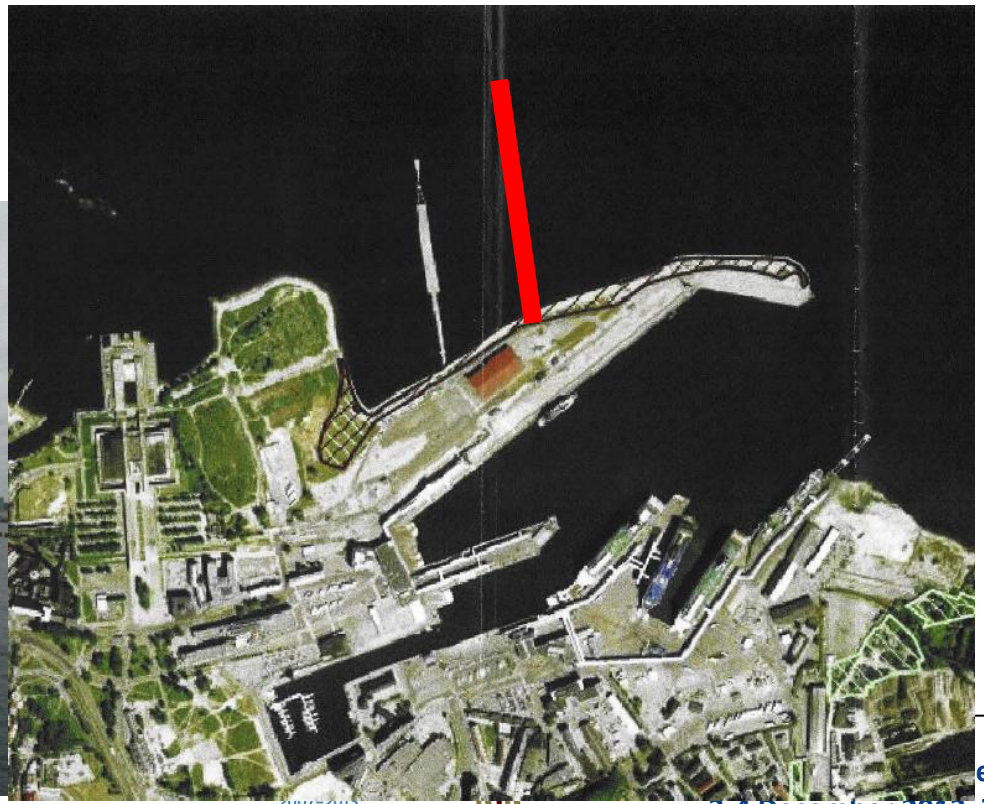
The main aim is to gain some experience in conducting underwater noise monitoring both for ambient noise and impulsive noise

The sub-tasks:

* Selection of equipment suitable for monitoring (frequency range, calibration of hydrophones, amplification, data storage capacities, power consumption, costs)
* Measurements of ambient noise in areas with high shipping activities and without shipping (what data can be acquired, procedures of data processing, how the results should be presented).
* Measurements of impulsive sounds at sites of offshore construction or harbour construction

Harbour construction

Vibroram Mueller MS-100H HF is the main tool, it's mechanical frequency is 26 Hz, it was expected to be the main source of the noise



Harbour construction

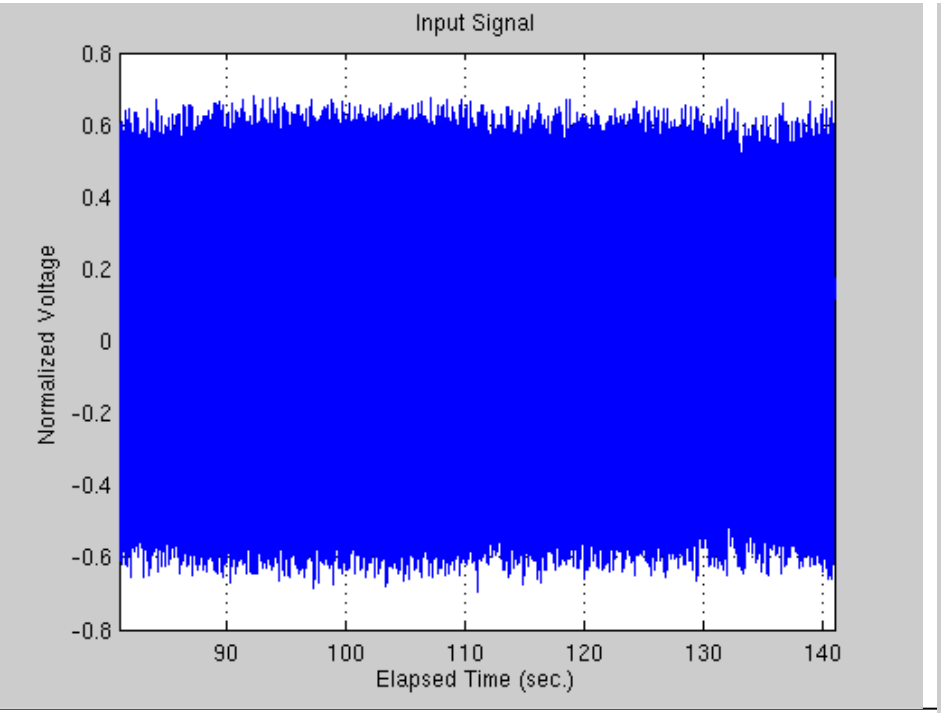
The task was to measure noise during the construction of the new quay in the old city harbour of the Port of Tallinn

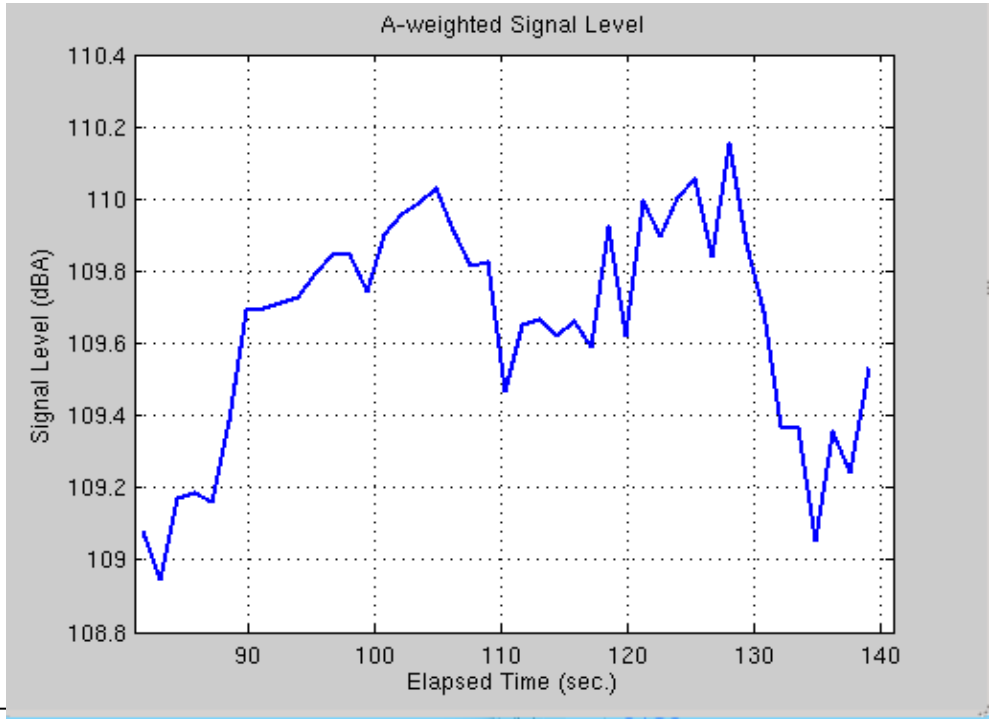
* The new quay is around 150 m long
* The measurement was performed from neighbouring parallel quay 150-160m away
* The depth was around 15-16 m between two quays
* Weather conditions with low wave activity selected
* If possible no marine traffic during the measurements

Data processing

Recorded data was calibrated using the known audio test files

Sound pressure levels for the water environment were computed

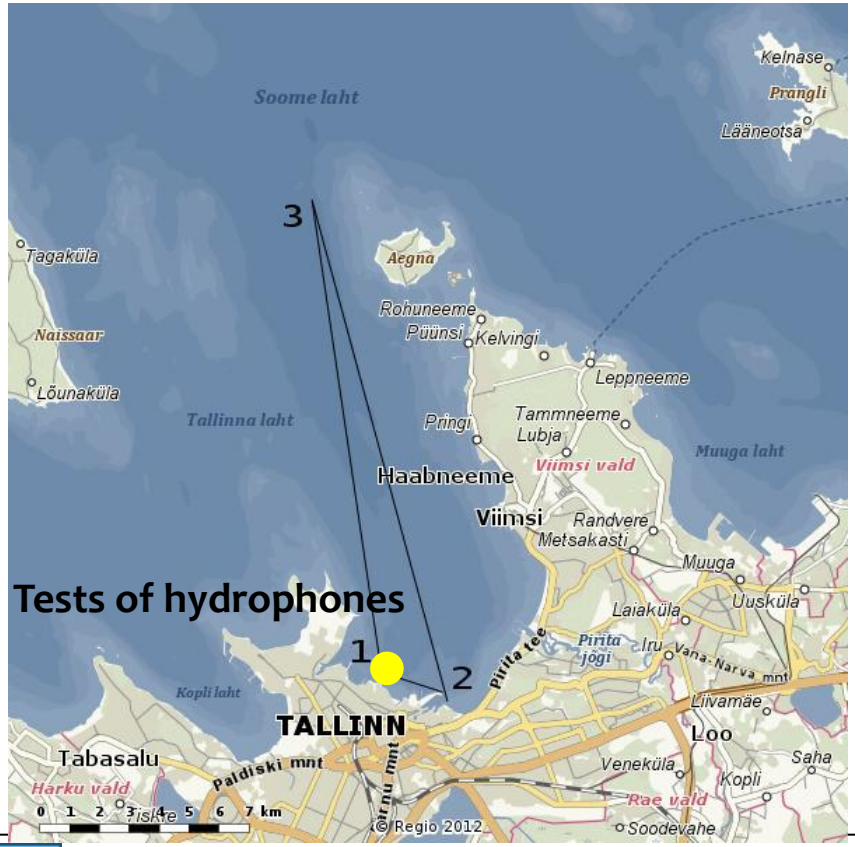


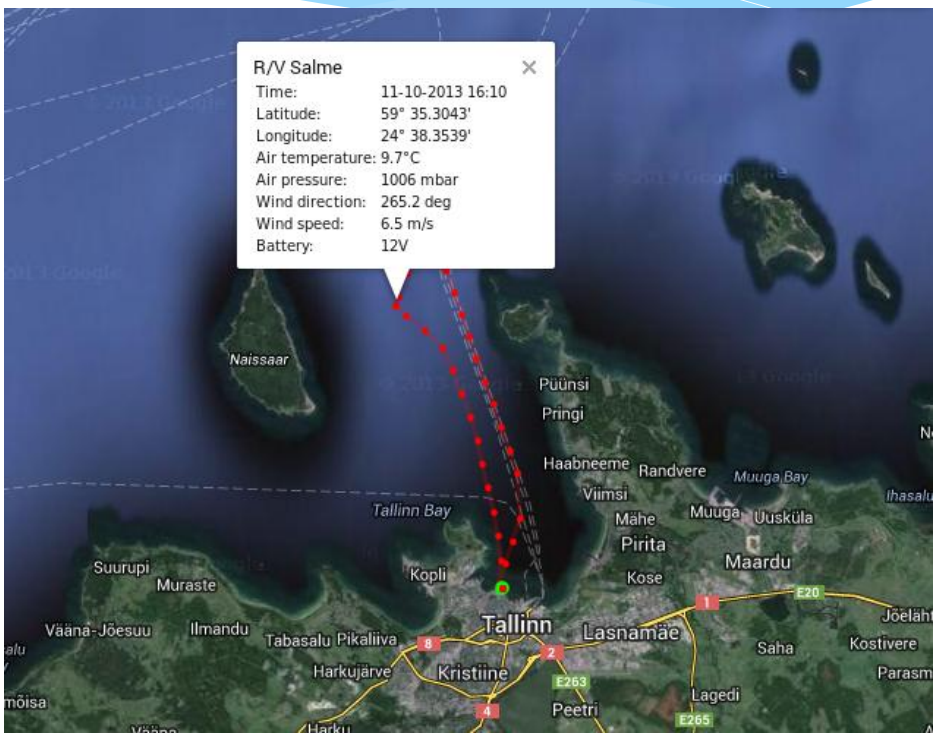


Ambient noise measurements

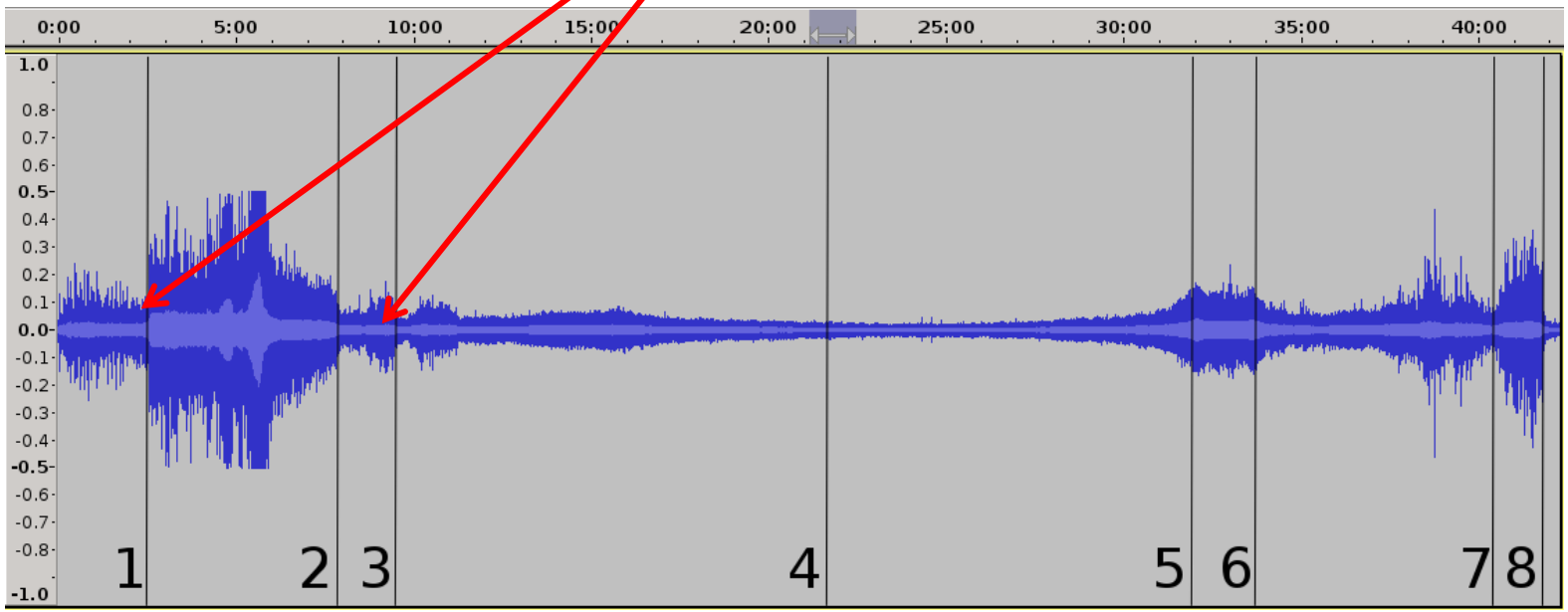
Laboratory calibrations, tests were conducted earlier in 2013

Successful deployment from 11-14 October 2013



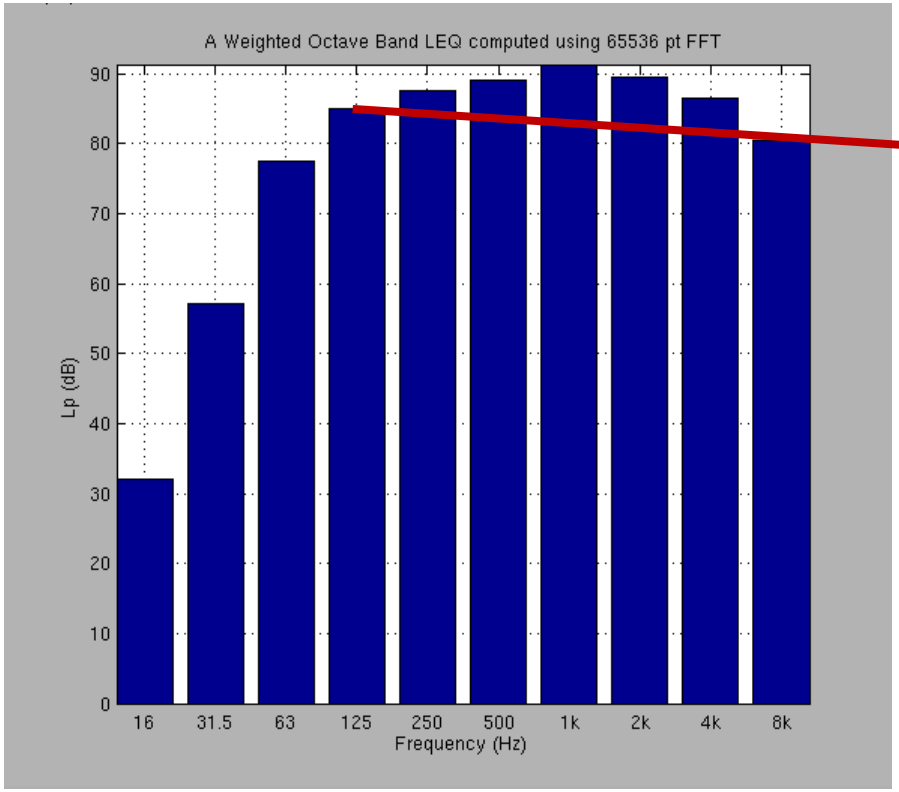


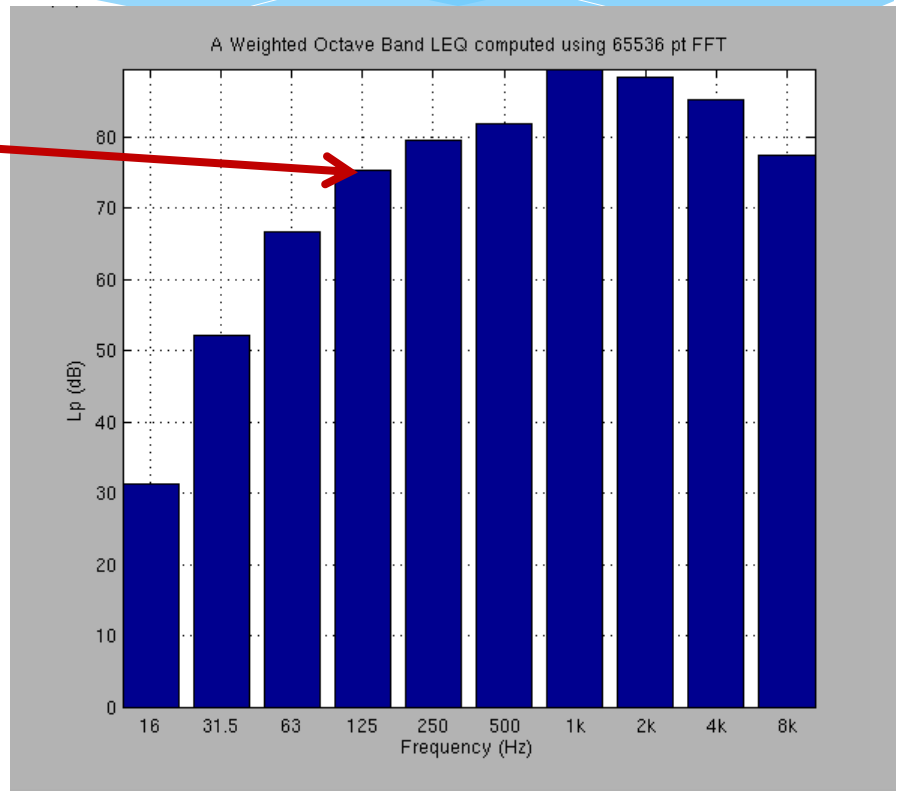
Test results



Pilot study results

Difference in pressure level spectra for in- and outgoing ship





Status and how to proceed

* Baseline data for ambient noise in a semi enclosed bay collected
* An outcome will be recordings of the signatures certain vessels measured at different distances (can be used for modelling taking information from AIS)
* Data analysis of monitoring of impulsive sounds conducted
* Recommendations for monitoring and assessment in regard of both indicators
* For GES and target settings impact studies still needed
* BIAS project for coordinated extensive measurements and modelling

Thank you for your attention

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