# UNDERWATER NOISE MAPPING METHODOLOGIES FOR SHALLOW WATERS

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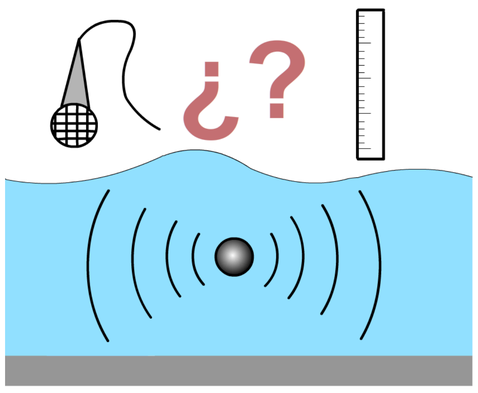
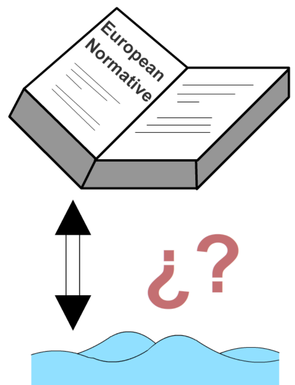
## 1. Motivation of the work

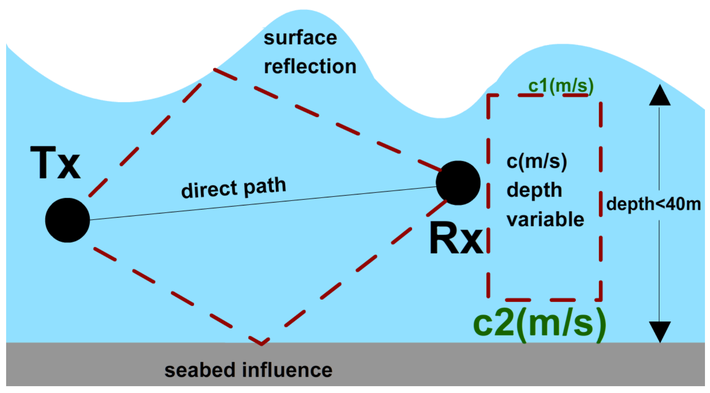



Methods for evaluation and quantification of underwater noise needed.




European Normative(2008/56/EC) asks for specific solutions but there's no standard answer. Evaluation of the good environmental status of the European waters is needed.


ECODRAGA experience calculating source level of a dredger. Environmental impact studies such as punta Langosteira blastings or Vigo harbor pilot driving.




Shallow water propagation is complex and less investigated, good examples in our area/location: multipath, depth variable speed of sound, influence of the bathymetry and seabed, etc.

## 2. Objectives

- **O1** Study and evaluation of the underwater noise measurement methodologies.
- **O2** Study and evaluation of the Propagation Losses calculation using both experimental and analytic models.
- **O3** Study and calibration of underwater noise prediction software.
- **O4** Characterization and classification of the different noise sources available in Ría de Vigo.
- **O5** Development of noise map construction methodologies.
- **O6** Construction of an underwater noise map of Ría de Vigo.

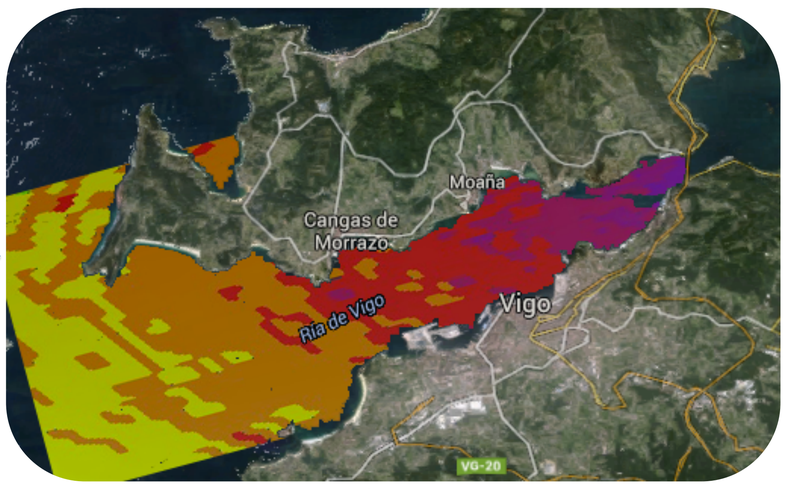



Figure 1: Ría de Vigo underwater noise map recreation

## 3. Research plan

**1** Study about the state of art of underwater noise measurement methodologies. Using databases as sciencedirect, scopus, WOK, etc.
**[Oct. 2015-Feb. 2016]**

**2** Evaluation of underwater noise measurement methodologies [1][2]. Experimental measurements in shallow water. Development of specific measurement protocols.
**[Mar. 2016-Jun. 2016]**

**3** Development of methods and protocols for calculating propagation losses based on experimental measurements. Field measurements with calibrated source .
**[Jul. 2016-Oct. 2016]**

**4** Underwater noise sources recording. Measurement of various sources of underwater noise in Ría de Vigo.
**[Jul. 2016-Ago. 2016]**

**5** Classification of the recorded sources. Creation of a detailed database in web format using data from sources measurements task. Study and evaluation of automatic classifiers. Development of an automatic classifier testing the usefulness of the database proposal.
**[Nov. 2016-Feb. 2017]**

**6** Study of software propagation models. Comparison of experimental and software propagation losses methodologies. Calibration of software models according to experimental measurements.
**[May.2017-Jun.2017]**

**7** Study of underwater noise mapping methodologies development. Evaluation of the usefulness of the models obtained in the previous tasks for the development of underwater noise maps, study of the uncertainty of the noise map data according to the uncertainty of the input data to the model.
**[Jul.2017-Agos.2017]**

**8** Development of underwater noise map of the Vigo estuary. Validation using field measurements.
**[Sep.2017-Feb.2018]**

**Next year planning… (3 to 6)** Focusing on the calculation of field propagation losses, underwater source database creation and study of software propagation models.
An article about the database will be send to Applied Acoustics some from 3 and 6 will be presented to UACE2017.

## 4. Results and discussion

Task 2 data have been obtained during Adricristuy dredger measurements session [3] in punta Langosteira harbor, A Coruña:

- A methodology to estimate the impact of dredging noise was established.
- A measurement set up and data processing were designed and successfully employed to provide received levels at different depths and distances from the source.
- A virtual image propagation model that considers source and receiver depths, sea depth and salinity, water and seabed density, and sound speed in both the water and in the sediment, is programmed to estimate the propagation losses, and adjusted to fit the measured levels at various distances from the source.
- Estimations of the source levels using estimated propagation losses were obtained.

These results have been presented at Internoise 2013 [3].
The most important research results are synthetized in figures 2 and 3:
-Figure 2 presents measurement setup used to provide reliable levels at different distances. Results pointed also that levels obtained at different depths (5m separation) can differ up to 10dB.
-Figure 3 shows the SL obtained for Adricristuy compared with other dredger measurements from [2]. As can be seen, the values obtained using our methodology differ considerably with other measurements. Causes of these differences could be:

- Our propagation model is too simple and underestimates propagation losses.
- The other ships have bigger dimensions than our dredger,

As a conclusion, a more sophisticated model for sound propagation will be tested.

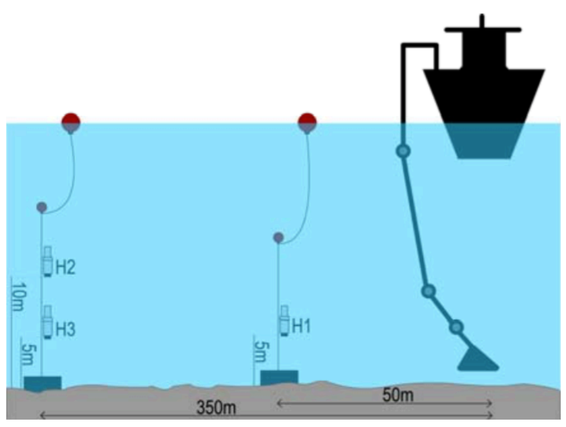



Figure 2: Measurement setup tested

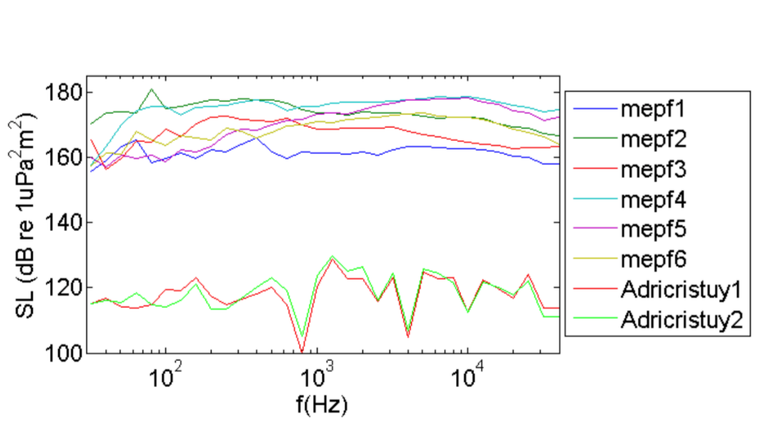



Figure 3: SL results comparison

## 5. References

[1] ANSI/ASA S12.64-2009/Part 1, "Quantities and Procedures for Description and Measurement of Underwater Sound from Ships - Part 1: General Requirements", American National Standards Institute, New York, (2009).
[2] S P Robinson, P D Theobald, G Hayman, L S Wang, P A Lepper, V Humphrey, S Mumford, "Measurement of noise arising from marine aggregate dredging operations, Final Report. MALSF (MEPF Ref no. 09/P108)", Published by the MALSF, ISBN 978 0907545 57 6 (2011).
[3] Soledad Torres-Guijarro, Manuel Sobreira-Seoane, David Santos-Domínguez and Antonio Pena, "Evaluation of underwater dredging noise", 42nd International Congress and Exposition on Noise Control Engineering (Internoise 2013), Innsbruck, Austria, September 2013.