

# The Effects of Noise on Aquatic Life: Seismic survey risk assessment on common dolphins in the south-western coast of Portugal

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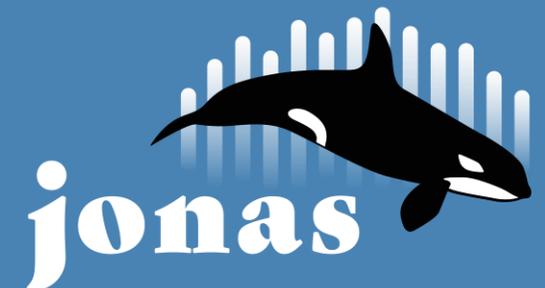
Contact: [gspadoni@ualg.pt](mailto:gspadoni@ualg.pt)

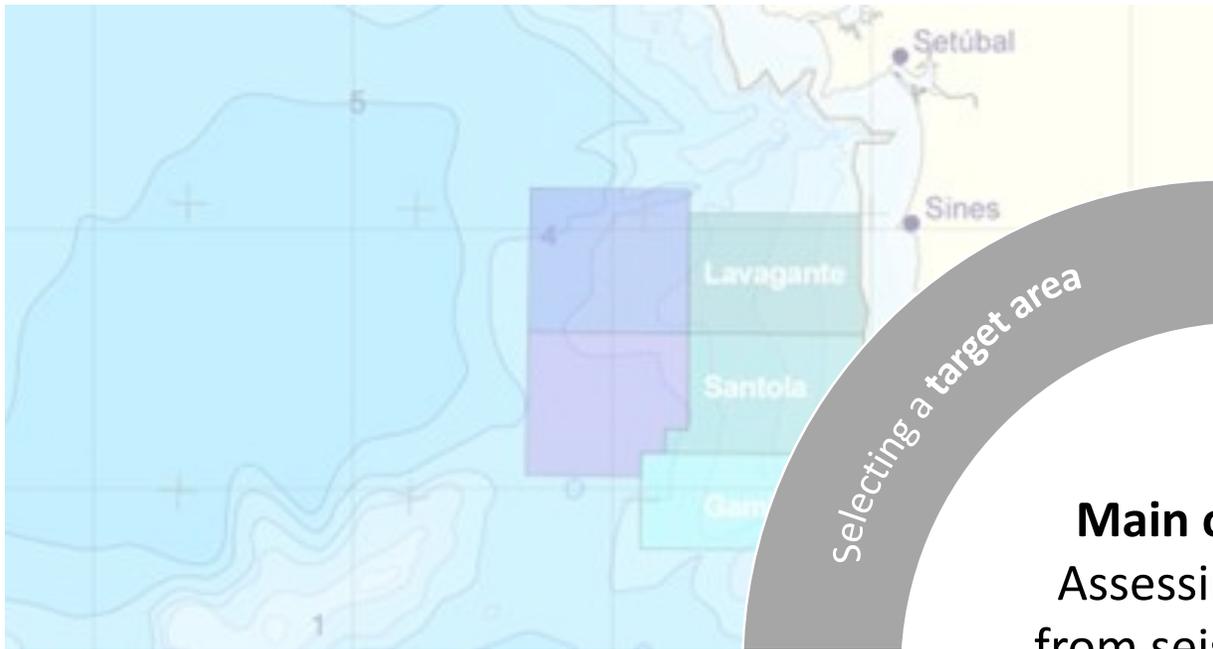
ASCOBANS Common Dolphin meeting  
January 9<sup>th</sup>-10<sup>th</sup> 2024



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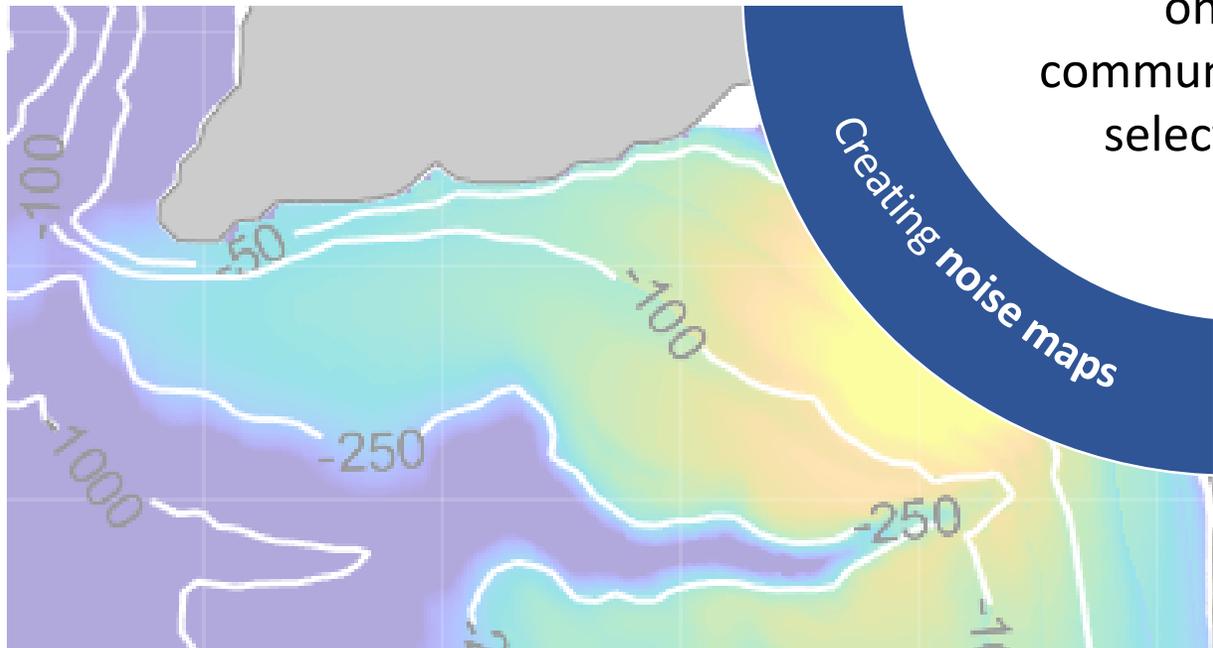


Selecting a target area

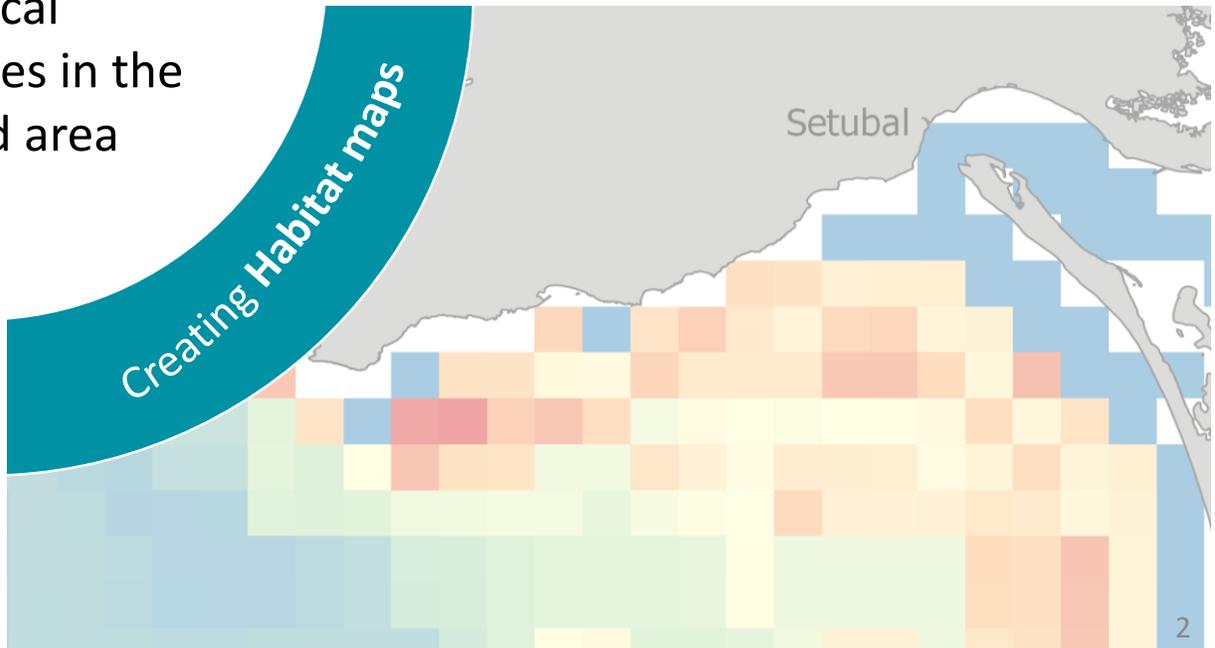


Select a target species

**Main objective:**  
Assessing the **risk**  
from seismic survey  
on local  
communities in the  
selected area



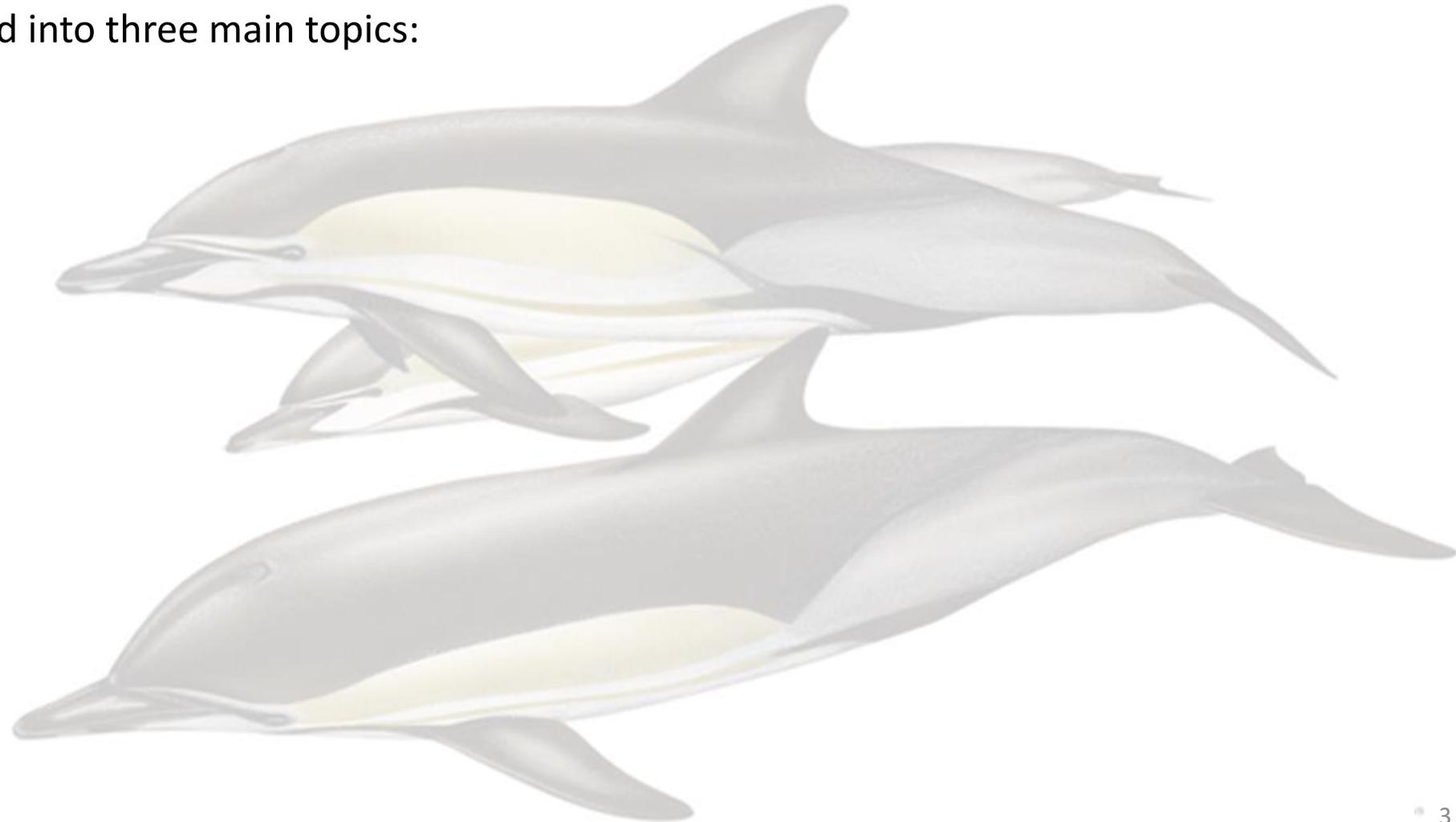
Creating noise maps



Creating Habitat maps

Presentation content divided into three main topics:

- ▶ **Noise**
- ▶ **Species**
- ▶ **Risk**

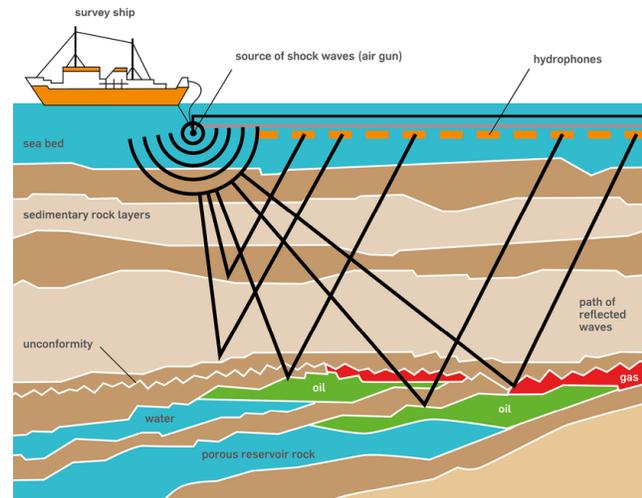


# Seismic survey

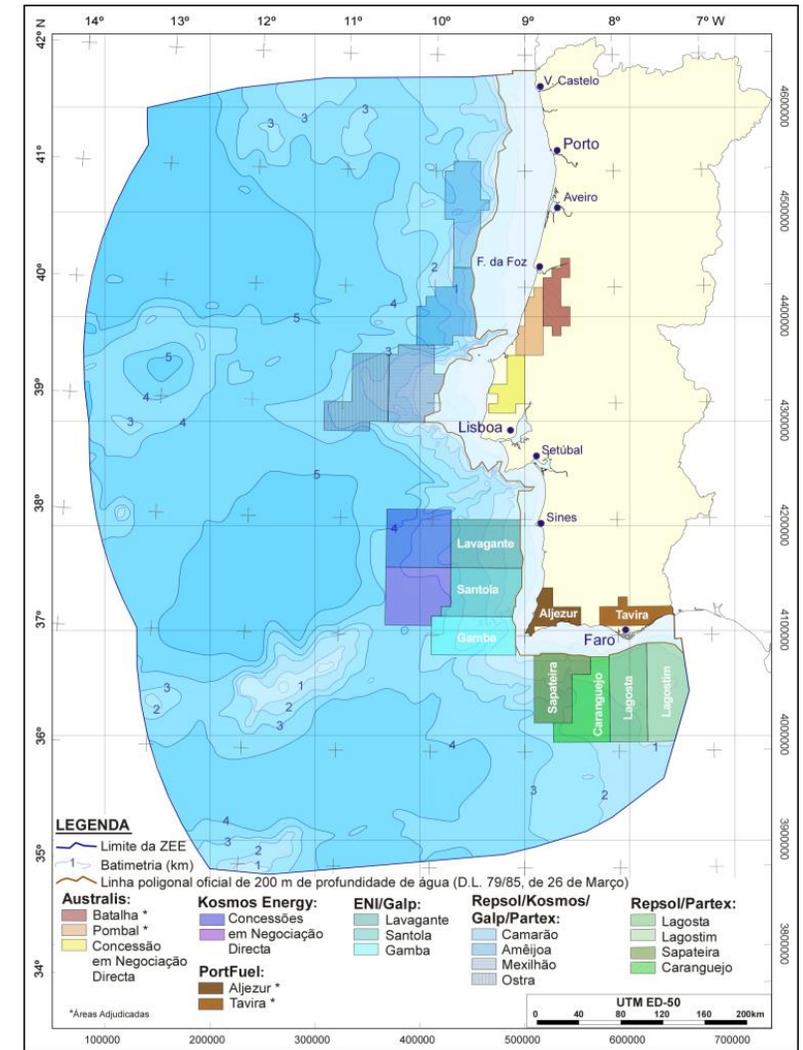
- **Seismic survey:** oil and gas exploration
- The case of the **coast of Portugal**
- Environmental conditions for **wind energy** exploration



Wind farm (source: TebNad/Shutterstock.com)



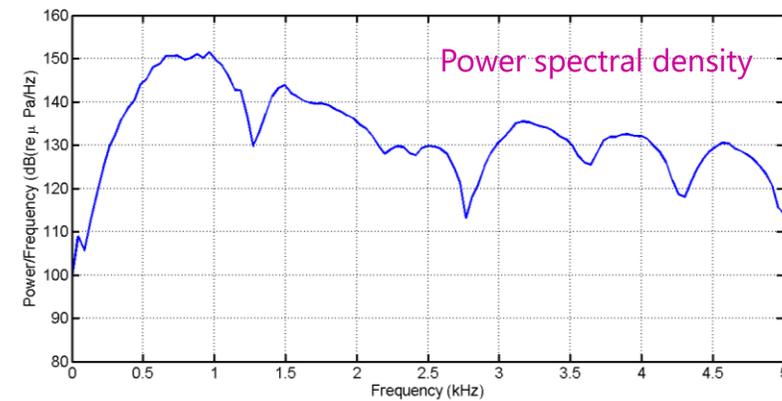
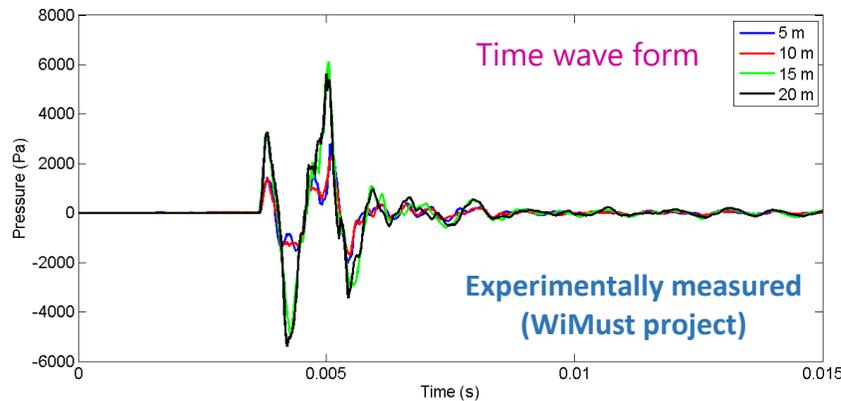
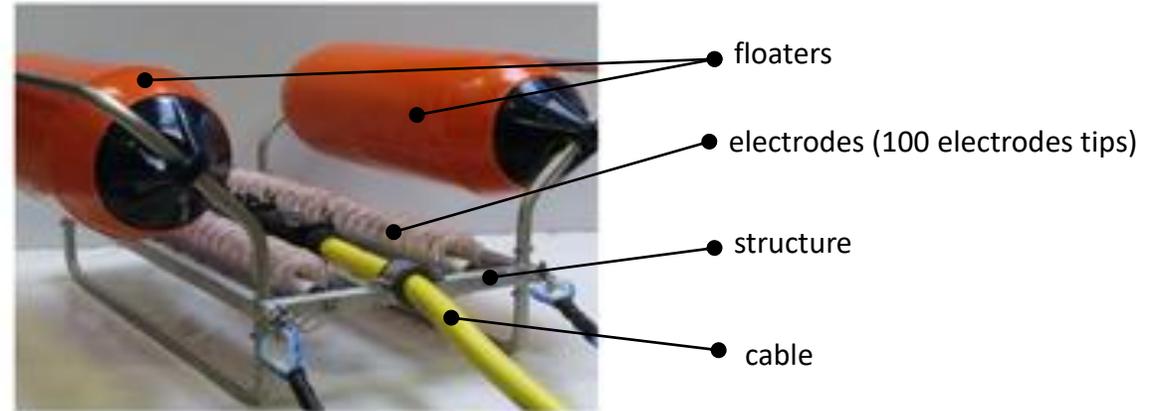
Seismic survey experimental setup (source: Kukreja et al. 2017)



Oil and gas exploration concessions in the Portuguese coast (source: [www.geoexpro.com](http://www.geoexpro.com))

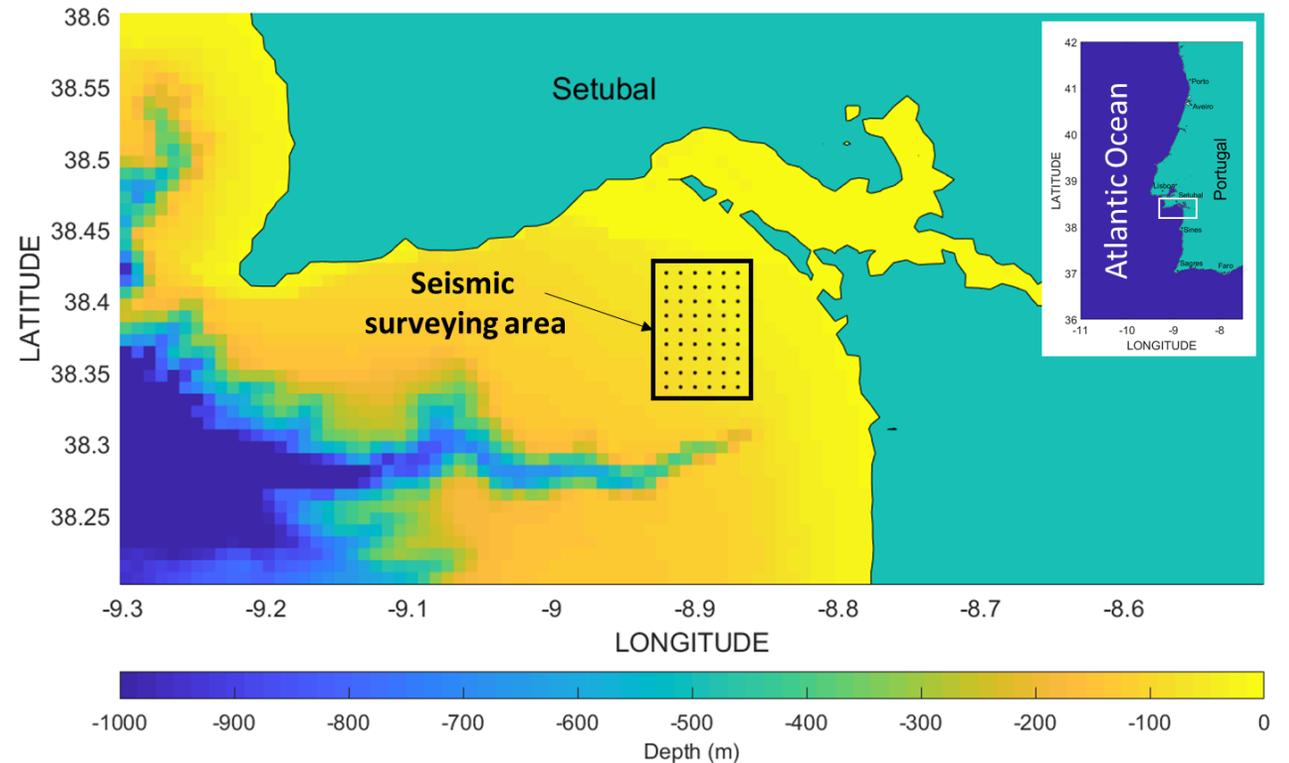
# ))) Light seismic survey

- **Light seismic survey:** wind farm installation
- **Shallow water** environment
- **Sparkers** (since they are the most used)
- **GEO-Source 200** as reference\*



# ))) Seismic survey modeling

- Location: **Setúbal** [Lat: 38.2; 38.6] x [Lon: -9.3; -8.5]
- **Challenging bathymetry**<sup>1</sup> of the area: (1km x 1km resolution)
- Period: **January and June 2019**
- **Sound speed profiles** calculated from Temperature and Salinity profiles<sup>2</sup>
- Assumed typical **seabed** parameters<sup>3</sup>(sediment layer + rocky semi-infinite sub-bottom)



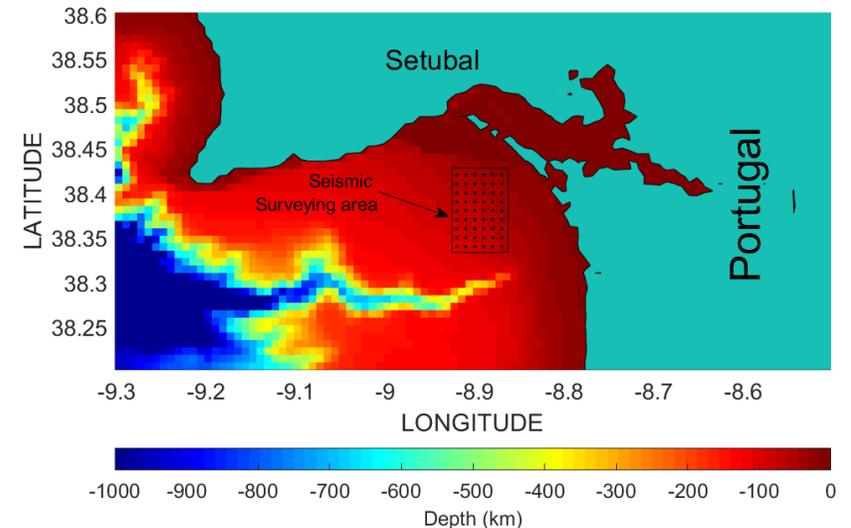
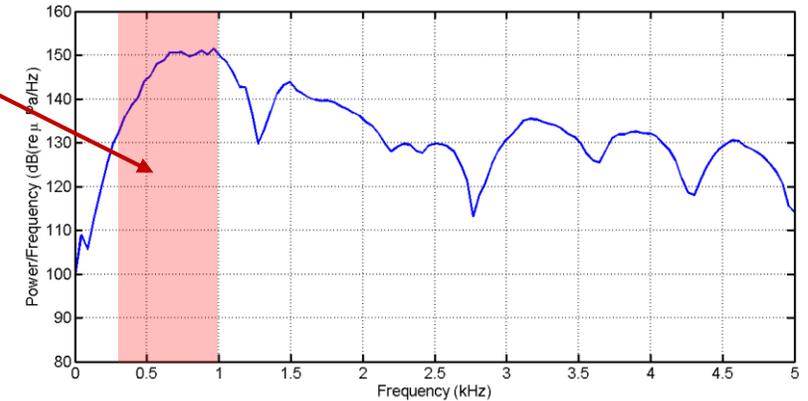
<sup>1</sup>GEBCO database: <https://www.gebco.net/>

<sup>2</sup>Source: CMEMS-Copernicus Marine Service

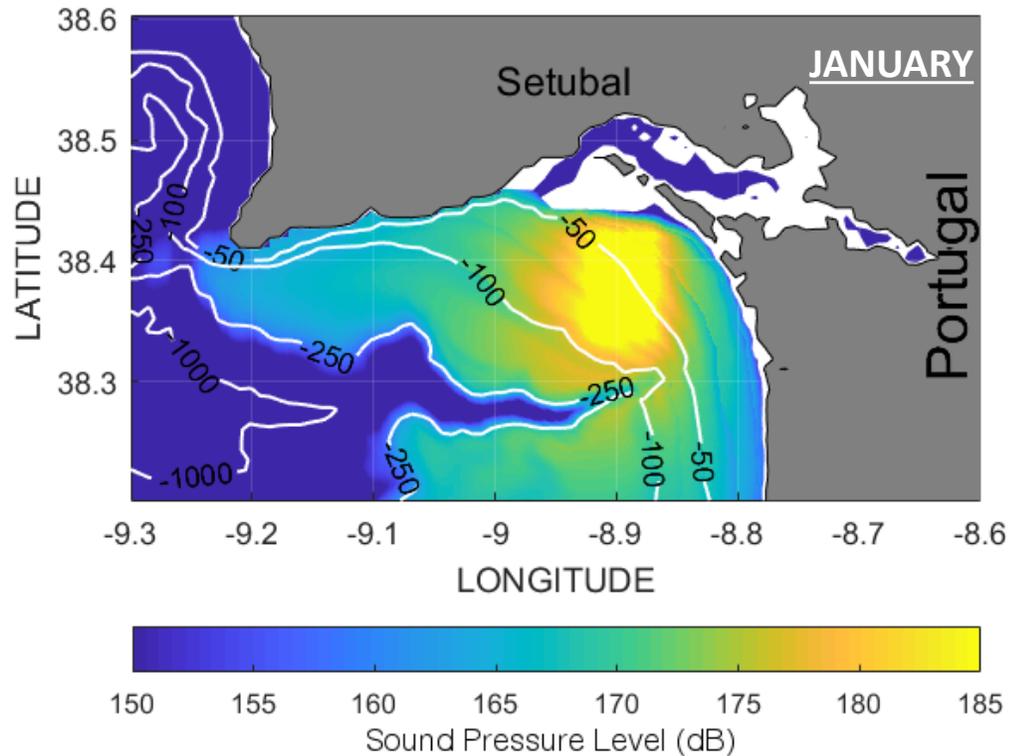
<sup>3</sup>C. Soares, F. Zabel, and S. M. Jesus, "A shipping noise prediction tool", 2015

# Seismic survey modeling (cont...)

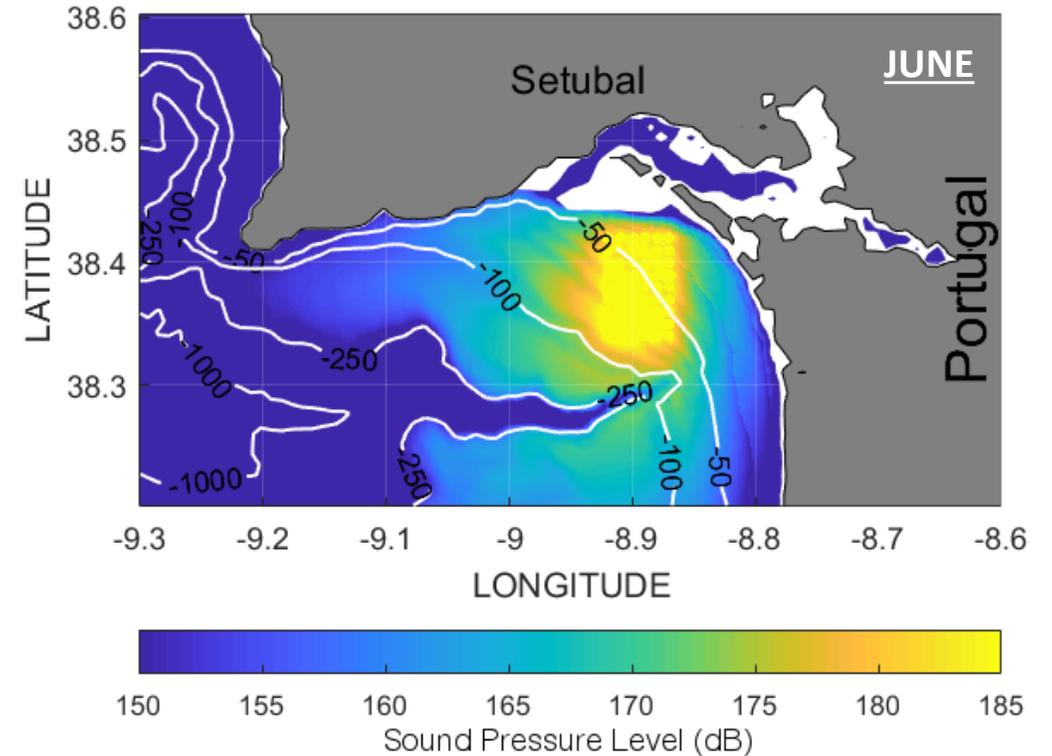
- GEO-Source200 Sparker: frequency range **300 - 1000Hz**
- Source level **220dB**
- **Depth: 1m; firing interval: every 5sec**
- **Analyzed area 50km<sup>2</sup> [-8.92;-8.87]x[38.34;38.42]**
- **Source movement: lawn-mower pattern**
- For modelling, receivers placed at: 5, 15, 30, 50, 75, 100m depth



# Noise Maps



- Results expressed as **SPL**;
- Extremely high dB (185dB in some areas);



- Influence of the **bathymetry** (250m);
- Larger spread in January (**seasonal**).

# ))) Modeling the Portuguese coast's biodiversity

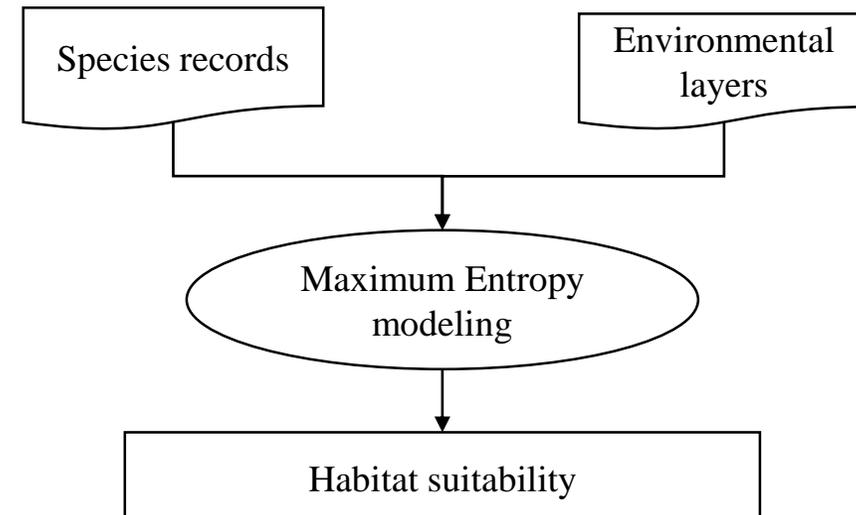
- Biodiversity in Portugal: **cetaceans**
- Target species: **common dolphin;**
- Chosen as a representative of the small cetaceans and MF/HF cetaceans;
- **Maximum Entropy model\*** developed for the entire Portuguese coast.



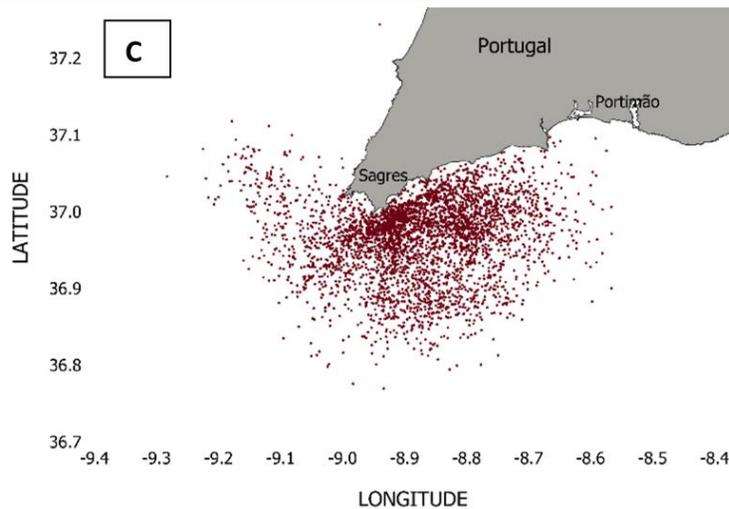
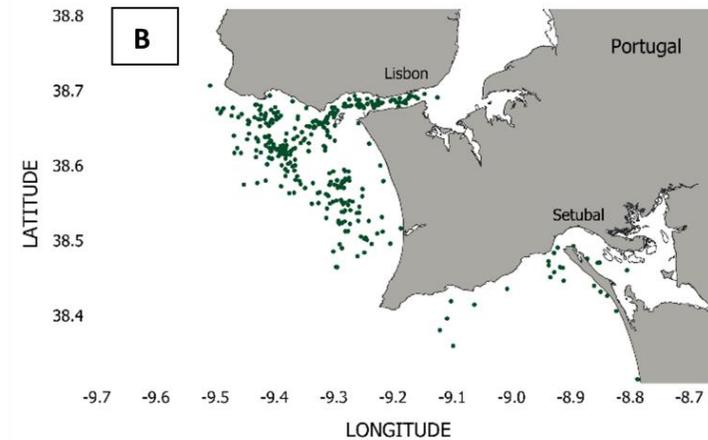
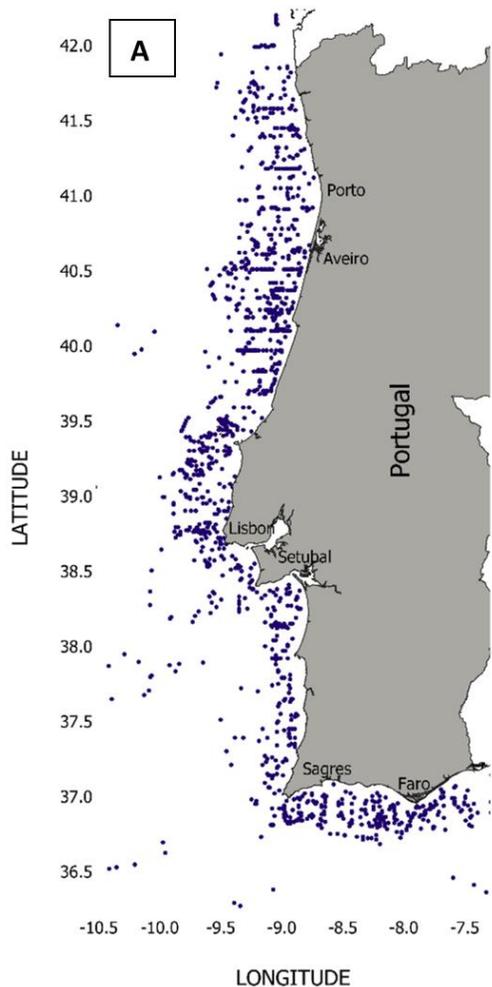
The common dolphin (*Delphinus delphis*)



Whale watching touristic activity



# ))) Modeling inputs for Maxent



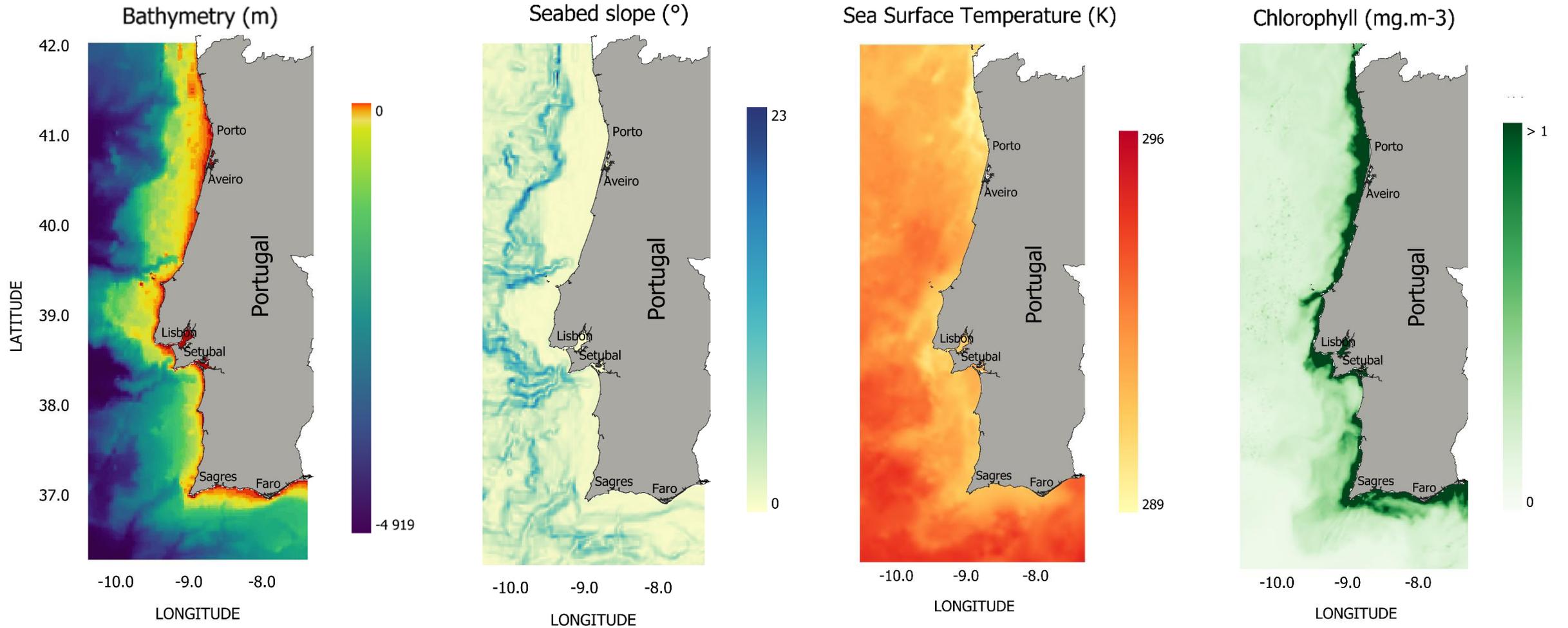
## Observations data

- A. **SPEA**, Portuguese Society for the Study of Birds [2005 – 2020]
- B. **SeaEO tours** [2018 – 2019]
- C. **Marllimitado** [2005 – 2020]

## Environmental layers

- **Terrain variables:** Depth; Seabed slope.
- **Oceanographic variables:** (2005 - 2020) Sea Surface Temperature (SST); Chlorophyll-a; Standard Deviation of the Chlorophyll-a.

# ))) Modeling inputs for Maxent



NOAA, ETOPO 1 Global Relief Model<sup>1</sup>

Calculated on QGIS 3.18

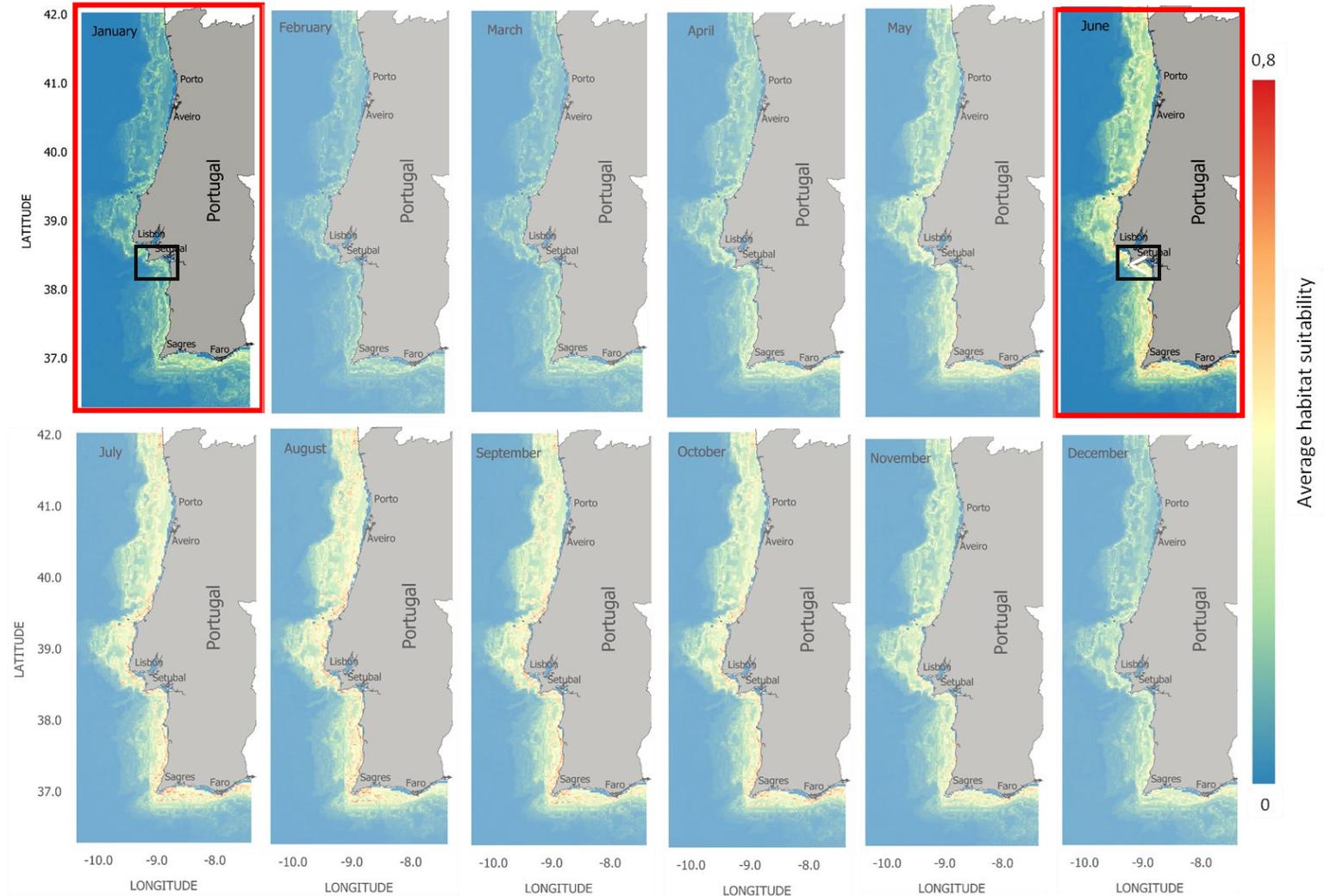
Copernicus Marine System<sup>2</sup>

Copernicus Marine System<sup>3</sup>

1. <https://www.ncei.noaa.gov/maps/bathymetry/>  
2. <https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-slstr/level-2/sea-surface-temperature-ghrsst>  
3. <https://cds.climate.copernicus.eu/cdsapp#!dataset/satellite-ocean-colour?tab=overview>

# Habitat Suitability Maps

- High HS values along all the coast of Portugal;
- **Summer** season presents the highest HS values;
- Areas with **low depth**.



# Habitat Suitability Maps

- Zoom from previous maps for the region of **Setúbal**

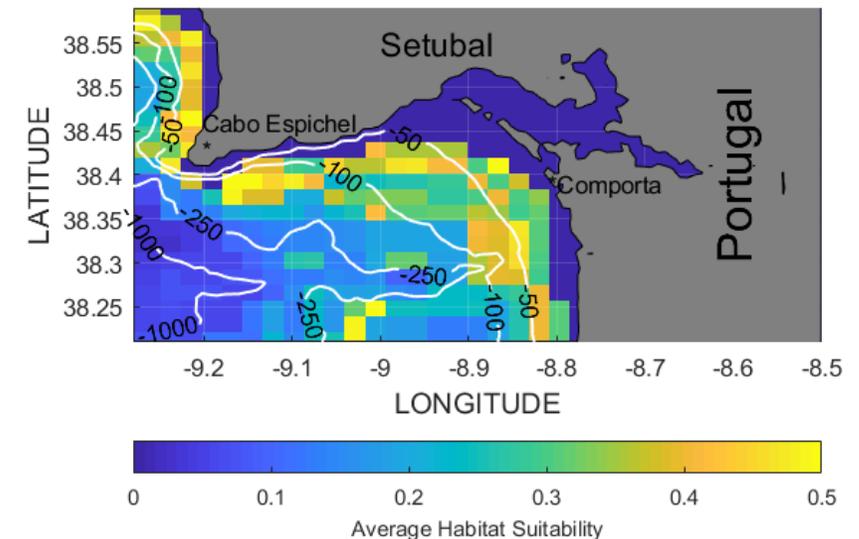
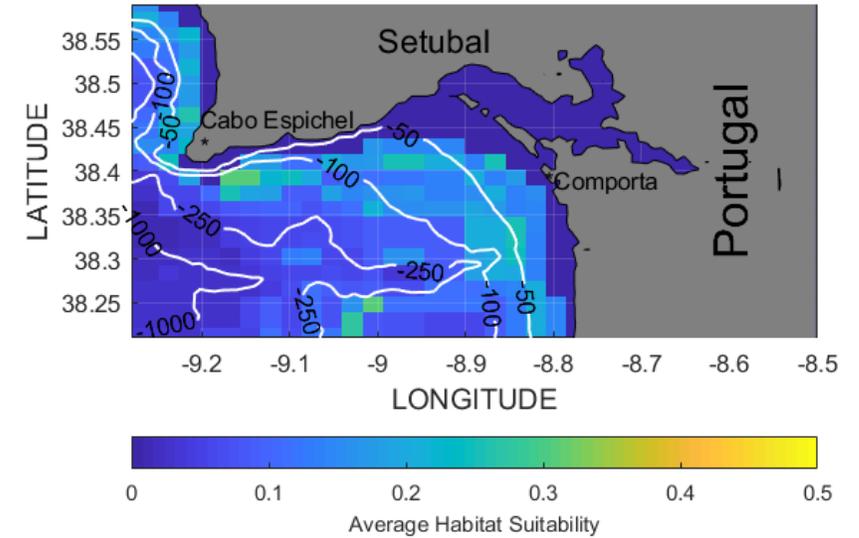
JANUARY

- Higher habitat quality in **June** than in January;

- Higher in areas with **low depth**;

- Higher near Comporta and Cabo Espichel.

JUNE



# ))) Risk Assessment

- **Typical approaches:** Erbe 2014<sup>1</sup>, Merchant 2018<sup>2</sup>, Verling 2021<sup>3</sup>

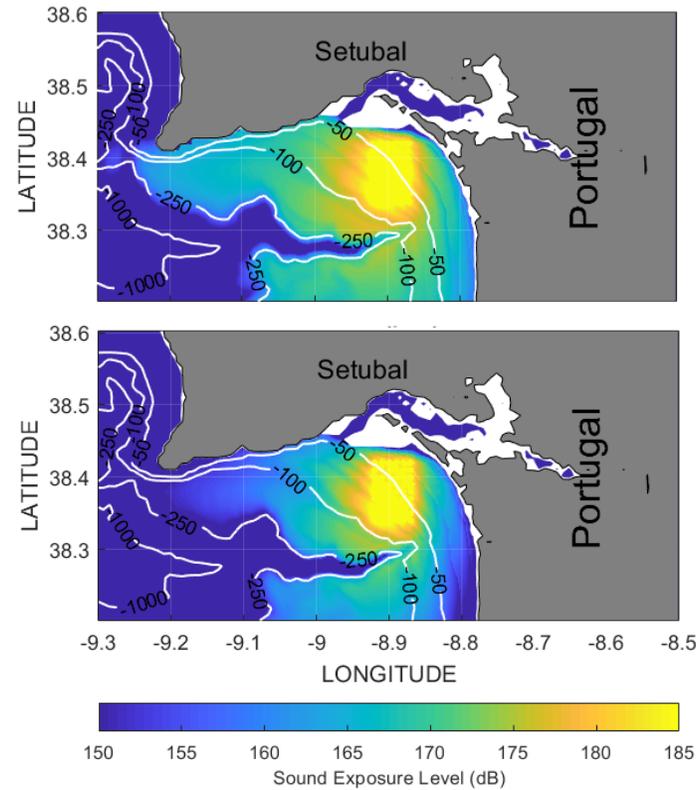
- Applied methodology: **Erbe 2014**

- The Effects of Noise on Aquatic Life: “Assessing Risk of Noise Pressure on Marine Life Using Bayes Estimator”

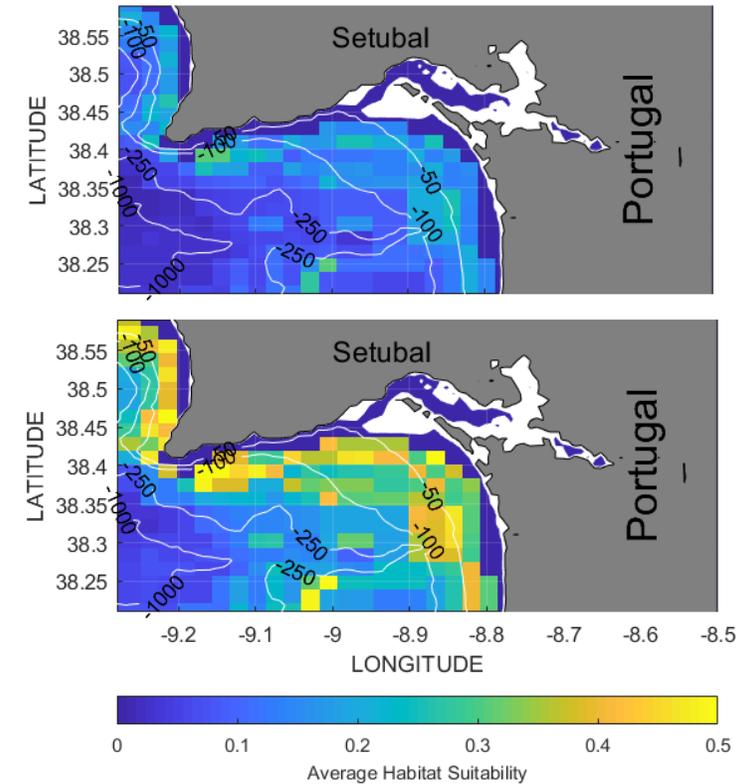
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Noise



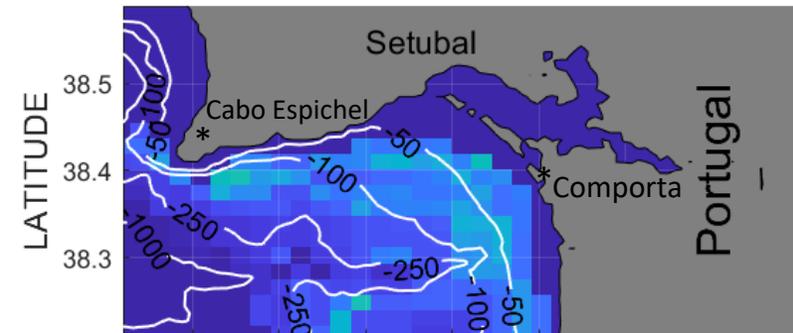
Habitat Suitability



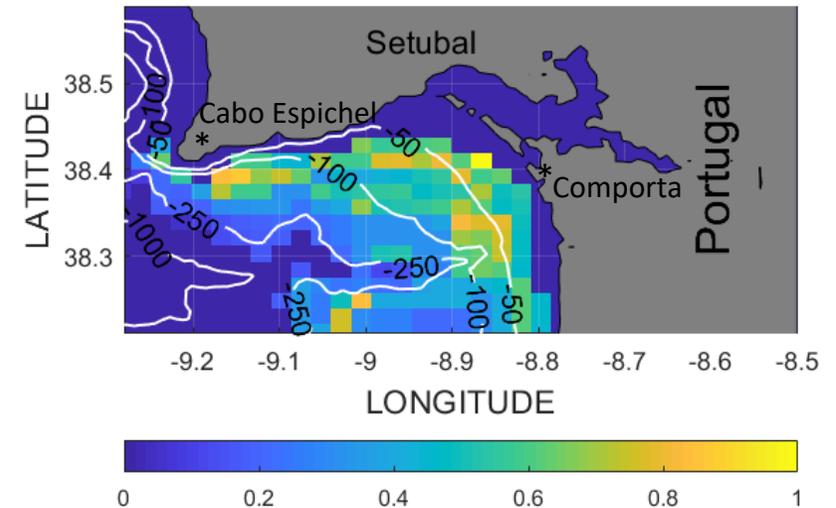
# ))) Risk Maps

- **Risk analysis: temporal and spatial variation**
  - **Habitat Suitability** higher in June and in costal areas
  - **Noise** less dissipated in June and higher values in shallow waters
- Sensitivity until the bathymetric line of 250m: ecological importance
- **Comporta and Cabo Espichel**

JANUARY



JUNE



## »» To conclude

- Sound propagation and species distribution depend on the **season**;
- They have an influence on risk;
- **Evaluation of the HS** before starting a seismic campaign recommended;
- Months less “harmful” than others

**Upcoming publications: *Common dolphin’s shipping noise risk assessment on the Portuguese coast.***

# THANK YOU FOR THE ATTENTION!

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