Linking Sperm Whale Azimuth to Maritime Traffic Using a Stereophonic Acoustic Array

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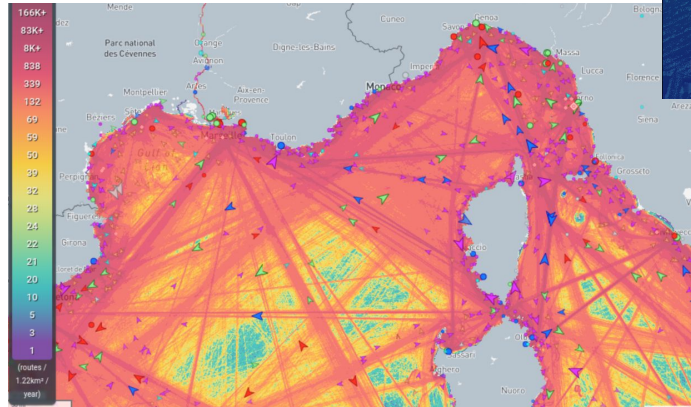*3 Longitude 181*
4 University of Pavia, Italy
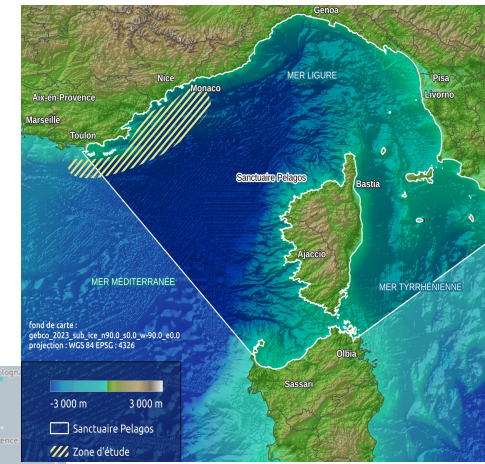*5 Chaire IA AID DGA ADSIL ANR-20-CHIA-0014*

State of the Art

◢ *Shipping activity*

◇ Around 80% of global trade carried by sea

◇ Marine traffic is expected to increase by **4% per year**

◇ **15%** of global shipping activity concentrated in Mediterranean Sea

Map of Pelagos sanctuary
© Chavin

Map of marine traffic density in Mediterranean Sea in 2022
© MarineTraffic

State of the Art

◢ *Noise pollution*

◇ Most ubiquitous and pervasive source of anthropogenic noise in the oceans

◇ Steady rise in ambient noise in low frequency (<500 Hz) (up to 3 dB/decade)

◇ Anthropophony → change behaviour, impair hearing capacity, communication and ability to detect threats or preys
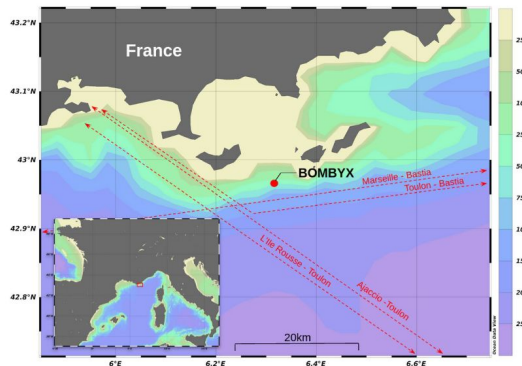

Spectrogram of boat noise, Norway, 2023-15-01 13:01

COMMUNICATION   PREDATOR PREY INTERACTIONS   GROWTH AND REPRODUCTION
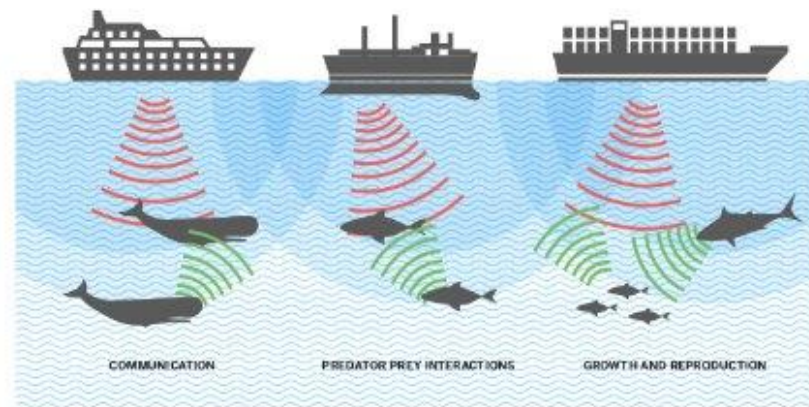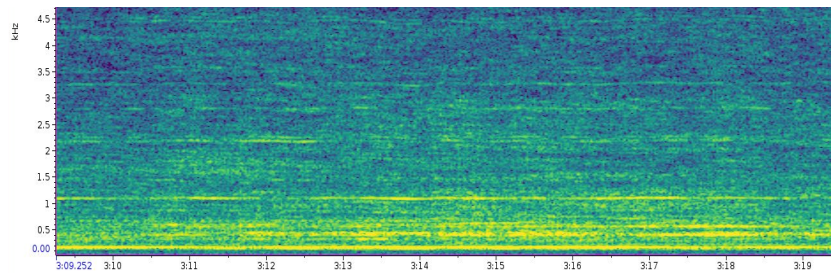
State of the Art

◢ *What has been done*

◆ Bombyx 1 – Acoustic recordings

◆ Two peaks of ambient noise

◆ Acoustic activity of sperm whale when ambient noise is lower

→ **Lack of AIS data**

Bathymetric map of the region showing the geographic location of the BOMBYX buoy and the ferry's trajectories (red lines). Poupard et al. 2022
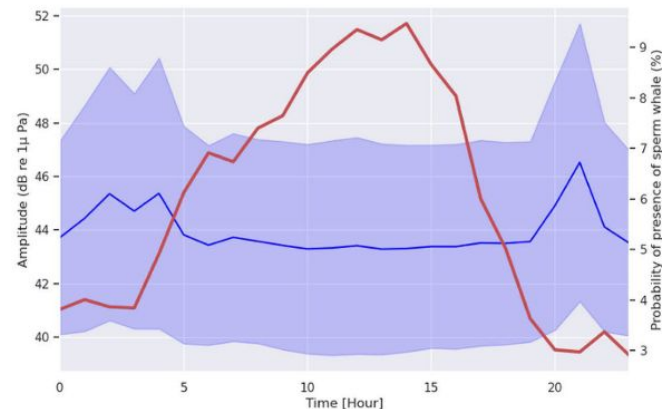

Superposition of diel pattern of amplitudes for the octave 12,800 Hz and probability of presence of sperm whales. Poupard et al. 2022

◢ **Objectives**

Following the purchase of AIS data, an in-depth analysis of BOMBYX 1 data is currently underway.

1. Use AIS data to calibrate bombyx orientation

2. Identify sperm sperm whales azimuth

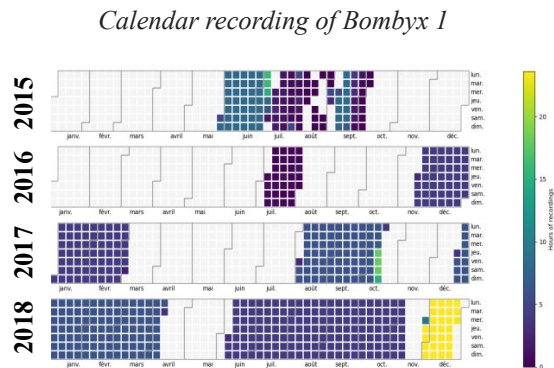3. Assess the influence of boat on sperm whale behaviour

◢ **Materials**
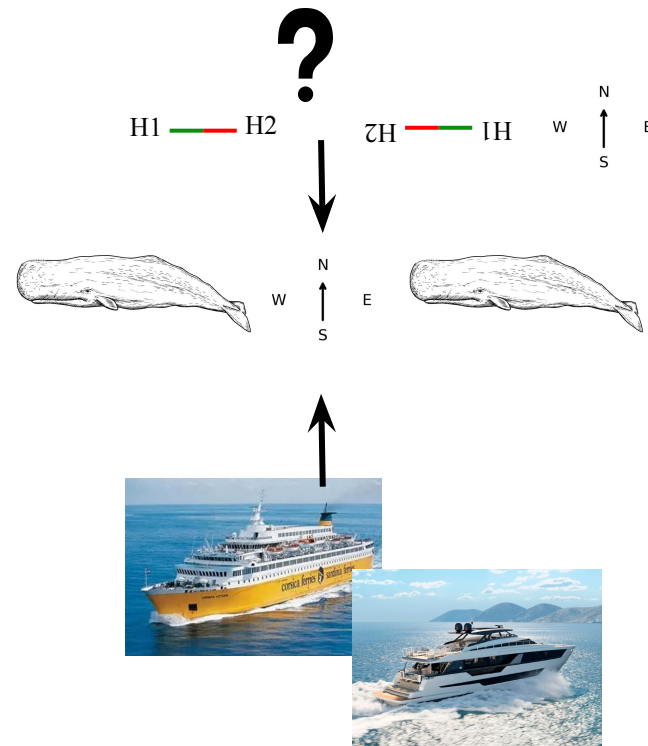
Bombyx-1

⬧ May 2015 to December 2018

⬧ Off Port Cros, close to the drop off

⬧ Stereophony

⬧ Hydrophones supposed to point south
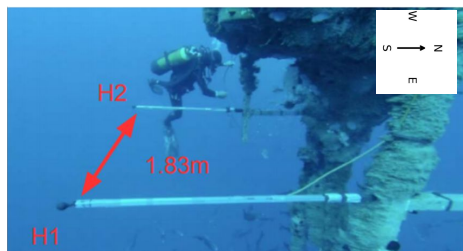
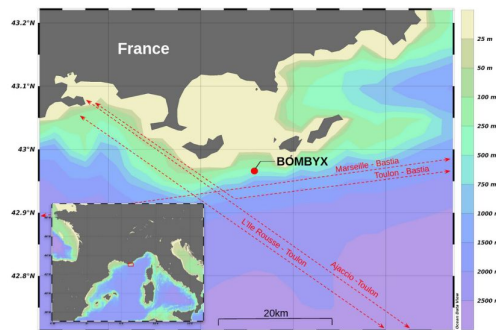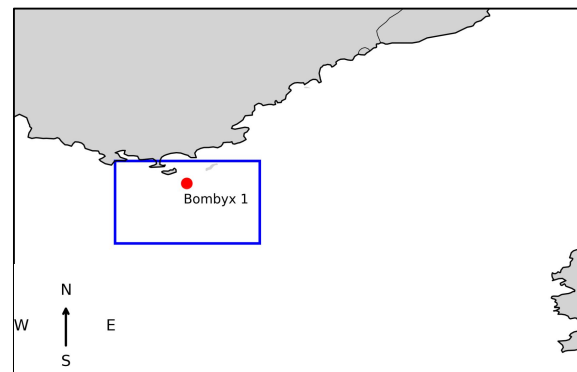*Underwater picture of Bombyx 1*

Bathymetric map of the region around Bombyx1. Poupard et al. 2022

AIS data

⬧ Every day of acoustic recording
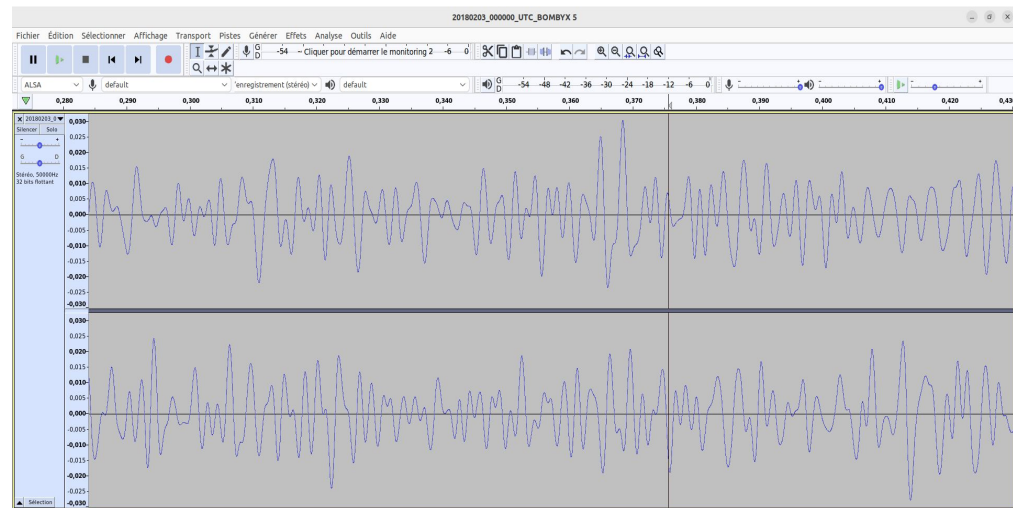
⬧ 30 on 40 miles

Map showing the requested area for AIS data around Bombyx 1
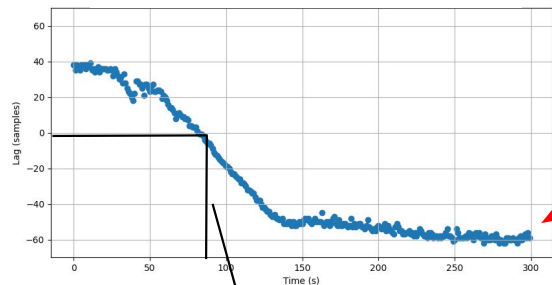
◢ Calibrate orientation

For each day :

⬦ Select a recording with a ferry nearby and no other boat → this ferry = major noise source

⬦ Correlation between signals on 1 second frame
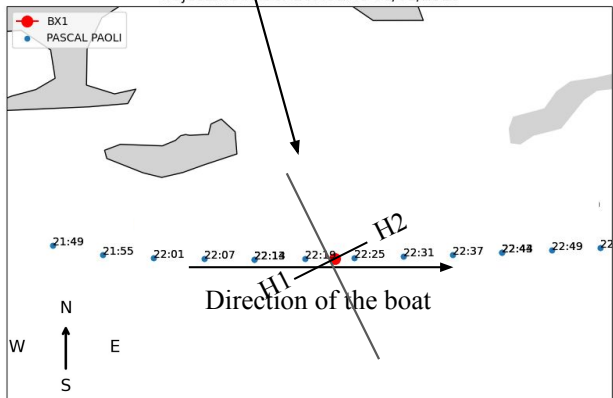
⬦ Positive lag: hydrophone 1 first

◢ Calibrate orientation
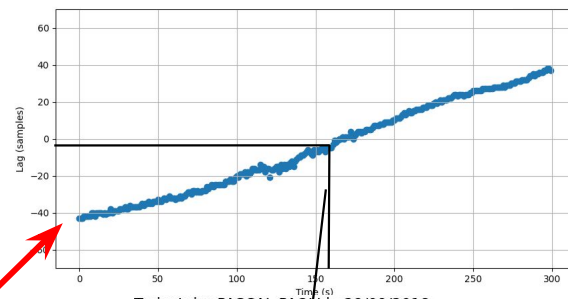
Examples:

2018-01-06 10:20 p.m.

◇ Positive lag: hydrophone 1 first

◇ Boat coming west, positive lag = H1 west
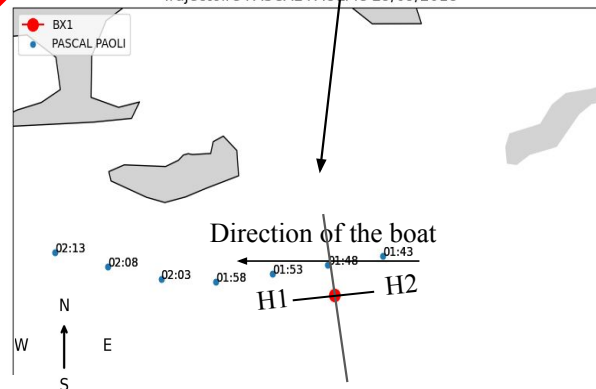
◇ Boat coming east, negative lag = H1 west

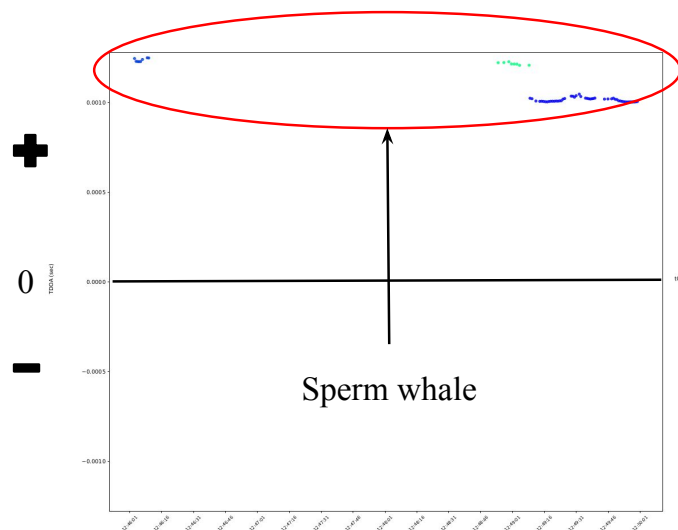◇ Buoy orientation stable: H1 west with small variations
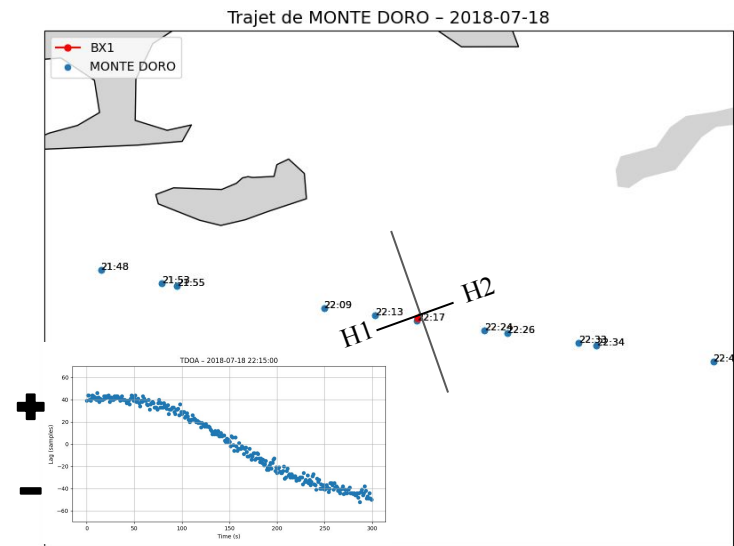
2018-09-29 1:45 a.m.

2018 07 18 12:45:00

1. Automatic detection of clicks and TDOA track

2. From the known orientation of the buoy

Sperm whale

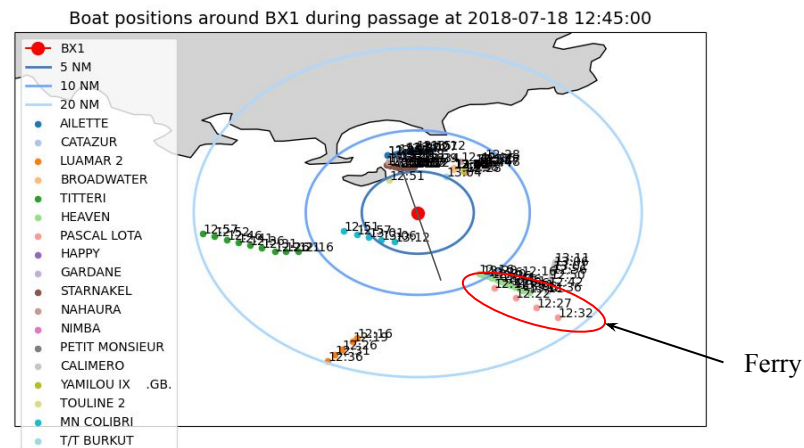3. Determine sperm whale azimuth: here, at **west**

◢ Marine traffic and sperm whales

2018 07 18 12:45:00

4. Count number of boats at the east and west

◇ Only south of the buoy is considered

◇ Number of boat 30 min before detections

Boat positions around BX1 during passage at 2018-07-18 12:45:00

Ferry

	Nb of boats	Nb of ferry
West	3	0
East	3	1

Marine traffic and sperm whales

◇ Repeat this methodology
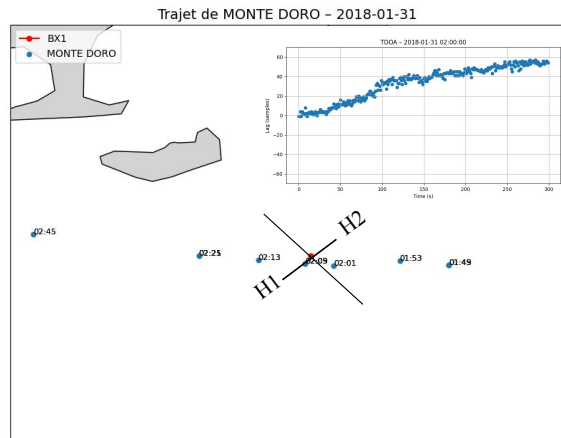
H1 west
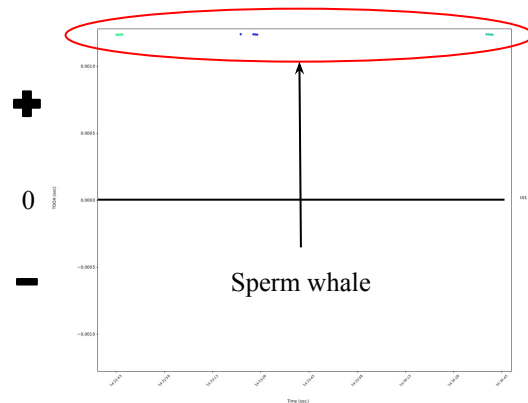
Sperm whale west
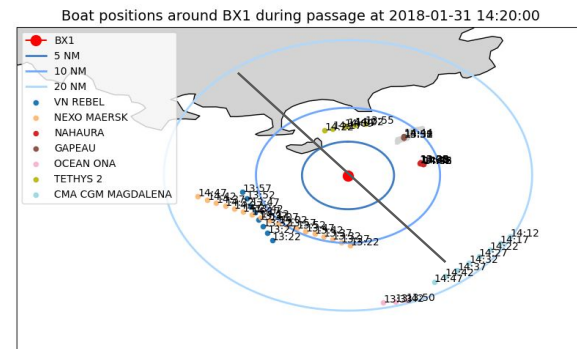
	Nb of boats	Nb of ferry
West	3	0
East	2	0

◣ Insights on marine traffic
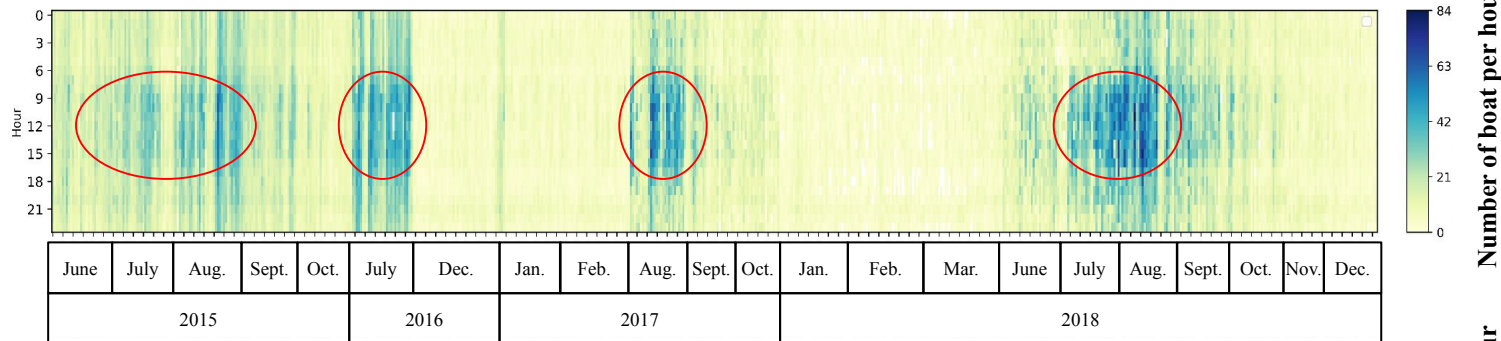
All boats with AIS

Intense pressure in summer

June	July	Aug.	Sept.	Oct.	July	Dec.	Jan.	Feb.	Aug.	Sept.	Oct.	Jan.	Feb.	Mar.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2015					2016		2017					2018									

Ferries only

Recurrent ferry lines
More ferries in summer
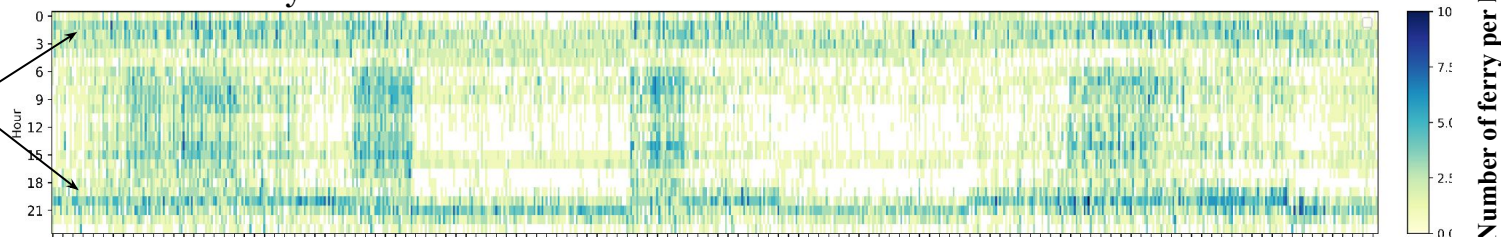
Calendar of hourly number of boat in a 10 miles radius around Bombyx 1. Top: all boats, bottom: ferries only. White cells indicate no boats for the category considered.

◢ Insights on marine traffic

All boats with AIS

Intense pressure in summer

Different pressure, predictable vs sporadic →same response ?

Ferries only

Recurrent ferry lines
More ferries in summer

Calendar of hourly number of boat in a 10 miles radius around Bombyx 1. Top: all boats, bottom: ferries only. White cells indicate no boats for the category considered.
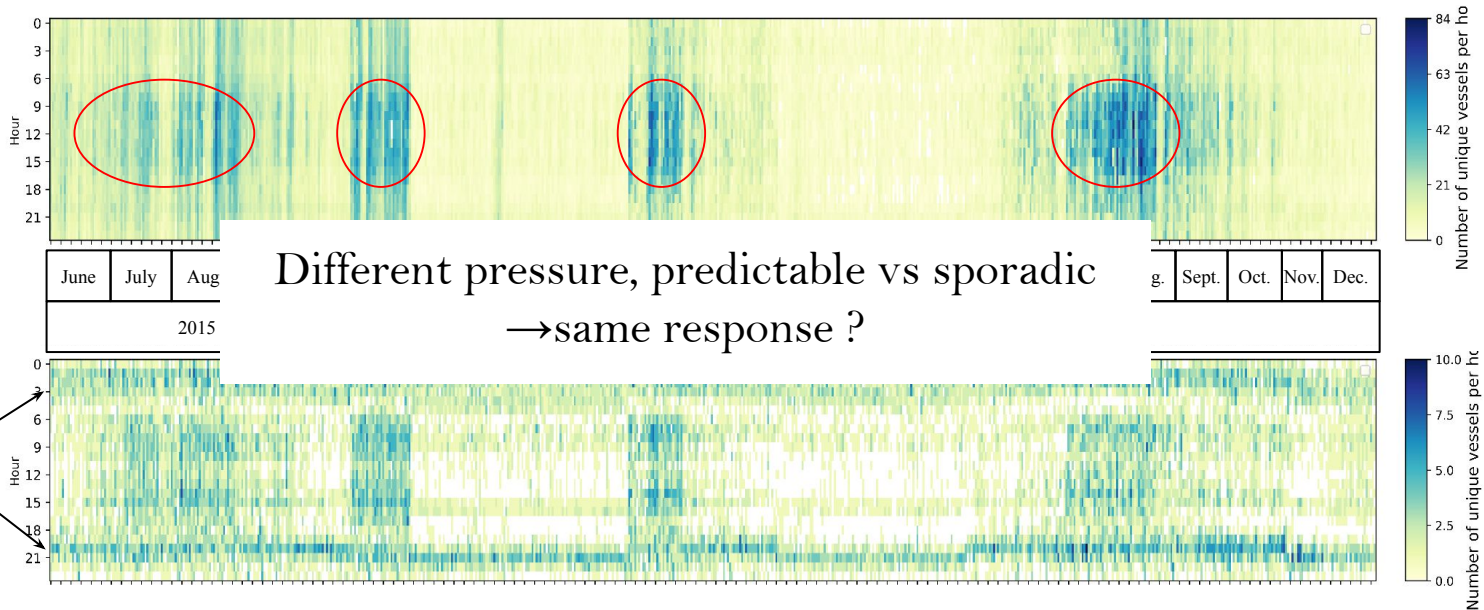
◢ Next steps

◇ Apply the described methodology to all recordings

◇ Account for small orientation variation of the buoy

◇ Determine the Inter Pulse Interval → proxy of the size and sex

◇ Analyse the Inter Click Interval and compare the variation with marine traffic

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Thank you for listening !