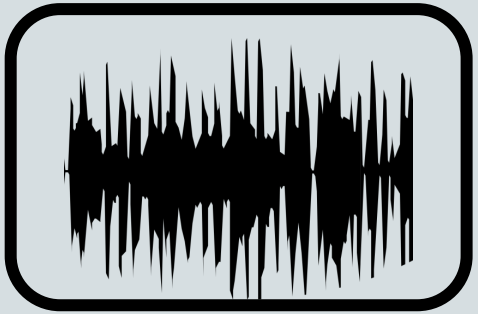


ORCA'S
PASSIVE ACOUSTIC in DYNI

Hervé Glotin, Marion Poupard glotin@univ-tln.fr
CNRS LIS DYNI, SMIoT, Univ Toulon, SABIOD MADICS

UNIVERSITÉ DE TOULON

VALHALLA EXPEDITION

SMIoT

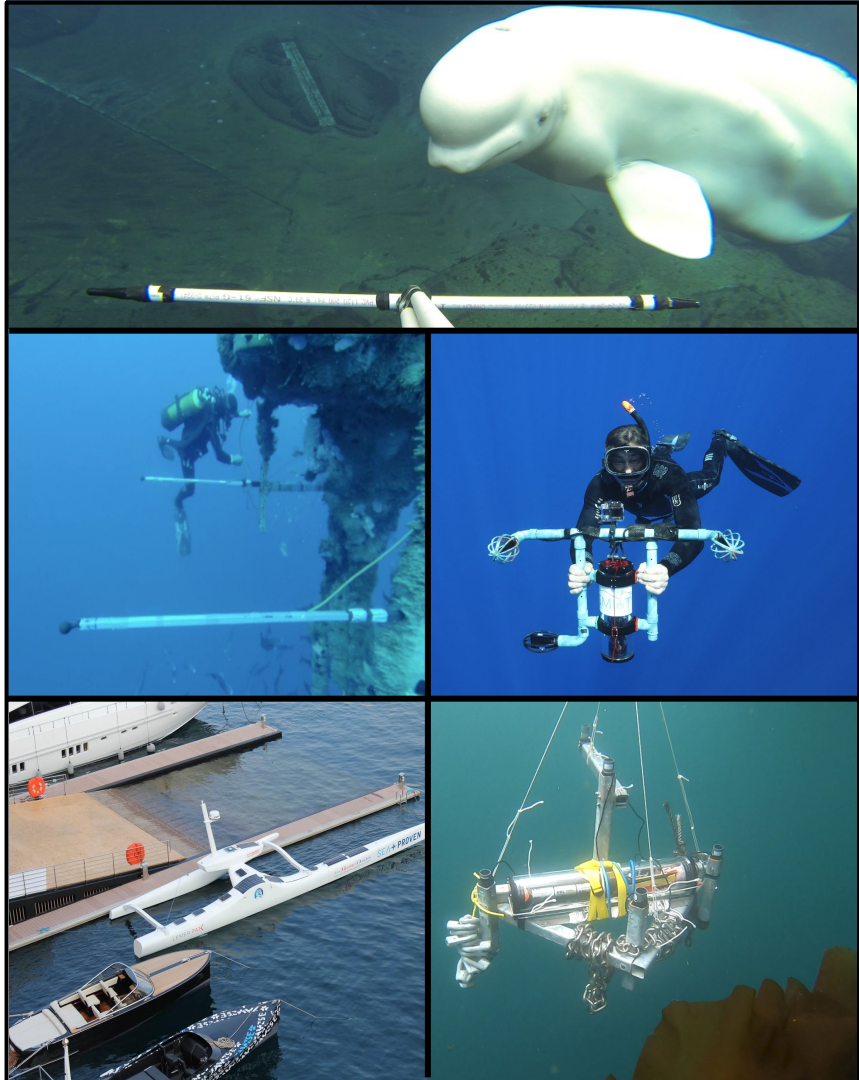
DYNI

cnrs

LIS

The team DYNI

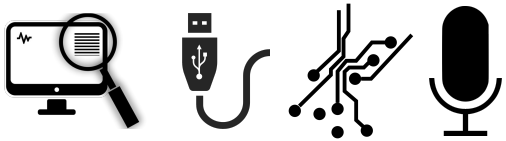
We are research group of the Laboratoire d'Informatique & Systemes (LIS) - UMR 7020 CNRS hosted at the Université de Toulon (UTLN), France. Our aim is develop and innovate in methods of machine learning, signal processing and data analysis in order to improve our knowledge and understanding in physical and natural systems.

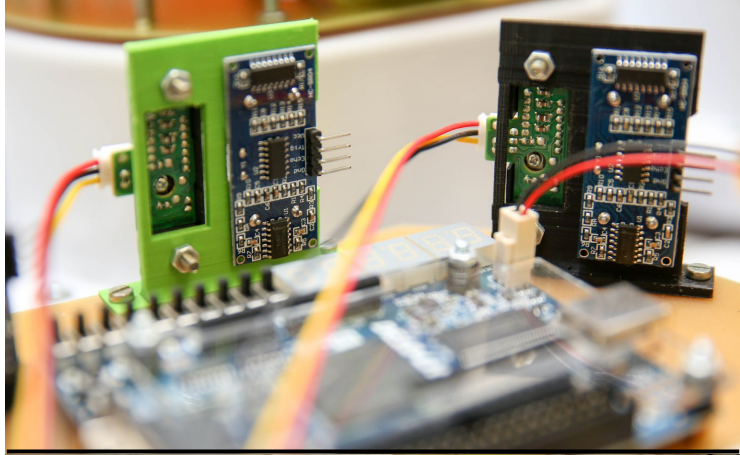


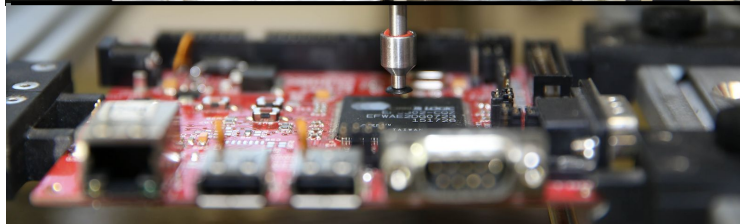
SMIoT: Scientific Microsystems for the Internet of Things

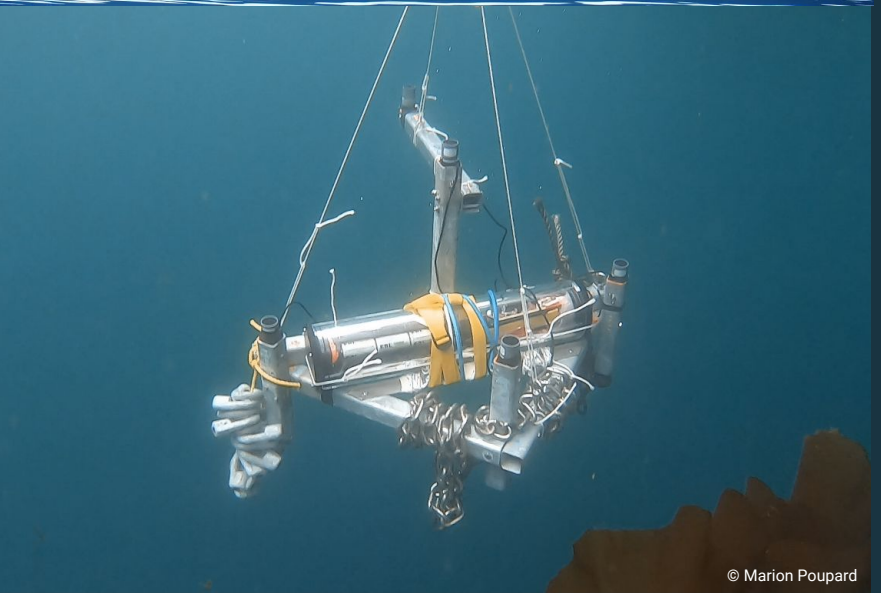
Design of electronic hardware (conception et routage des PCB), front-end, RF.
Assembly and testing of electronic prototypes
Industrialization of connected objects

Design, Test and Construction of the
HIGH BLUE MONO system





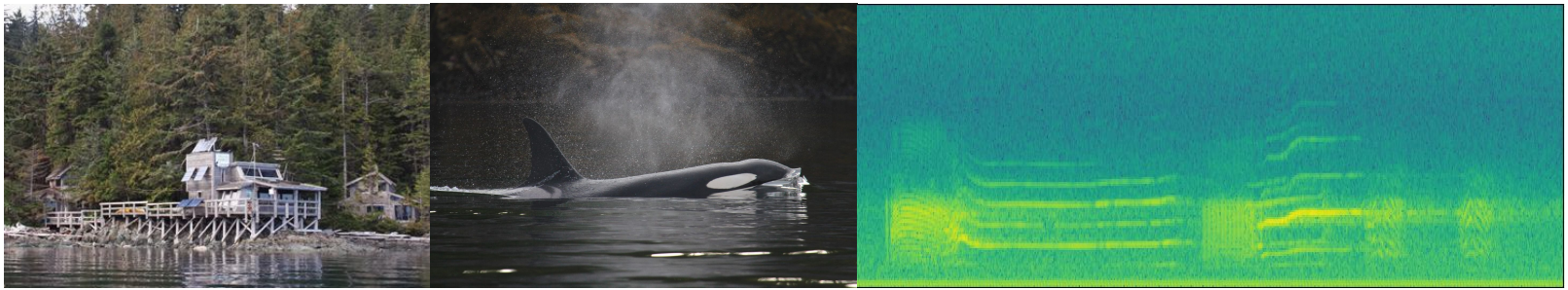




Our recent and futur projects

a. Detection of orcas over 3 years in Orcalab
b. Projects in Norway

Deep Learning for Ethoacoustics of Orcas on three years pentaphonic continuous recording at Orcalab revealing tide, moon, and diel effects



Introduction

- Orca *(Orcinus Orca)* top predator of the marine food chain.
- The Northern resident killer whale community [1]
- Pods dialect: repertoire of 7-17 discrete calls.
- How describe the orca communication?
- Automatically detect orca calls emitted throughout 3 years of continuous recording from 2015 to 2017
- Influence of environmental data on orca vocalization ?

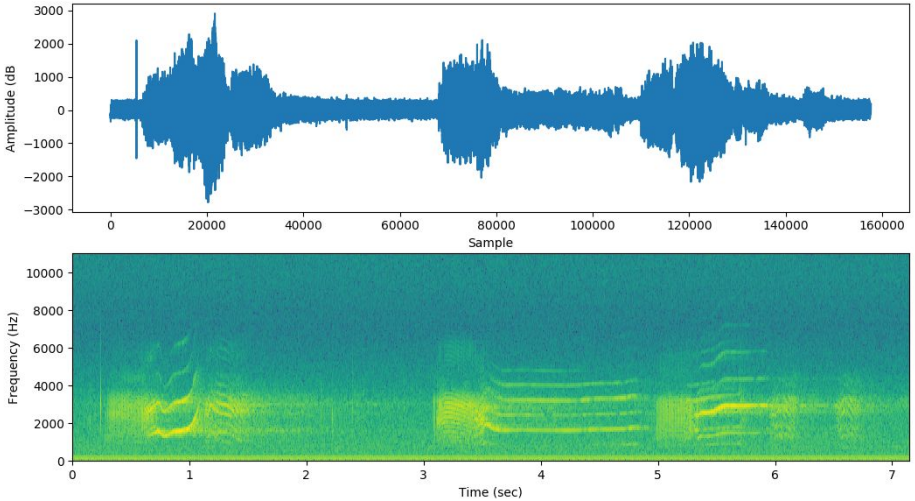


Fig 1: 7 seconds of vocalizations

Material

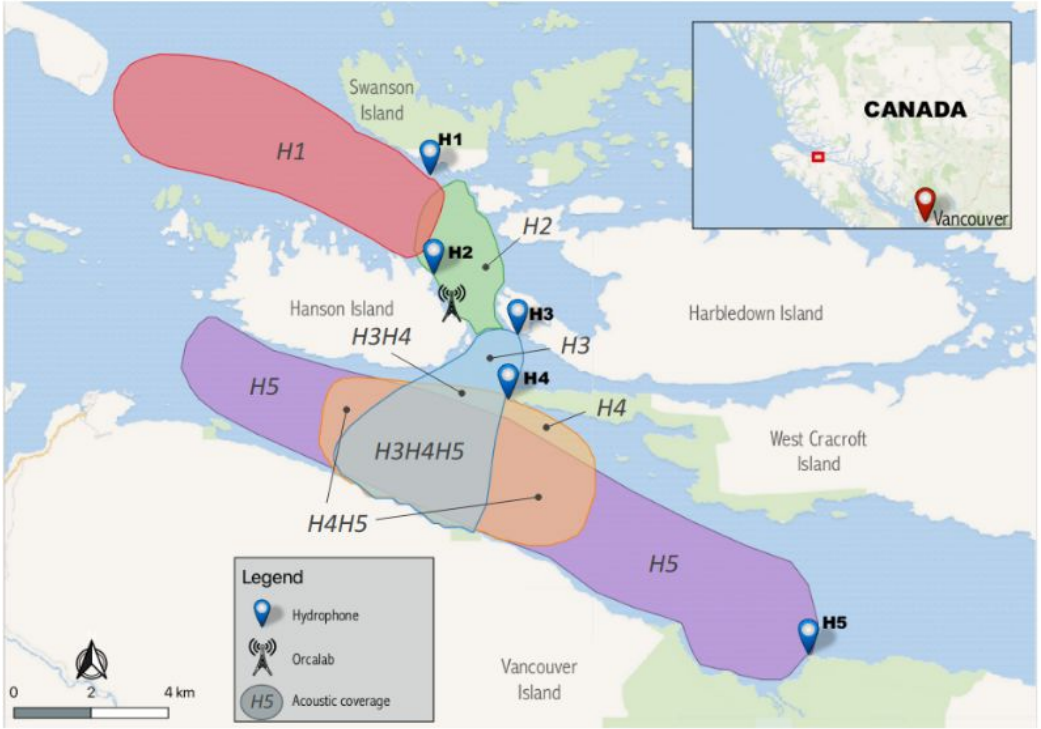


Fig 2: Map of the area and the listening range of the 5 hydrophones

Fig 3: Orcalab Station, Hanson Island, Canada

- The hydrophones record the soundscape continuously.
- Transmission of recordings to the Orcalab station in real time via VHF.
- Then digitized to a Presonus analog-to-digital converter (ADC) and sent to a PC in Orcalab.
- The recordings are then compacted in segments of 2 minutes including all 5 channels (.flac, 22050 Hz)
- Each segment is then sent to DYNI Toulon University big data NAS (Network Attached Storage) .
- In total, from July 2015 to 2017, around 50 TB of sound (about 14,500 h) was stored on our server.

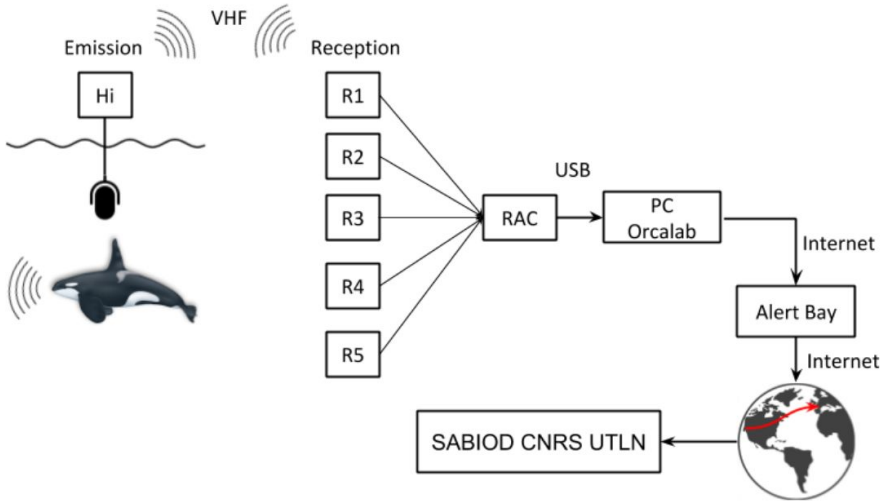


Fig 4: Representation of the data acquisition, from recording until storage on SABIOD CNRS UTLN server

Large scale statistics

- 2 days of computation required for 2015-2017 data.

- Orcas are present (acoustically) mostly during summer (June, July, August and September).

- orcas are abundant in Johnstone Strait between July and October, when salmon migrate into it.
- The second peak (October-December) may reflect the presence of Humpback whales.

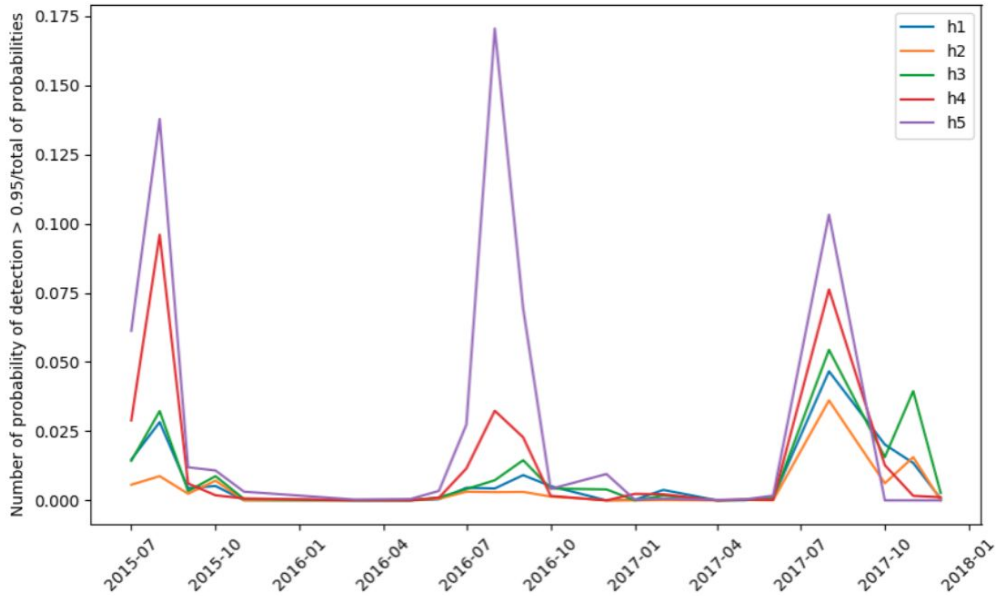
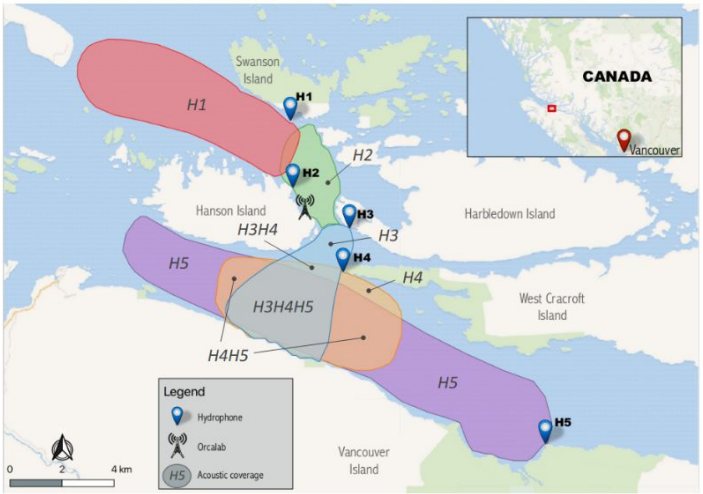


Fig 6: Proportion of two-minutes recordings with detected orca calls per month and hydrophone, from 2015 to 2017.

Trajectography

- Estimation of the acoustic activity of orcas in the range of each hydrophone over time.
- Example for August 24, 2017.



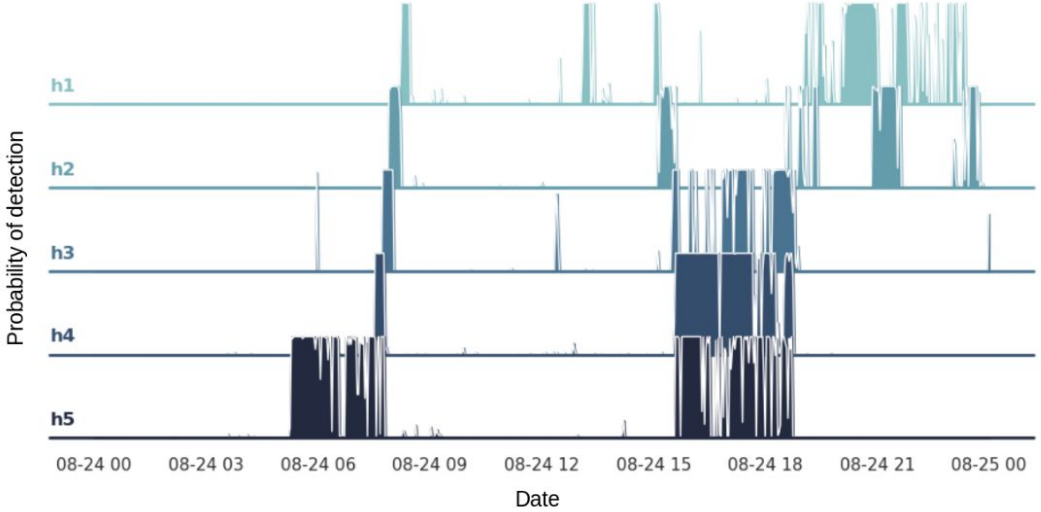


Fig 7: Example of the evolution of the probability of call detection for each hydrophone during one day (August 24, 2017). During the morning, a group of orcas comes from the east on H5, and is moving on H4, H3, H2 then on H1. Different round trips are made during the day.

Voicing statistics

Analyze of the voicing activities according to:

- Day time/Night time.
- Full Moon time (from 4 days before to 4 days after a full moon), new Moon time .
- Rising tide / falling tide.
- Detect orca calls in each zone during a given time interval.
- Global patterns of the orcas' voicing activity in time and space variations in the voicing.
- Activities of up to a factor of four between conditions and zones.
- The biggest variation concerns the influence of tide and moon in zone H5.

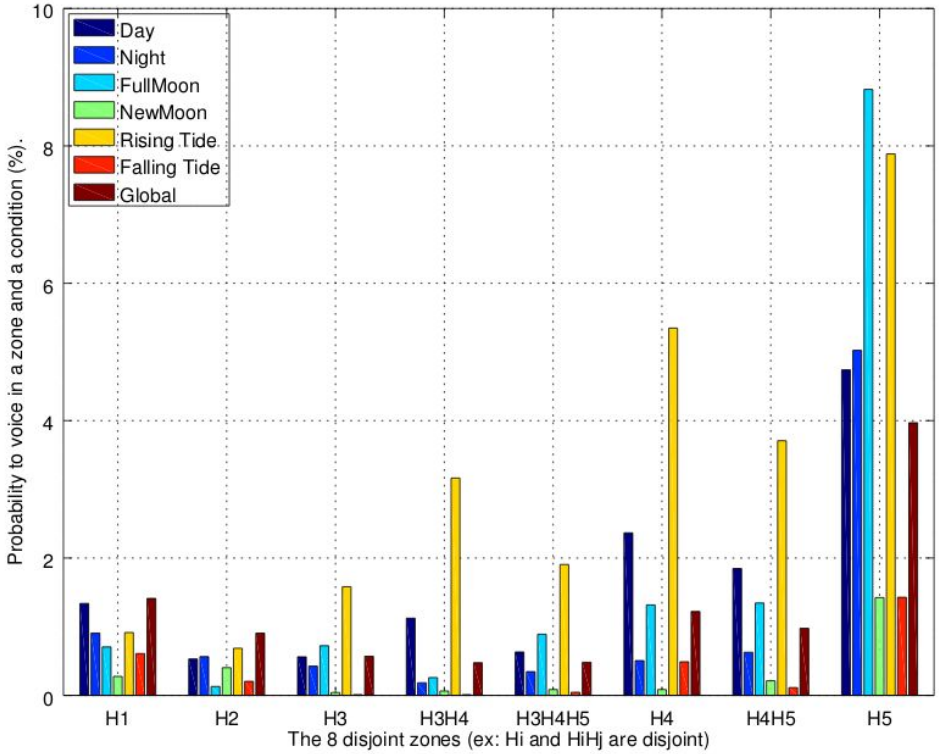


Fig 12: Probability of voicing of orca in a zone during a given condition.'Global' refers to no specific condition.

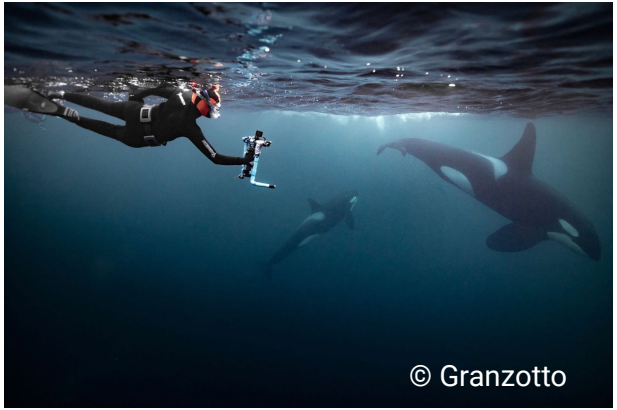
Project 1 in Norway: 2 mobile acoustic antennas

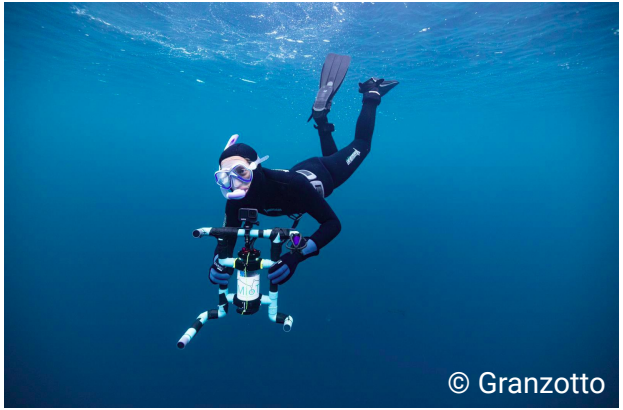
2 acoustic antennas with 5 hydrophones

Objectives : understand how orcas communicate during hunting/travelling periods

Associate calls/clicks to an individual

What are the interactions with humpback whales?





Project 2 in Norway: 2 static acoustic antennas

The hydrophones record the soundscape continuously for 3 months.

Analyze of the voicing activities H24 of rorqual, humpback, orcas and others (purposis, pilot whales…).

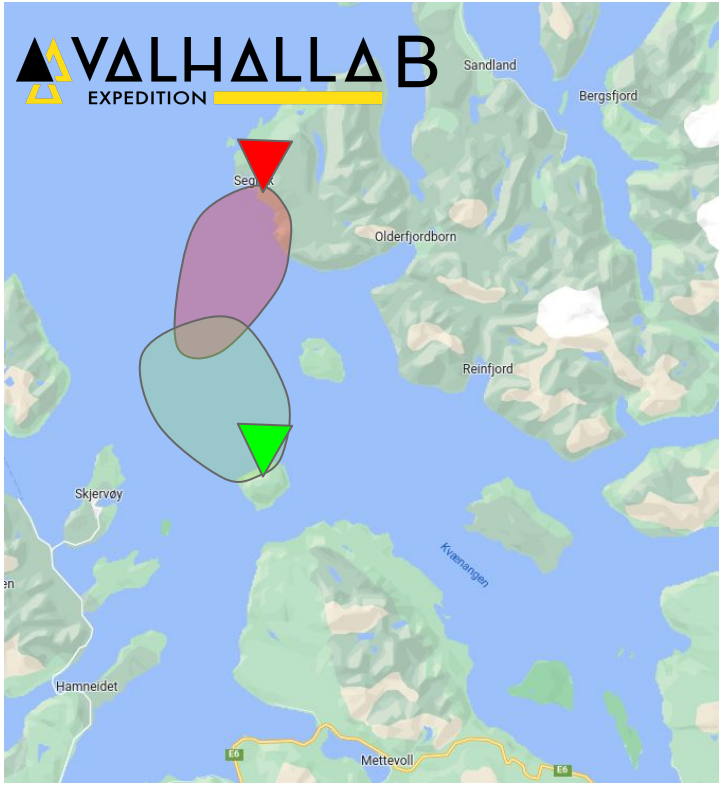
How cetaceans enter the fjord ? How long they stay in ?

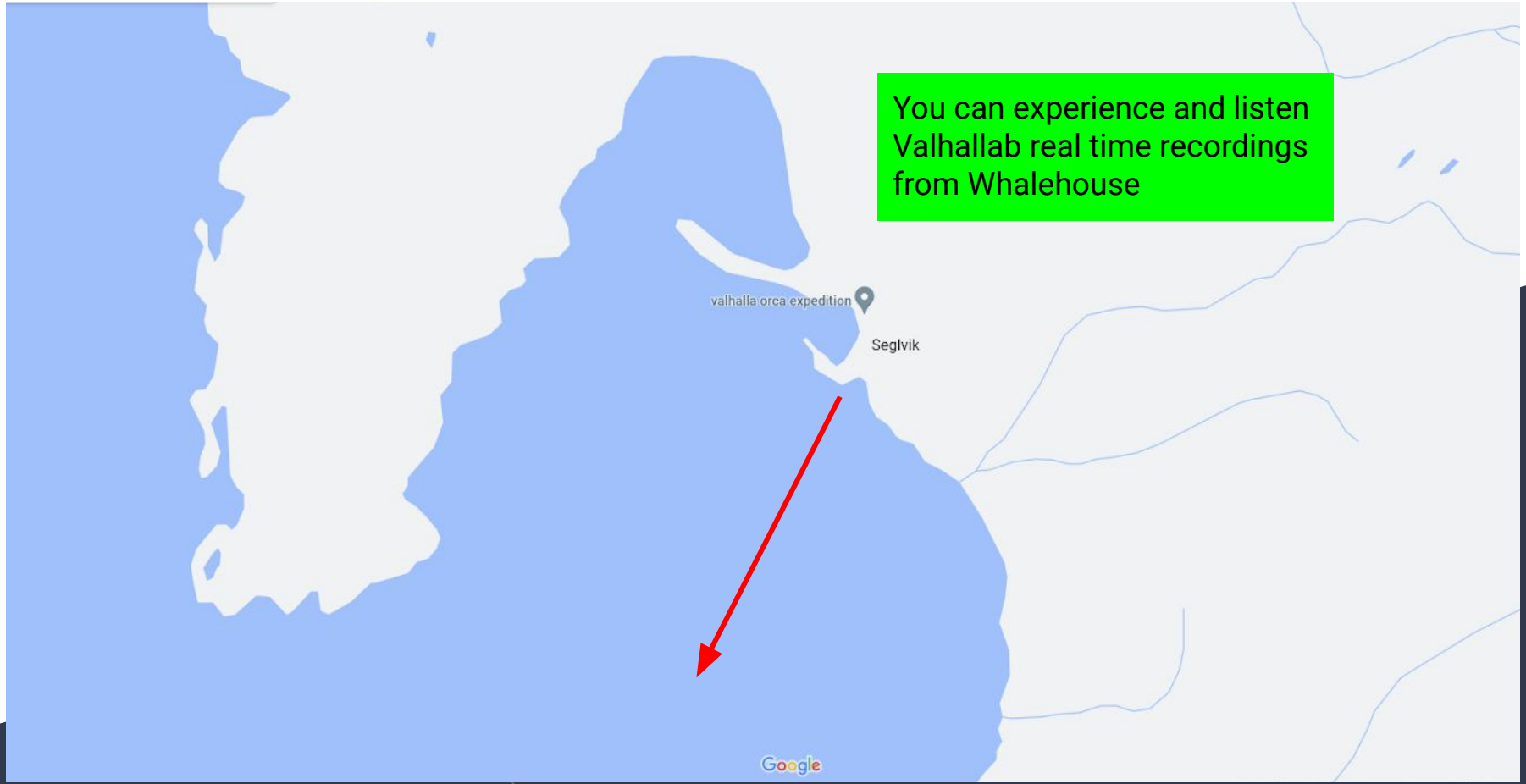
Variation of vocal activities between night versus day time ?

Can we built a catalogue of the calls ?

Influence of environmental data on cetaceans vocalization ?

Monitoring of the antropophony (fishers…) during months / years, and climate changes.




You can experience and listen Valhallab real time recordings from Whalehouse
valhalla orca expedition
Seglvik
Google

Thanks for your attention !