



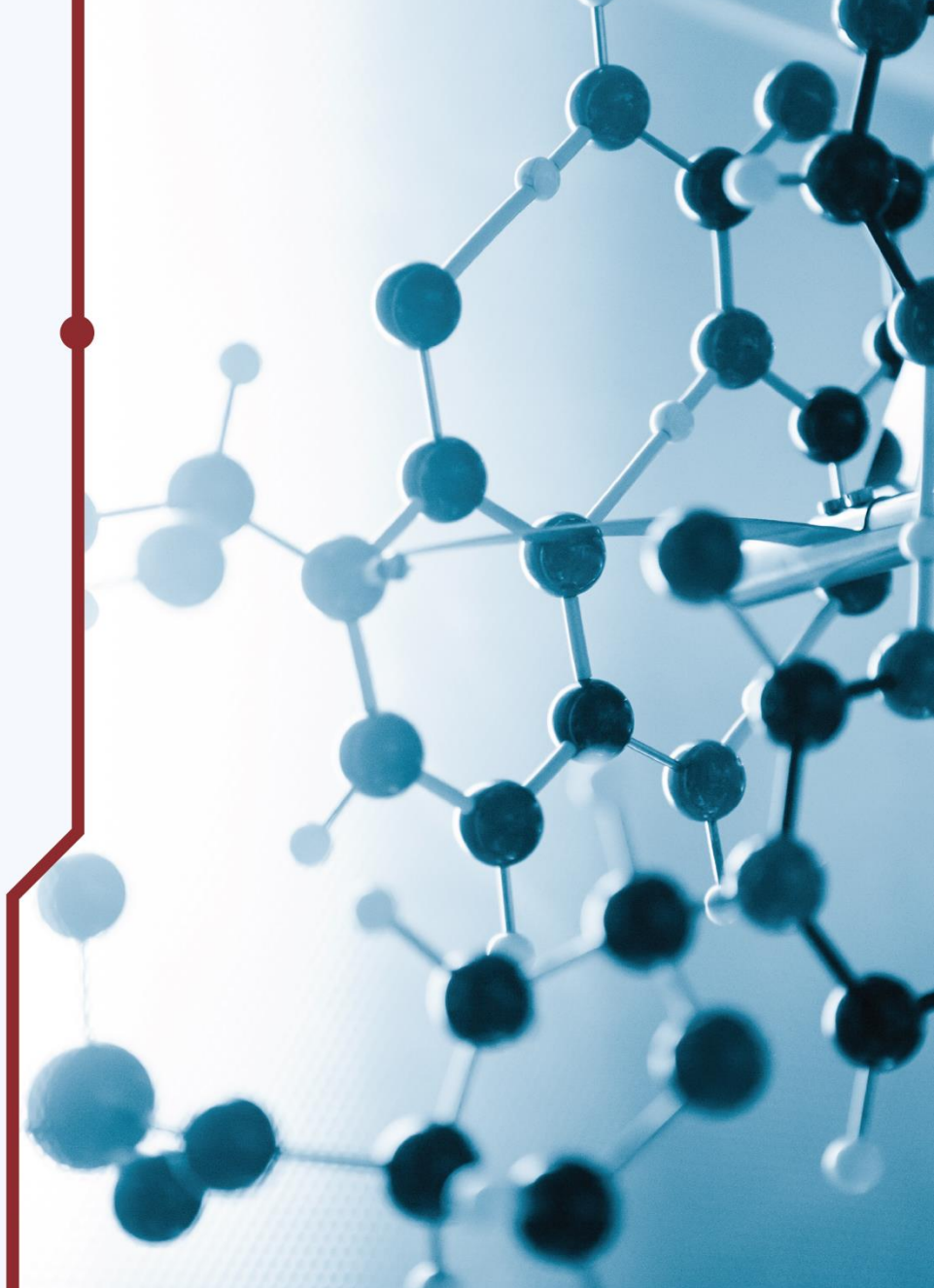
REINFORCE

REsearch INfrastructures FOR Citizens in Europe

Deep Sea Hunters on Zooniverse

Rémy Le Breton

February 26, 2021, 15:20 CET







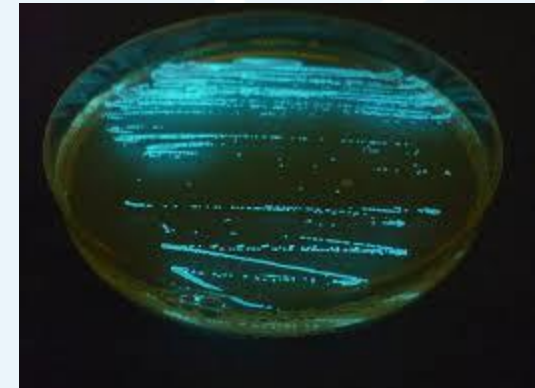
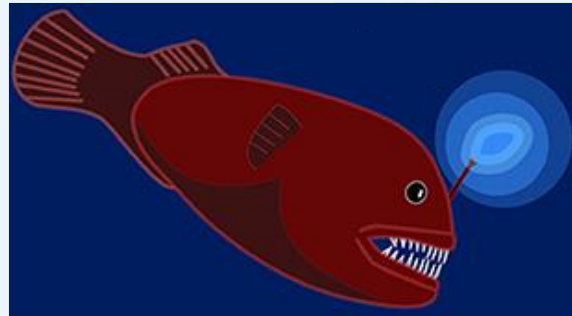
From Gwenhaël's talk you have learned:

 We can detect **light** at the bottom of the sea thanks to KM3NeT's DOM



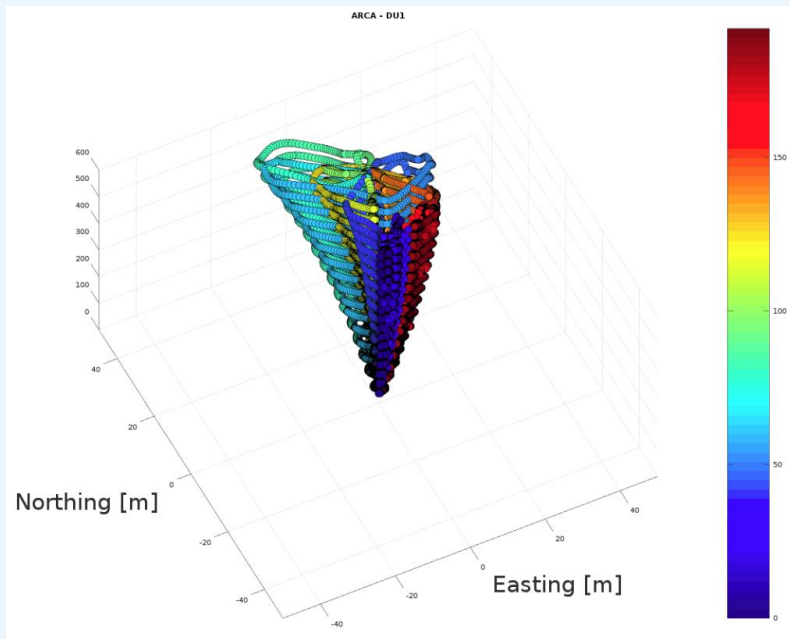
One KM3NeT DOM (31 PMT)

-  Any kind of light:
 -  Light coming from neutrino interactions of course
 -  But also light coming from life forms!
-  We can study marine biodiversity with a neutrino telescope!



We can also detect sound! How and why?

- KM3NeT lines moves because of currents at the bottom of the sea
- We want to precisely monitor the positions of all our DOM
- We have installed acoustic emitters and receivers



- ❗ Acoustic devices? We can detect sounds coming from different origins!
 - ❗ In particular from cetaceans!
- ❗ We can study sea mammals with a neutrino telescope!



Striped dolphin

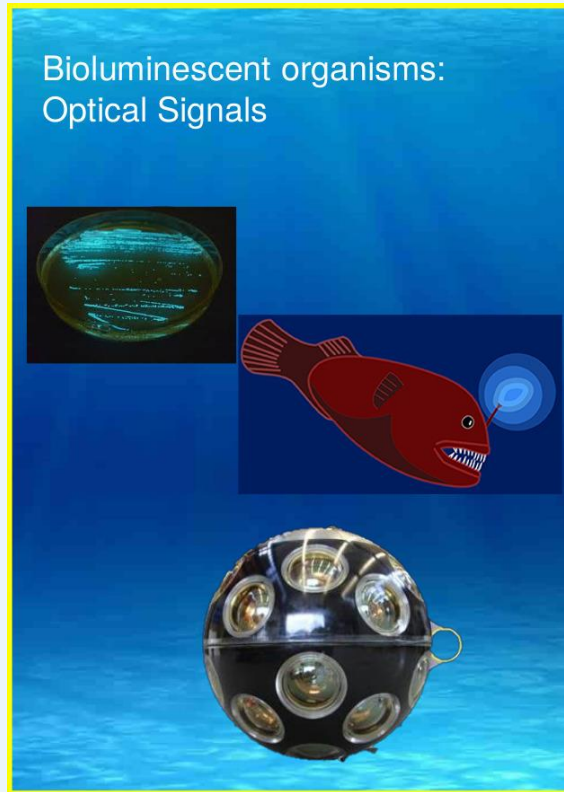


Sperm whale



Two Workflows

Bioluminescence



Bioacoustics



 Goal: Getting help from Citizen Scientists to classify the data recorded in KM3NeT



Live demo

 Zooniverse : <https://zooniverse.org>

 Front page

 Introduction

 Learn more:

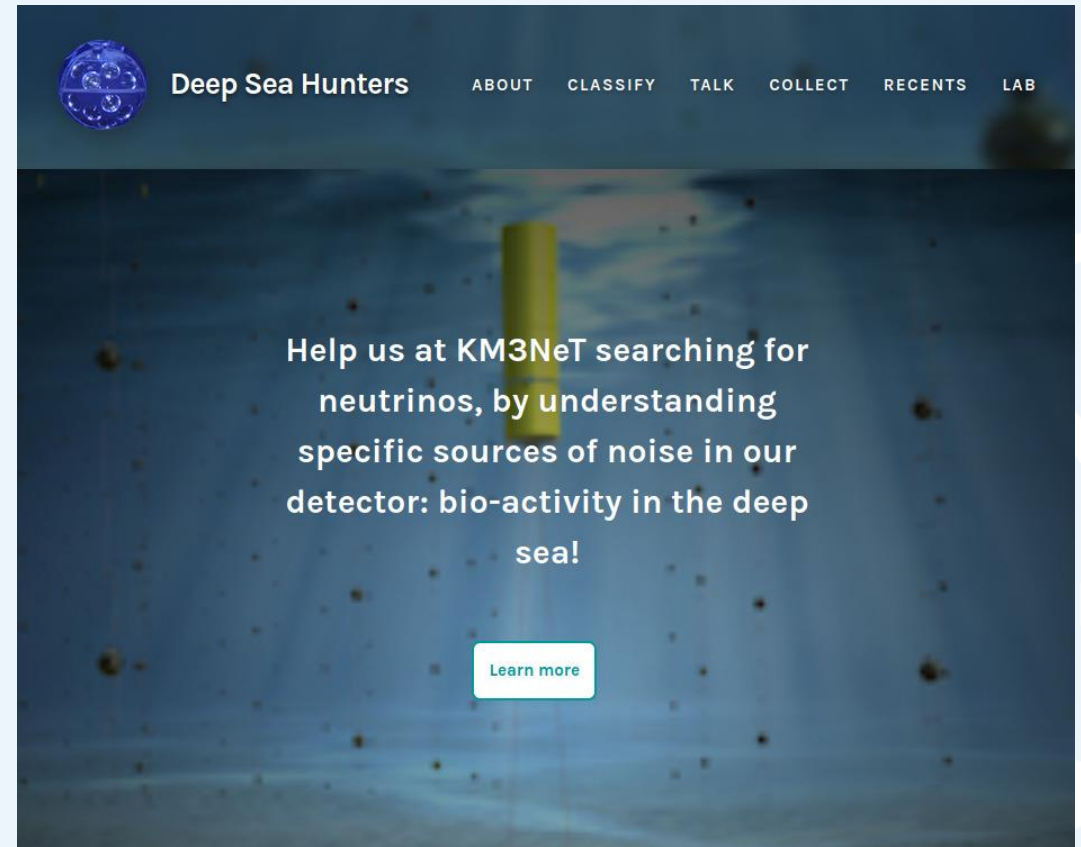
 Research Tab

 Team Tab

 Two workflows:

 Bioluminescence

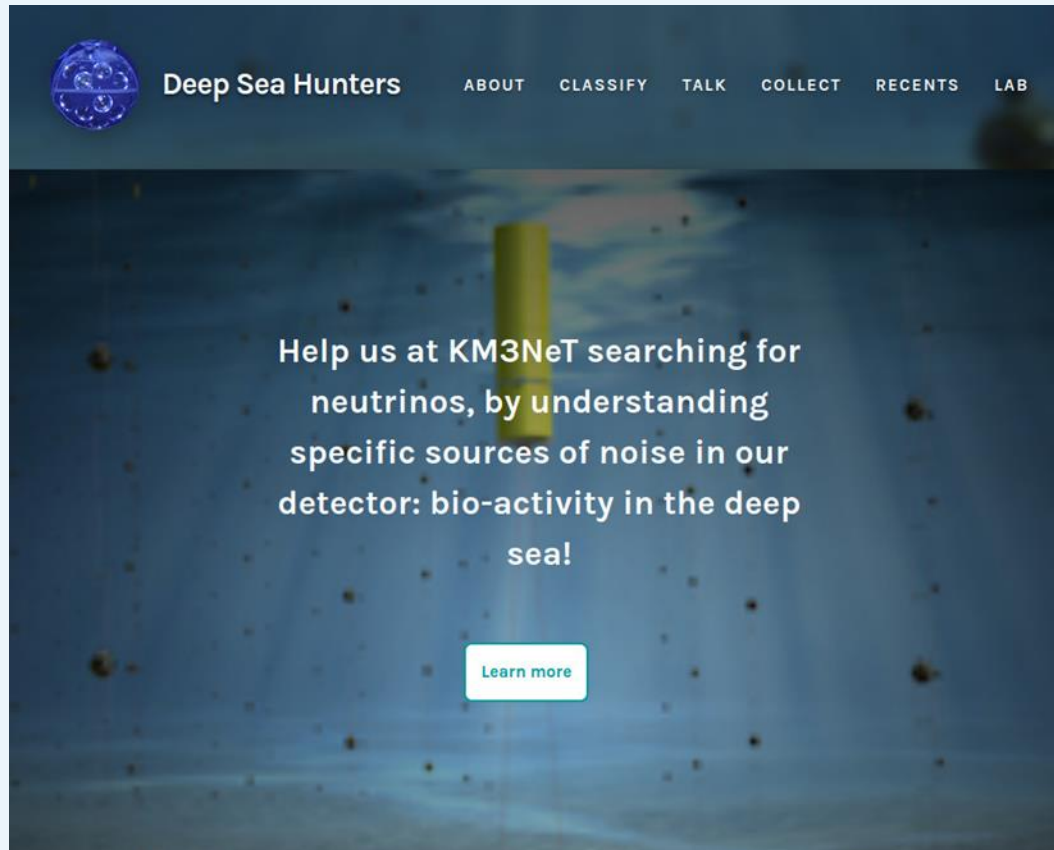
 Bioacoustics





Live demo

 Access to the current workflows, some statistics about the project and short presentation



ABOUT DEEP SEA HUNTERS

Wait... What? We can do sea science with a neutrinos telescope?!

Neutrinos are very peculiar elementary particles. Even if we know a lot more about them since their first prediction in 1930 and their first experimental detection in 1956, we still don't fully understand them. Why? Mainly because they are very (very!) difficult to detect.

To increase our chances of seeing them, we need huge detectors. And by huge we mean at the km³ scale. Neutrino detection relies on the observation of Cherenkov light, which can easily be seen in transparent medium like water or ice. That is why KM3NeT, the Kilometer Cube Neutrino Telescope, is currently deployed in the Mediterranean sea.

Unfortunately, sea water has some drawbacks that we call **noises**. We want to get rid of them in order to improve our detection of neutrinos. **This is where we need you!** One of our main sources of noise comes from bio-activity in the deep sea, in the form of light and acoustic signals that have never been systematically studied.



Your mission as a Deep Sea Hunter (if you accept it!) is to help computers better classify these light and acoustic signals. While computers might outshine us in analyzing very large data set, human eyes and ears are still better than a computer to notice subtleties.

The 'Deep Sea Hunters' project is part of the **REINFORCE** project that has received funding from the European Union's Horizon 2020 project call H2020-SwafS-2018-2020 funded project Grant Agreement no. 872859.





Live demo

-  Research: main facts of the project and description of the science behind
-  The Team: pictures and short description of the members

The Science Behind "Deep Sea Hunters"

The Deep Sea Hunters project takes place in the context of [KM3NeT](#), the KiloMeter Cube Neutrino Telescope. The purpose of this introduction is to give you all the scientific background you need to fully enjoy the classifications you are going to achieve in this project. Why KiloMeter Cube? And Neutri-what? Reading through the following sections, you will be able to understand what is a neutrino, how they are produced, how we can detect them, why we want to observe them and (the most important!) **why we need you!**

The first part of this research tab is dedicated to the main aspects of the Deep Sea Hunters project. In the second part, you will find a lot more details!

Deep Sea Hunters: main facts!

- The Deep Sea Hunter project is related to the **KM3NeT** experiment, a neutrino telescope deployed in the Mediterranean Sea.
- **Neutrinos** are elementary particles extremely difficult to catch. We need huge detectors (at the cubic kilometer scale) to have a better chance to observe them.
- Neutrinos are produced in a lot of different mechanisms, all involving the **weak nuclear force**.
- Neutrinos have a lot of different origins: nuclear reactors on Earth, the Sun, supernovae and lot more.
- Neutrinos are invisible to us. To see them, we record **Cherenkov radiations**.
- The Cherenkov radiation is a kind of shock-wave phenomenon for light, similar to the acoustic shock-wave emitted when an airplane is going faster than the speed of sound.
- The Cherenkov radiation is seen in medium denser than vacuum, that is why KM3NeT is deployed in the seawater.
- The Seawater in the vicinity of our detector is full of life: **bioluminescence** and **marine mammals**.
- Bioluminescence and marine mammal are noises in our detector, **light and acoustic noises** respectively.
- Bioluminescence can be mixed with the Cherenkov radiation we want to detect. Marine mammals emit acoustic signals that can interfere with our acoustic triangulation system.
- Bioluminescence and marine mammals are also marine life that can be studied. **They have never been systematically studied in the deep sea.**
- Your classifications of light and acoustics "noises" from marine life will help us to better tuned our detector (for neutrino observations), AND to better understand life in the vicinity of our detector in the deep sea.



The KM3NeT Collaboration has started as an European collaboration, but is now an international collaboration! Each year, new countries are joining us. We are now more than 250 researchers, belonging to 51 institutes and groups. We are located in 41 cities and spread around 15 countries.

In addition to the members displayed on the map, we also have as observers: Algeria, AstroCeNT, Caen, Georgia and The United Arab Emirates.

In the following, you have a brief description of the members of the KM3NeT collaboration who are involved in the Deep Sea Hunters project.

The Deep Sea Hunters team

CPPM team

Vincent Bertin (High Energy Physics Researcher): *Instrumentation, Positioning calibration, Acoustics*

I am a CNRS researcher. After participating to two particle physics experiments at CERN, I have been involved in the neutrino detection in the deep sea for the last 25 years, first with the ANTARES neutrino telescope and then with KM3NeT. Thanks to these gigantic detectors, we can do a lot of exciting physics from multi-messenger astronomy to studies of the neutrino fundamental properties, and I have particular interest in the search for the still mysterious Dark Matter. I am also strongly involved in the acoustic positioning systems of the detectors, that we use to reconstruct in real time their geometry with few centimetres accuracy, and to multidisciplinary studies which very important to understand our detection medium. We warmly thank your participation to this project to help us characterize our backgrounds and the diversity in the deep sea !





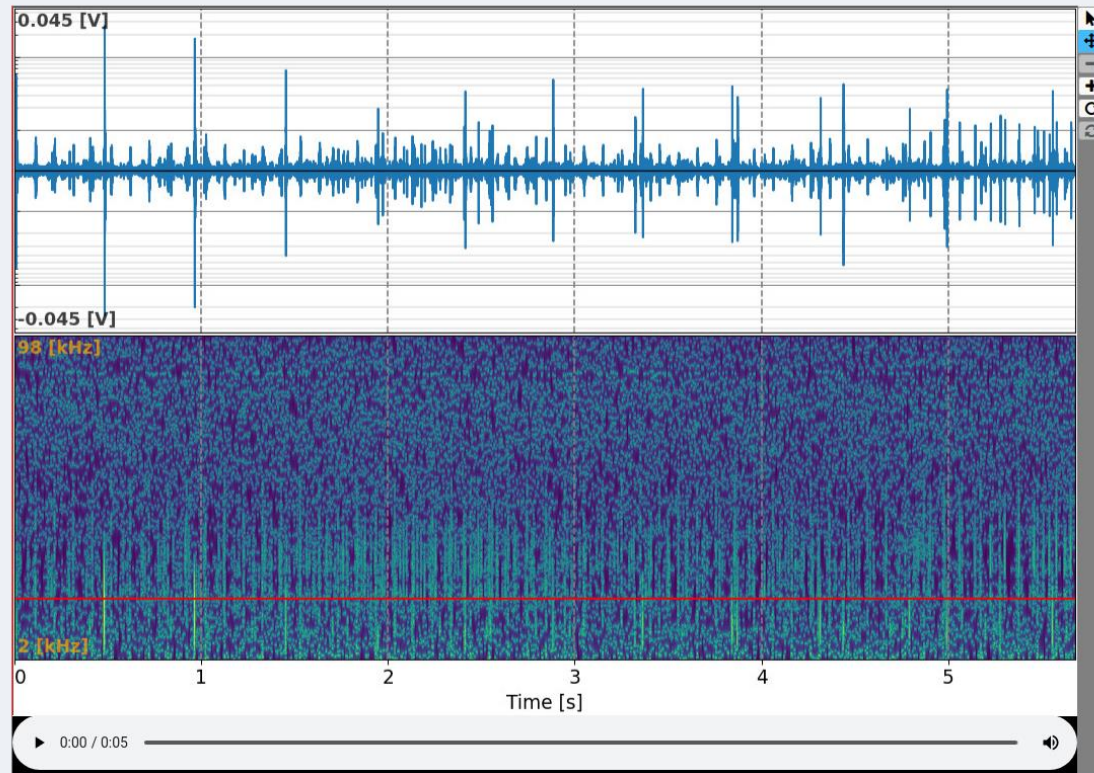
Live demo

The screenshot shows the REINFORCE web interface for the 'Deep Sea Hunters' project. At the top, there is a navigation bar with links for PROJECTS, ABOUT, GET INVOLVED, TALK, BUILD A PROJECT, NEWS, NOTIFICATIONS, MESSAGES, and REMY.LE-BRETON. Below this, the project title 'Deep Sea Hunters' is displayed with a globe icon. A secondary navigation bar includes ABOUT, CLASSIFY, TALK, COLLECT, RECENTS, and LAB. The main content area features a scatter plot of 'Rate [kHz]' versus 'Time [s]'. The plot shows a baseline around 210 kHz with three distinct peaks: one at approximately 5 seconds (reaching ~250 kHz), another at 35 seconds (reaching ~260 kHz), and a third at 90 seconds (reaching ~305 kHz). To the right of the plot is a 'TASK' panel with a 'TUTORIAL' tab. The task asks 'What is the classification of this event?' and provides four radio button options: 'One peak', 'Two peaks', 'Multiple peaks', and 'Weird'. A green 'Done' button is located at the bottom of the task panel. Below the plot, there are icons for zooming (+, -), panning, and a 'SWITCH TO DARK THEME' link.



PROJECTS ABOUT GET INVOLVED TALK BUILD A PROJECT NEWS SIGN IN REGISTER

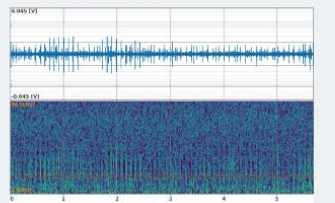
 **Deep Sea Hunters** ABOUT CLASSIFY TALK COLLECT



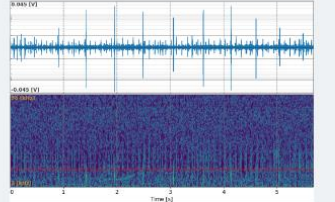
TASK **TUTORIAL**

What kind of clicks do you recognize in the plot?

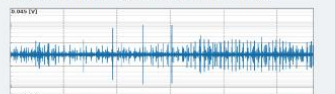
Striped dolphin clicks



Sperm whale clicks

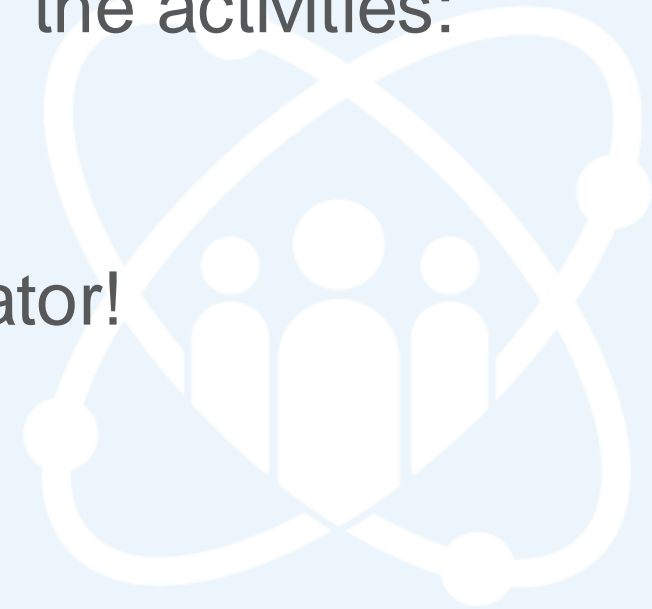


Striped dolphin and sperm whale clicks



Conclusion

- Demonstrator not public yet, stay tuned!
 - Don't hesitate to subscribe to REINFORCE newsletter: <https://reinforceeu.eu/newsletter>
- Thanks to discussions with experts, we are improving the activities:
 - Séverine Martini, bioluminescence
 - Hervé Glotin, bioacoustics
- We will add new activities/workflows to the demonstrator!



Thanks!





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