

Thursday 29 June 2017, ASA Boston



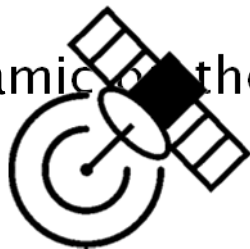
POLAR COASTAL SOUNDSCAPES : TRIDIMENSIONAL MAPPING WITH A COMPACT 4 HYDROPHONES ARRAY

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CONTEXT : GAAP PROJECT

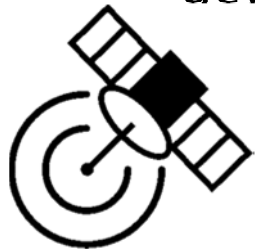
ANR ASTRID Program, funded by the DGA
Passive Acoustic monitoring of Arctic Ice : Global warming context

- Safety of human activities carried out at sea
- Detection, localization and tracking of icebergs (growler) with PAM
- Comparison between the acoustic tools and the satellite imagery
- Impact of ice dynamics on the trophic chain



QUESTIONS ?

Understand the dynamic of Arctic and its ecosystems, and develop new human activities require monitoring tools :



Satellite imagery



Large spatial scales
Long periods time



No continuous monitoring possible
Low resolution (few meters)



Passive acoustic monitoring

Long term monitoring

Continuous monitoring possible

High spatial resolution →
Growlers

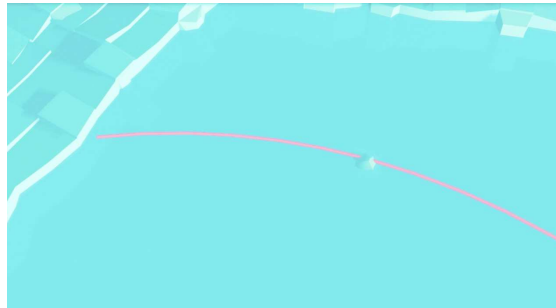
Integrative tool



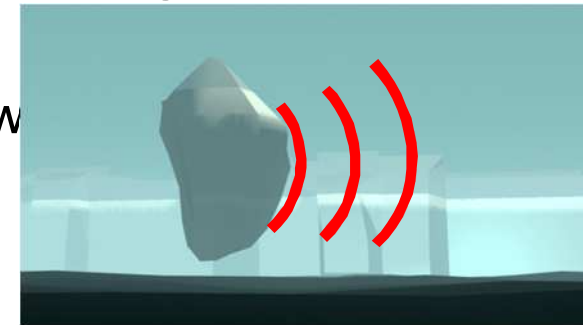
OBJECTIVES PAM

Complement the limitations of satellite imagery to monitor ice and Arctic ecosystems

TRACKING
& SIGNATURES

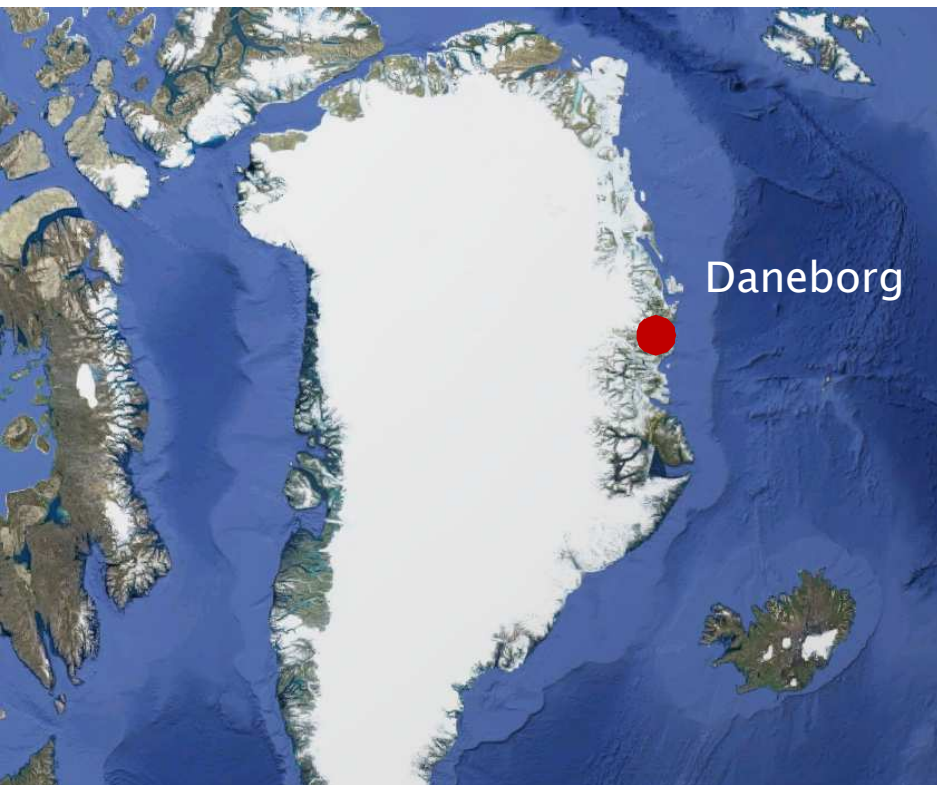


- 1) $s(t)$ different types of sounds
→ TDOA to localize the icebergs
- 2) SL (iceberg) → range and pow
- 3) Tracking

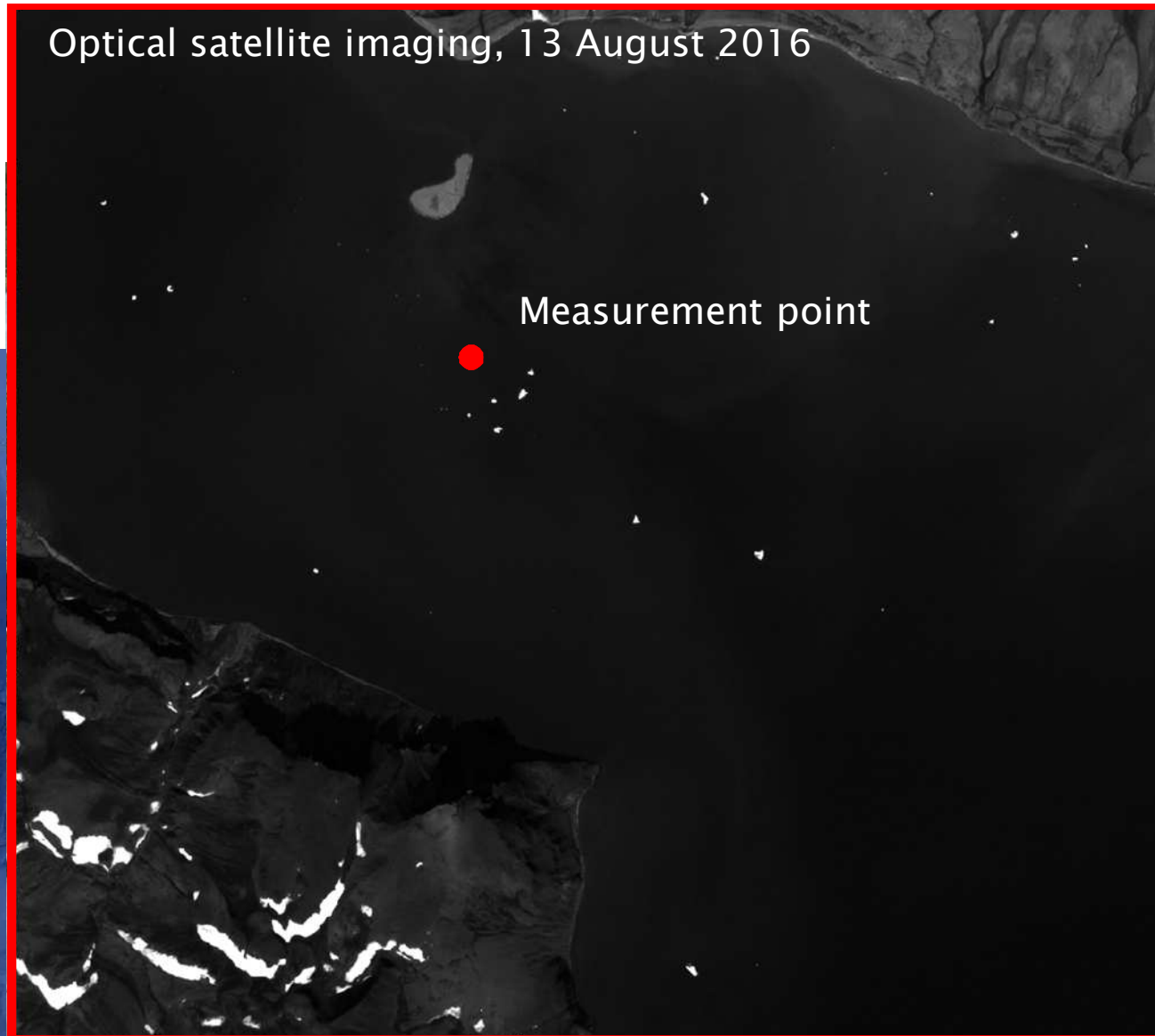


METHODS

Study site

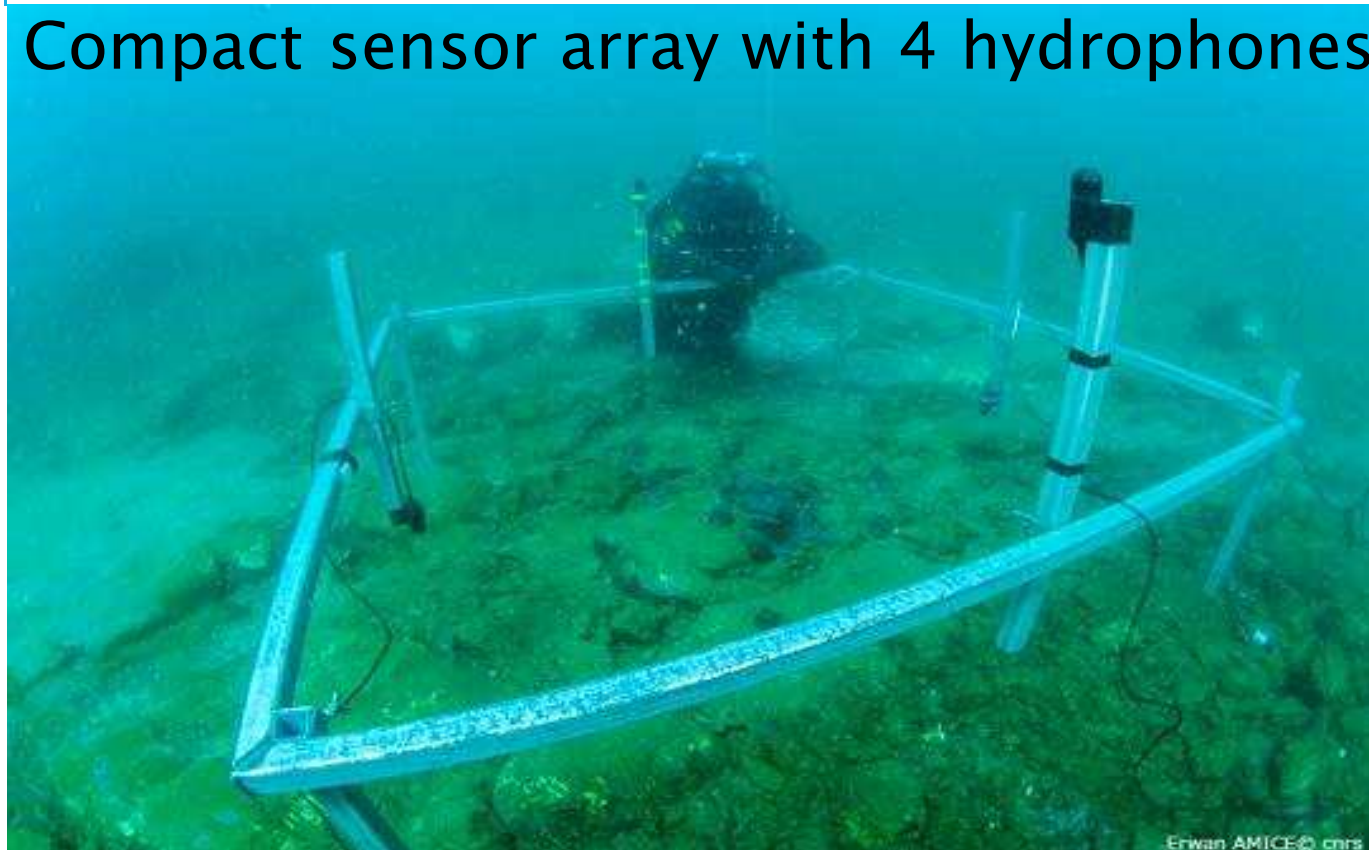


Optical satellite imaging, 13 August 2016



METHODS – PASSIVE TRIANGULATION TDOA

Compact sensor array with 4 hydrophones



2 types of signatures recorded

→ Pschitttt : short wide band energetic pulses



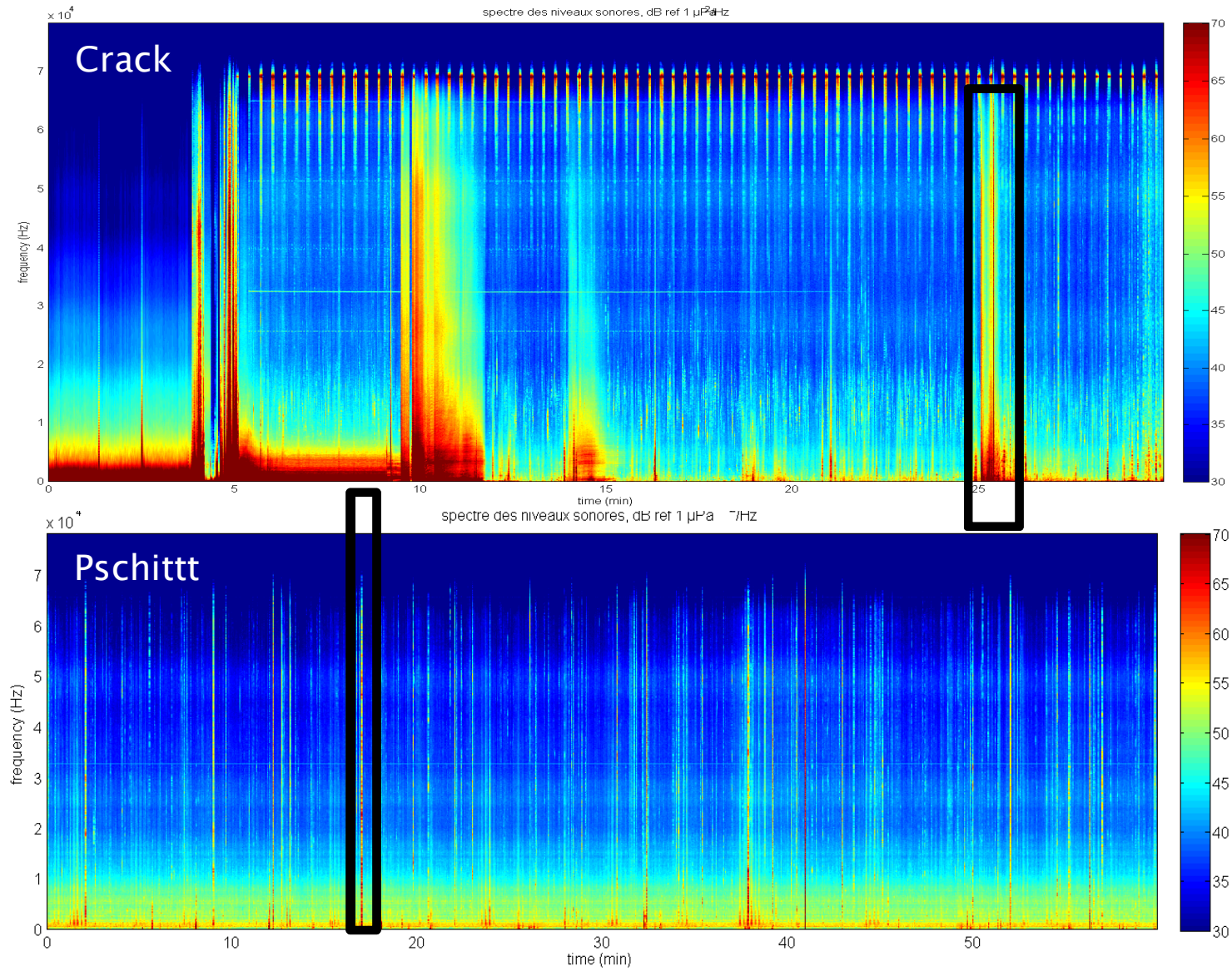
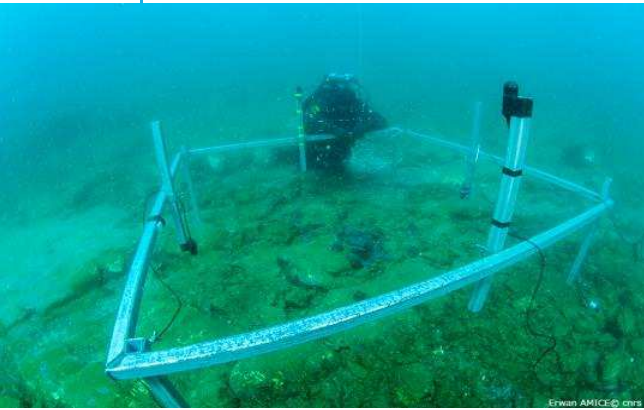
→ Crack : major events of glacier cracking, high energetic



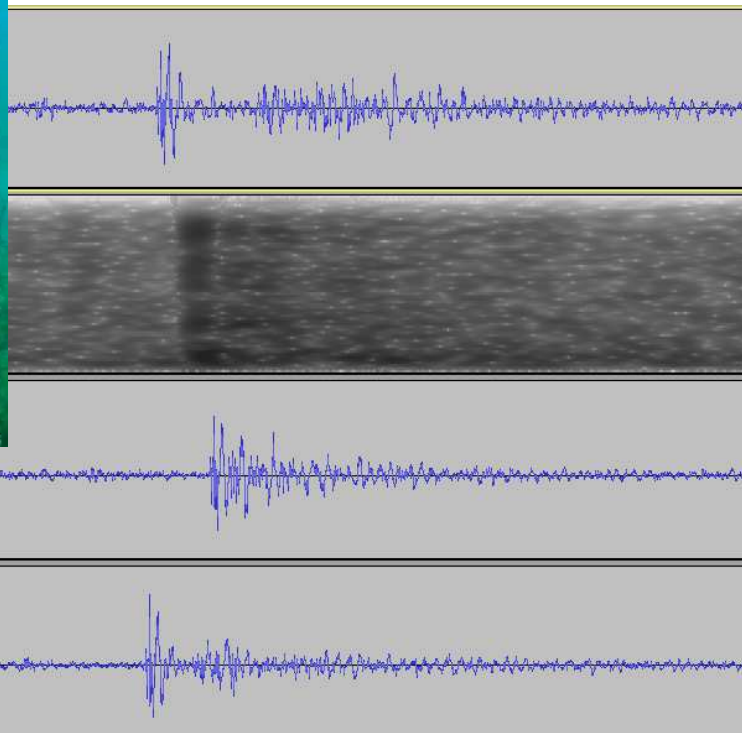
Tegowski et al., 2011 & 2012;

Glowacki et al., 2015

METHODS



METHODS

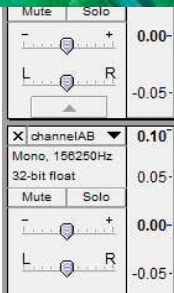


4 channels

TOA of the pulses

TDOA of the pulses

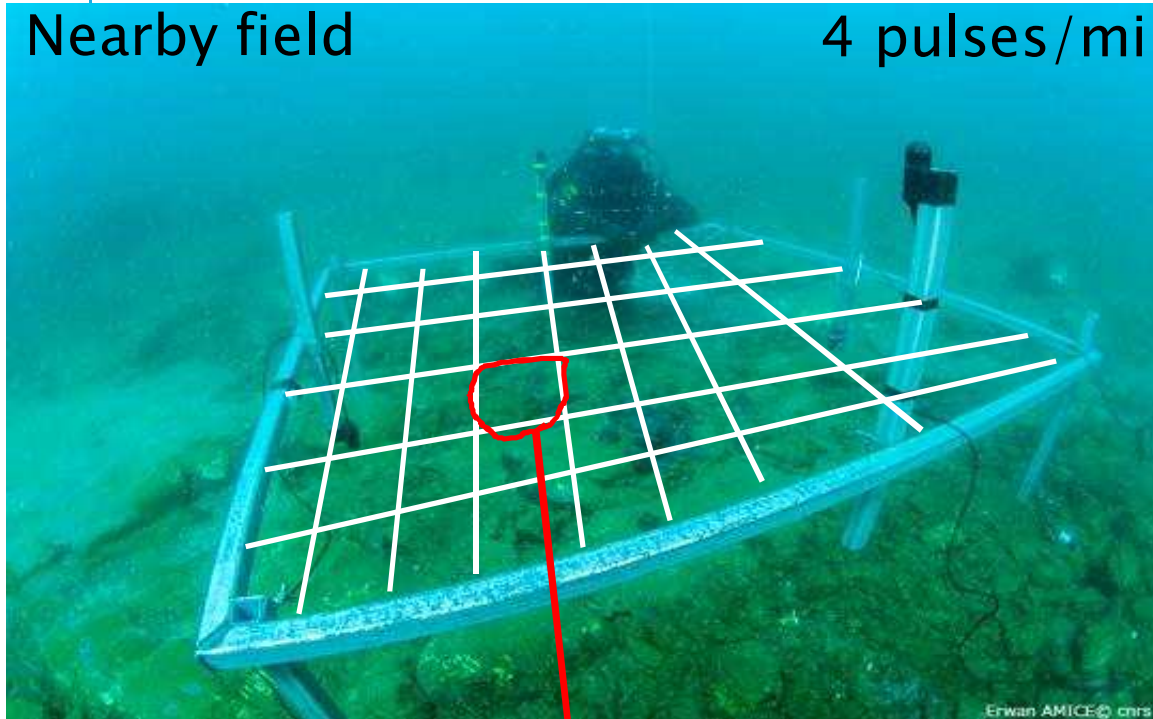
→ triangulation



METHODS

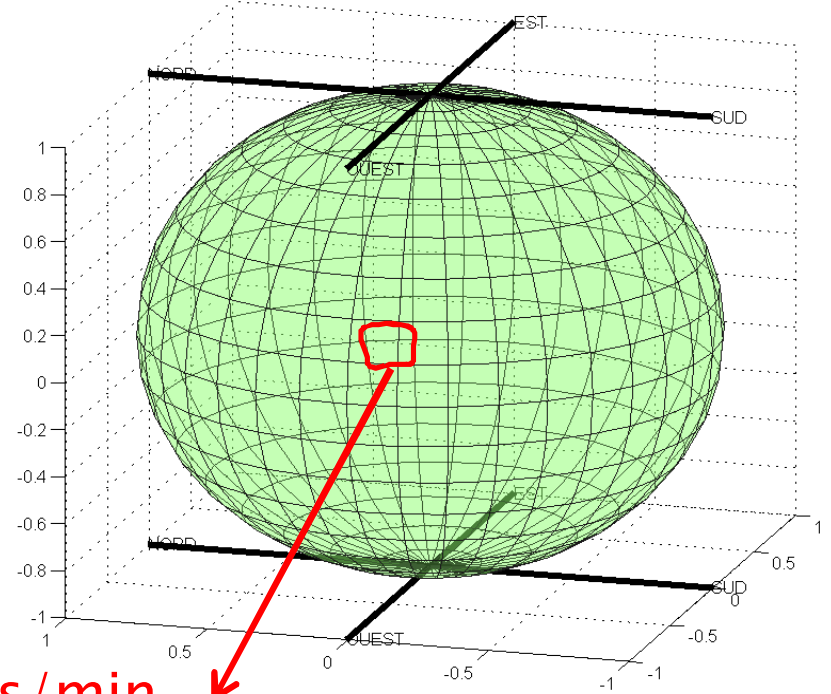
Nearby field

4 pulses/min



Far field

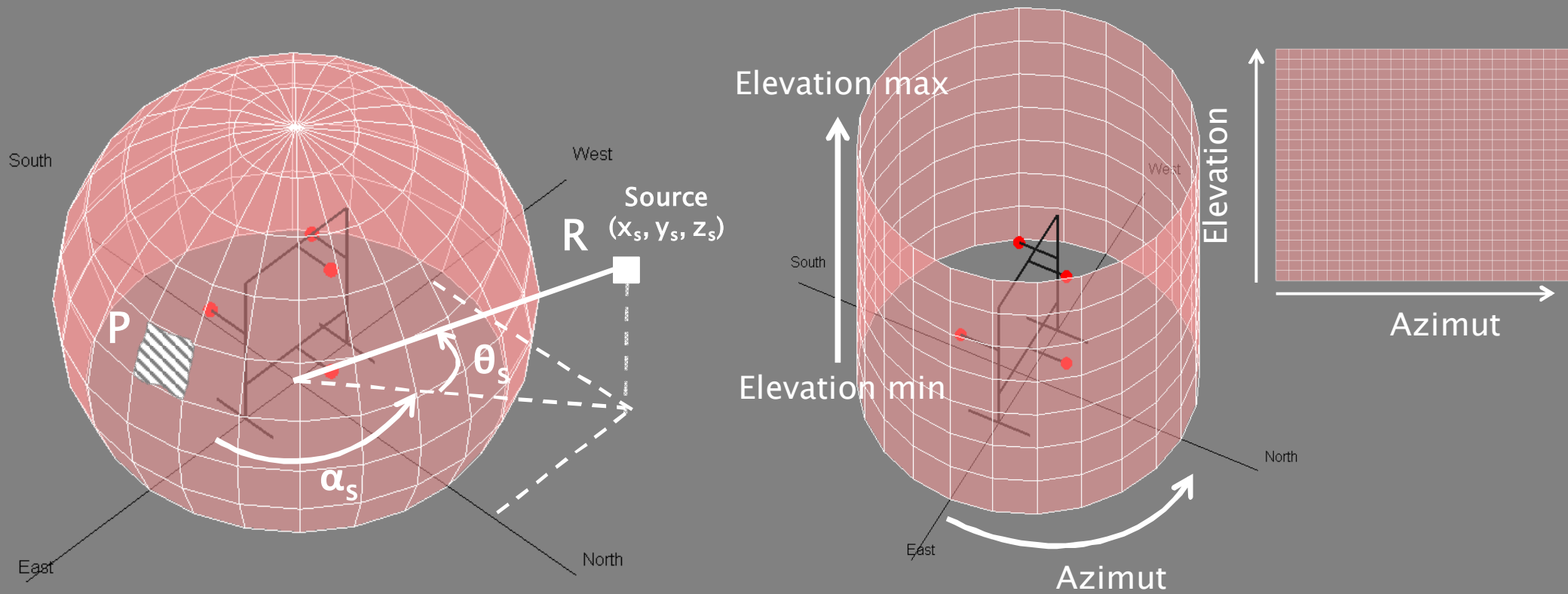
190 pulses/min



↓ Date, Number of signals/min ↓
Time series of features (SPL, fpeak) and their statistics

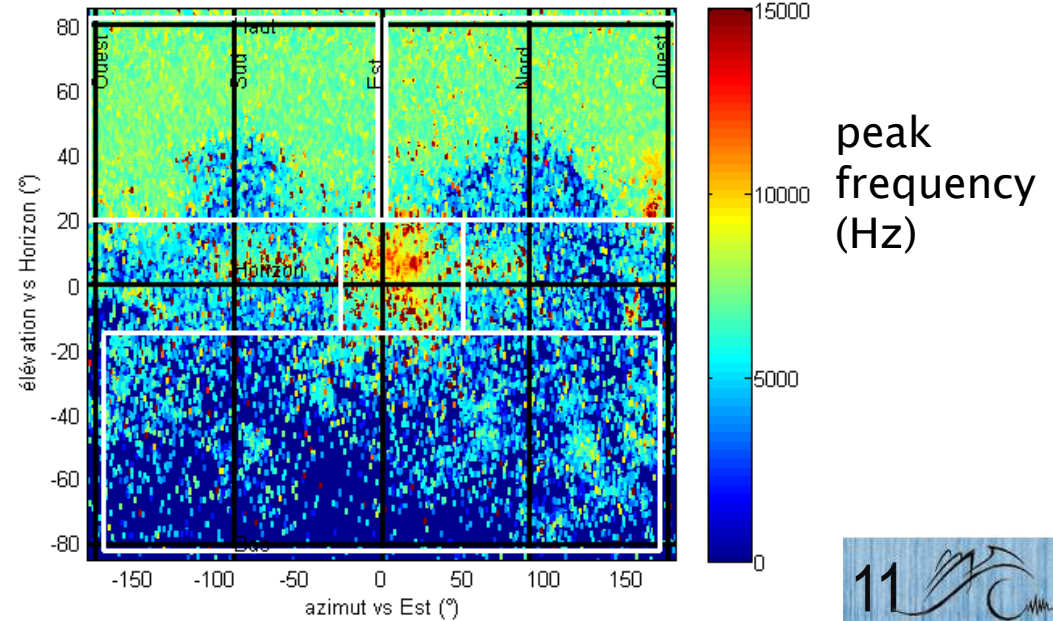
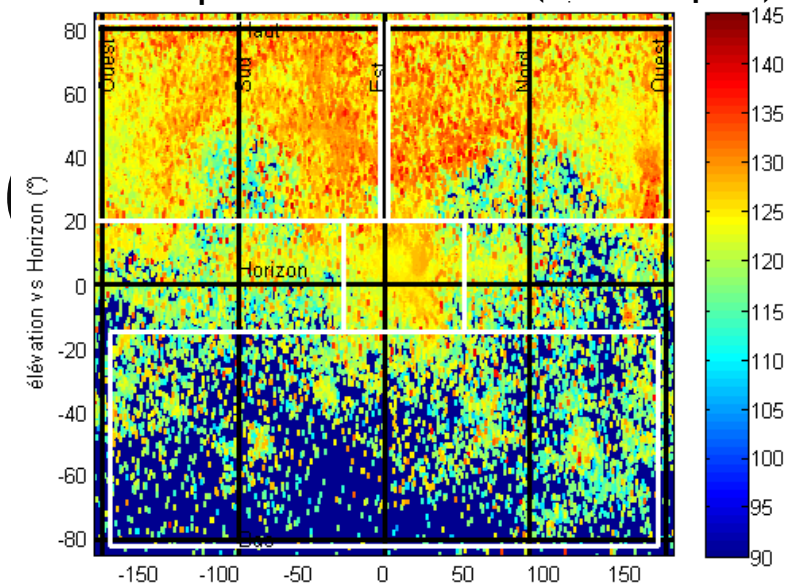
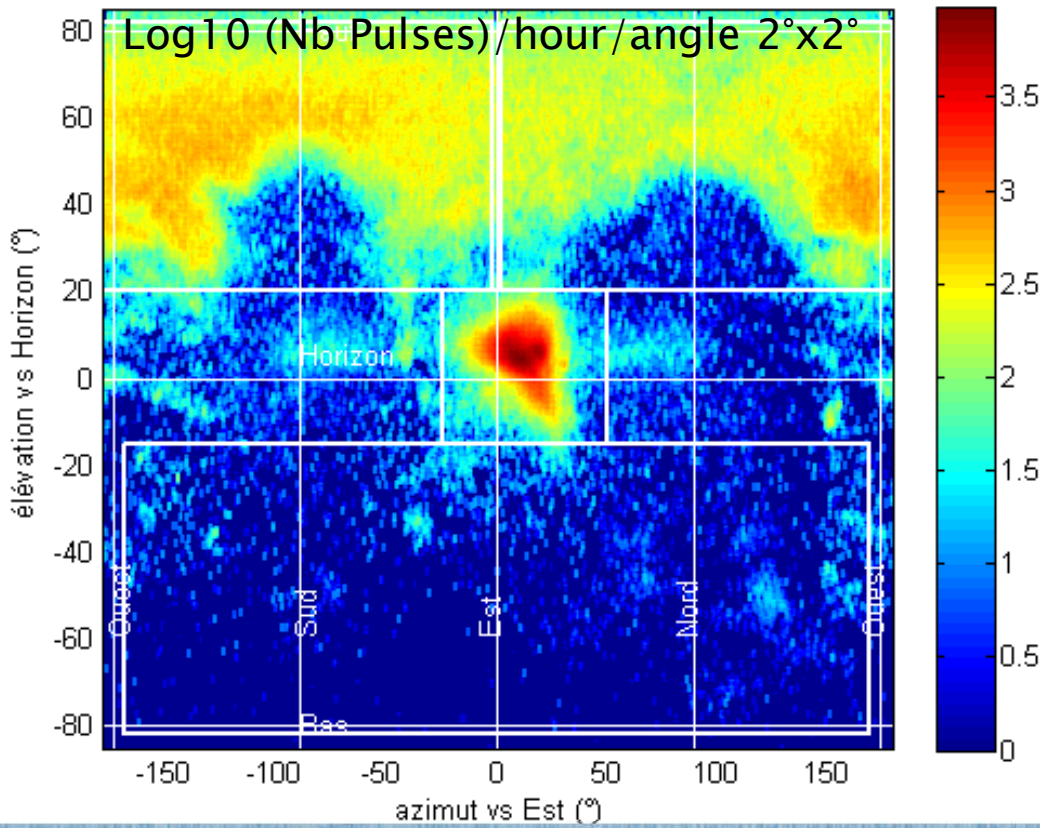


METHODS



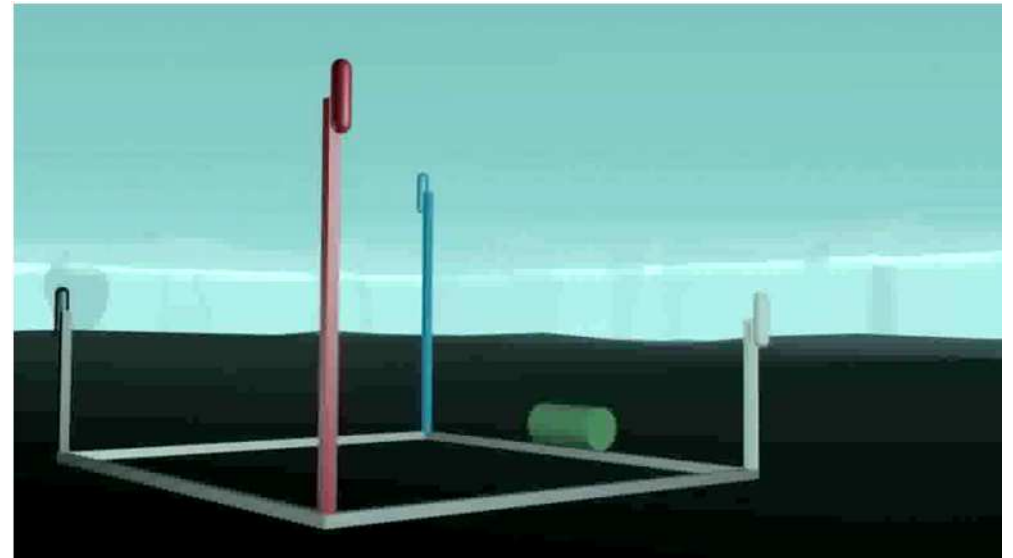
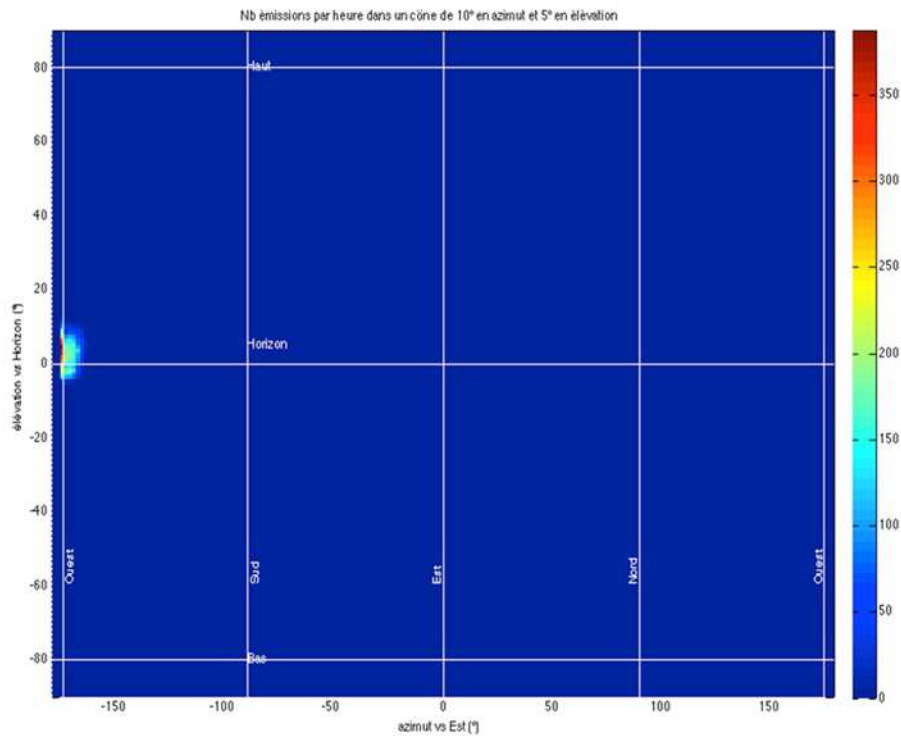
SPL 95 percentile pulses detected (dB re 1 μ Pa)

MAPPING CRYOGENIC S



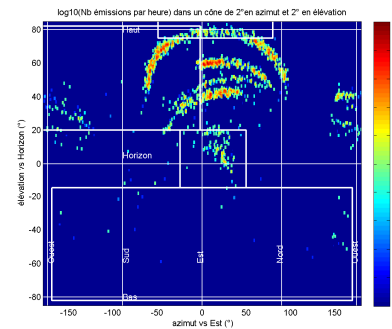
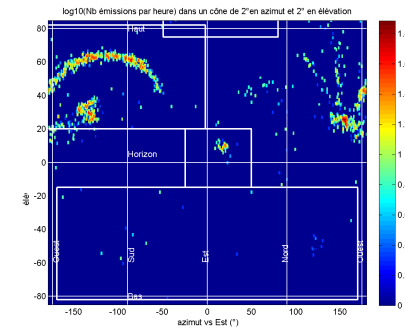
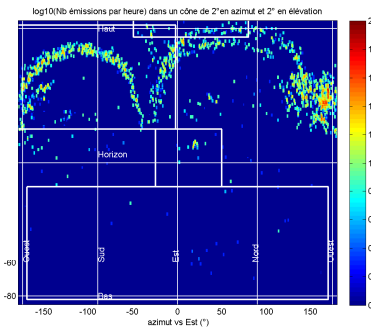
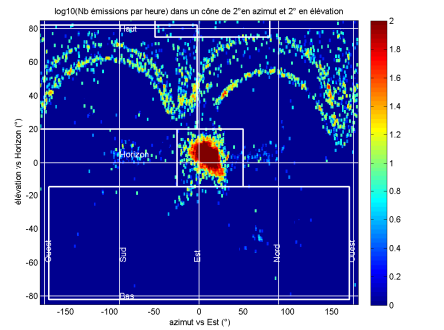
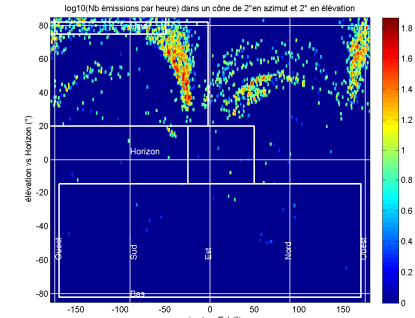
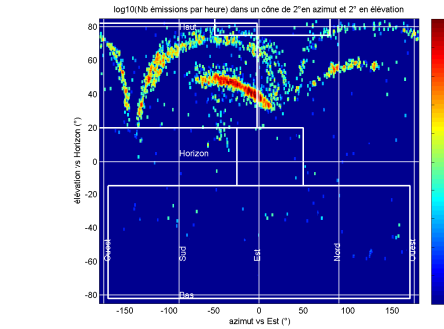
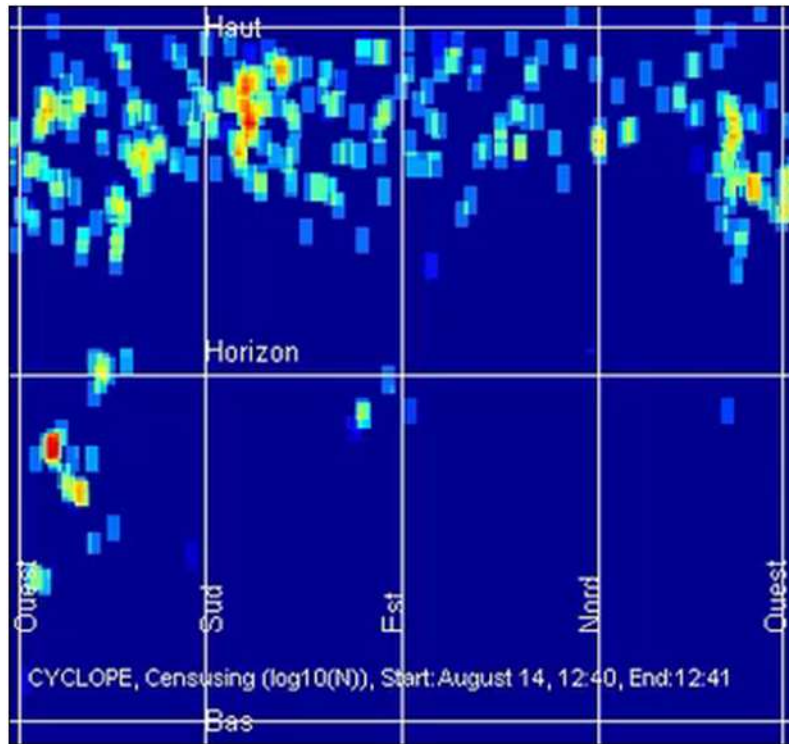
TRACKING

Simulation : Growler emitting 5000 pulses/position

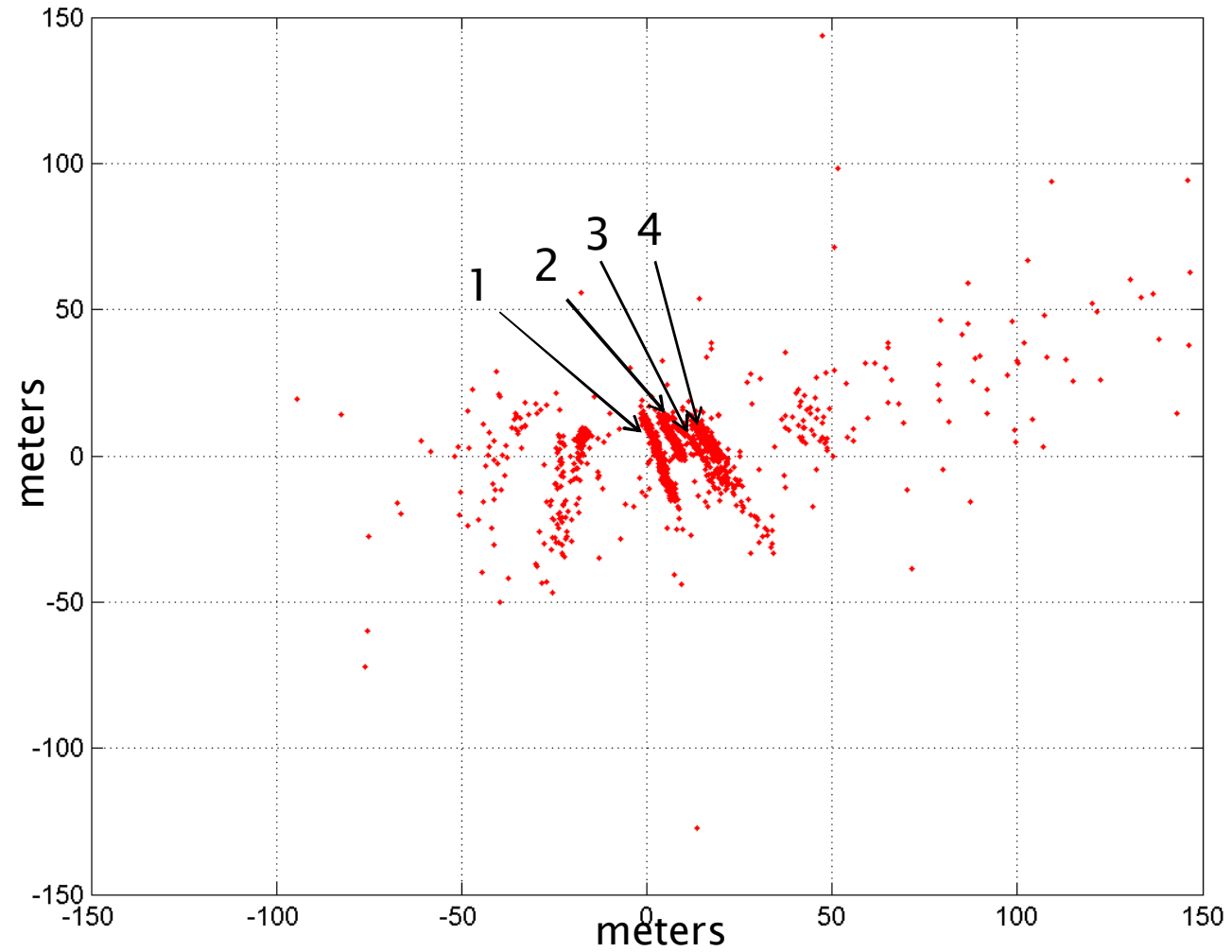
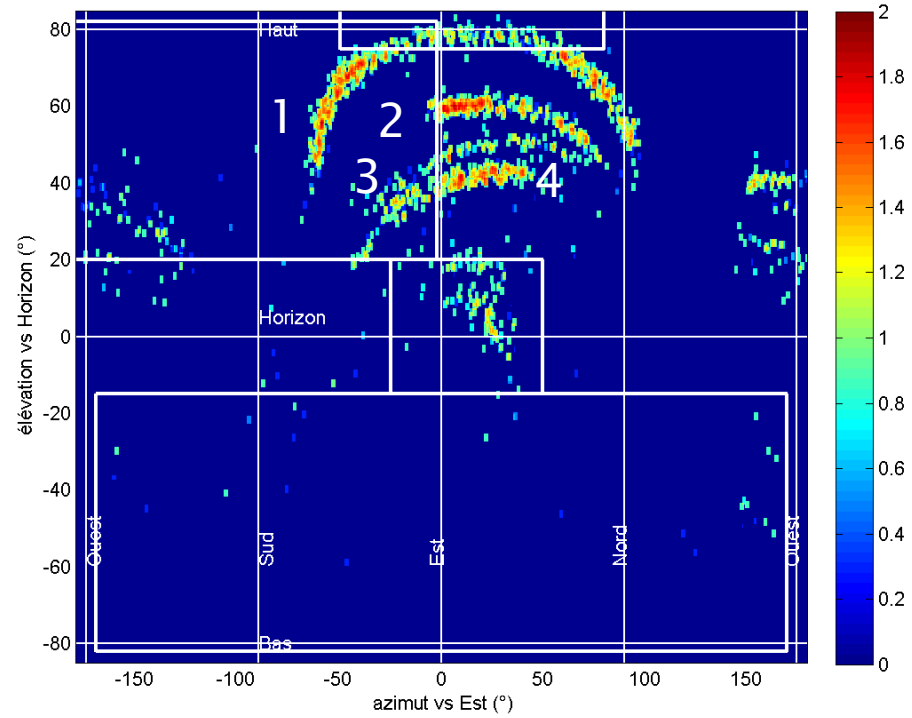


TRACKING

Real data

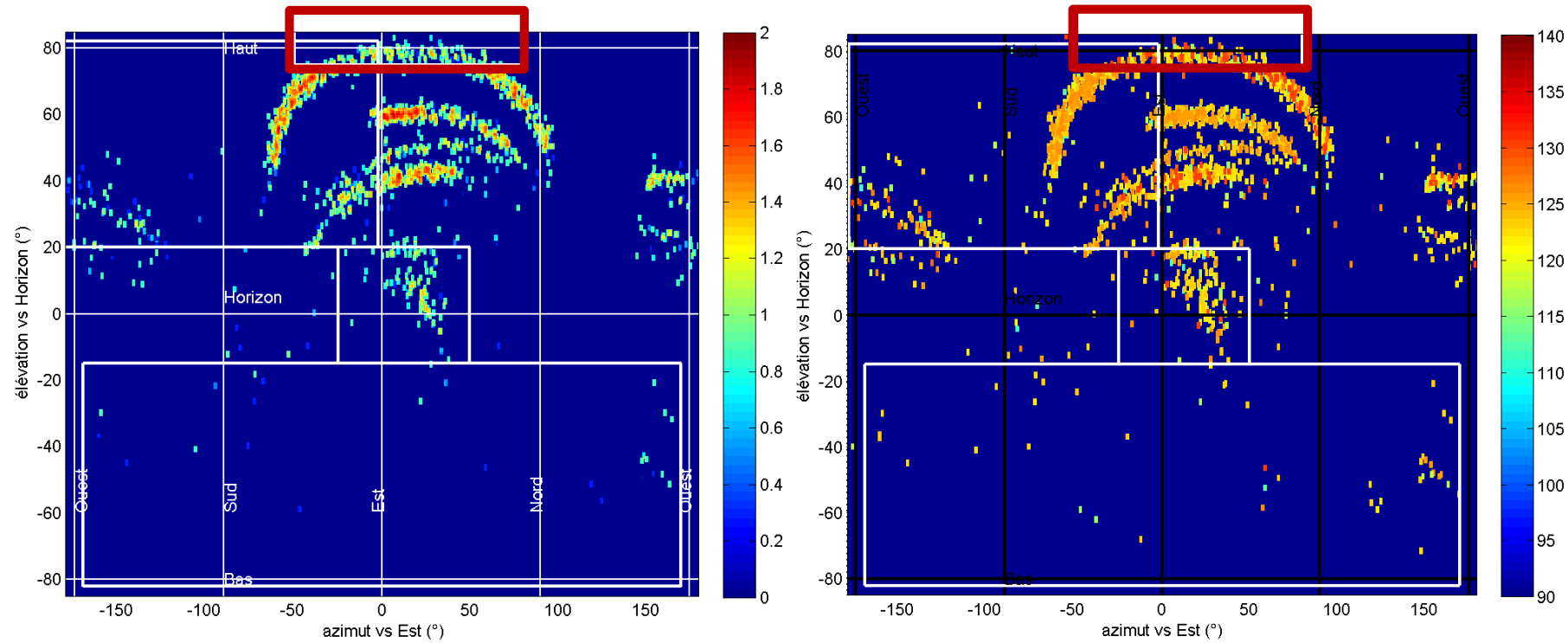


TRACKING

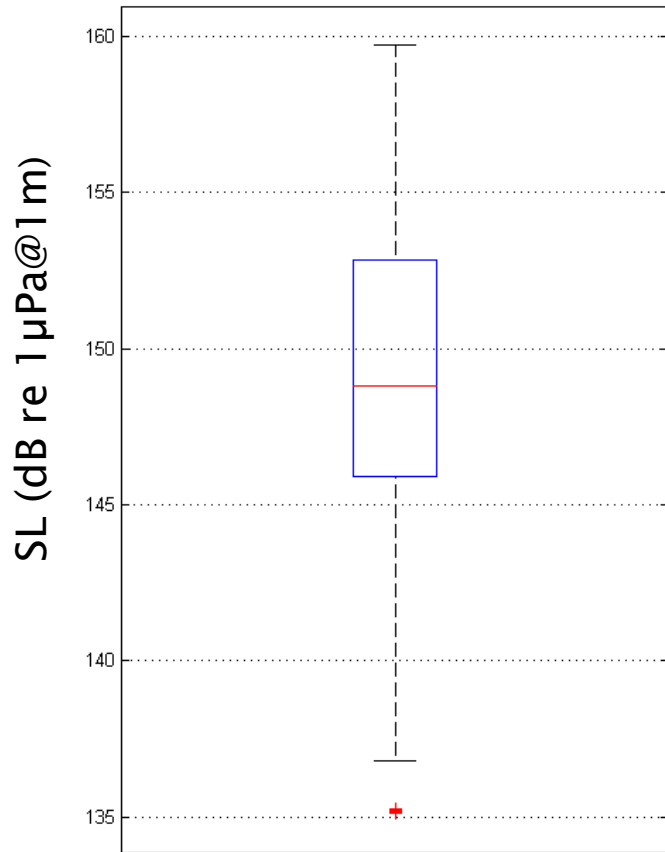


SL OF A GROWLER

Log10 (Number of pulses detected & location) vs Level (dB re 1 μ Pa) of the pulses



SL OF A GROWLER



2952 pulses at 5m(max) of the recording array

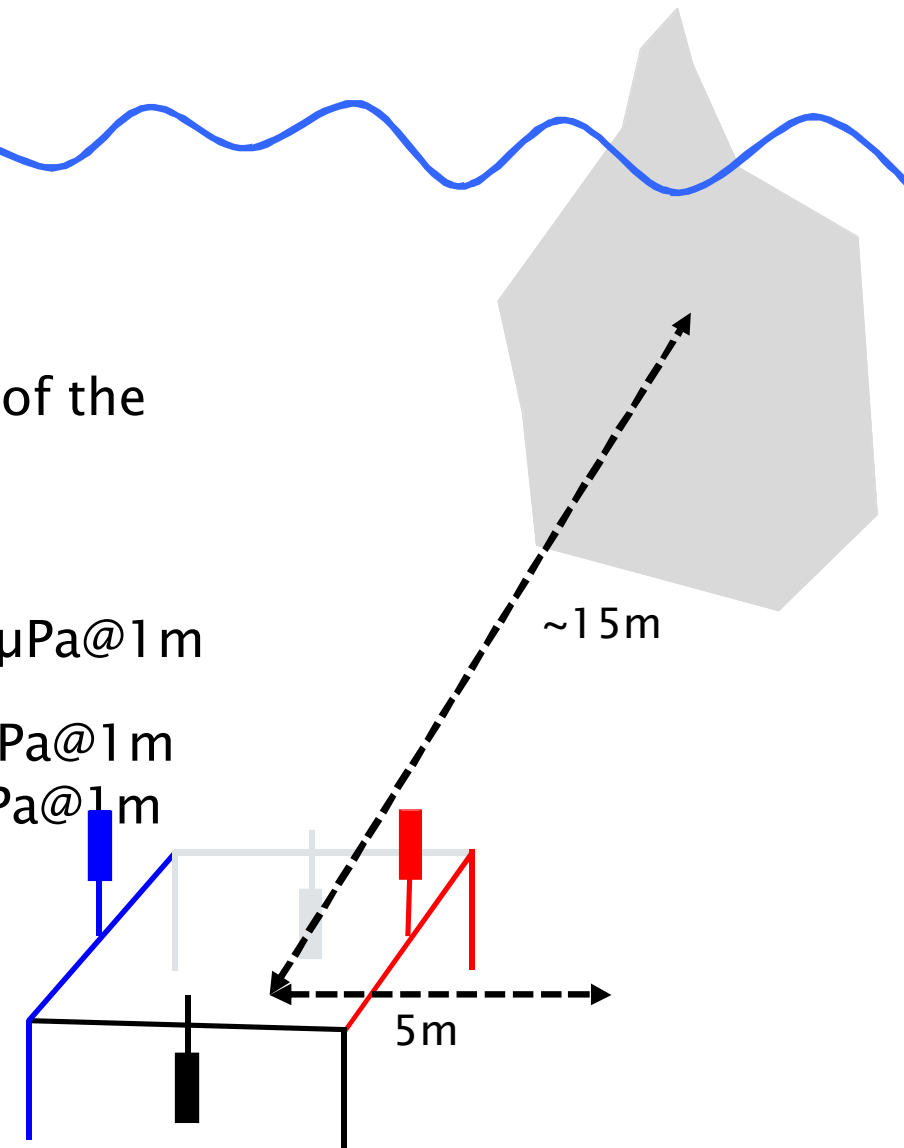
→ estimation of the SL

Mean SL = 148,8 dB re 1 μ Pa@1m

Max SL = 159,8 dB re 1 μ Pa@1m

Min SL = 135,1 dB re 1 μ Pa@1m

Range \approx 316m
(ANL \approx 90dB re 1 μ Pa)



CONCLUSIONS & PERSPECTIVES

DONE :

- Quantitative description of the noise emitted by growler with its SL
- Triangulation & tracking of small icebergs

TO DO :

- ➔ Localization of “Crack” sounds
- ➔ Complementarity with satellite imagery

Thank you for your attention !

<https://chorusacoustics.com/>



