Biolloging

Overview of existing techniques and future directions

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Introduction

Compared to seabirds or pinnipeds investigating the ecology of whales is a complicated task.

- They do not come on land
- They are “naked” (no hair or feather to glue things on)
- They are very big

- And it is even more challenging in the SO (rough seas, sea-ice, remote conditions…)

But despite these difficulties (and because researchers are resourceful) many things have been achieved to address 2 main questions.

- Where do they go?

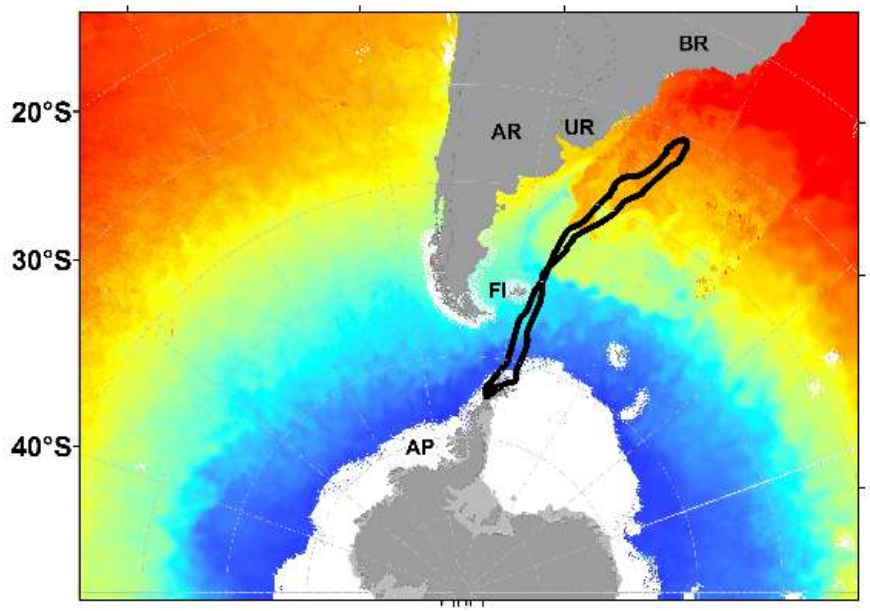
- What do they do ? (Foraging and behavioral data)

As part of this presentation I will present

- A brief overview of what is being done in these two main areas
- Explore new approaches

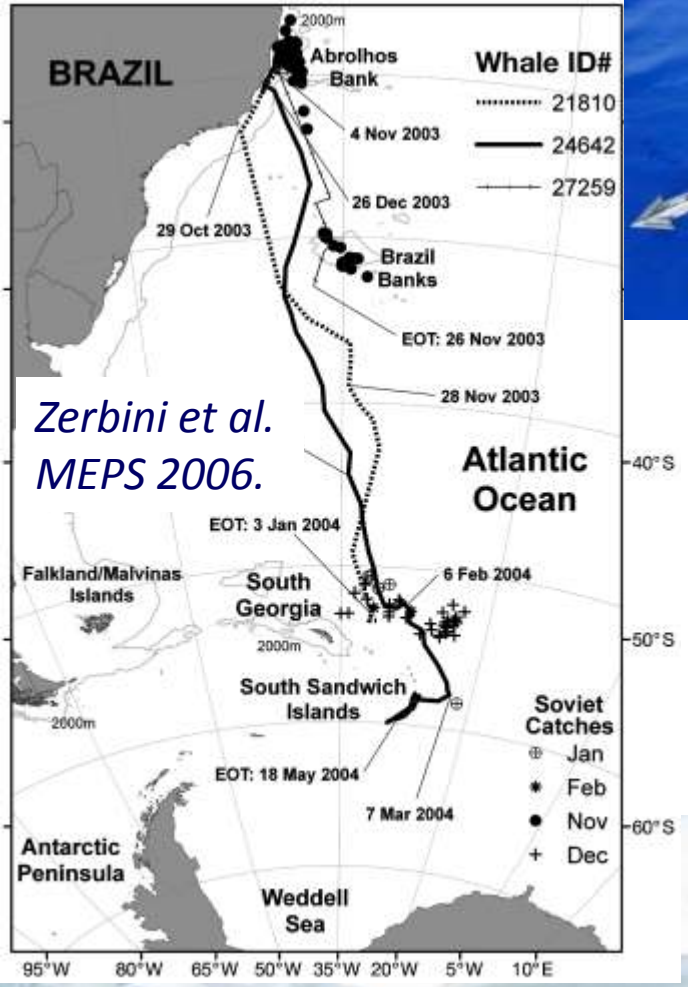
The time scale at which these behaviors are investigated are critical as it determines the attachement method

Part A. Where do they go ? (Tracking)

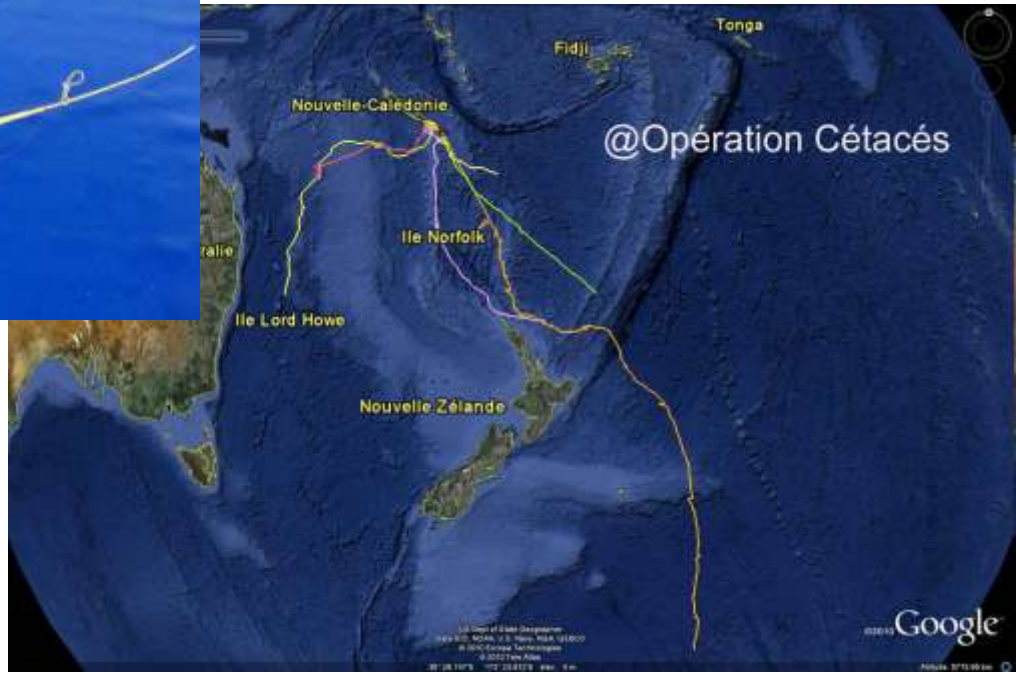


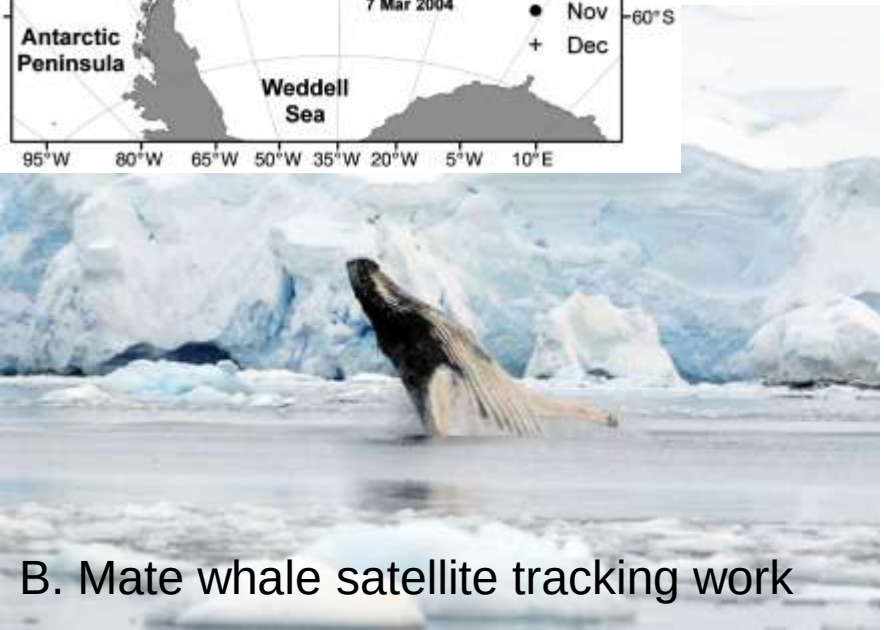
Pitman, Durban
NOAA 2011

Figure 3: Example of the rapid migration of a type B killer whale from the Antarctic Peninsula to the edge of the tropics and back, in just 42 days. Durban and Pitman 2011



Zerbini et al. MEPS 2006.





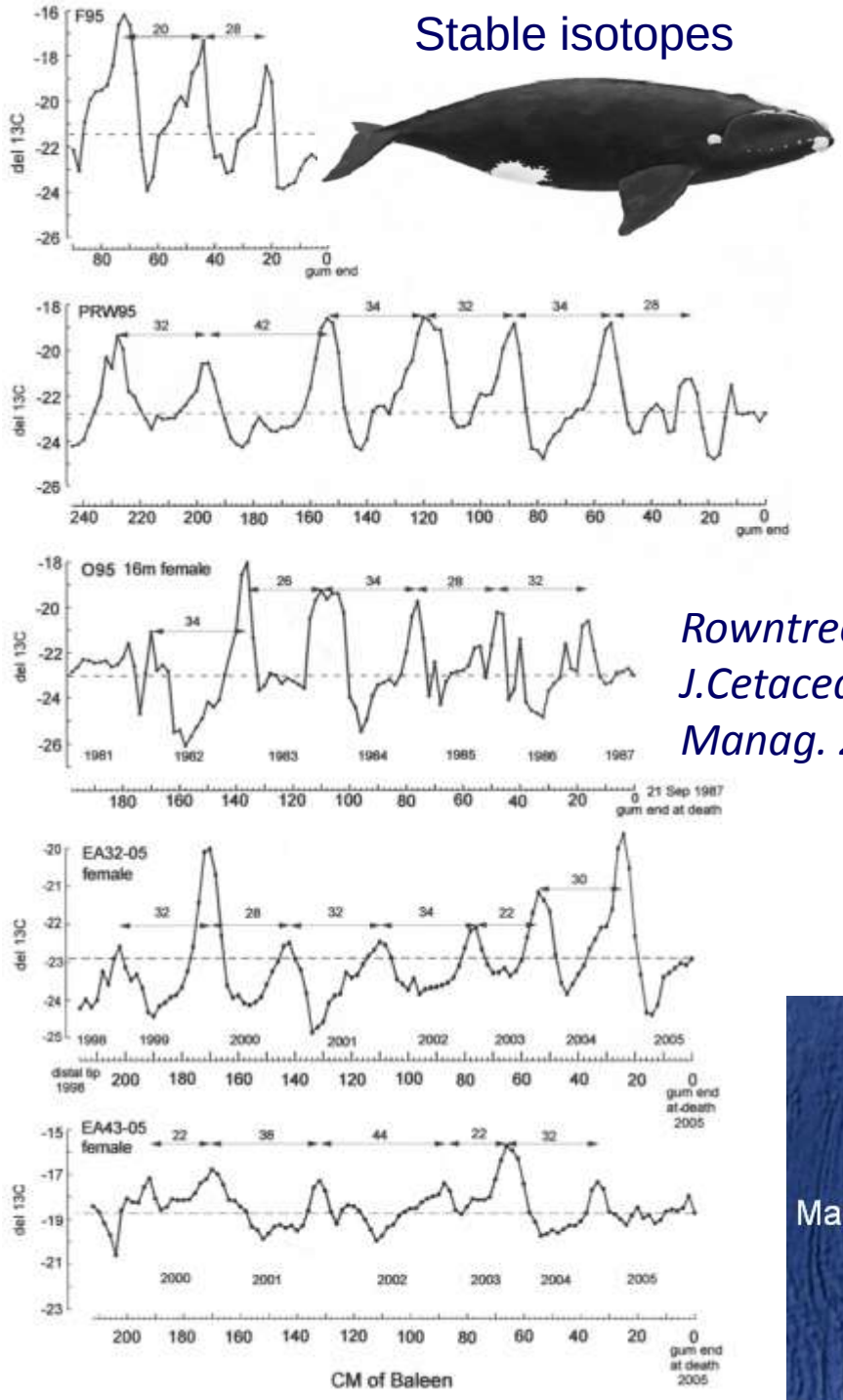
B. Mate whale satellite tracking work

AAD & New Zeland Government, Gales et al. IWC 2011.

But there are still issues with satellite tracking:

- Deployments duration
- Mainly location only satellite tags
- Tracking data may ot be enough
- Worth completing the biolloging approach with some other techniques.

Stable isotopes



Rowntree et al. J.Cetacean Res. Manag. 2009

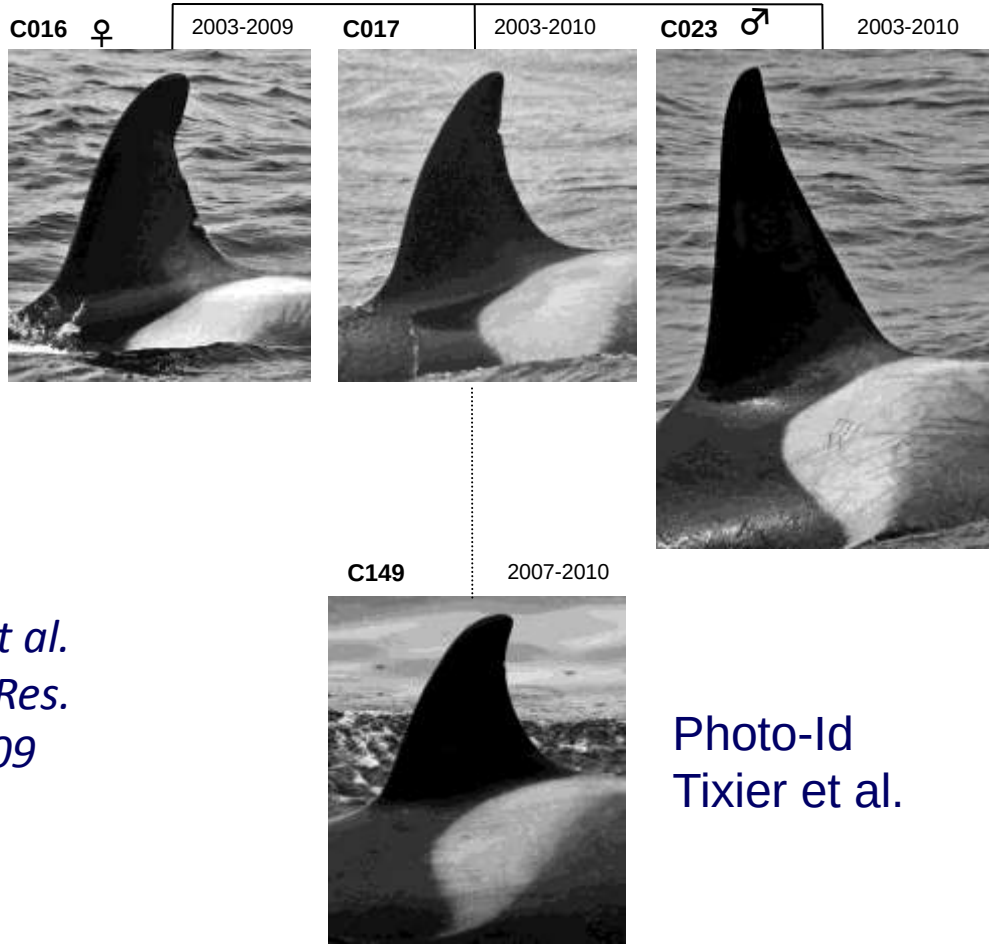
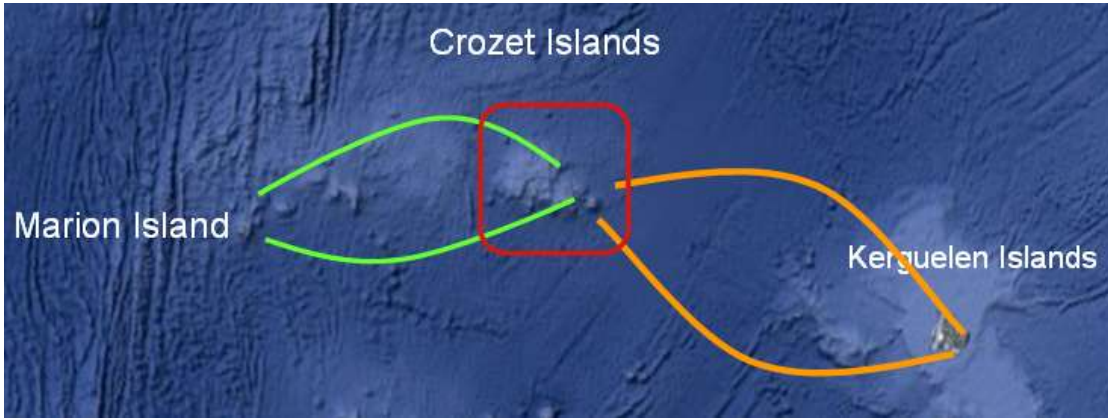


Photo-Id
Tixier et al.

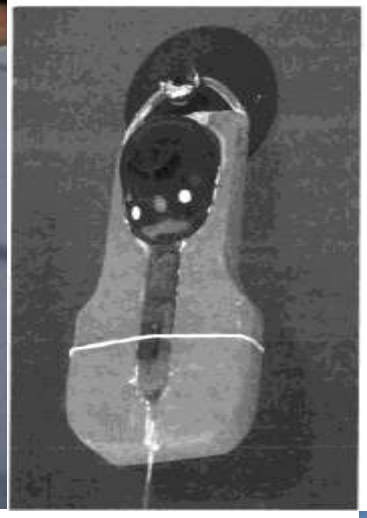


Part B: What do they do?

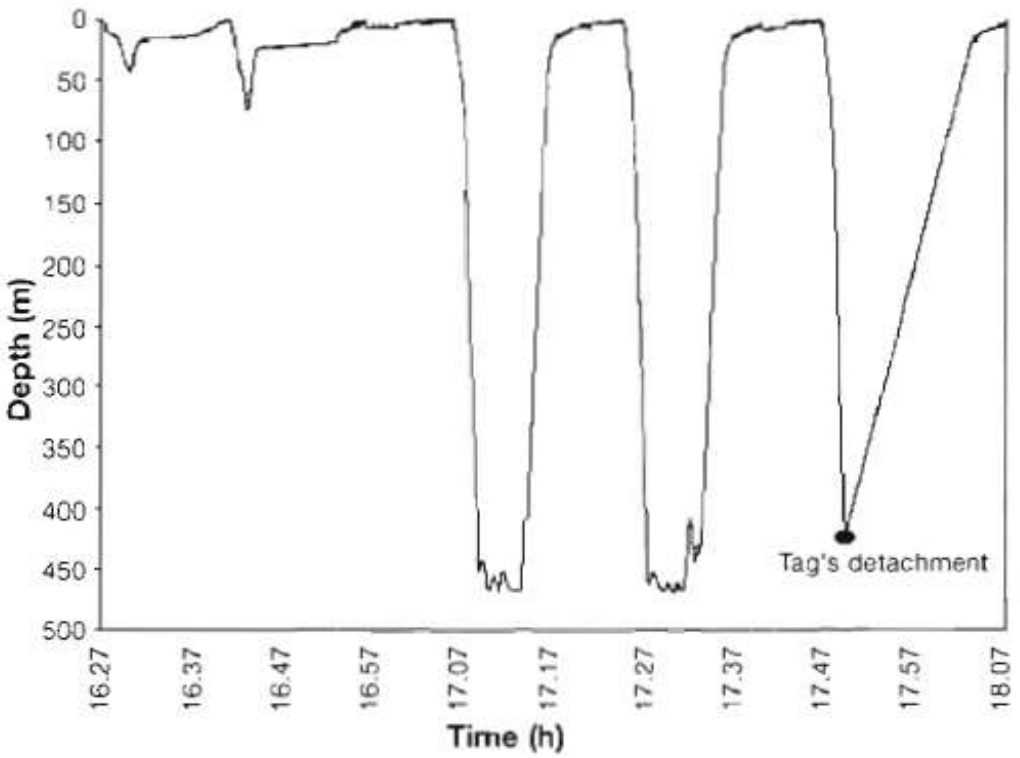
- A better understanding of their foraging behavior (diving, feeding, …)

- Assess how successful they are.

- To address these questions the main strategy is to proceed to short term deployment of a broad range of loggers

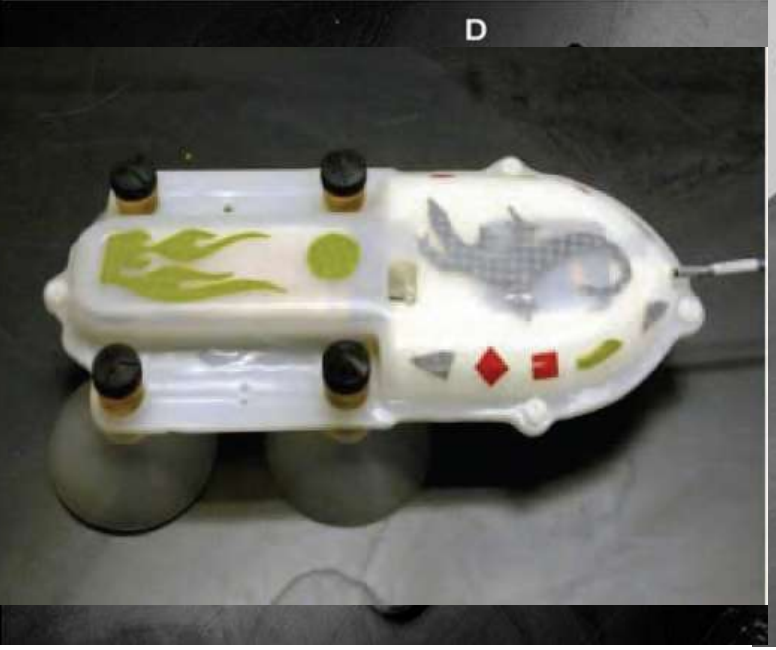


But we need to recover the instrument… to recover the data !!!

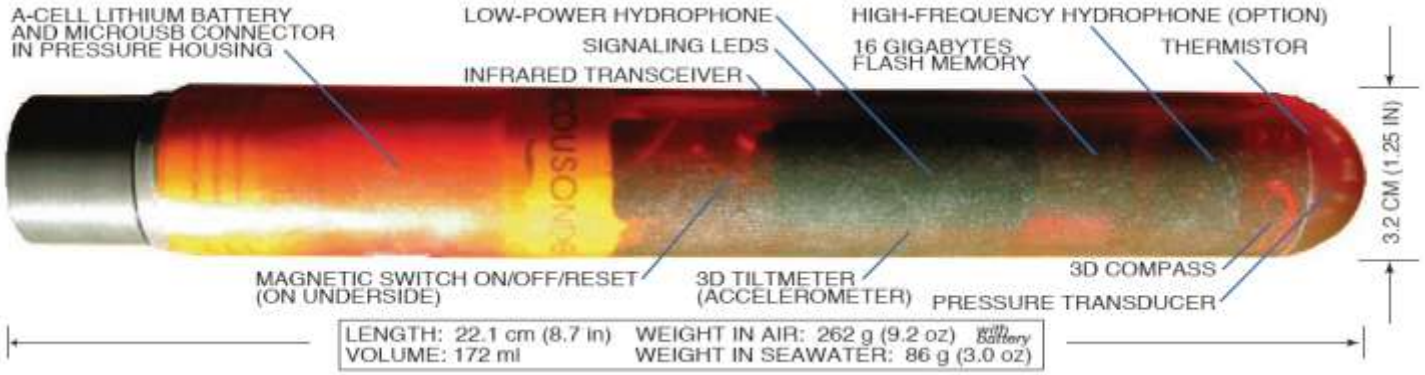


Panigada et al. 1999. MEPS

See presentation Ari Friedlander

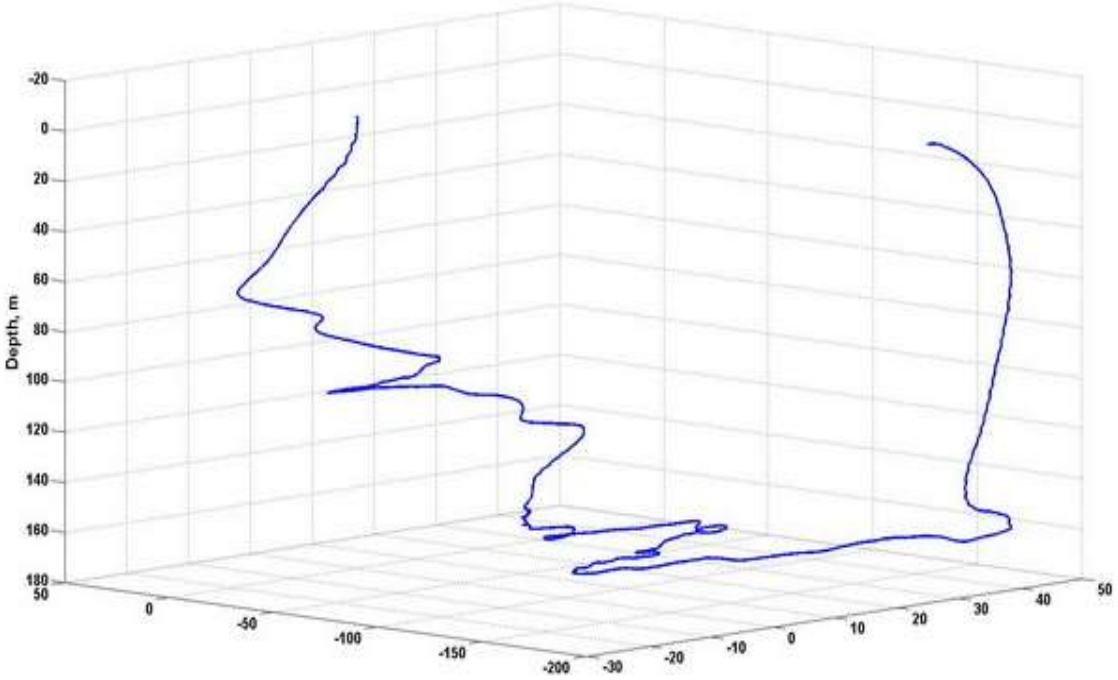


Acousonde,
W. Burgess



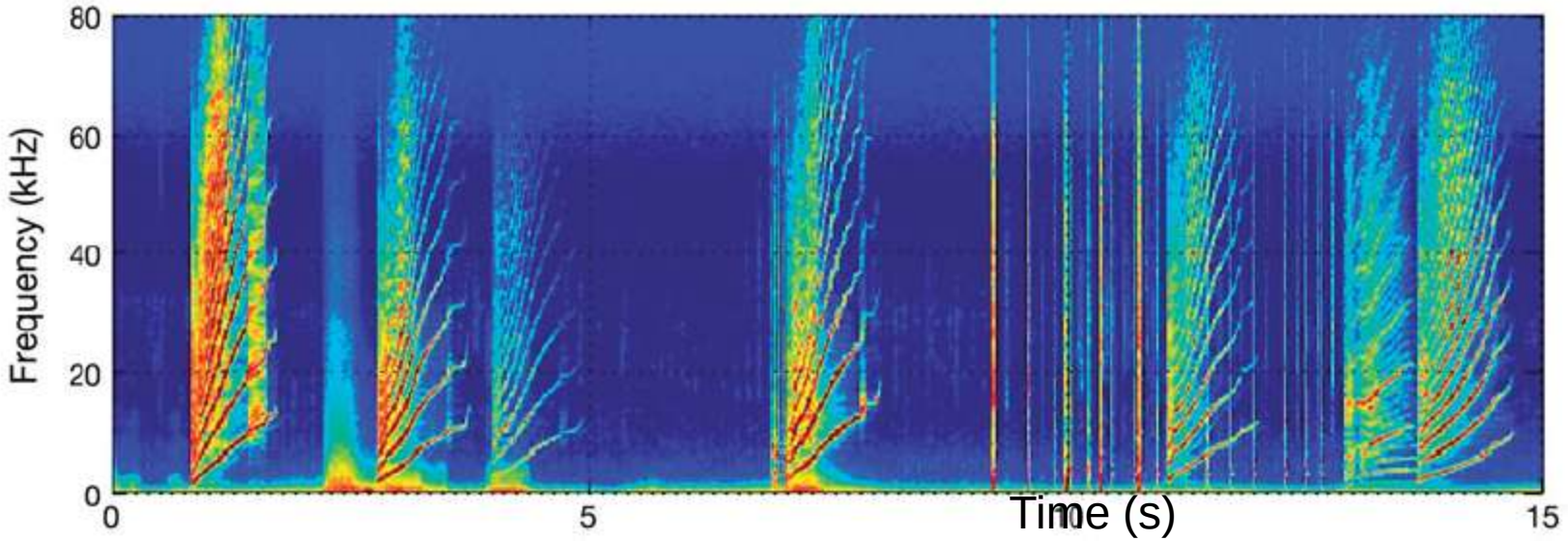
Pressure sensor, accelerometer, magnetometer, hydrophones, temperature, light sensor, …

These loggers provides a huge amount of data over short periods of time



3-D dive tracks

Acoustic Behavior



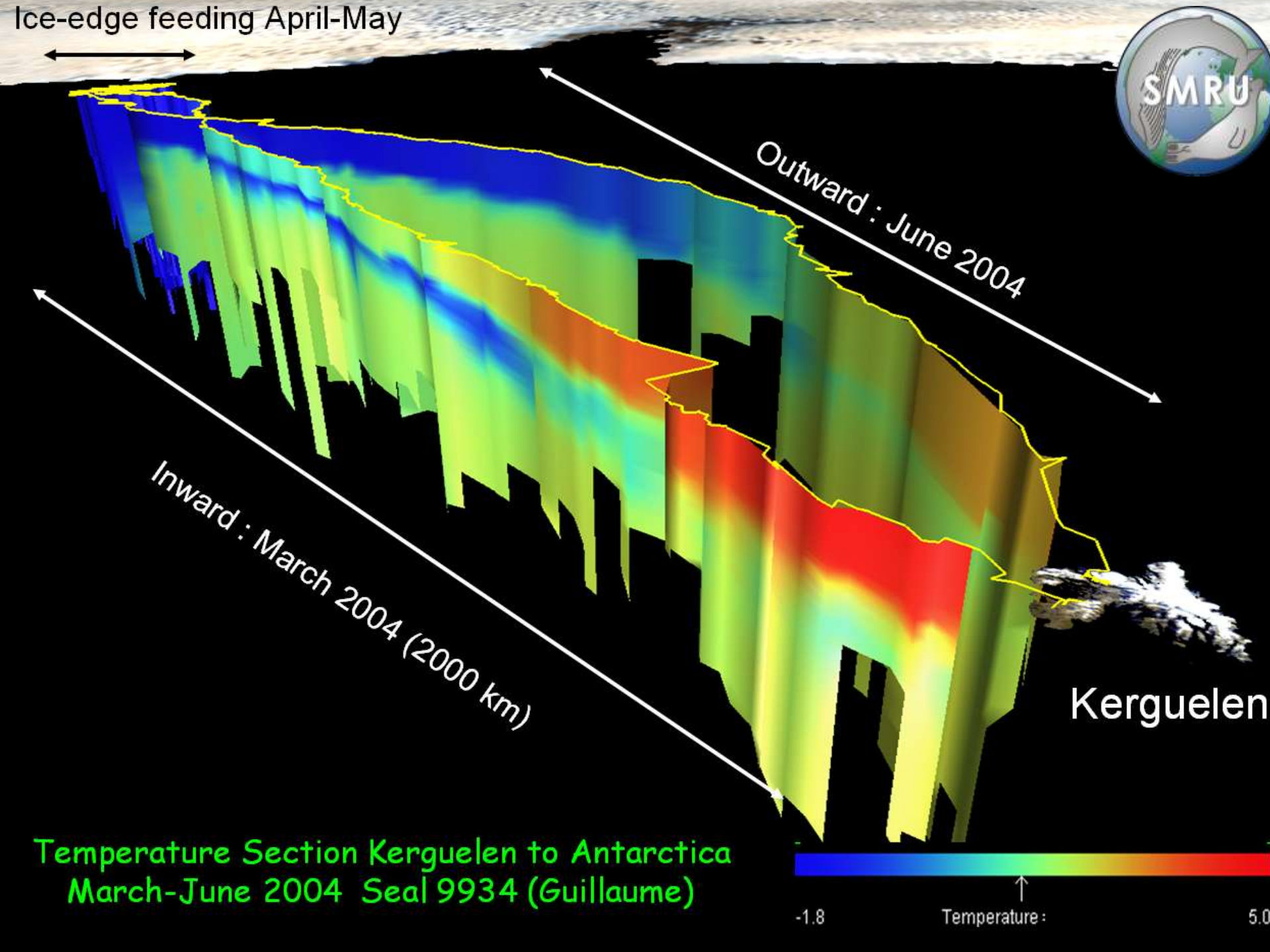
Jonhson et al. MEPS 2009.

Prey species/encounter

Acoustic/social behaviour

Part C: Toward a Cetacean Satellite Data Relayed Tag

- Already exists for small cetaceans and whales (Spot 5 tags Wildlife computers)
  - dive profiles or summary
  - environmental data (temperature)
- For the SO and on Cetaceans Argos transmission is likely to remain the main transmission mode.
  - very short messages
  - but good coverage of the SO


Ice-edge feeding April-May
Outward : June 2004
Inward : March 2004 (2000 km)
Kerguelen
SMRU
Temperature Section Kerguelen to Antarctica
March-June 2004 Seal 9934 (Guillaume)
-1.8
Temperature :
5.0

On-board processing of the data

- We are facing the same challenges than with pinnipeds that we can't recapture (too difficult or because they die at sea)

  ➢ Behavioral tags are generally too big and the volume of data collected is too large to be processed inboard (both in terms of processing time and energy consumption) to be transmitted via Argos.

  ➢ the need to identify the relevant summary variable (to be transmitted) and assess the energy consumption and time necessary for inboard processing

  ➢ Priorities have to be defined depending on the questions to be addressed.

A Personal point of view: the accelerometer priority

➢ Many questions relevant to foraging ecology can be addressed by the use of accelerometer in combination to pressure data.

- foraging effort (swimming effort)
- foraging success (prey catch rate)
- net foraging success (body condition)

➢ 3-D accelerometers are small, easy to integrate in a tag,

➢ They are new fast Fourrier transform methods allowing the rapid and efficient processing of inboard the data, data from only one accelerometer axe might be necessary.

However they are un number of issues

- It is critical to have previously assessed

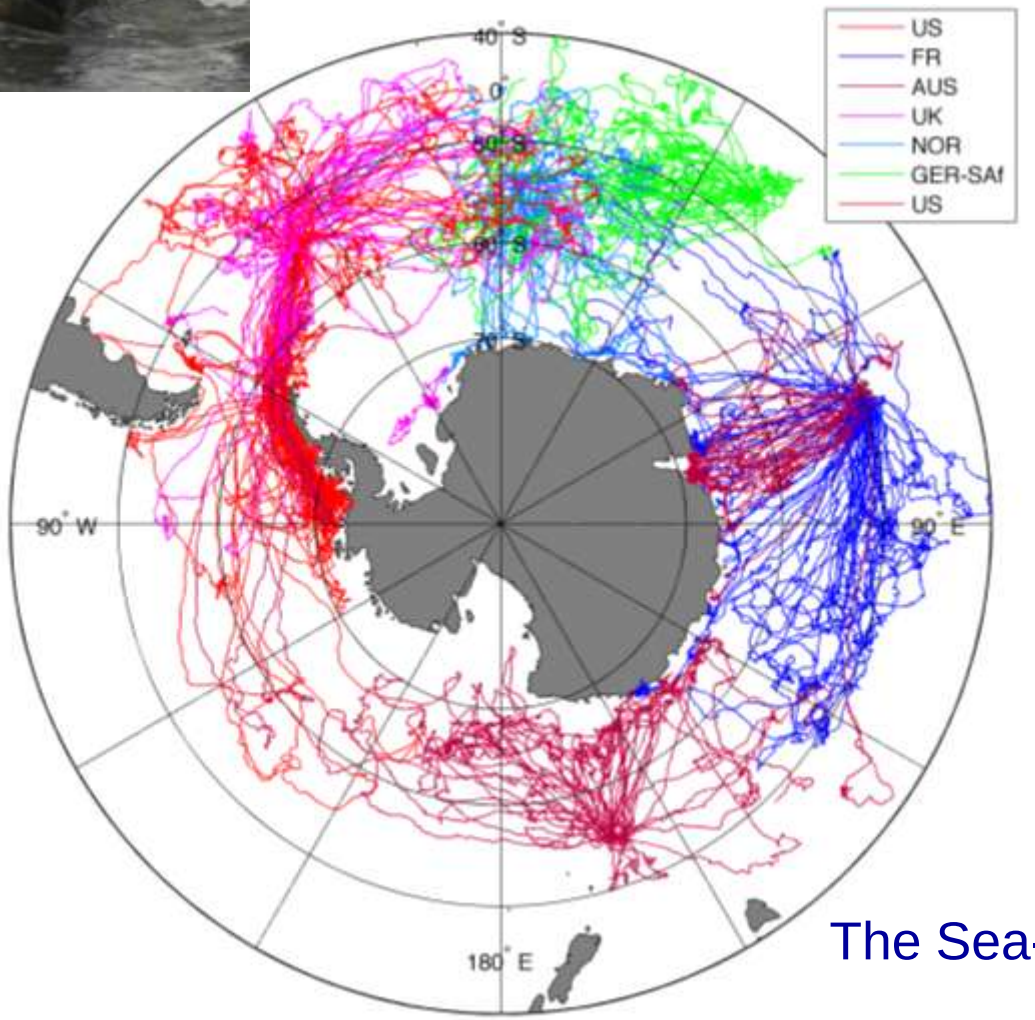
  - Time and energy requested to inboard processing of the data

  - To develop processing alorythm high resolution data sets are needed to assess the most efficient processing method and the most informative output variable…

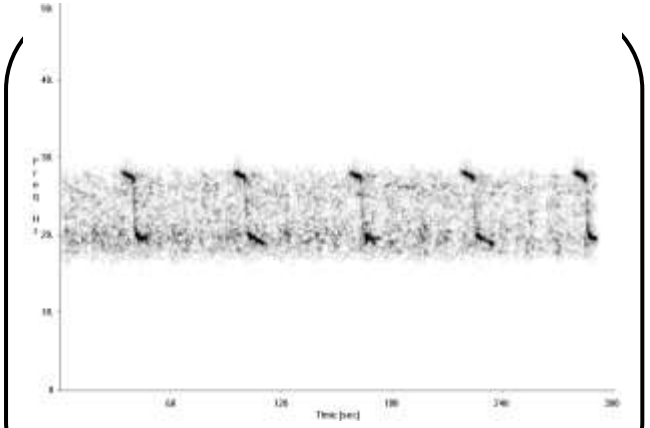
- Species (or group of species) adjusted

- Difficult to control for the accelerometer position on a tag deployed on a whale (1) correction method, (2) these approaches are more likely to provide relative values more than absolute ones (uncalibrated)

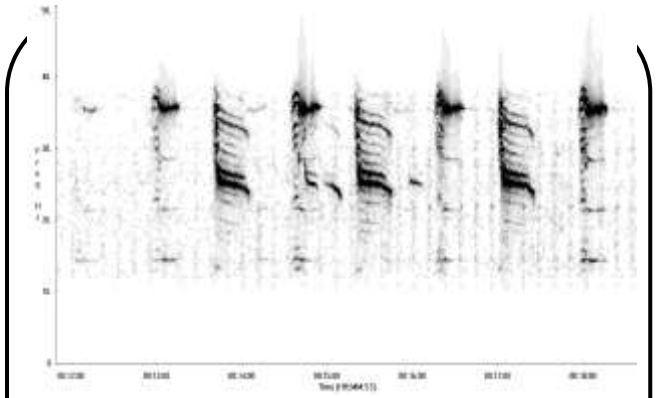
Part D : Using pinnipeds to investigate cryptic Cetacean ecology.

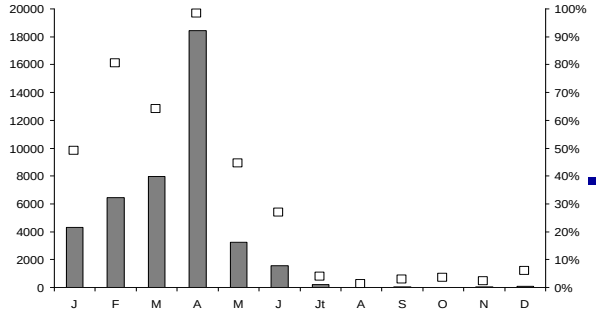


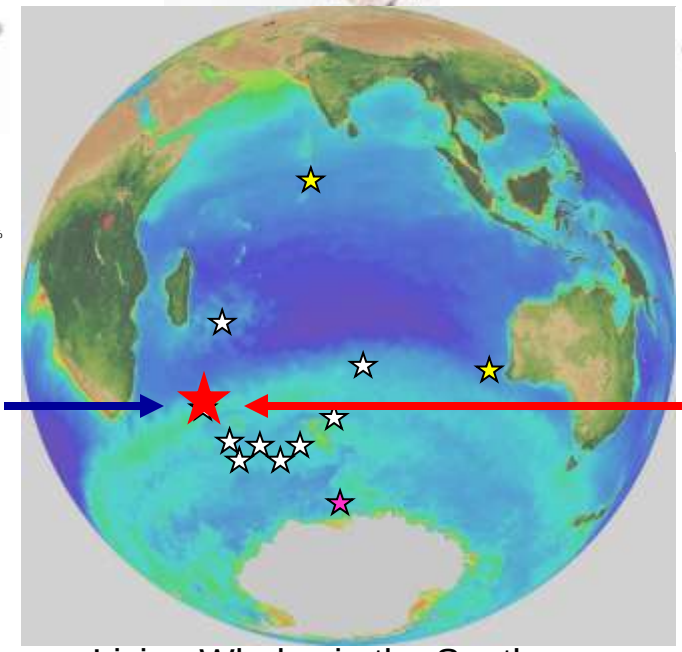
Antarctic Blue whale call

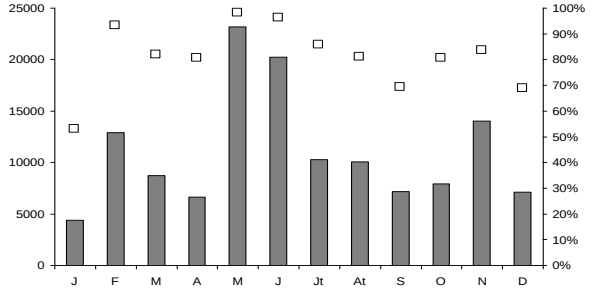


Madagascan pygmy blue whale



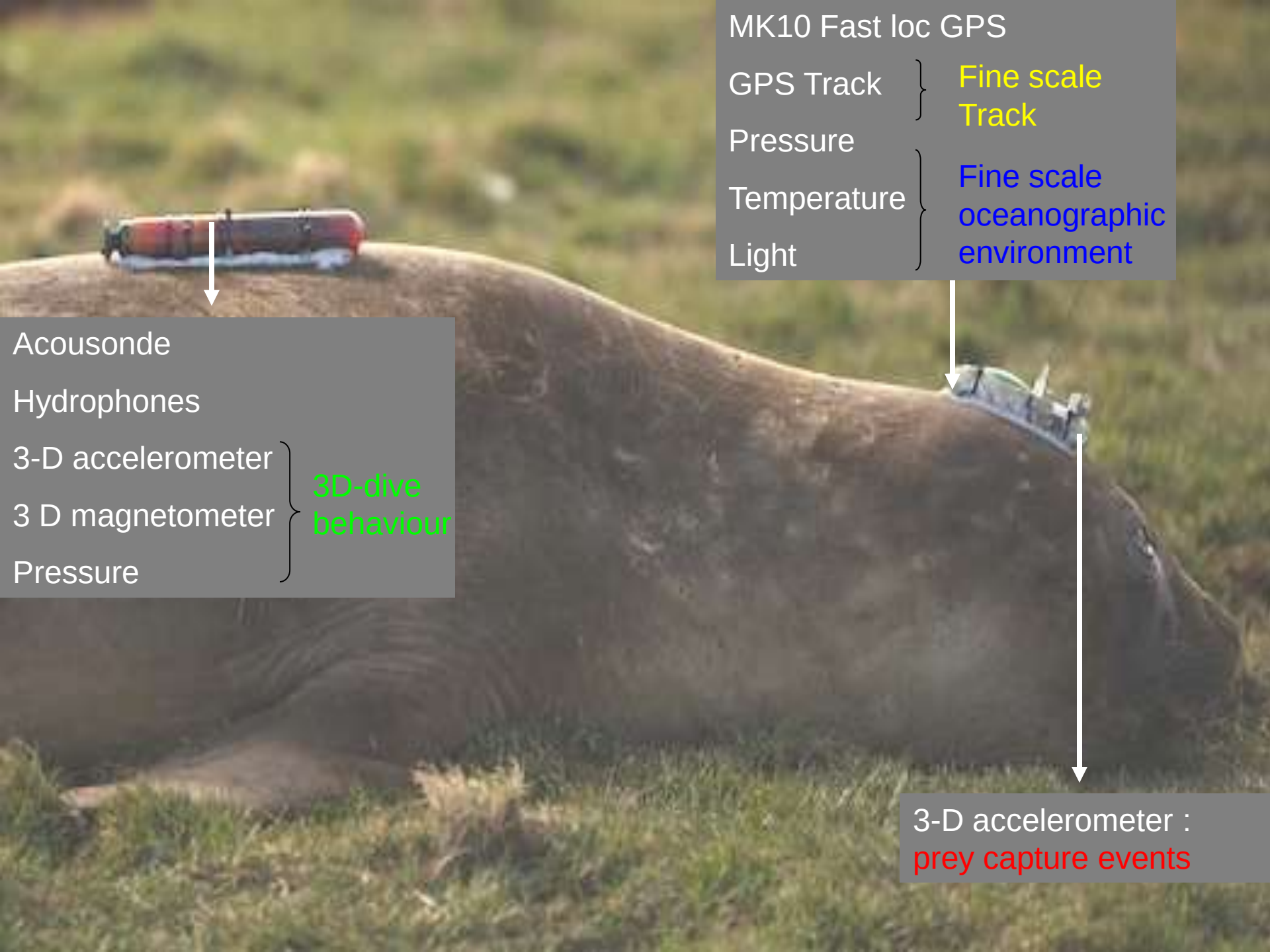


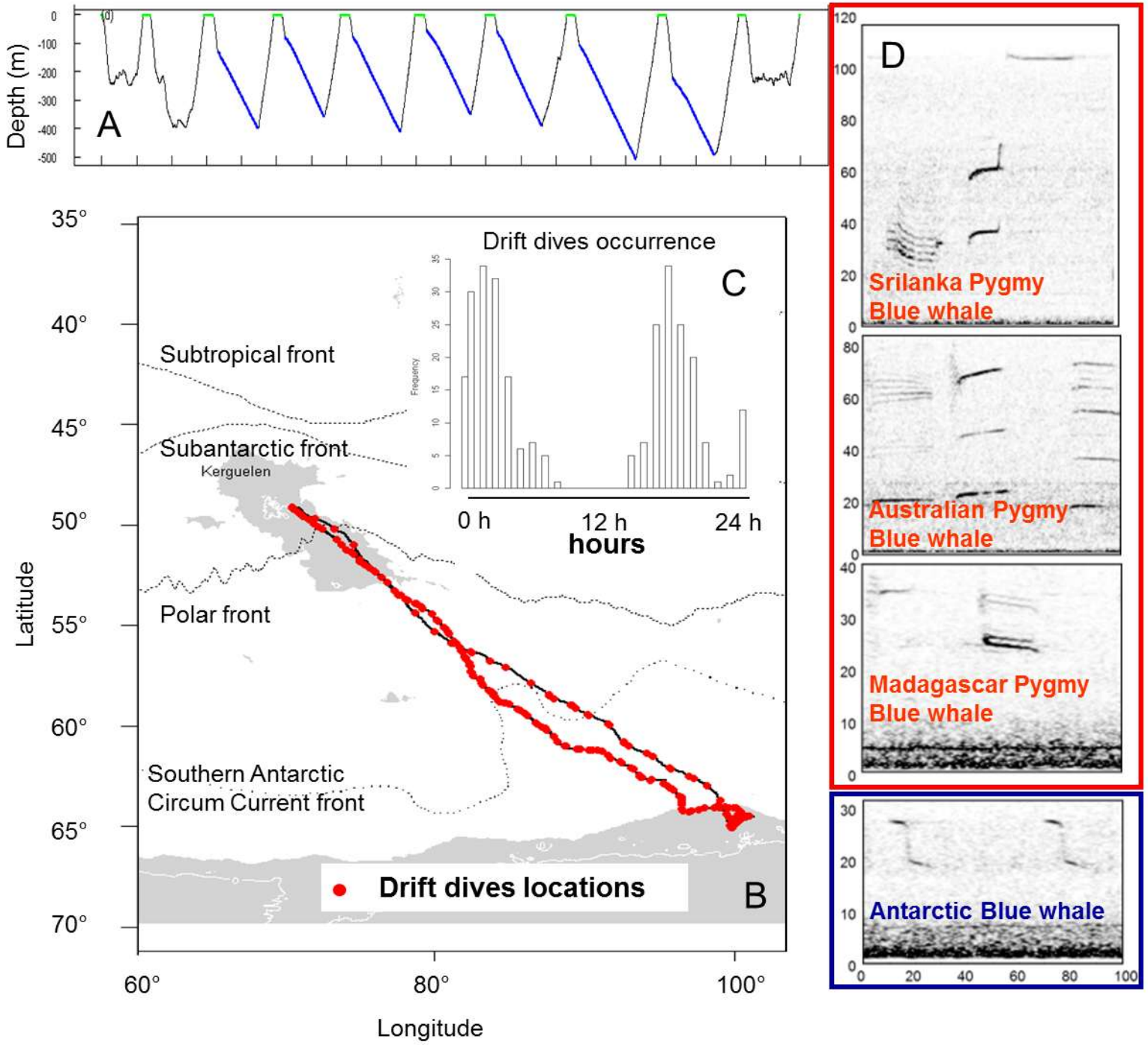


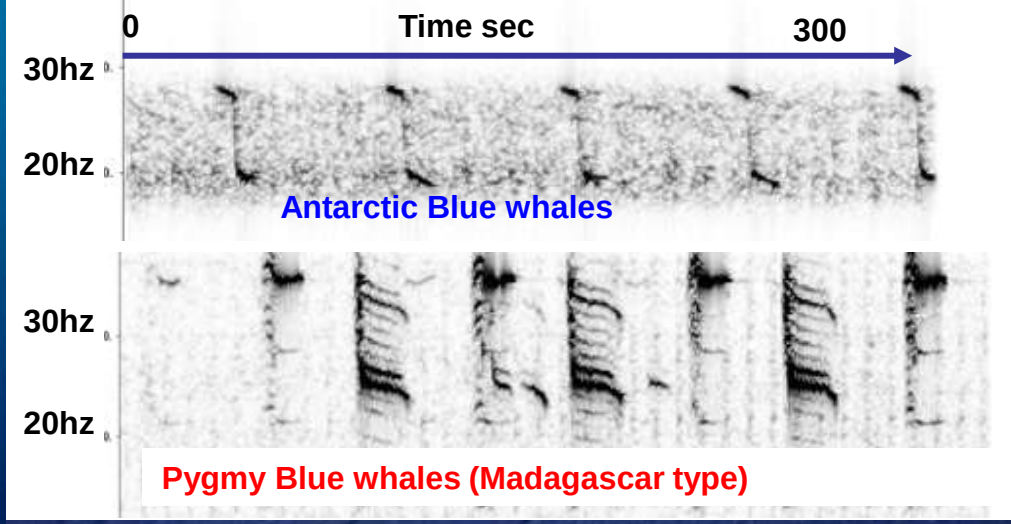


F. Samaran et al. 2010.

See K. Stafford presentation

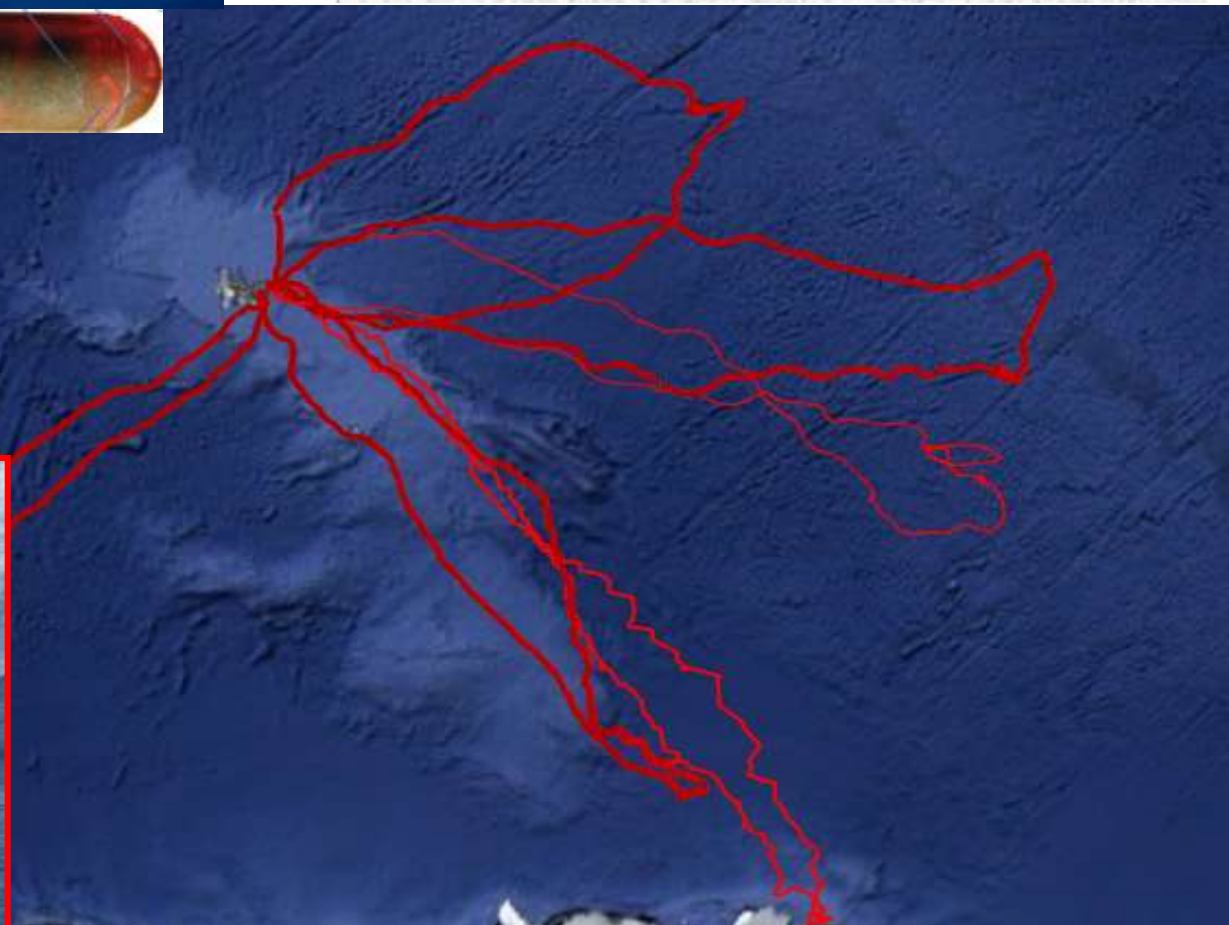

MK10 Fast loc GPS
GPS Track
Pressure
Temperature
Light
Fine scale Track
Fine scale oceanographic environment
Acousonde
Hydrophones
3-D accelerometer
3 D magnetometer
Pressure
3D-dive behaviour
3-D accelerometer : prey capture events

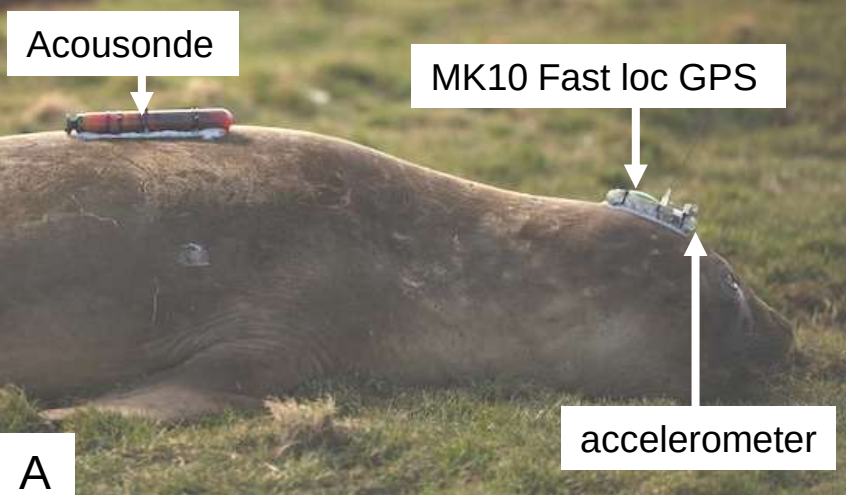

Depth (m)
A
Drift dives occurrence
C
Frequency
0 h
12 h
24 h
hours
Subtropical front
Subantarctic front
Kerguelen
Polar front
Southern Antarctic
Circum Current front
Drift dives locations
B
Latitude
Longitude
35°
40°
45°
50°
55°
60°
65°
70°
60°
80°
100°
D
Srilanka Pygmy
Blue whale
Australian Pygmy
Blue whale
Madagascar Pygmy
Blue whale
Antarctic Blue whale

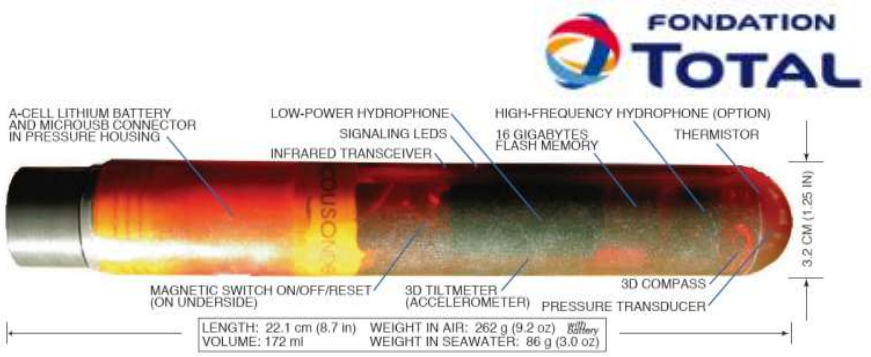


➢ Evaluation of the large cetaceans distribution and abundance (Blue Whales, fin whales…)

Acoustic encounter rate with predators



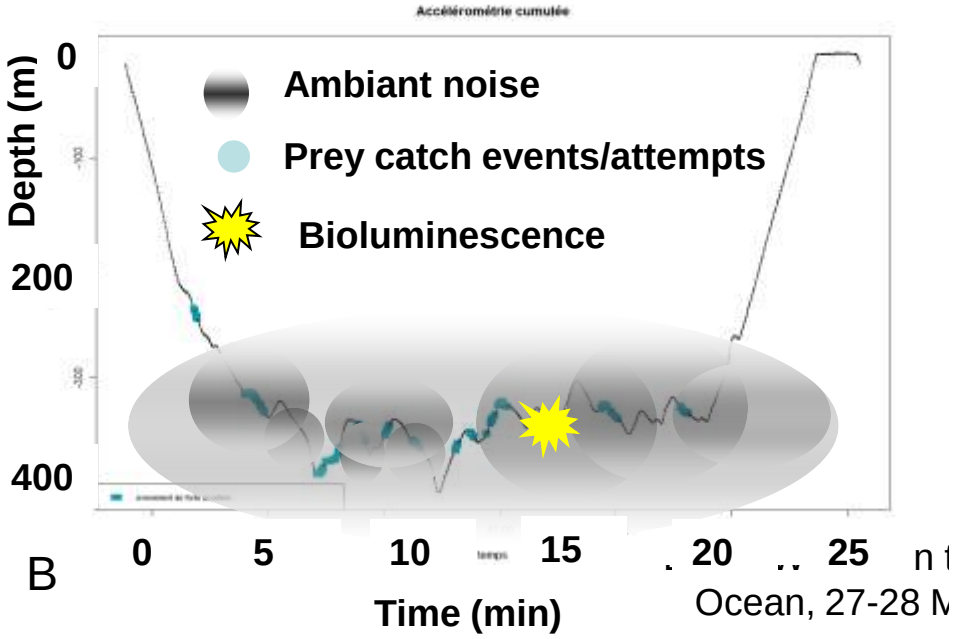




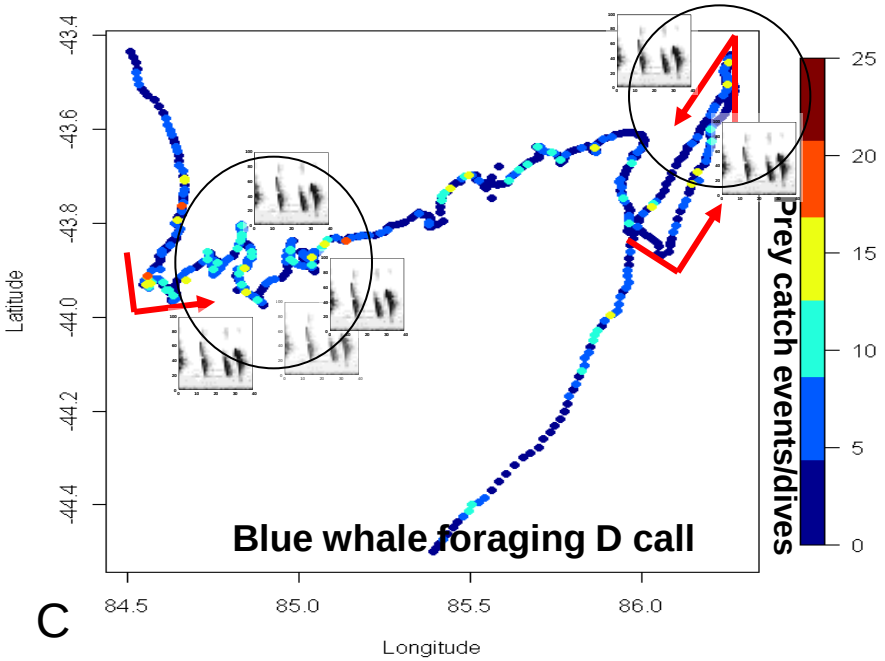
(*Oceanography : Acoustic Method to evaluate waves height and rain fall*).

Do elephant seals use acoustic cues to locate their prey?

Dive scale



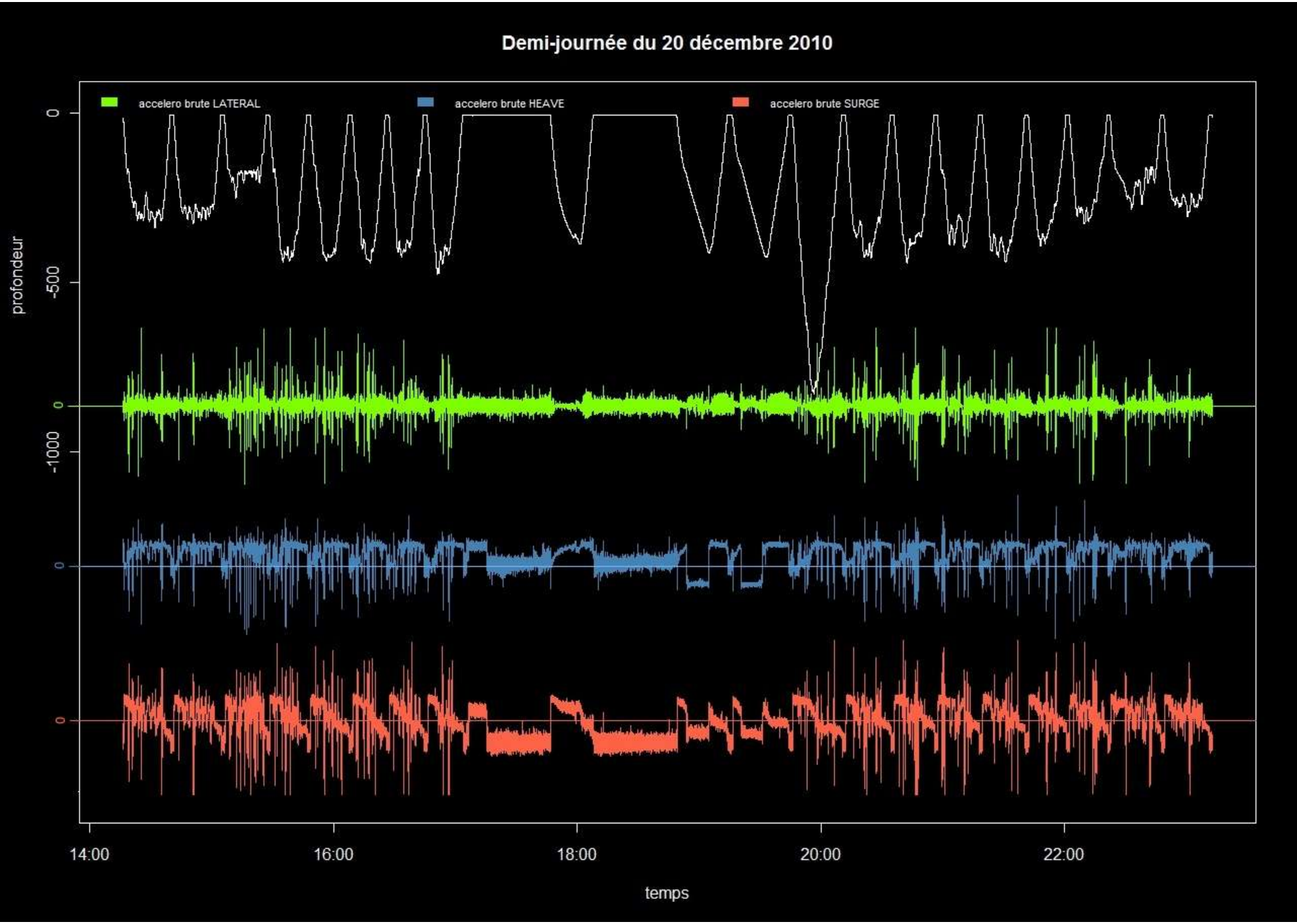
Track scale



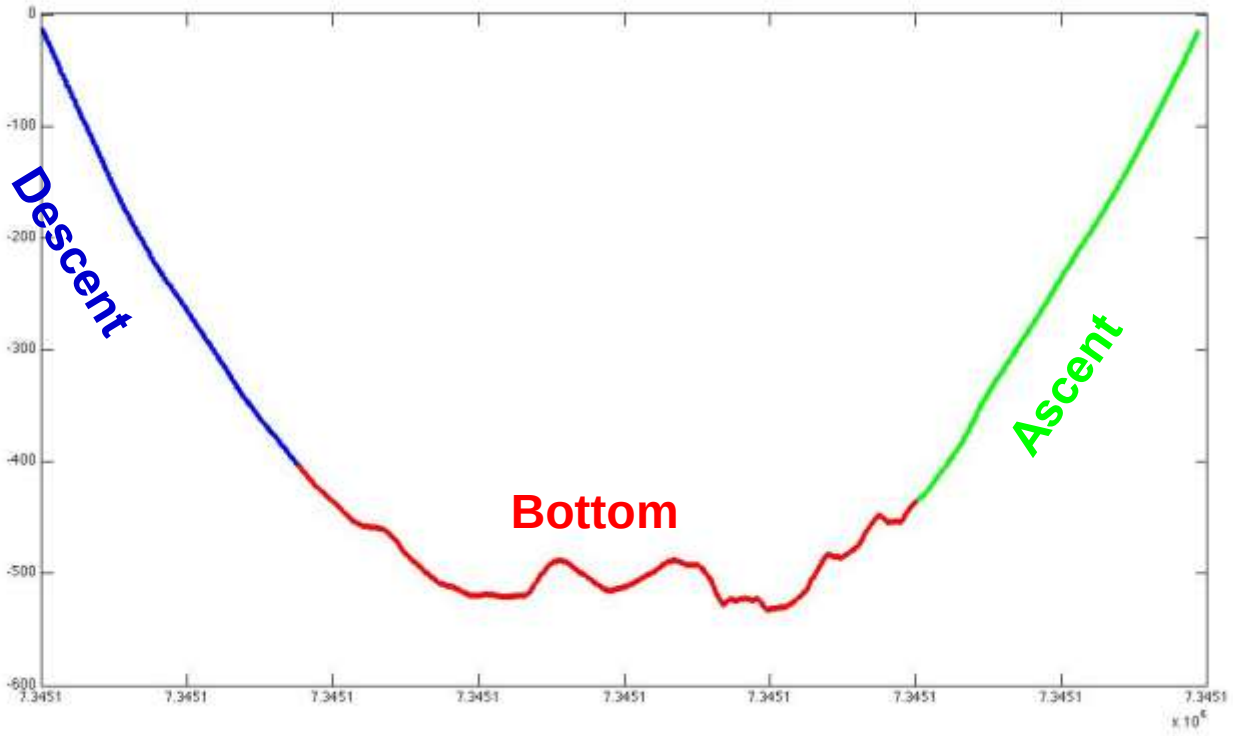
Ocean, 27-28 M

To conclude

- The need for collaborative effort between cetacean & signal processing researchers, tag designers, software developpers.
- Clearly identifiy the questions to be adressed.
- Developments of signal processing may require to be adapted at the species/group of species level (likely to vary with the size of individuals).
- Multidisciplinary approach: the « story » may emerge from the combination of biolloging tools with other methods (stable isotopes, photo-identification, acoustic…)

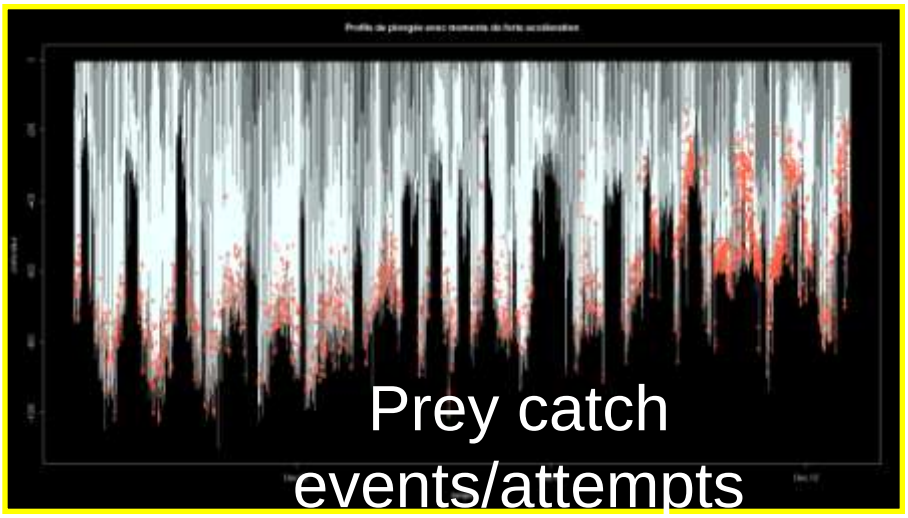

Demi-journée du 20 décembre 2010
accelero brute LATERAL
accelero brute HEAVE
accelero brute SURGE
profondeur
0
-500
-1000
0
0
0
14:00
16:00
18:00
20:00
22:00
temps

Automatic identification of the different dive phases : Yves Lebras (Césure ENSAT).

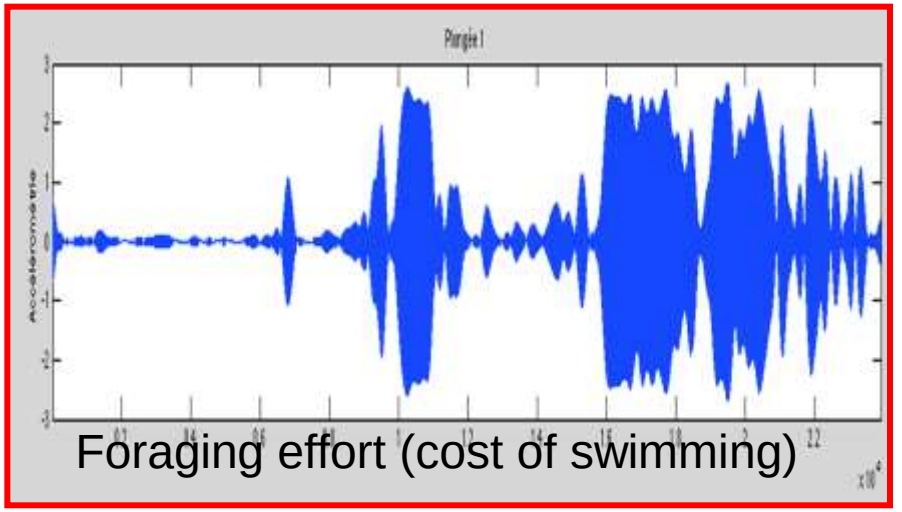


To be transmitted (7 per dive):

- dive duration (multiple of an hour)
- 2 depths and corresponding time (beginning and end of bottom) expressed as a % of dive duration
- Max depth and time



Prey catch events/attempts

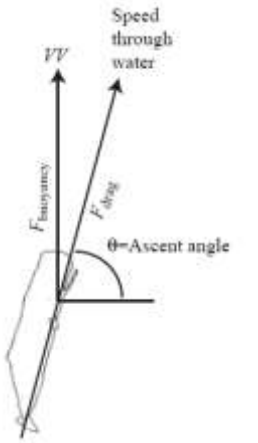


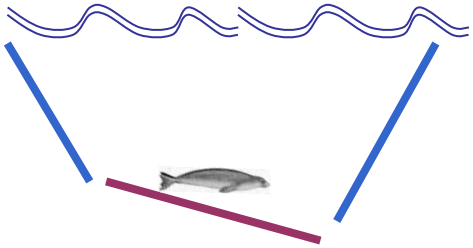
Foraging effort (cost of swimming)

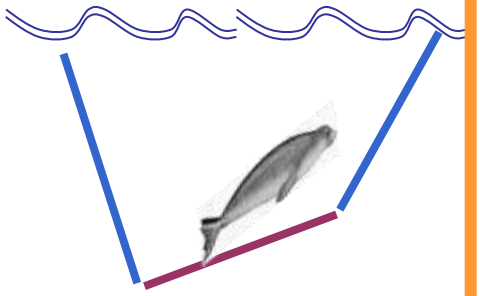
To be transmitted

1 value/unit of time (dive, hour, day…)

1 value/unit of time (dive, hour, day…)







Glides and drifting phase

Change in Body condition = net foraging gain

1 value/day