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On-board Underwater glider real-time detection/classification of marine mammals

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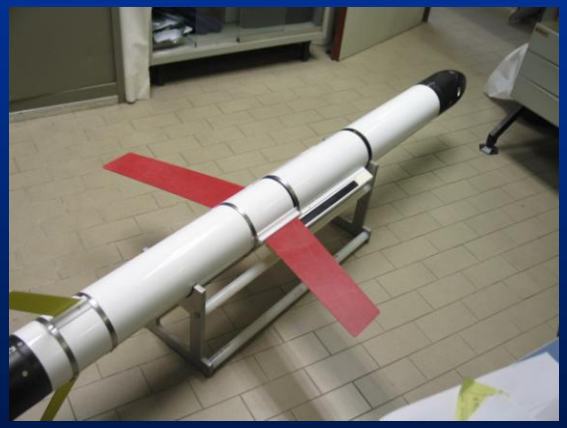
OUTLINE

- Rationale
- Objectives and Technical challenges
- Hardware description
- Software description
- At-sea Preliminary results
- Summary

RATIONALE

- NURC has a fleet gliders mainly dedicated so far to oceanographic measurements
  - 5 Shallow water WEBB
  - 1 Deep water WEBB
  - 1 Deep water Bluefin
  - 5 eFolagas



RATIONALE

- But wants to use them for acoustic purpose (main field of expertise in NURC) such as:
  - Persistent monitoring of underwater acoustic environment
  - Investigate the presence of marine mammals

- Politècnica de Cataluny (UPC) has great experience in marine mammals processing acquired within the ESONET (European Seafloor Observatory Network of Excellence)

OBJECTIVES

- NURC/UPC wanted to jointly develop a acoustic payload capability on a glider that will:
  - Record high frequency acoustic signals (up to 70 kHz) for few days
  - Simultaneously detect/classify marine mammals events (an other any events) in real-time

With the objectives, while the glider is at-sea, to provide real-time feedback on acoustic environment

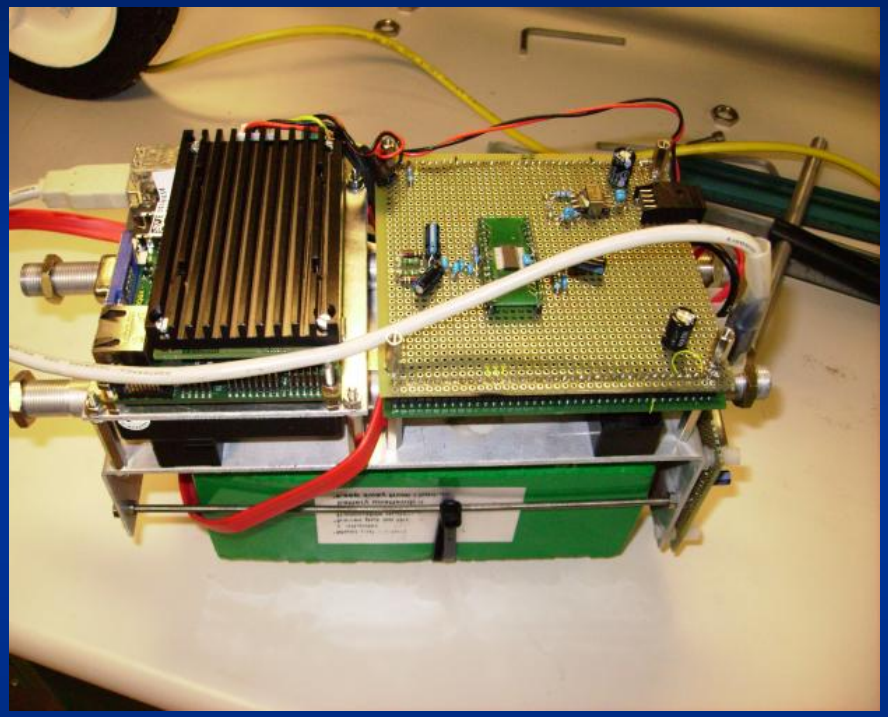
TECHNICAL CHALLENGES

- Payload capability on glider is very limited in size and energy (Gliders were designed for oceanographic measurements which do not require a lot)
- Acoustic bandwidth of events of interest for NURC/UPC is very large (from few Hz to 70 kHz) and is difficult to be realized with low power characteristics (No such system on market)
- Real-time detection/classification of marine mammals is a challenge, moreover if done in real-time

Acoustic Payload Hardware

2 channels, Omnidirectional Beam Pattern, Dynamic range 118 dB, Simultaneous sampling frequency (kHz) 96/192, Frequency range 20 ÷ 70 kHz

60 hours endurance (with data storage, real time detection /classification). Extended to 9 days with primary battery for one channel

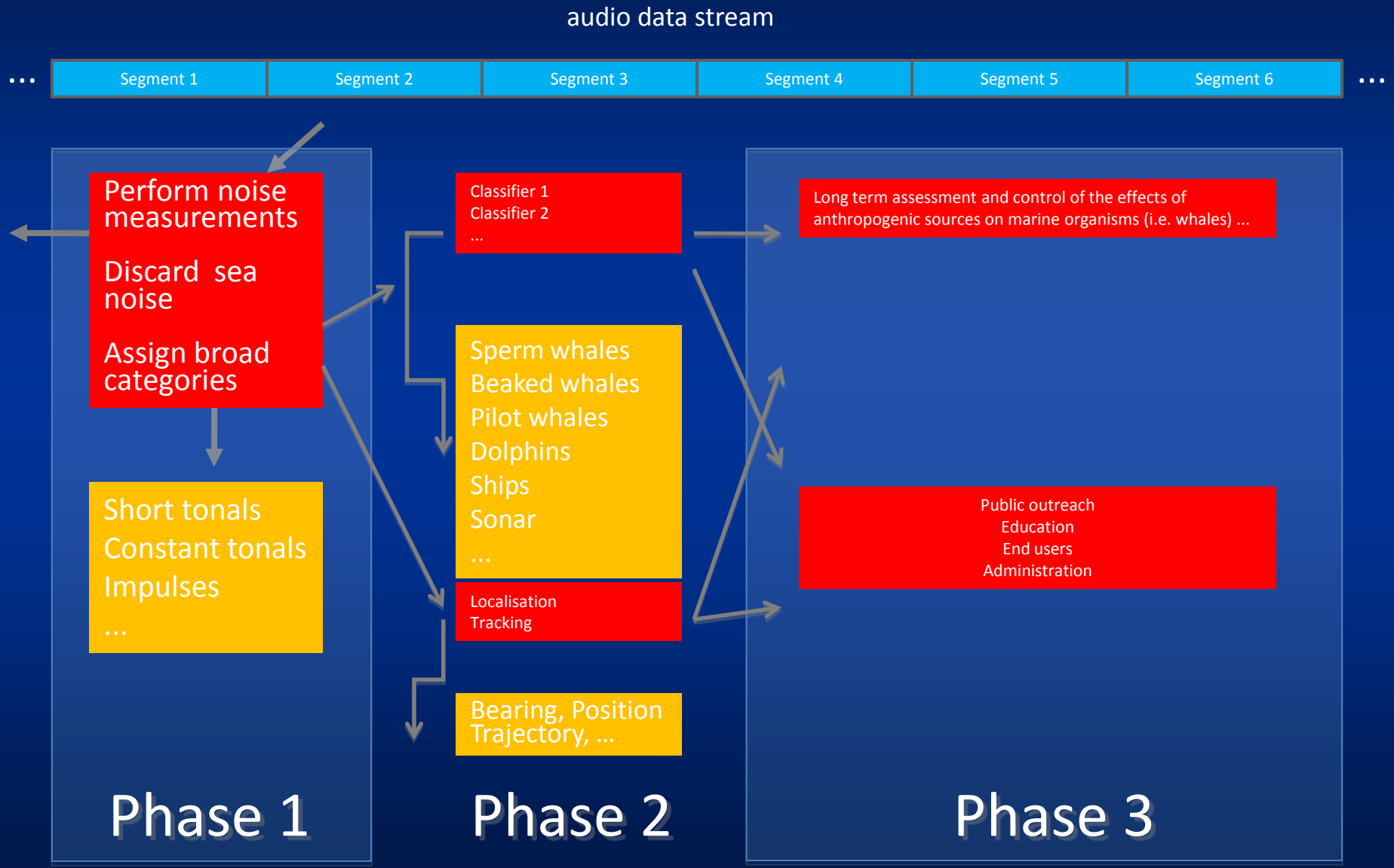


Intel® Atom™ Z530 @ 1.6 GHz , 512MB DDR2 533 MHz, Gb Ethernet, 1 TB SATA SSD

Acoustic Payload Hardware

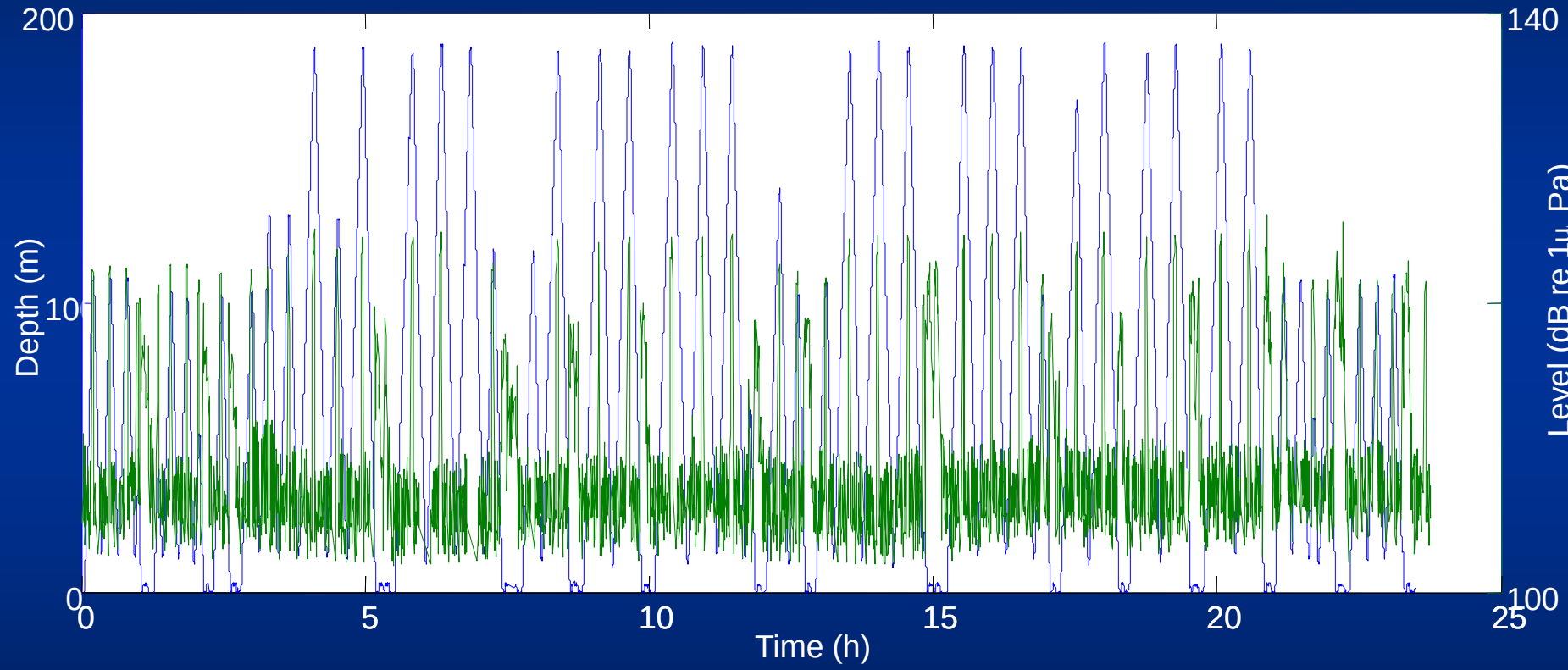
Fully tested and integrated in glider

UPC LIDO Software

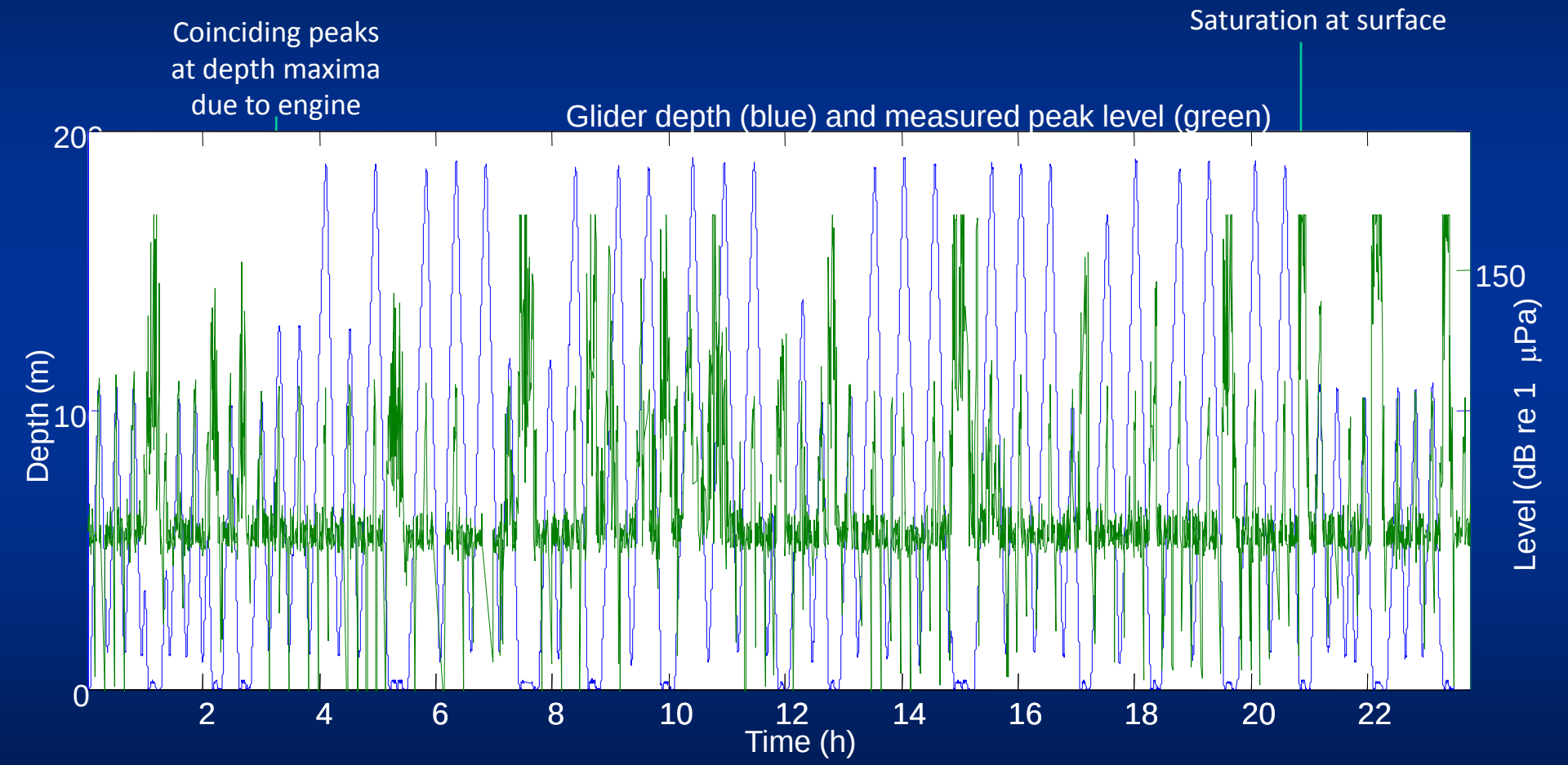


At-sea results – Glider noise

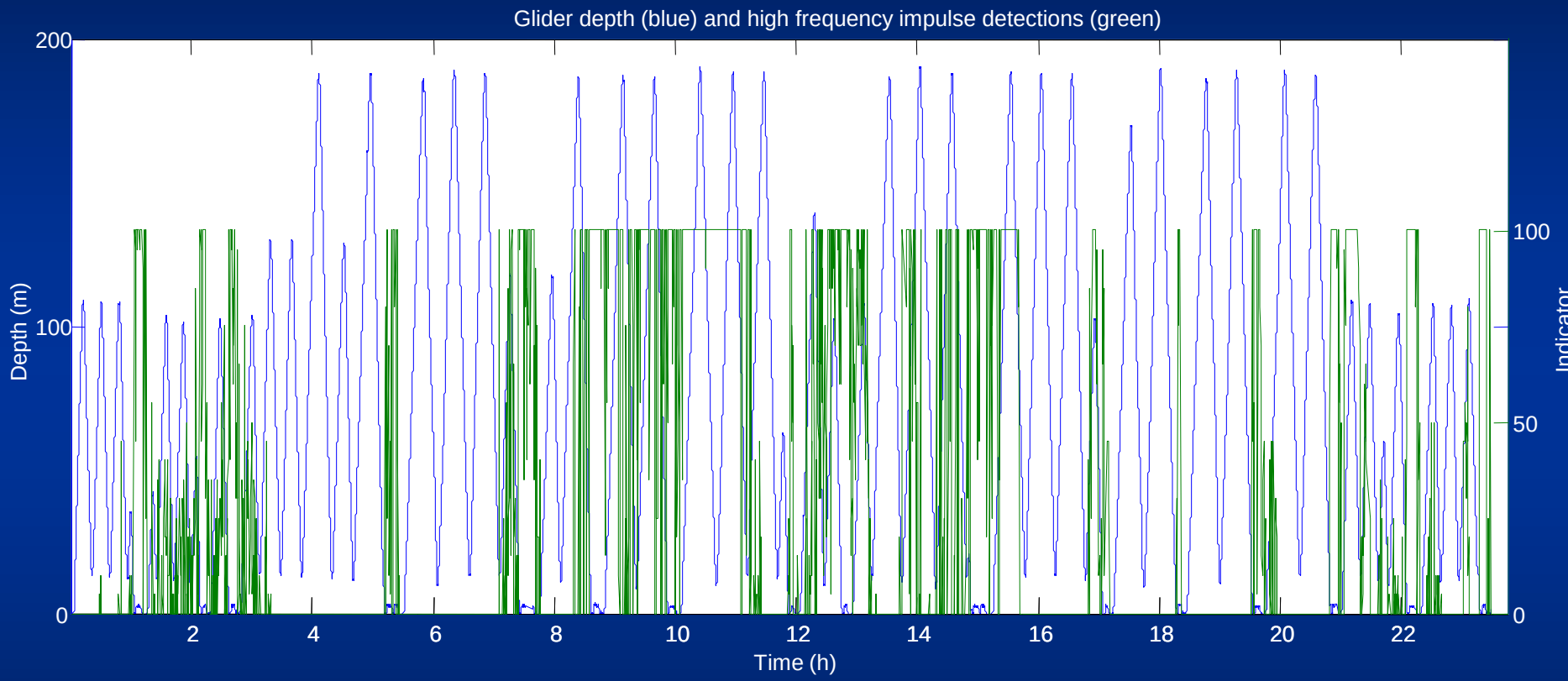
Glider depth (blue) and measured RMS level (green; mean = 108.67, std = 5.62)



At-sea results – Glider noise Peak levels

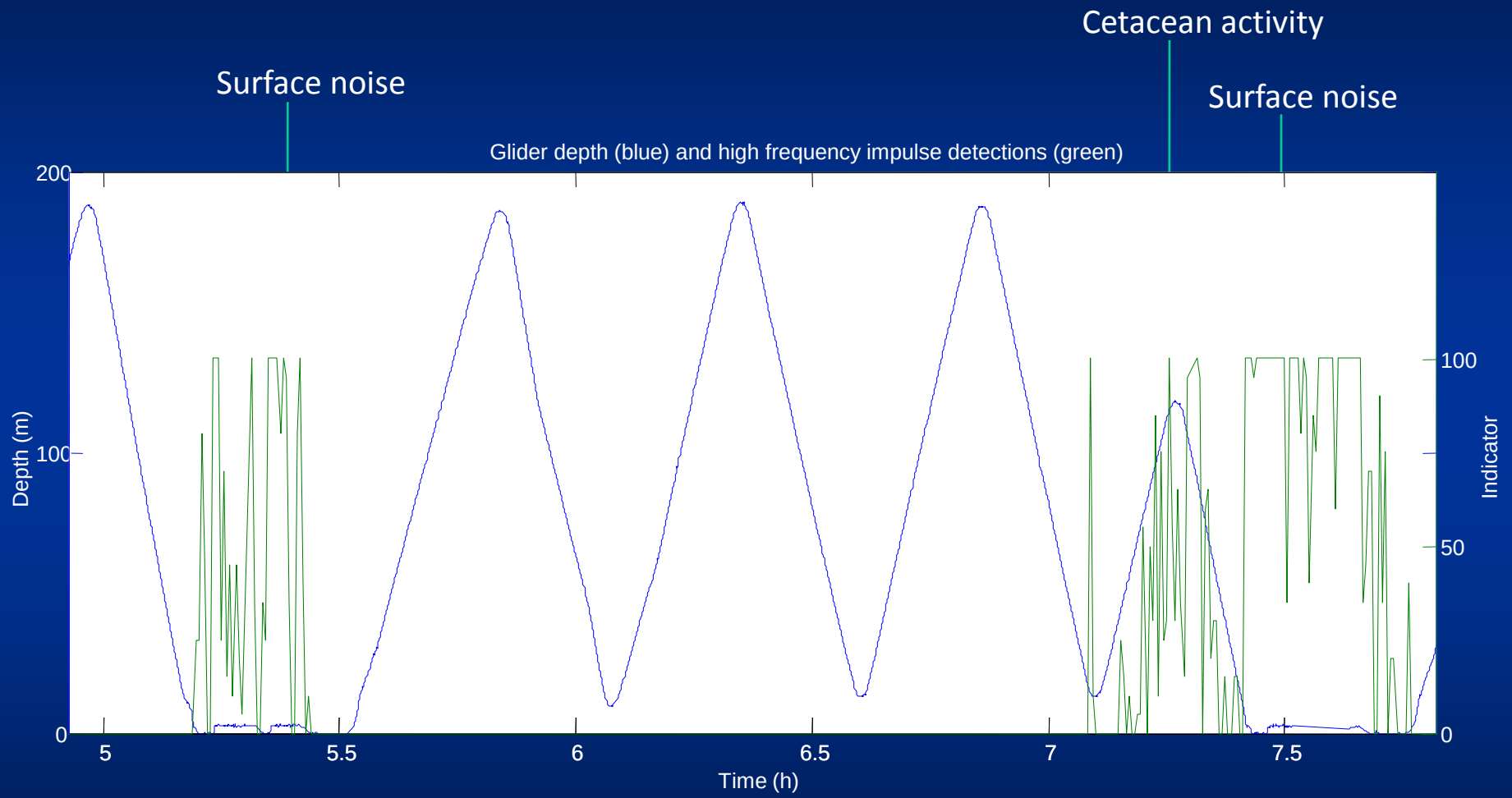


At-sea results – Glider noise
High-frequency sonar detection

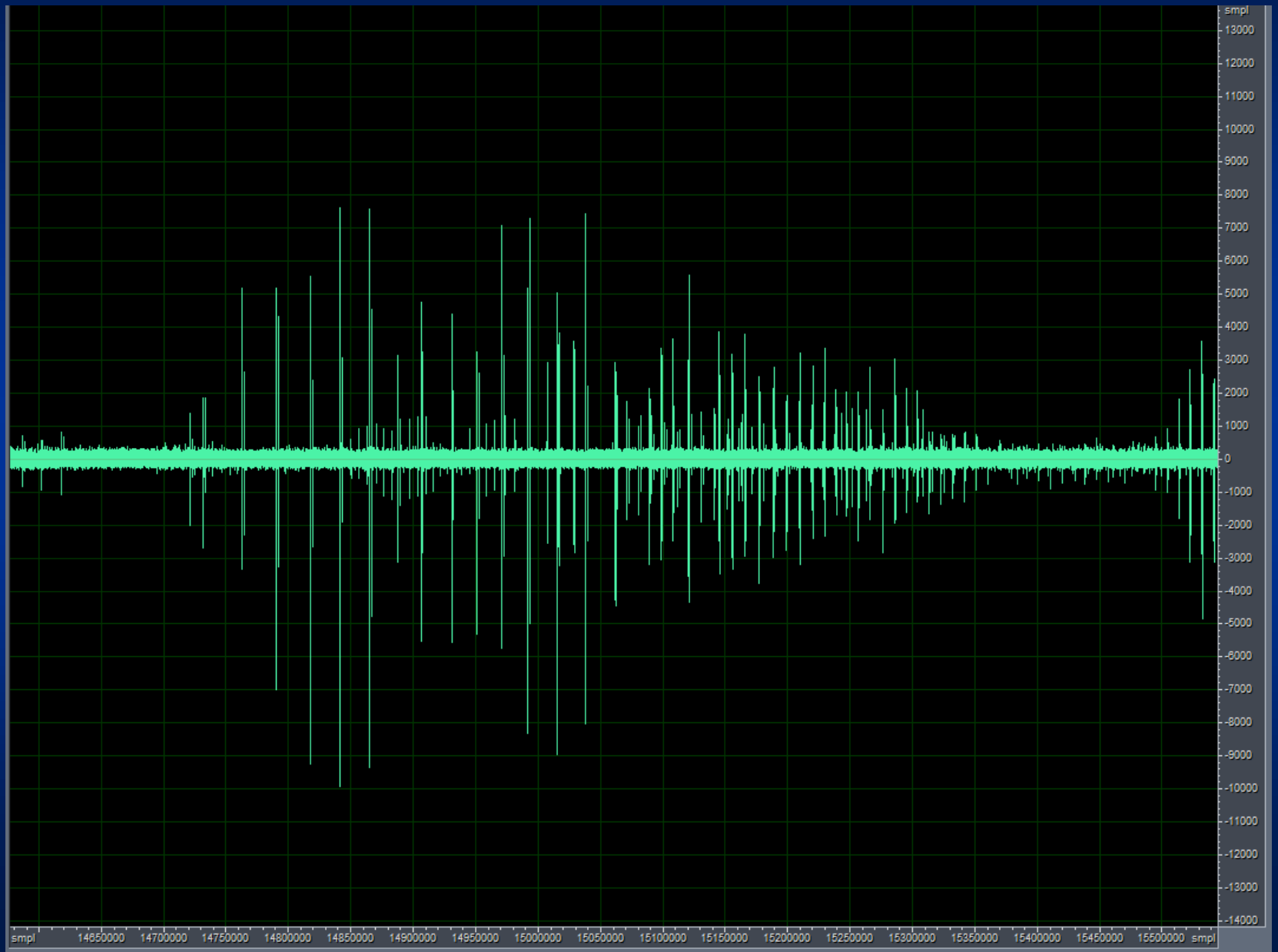


Note: at the surface there are always detections due to water splashing against the hydrophone. Otherwise there is no correlation between glider activity and high frequency detections.

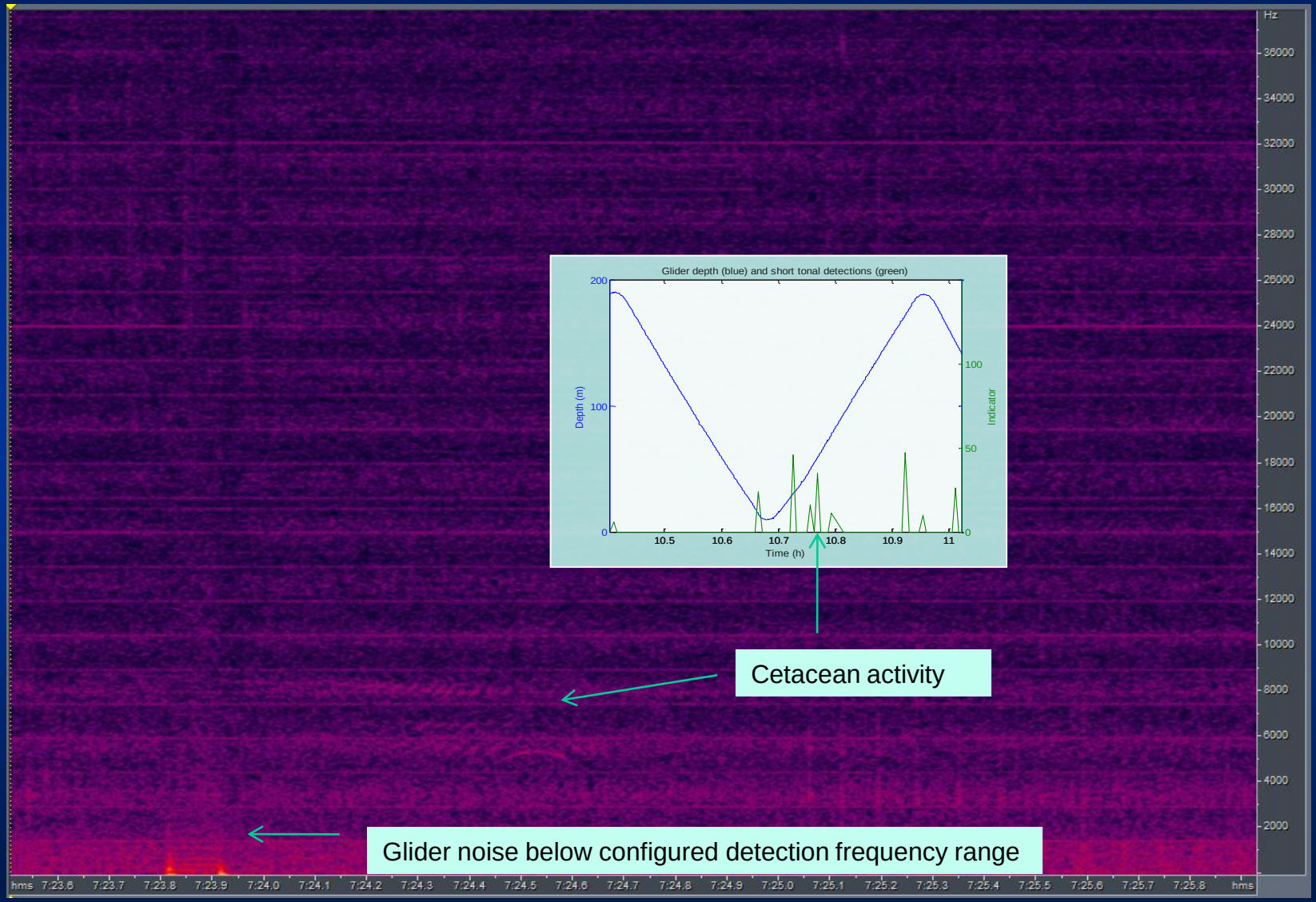
At-sea results – Glider noise
High-frequency sonar detection



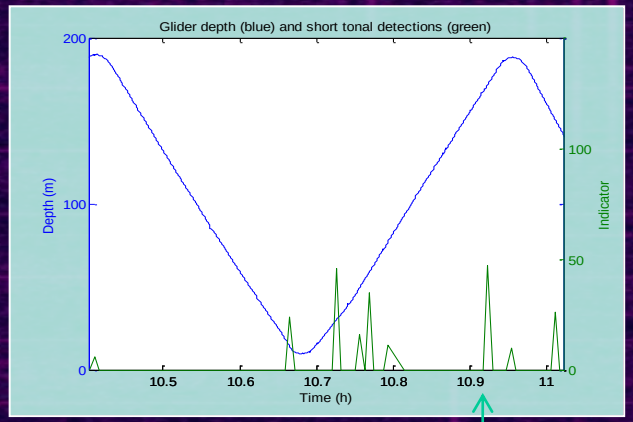
At-sea results
Examples of sonar detection



At-sea results
Examples of short tonal detection

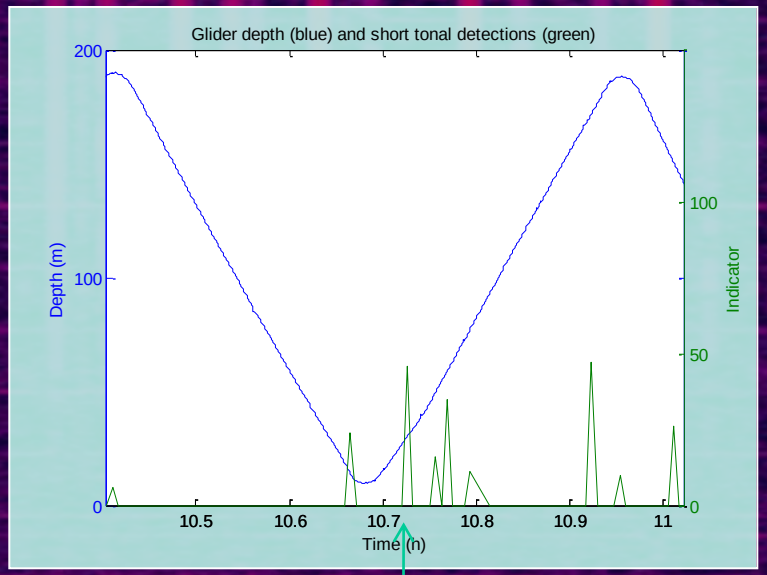


At-sea results
Examples of short tonal detection



Glider engine startup

Short Tonal Detection



Glider noise just inside configured detection frequency range

30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000

4:53.4 4:53.5 4:53.6 4:53.7 4:53.8 4:53.9 4:54.0 4:54.1 4:54.2 4:54.3 4:54.4 hms

SUMMARY

- Acoustic payload for glider fully developed and tested. Endurance is 9 days for one hydrophone recording / detection / classification

- Real-time Detection/classification demonstrated

- Extensive at-sea tests (60 days) for collecting marine mammals data (and other acoustic noise)