Probability of detecting right whales from autonomous platforms equipped with a real-time monitoring system

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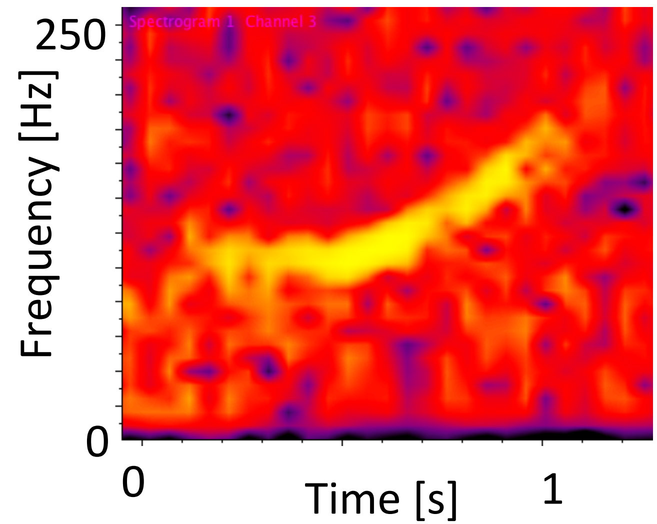
Motivation

- Real-time monitoring
  - Dynamic management / risk mitigation
  - Putting survey teams on whales more quickly
- Passive acoustic monitoring
  - Persistent, efficient, effective



Challenge: real-time passive acoustic monitoring?

Image credit: whaleopedia.org

Near real-time acoustic monitoring

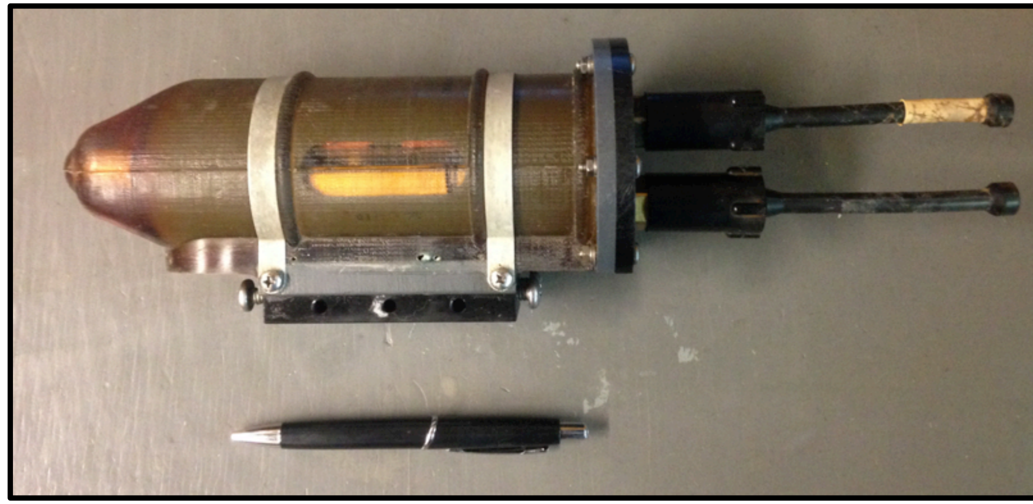
DMON

(Digital acoustic monitoring instrument)

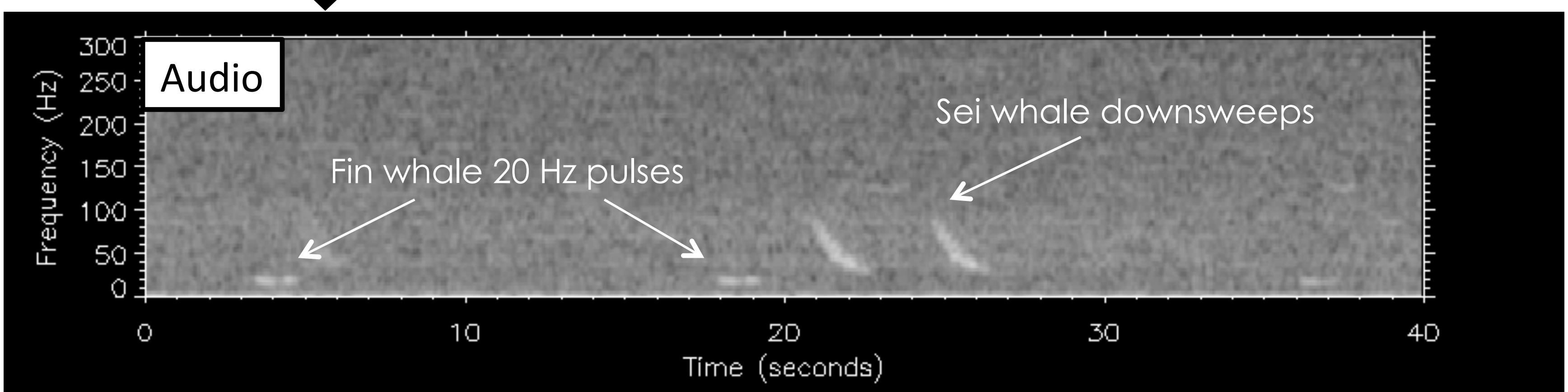
+

LFDCS

(Low-frequency detection and classification system)



Johnson, Hurst & Shorter at WHOI



Baumgartner & Mussoline (2011) JASA 129:2889-2902.

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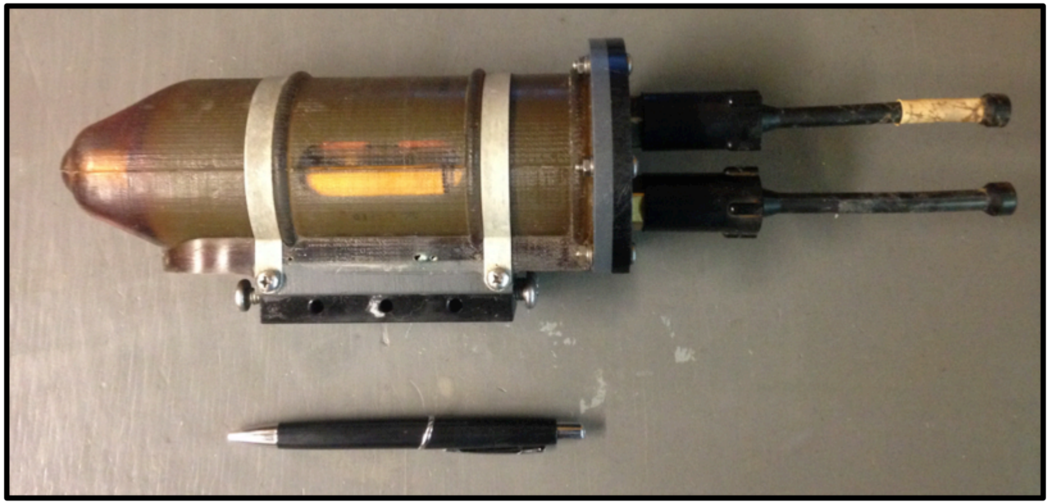

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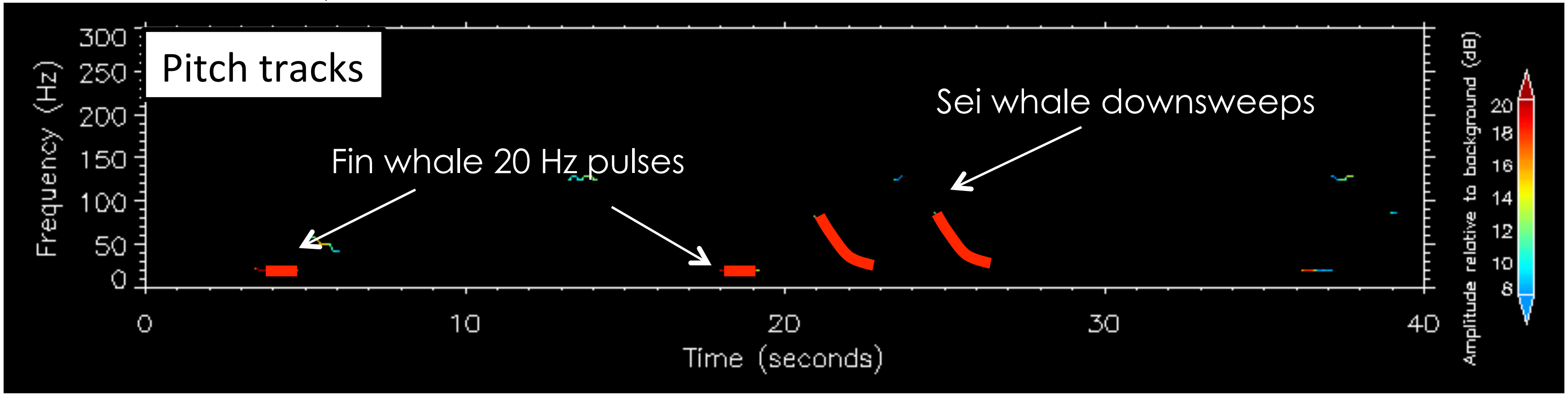

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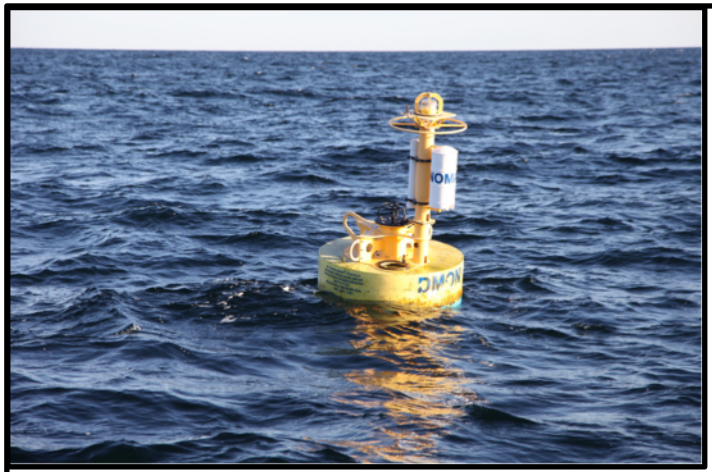
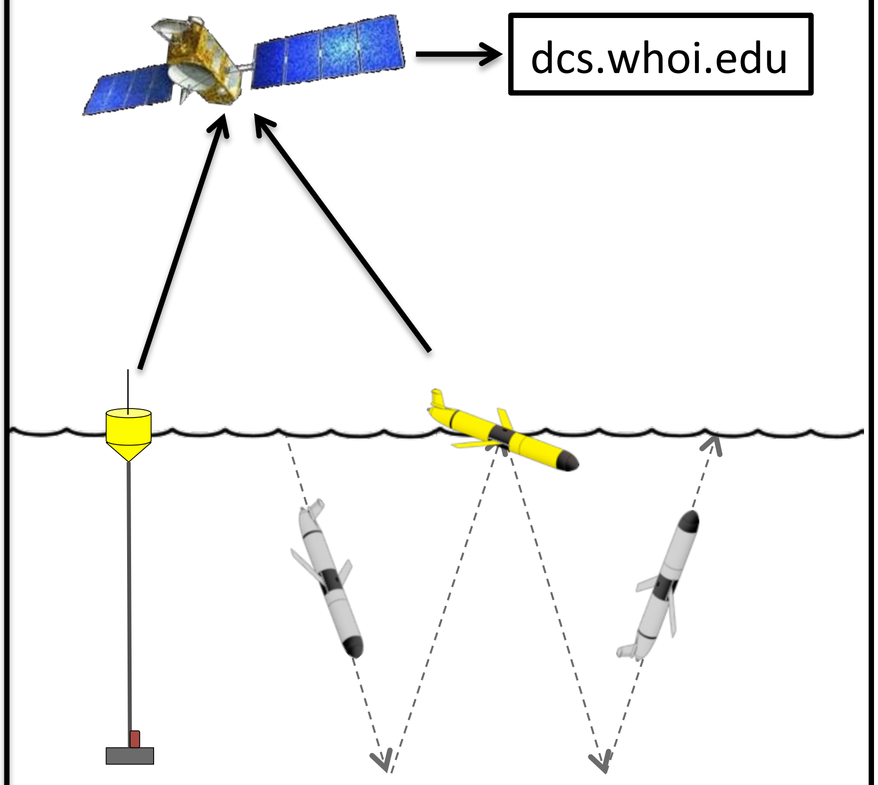
Near real-time acoustic monitoring

DMON-LFDCS operational platforms



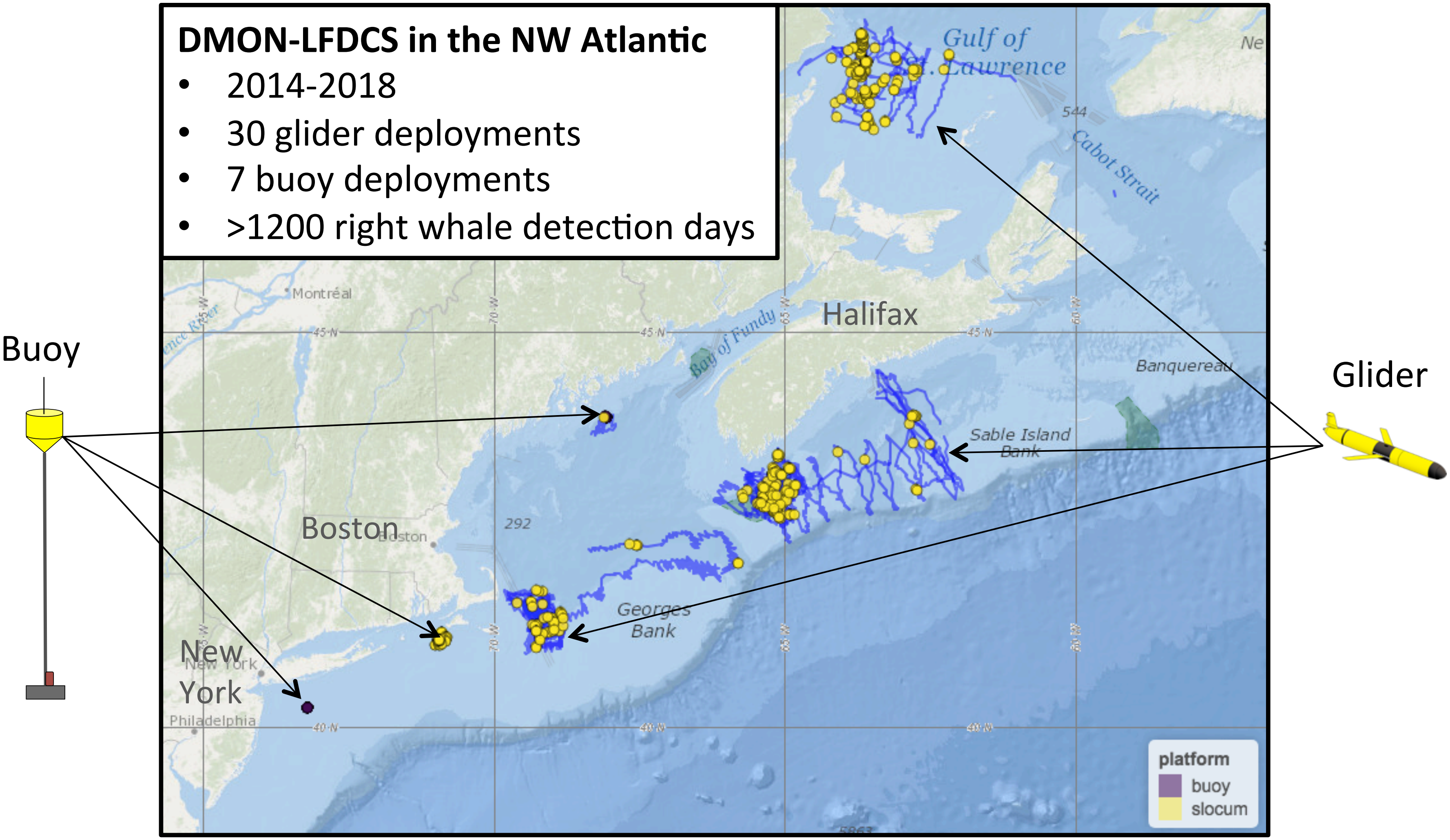
DMON-LFDCS buoy

DMON-LFDCS Slocum glider



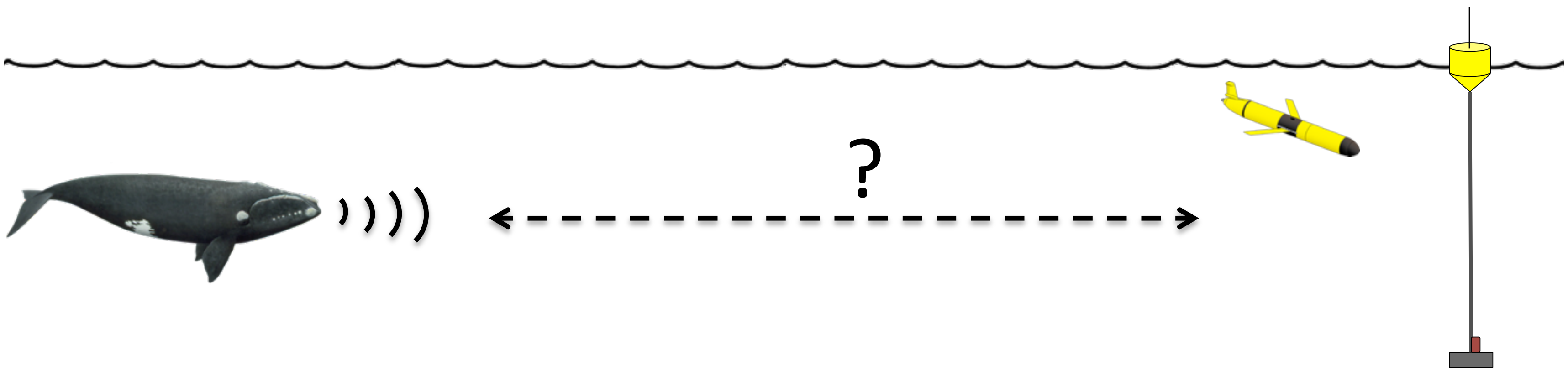
Near real-time acoustic monitoring

DMON-LFDCS in the NW Atlantic
- 2014-2018
- 30 glider deployments
- 7 buoy deployments
- >1200 right whale detection days



Performance of DMON-LFDCS

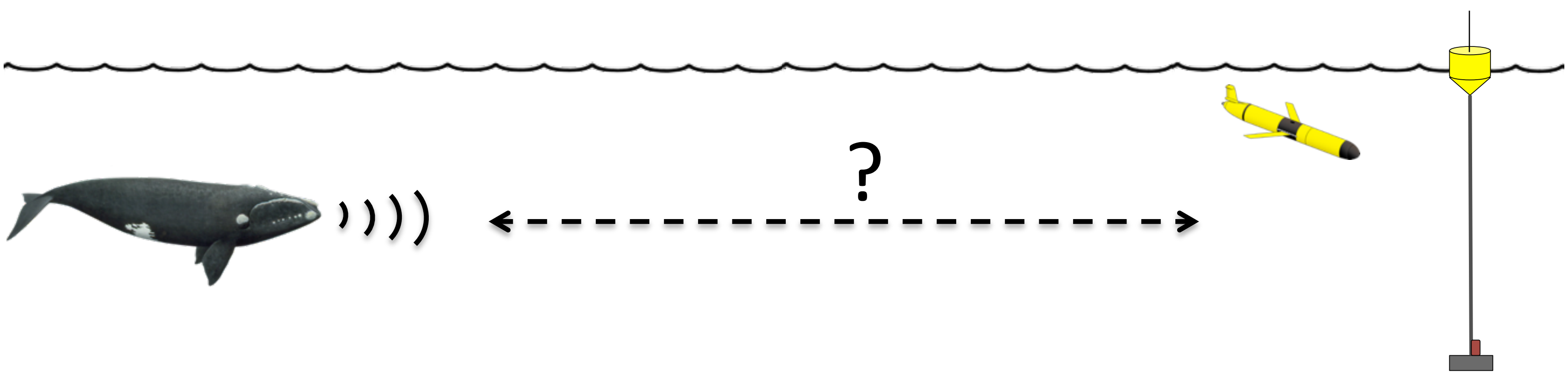
- Demonstrated the system is operational
- Quantified system performance[1]
- Knowledge gap: detection range



[1]Baumgartner et al, submitted. Methods in Ecology and Evolution

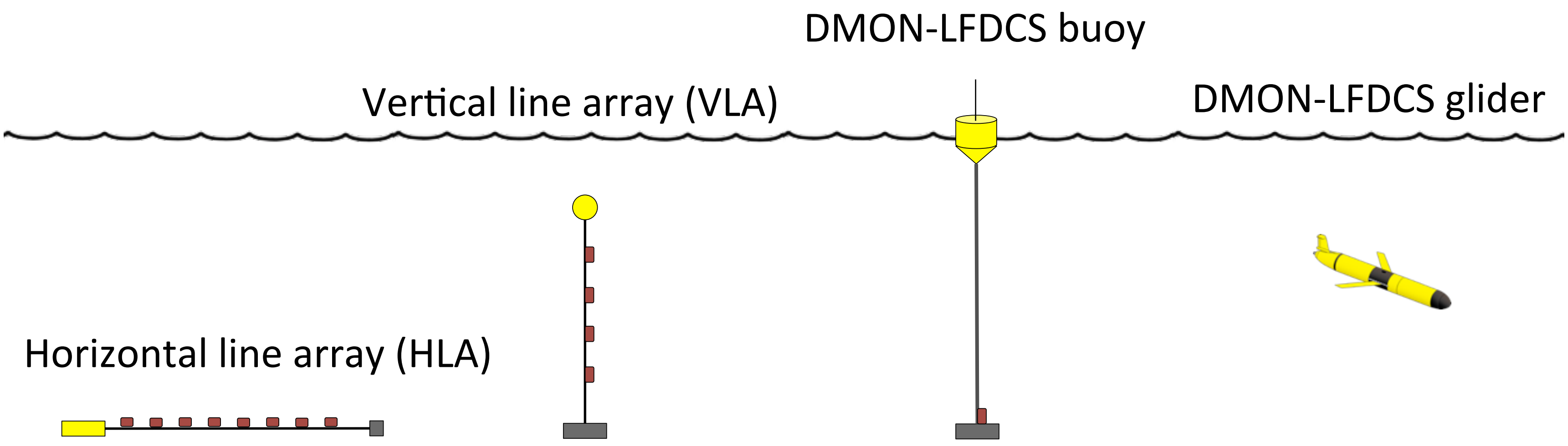
Study Goal:

Quantify the range-dependent probability of detection of the DMON-LFDCS on mobile and fixed platforms



Experimental design

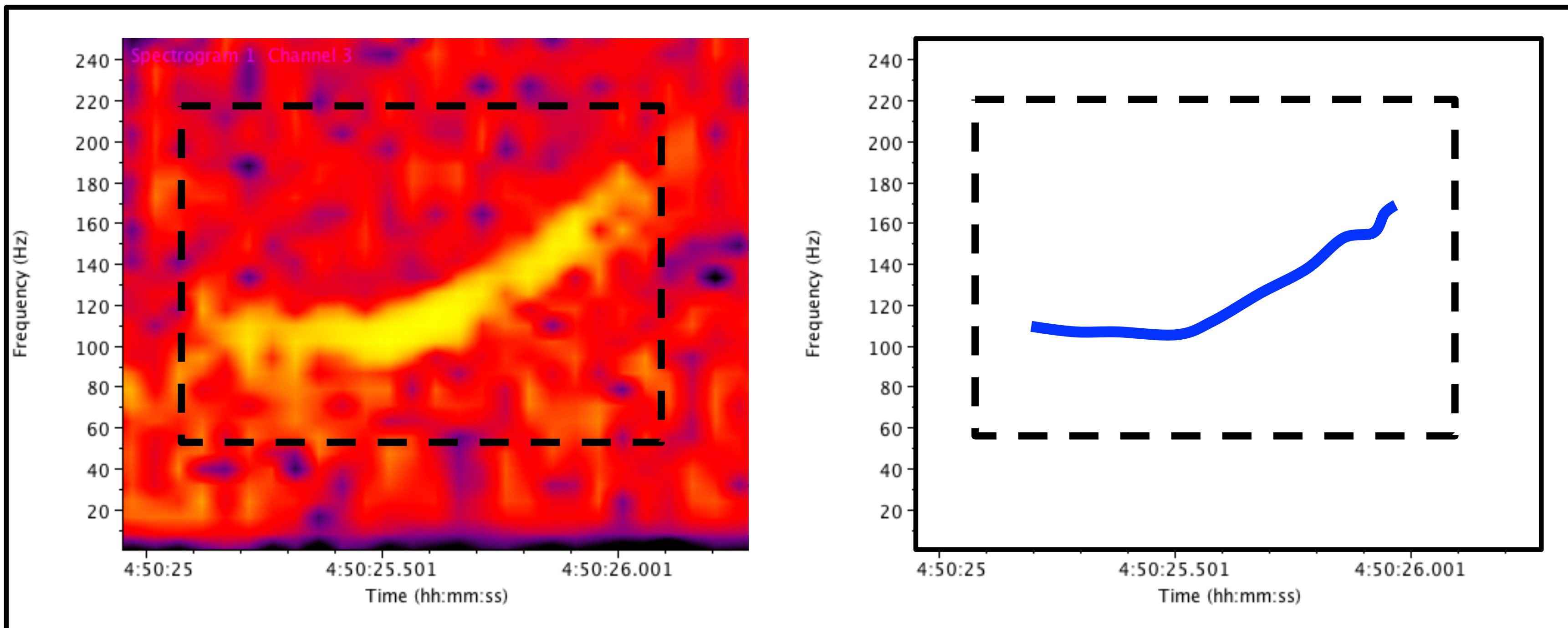
1. Deploy an acoustic array alongside a DMON-LFDCS Slocum glider and moored buoy.



Experimental design

2. Identify all upcalls in acoustic records

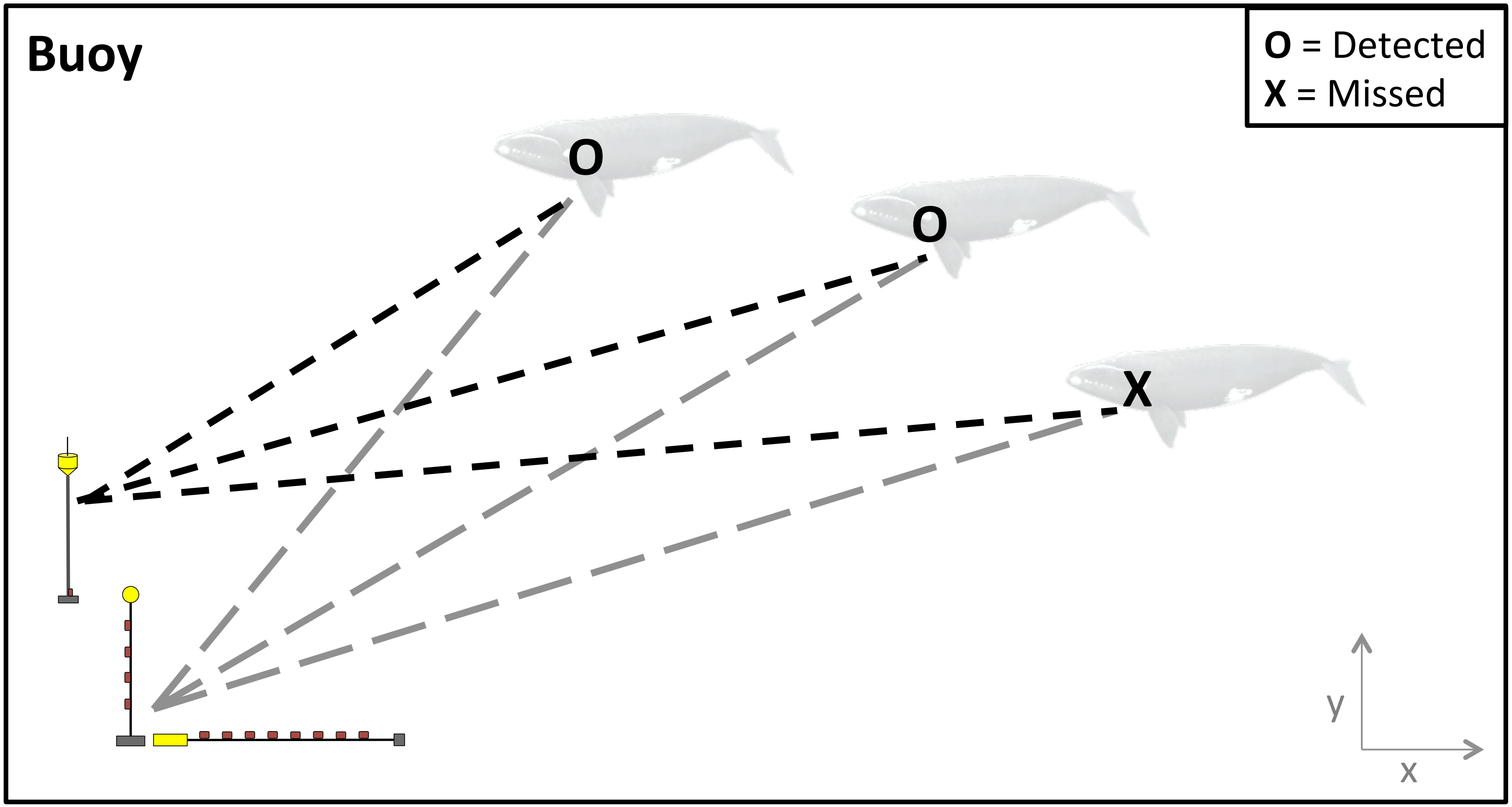
- Audio/spectrograms for HLA/VLA [manual; no detector]
- Pitch tracks for glider and buoy



Spectrograms Pitch tracks

Experimental design

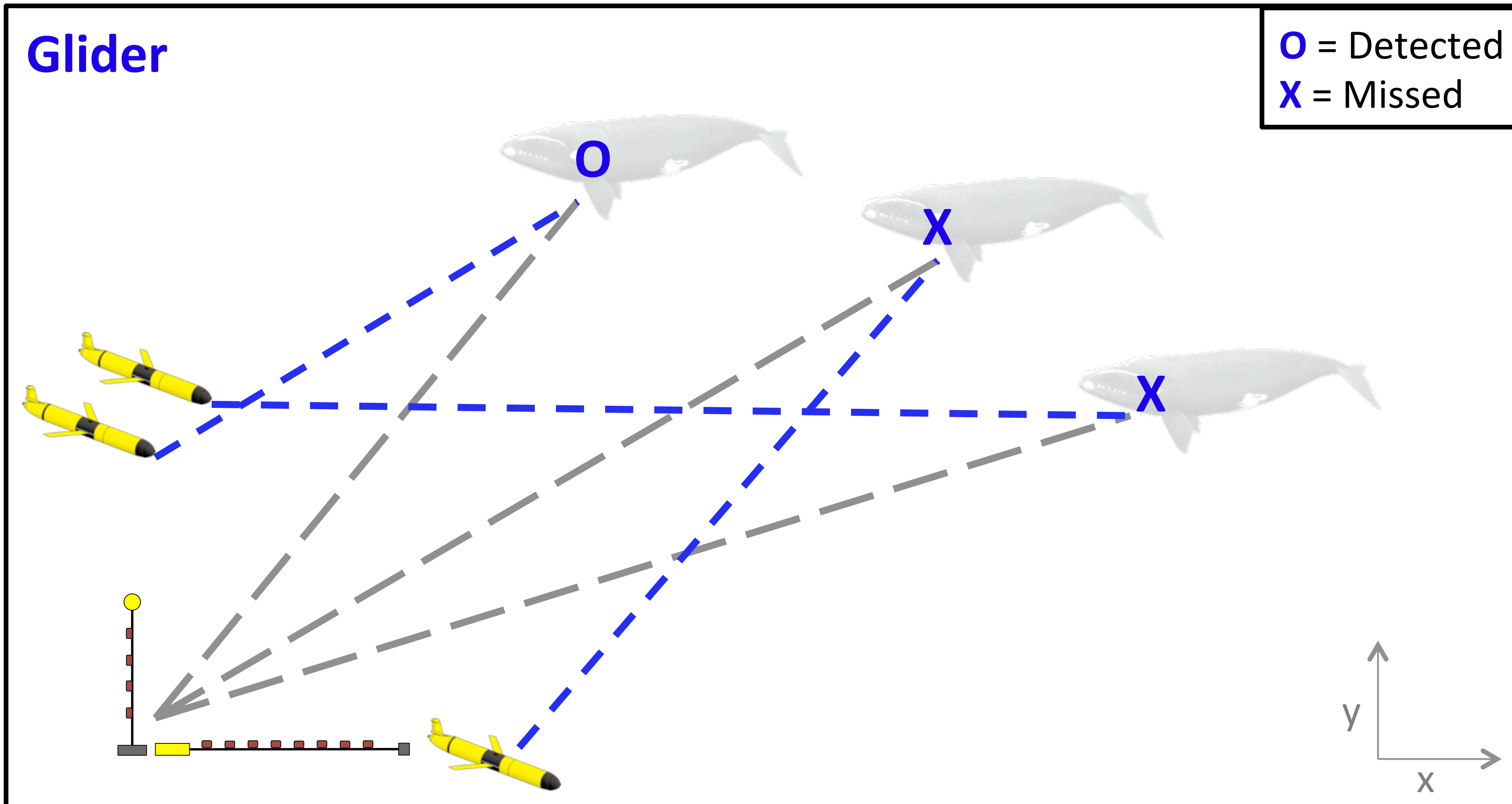
3. Conduct a call-by-call comparison (buoy versus array)



Localization methods: Lin et al (2012) JASA 131:1798–1813

Experimental design

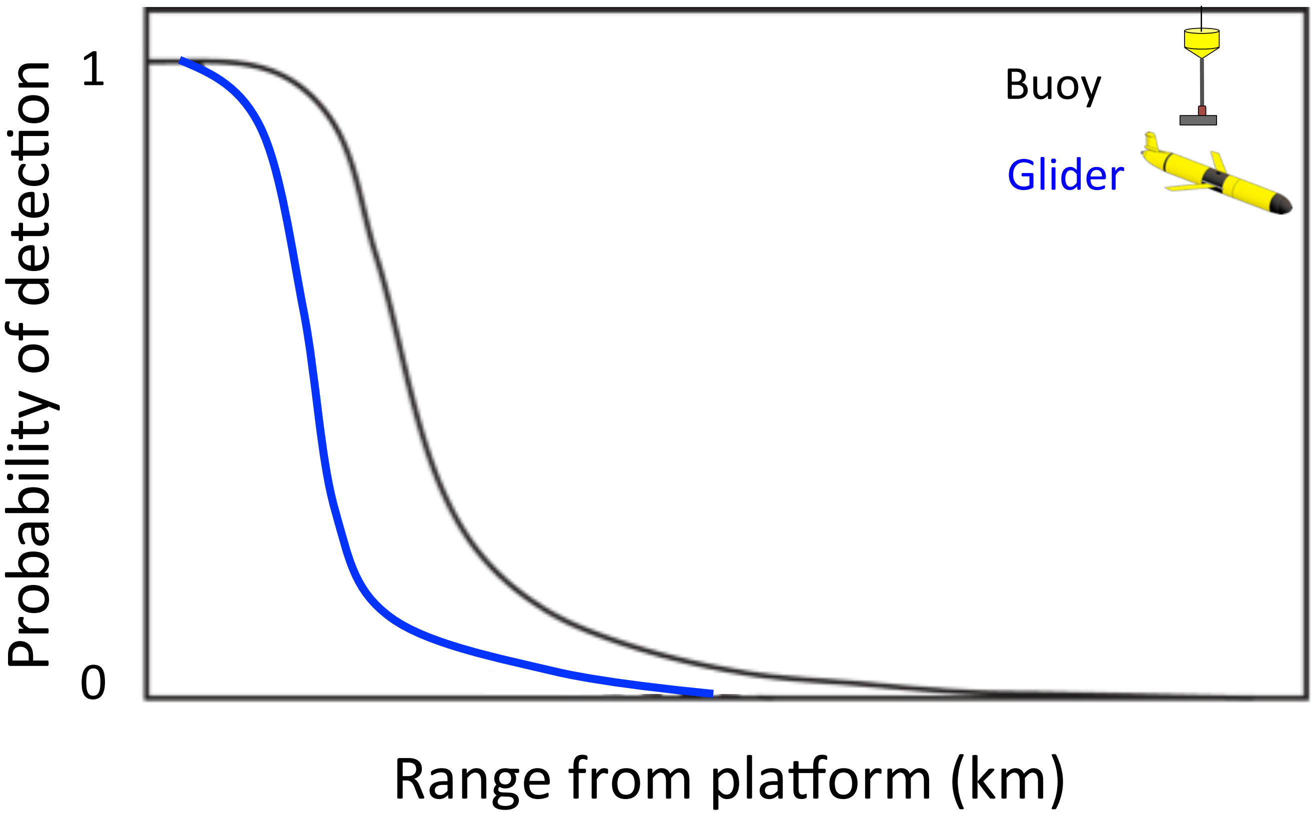
3. Conduct a call-by-call comparison (**glider** versus array)



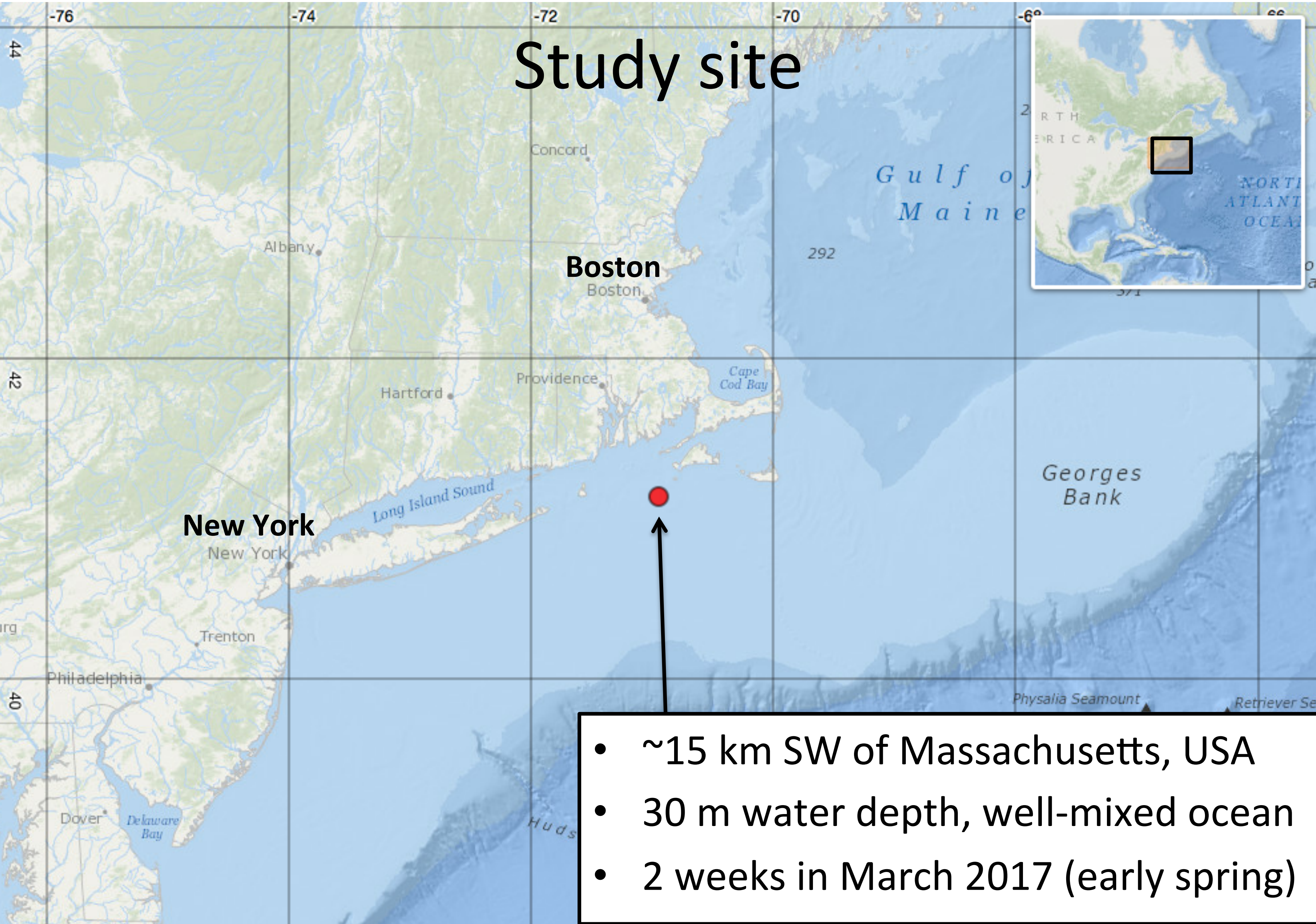
Localization methods: Lin et al (2012) JASA 131:1798–1813

Experimental design

4. Quantify the probability of detection as function of range to the call for each platform



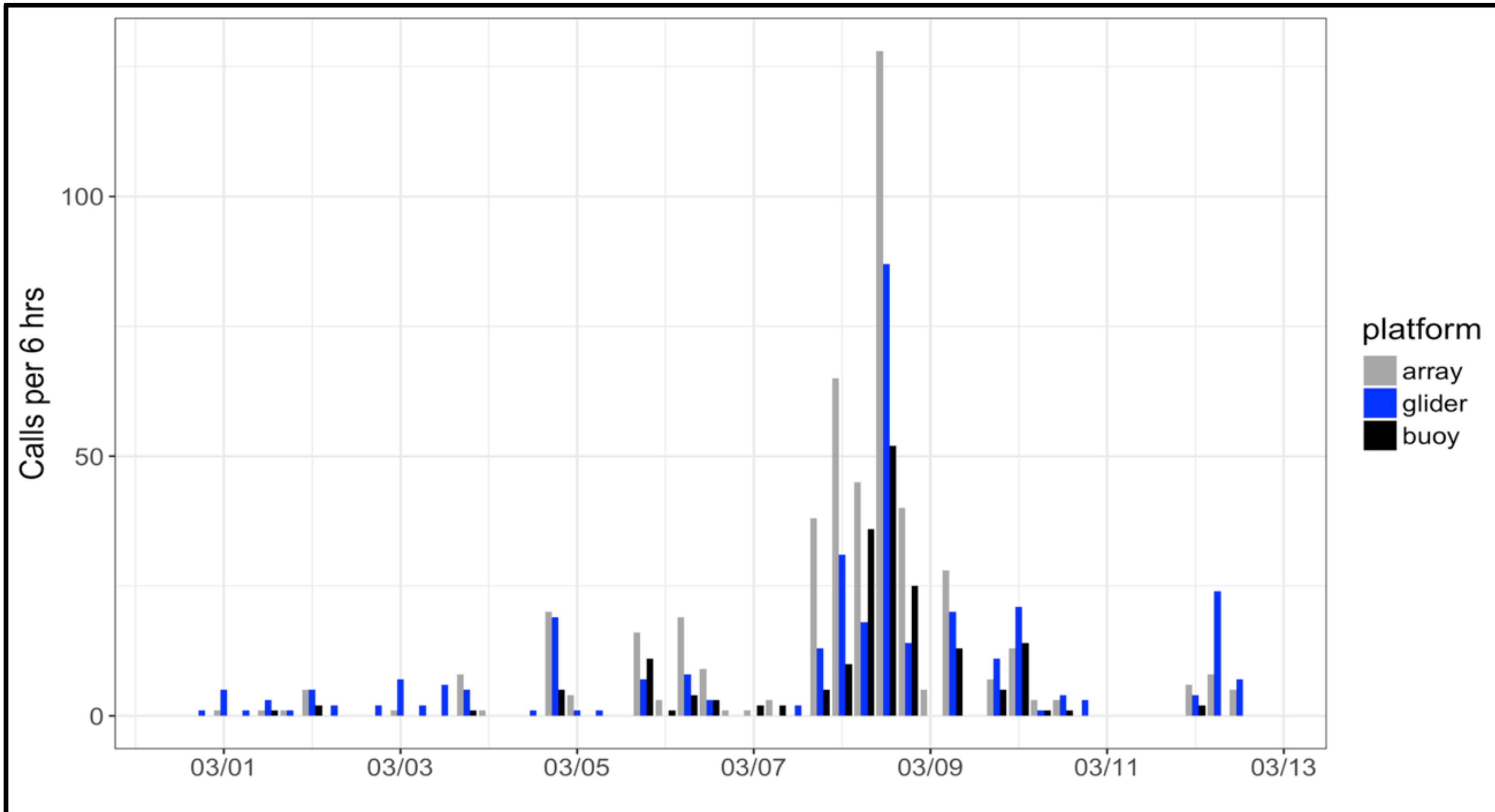
Study site



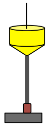
- ~15 km SW of Massachusetts, USA
- 30 m water depth, well-mixed ocean
- 2 weeks in March 2017 (early spring)

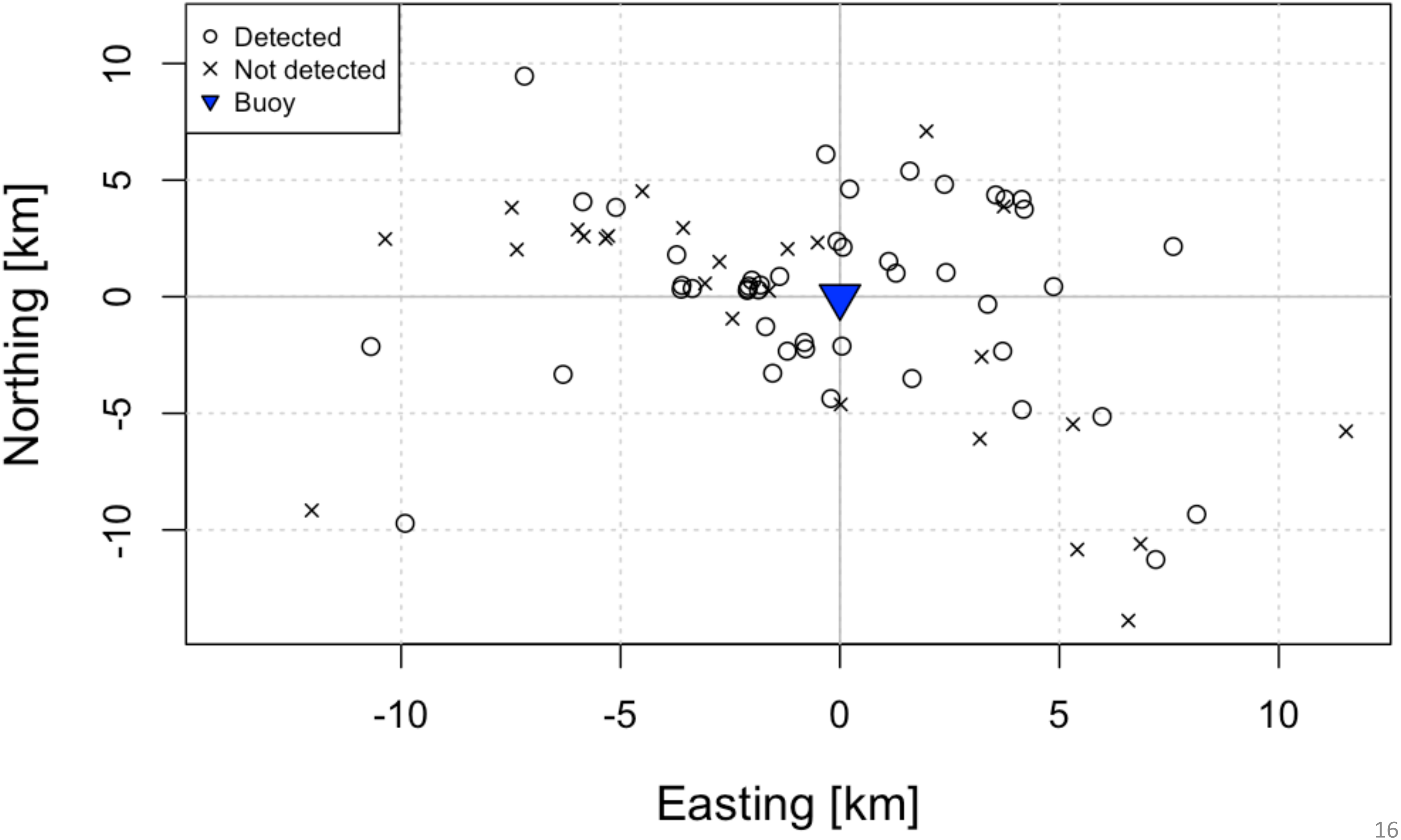
All detections

- 488 right whale upcalls detected on the HLA/VLA
- 75 calls localized

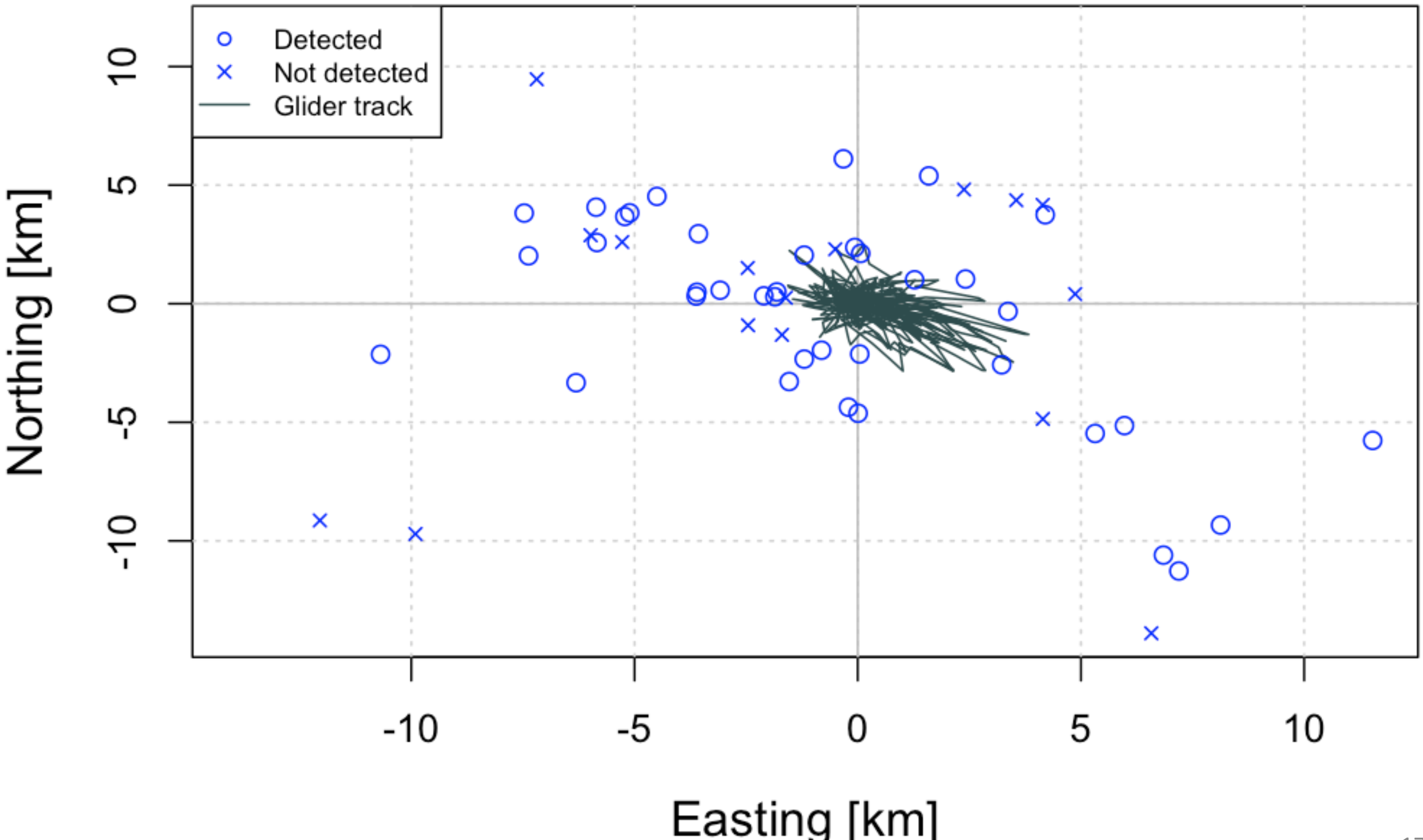


Detections by buoy

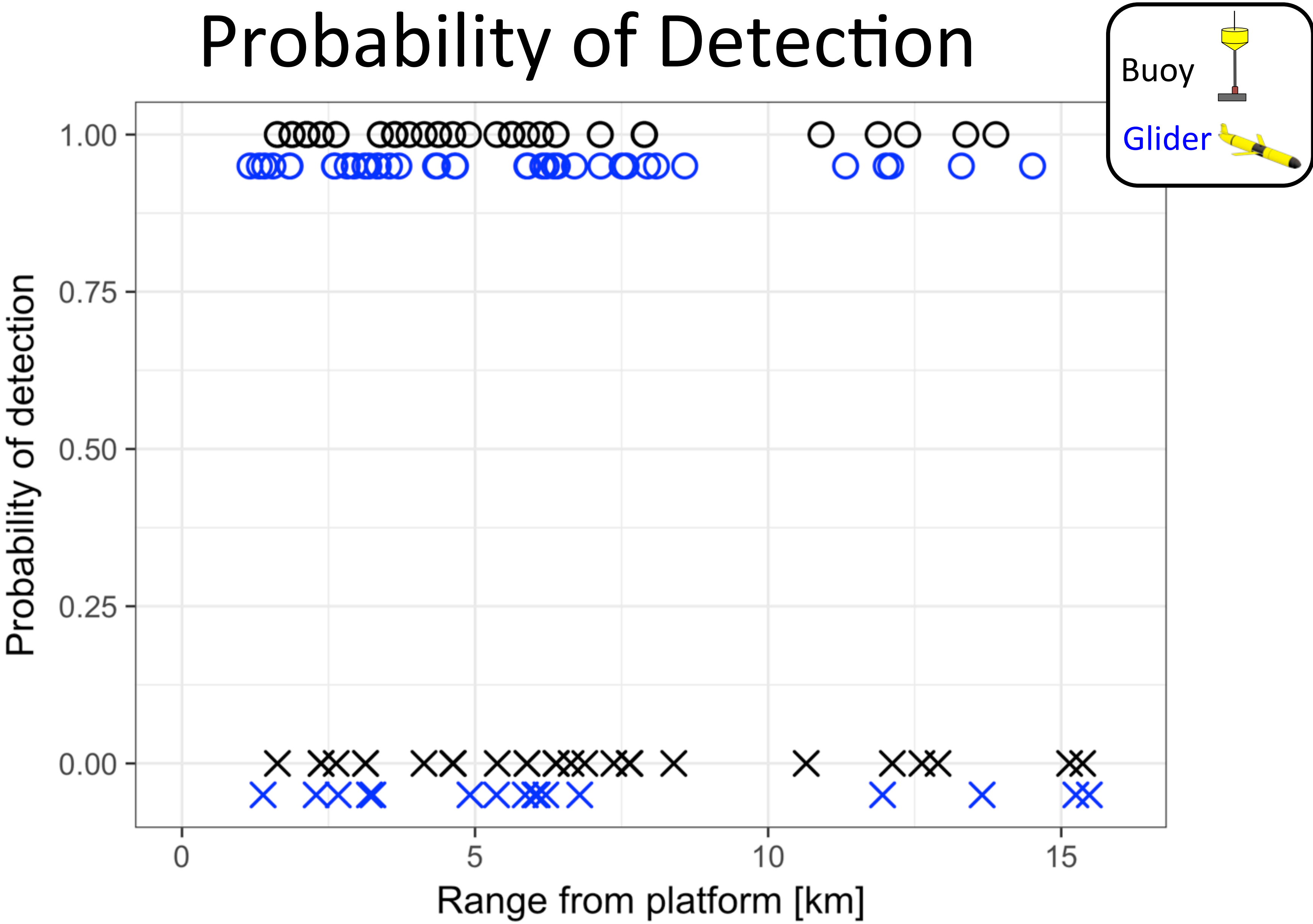




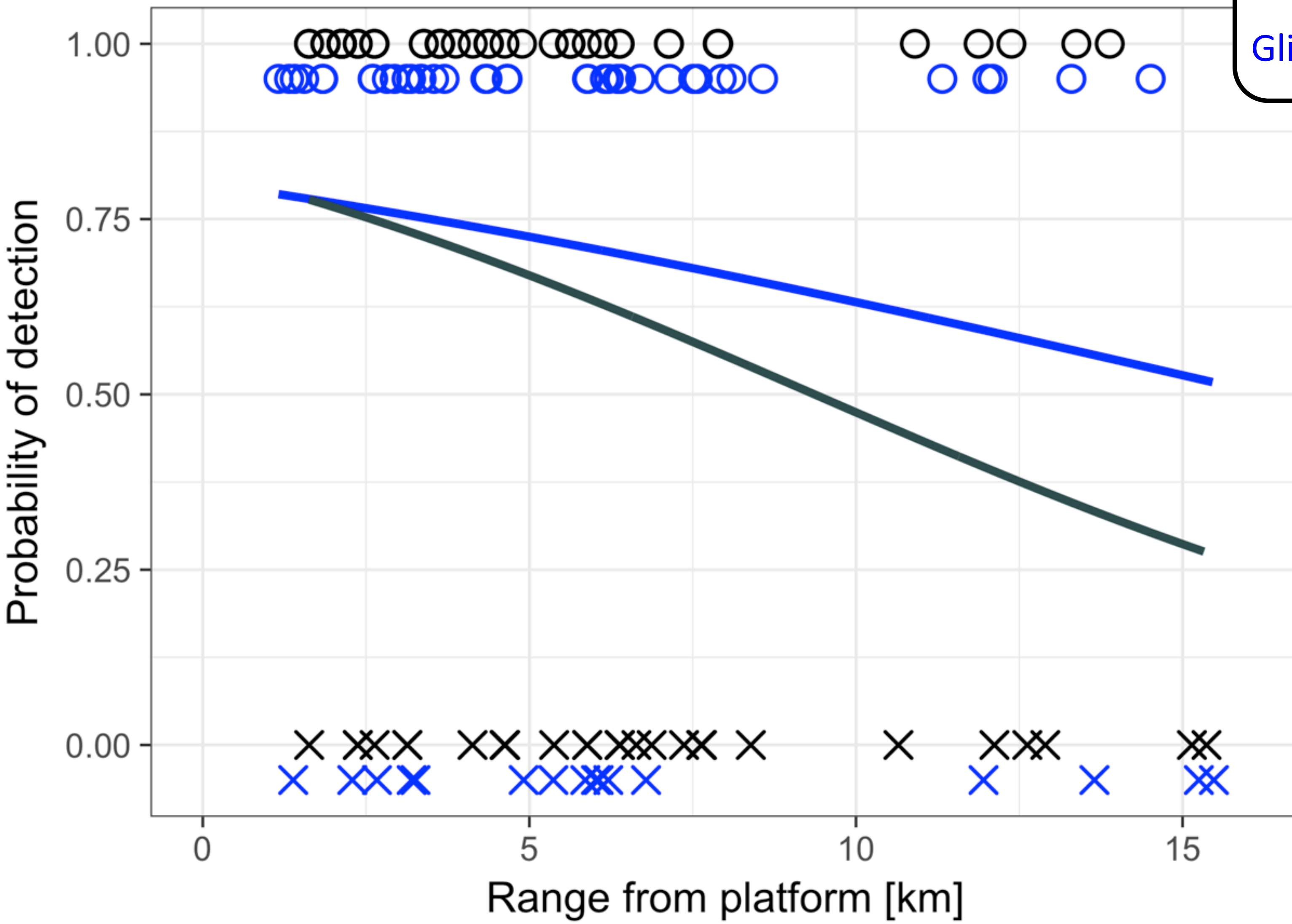
Detections by glider

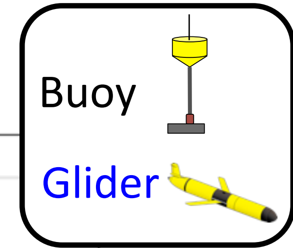


Probability of Detection

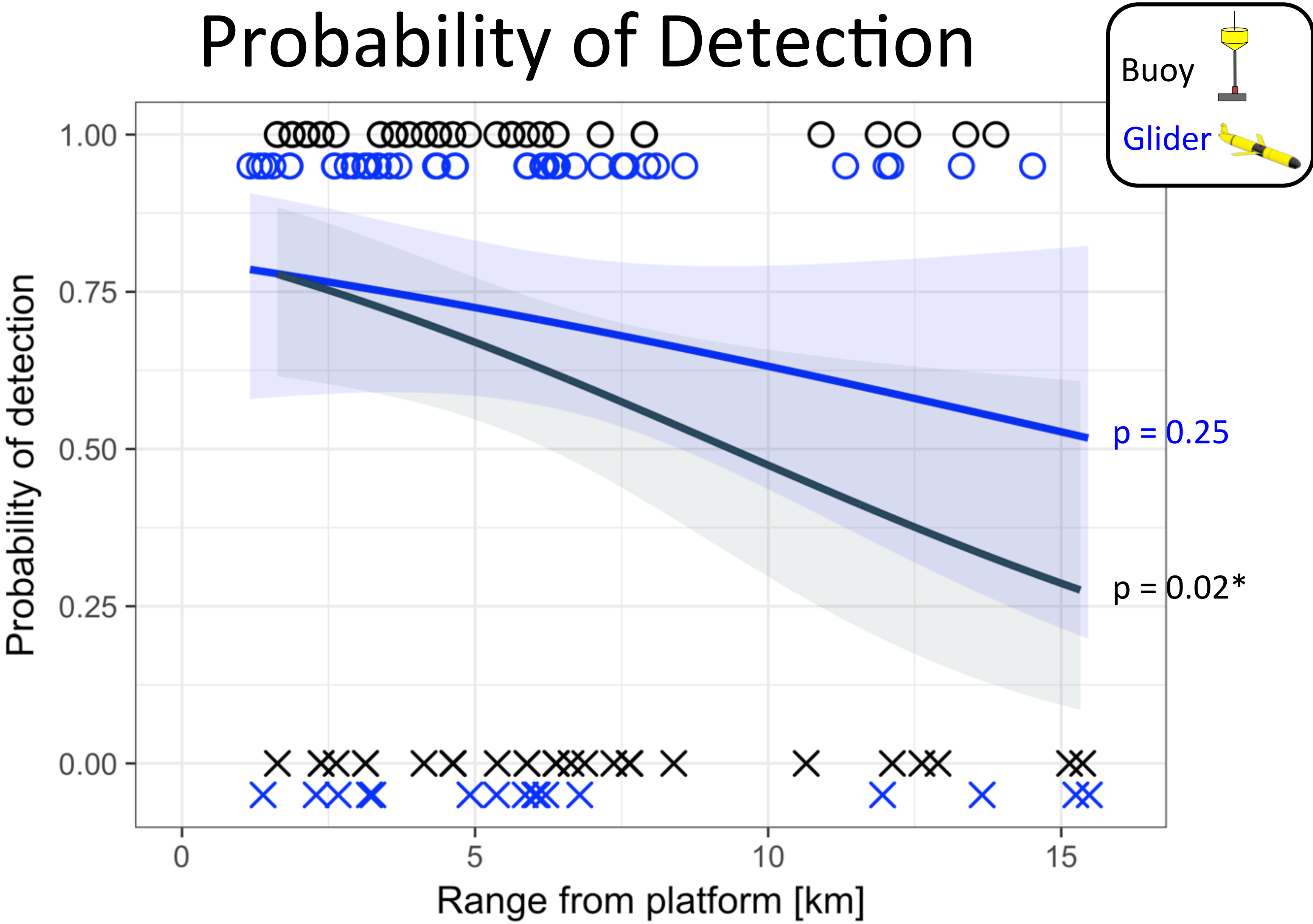


Probability of Detection





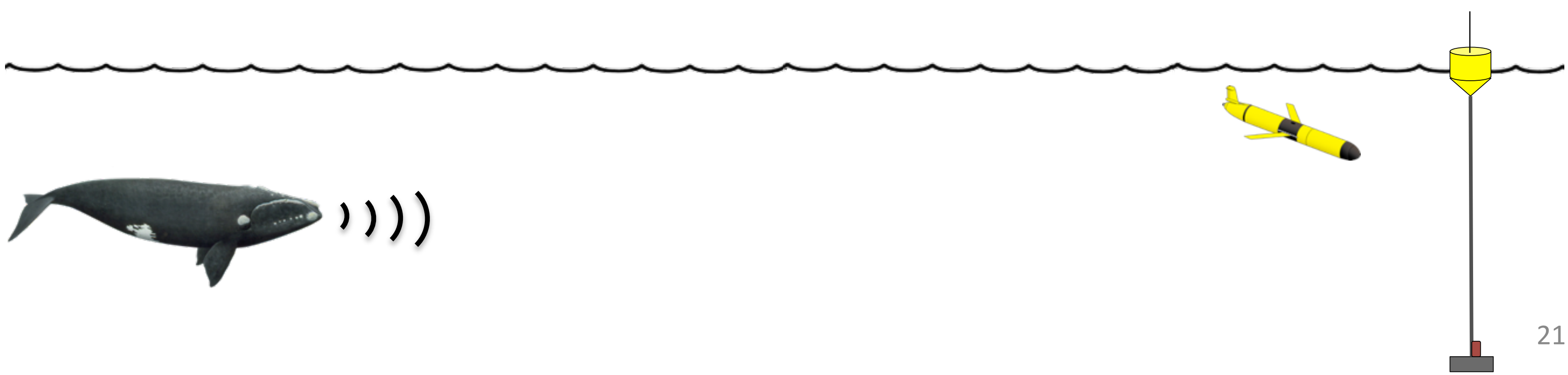
Probability of Detection



Showing 95% confidence intervals

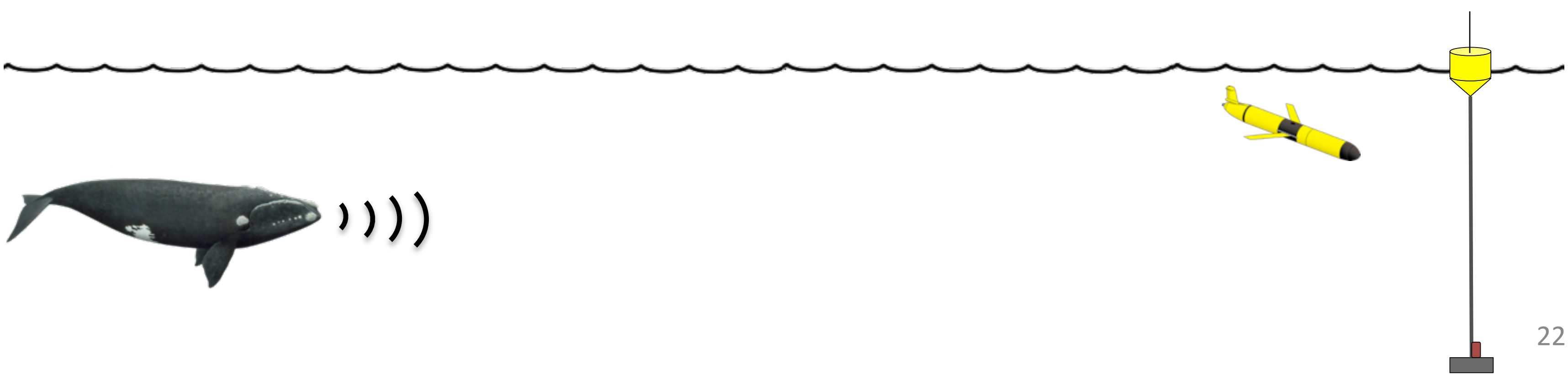
Conclusions

- Regression suggest the buoy (and perhaps glider) detects >50% of calls out to ~9 km (buoy significant, glider marginal)
- Factors other than range contribute to missed calls at close range
- DMON-LFDCS platforms likely detecting calls at equal or greater ranges than the array



Next steps (in progress)

- Reduce uncertainty in logistic regression
  - More calls (localization methods, extra deployment, etc.)
- Repeat experiment with a distributed array
- Sound transmission experiments
- Parameterize model-based estimates to apply to new areas
- Continue to work to integrate real-time PAM into management decisions and AIS-based whale alert



Questions?

Thanks to:

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WHOI AOPE: Peter Koski, Julien Bonnel and Dan Zitterbart

WHOI Dive Group: Ed O'Brien

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