

# Quantifying the response of Blainville's beaked whales to Naval sonar exercises in Hawaii

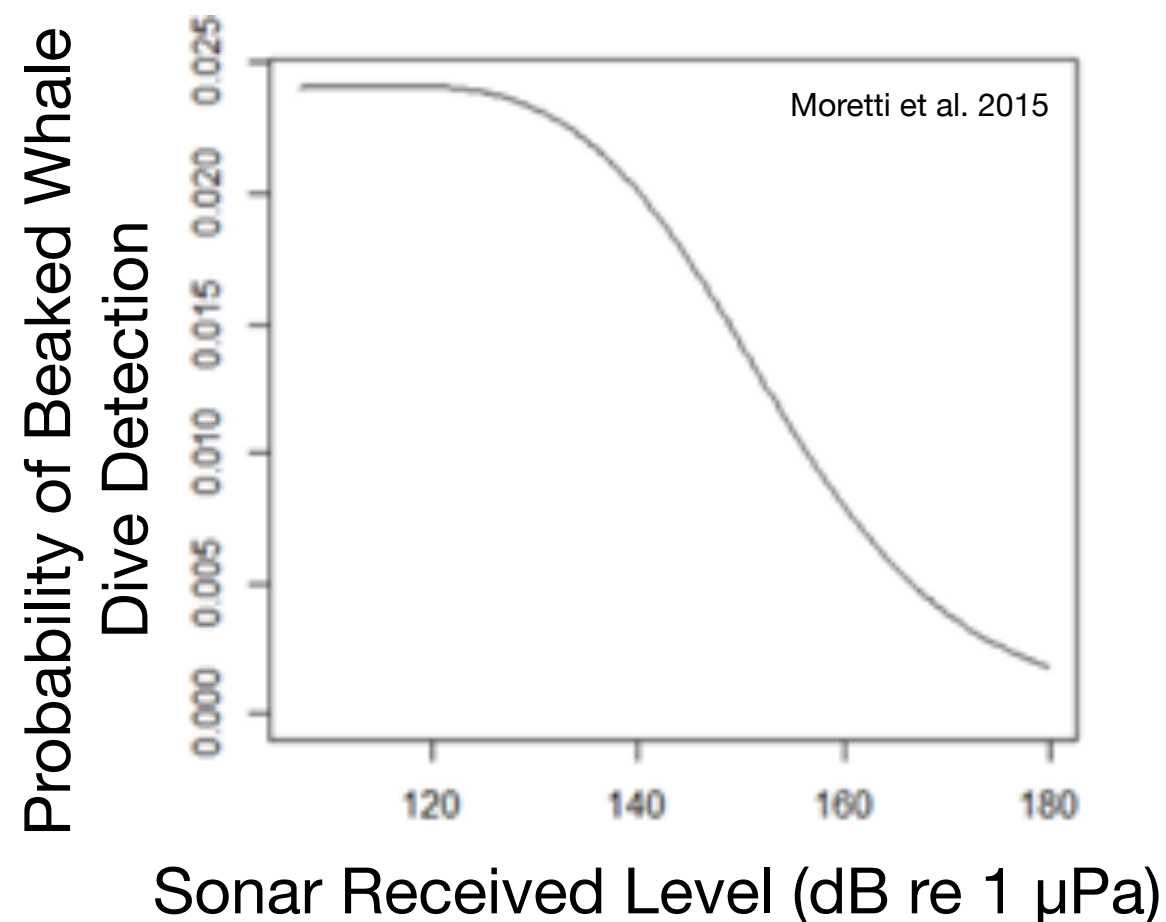
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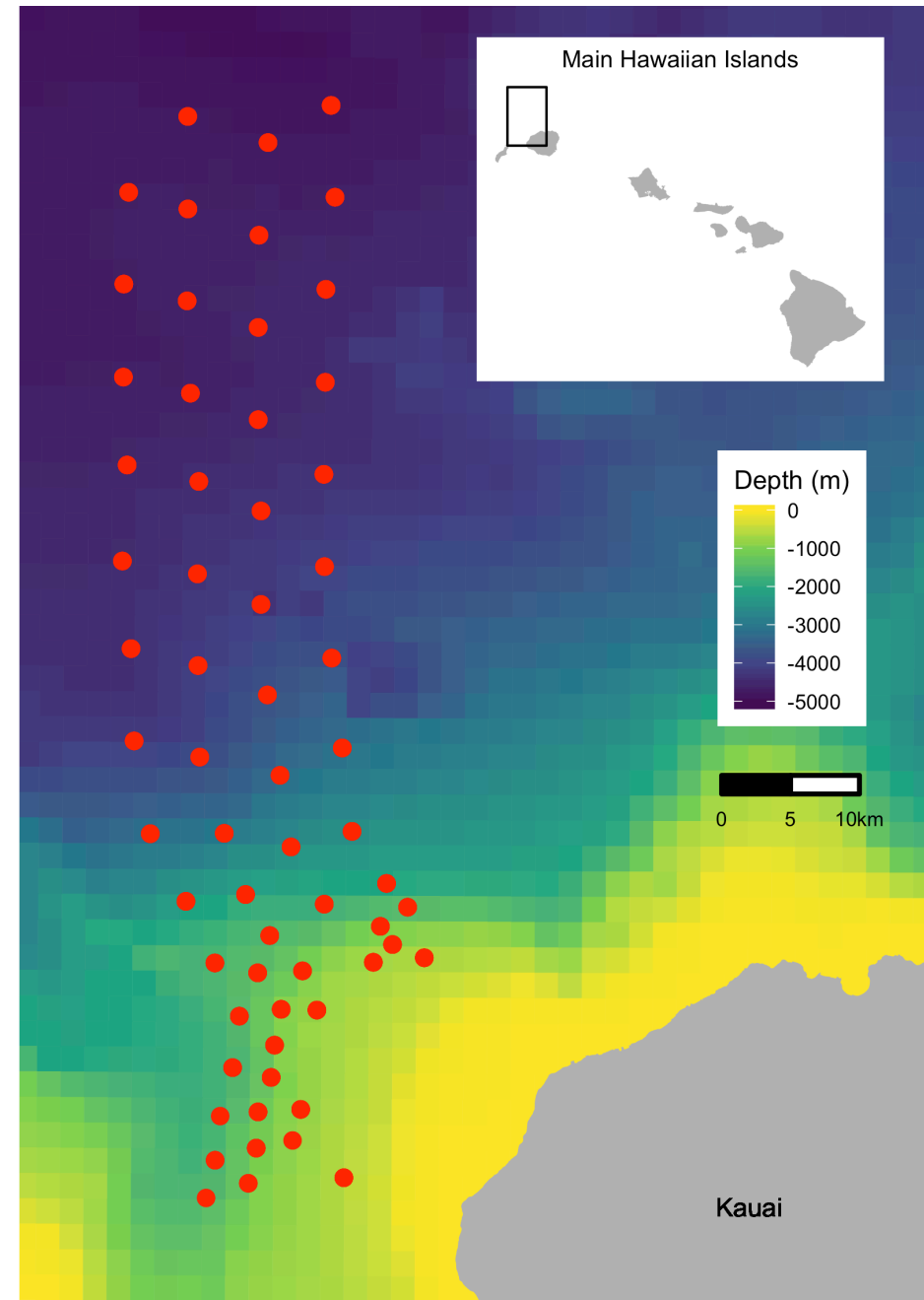
# Motivation

Goal was to develop a behavioral dose-response function for Blainville's beaked whales in Hawaii

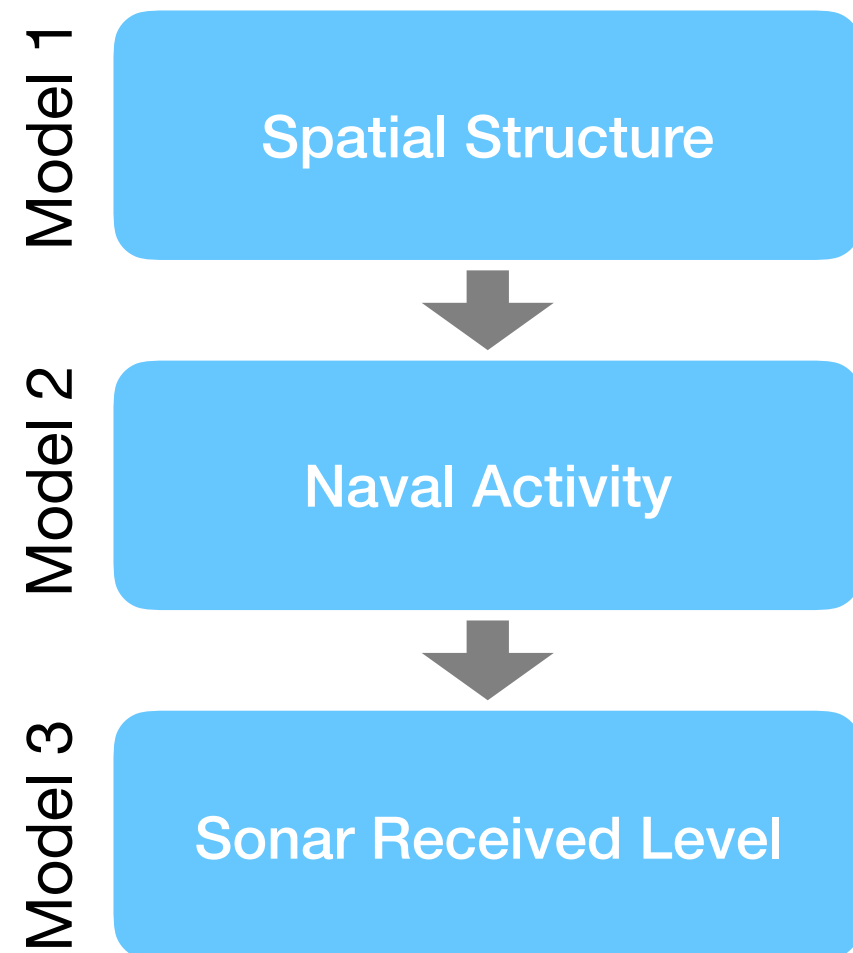


# Data

- 62 hydrophones NW of Kauai
- Data from before and during six training events over three years
- For each 30-min period:
  - Naval activity presence/absence
- For each hydrophone:
  - Sonar received level
  - Beaked whale presence\*
- $n = 190,928$

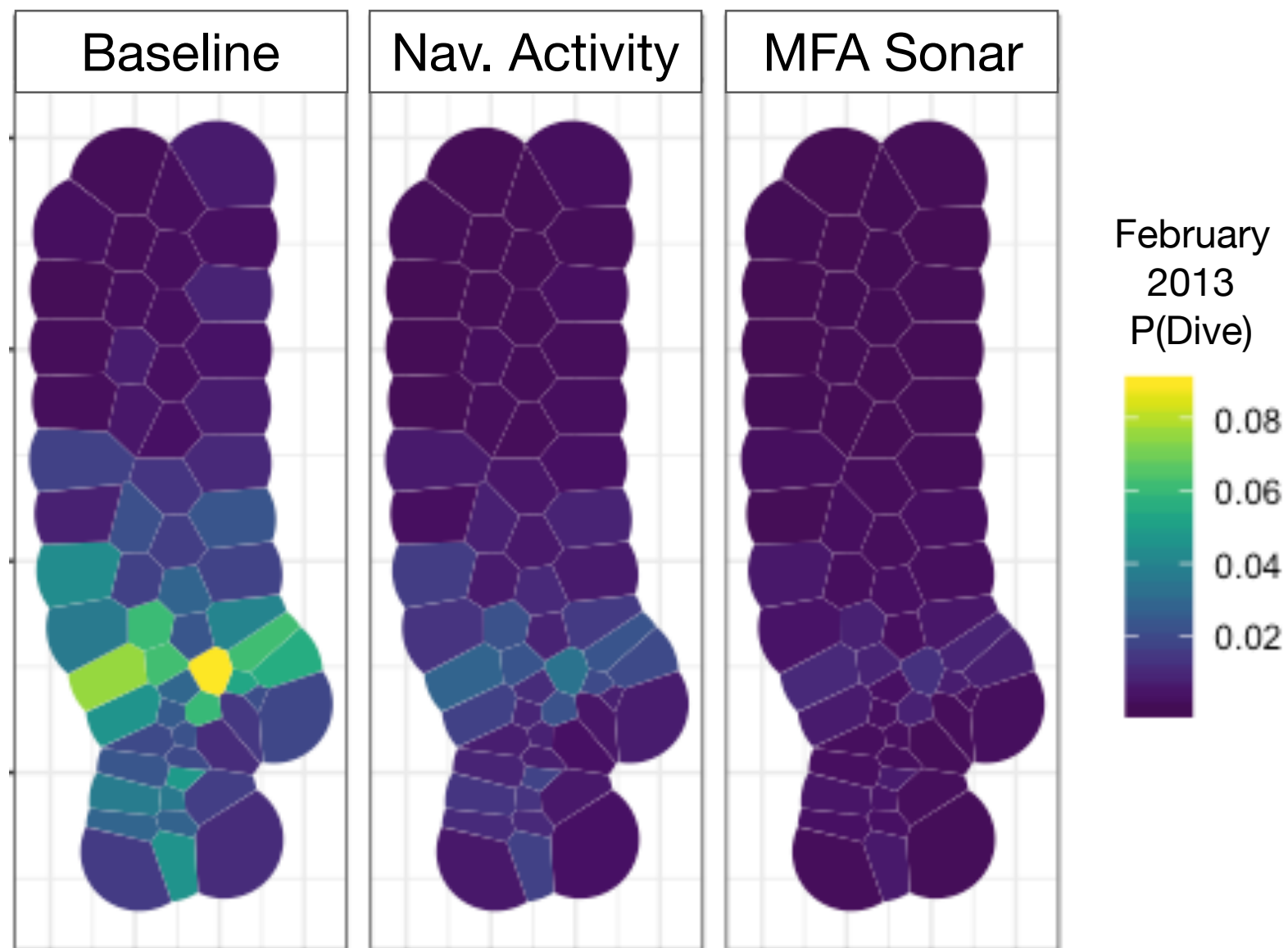


# Approach



- Needed to account for spatial correlations between animal density and sonar intensity
- Used a multi-stage GAM modelling approach to isolate the effect of sonar
- The output of each model was used as an offset in the next
- Bootstrapped to propagate uncertainty through models

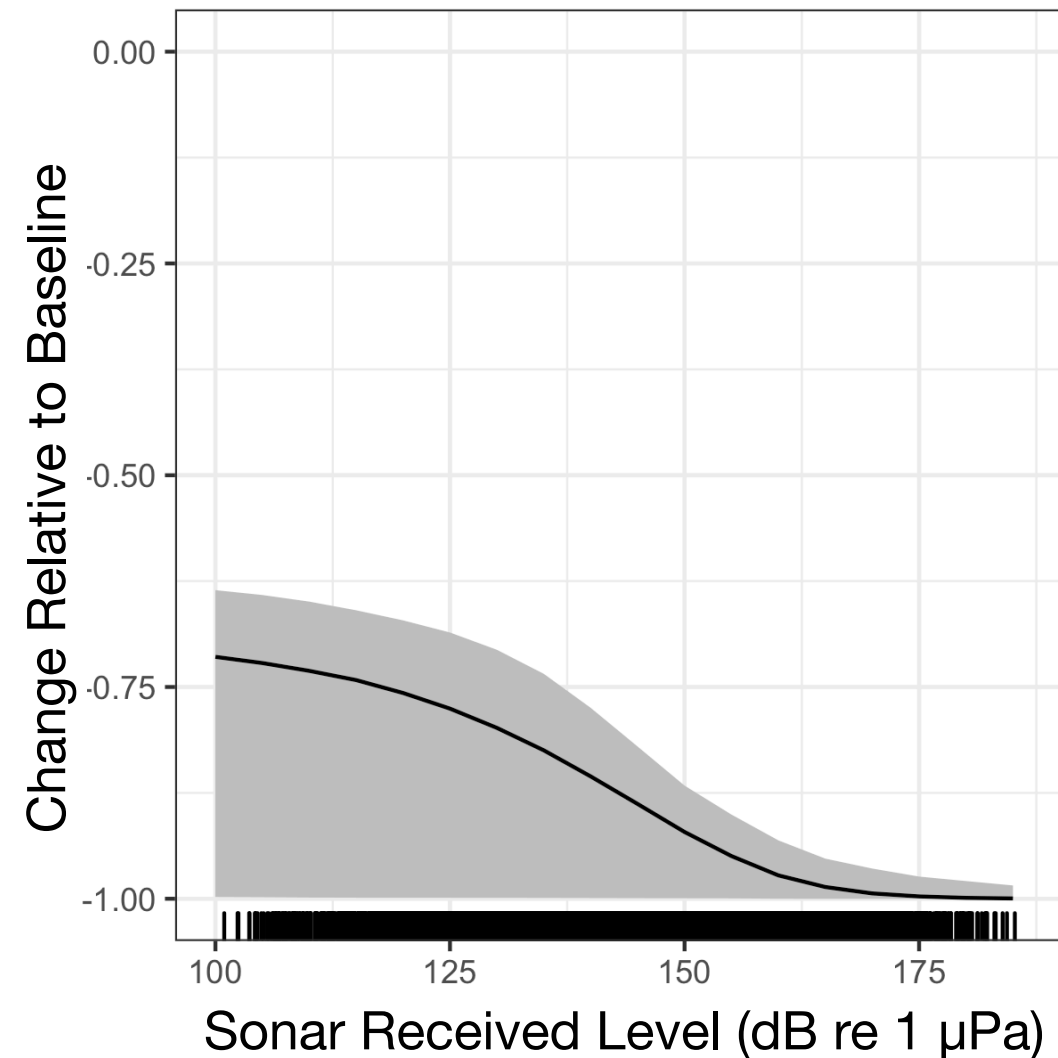
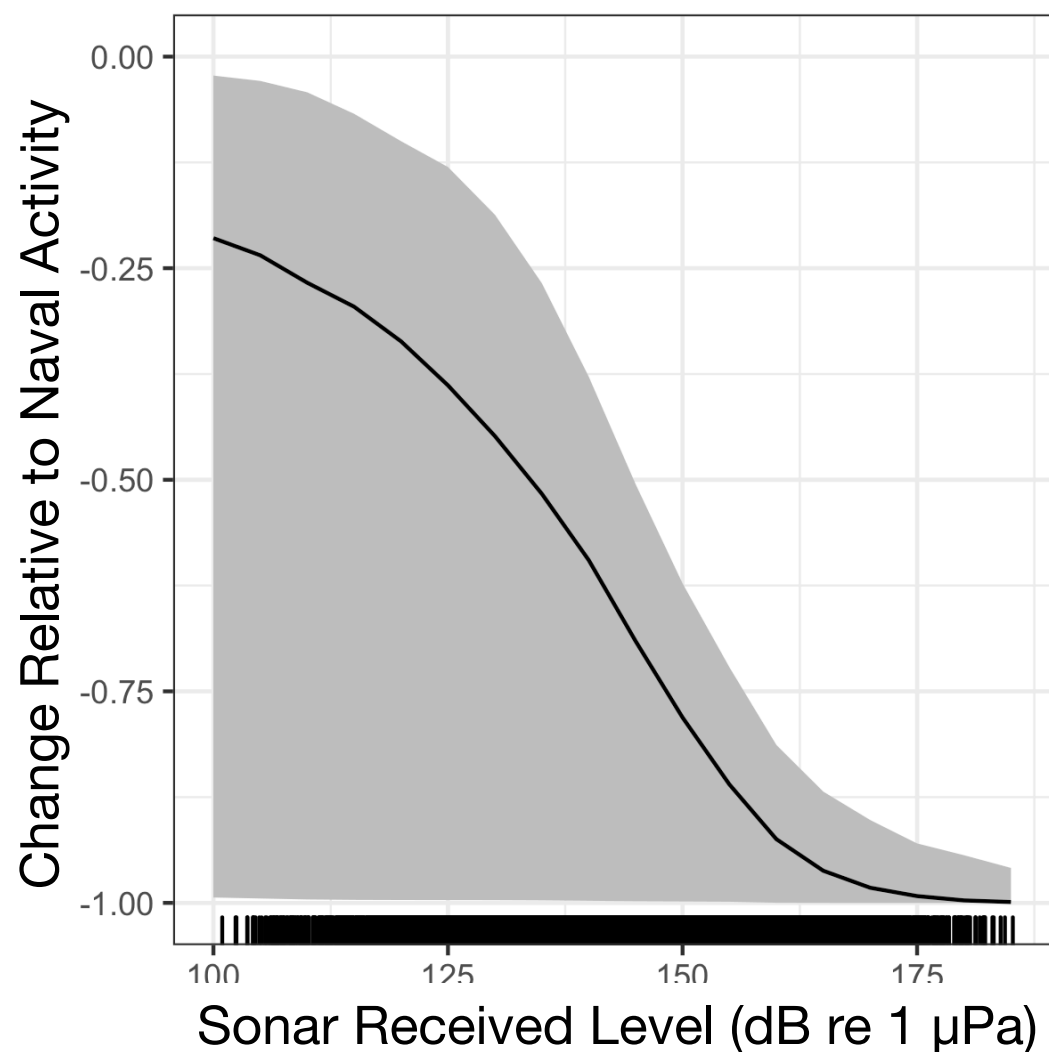
# Results



Naval activity results in 64% (95% CI 59-68%) reduction in probability of beaked whale detection relative to baseline

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Sonar received level of **150 dB re 1  $\mu$ Pa** results in a 78% (95% CI 62%-100%) reduction relative to when Naval activity is present, but a **92% (95% CI 87%-100%) reduction relative to baseline**



# Conclusions

- Animals are responding to stimuli other than active sonar
  - Need to investigate possible mechanisms for observed response to presence of Naval activity
  - Periods when Naval activity are present are not representative control periods
- Probability of dive presence decreased by >50% relative to baseline with any level of sonar exposure

