Applied Ocean Sciences

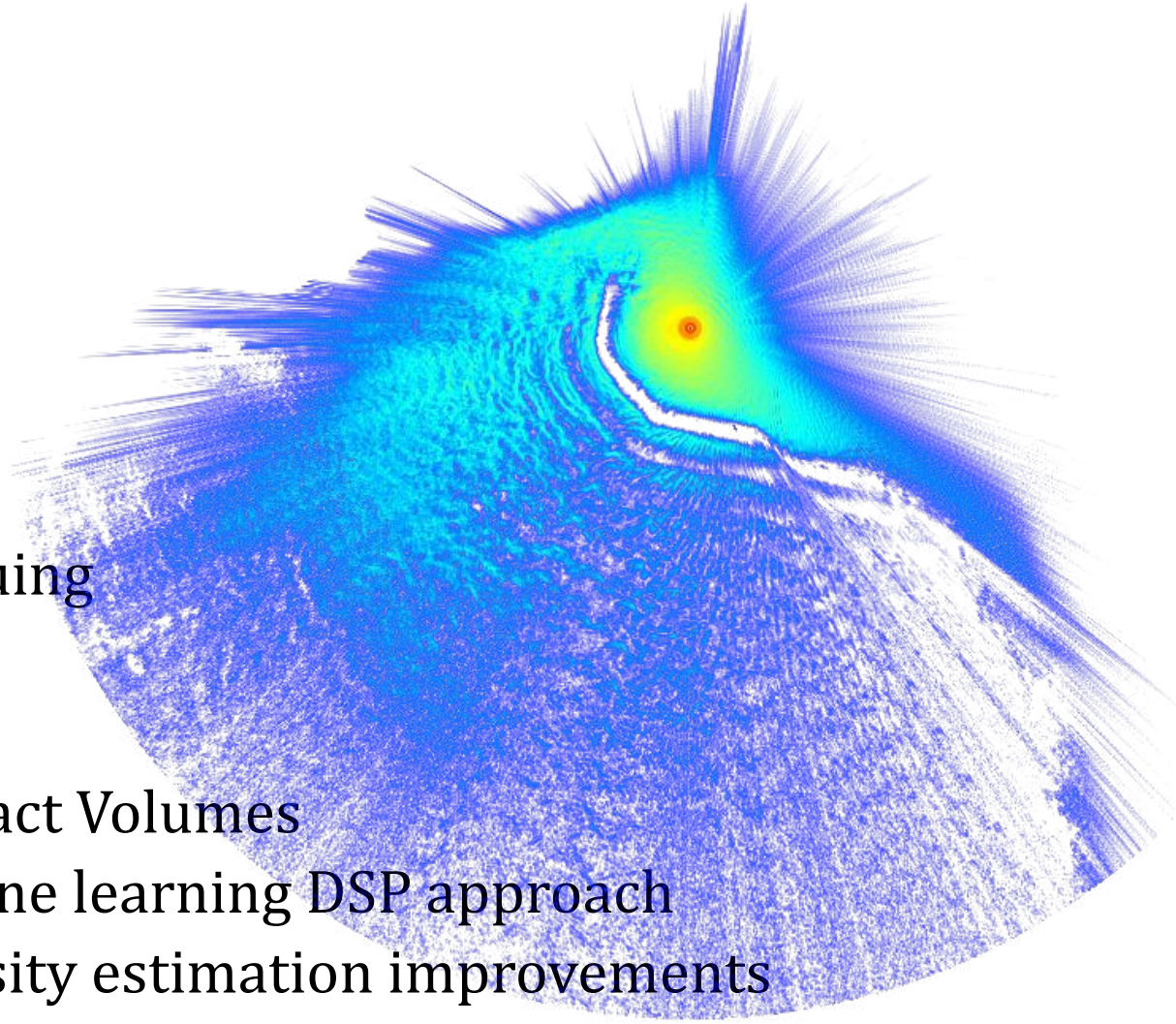
Detection Range for a Rice's Whale Call Along a Previous infiniTE™ Float Track

Workshop to Monitor Rice's Whales in the Gulf of Mexico

Kerri D. Seger

Getting the best science into the hands of people solving the ocean's hardest problems.

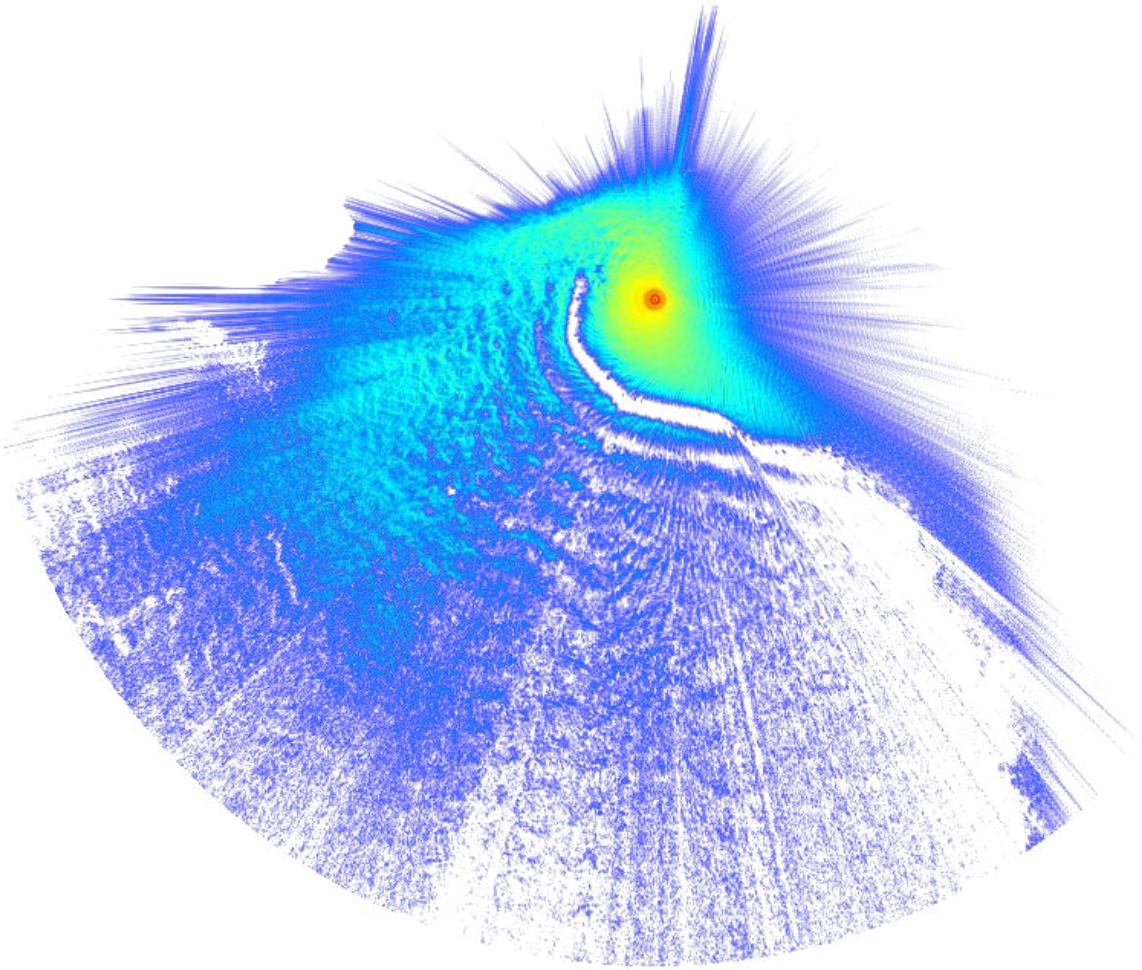
Quick Intro



- Bioacoustics
  - Soundscape analysis
  - Humpback whale social call cataloguing
  - Effects of noise
  - PHySIColombia
  - Ship Shock Trials / Pile Driving Impact Volumes
  - Mode Decomposition for non-machine learning DSP approach
  - Improving D/C for cue rate and density estimation improvements

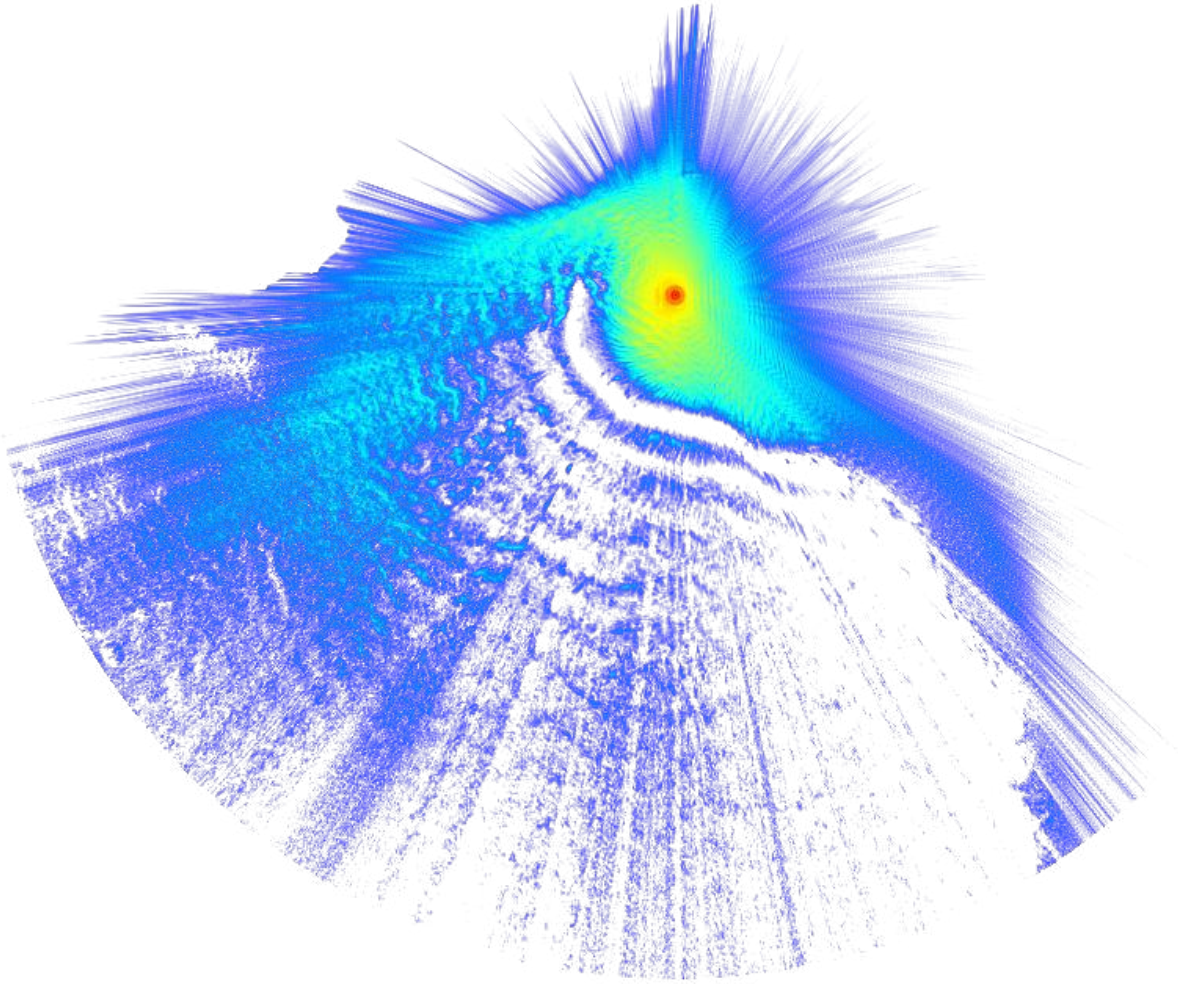
Yi’s initial proposal:

If we put a hydrophone on the infiniTE™ float in the Gulf of Mexico, do you think we could pick up Rice’s Whales?



My response:

Yes. But. How far? What depth do we deploy it at? And what if they are farther South than Melissa has recorded them?



Literature Review

- Soldevilla et al., 2022
  - Call at 1-14 m deep
  - (average of 6 m for model)
- Sirovic et al., 2014
  - Downswept pulse pair source levels of 155 +/- 14 dB re: 1 µPa at 1m (Sirovic´ et al., 2014)
  - (assume 160 dB for model)

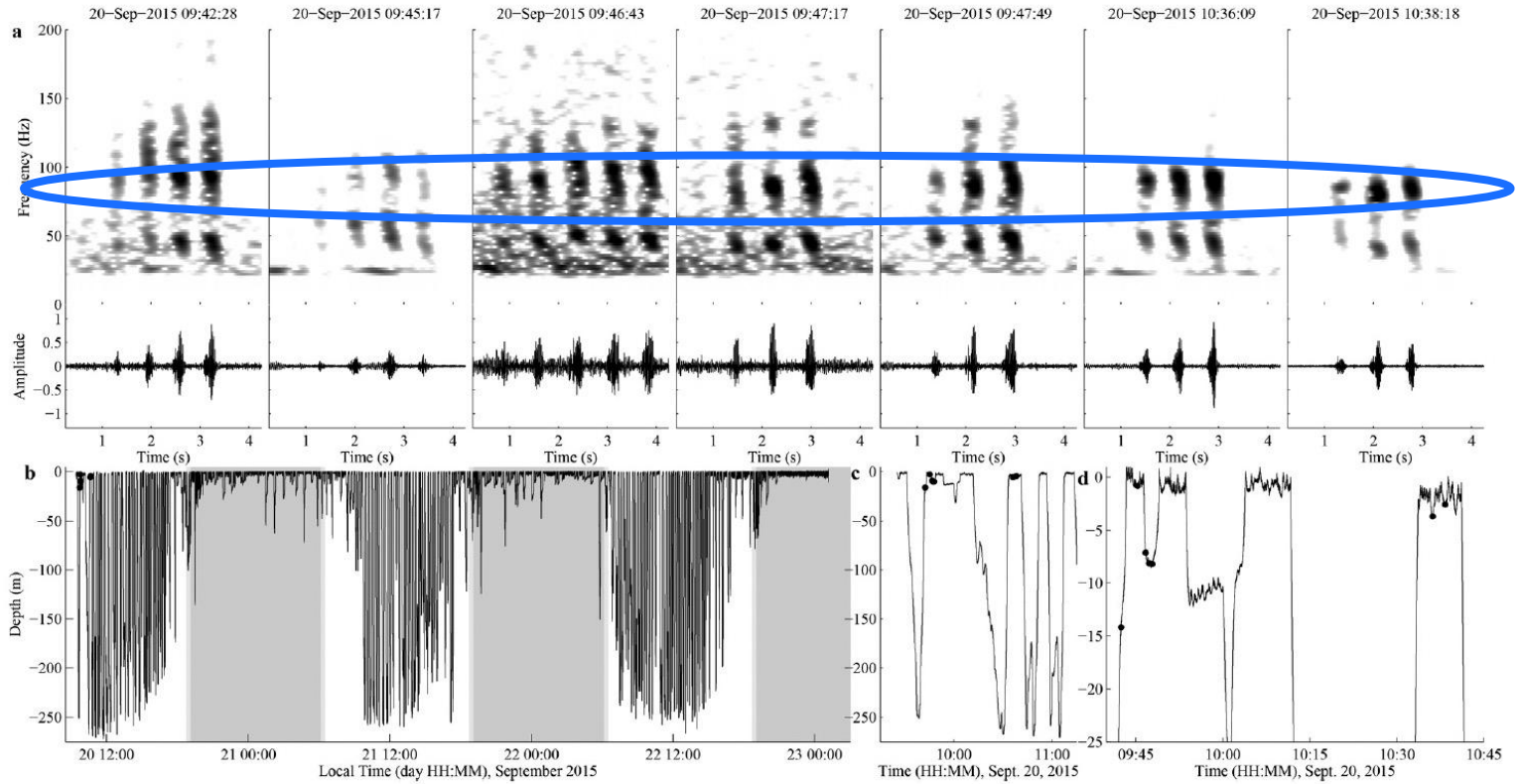
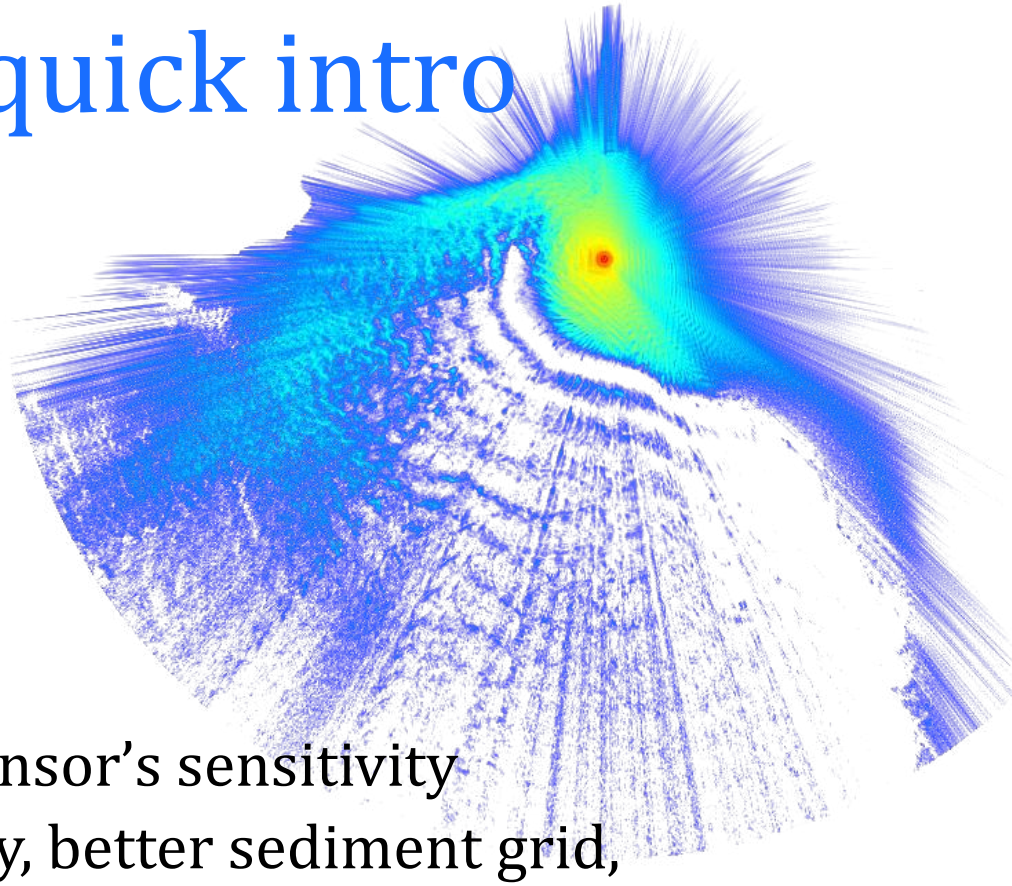


FIG. 5. Spectrograms with waveforms (a), and call occurrence timing during dive cycle (b–d) for 50 Hz downsweep pulse series recorded on a multi-sensor Acousonde tag attached to a Rice's whale in the Gulf of Mexico for 3 days in September 2015. Spectrogram resolution is 3 Hz x 3 ms based on DFT of 3037 samples and 99% overlap. Black dots on dive cycles indicate whale locations during each call detection. The seven plots in (a) represent the only calls detected during the 2.7 days tag deployment. Plot (b) indicates when in the 2.7 days period calls were detected (shading indicates nighttime). Plots c and d provide more detail in time and depth of where calls were detected with respect to the dive cycle.

Propagation Modeling: quick intro

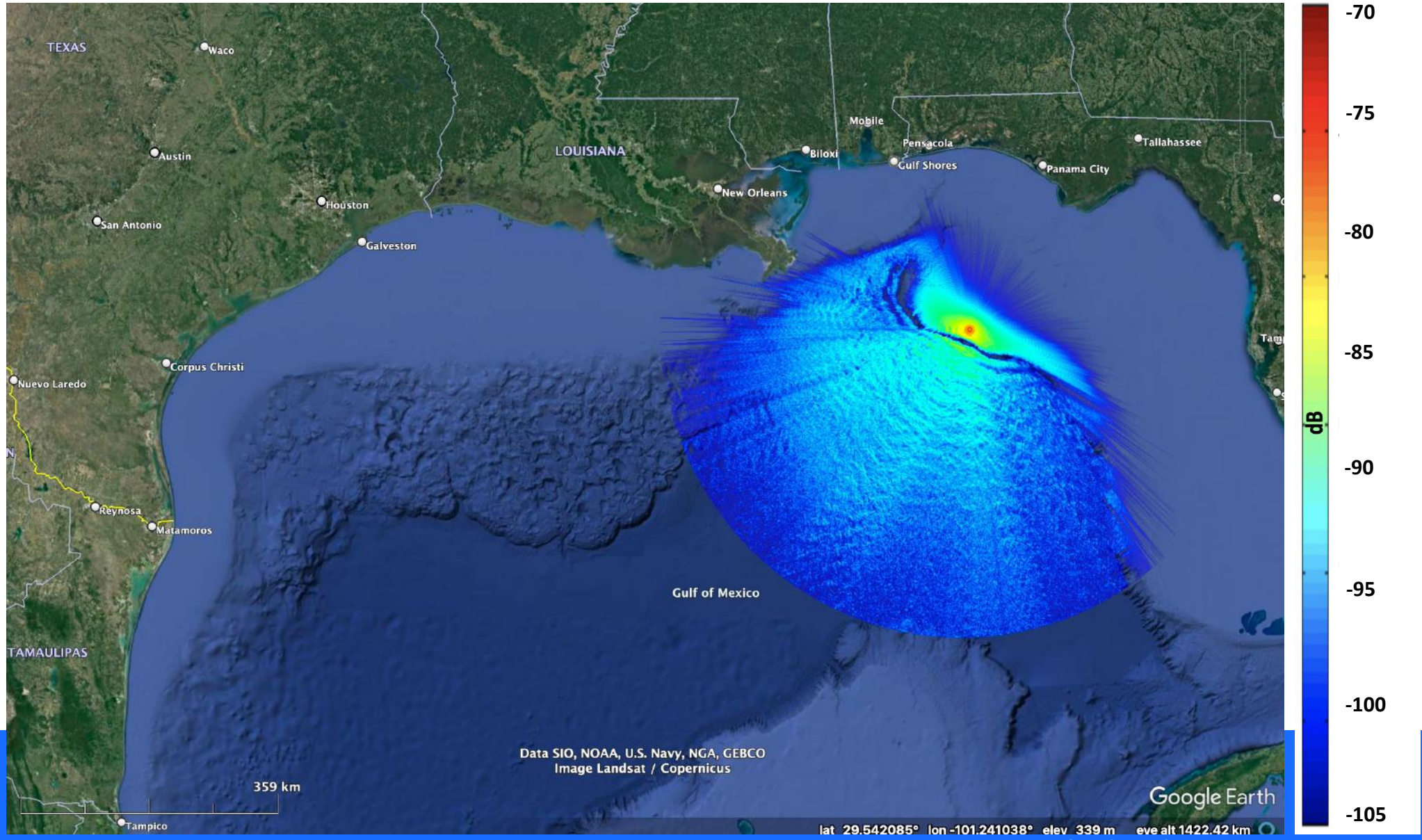


- In SONAR Equation of SL – TL = RL,
  - Propagation modeling software calculates TL
  - Red areas most intense
  - Blue areas least intense
  - Can include NL for more realism
  - Can introduce threshold for RL depending on sensor's sensitivity
  - Improved TL predictions with better bathymetry, better sediment grid, better SSP grid, etc.
  - For project planning, can calculate area or volume of expectation of receiving a Rice's Whale call from infiniTE™ float for various locations

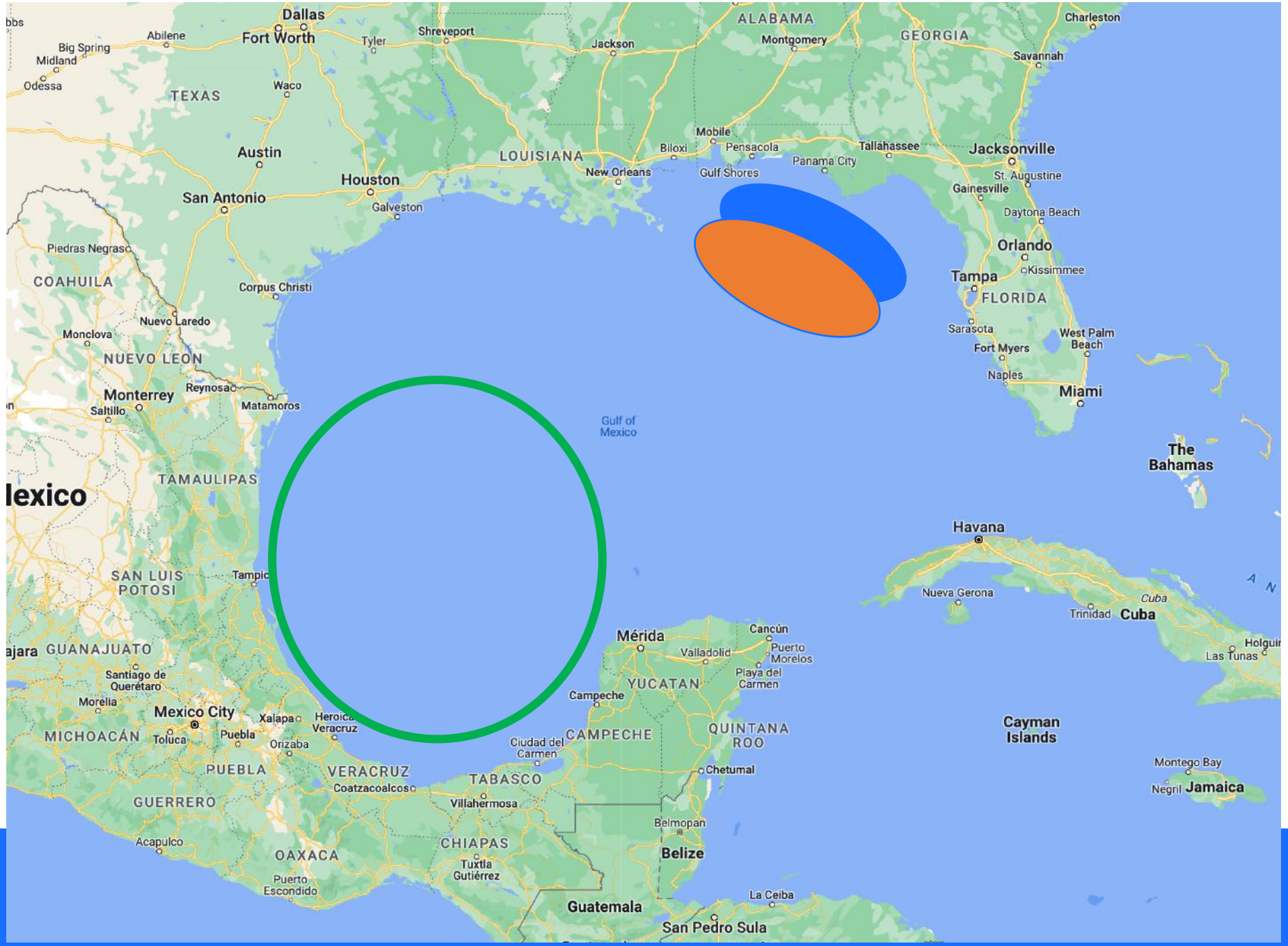
Propagation modeling of actual float track

- “Peregrine” – parabolic equation software (AOS)
  - Track line once per day from infiniTE™ float
  - Transmitter depth = 6 m
    - (can make random set of depths to imitate whale)
  - Receiver depth = 20 (or actual float track depth)
    - 20m stationary better to be close to Rice’s whale calling depth, above SSM, and far enough away from surface (above 18 m in other study in similar area was showing too much loss of reception from surface refraction)
  - Freq = 100 Hz
  - Bathymetry = GEBCO
  - SSP = WOA
  - Sediment size = -2 phi (Wentworth)

Transmission Loss from actual float track



Assume hydrophone receptive to 60 dB


Dallas
Fort Worth
Abilene
Big Spring
Midland
Odessa
Waco
TEXAS
Austin
San Antonio
Houston
Galveston
Tyler
Shreveport
Jackson
ALABAMA
Montgomery
GEORGIA
Charleston
Savannah
LOUISIANA
New Orleans
Mobile
Biloxi
Pensacola
Panama City
Tallahassee
Gulf Shores
Jacksonville
St. Augustine
Gainesville
Daytona Beach
Orlando
Kissimmee
Tampa
FLORIDA
Sarasota
Fort Myers
West Palm Beach
Naples
Miami
Piedras Negras
COAHUILA
Corpus Christi
Nuevo Laredo
Monclova
NUEVO LEON
Monterrey
Reynosa
Matamoros
Saltillo
Gulf of Mexico
The Bahamas
TAMAULIPAS
Havana
Nueva Gerona
Cuba
Trinidad
Cuba
SAN LUIS POTOSI
Tampico
Mérida
Cancún
Puerto Morelos
Valladolid
Playa del Carmen
YUCATAN
Campeche
GUANAJUATO
Santiago de Querétaro
Morelia
Mexico City
Xalapa
Heroica Veracruz
MICHOACÁN
Toluca
Puebla
Orizaba
CAMPECHE
Ciudad del Carmen
QUINTANA ROO
Chetumal
Cayman Islands
PUEBLA
VERACRUZ
Coatzacoalcos
TABASCO
Villahermosa
Montego Bay
Negril
Jamaica
GUERRERO
Acapulco
Belmopan
Belize
CHIAPAS
OAXACA
Tuxtla Gutiérrez
Puerto Escondido
Guatemala
La Ceiba
San Pedro Sula

What if deploy off Eastern Mexico?

- Open to options of where to deploy in SW GoM
- Invited Dra. Esther Jimenez and Dr. Hiram Nanduca to our conversations to determining best location for that
- Could leverage current data to make a few predictive tracks and determine largest potential detection range with propagation modeling
  - Other ideas / input?
- Intended roles
  - Deployment planning for optimal detection
  - Analysis of data for Rice's Whale calls (possibly bring in more AOS DSPs for auto detection/classification of calls to send to the cloud in real time)