SCALLOP FISHING ACTIVITY CHARACTERIZATION IN SOUTHERN NEW ENGLAND: OFFSHORE WIND DEMANDS AND FISHERIES-DEPENDENT METHODS

Julia Livermore and Todd Guilfoos

RIMFI Spring Research Meeting

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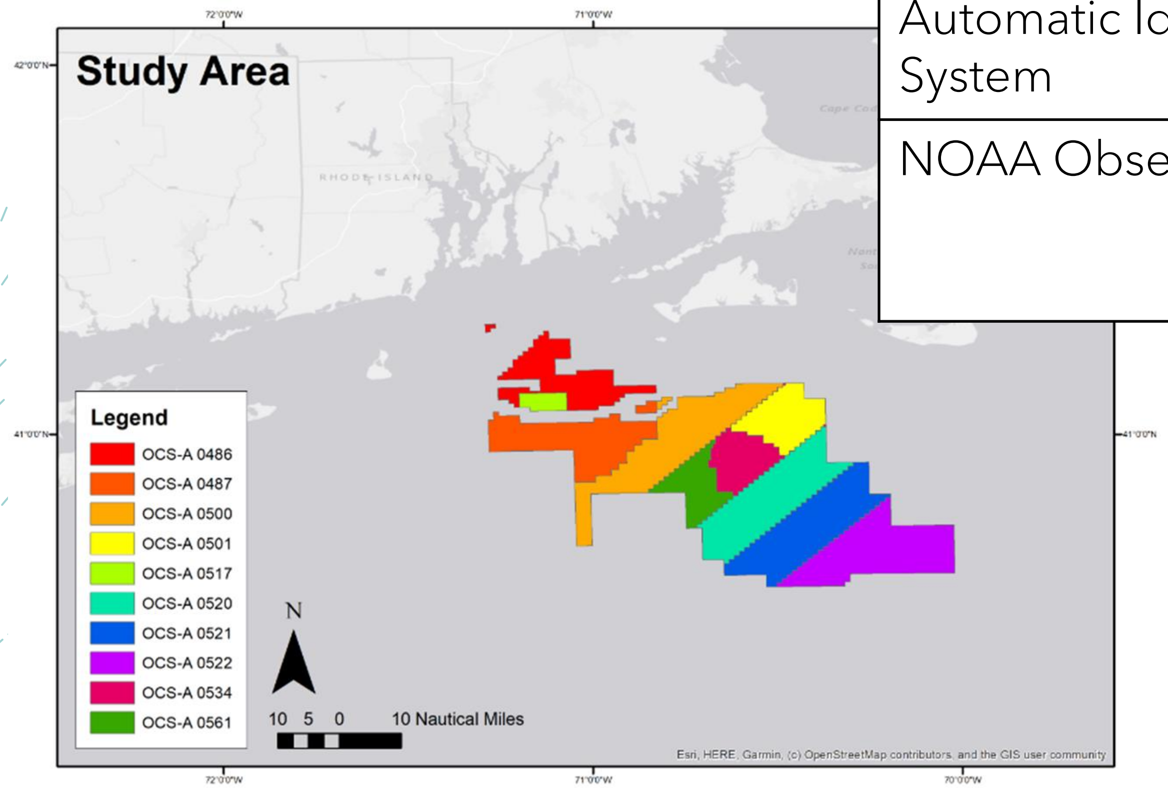
INTRODUCTION

- Wind development occurring in areas that have historically been fishing grounds



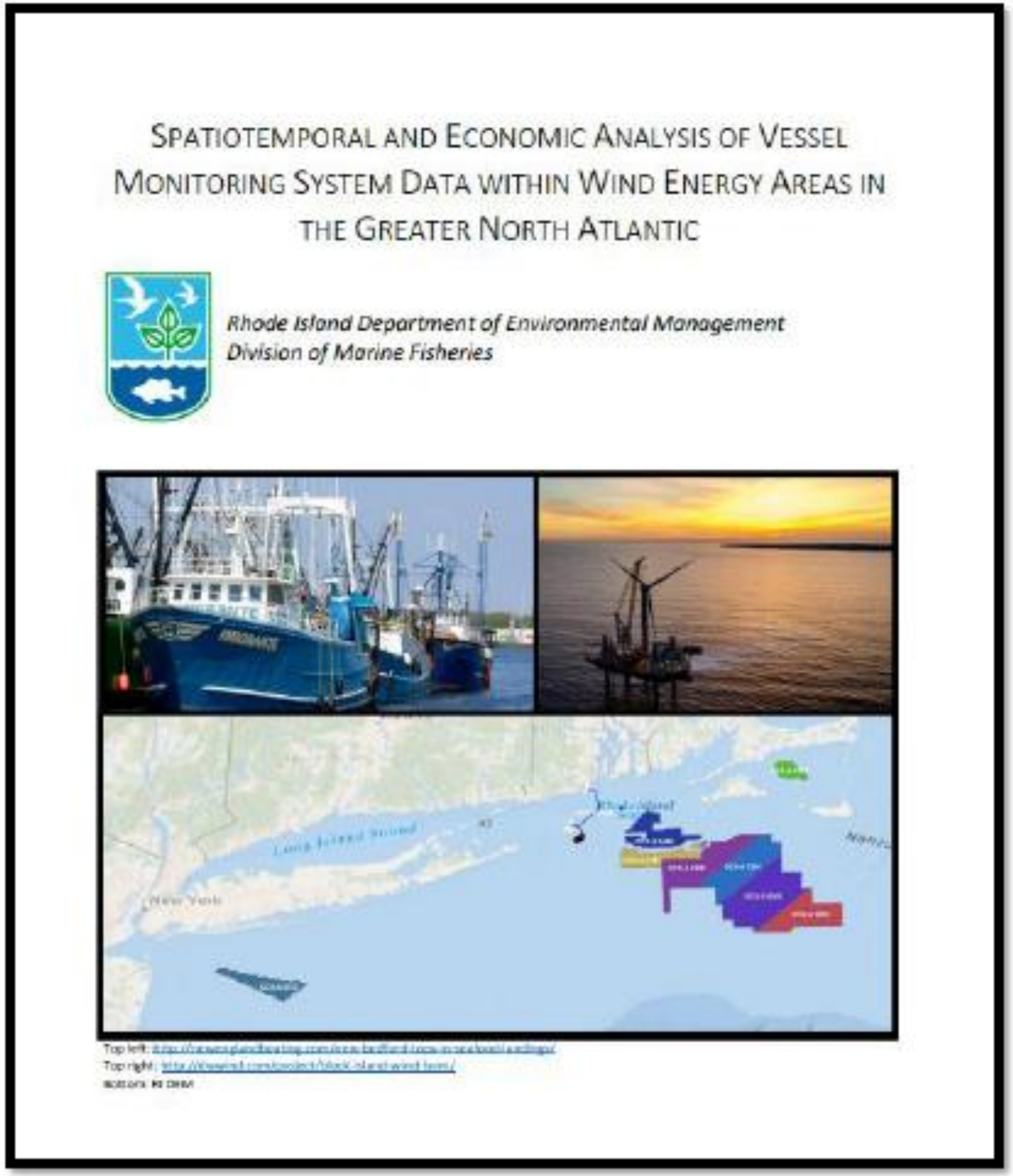
Dataset	Description
Dealer Reports	Value, amount, and grade of seafood landed
Vessel Trip Reports/Logbooks	Self-reported effort info (location, gear used, catch, etc.)
Vessel Monitoring Systems	Location information for fishing vessels
Automatic Identification System	High resolution location information for any vessel
NOAA Observer Reports	Highly reliable fisheries observer data on catch, bycatch, gear, location, etc.

- What economic value do these grounds provide and how will the fishing industry respond to offshore development?
- What data are available to answer these questions?

Livermore and Guilfoos (2024)
doi: 10.1371/journal.pone.0313197

EXISTING RESOURCES

- NOAA VTR and Observer Revenue Data Model
- VMS Data on NROC/MARCO Data Portals
- RIDEM VMS/VTR/Dealer Revenue Analysis
- Other models in development

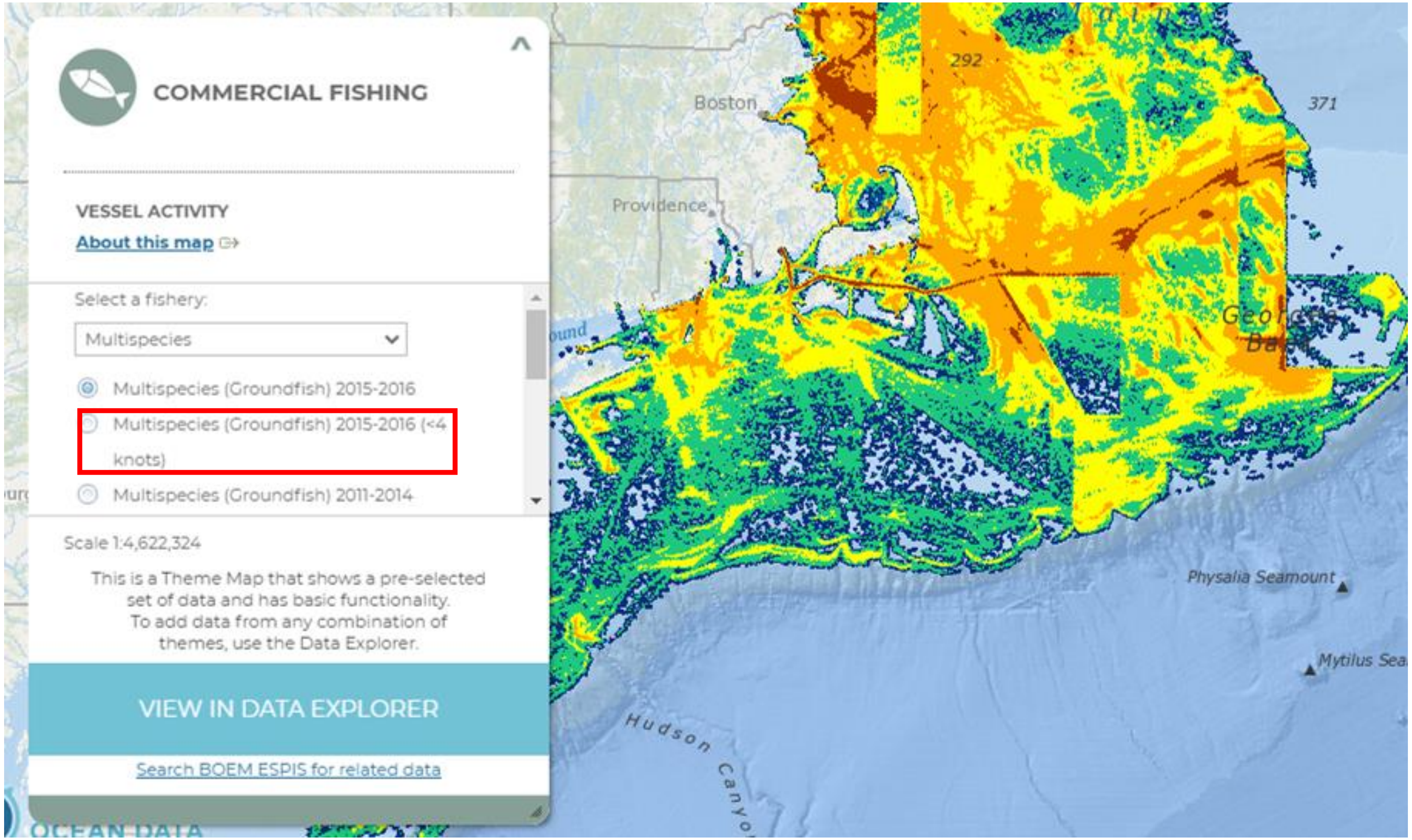

SPATIOTEMPORAL AND ECONOMIC ANALYSIS OF VESSEL MONITORING SYSTEM DATA WITHIN WIND ENERGY AREAS IN THE GREATER NORTH ATLANTIC

Rhode Island Department of Environmental Management
Division of Marine Fisheries

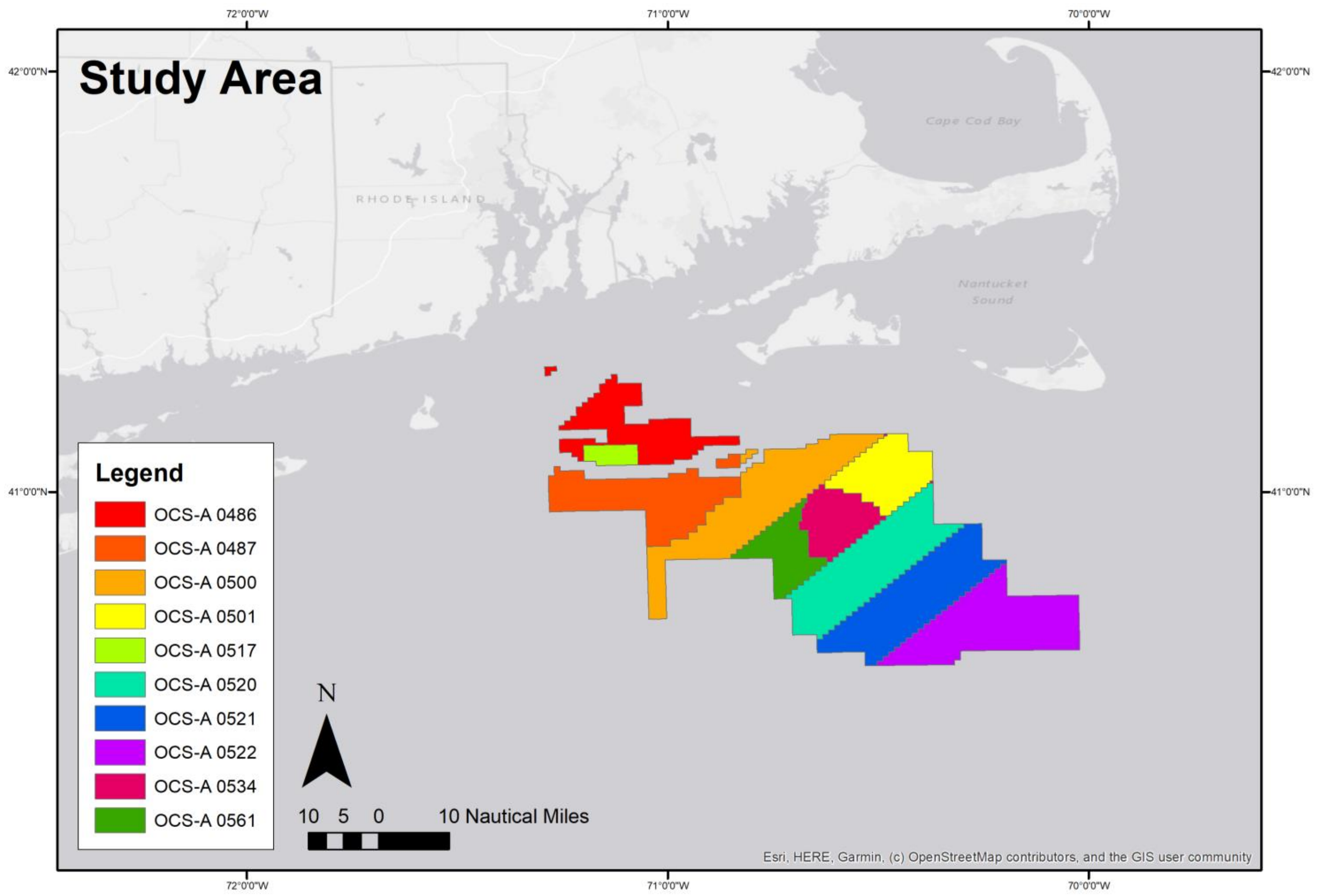
KEY PROBLEM WITH EXISTING APPROACHES

- Muench et al. (2017) - On the precision of predicting fishing location using data from the Vessel Monitoring System (VMS)
  - Using speed to separate fishing from non-fishing activity is <u>not accurate for most gear types</u>

This is the problem we're focused on addressing!



STUDY SCOPE

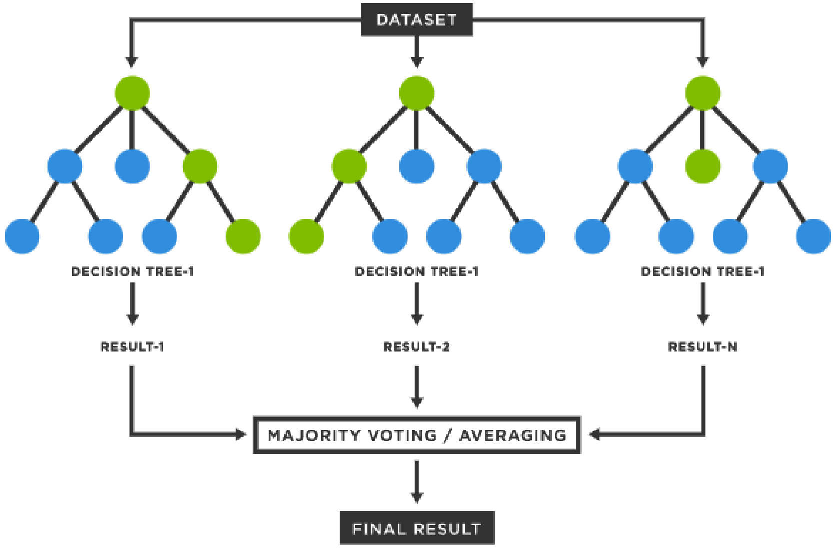


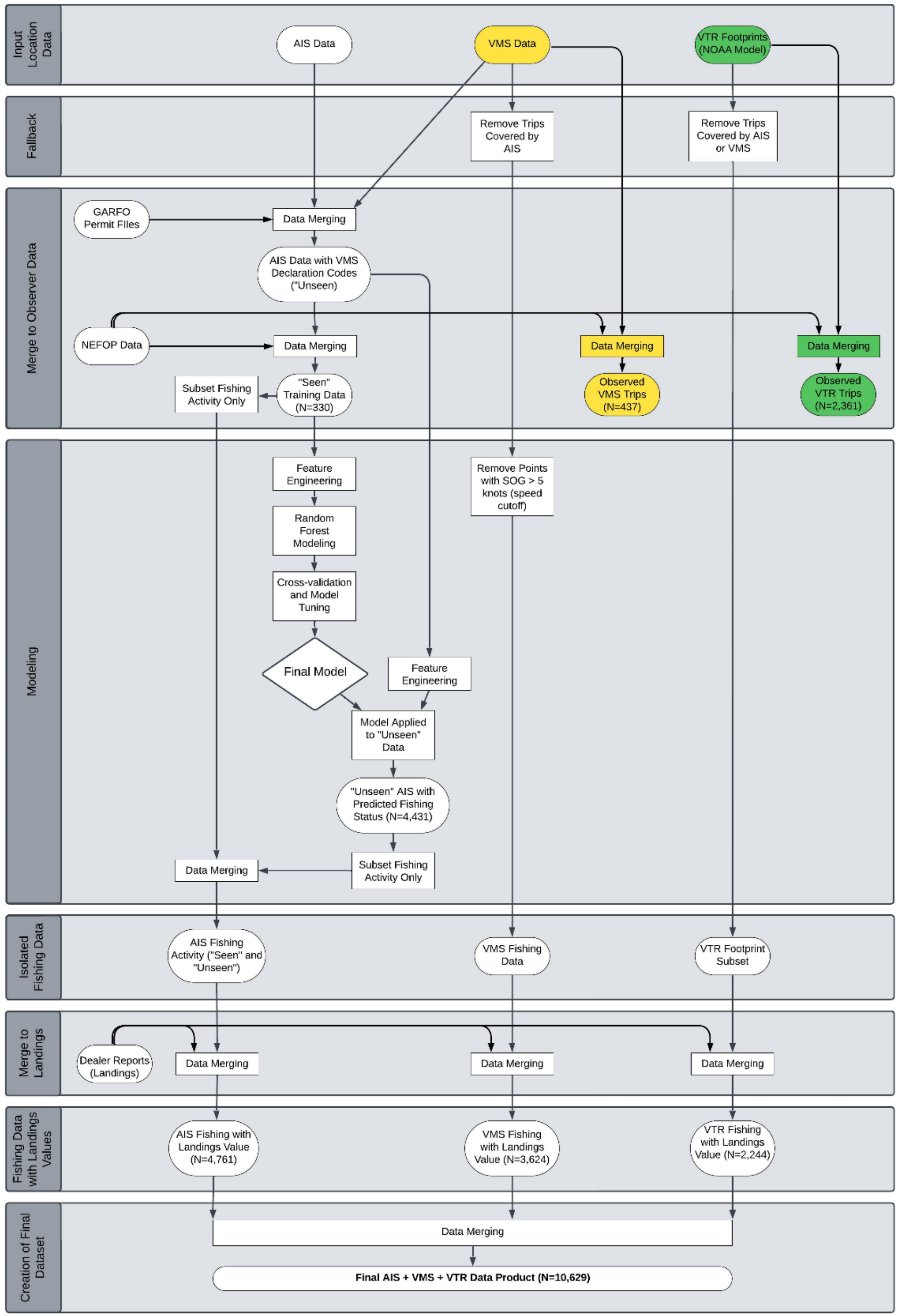
- 2013-2018 data
- Spatial extent defined at left
- Fishery Management Plans:
  - Atlantic Sea Scallop
  - Northeast Multispecies (groundfish): American plaice, Atlantic cod, Atlantic halibut, Atlantic pollock, haddock, redfish, white hake, winter flounder, witch flounder, yellowtail flounder, and ocean pout (currently prohibited)
  - Monkfish (likely insufficient data)
  - Small-mesh Multispecies: offshore hake, red hake, silver hake
  - Surfclam and Ocean Quahog
  - Atlantic Mackerel, Squid, Butterfish

METHODS

Livermore and Guilfoos (2024)
doi: 10.1371/journal.pone.0313197

- Connected AIS, VMS, VTR, USCG vessel registration, and dealer reports for vessels landing scallop
- Also connected to NEFOP observer data to serve as our source of truth ("seen fishing")
- "Engineered" model features over 15-min windows with insight from commercial harvesters
- Used seen data to train random forest model
  - Tuned hyperparameters using cross-validation
- Applied model to "unseen" dataset
- Fell back to VMS approach or VTR approach where AIS data were unavailable





DATA COVERAGE

These are the data the model is applied to.

Source	# Trips	All Trips	% Coverage	# Seen Trips	% Seen
AIS	4761		44.79%	330	6.93%
VMS	3624	10629	34.10%	NA	NA
VTR	2244		21.11%	NA	NA

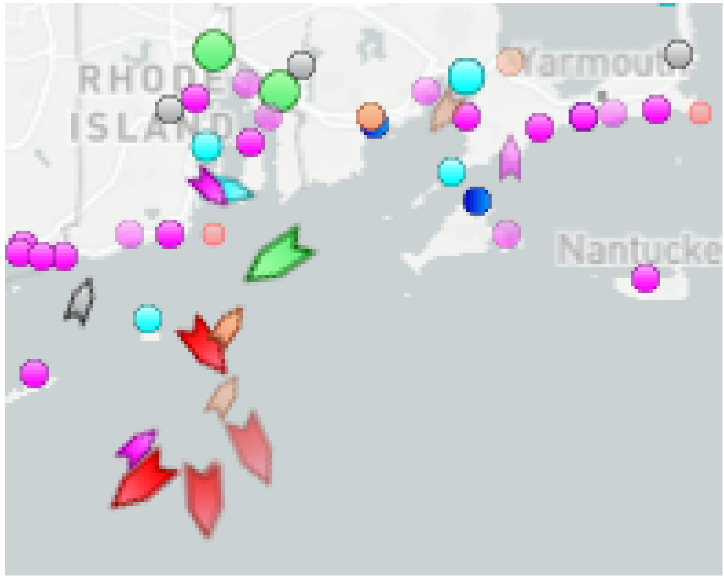
These are the data used to train the model.

These are the trips we fall back to other methods for.

FEATURE ENGINEERING

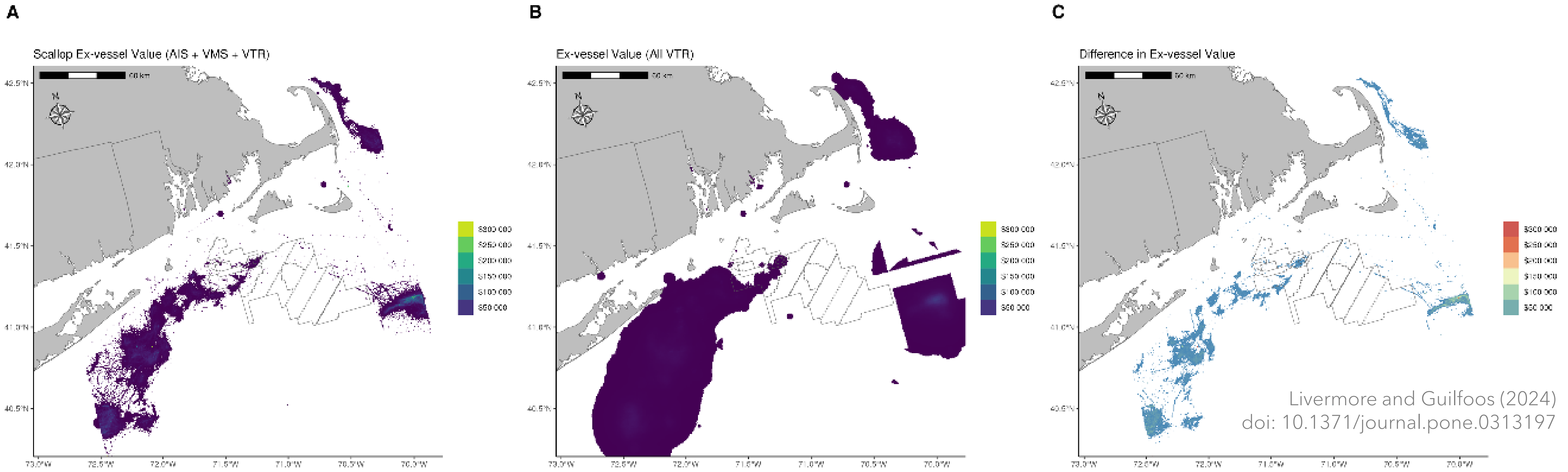
- Moving window approach to estimate fishing or not, per O'Farrell et al. (2017)
- Features engineered on 15-minute windows (based on industry input)

  - SOG_Avg (average speed over ground)
  - SOG_Std (standard deviation of speed over ground)
  - Crow_flies_km (straight line distance from start to end locations)
  - Depth_Avg (average depth)
  - Depth_Std (standard deviation of depth)
  - Moon (moonlight - percentage)
  - Month (month dummy)
  - COG_Avg_Abs_d (average of change in course over ground between consecutive points throughout the window)
  - Weekday (weekday dummy)
  - d_COG_StartEnd (change in course over ground start to end point)



RESULTS

- AIS model achieved 97.9% accuracy (24.7-50% improvement)
  - 49.3% accurate using speed cutoff of 5 knots, per Fontenault (2018) when applied to AIS
  - 47.9% accurate using speed cutoff of 5 knots when applied to VMS
  - 73.2% prediction accuracy of VTR footprints (based on OLS regressions between trip level VTR rasters and corresponding observer data)



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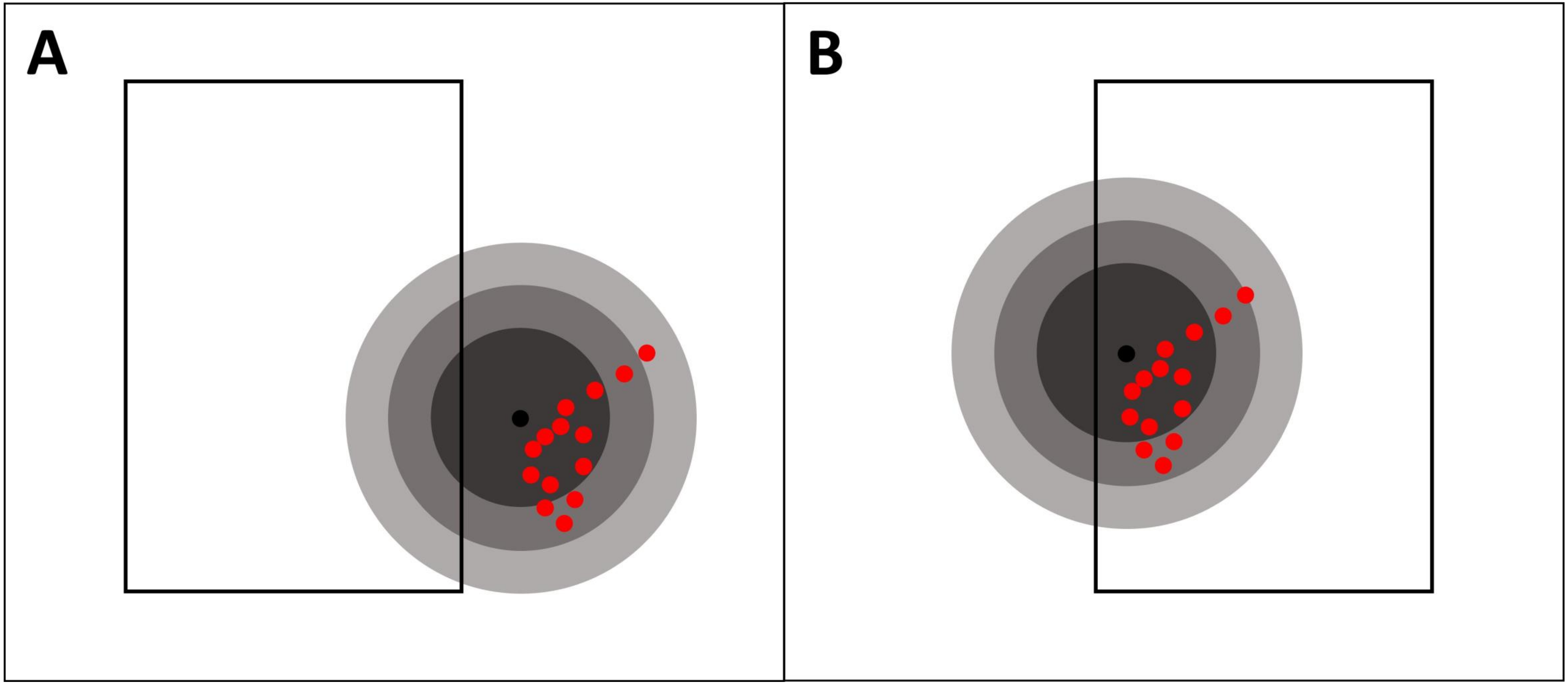
WHY AIS AND VTR ESTIMATES MAY DIFFER

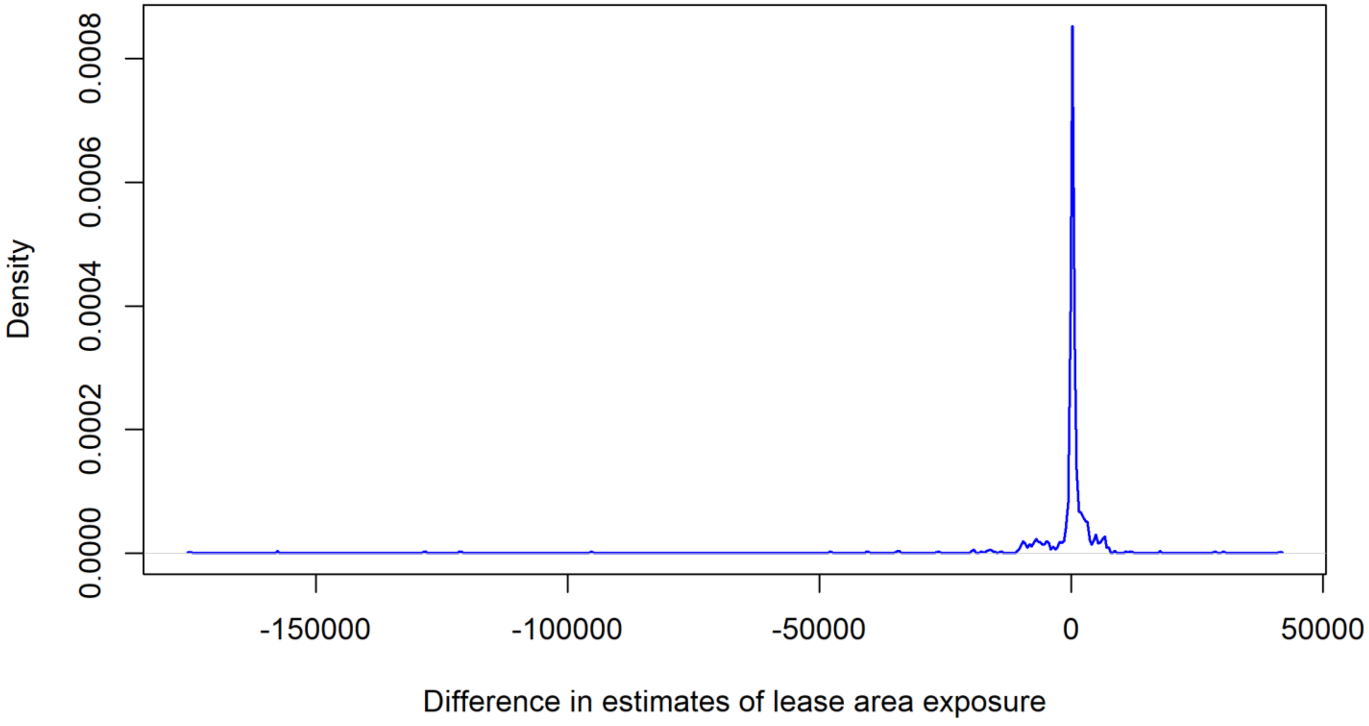


RESULTS

Comparisons to NOAA's VTR Fishing Footprints

AIS values occasionally MUCH larger

VTR values usually slightly larger



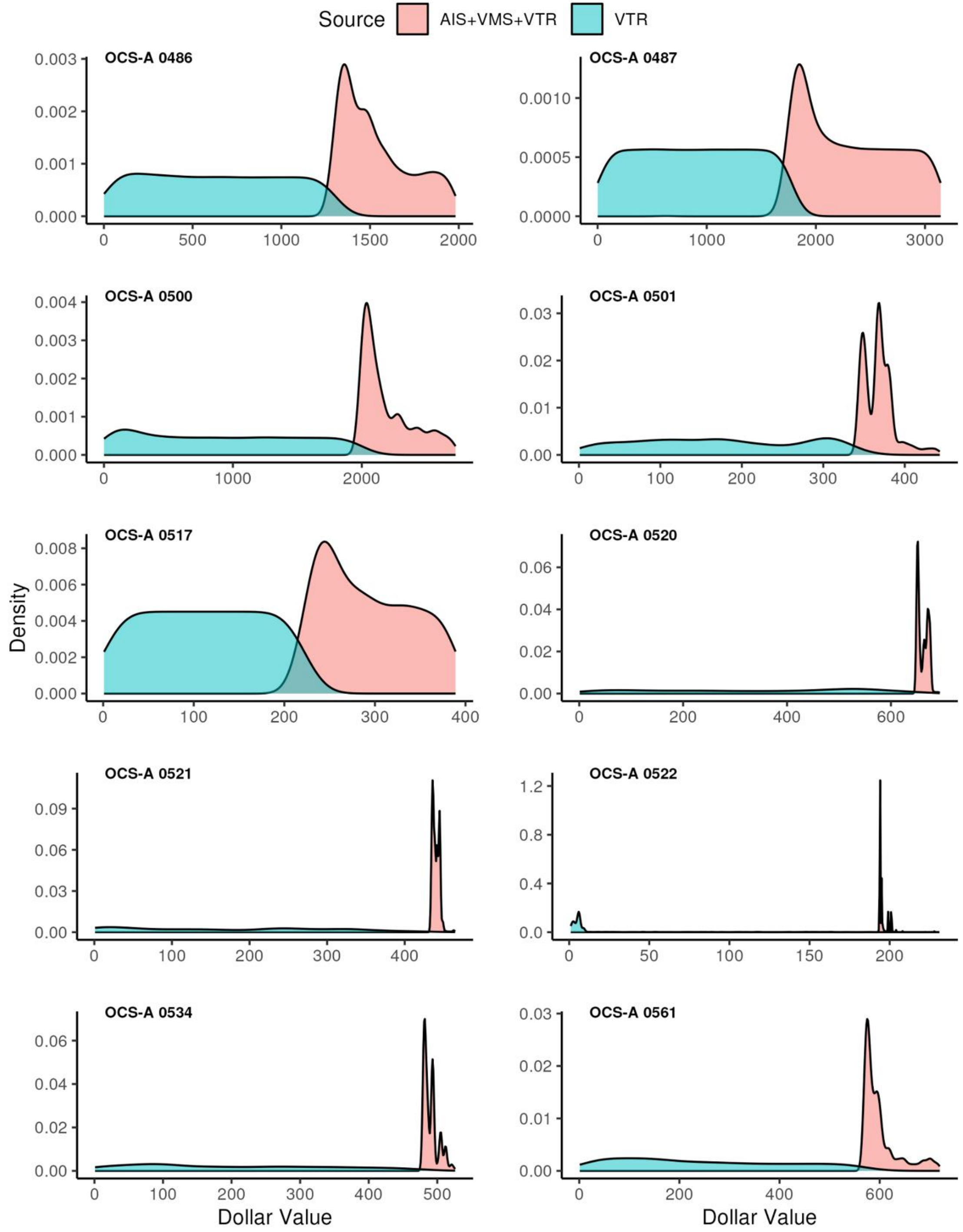


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Image: https://newbedfordlight.org/port-of-new-bedford-cites-grave-concern-about-new-offshore-wind-area/

CONCLUSIONS

- AIS RF model dramatically improved accuracy over other methods to delineate fishing activity.
- Tools distributed exposure differently within lease areas.
  - VTR footprints generally more conservative but can severely underestimate exposure at the trip-level.
- AIS tool's increased precision valuable for micrositing and evaluating changes in fishing at the trip or vessel level

PLOS ONE

RESEARCH ARTICLE

Scallop fishing activity characterization in Southern New England: Offshore wind demands and fisheries-dependent methods

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OPEN ACCESS

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Data Availability Statement: AIS data for all vessel types, and shapefiles of federal and state waters are publicly available through the Marine Cadastre (https://marinecadastre.gov/ais/). Federal fishing permit data are publicly available via NOAA's Greater Atlantic Regional Fisheries Office (https:// www.greateratlantic.fisheries.noaa.gov/public/

Abstract

Managers attempt to minimize spatial use conflicts in siting of offshore wind developments, but they must rely on available data to balance biological, commercial, and recreational needs. Marine spatial planning products are only as good as the data they are built upon and fishing data present major challenges due to their confidentiality and the difficulty in isolating true fishing activity. We present a methodology to increase the spatiotemporal resolution of fishing effort and exposure estimates for Southern New England scallop fishing activity using random decision forests to perform supervised classification on AIS data, with fallback to lower resolution datasets for vessels without AIS coverage. Final predictive accuracy of the tuned random forest AIS model was 97.9%, offering improvements of 24.7, 48.6, and 50% over VTR fishing footprints, and AIS and VMS speed cutoff methods, respectively, to predict whether vessel locations correspond to fishing activity. Comparison of the AIS model with VMS and VTR fallback to the VTR fishing footprints data product demonstrated that the increased precision of the AIS point data delineated as fishing dramatically changed how fishing effort, and therefore exposure in the form of fishery landings values, is distributed spatially in Southern New England wind energy areas. This is due to how the probability of fishing is distributed across location data points in the various products, which has implications for marine spatial planning and mitigation decision-making. Therefore, multiple data products should be considered when evaluating management options, as exposure estimates may differ depending on what inputs are used. The higher resolution AIS product may offer enhanced value in understanding exposure and impacts to individual vessels, especially once wind farms are under construction or operational.

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