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PREDICTING SHOALING ON THE MISSISSIPPI RIVER USING CROWD-SOURCED AND USACE OPERATIONAL DATA

Andrew Courtois, Nick Howes, Mike Miner

SmartPort

WEDA Gulf Coast Chapter 2022

BACKGROUND & INCEPTION

PHASE 1

Brian Gauvin

PHASE 2

Crescent Towing

PORT NOLA
THE PORT OF NEW ORLEANS

Crescent Towing
A Cooper Company

LED LOUISIANA ECONOMIC DEVELOPMENT

U.S. DEPARTMENT OF COMMERCE
ECONOMIC DEVELOPMENT ADMINISTRATION

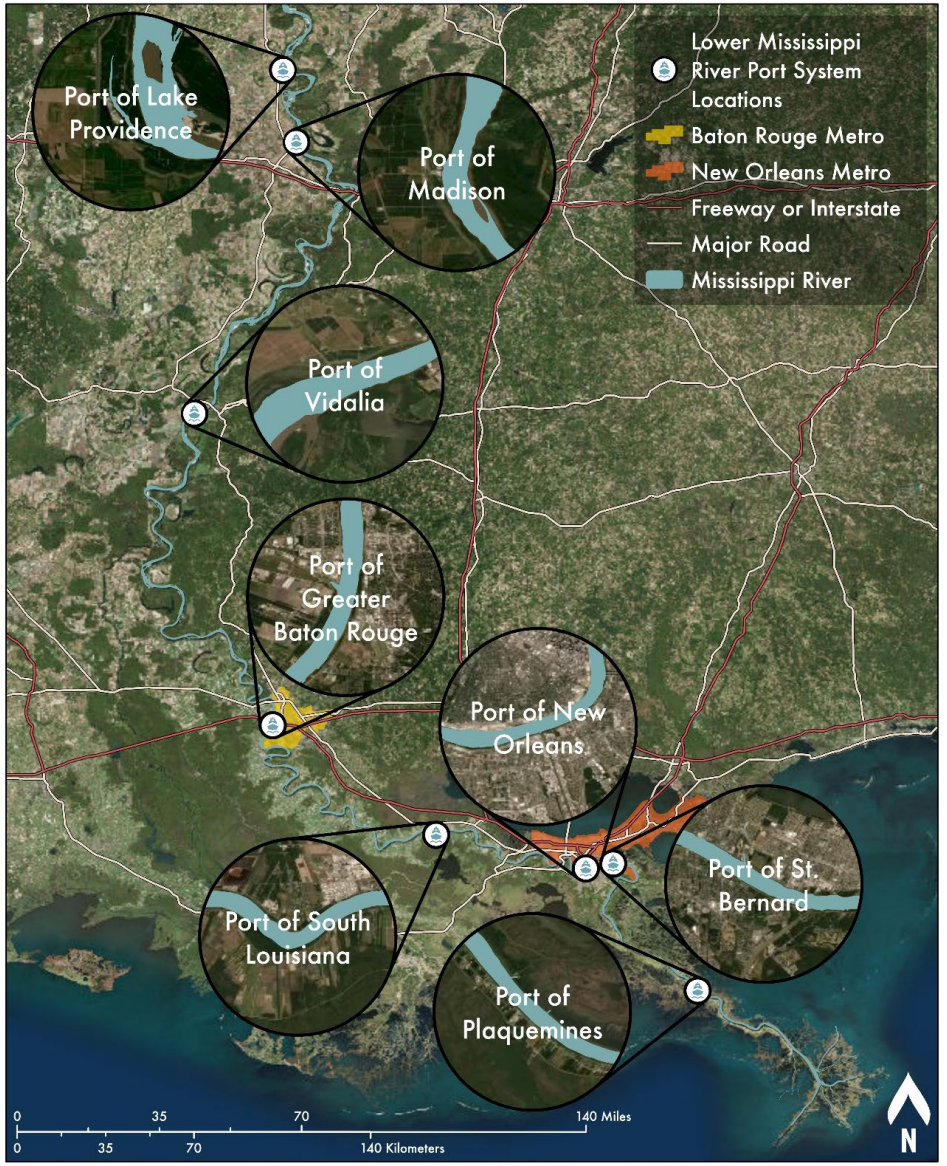
Port Of South Louisiana
TRANSPORTATION CENTER OF THE AMERICAS

PORT NOLA
THE PORT OF NEW ORLEANS

SMARTPORT OVERVIEW

Project objectives include developing:

- A shoaling forecast tool
  - Days-months
- Resiliency strategy
- Customized dashboards
- Physical center for emergency operations



Source: Earthstar Geographics, U.S. Department of Transportation, National Transportation Atlas Database

SHOALING TOOL OBJECTIVES

Questions

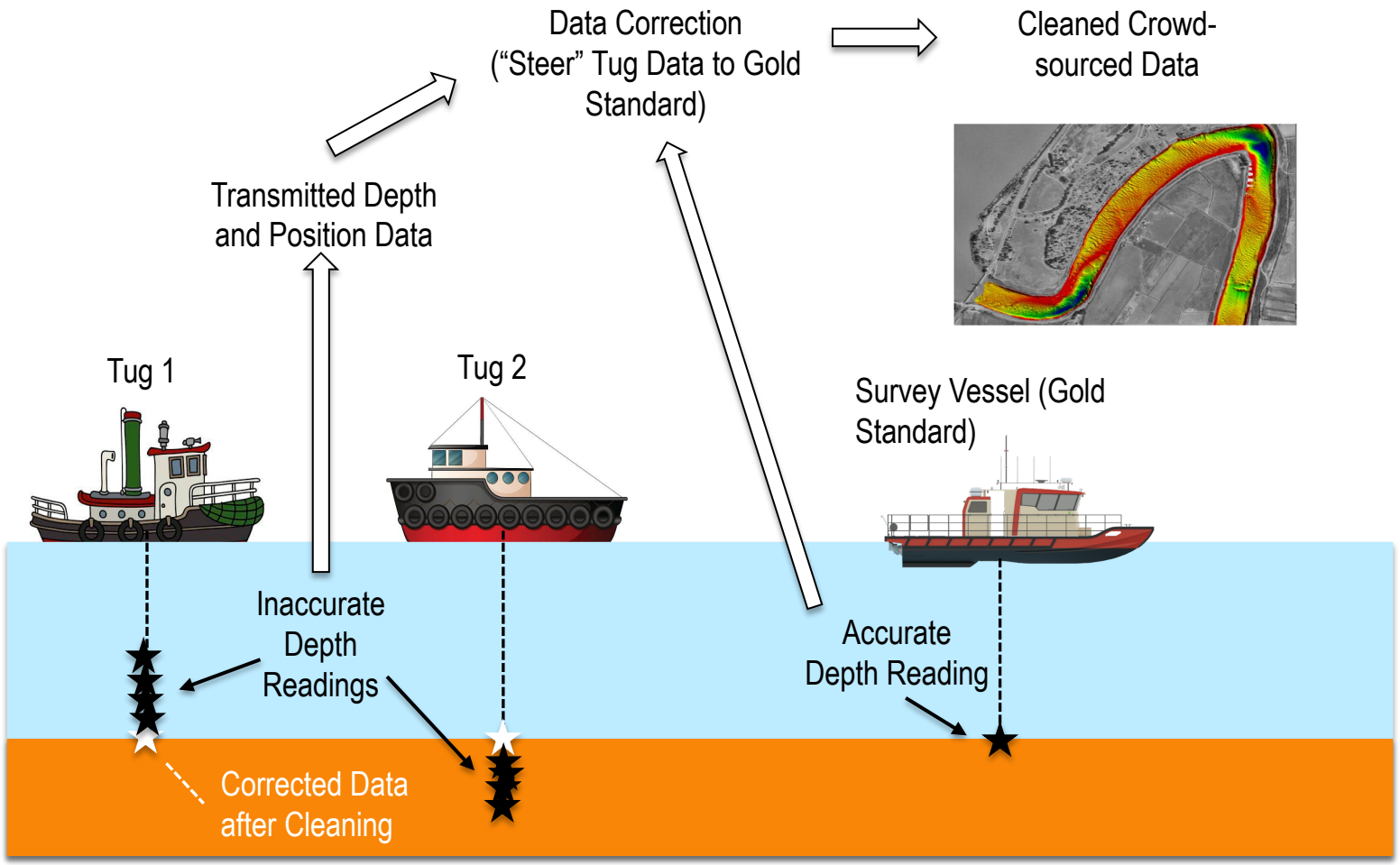
- Do we have draft to berth a ship this afternoon?
- Can we anticipate future dredging needs (weeks to months)?

Solution

- Crowd-sourced data; increases data volume and frequency and cost effective.
- Implement a machine learning (ML) approach to forecast shoaling.

Port of New Orleans

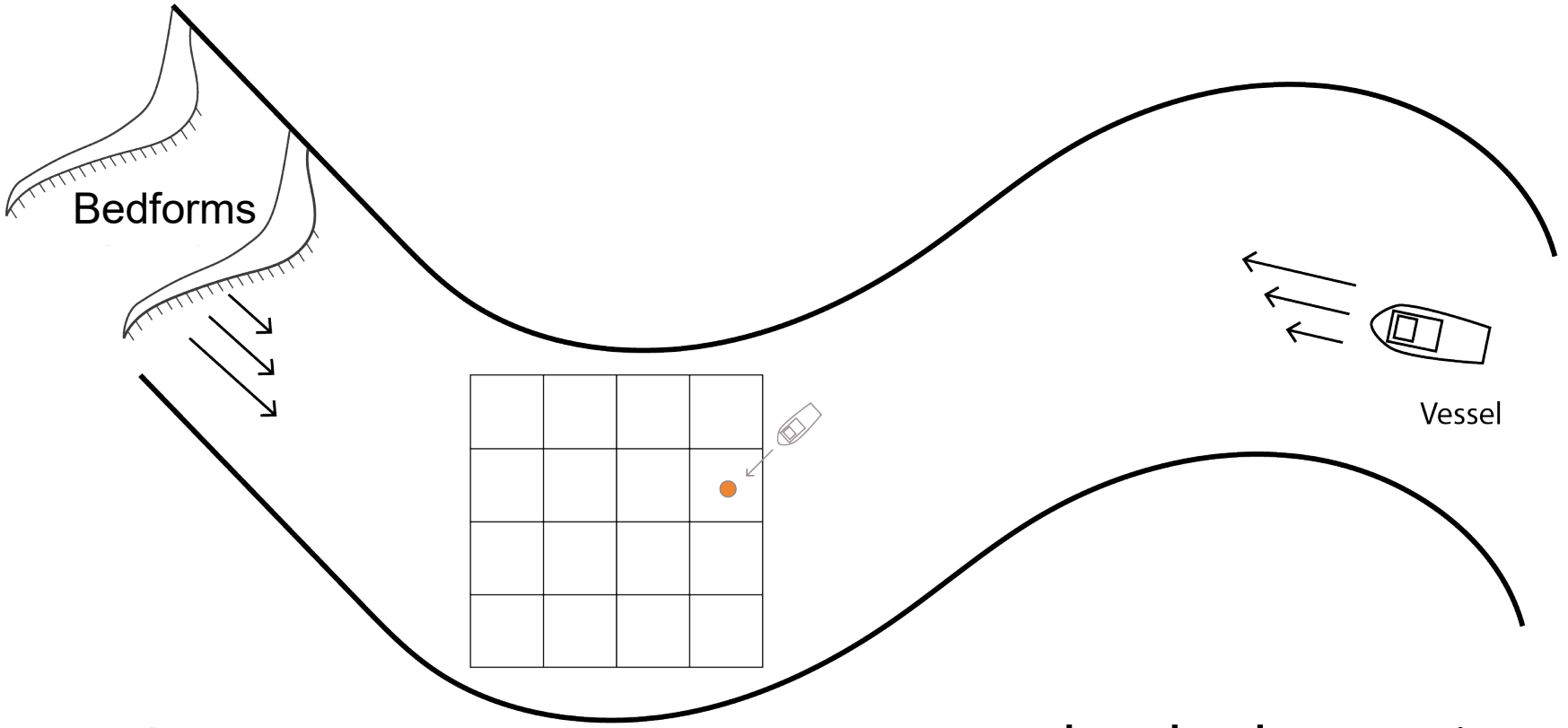
CROWD-SOURCED DATA



- Utilize existing sensors on vessel and networks
- Software captures available data streams on vessel:
  - GPS
  - AIS
  - Depth
- Transmit data to cloud storage

PARTNERS ENGAGED IN CROWD-SOURCE EFFORT

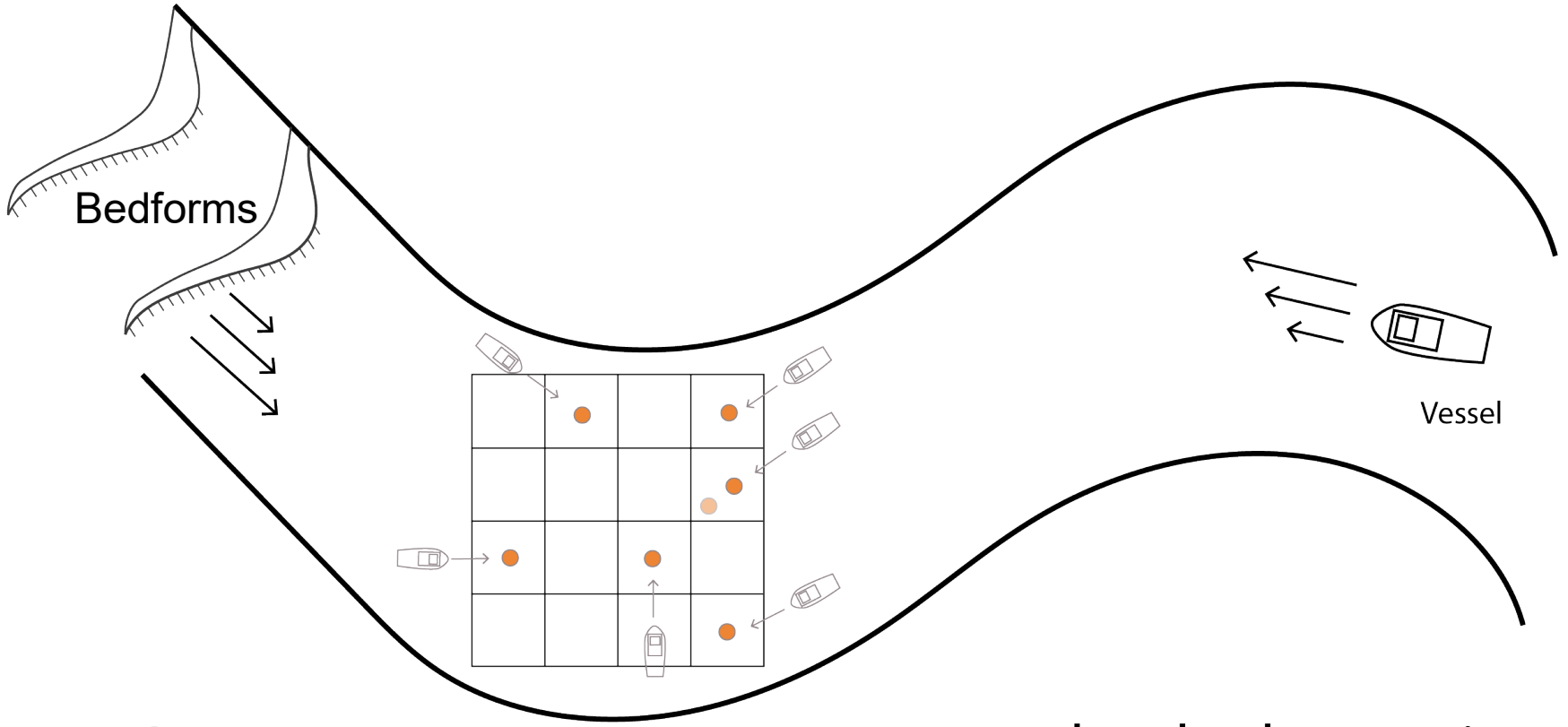
SMARTPORT ILLUSTRATION



Region of Interest
[day 1]

- depth observation

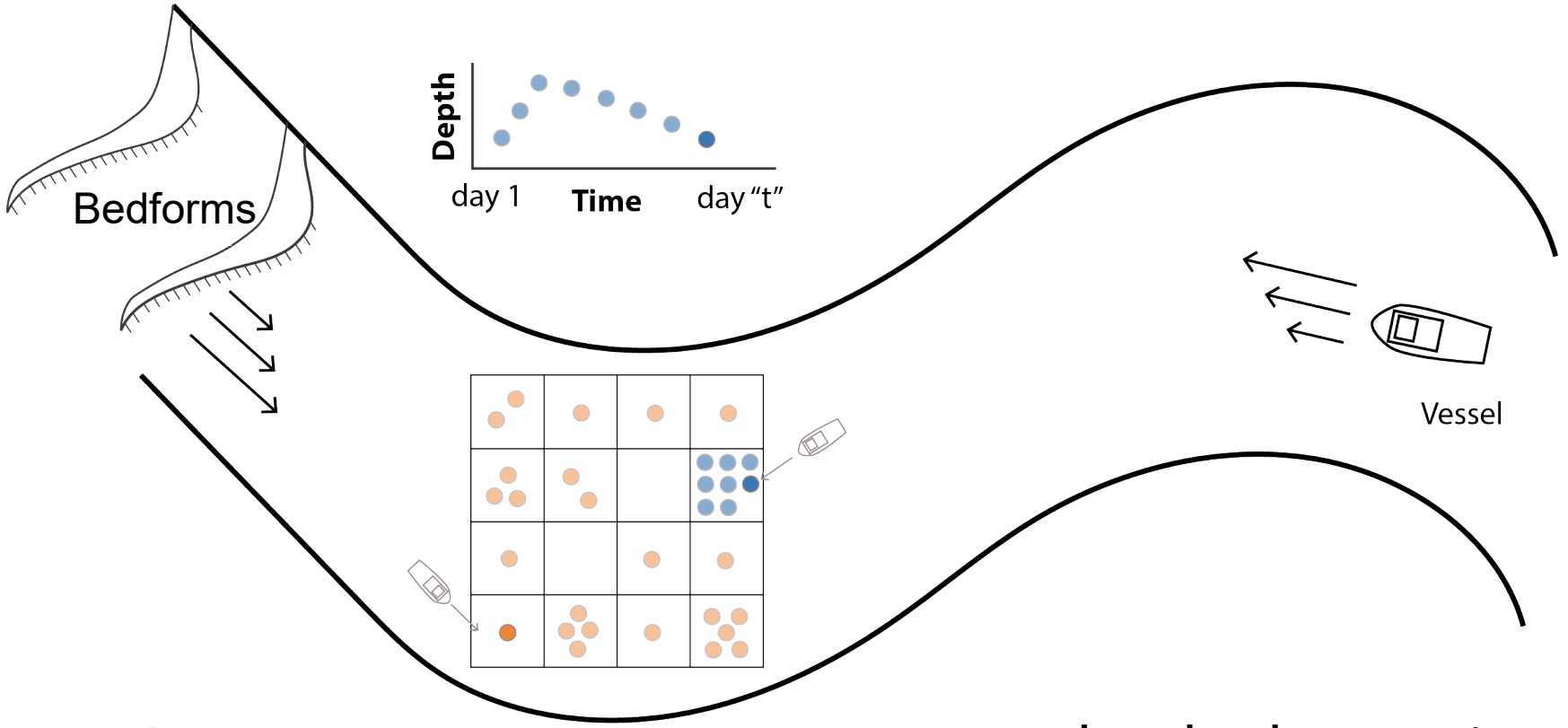
SMARTPORT ILLUSTRATION



Region of Interest
[day 2]

- depth observation

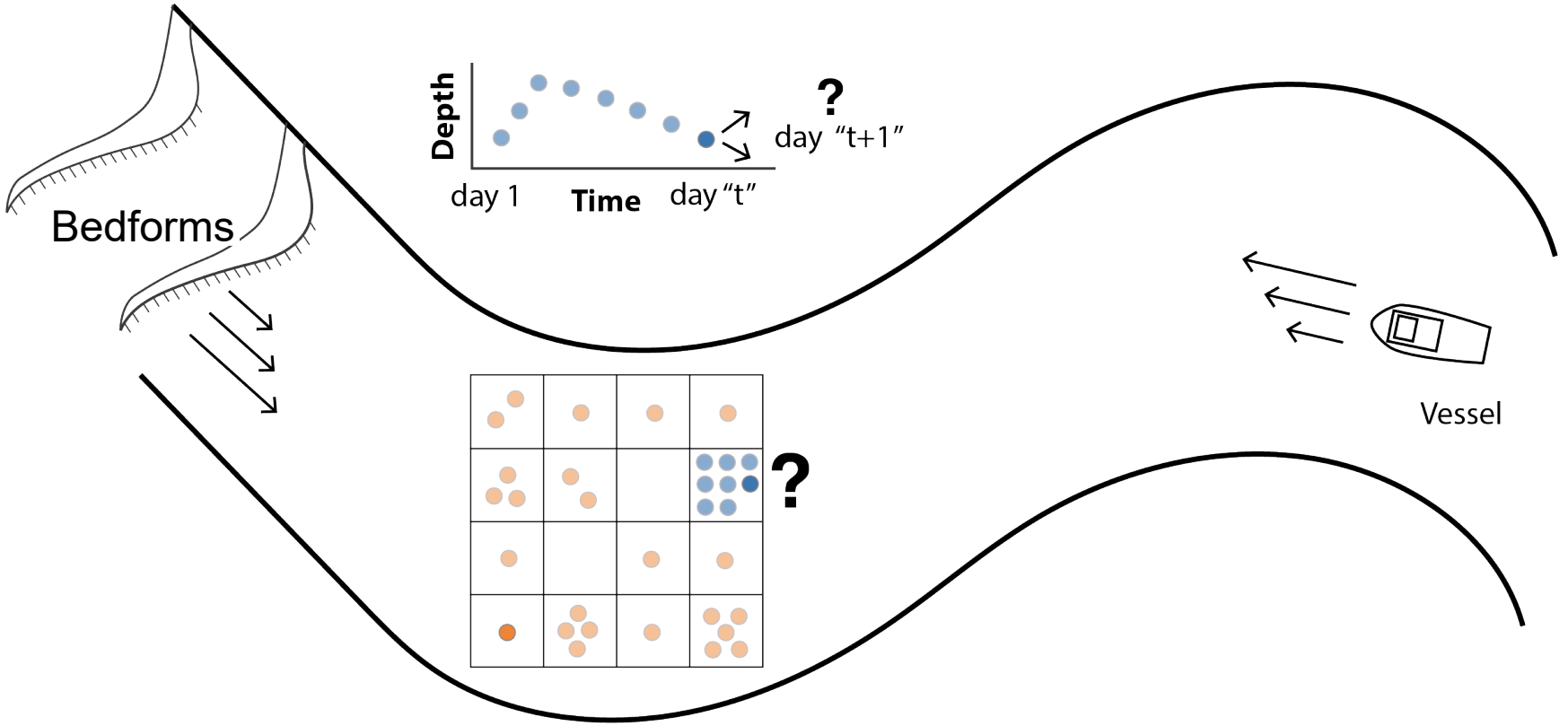
SMARTPORT ILLUSTRATION



Region of Interest
[day "t"]

- depth observation
- depth observation (focus cell)

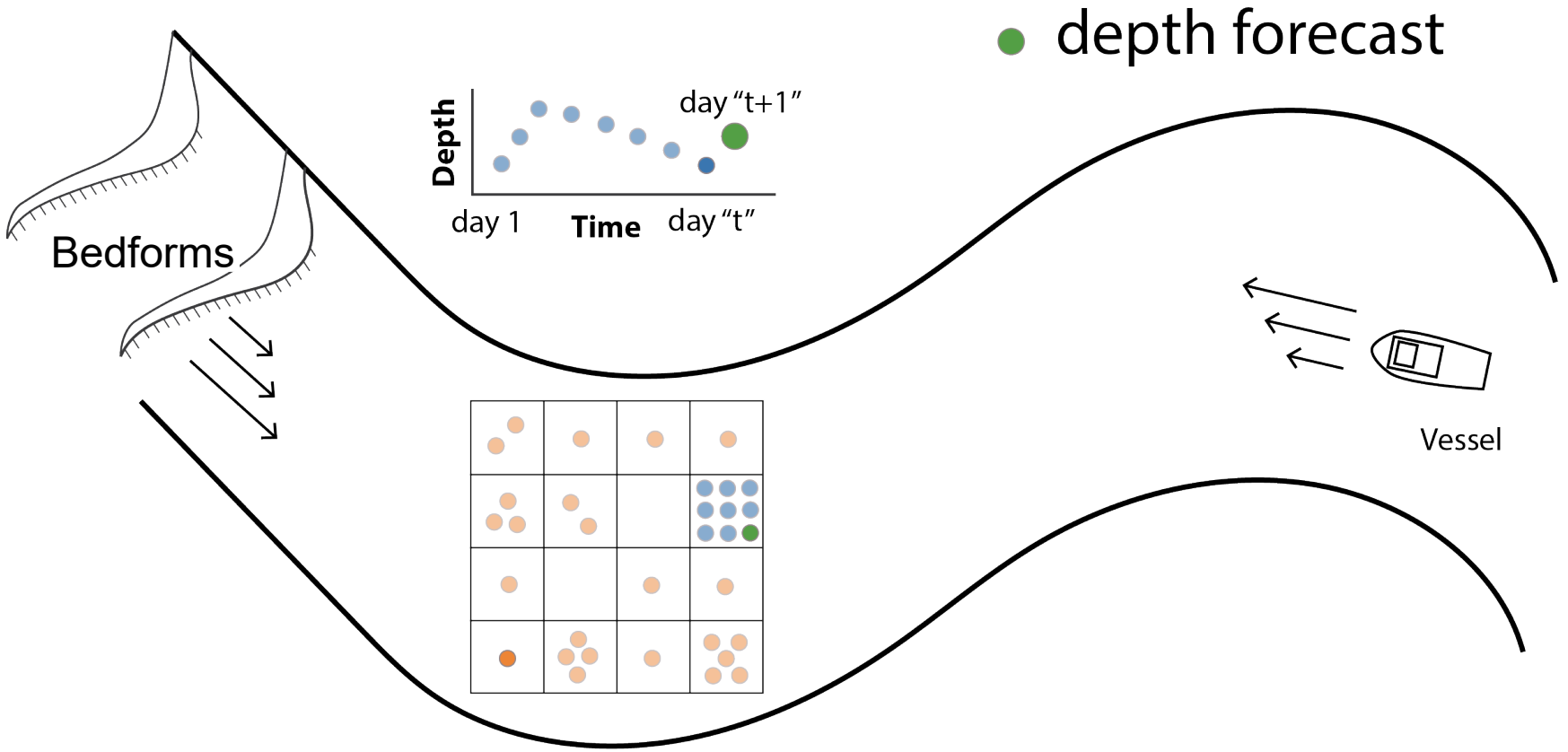
SMARTPORT ILLUSTRATION



Region of Interest
[day "t+1"]

- depth observation
- depth observation (focus cell)

SMARTPORT ILLUSTRATION

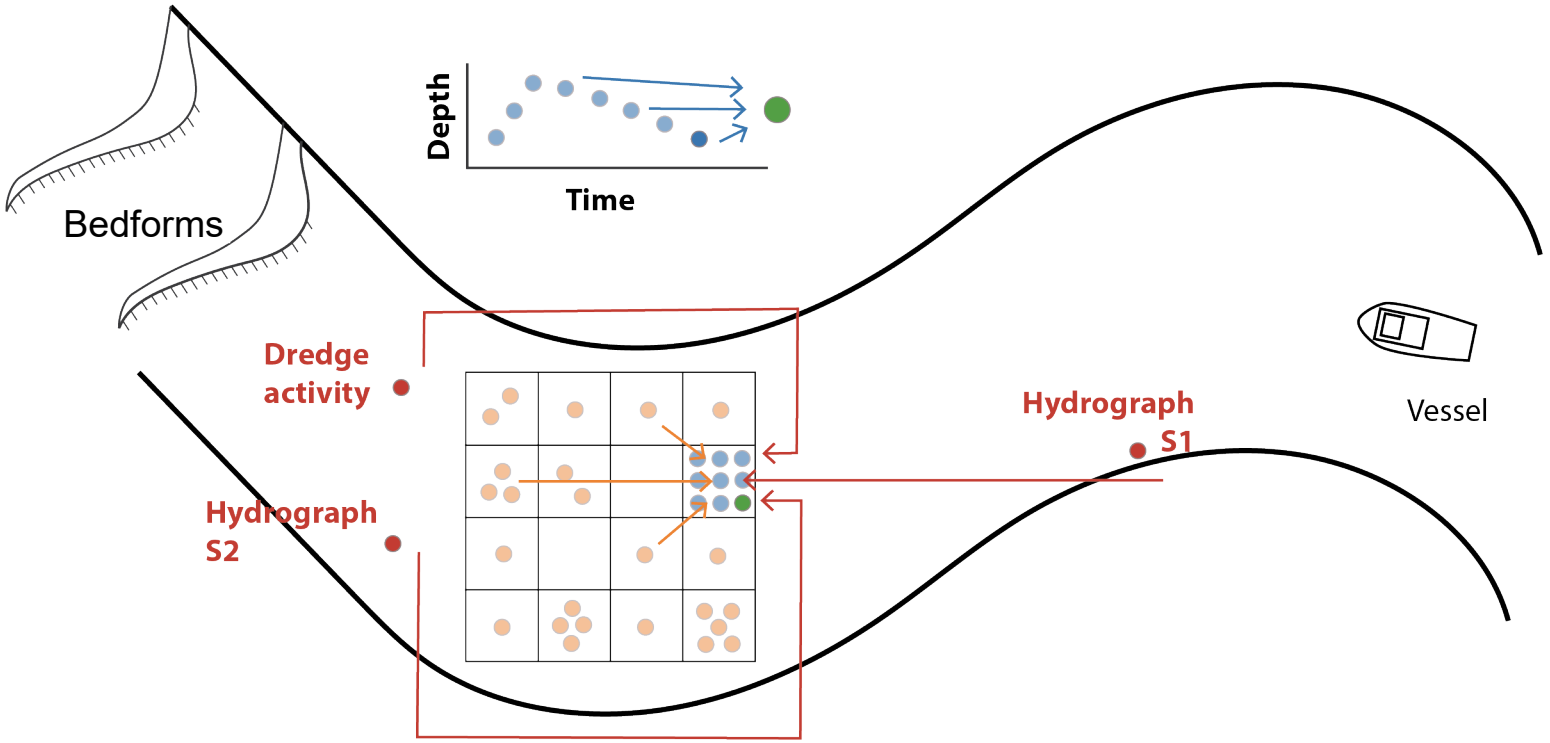


- depth forecast

Region of Interest
[day "t+1"]

- depth observation
- depth observation (focus cell)

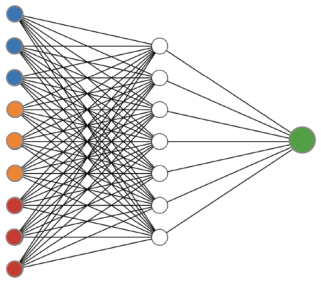
SMARTPORT ILLUSTRATION



depth (time)

depth (space)

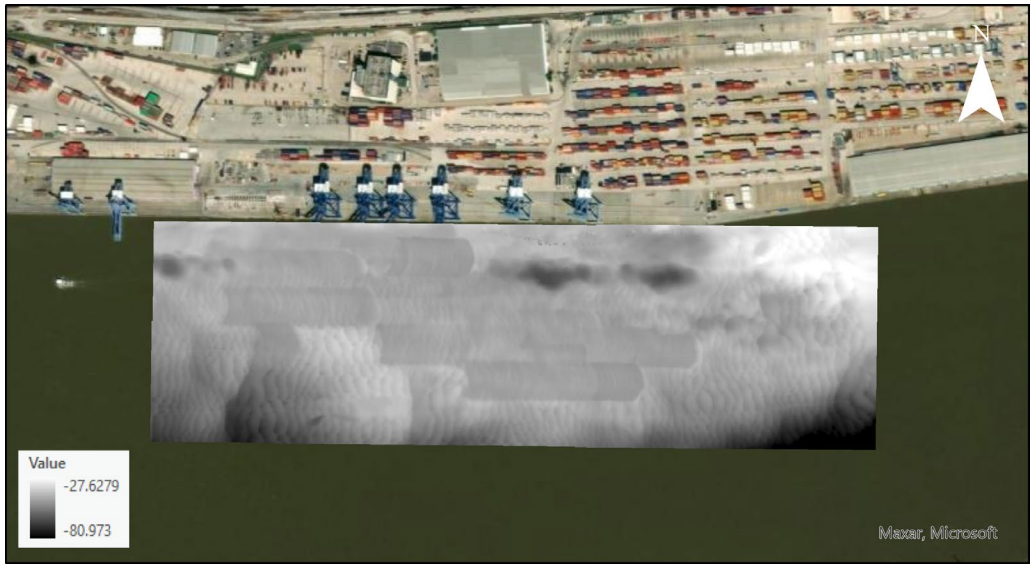
context (exogenous)



depth forecast (target)

DATA GATHERING

- Crowd-sourced vessel data
- USACE survey data (eHydro)
- USACE & USGS river gages
- Port survey data
- NWS river forecast



Port of NOLA Multibeam

USACE, 2022

Bisso Towboat Company, 2022

USACE, 2022

DATA CLEANSING FOR 'XY' AND 'Z' OUTLIERS USING SUPERVISED MACHINE LEARNING

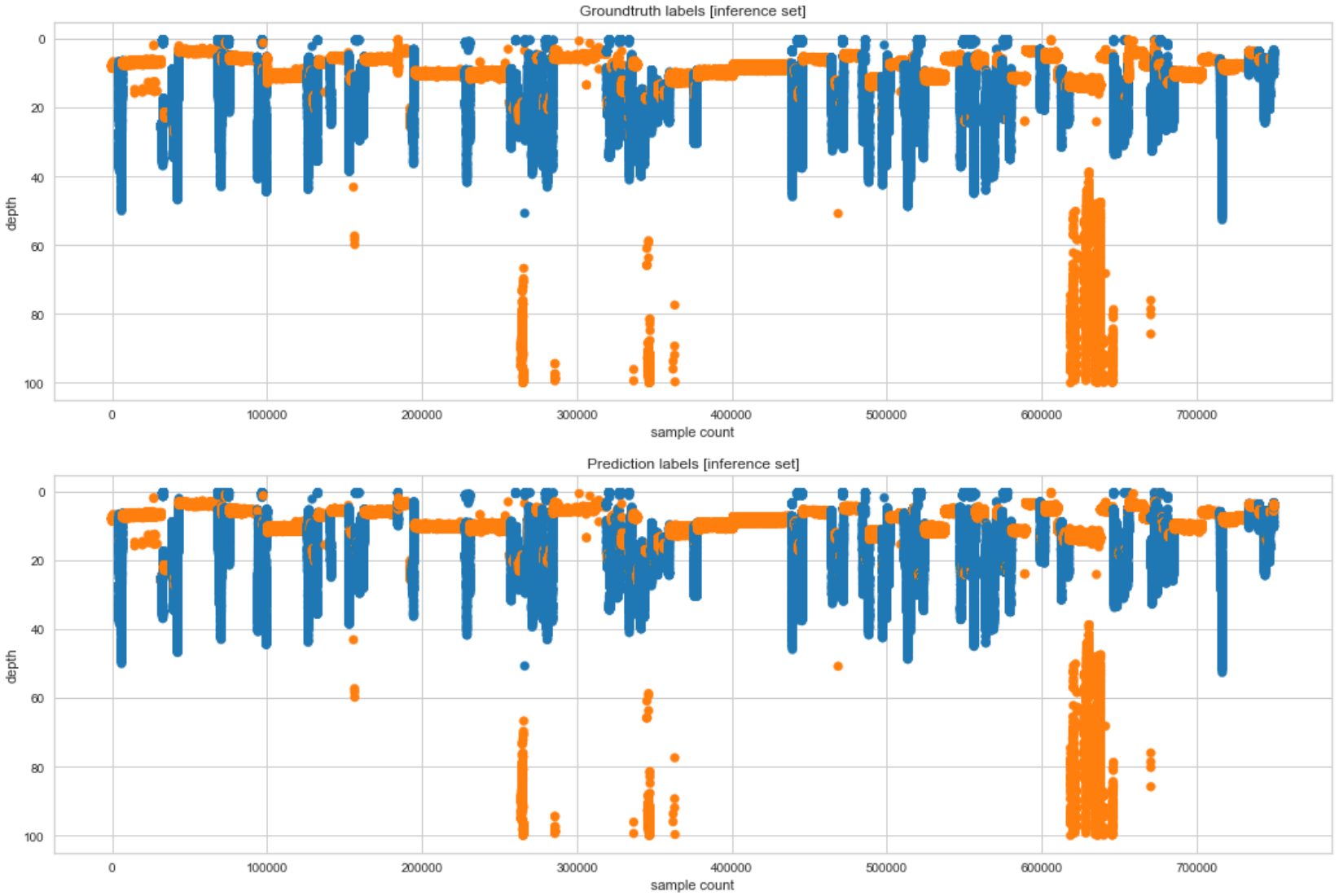
Issue

- Both GPS and depth sounder measurements are prone to error for a variety of reasons

Solution

- Train a ML model to classify 'xy' and 'z' outliers based on user labelling (supervised learning)

DWELL/'XY' DETECTION



- MVP Dwell
  - Accuracy: 97.0%
  - Precision: 97.4%
  - Recall: 98.9%
  - F1: 98.1%

Test set: "base-20"
20 mmsi-days

Legend

: non-dwell

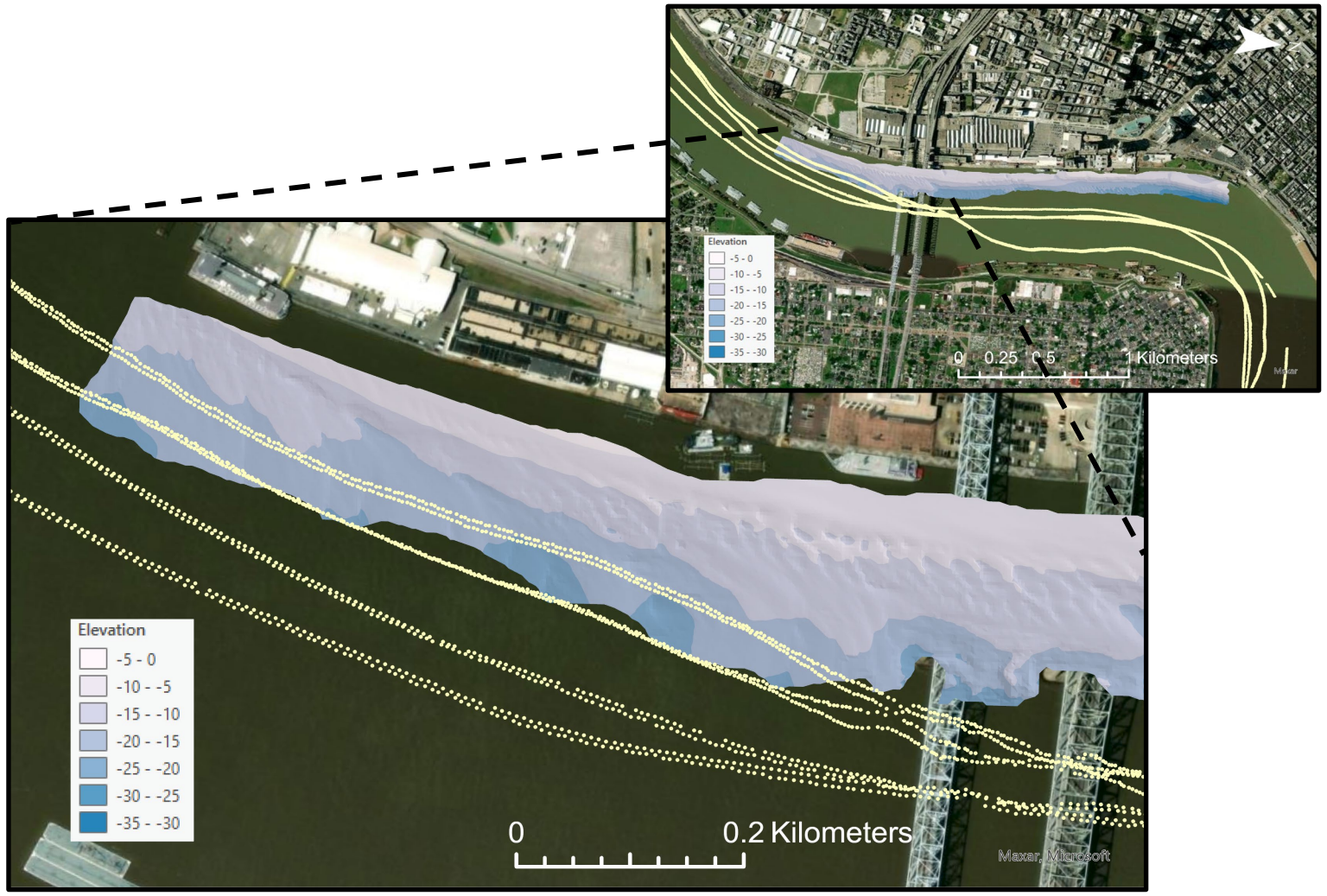
: dwell

TUG DEPTHS TO ELEVATIONS

Data shown:

- USACE Multibeam; MR_56_NO3
- Vessel track data

A known bed elevation, water surface elevation, and vessel data provide necessary information to ‘convert’ tug depths to elevations.



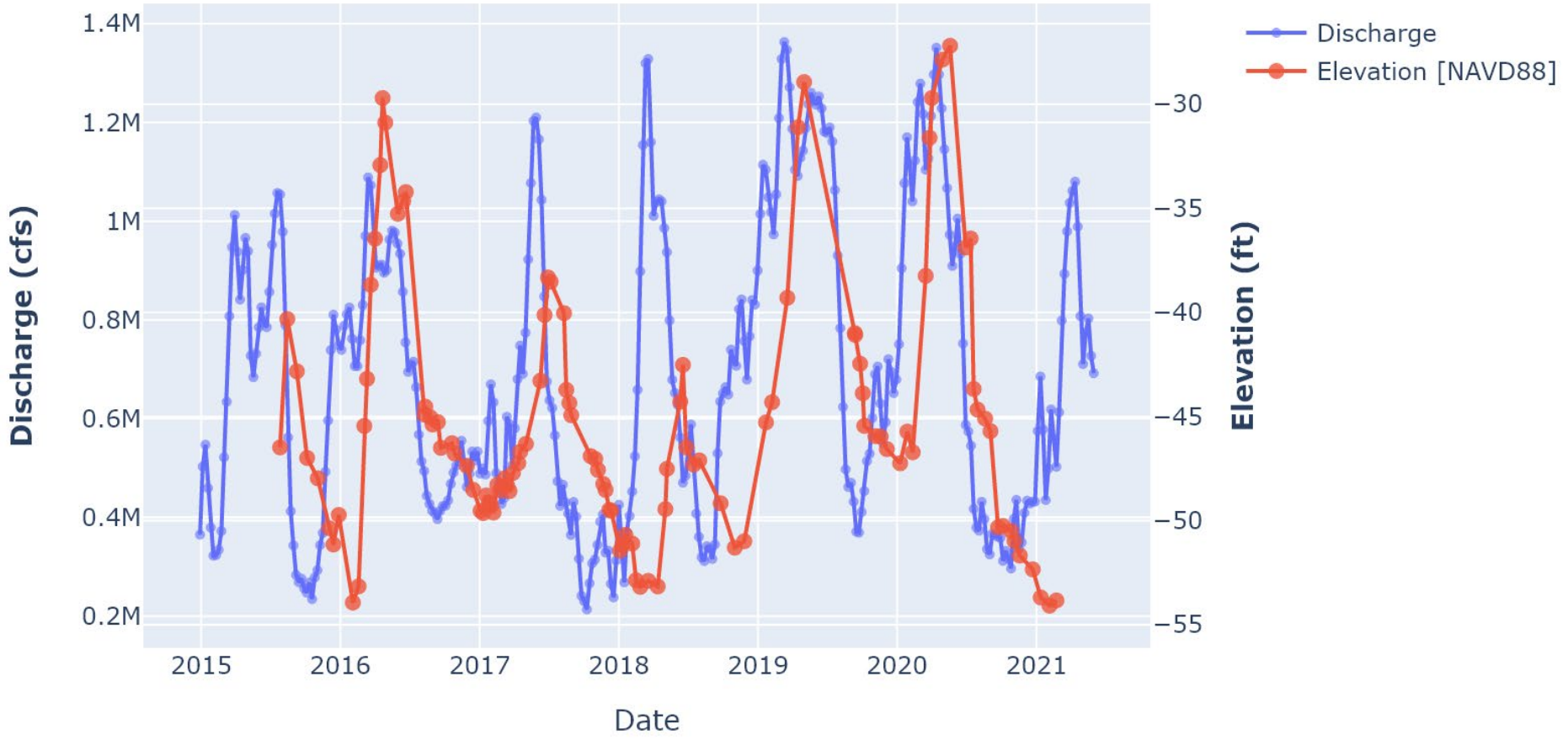
MR DEEP DRAFT CROSSINGS

- 12 deep draft navigation crossings
- Focus of dredging between Baton Rouge and New Orleans
- Wealth of bathymetric data from channel condition surveys
- Multiple gages in region

USACE, 2022

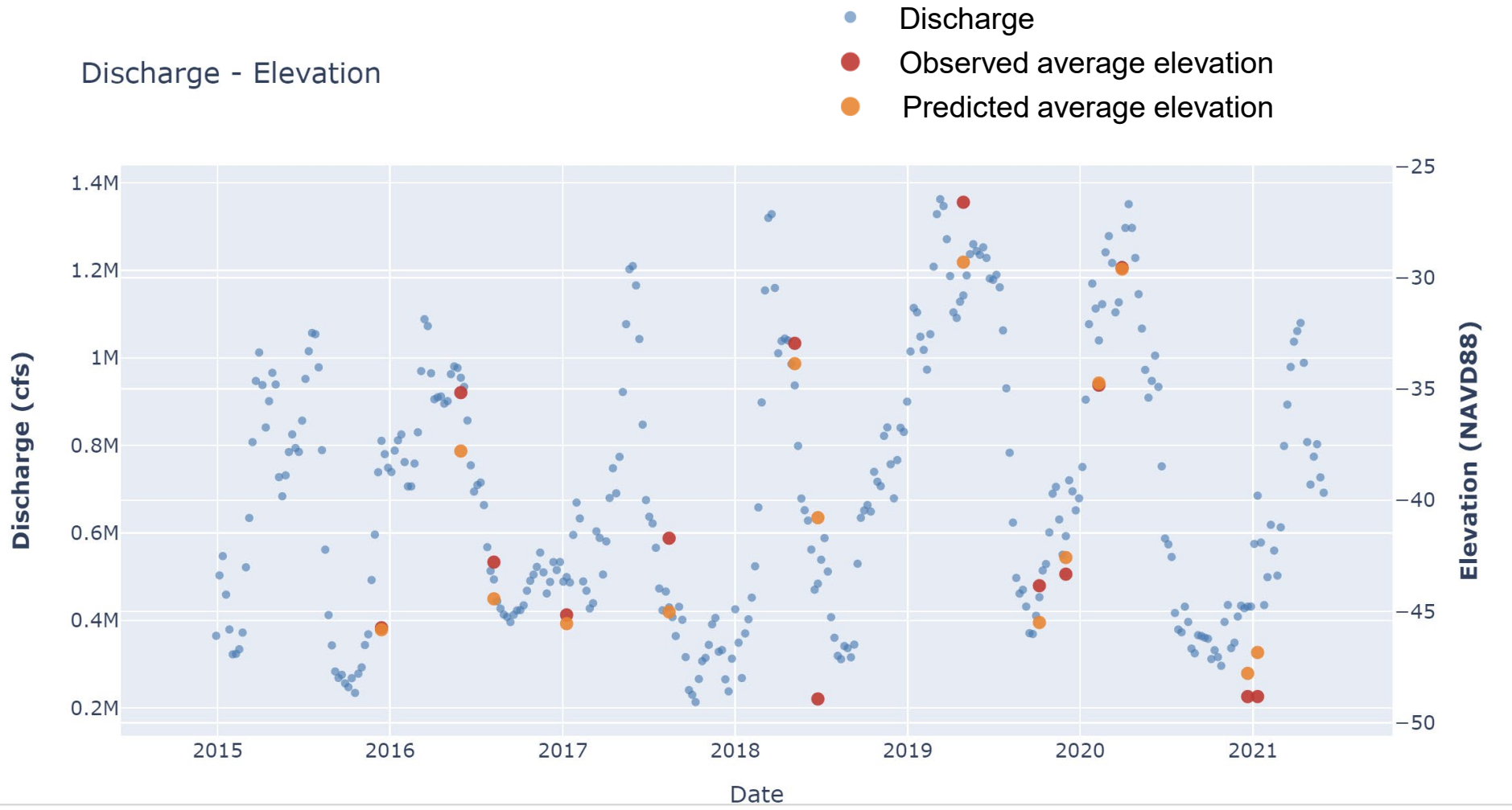
REDEYE CROSSING

"Discharge - Elevation": RED



OBSERVATIONAL ML PRELIMINARY RESULTS

- Redeye Crossing
- Predict bed elevation using multiple river parameters



OBSERVATIONAL ML PRELIMINARY RESULTS

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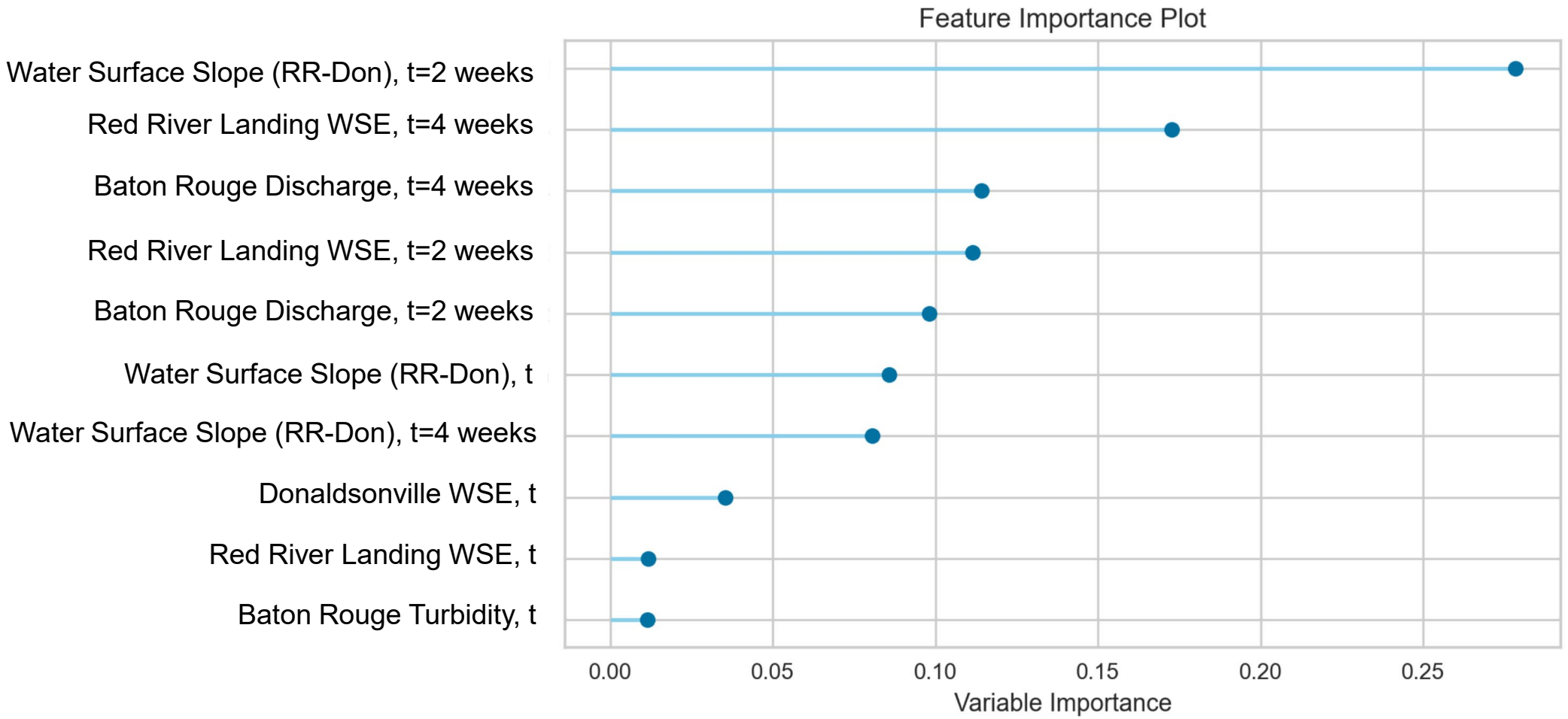

CONCLUSIONS

- Established process to crowd-source and ‘correct’ vessel data
- ML model to predict bed elevation based on observational data

NEXT STEPS

- Integrate crowd-sourced and dredging data into ML model
- Expand ML model to other areas of the river
- Version 1 of Shoaling Forecast Tool expected Q1 2023
- Customized dashboards for real-time decision management

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THANK YOU

Andrew Courtois

acourtois@thewaterinstitute.org

337-321-1334