Predicting Future Vessel Arrival Times Using AIS Tracking Data

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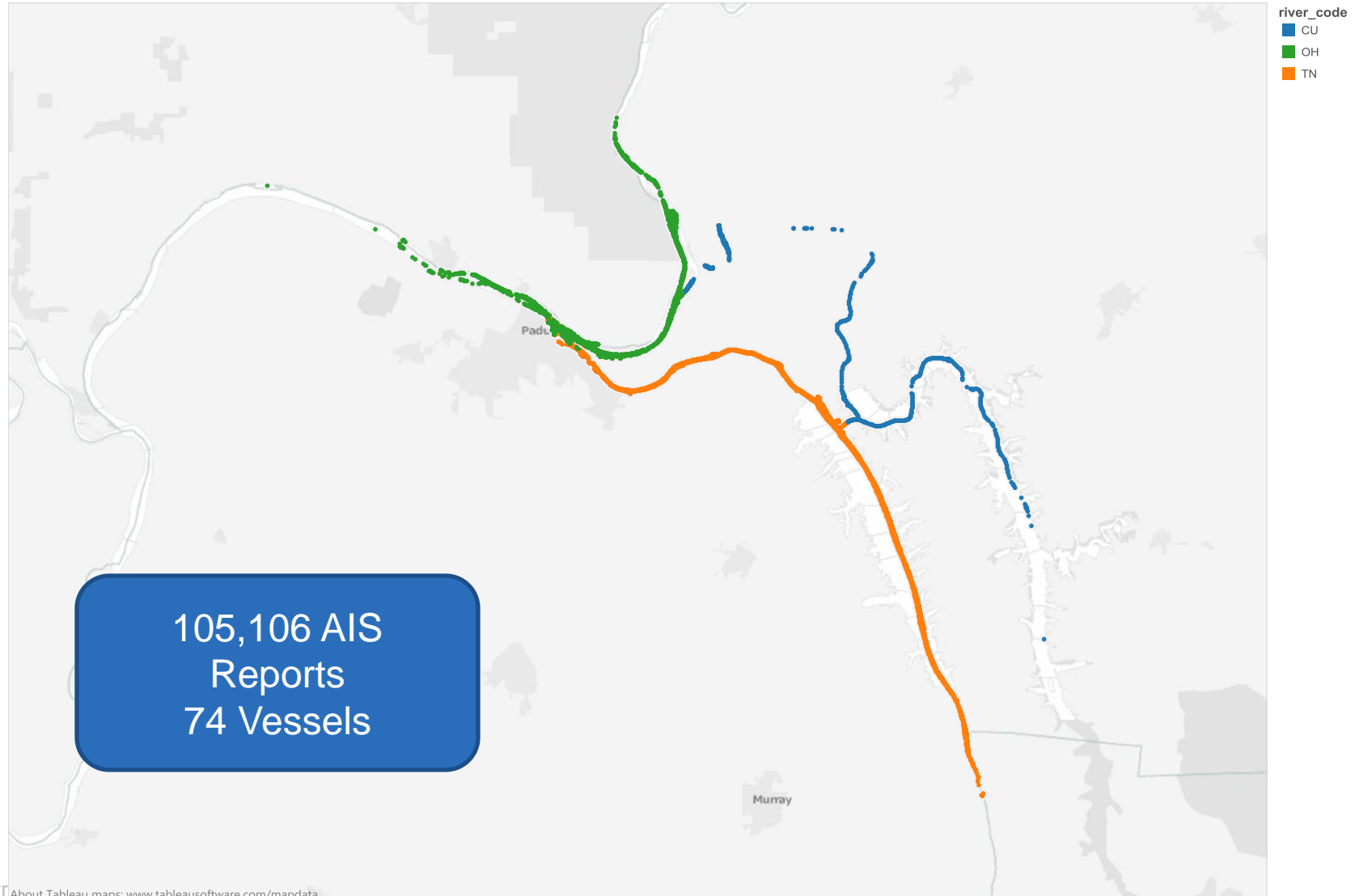June 24, 2014

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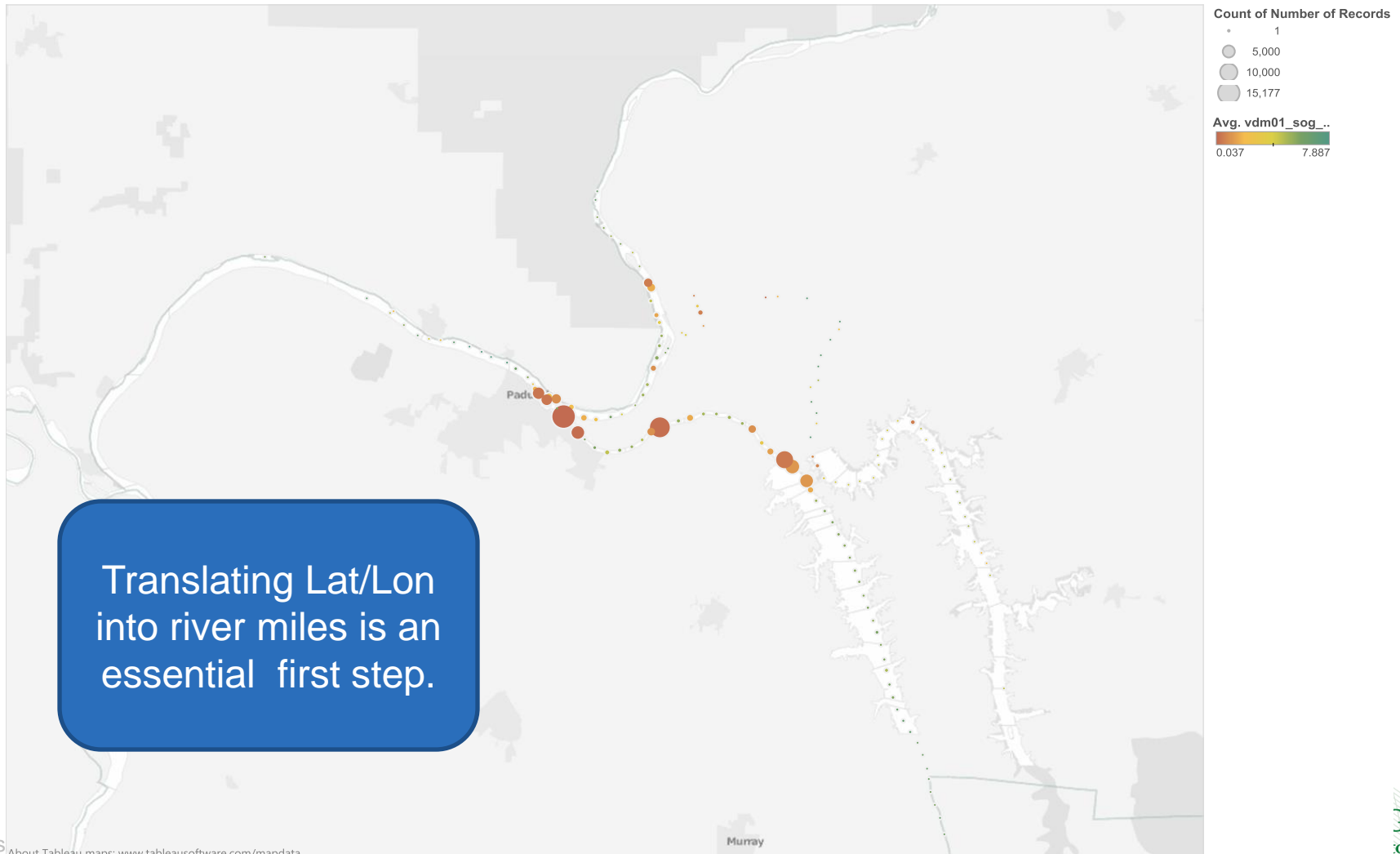
Background and Goals

- Corps of Engineers continues efforts to upgrade technical support for locks and lockmasters

- Widespread adoption of AIS on inland waterways.

- Goal: Prototype system to predict arrivals at a lock using AIS information from across the system.
  - Target: Kentucky Lock
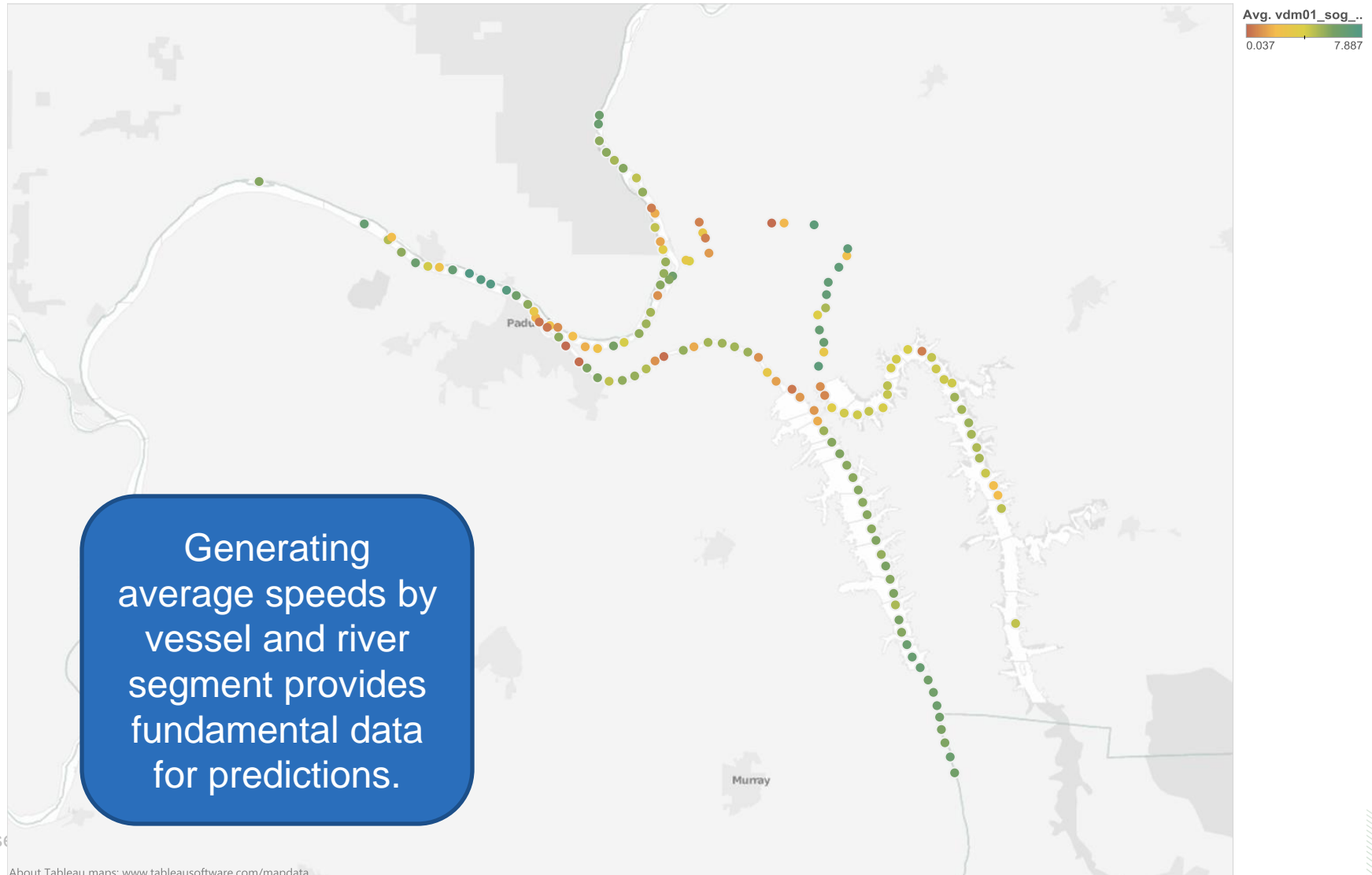
- Goal: Support for river information systems

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Overview of 1 day AIS Data

Map

river_code
- CU
- OH
- TN

105,106 AIS
Reports
74 Vessels

About Tableau maps: www.tableausoftware.com/mapdata

Map based on average of longitude and average of latitude. Color shows details about river_code. Details are shown for DateTimeRpt Minute and vessel_id. The data is filtered on vdm01_sog_kt, Date-TimeRpt (MDY) and name. The vdm01_sog_kt filter ranges from 0 to 13.6. The DateTimeRpt (MDY) filter keeps May 29, 2013. The name filter keeps 129 of 129 members.

Number of AIS Messages by River Mile

Count of Number of Records
- 1
- 5,000
- 10,000
- 15,177

Avg. vdm01_sog_..
0.037 — 7.887

Translating Lat/Lon into river miles is an essential first step.

Padu...

Murray

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Average Speed by River Mile

Avg. vdm01_sog_..

0.037   7.887

Generating average speeds by vessel and river segment provides fundamental data for predictions.

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Number of Reports (vessels moving)

Count of Number of Records
- · 1
- ○ 200
- ○ 400
- ○ 600
- ○ 800
- ○ 1,027

Avg. vdm01_sog_..

2.200   7.887

Analysis must distinguish between stopped and moving vessels.

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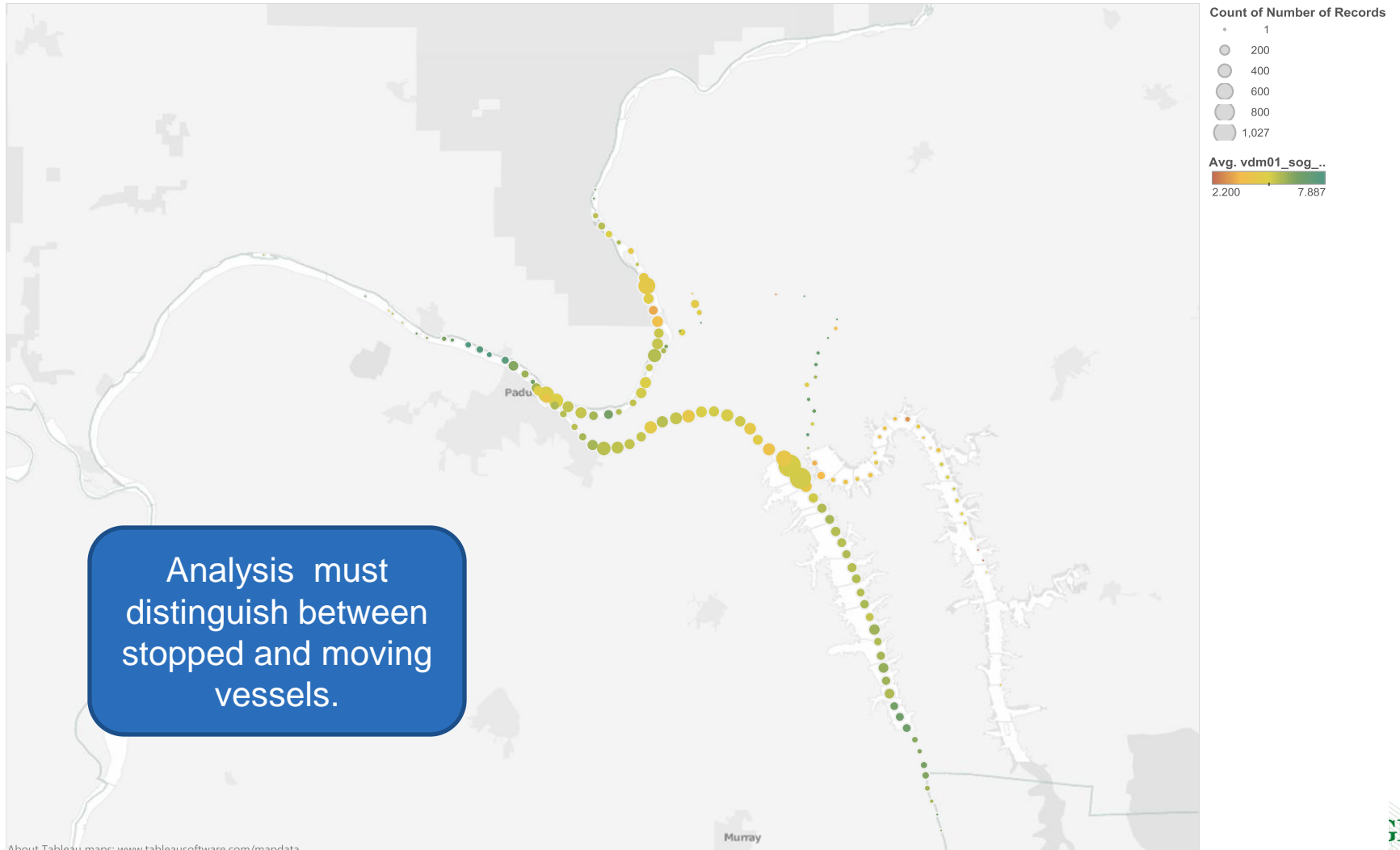
Time/River Mile view of Ohio Traffic

AIS Reports

Time between reports is not predictable .
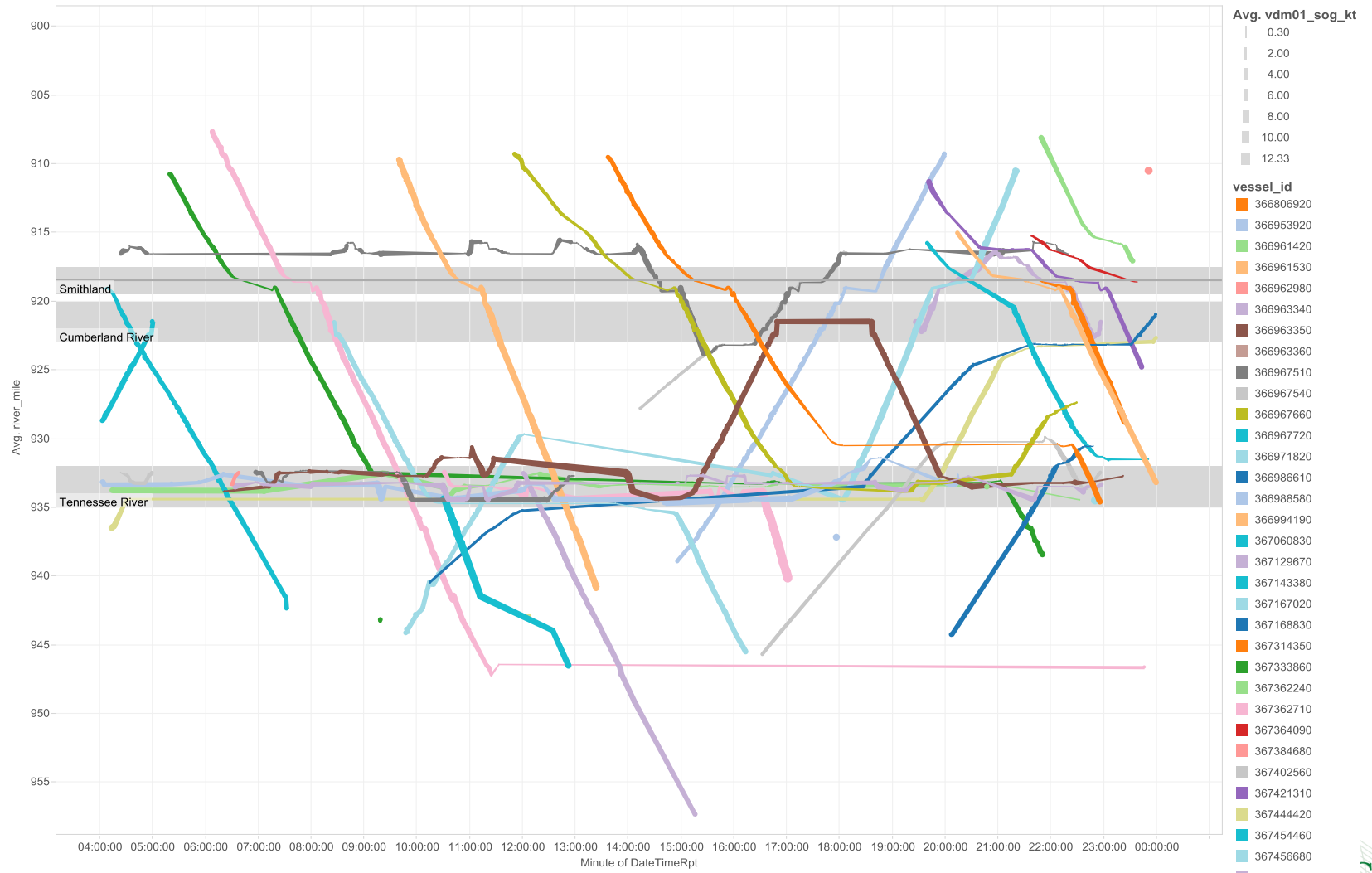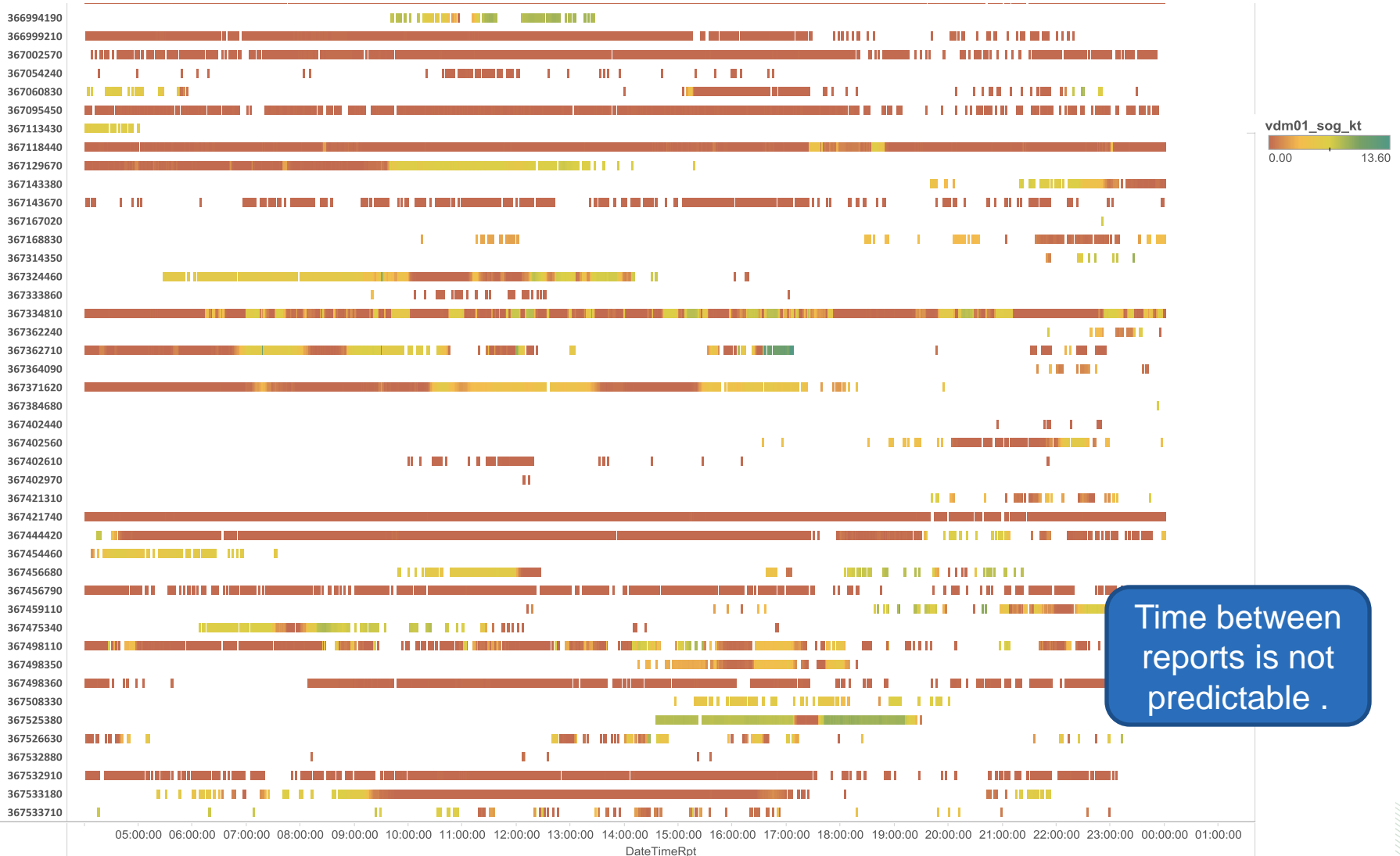
Predictions over time for vessels approaching Smithland

4 fundamental predictors are combined by regression . Many predictions have trends up or down.
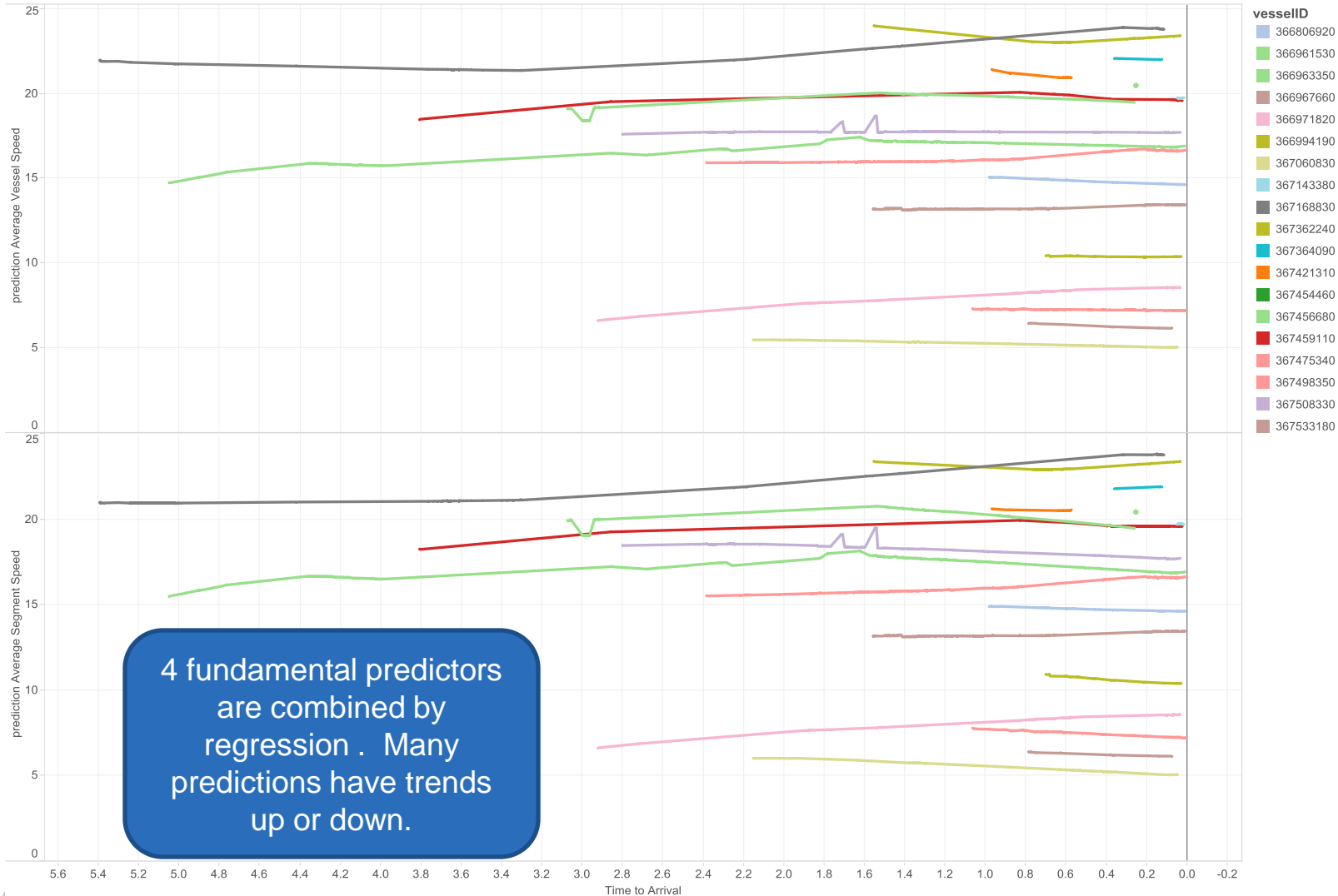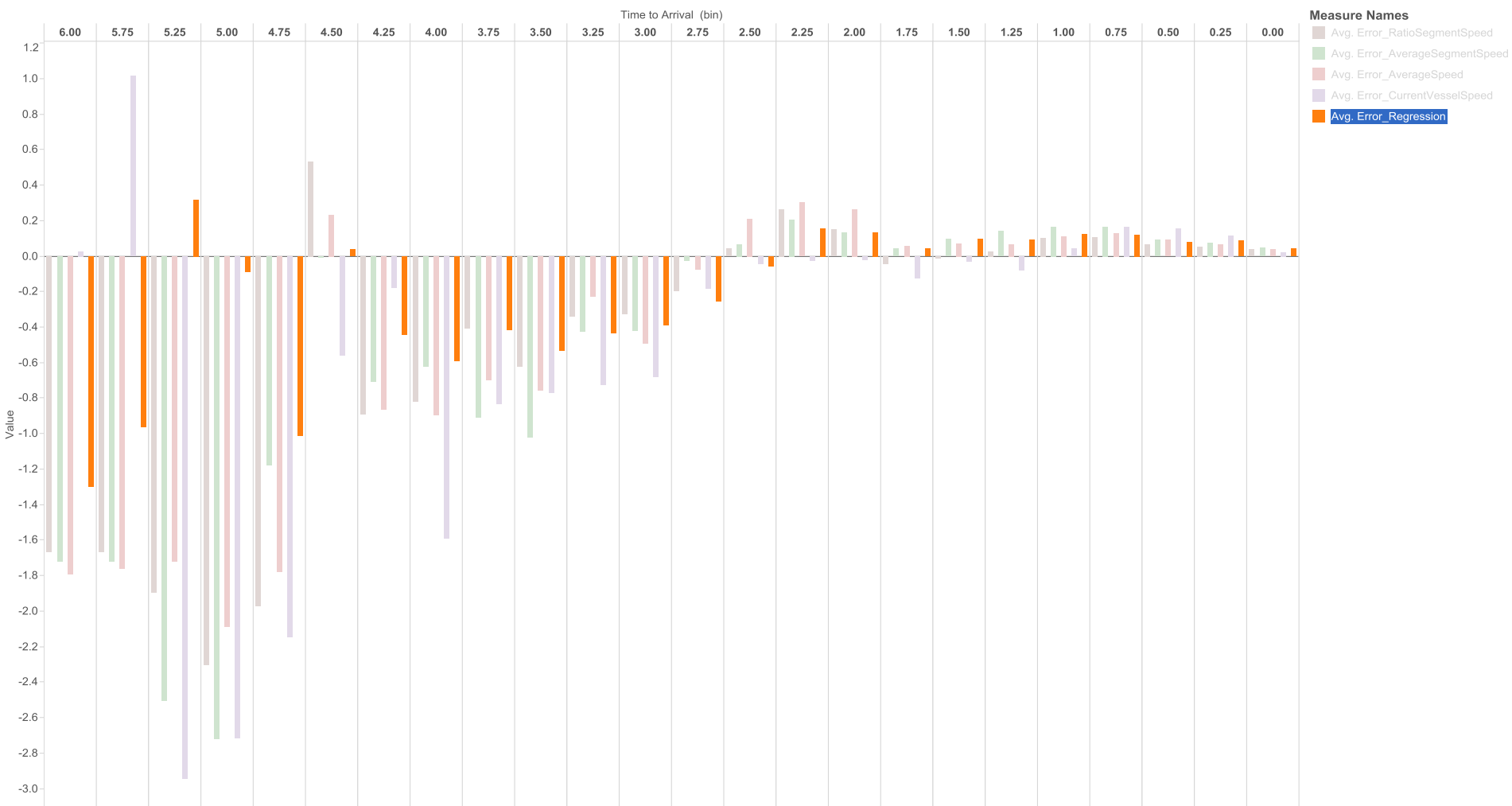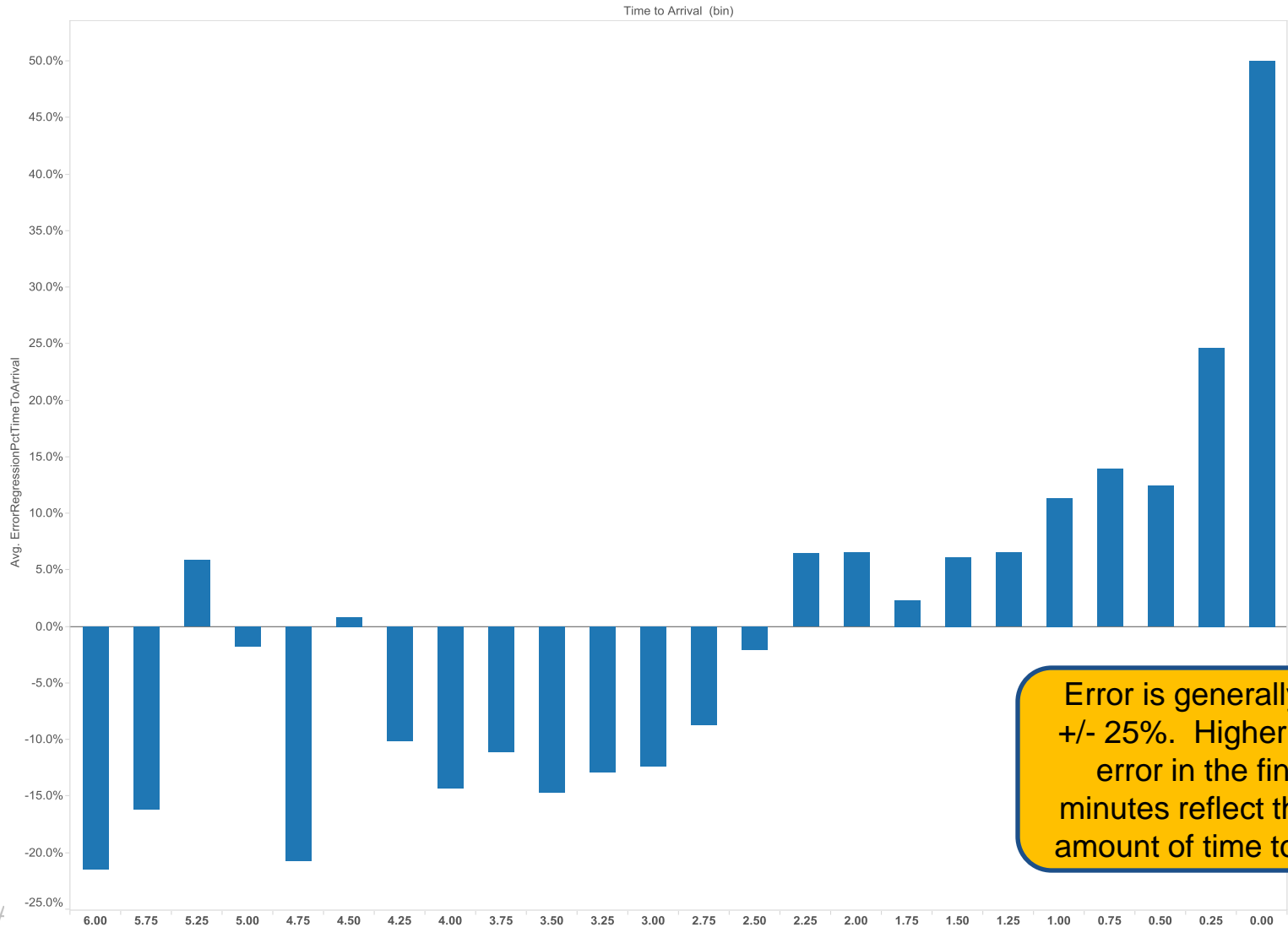
Comparison of Error by 4 Predictors
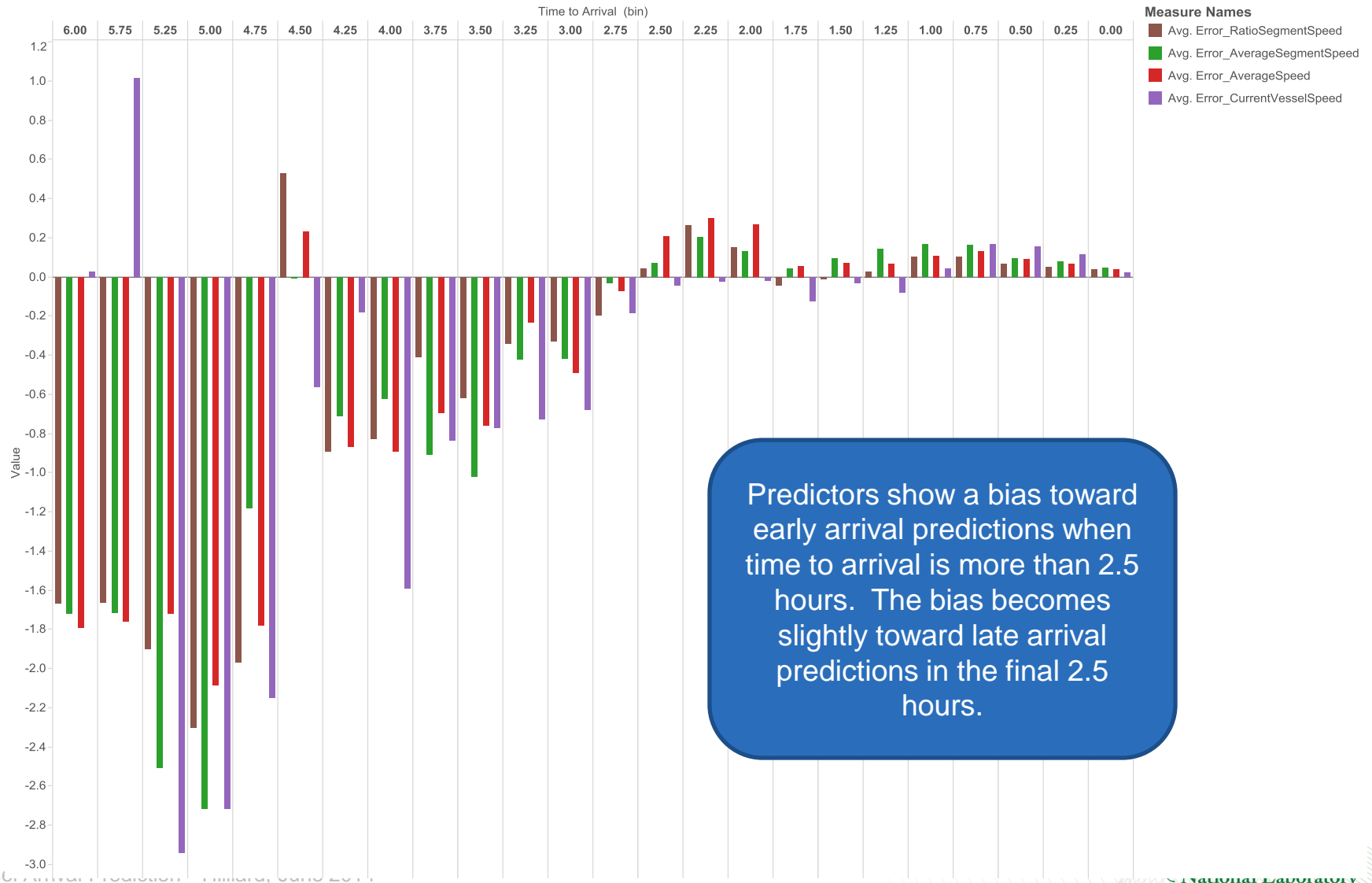
Predictors show a bias toward early arrival predictions when time to arrival is more than 2.5 hours. The bias becomes slightly toward late arrival predictions in the final 2.5 hours.

Regression vs. Individual Predictors

Vessel Arrival Prediction—Hilliard, June 2014

Regression Error as Percentage of Time to Arrival

Error is generally within +/- 25%. Higher relative error in the final 15 minutes reflect the short amount of time to arrival.
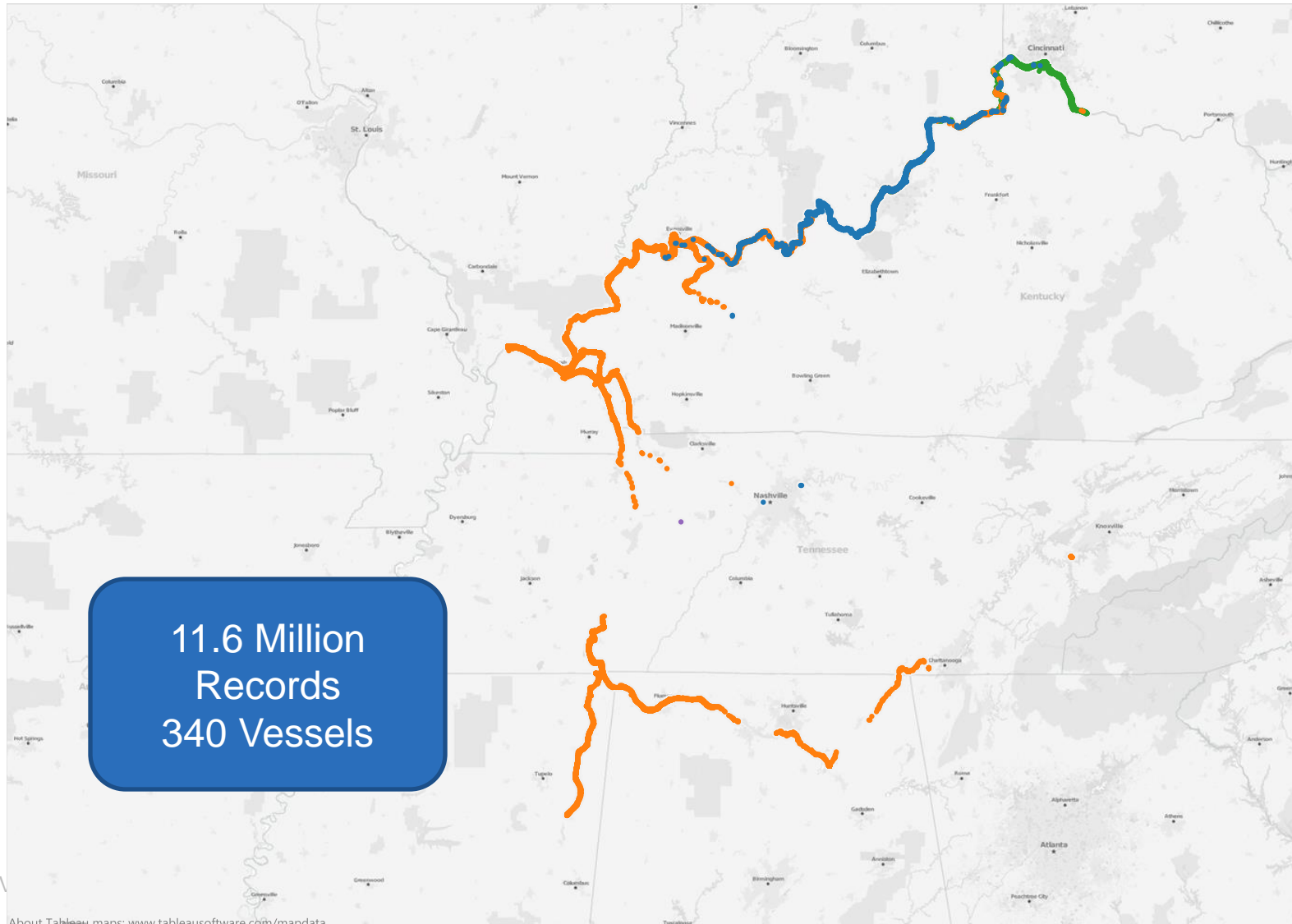
Next Steps

- Begin analysis on two week data set

- Smooth predictions for 15 minute updates

- Use trending errors as self-correcting feedback

- Improve speed of river mile generation function.

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Long Range Vision

- Traffic forecasts: Number and speed of vessels in each river segment over the next few hours.

- Average vessel speeds +/- normal
  - Trip planning
  - Quantify abnormal conditions

- Coordinated lockage management—throttle back vs. queue up.

- Real time planning for vessel arrivals—onload, offload, refleeting.

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Two Week Data Set

RECEIVER
- b003669732
- D08MN-MO-SROBS1
- r08ACERDC
- r08NFTK1
- r08NHNT1
- r08XSTL1

11.6 Million
Records
340 Vessels

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