Safety Applications of Crowd-Sourced Traffic Data

Dan Flynn, PhD

Erika Sudderth, PhD

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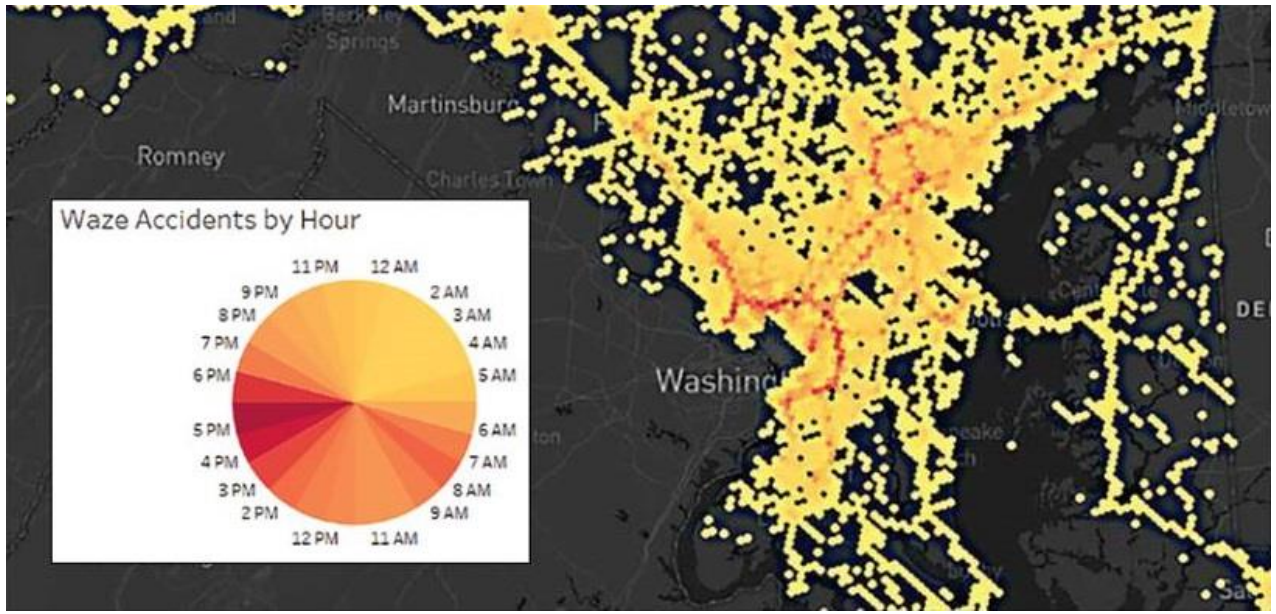
Safety Data Initiative – Waze Pilot Project

- DOT became a Waze Connected Citizens partner (data from April, 2017)
- Analysis in Secure Data Commons: AWS cloud platform to process, curate, and analyze big data within DOT (Waze and other transportation data)
- Waze pilot: Integrate transportation data to develop rapid crash indictors
  - Phase 1: State-wide indicators of police-reportable traffic crashes
  - Phase 2: State and local applications of Waze analysis pipeline
    - Tennessee: Crash propensity model to target safety risk with highway patrols
    - Bellevue: Crash risk model to inform Vision Zero action plan

Phase 1: State-Wide Crash Models using Waze data

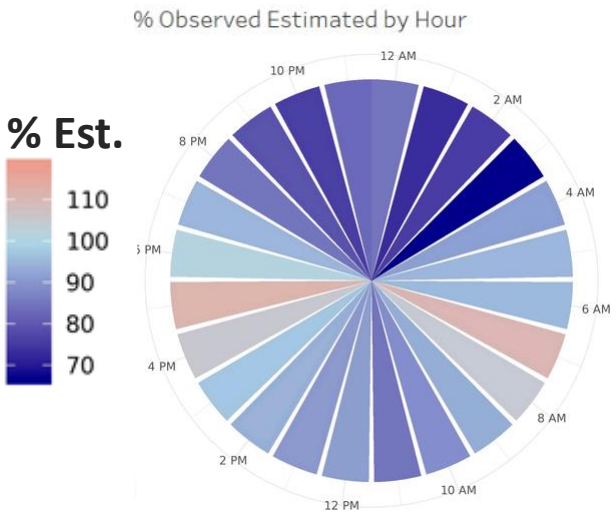
- Assessed spatial and temporal relationships between Waze events and police-reported traffic crashes
- Integrated statewide Waze, traffic volume, job, and weather data for MD, VA, CT, and UT
- Applied machine learning to reliably estimate hourly police reportable crashes in four states
- Created interactive Tableau dashboards: when and where are model estimates accurate?



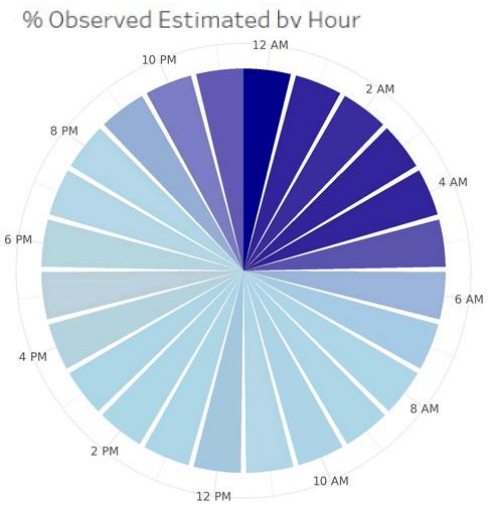
Our Waze data integration, modeling, and visualization pipeline can support nationwide studies or state and local applications

Models perform well across multiple states
Variation by hour and location related to Waze coverage

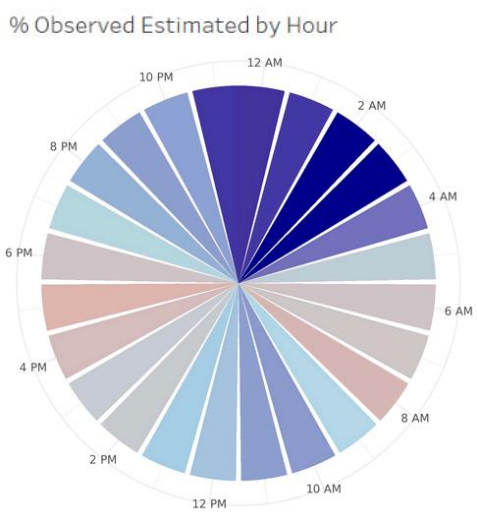
Maryland



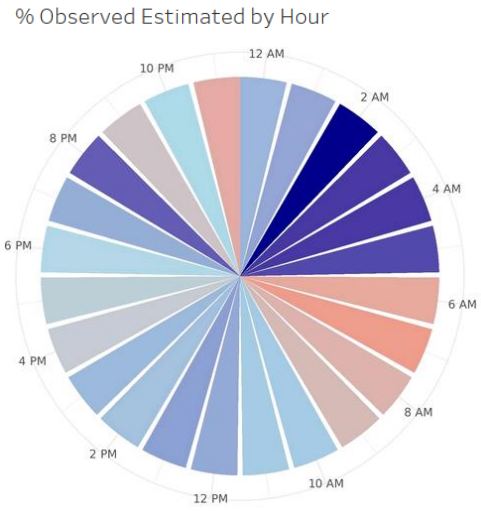
Connecticut

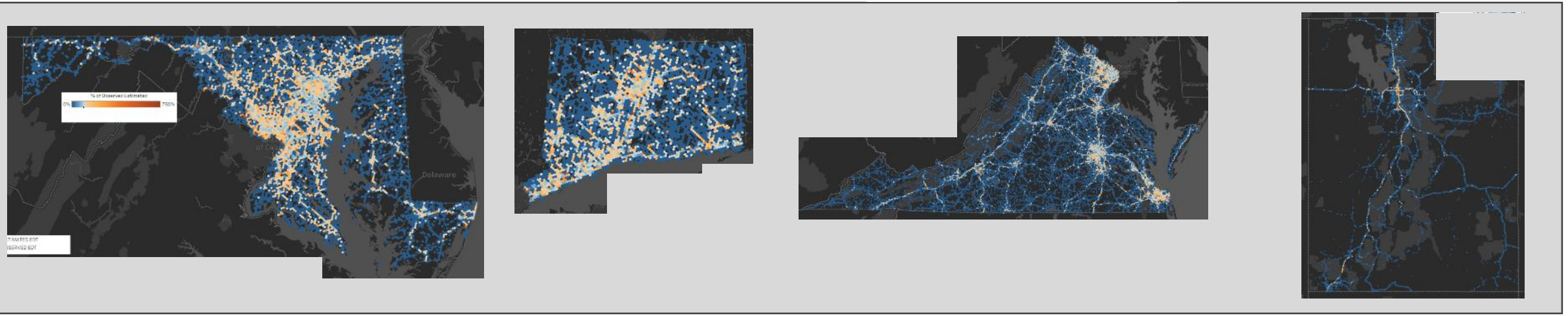


Virginia



Utah





Phase II: Tennessee Case Study

- Highway Patrol uses machine learning to predict crash propensity and target patrols
- Integrating Waze data with existing grid models improves estimates
  - Spatial resolution: 42 to 1 sq mile
  - Temporal resolution: 4 hrs to 1 hr
- Results will help HP better target high crash risk locations and times

Phase II: Bellevue Case Study

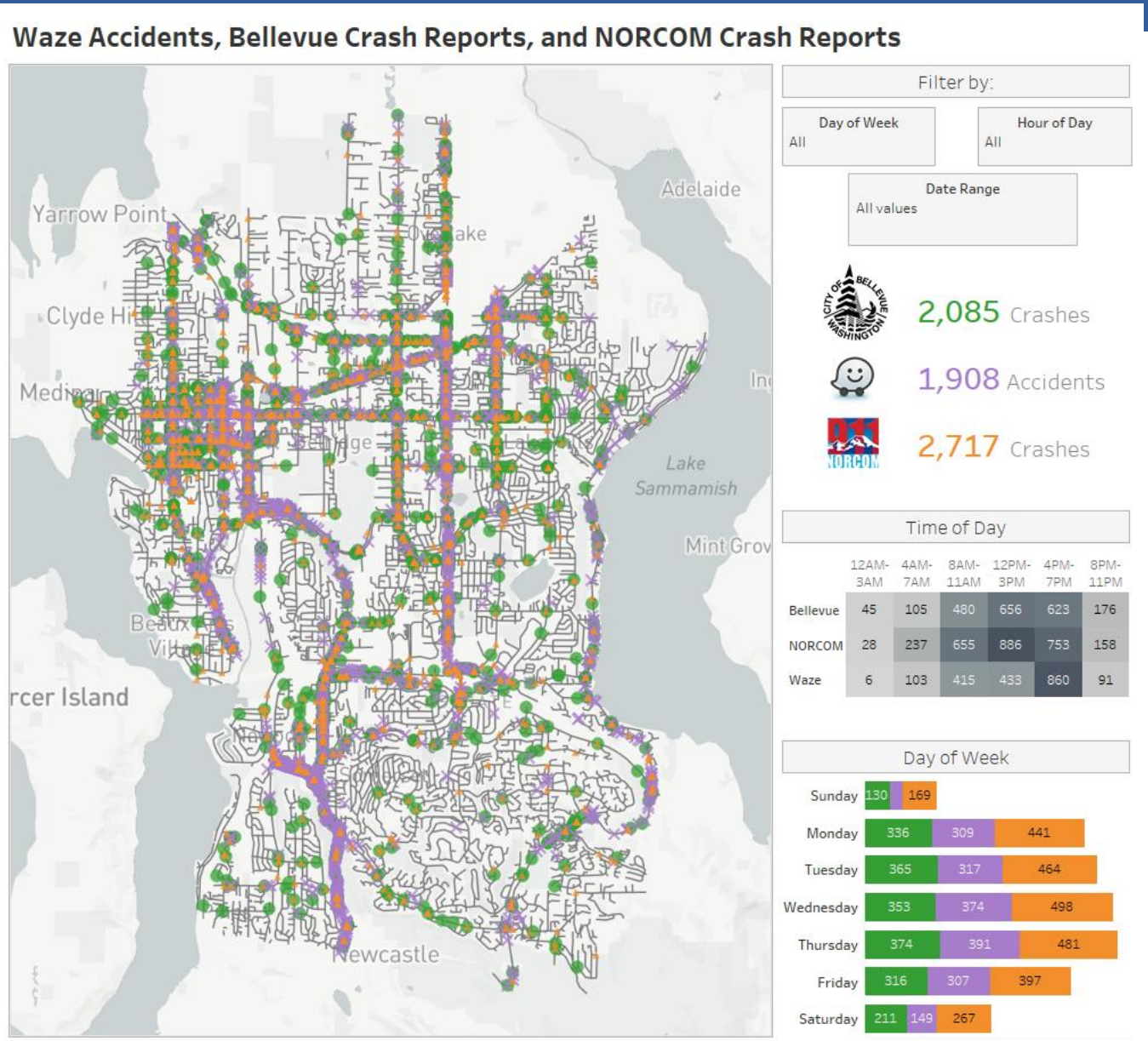
Crowdsourced traffic incident data to improve traffic safety management

Approach:

- Integrate data sources and create dashboards
- Develop crash estimation models: conditions, times, locations with high propensity
- Transfer methods to Bellevue (CC partner)

Outcomes:

- First integrated view of 3 traffic crash datasets highlights unique contributions of each by time and location
- Segment-level crash models will guide transportation safety investment decisions

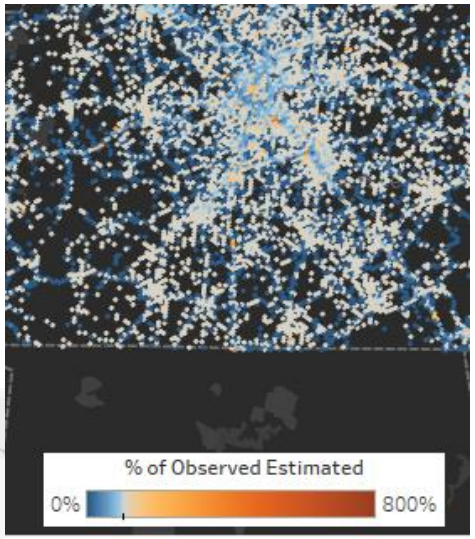


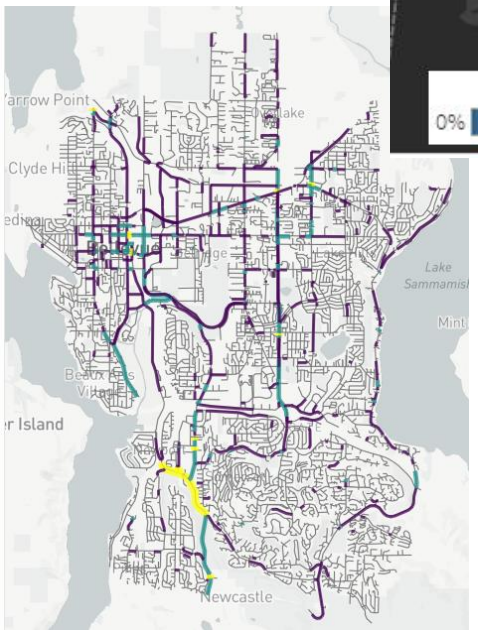
Insights – What Have We Learned?

Waze data provide important contextual information to inform state and local safety applications

- Crash models based on integrated Waze, traffic volume, job, and weather data give reliable estimates
- Tennessee Highway Patrol will more effectively target high-risk times and areas
- Crash propensity models will guide city-wide safety investment decisions

Crowd-sourced traffic data can enhance other roadway data to illuminate safety risk patterns and inform decision making





Waze Pilot: Next Steps

- Transfer data integration, modeling, and visualization approaches to state and local case study partners (grid and segment models)
  - Tennessee: Deploy updated crash propensity models with Waze data at finer spatial and temporal resolution
  - Bellevue: Complete crash estimation models and prepare dashboards that will guide safety investment decisions
- Publish phase 1 methods and findings in peer-reviewed journal
- Explore safety applications with other state and local partners

Background Slides

Statistical Approach: Supervised Classification

Random Forests

- Machine learning approach which minimizes overfitting
- Trained models on 70% of data using EDT reports as our labeled “ground-truth”
- Tested model performance using 30% of data to compare estimated EDT crashes with observed EDT crashes
- Rigorously trained and tested data feature combinations (50+ models)
- Best crash estimation models minimize false positives and false negatives

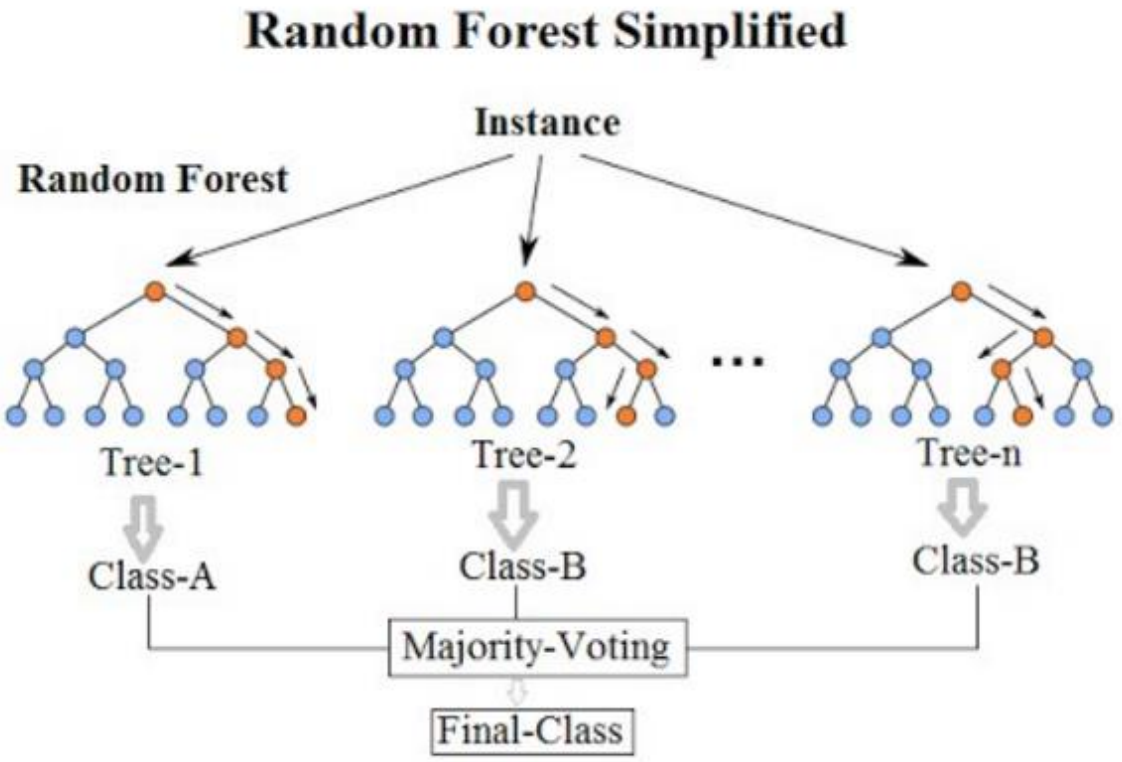
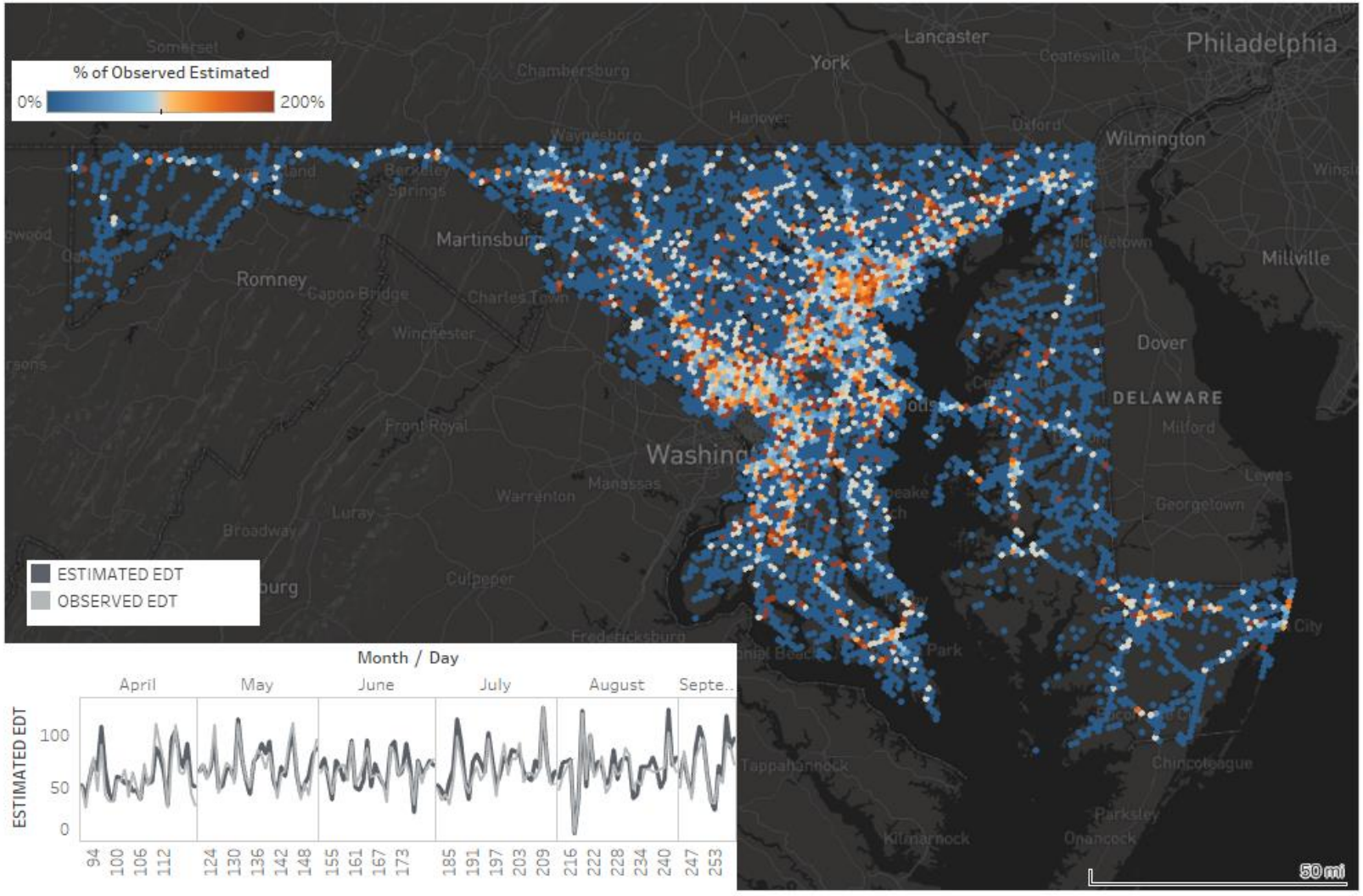


Image credit: https://medium.com/@williamkoehrsen/random-forest-simple-explanation-377895a60d2d

Model Performance (April-Sept 2017 in MD)

Model estimates highly accurate overall; miss some precise patterns



Crashes by Day

Day Of Week	ESTIMATED EDT	OBSERVED EDT	PRCT OBSERVED
Monday	1,089	1,099	99.09%
Tuesday	1,623	1,602	101.31%
Wednesday	1,788	1,709	104.62%
Thursday	1,768	1,694	104.37%
Friday	1,922	1,840	104.46%
Saturday	1,945	1,869	104.07%
Sunday	1,390	1,413	98.37%

% Observed Estimated by Hour