

The Puget Sound Stormwater Heatmap

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23 February 2022

Geosyntec 
consultants



What we are building

Puget Sound Wide Tool

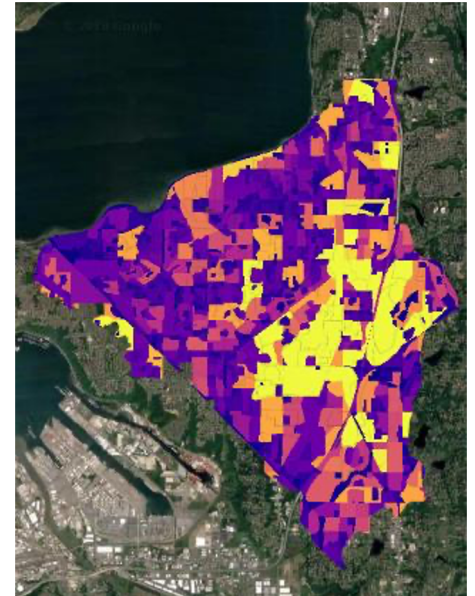


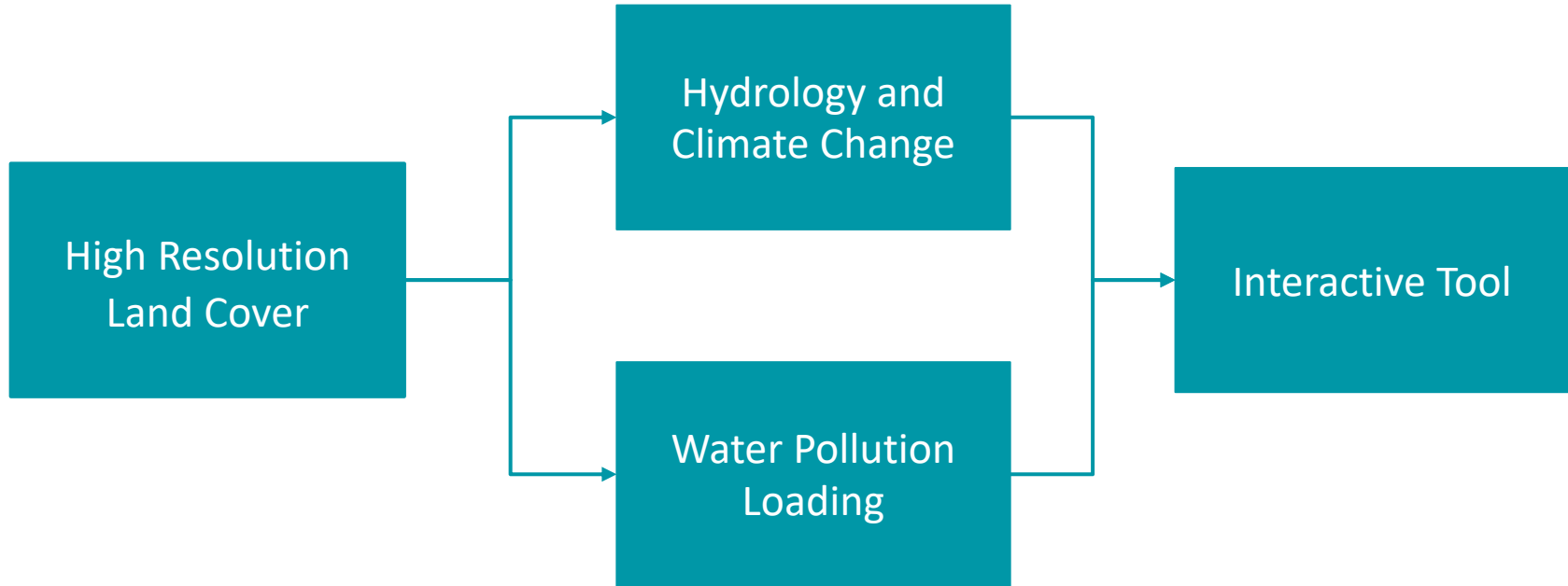
Puget Sound Basin in Washington State

To Help Stormwater Planners



Prioritize areas and watersheds for stormwater improvements





Input Data

Training Data

Classification

Evaluation

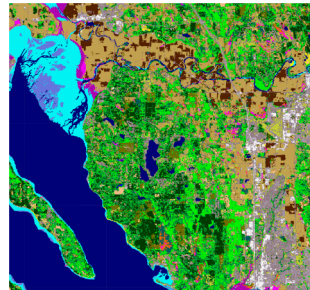
Primary Data

NAIP 4 Band Imagery

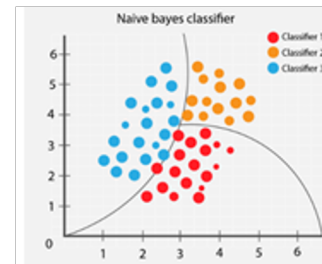
Additional Data

- Lidar derived rooftops (~ 1 million)
- Open Street Maps water features
- TIGER Roadways
- National Landcover Dataset
- Microsoft-derived rooftop data
- USGS National Elevation Dataset

NOAA Land Cover Data for Snohomish County

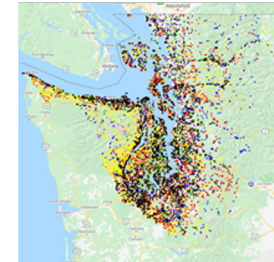


ee.Classifier.
smileNaiveBayes()

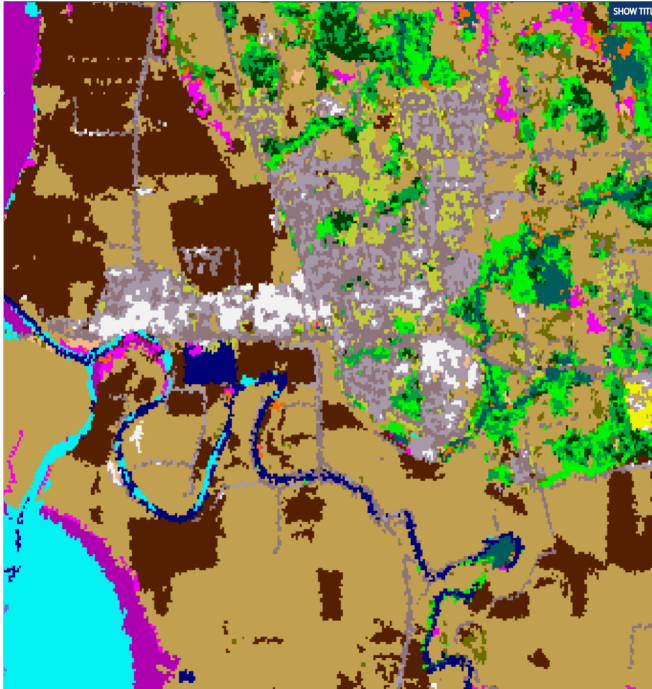


ee.Classifier.
explain()

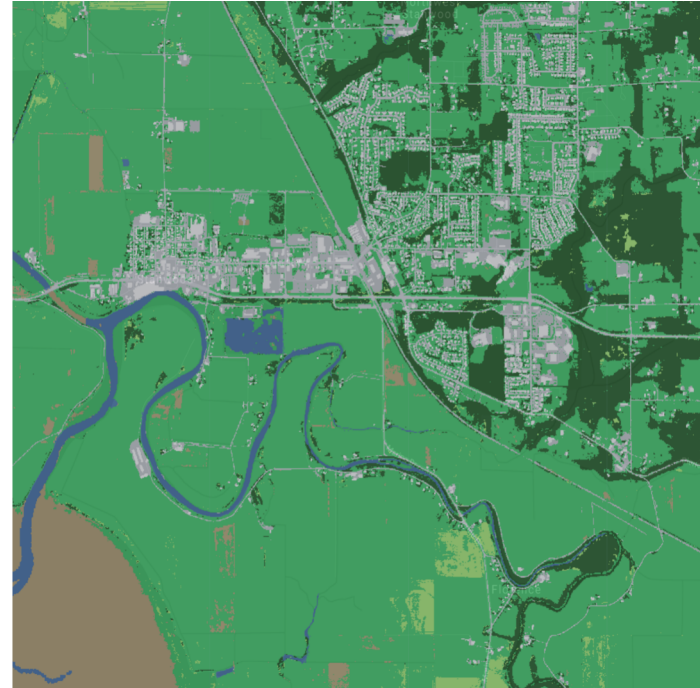
ee.ConfursionMatrix()



NOAA C-CAP 30m



TNC Stormwater Heatmap ~1m

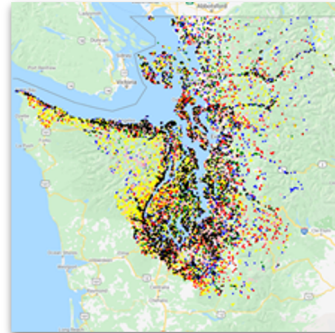


Results

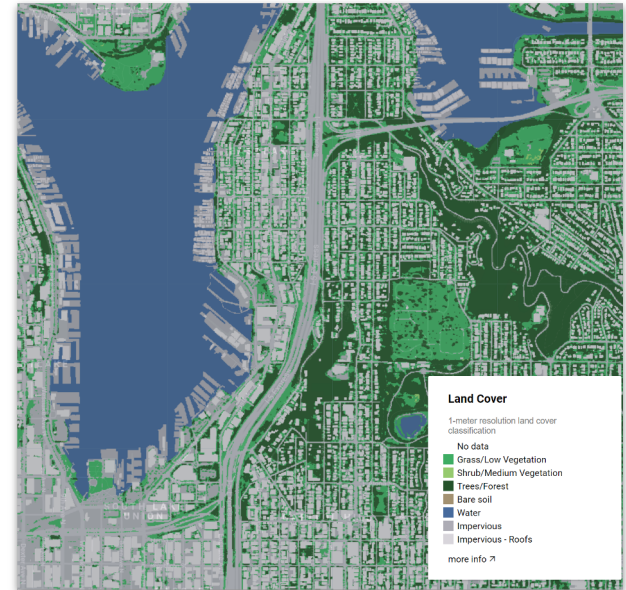


Accuracy and kappa statistics

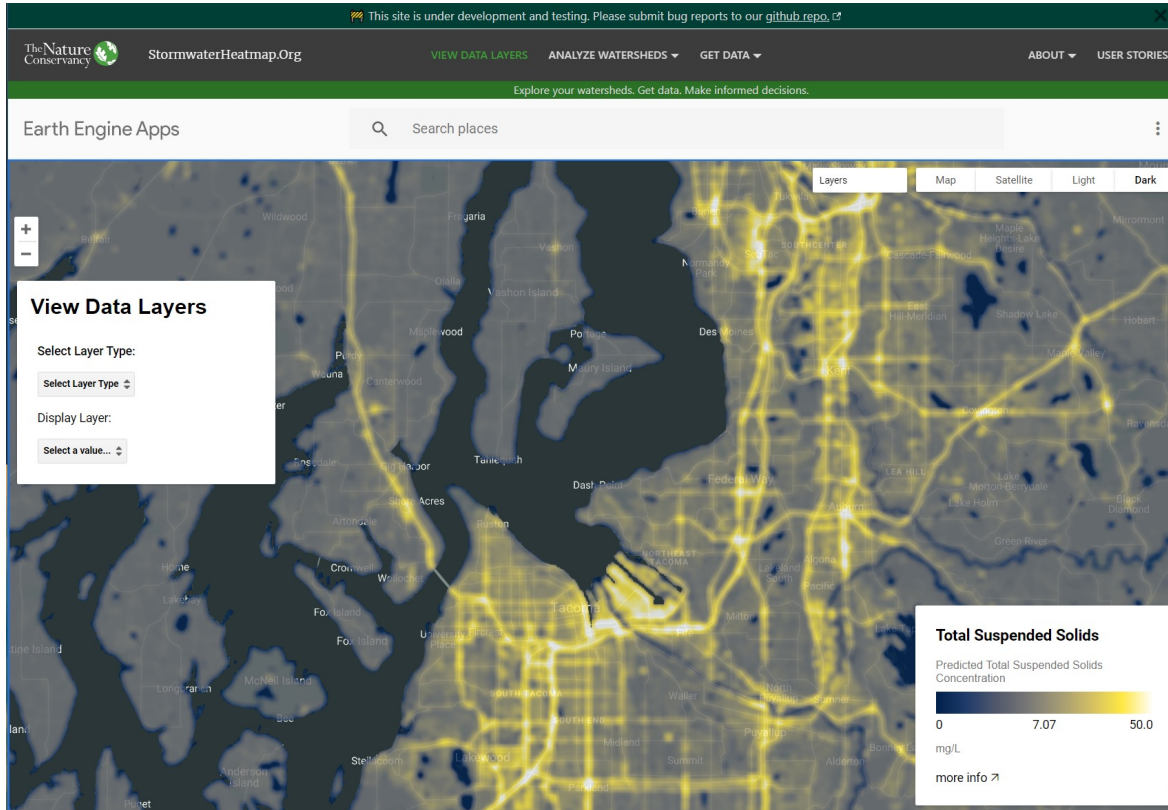
County	Imperviousness		Landcover	
	Accuracy	Kappa	Accuracy	Kappa
Clallam	0.99	0.95	0.92	0.89
Island	0.99	0.94	0.91	0.88
Jefferson	0.98	0.93	0.91	0.88
King	0.97	0.90	0.93	0.90
Kitsap	0.98	0.92	0.95	0.93
Lewis	1.00	1.00	0.96	0.93
Mason	0.98	0.92	0.93	0.90
Pierce	0.97	0.91	0.89	0.85
San Juan	0.98	0.90	0.83	0.77
Skagit	0.98	0.93	0.91	0.88
Snohomish	0.96	0.86	0.93	0.90
Thurston	0.98	0.92	0.91	0.88
Whatcom	0.99	0.94	0.87	0.82

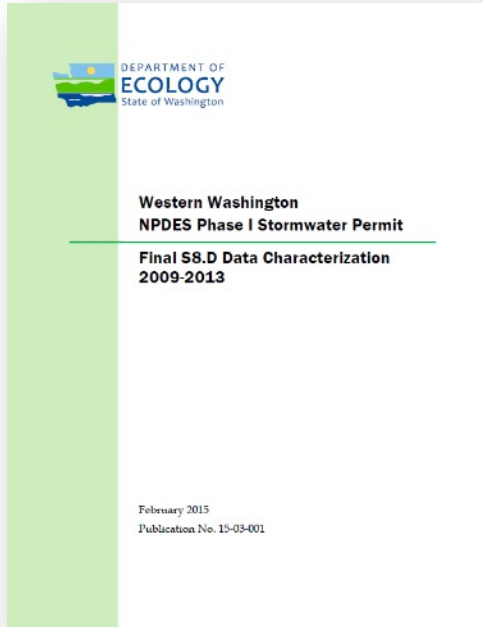


WDFW Land Cover Classifications



Pollutant Loading Estimates

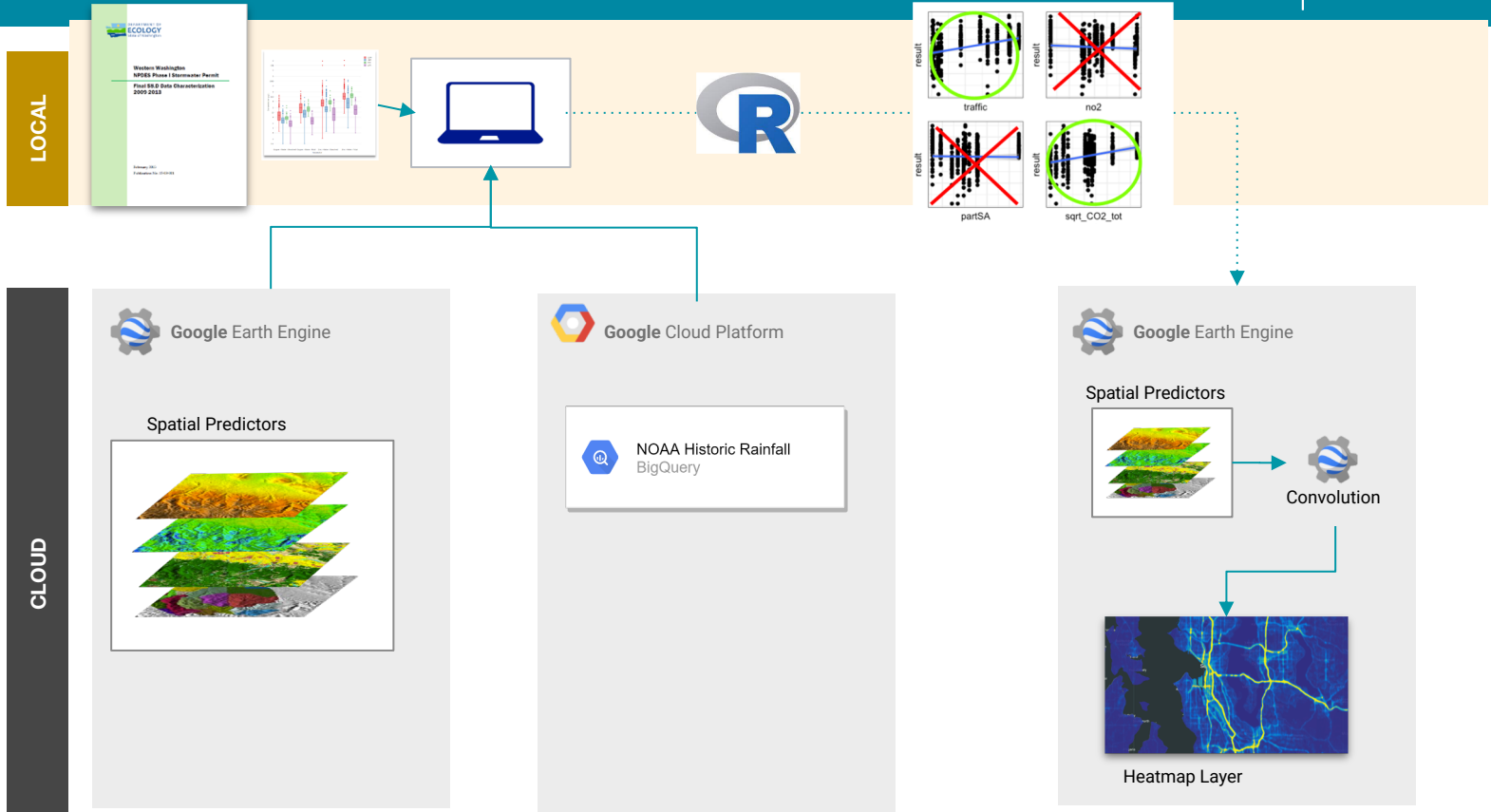


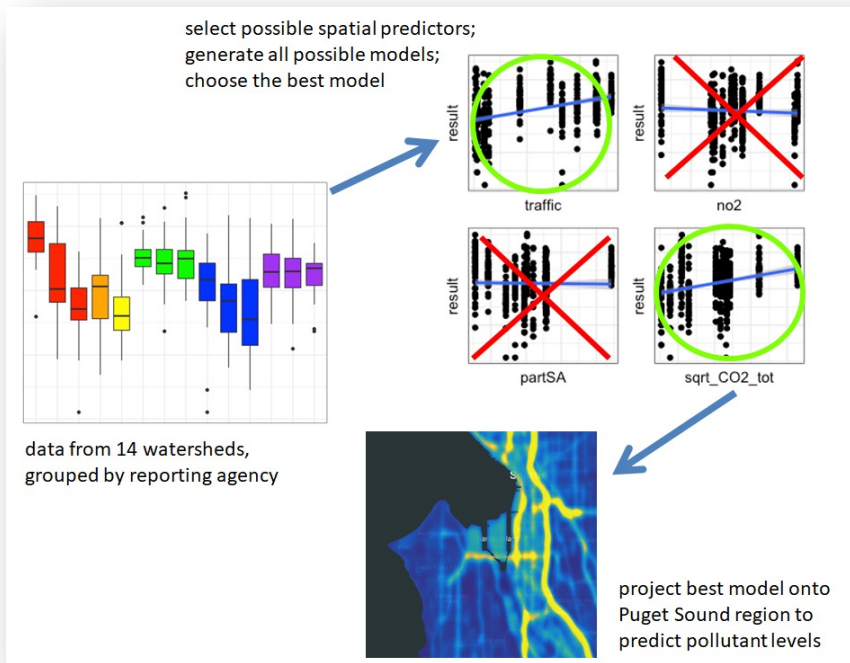


- Outfall Monitoring Data
 - King County
 - Snohomish County
 - Pierce County
 - Tacoma
 - Seattle
 - Port of Tacoma
 - Port of Seattle

Sources:
Western Washington NPDES Phase I Stormwater Data Characterization
(Ecology)
Highway-Runoff Database (USGS & FHWA)

Stormwater Pollution Predictions





Mixed effects model

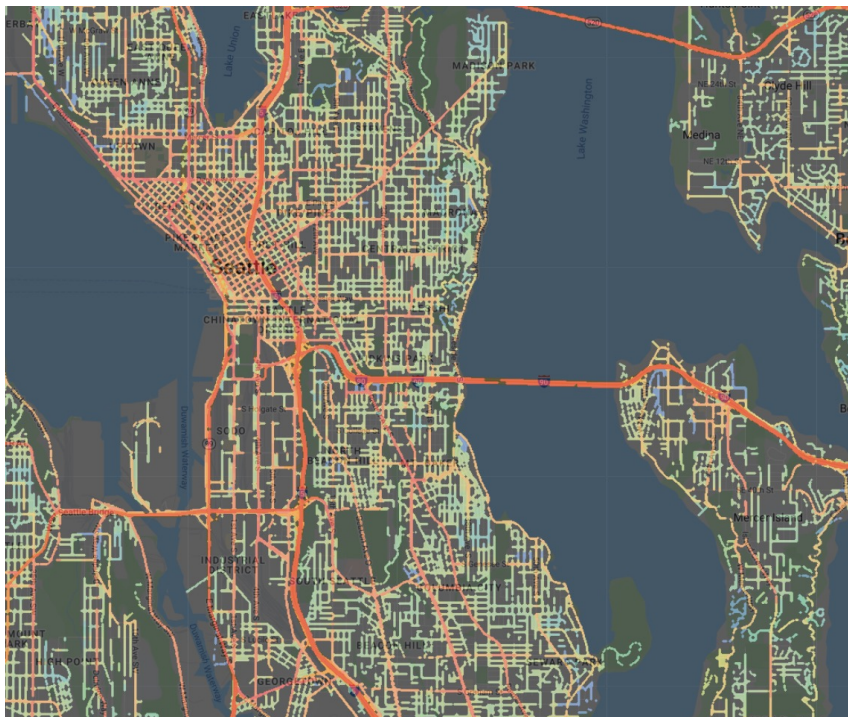
$$y_{i,j} = \beta_0 + \beta_1 x_1 + \dots + \beta_n x_n + b_i + \epsilon_{i,j}$$

More details at

<https://www.stormwaterheatmap.dev/docs/Technical%20Reference/Components/Water%20Quality%20Statistics>

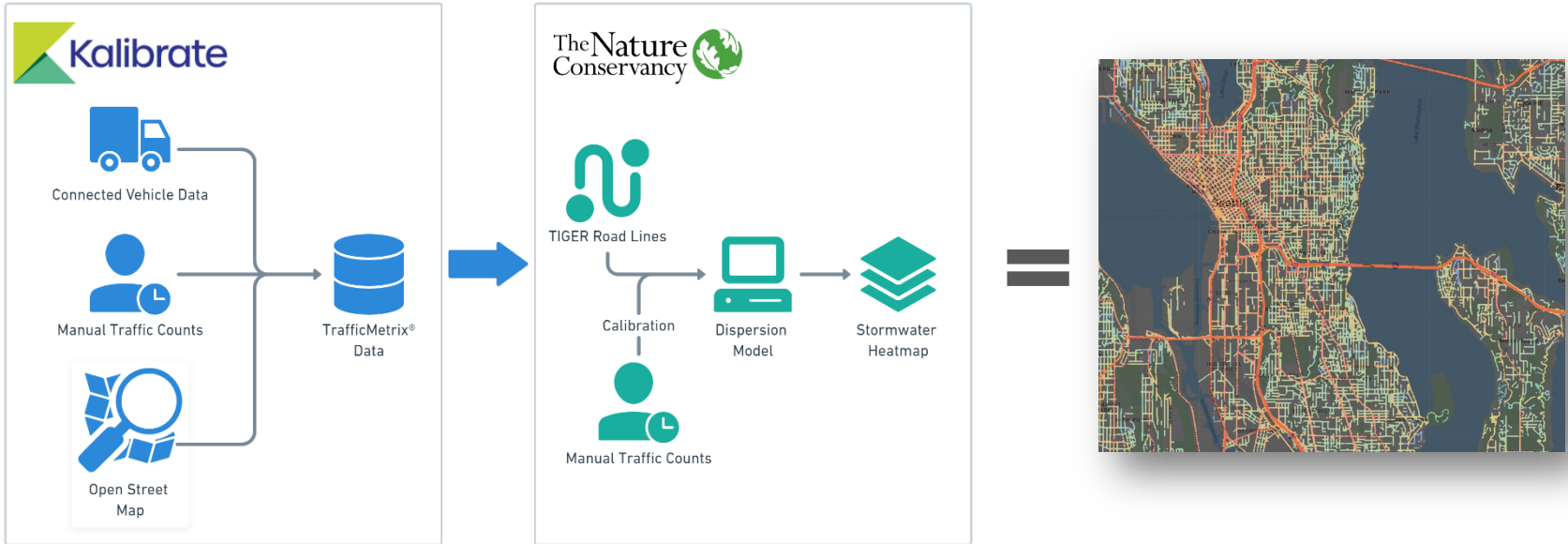
Explanatory Variables for COCs

Parameter	Predictors
Copper - Water - Total	<ul style="list-style-type: none">• Age of Development• Fine particulate matter (PM2.5)• Traffic Volume
Total Kjeldahl Nitrogen - Water – Total	<ul style="list-style-type: none">• Age of Development• Roadway Carbon Dioxide Emissions
Total Phosphorus - Water - Total	<ul style="list-style-type: none">• Grass land cover• Non-roof imperviousness• Roadway Carbon Dioxide Emissions
Total Suspended Solids - Water - Total	<ul style="list-style-type: none">• Non-roof imperviousness• Traffic Volume
Zinc - Water - Total	<ul style="list-style-type: none">• Non-roof imperviousness• Fine particulate matter (PM2.5)• Traffic Volume

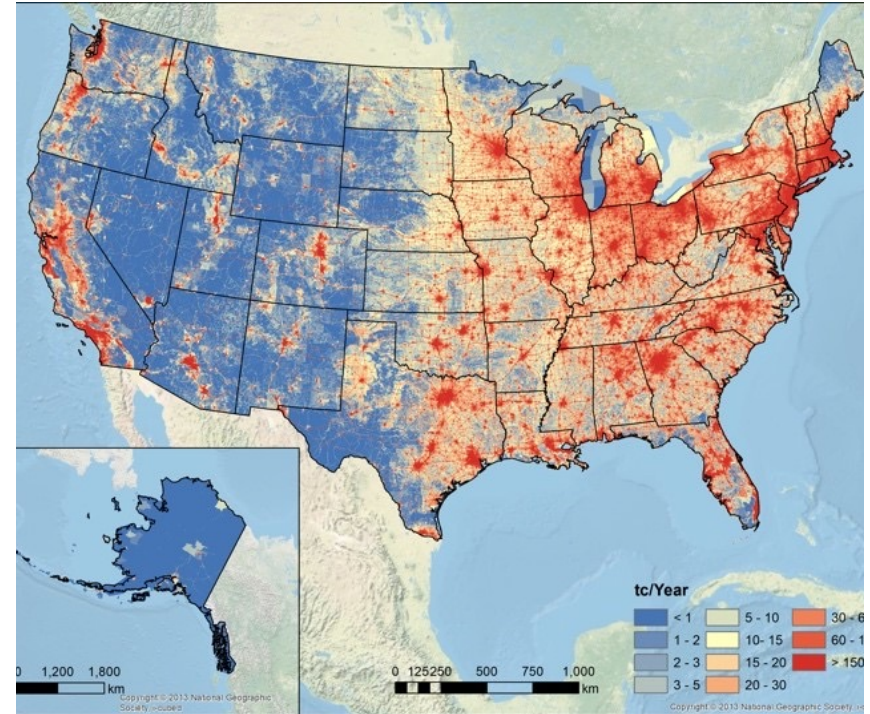
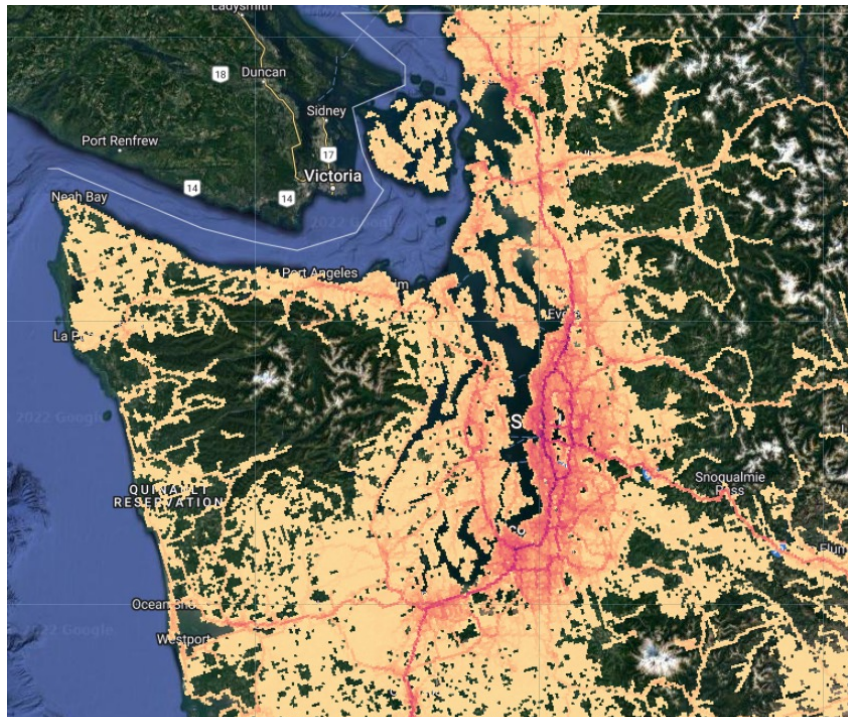


- Average Annual Daily Trips (AADT)
- Based on Connected Vehicle Data
- Almost every street in Puget Sound
- ~5 m scale

Traffic (AADT)



On Road CO₂ Emissions



- Now
 - Development site in progress
- March 7
 - Launch of new site
(www.stormwaterheatmap.org)
- 2022 & Beyond
 - Additional improvements
(climate change, hydrology,
data access)

Thank you

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Thank you

- Jamie Robertson, TNC
- Ken Pierce, Washington Dept of Fish and Wildlife,
- Nate Herold, NOAA Office of Coastal Management,
- Eric Strecker P.E., Terraphase engineering
- Jeff Burkey, King County Hydrology,
- Anand (Ani) Jayakaran, Washington State University Stormwater Center
- Eva Dusek Jennings, Cheva Consulting
- The Boeing Company
- Google