Geospatial Mapping with Coverage Overlays

Team 1610
Client: John Deere
Client Representatives: Benazir Fateh and Nicholas Sitter
Advisors: Swamy Ponpandi, Akhilesh Tyagi

Responsibilities

- **Team Leader:** Luke Milius - Server deployment/Mapping interface
- **Database Leader:** Brenda Lopez - PostGIS database/Mapping interface (county outlines)
- **Team Communication Leader:** Jacob Caithamer - Reporting tool
- **Team Webmaster:** Sarah Ulmer - Reporting tool
- **Team Key Concept Holder:** Franklin Nelson - Mapping interface (markers)

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Project Overview & Goal
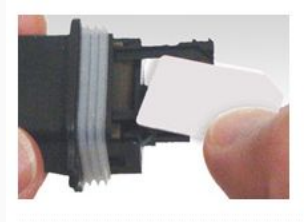
John Deere Telematics

The success of telematics solutions provided by John Deere depends on the satellite and wireless communication infrastructure. The telematics products are extensively drive tested. A drive test collects data from the GPS antenna attached to a commercial vehicle and formatted into a CSV file.

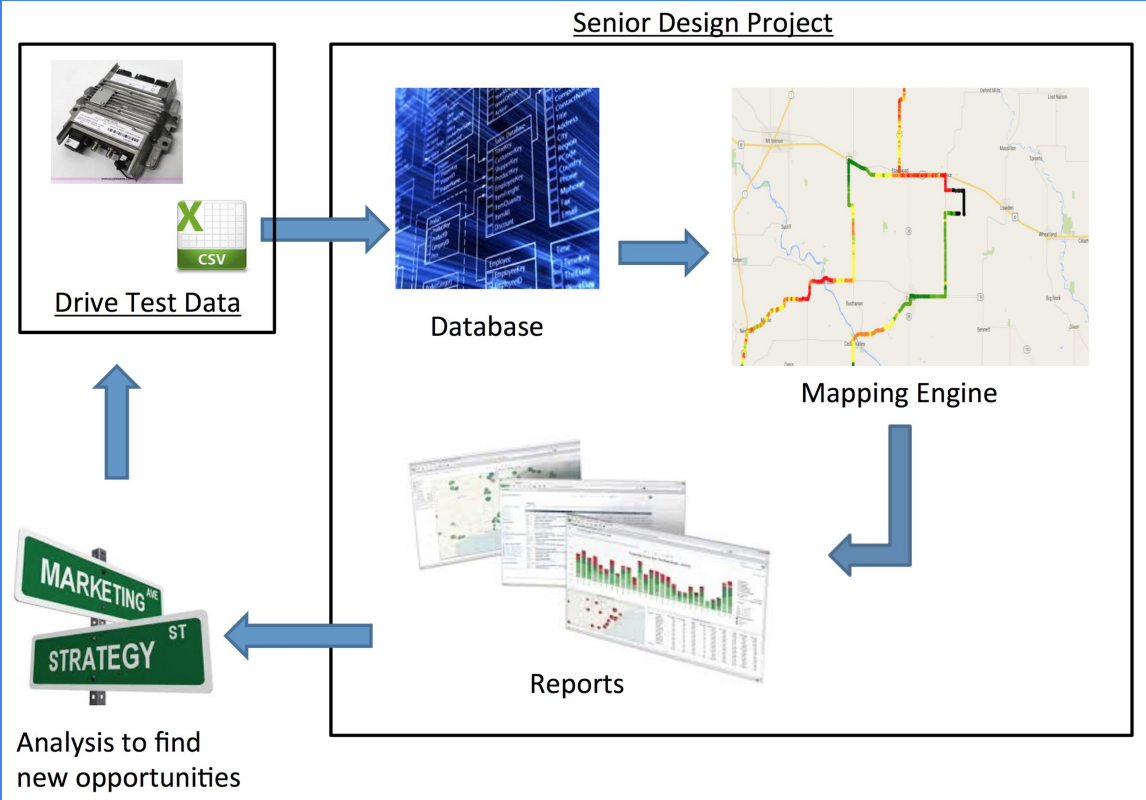Satellite Gateway

Modular Gateway

SIM Plug

Why is our project important?

- John Deere real-time products require great data coverage and AT&T coverage maps are not completely accurate

- Business intelligence system for the client, so be able to market their products in areas with good coverage and determine areas that need coverage improvement.

- This project will be integrated into existing applications and analyze existing data.

Conceptual Overview

Senior Design Project

Drive Test Data

Database

Mapping Engine

Reports

Analysis to find new opportunities

Goal

To design a lightweight interface for overlaying contextual information on geo-referenced maps and reports for intuitive coverage analysis.

Time	Fix Time	Latitude	Longitude	Altitude	Speed	Heading	RSSI	Quality	Technology	Operator	Call Type	Call Result
1.43E+09	1.43E+09	42.05392	-93.6208	2876	0	907	-1	99	0	---	3	4
1.43E+09	1.43E+09	42.05392	-93.6208	2873	1	907	-1	99	0	AT&T		
1.43E+09	1.43E+09	42.05392	-93.6208	2863	0	907	-1	99	0	AT&T	3	4
1.43E+09	1.43E+09	42.05393	-93.6208	2860	0	842	-1	99	0	AT&T		
1.43E+09	1.43E+09	42.05394	-93.6208	2851	0	848	-1	99	0	AT&T		
1.43E+09	1.43E+09	42.05394	-93.6208	2850	1	848	-1	99	0	AT&T		
1.43E+09	1.43E+09	42.05394	-93.6208	2848	25	850	-1	99	0	310410		
1.43E+09	1.43E+09	42.05394	-93.6208	2848	76	885	-1	99	6	310410		
1.43E+09	1.43E+09	42.05394	-93.6208	2848	76	885	-67	99	6	310410		
1.43E+09	1.43E+09	42.05442	-93.6205	2863	398	3582	-67	99	6	310410		
1.43E+09	1.43E+09	42.05547	-93.6206	2891	618	3584	-67	99	6	310410	1	0

Market Survey

- Current version used by John Deere
    - A few hundred to a thousand points that take over a minute to load each data point
    - Very limited possibilities for analyzing data
- Lots of different mapping & analysis products

Design Requirements

Requirements

Functional

- Transfer csv file data to database
- Filter out map points by region
- Change marker types & attributes they measure
- Generate graph of drive test attributes

Non-functional

- Render thousands of map points
- Lightweight & Efficient
- Secure

Risks

- *Time Constraint*: Can't plot points on map under one minute
- *Compromised Data*: Data in server is not secure
- *Geolocation*: Can't find efficient method to calculate county boundaries

Resource/Cost Estimate

- *MapBox*: $499 for 1 million map views per month
- *Amazon Web Server*: Approx. $19 per month

Project Milestones

- October 5th - Finished first draft of project plan
- October 22nd - Finished first draft of design document
- November 6th - Finished second draft of project plan
- November 17th - Demoed prototype to John Deere
- December 8th - First semester demo
- March 31st - Complete main development
- April 4th - Second instructor meeting
- April 25th - Final design & project plan
- **April 29th - Final Presentation**
- April 30th - Give handoff documentation to John Deere

Design

Schematic

Coverage Overlays   May 1610   Luke Milius, Brenda Lopez, Sarah Ulmer, Franklin Nelson, Jake Caithamer

Client

GUI
- Mapping Engine
- CSV Interface
- Reporting Tool

Controller
Java Script
- Mapbox
- SVG

Ajax

Server

Controller
- Servlets
- Model
- Database Management

Database
- Geospatial Database
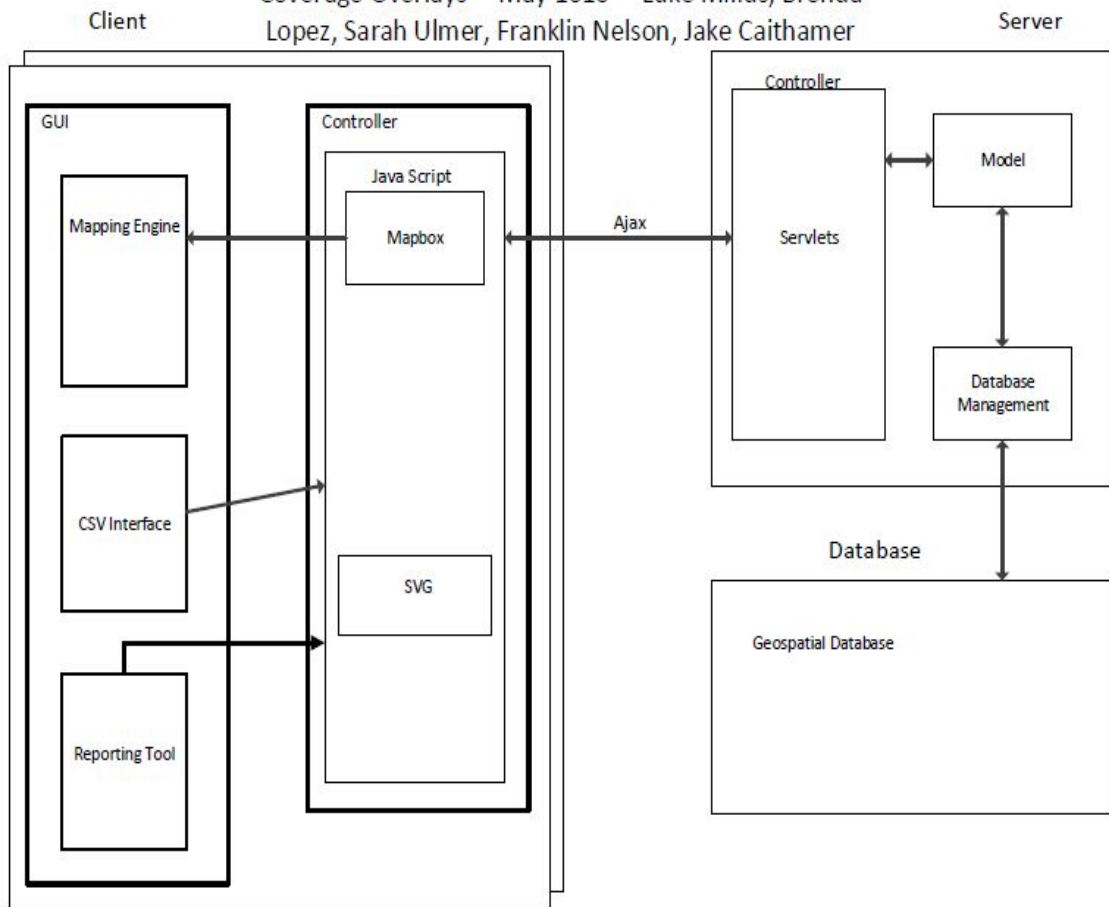
Technologies Used

- Java & Spring MVC
- PostgreSQL with PostGIS
- HTML5, Javascript, SVG
- MapBox w/Heat & MarkerCluster
- TIGER/Line® Shapefile
- jQuery/AJAX

Database Schema

dataPoints

dataid

time

fixtime

...

logfileid

geom

logFiles

logfileid

...

drivetestid

averages

averageid

drivetestid

...

driveTests

drivetestid

name

notes
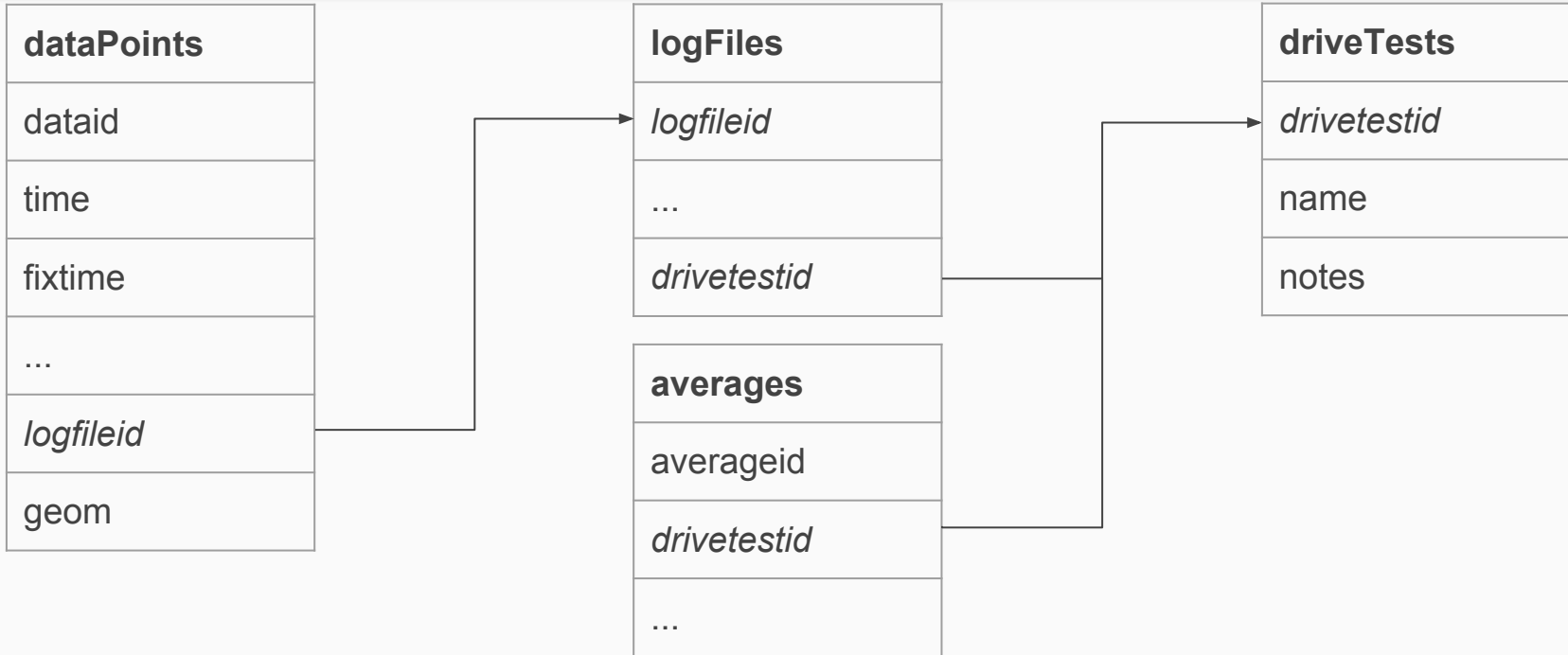
Implementation

Login

- Login page backed by Spring Security
- Challenges

Please Sign In to Coverage Overlays

username

password

Login

Coverage Overlays

Upload A CSV File   View Map

Reporting Graphs

Upload

- Create/Delete drive tests
- Upload a csv file & put data in drive test
- Create a random csv file
- List data points contained in a drive test
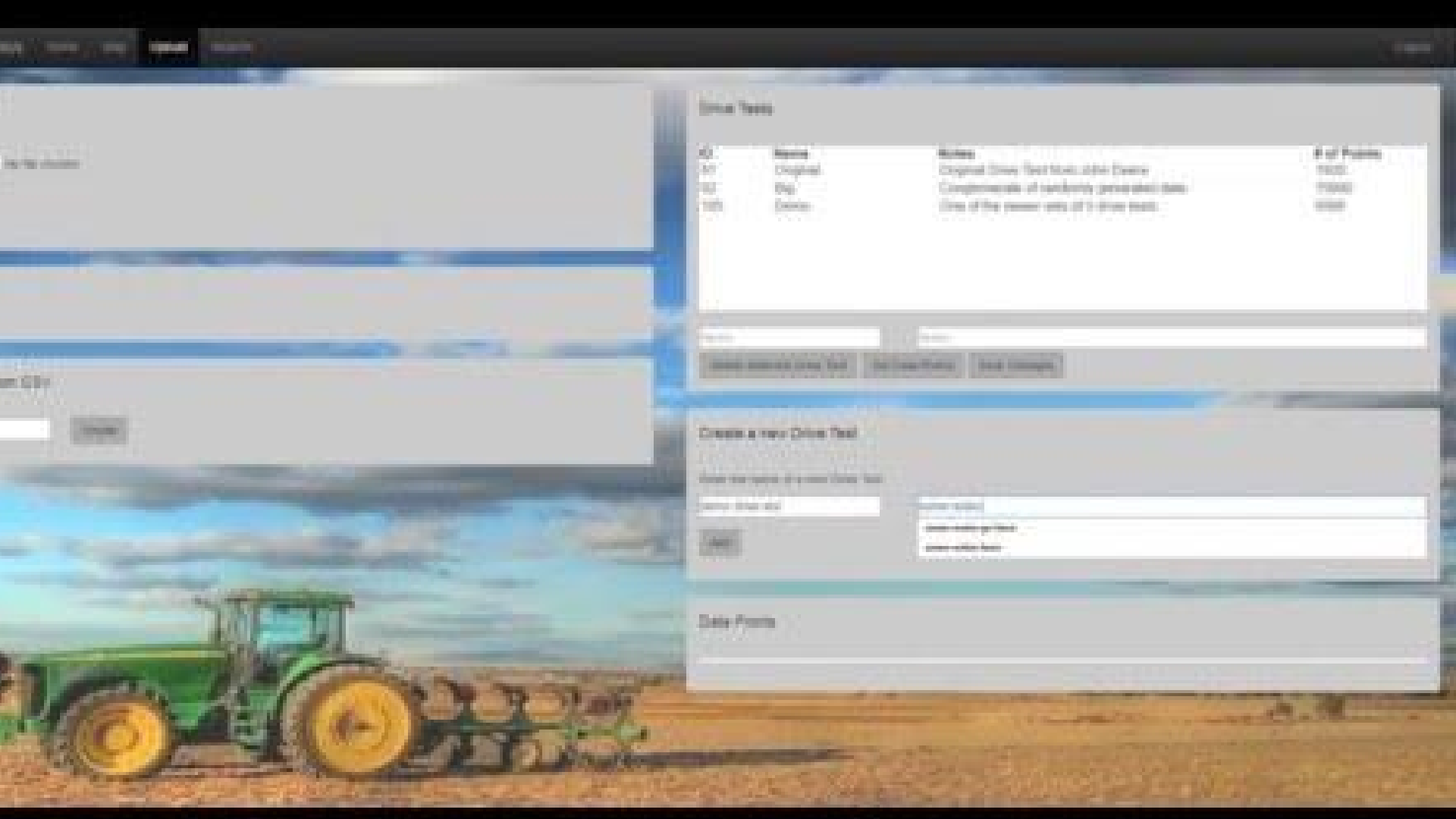
Drive Tests

ID	Name	Notes	# of Points
97	Original	Original Drive Test from John Deere	7500
12	Big	Conglomerate of randomly generated data	75000
105	Demo	One of the newer sets of 3 drive tests	5000

Create a new Drive Test

Create a new Drive Test

Data Points

Map

- Add/Remove markers to map from drive test
- Change between:
  - Markers
  - Clustered Markers
  - Heat Map
- Change attribute determining the colors of each marker
- Change date range for markers
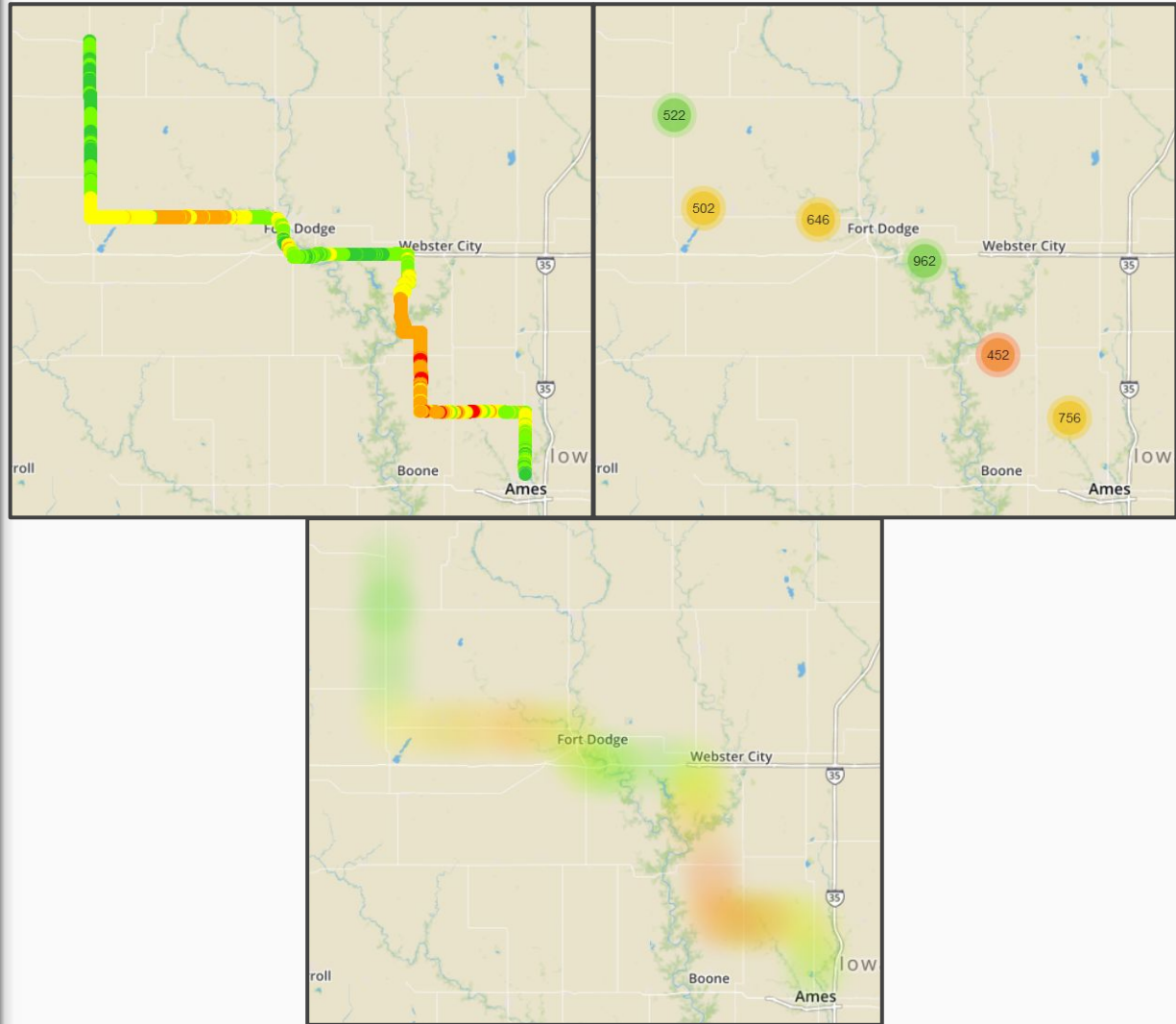
Map

- Add/Remove county heat map (load time = 8.62 seconds with 70,472 data points)
- Filter out markers based on county
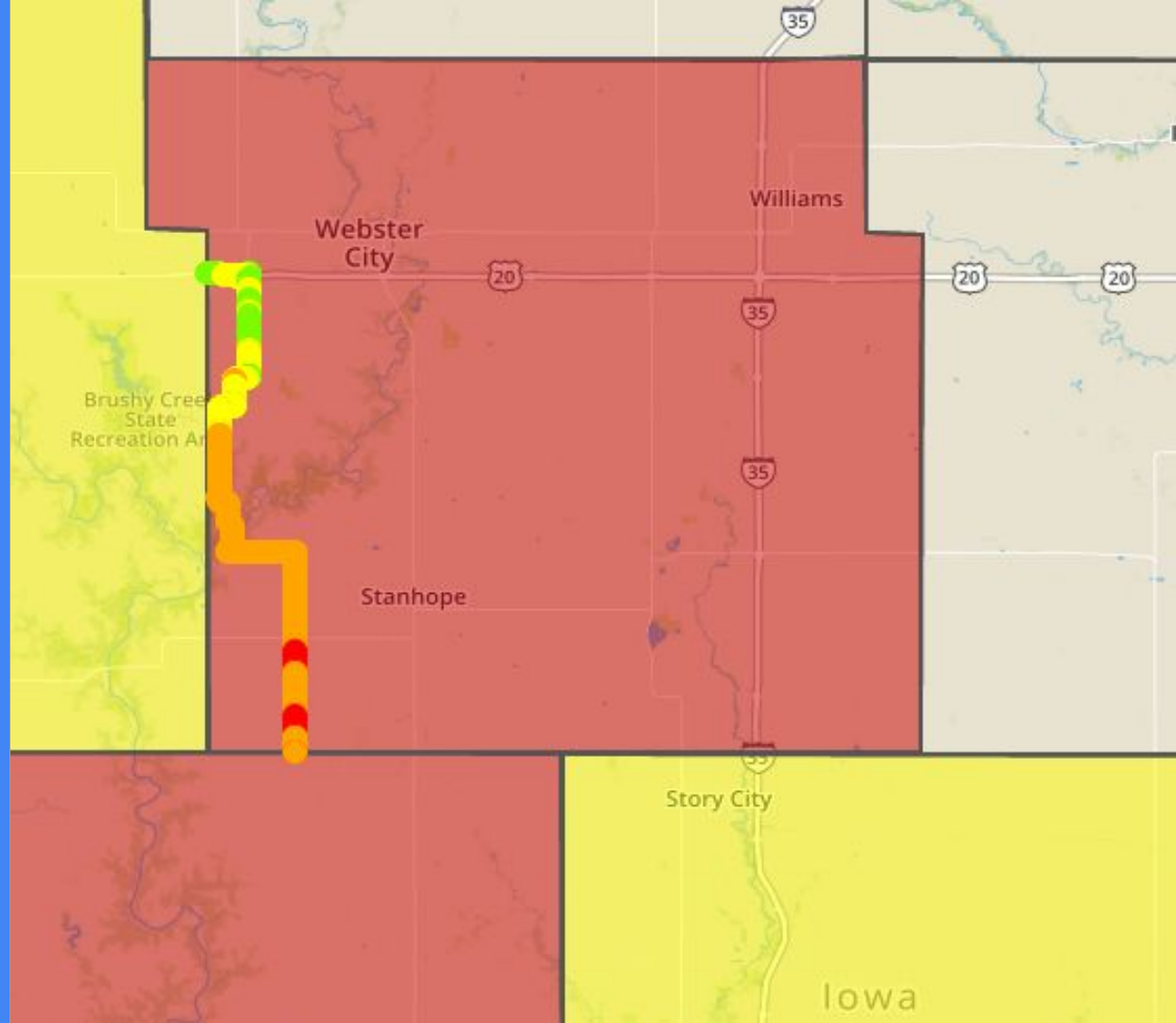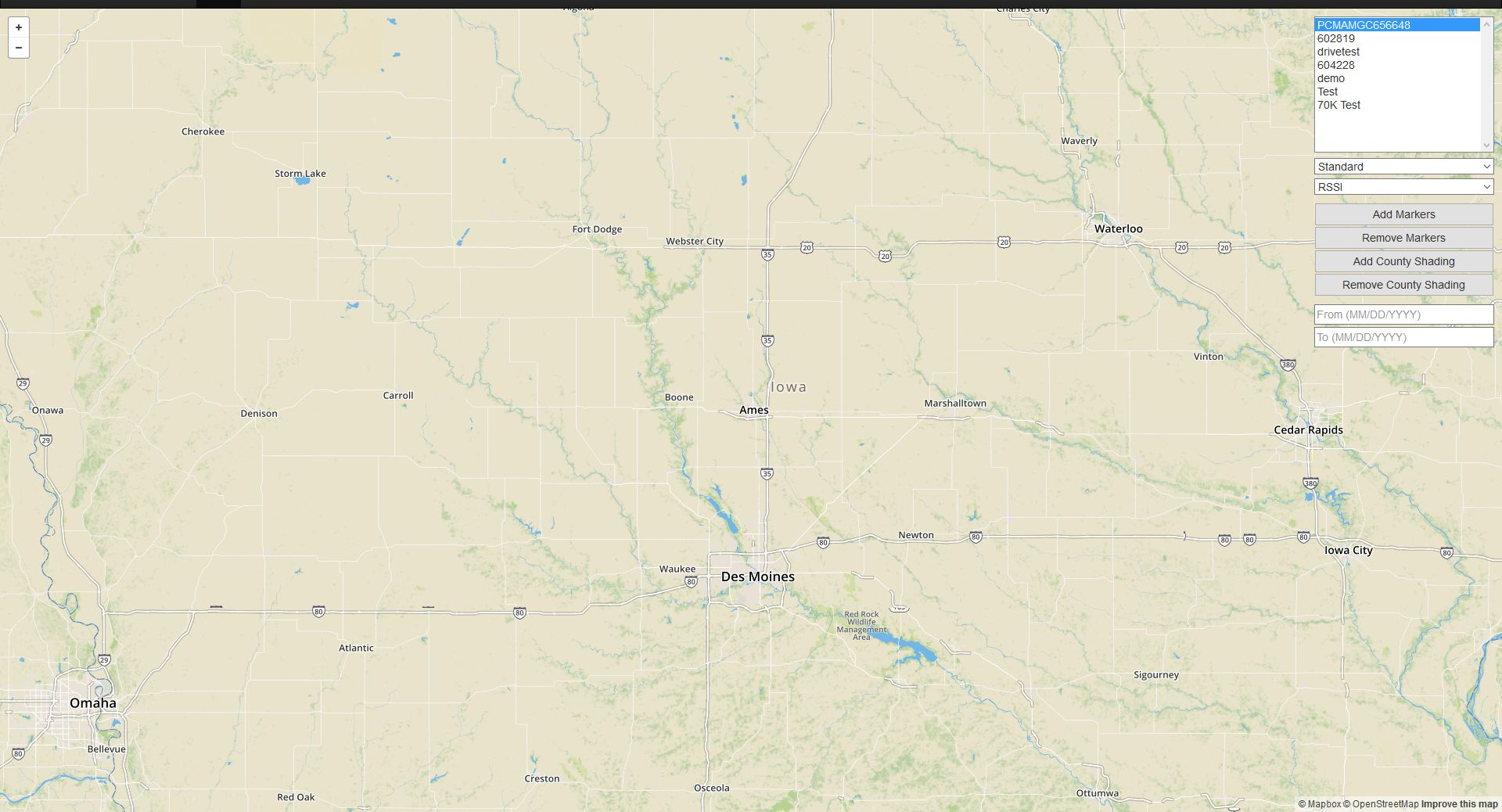
PCMAMGC656648
602819
drivetest
604228
demo
Test
70K Test

Standard
RSSI

Add Markers
Remove Markers
Add County Shading
Remove County Shading

From (MM/DD/YYYY)
To (MM/DD/YYYY)

Exporting map to image

- One of the harder challenges in this project because leaflet-image does not work well with custom markers & plugins

Reporting Tool

- SVG-based graphs & charts
- Used to search for relations between different metrics
- View an area or metric over time
- Save screenshots of interesting data

Moving Forward

- Final Documentation
- Handoff & Integration
- Completed!

Conclusion

- Project goal
- Design & Project Plan
- Technical Choices
- Progress
- Future Plans

Questions?

Why is the project lightweight?

For 70,472 data points:

- Cluster markers load time is 42.87 seconds.

- Heatmap markers load time is 3.0 seconds.

- Uploading the data points into database takes 6-12 seconds.

Mapbox Interface:

Mapbox uses vector tiles, which are image tiles for web maps. The vector tiles contain vector data for each part of a layer. Allowing to cache, and scale the map rapidly.

Upload Files

Browse... No files selected.

Upload

Status

Retrieve Successful

Create Random CSV

Seed Create

Drive Tests

DriveTest

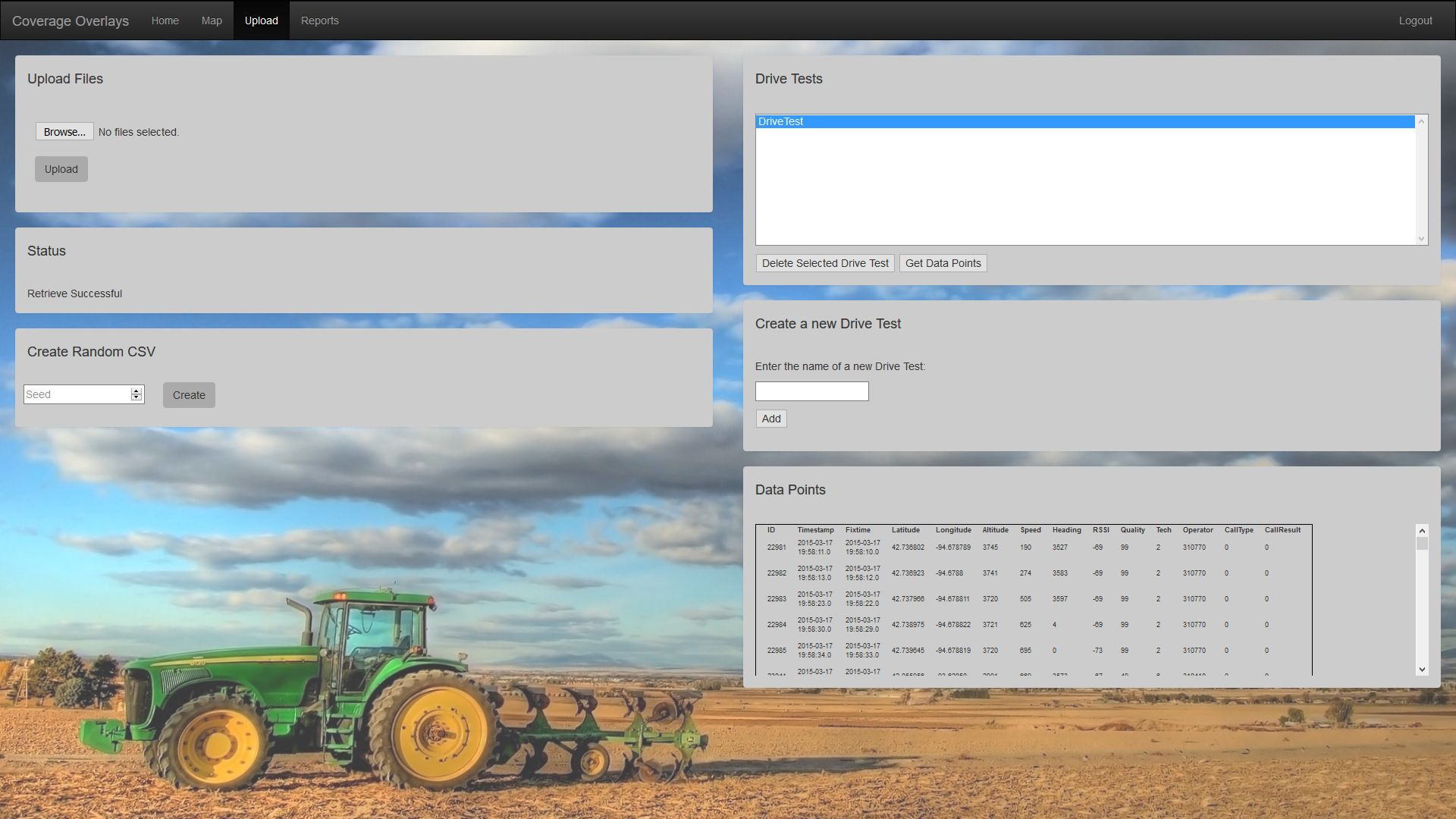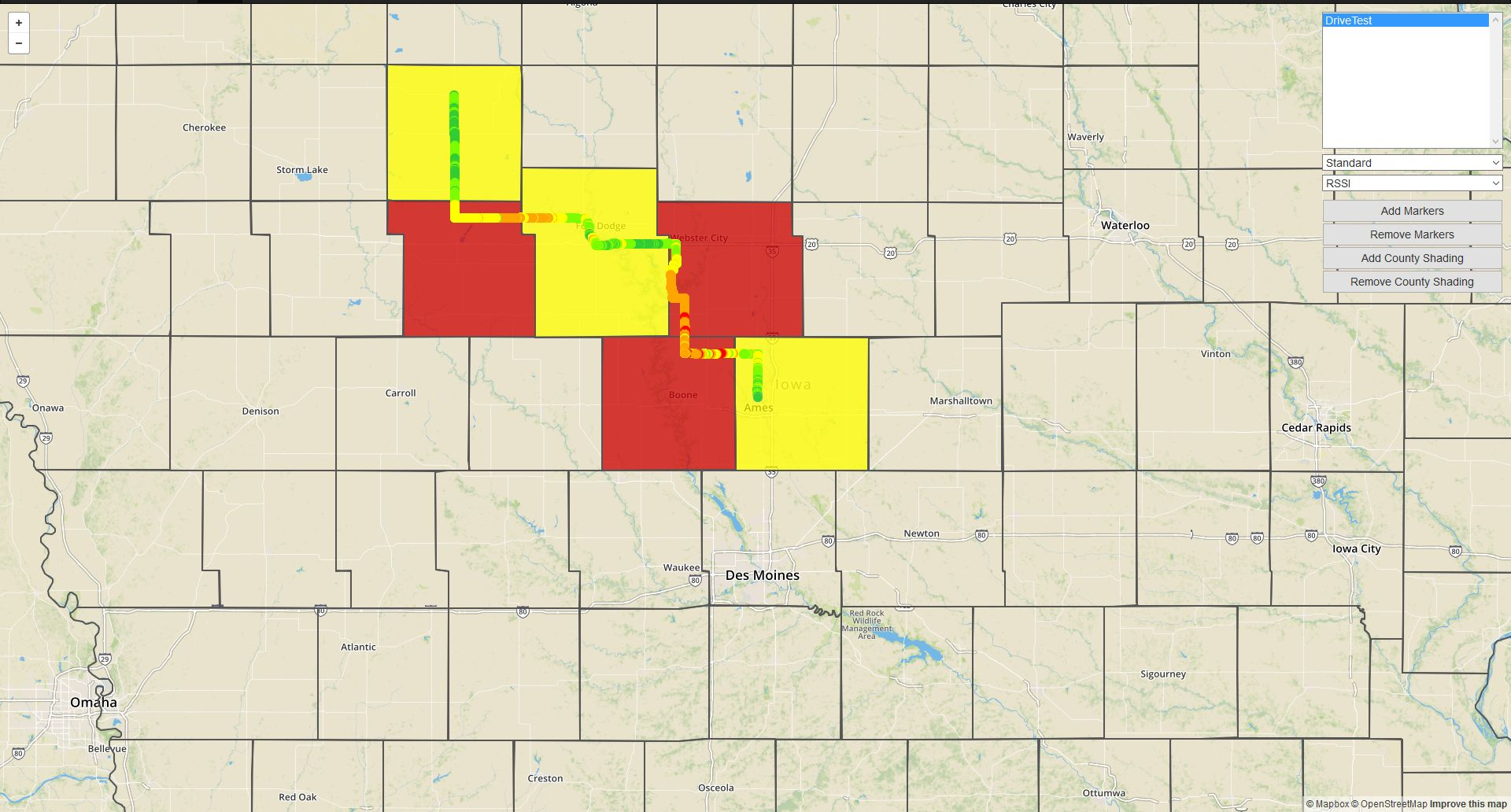Delete Selected Drive Test Get Data Points

Create a new Drive Test

Enter the name of a new Drive Test:

Add

Data Points

ID	Timestamp	Fixtime	Latitude	Longitude	Altitude	Speed	Heading	RSSI	Quality	Tech	Operator	CallType	CallResult
22981	2015-03-17 19:58:11.0	2015-03-17 19:58:10.0	42.736802	-94.678789	3745	190	3527	-69	99	2	310770	0	0
22982	2015-03-17 19:58:13.0	2015-03-17 19:58:12.0	42.736923	-94.6788	3741	274	3583	-69	99	2	310770	0	0
22983	2015-03-17 19:58:23.0	2015-03-17 19:58:22.0	42.737966	-94.678811	3720	505	3597	-69	99	2	310770	0	0
22984	2015-03-17 19:58:30.0	2015-03-17 19:58:29.0	42.738975	-94.678822	3721	625	4	-69	99	2	310770	0	0
22985	2015-03-17 19:58:34.0	2015-03-17 19:58:33.0	42.739645	-94.678819	3720	695	0	-73	99	2	310770	0	0
22941	2015-03-17	2015-03-17	42.055658	-93.82068	3904	680	3573	-87	49	8	310410		