

Can A.I. Take Over Winter Road Condition Reporting?

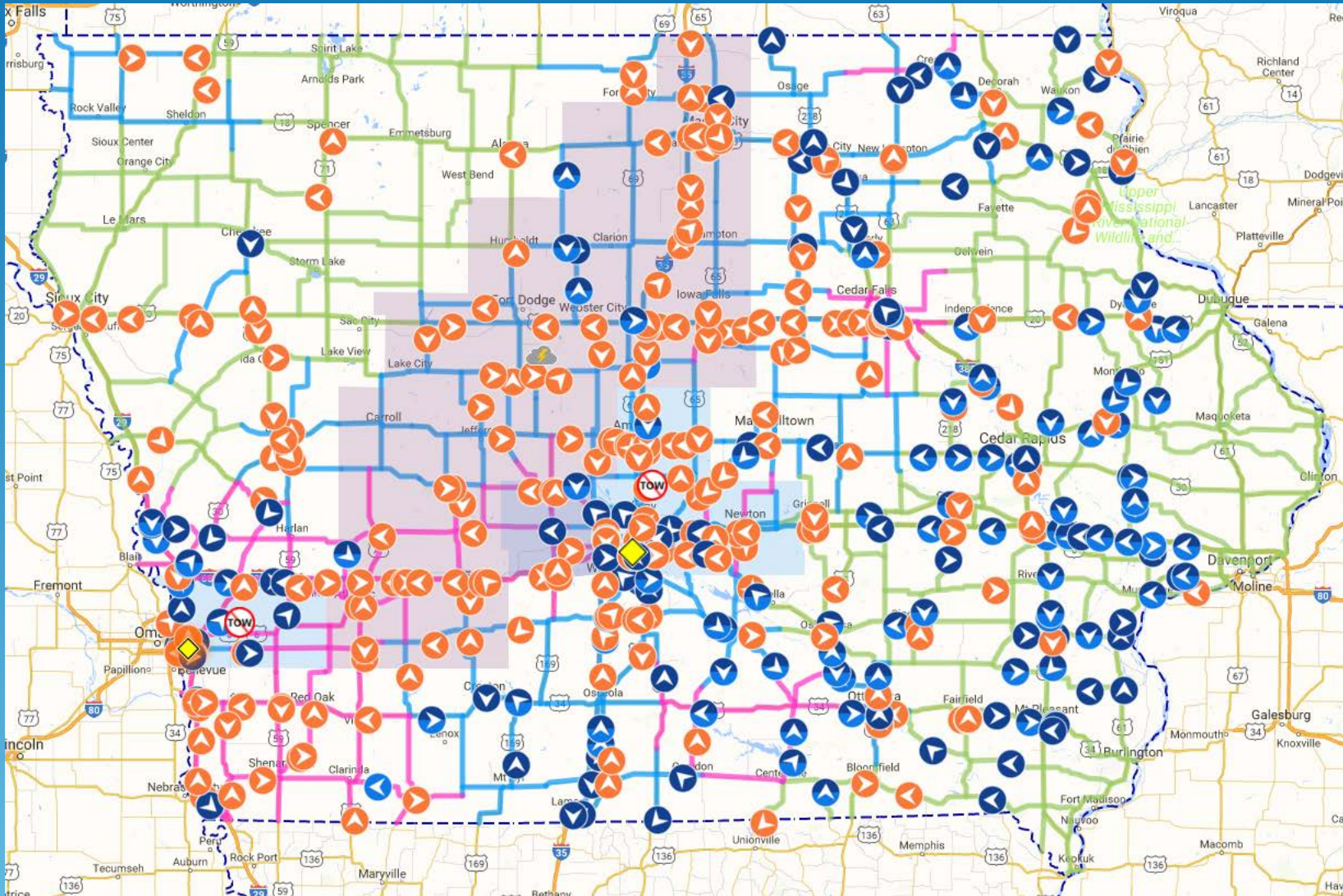
2018 National Rural ITS Conference

October 24, 2018

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Iowa DOT, Traffic Management Systems Engineer

Why?



No. Really. Why?



Iowa DOT Maintenance


- 101 garages
- 900 snow plows
- 1,000 permanent drivers
- 462 seasonal part-time drivers
- 9,480 centerline miles
- 24,200 total lane miles
- Report winter road conditions as conditions change

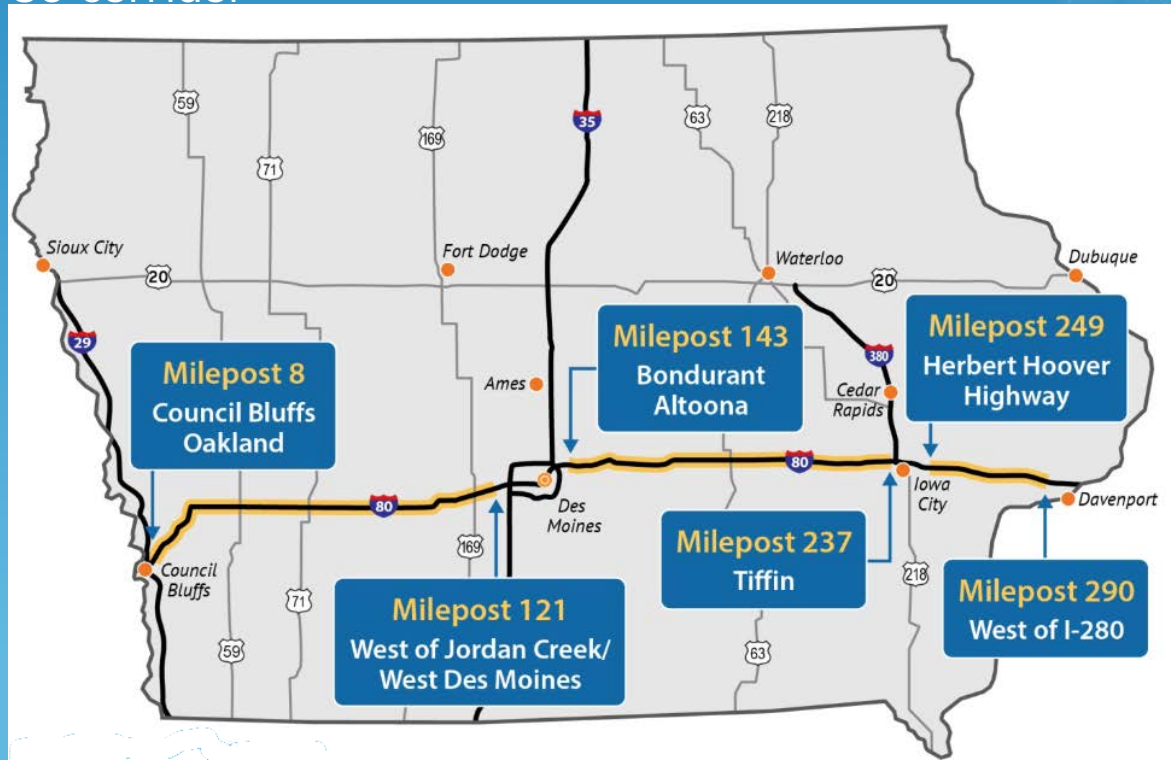


Can it be done?

We're gonna try!

Project Overview

- Research project with 
- Started in February 2018
- Develop an approach for modeling winter road conditions
 - Build analytic foundation to spatially predict conditions
 - Leverage historical data (2016-17 and 2017-18)
 - Concentrate on I-80 corridor



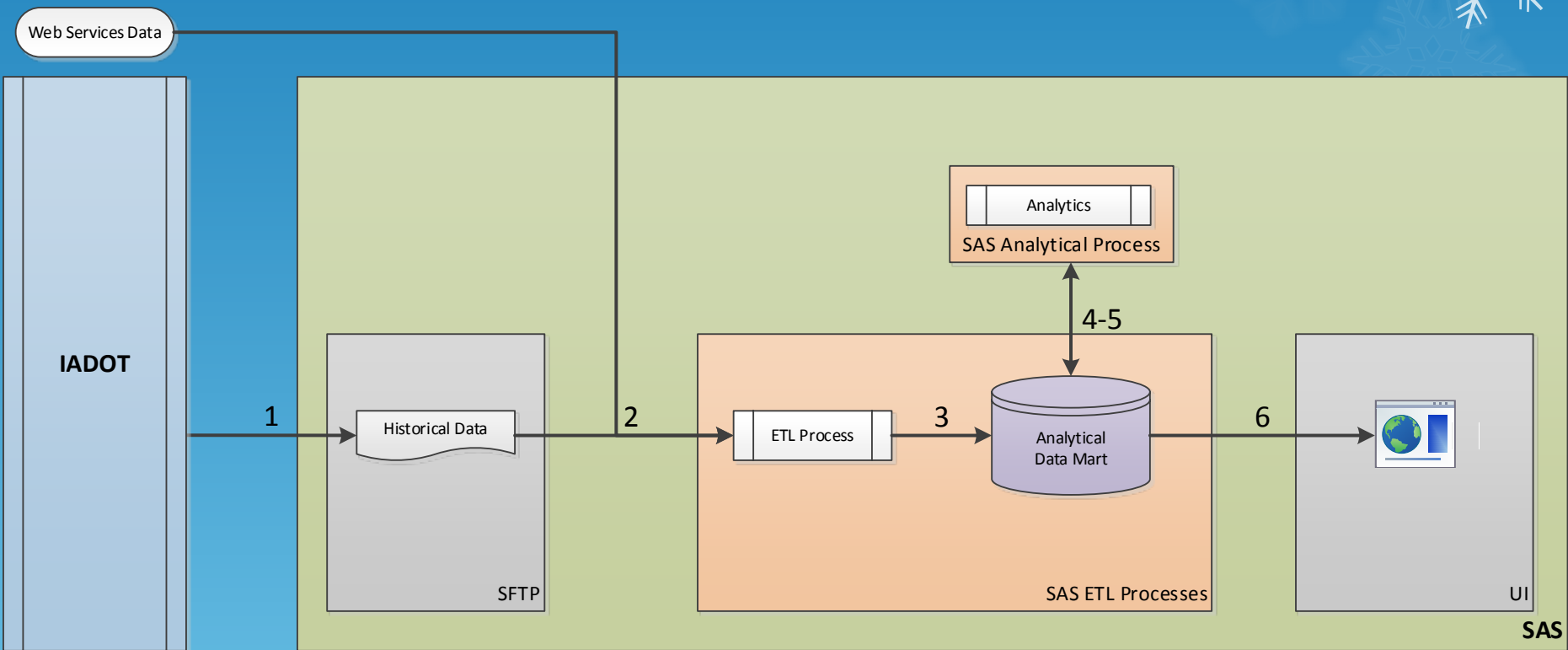
Project Overview

- Produce a user interface (UI) for consuming model results that the field maintenance staff can verify or reject the model predictions.
 - Results updated at 15 minute intervals

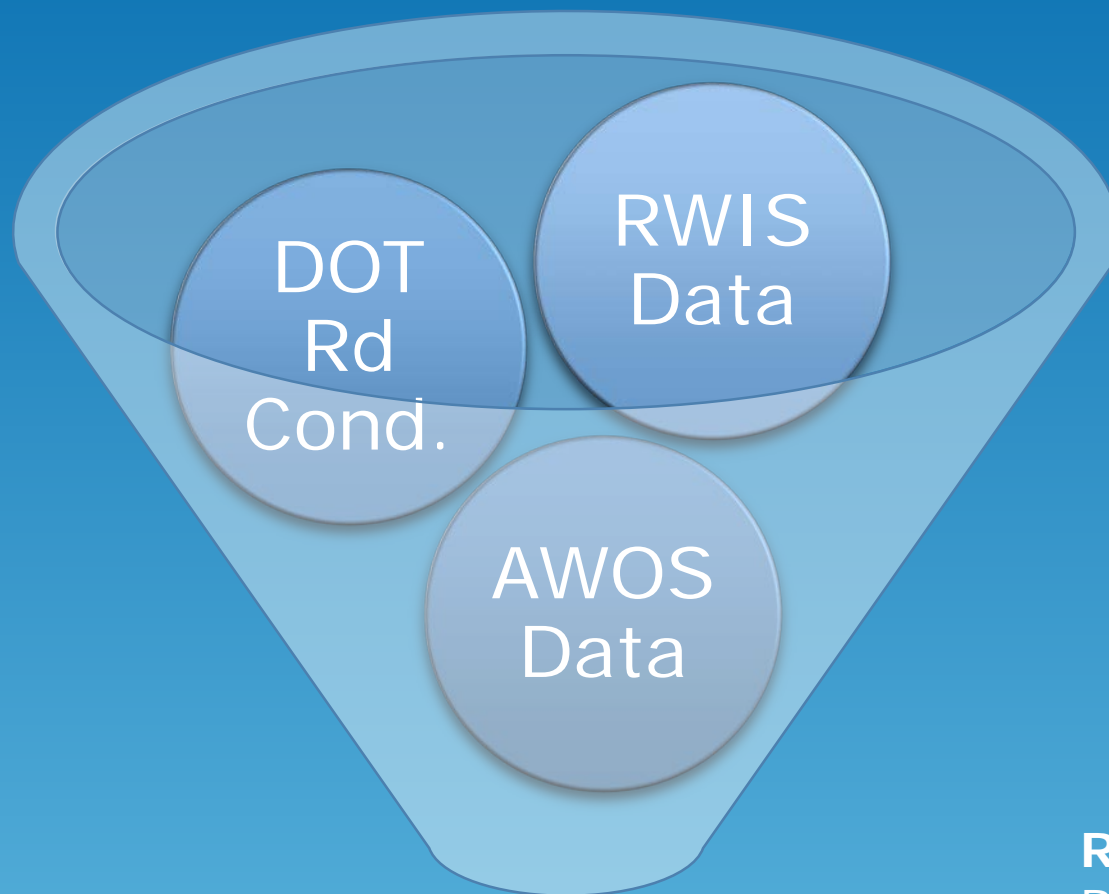


Model Review - Data

- Ingest historical data sources
- Develop data model and analytic data mart



Data Sources



Modeled Road
Conditions



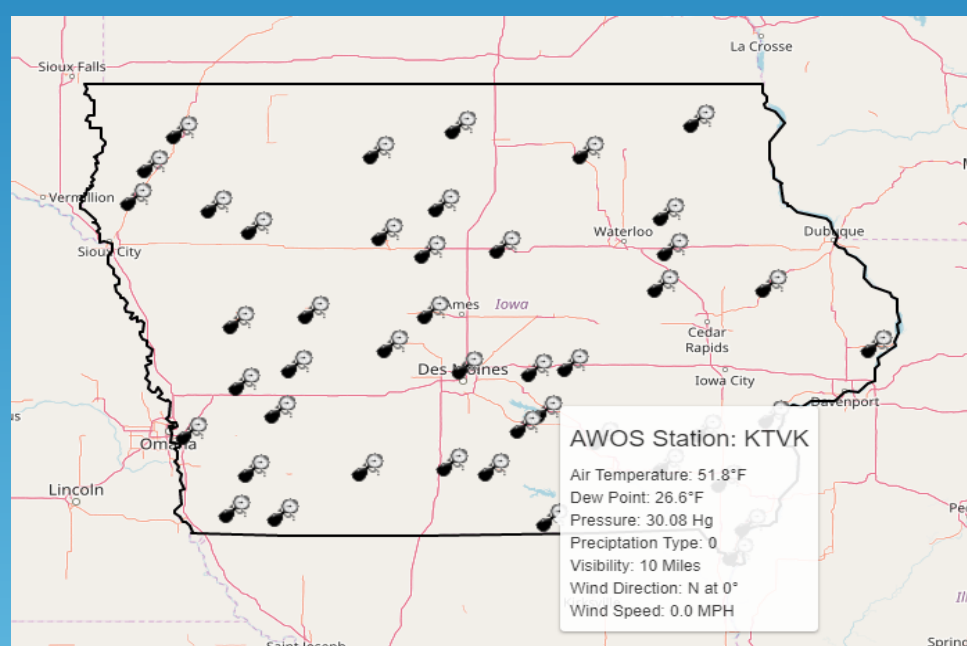
RWIS Data Attributes:

- Barometric pressure
- Dew point
- Humidity
- Precipitation rates
- Surface temperature
- Wind direction

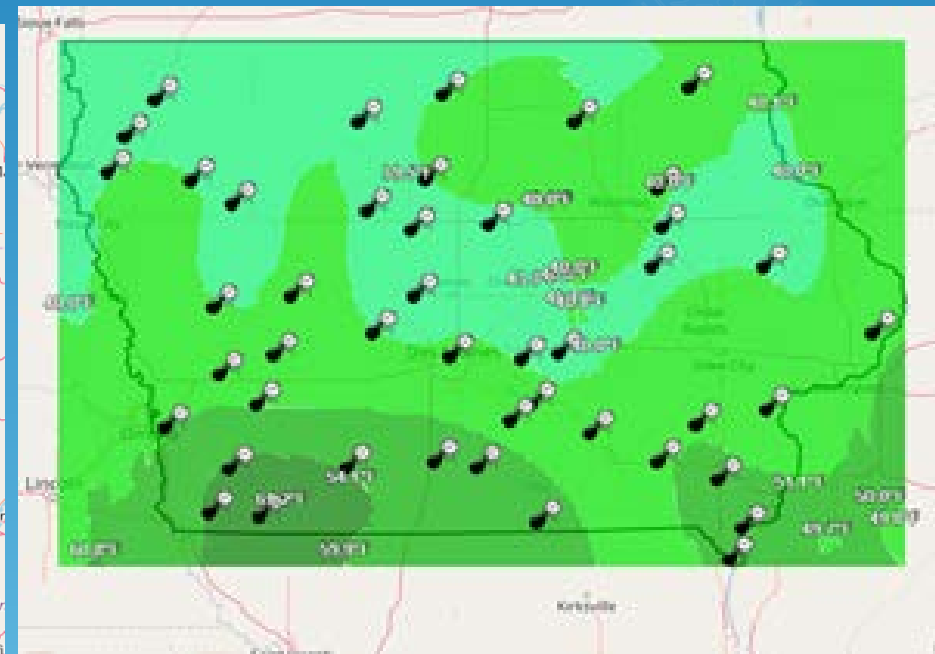
Model Review - Spatial Analysis



Expand RWIS & AWOS sensor station data to cover I-80 corridor and beyond through variogram analysis and kriging technique. (standard spatial analysis techniques)



Before



After

Developing the Model



Model Building Methodologies Assessed

- Decision Tree
- Regression
- Neural Networks

The champion model was the decision tree, based on the number of correctly predicted road conditions and that there are simpler and less variables without sacrificing accuracy.

Preliminary Results

- Out of ~242,000 road condition observations:
 - ~237,000 were correctly classified
 - 97.8% Model Accuracy

Actual Road Conditions	Modeled Road Conditions				Accuracy
	Completely Covered	Partially Covered	Seasonal	Total	
Completely Covered	6,829	354	498	7,681	89.9%
Partially Covered	420	32,007	2,066	34,493	92.8%
Seasonal	235	1,685	197,789	199,709	99%
Total	7,484	34,046	200,353	241,883	97.8%

Winter Storm #14

February 9-10, 2018



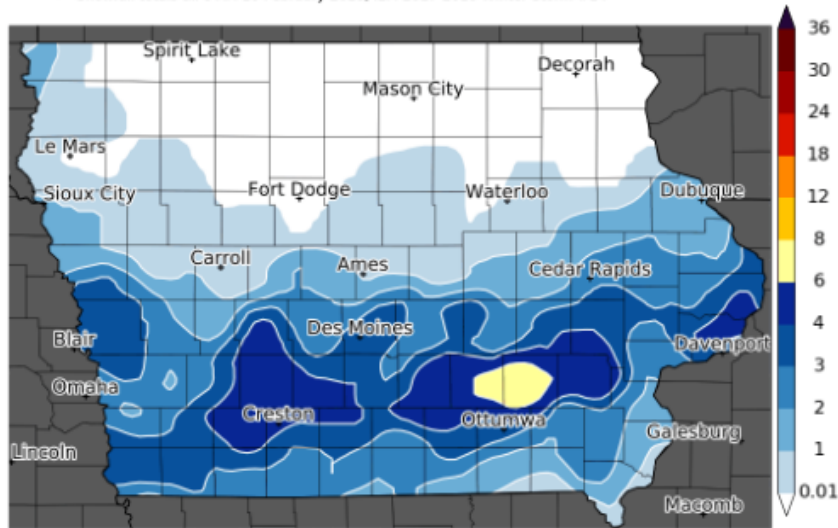
<http://mesonet.agron.iastate.edu/onsite/features/cat.php?day=2018-02-10>

88.5% (3,821) road segment observations from 511 Road Conditions accurately predicted

'17-'18 Winter Storm #14

Posted: 10 Feb 2018 07:31 PM

 9 (Eve)-10 Feb 2018 - IEM Snowfall Total Analysis
Snowfall totals till 8 AM 10 February 2018, IEM 2017-2018 Winter Storm #14



Iowa Environmental Mesonet :: generated 10 February 2018 07:27 PM

data units :: inch

The snow producing winter storms are coming fast and furious with the most recent storm dumping its heaviest totals over southern Iowa. The featured map displays the combination of NWS COOP, Local Storm Reports, and CoCoRaHS reports for the event. Areas north of Ottumwa reported the heaviest totals over six inches. The next round of snowfall is already here this Saturday evening with the heaviest totals expected over southern Iowa again.

Voting:

Good = 5

Bad = 0

Tags: **winter1718**

Controlling for STORM=2/8/2018 <= date < 2/11/2018

TARGET_Road_condition(ROAD_COND)	MODELED_Road_condition				
Frequency	Completely Covered	Partially Covered	Seasonal	Total	Accuracy
Completely Covered	350	20	104	474	73.8%
Partially Covered	40	660	226	926	71.3%
Seasonal	37	68	2811	2916	96.4%
Total	427	748	3141	4316	88.5%

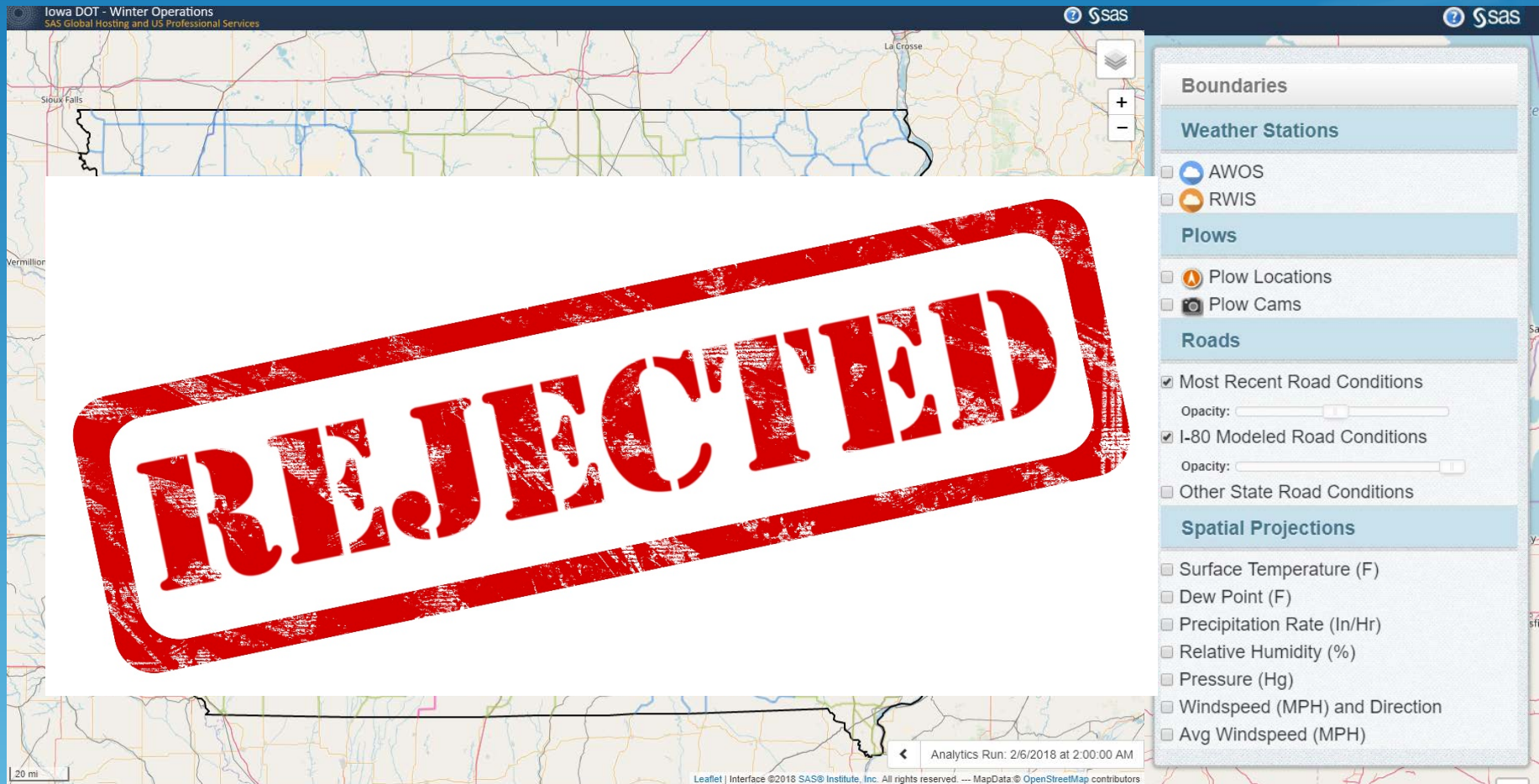
Model Trained, Now What?

Produce a user interface (UI) for consuming model results

- Results updated at 15 minute intervals from historical data.
- Research & Testing Team for UI
 - 9 Maintenance field staff from around the state
 - 5 Central Office project team members
 - 2 Staff from Iowa State/CTRE
- User Acceptance Testing Started 9/27/18

User Interface

Map – Overview





HOUSTON

WE HAVE A PROBLEM....

User Acceptance Testing



- Almost immediately, it was apparent something wasn't right with the data.
 - Screenshots of winter storms I had weren't matching up with what was showing in the UI.
 - Snow plow images for a 10am view in the UI were showing a nighttime view image.
- After digging deeper, we found that Iowa DOT had given SAS some bad data related to time stamps.

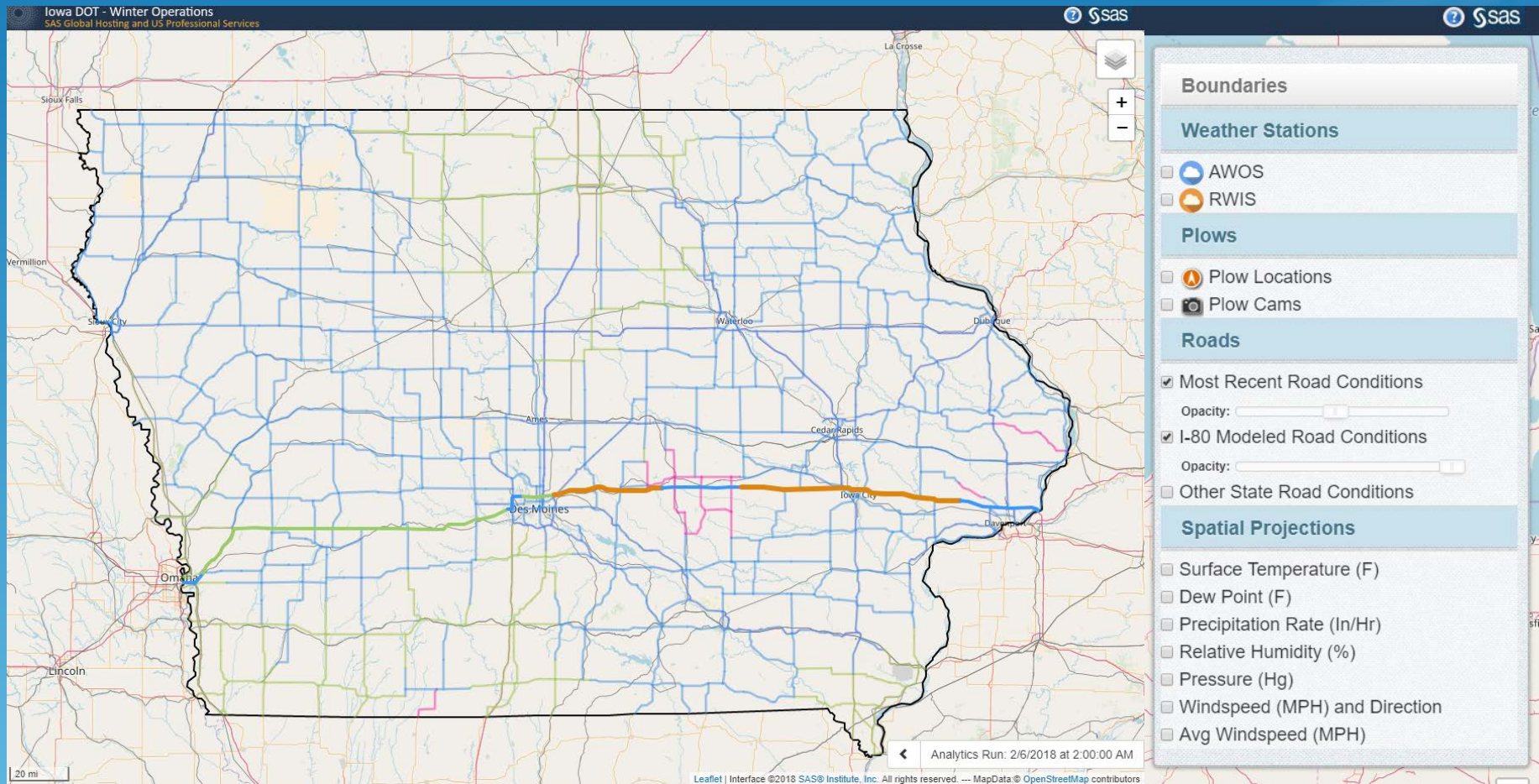
Data Governance

SO IMPORTANT!!!

- Up until this point, we had never really used winter road condition data fused with other data sources.
- Found it needed to be cleansed and the event time stamps needed to be standardized.
- Iowa DOT has a lot of data
- We believe we have everything corrected and SAS has started re-running the model.
- Hoping to restart UAT on 10/29/18.

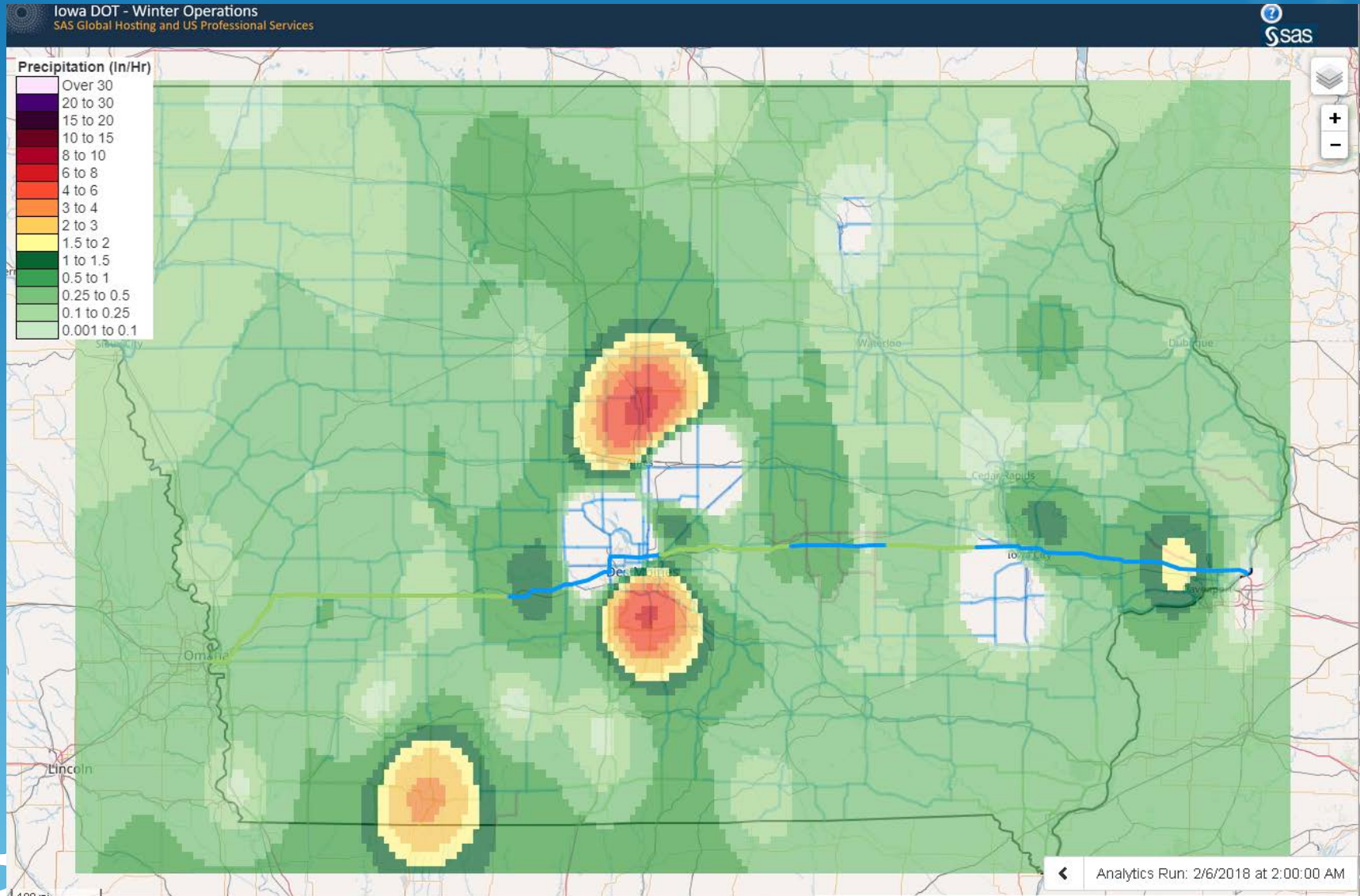
User Interface

Map – Overview



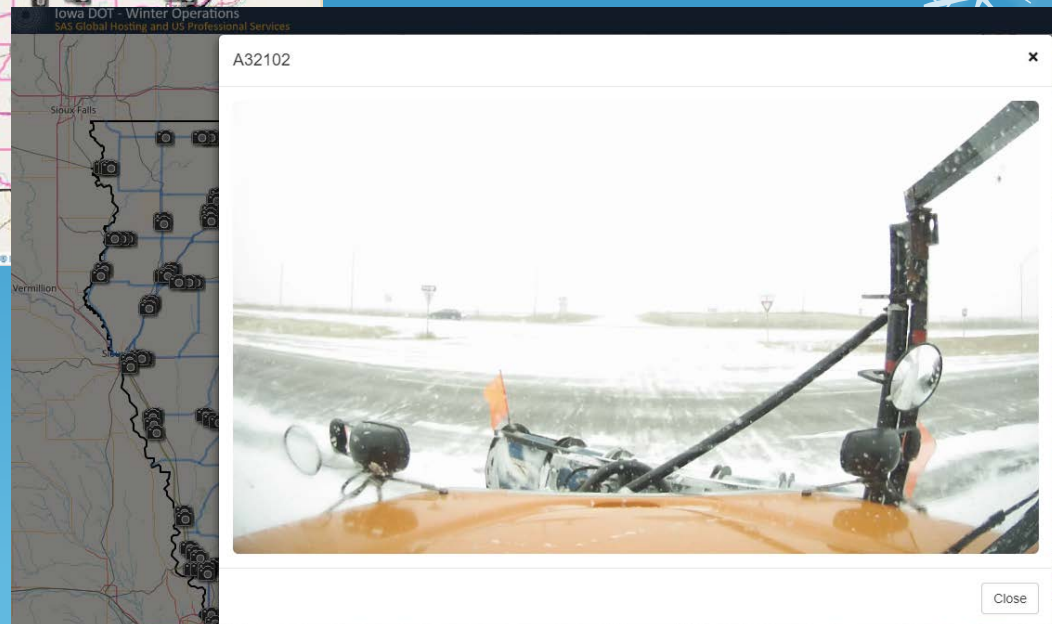
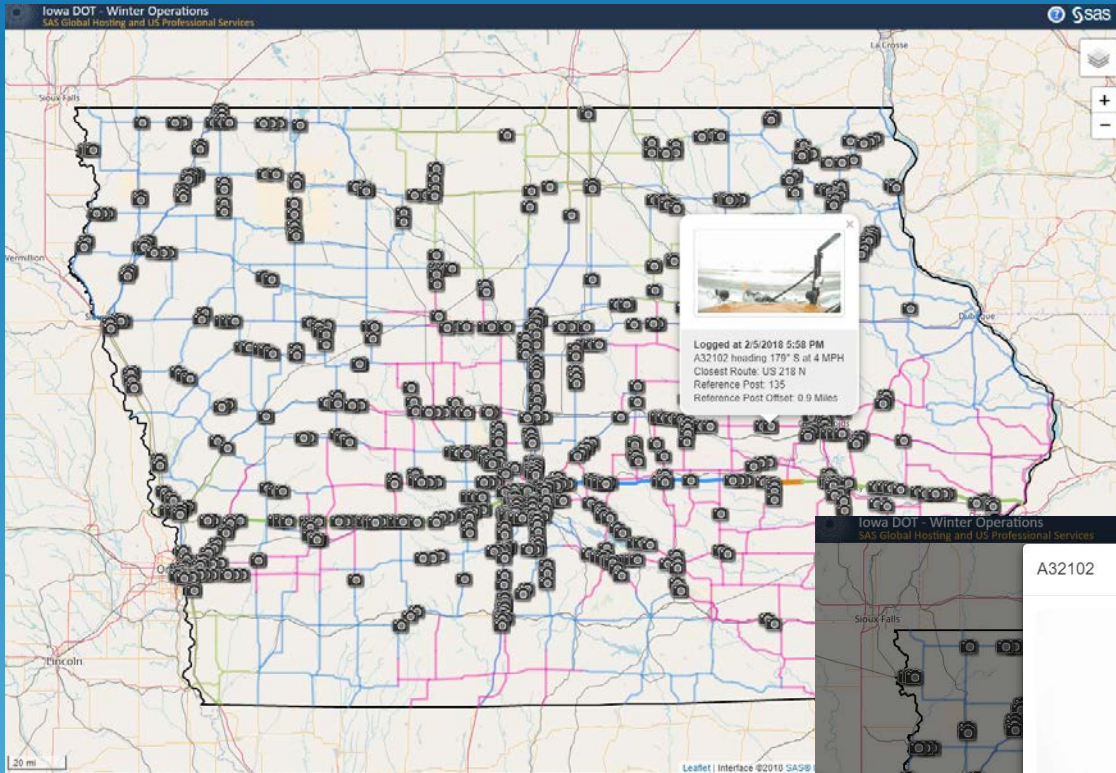
User Interface

Map – Precipitation Layer



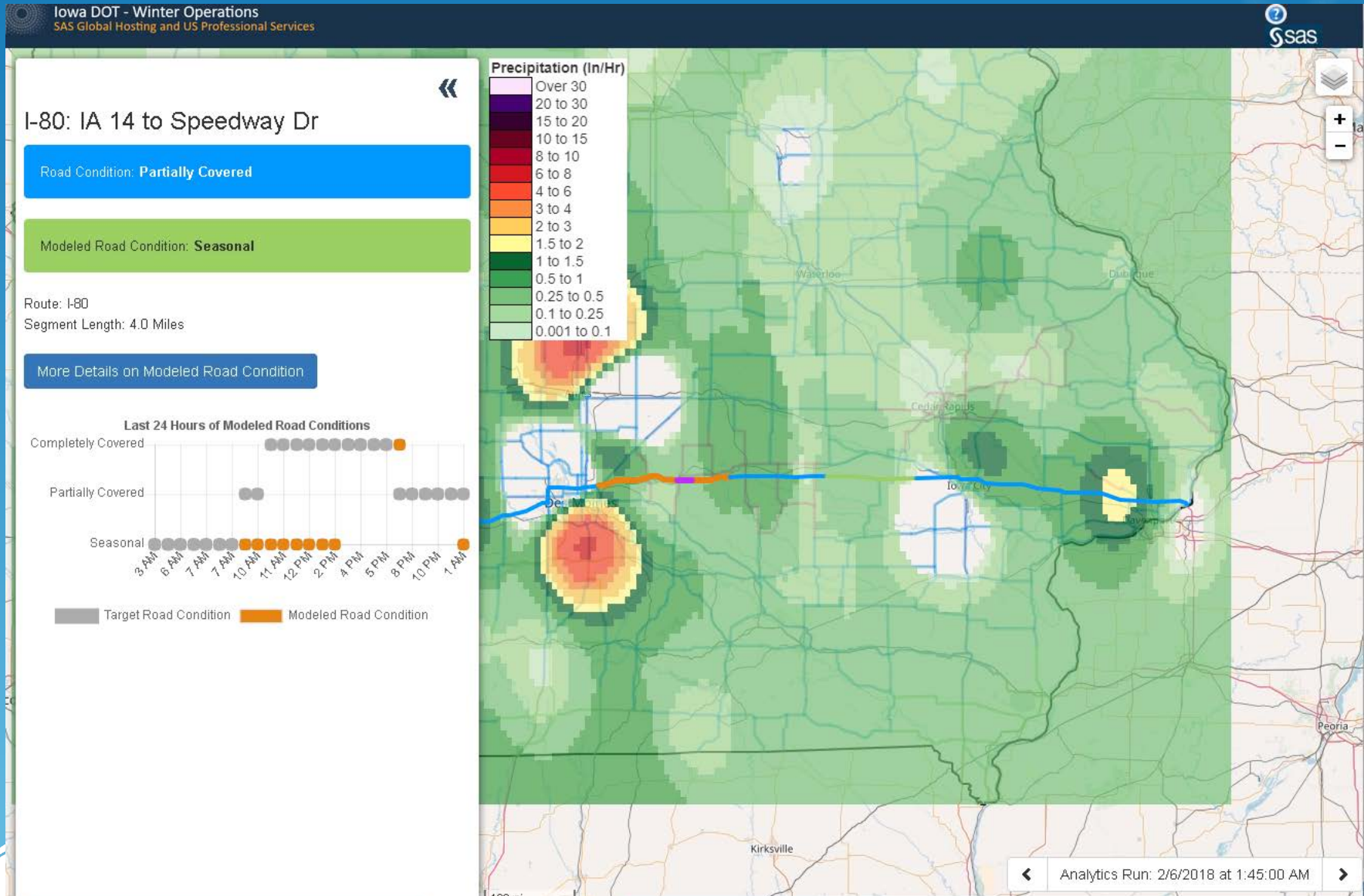
User Interface

Snow Plow Cam



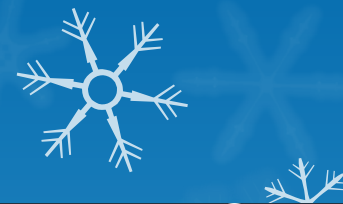
User Interface

Modeled Road Segment



User Interface

Detailed Road Segment



Iowa DOT - Winter Operations
SAS Global Hosting and US Professional Services



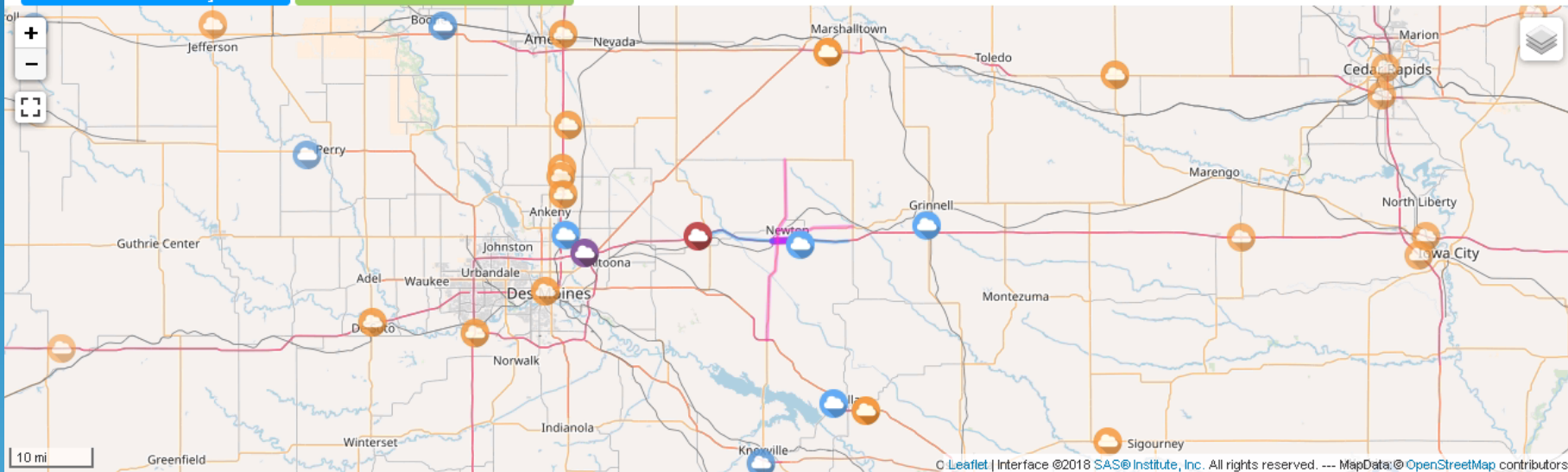
[Back to Map](#)

I-80: IA 14 to Speedway Dr

Analytical Run Date: 2/6/2018 at 1:45:00 AM

Road Condition: Partially Covered

Modeled Road Condition: Seasonal



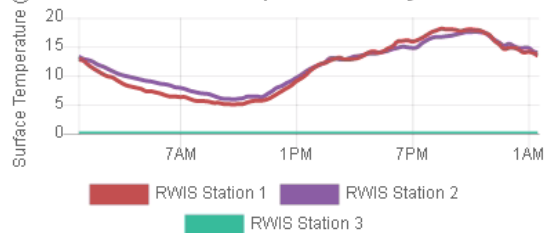
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Nearby RWIS Stations for Road Segment Reports

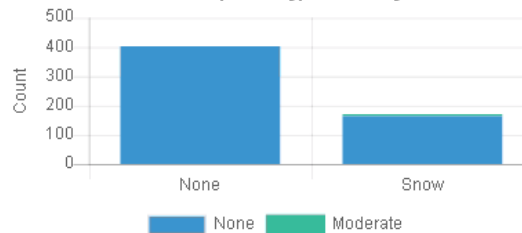
Weather Station Reports ▾

All Reports

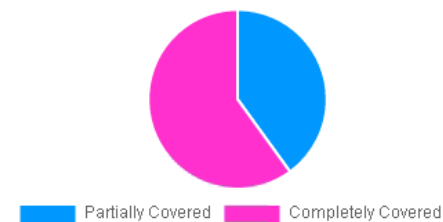
Last 24 Hours of Surface Temperature for Nearby RWIS Stations



Last 24 Hours of Precipitation Type for Nearby RWIS Stations



Neighboring Road Segment Road Conditions



Last 24 Hours of Modeled Road Conditions



Next Steps

- Review the historical winter storms
- Review the Mis-Matches
 - Reported Condition vs Modeled Condition
- Determine Correct Condition
 - Reported vs Model vs Either
- Fix any User Interface bugs and ease of use
- Process Live Data Starting October 15th
(already started)

So, can it?

Can A.I. Take Over Winter
Road Condition Reporting?

Jury is still out. 😊

Questions?

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