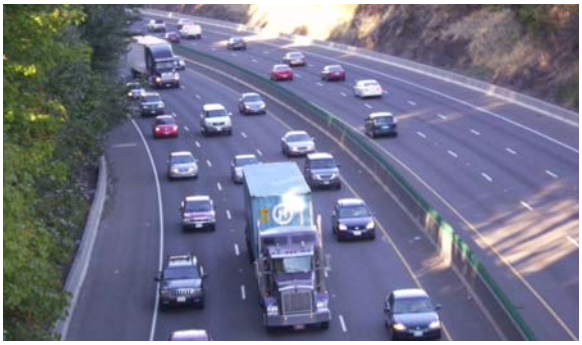
# Techniques for Mining and Complementing Truck Traffic Data to Analyze the Impacts of Congestion




| | |
|---|---|
| Nikki Wheeler | Graduate Research Assistant, PSU |
| Shreemoyee Sarkar | Graduate Research Assistant, PSU |
| Dr. Miguel Figliozzi | Assistant Professor, PSU |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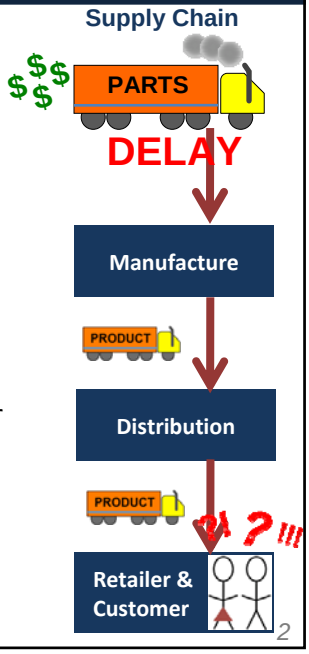
# Introduction

- **Projected Growth will Increase Delay and Congestion**
- **Delay and Congestion Impact Freight Industry**
  - Timely deliveries
  - Increase in emission
  - Increase in cost
  - Difficulty scheduling
- **Freight Performance Measures (FPM) not widely used**
  - Early focus on passenger vehicles (Schofield and Harrison, 2007)
  - Current measures may not meet needs of all users (e.g., loop sensors)
  - Better understanding of Freight reliability = Better planning/engineering
- **OBJECTIVE: Develop tools for measuring impacts of congestion on freight vehicles**

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## Outline

- Background/Context of problem
- Description of Data Sources
- Methodology
- Case Study Results
  - Recurring Congestion
  - Non-Recurring Congestion
- Conclusions




## Background

**Performance Measures**
- Tools to evaluate current/future needs
- Travel time, speed, travel time reliability

(NCHRP, 2006)

**GPS Technologies**
- Travel Time Reliability & Bottlenecks

(ATRI, 2005), (ATRI, 2009), (Kamran and Hass, 2007)
(McCormack et al., 2010)

**Electronic Truck Transponders (Weigh-in-Motion)**
- Many freight vehicles needed

(McCormack and Hallenbeck, 2006)
- Rural areas in Oregon

(Monsere et al., in Progress at PSU)

**PSU direct access to Loop Sensor data from Oregon DOT**
- Recurring, Non-Recurring studies

(Monsere et al., 2006), (Bertini et al., 2005),
(Wieczorek et al., 2009)

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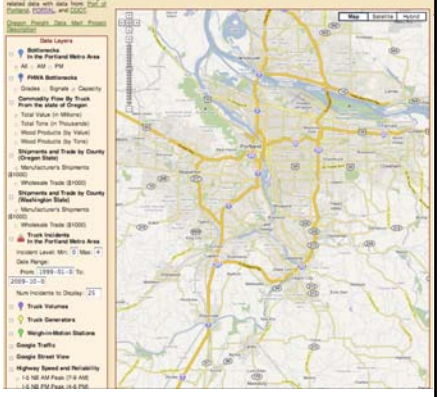
# Background cont.

## Unique Contributions of this Work

- **Combining Multiple Data Sources**
  - GPS data from commercial trucks
  - Loop sensor data (Oregon DOT)
  - Incident data (ODOT ATMS)
- **Create unbiased FPM**
  - Separating trucks experiencing congestion vs rest/refuel
  - Develop alternatives to current PM
- **Useful to Public Agencies**
- **Oregon Freight Data Mart**

  in Development at PSU (Figliozzi and Tufte, 2009)
  - Web-based platform
  - Available to commercial & private carries

Oregon Freight Data Mart

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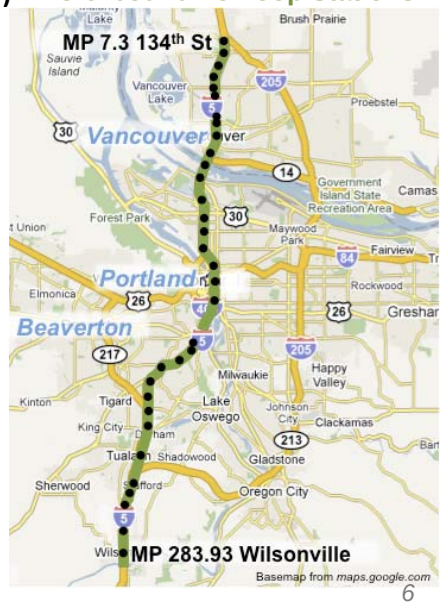
# Description of Data Sources Available

- **PORTAL (SEE: http://portal.its.pdx.edu )**
  - Loop Sensor Data from ODOT
- **Incident Data**
  - Type, Severity, Approximate location, Start/End time (duration)
- **GPS Truck Data**
  - TruckID number, Date, Time
  - Position (Latitude/Longitude)
- **Data Challenges**
  - No common gap time btw readings
  - Multiple trips on same day
  - Different truck types (travel behavior)

Northbound I-5 Loop Stations

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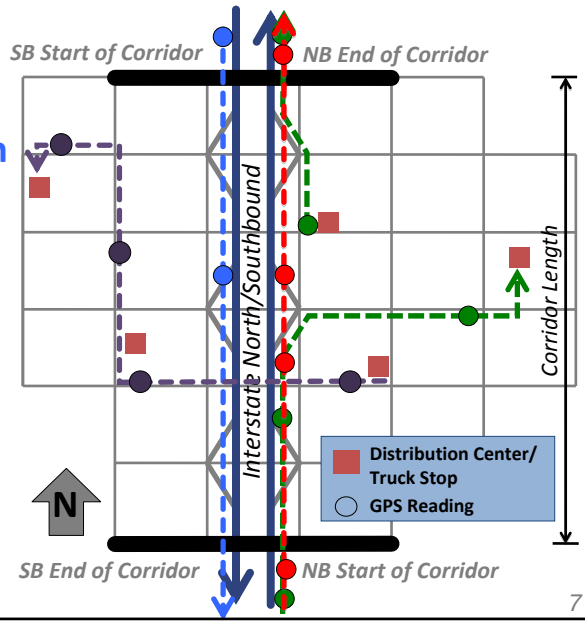
## Description of Data Sources Available cont.

- GPS Truck Types
  - **Through**
  - **Partial Through**
  - **Partial Local**
  - **Local**

- Develop Filter to ID **Through Trucks**
- Best Representation of Corridor Congestion
- Use Through Trucks to develop FPM

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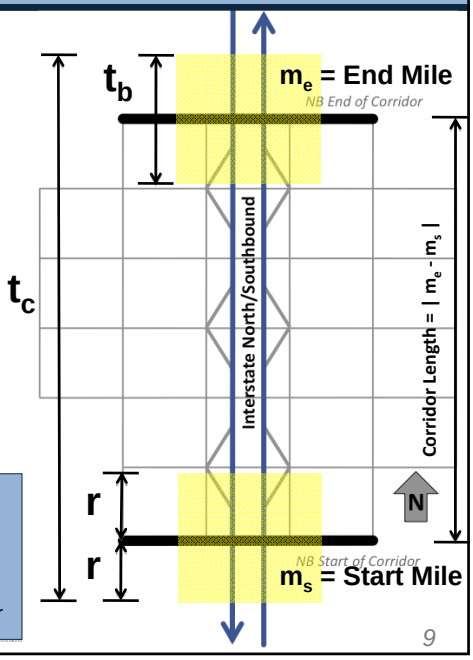
# Methodology

# Methodology

- **Purpose of Filter: To Identify Through Trucks for analysis**
- **Two Step Process:**
  - Filter Process 1: Matching GPS Readings to Identify Potential Through Trucks
  - Filter Process 2: Comparison to PORTAL Average Travel Times
  - Integrates available data sets and ensures no stops midway for rest/refuel

**Filter Parameters**

| | | |
|---|---|---|
| $m_s$ | = | Start Milepost |
| $m_e$ | = | End Milepost |
| r | = | Buffer radius |
| $t_b$ | = | Threshold to clear buffer |
| $t_c$ | = | Threshold to clear corridor and buffer |

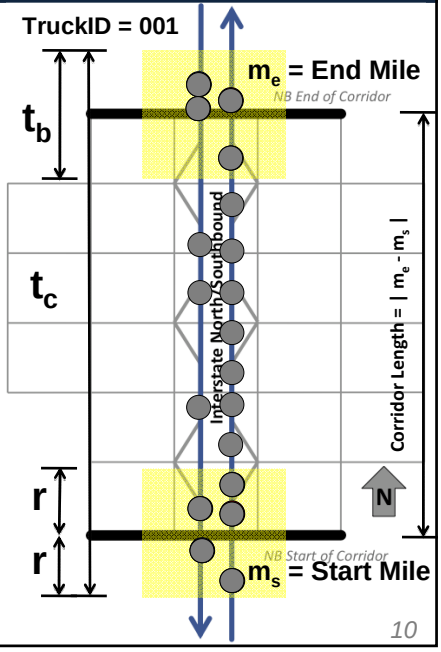





# Methodology cont.

**Filter Process 1:** Matching GPS Readings to Identify Potential Through Trucks

1. Obtain milepost measures using ArcGIS
2. Determine $m_s$ and $m_e$
3. Look at points falling in buffer ranges
4. Distinguish individual trips by each truck using time thresholds $t_c$ and $t_b$ and identify the "start" and "end" points of each trip
5. Match readings in "start" buffer to downstream reading in "end" buffer occurring within $t_c$

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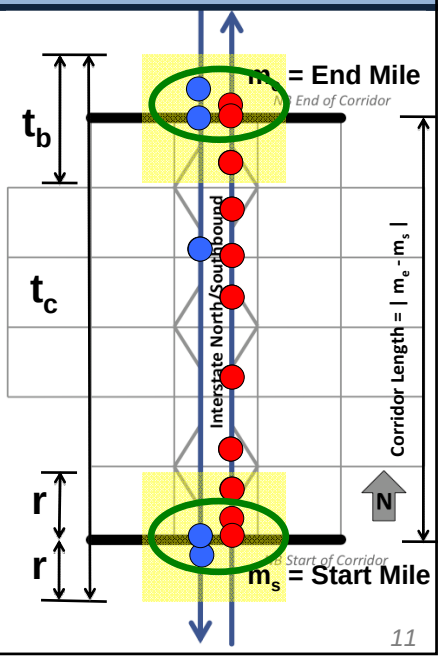
# Methodology cont.

**Filter Process 1:** Matching GPS Readings to Identify Potential Through Trucks

6. Find all intermediate readings for a truck ID falling between the trip "start" and "end" readings

7. Adjust the "start" and "end" reading timestamp and milepost to begin at $m_s$ and $m_e$ using speeds obtained from the next closest reading

8. Obtain the travel time and speed through the corridor, and identify trip direction using milepost data

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# Methodology cont.

**Filter Process 2:** Comparison to PORTAL Average Travel Times

1.Data sorted by the "start" reading timestamp into time bins of 15 minute intervals.

*2.Deviation Index* is calculated using the PORTAL:

For a 15 minute time bin $t$ ,
Then the Deviation Index $g_k$ is defined as

$$g_k = | a_t - T_k | / \sigma_t$$

Where:

$a_t$ = PORTAL average travel time at time bin $t$

$\sigma_t$ = PORTAL day-to-day standard deviation of travel time

$T_k$ = the corridor average travel time for truck trip $k$

3.Truck trip is too far from the expected average if:

$$g_k > m * \sigma_t$$

Where:

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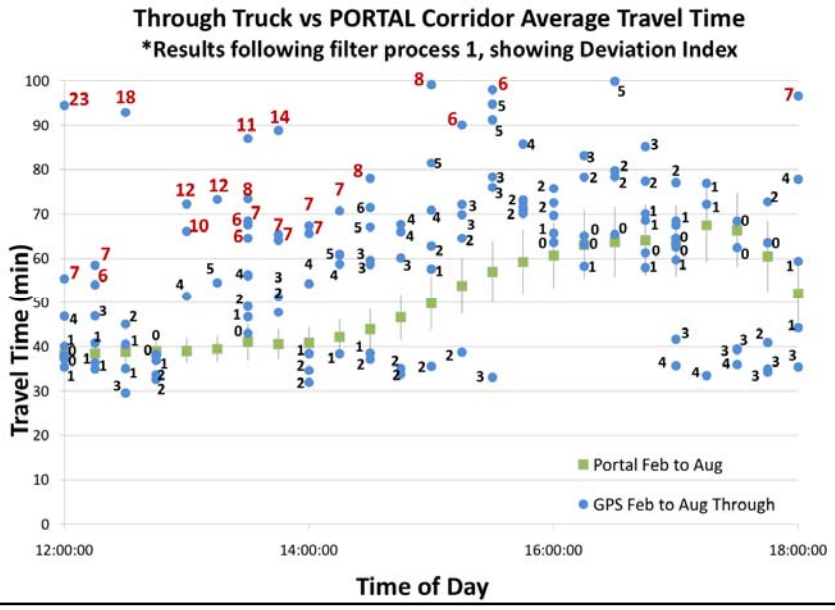
# Methodology cont.

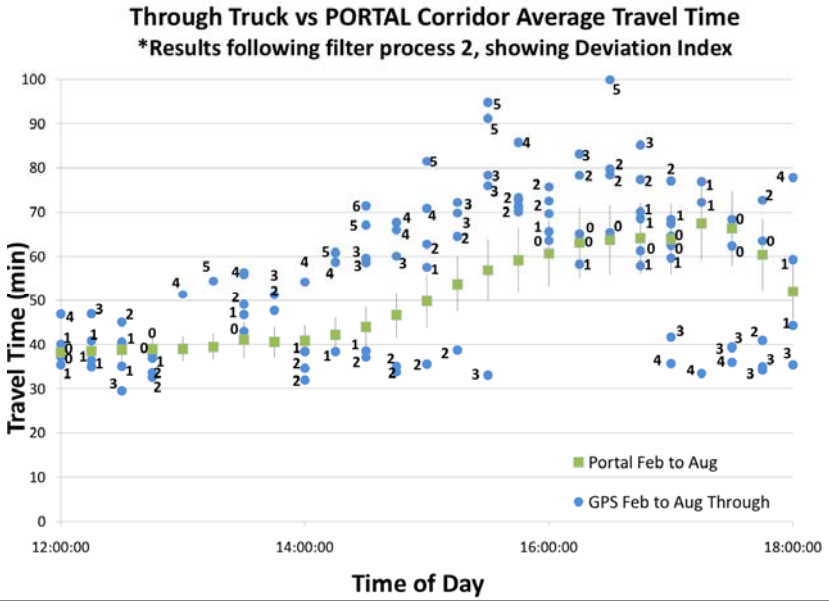
**Filter Process 2:** Comparison to PORTAL Average Travel Time






# Methodology cont.

**Filter Process 2:** Comparison to PORTAL Average Travel Time



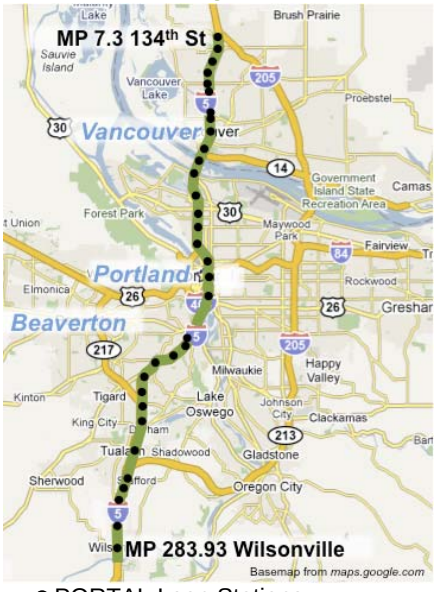
# Recurring Congestion Analysis

## Case Study: Recurring Congestion

**Recurring Congestion**

- I-5 NB
- Wilsonville, OR to Vancouver, WA
- 31.75 miles
- Feb-Aug, 2007 (weekdays)

Study Area




● PORTAL Loop Stations

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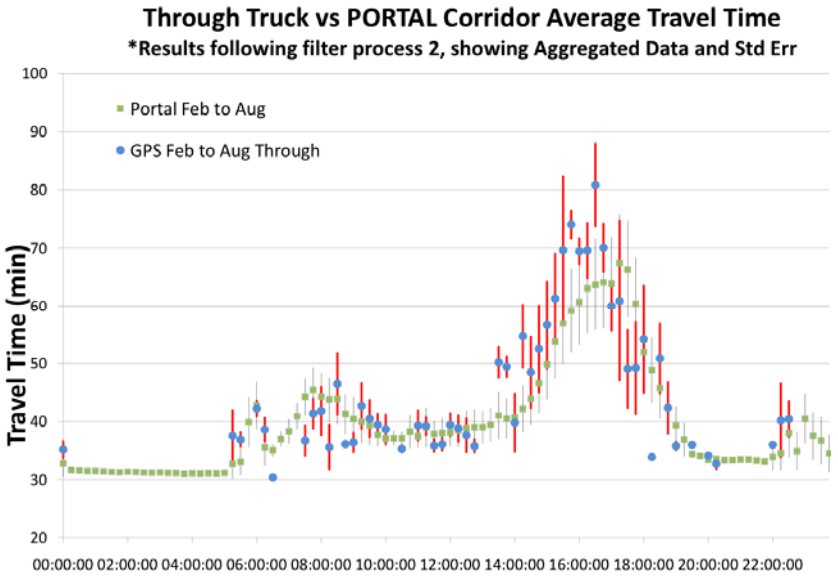
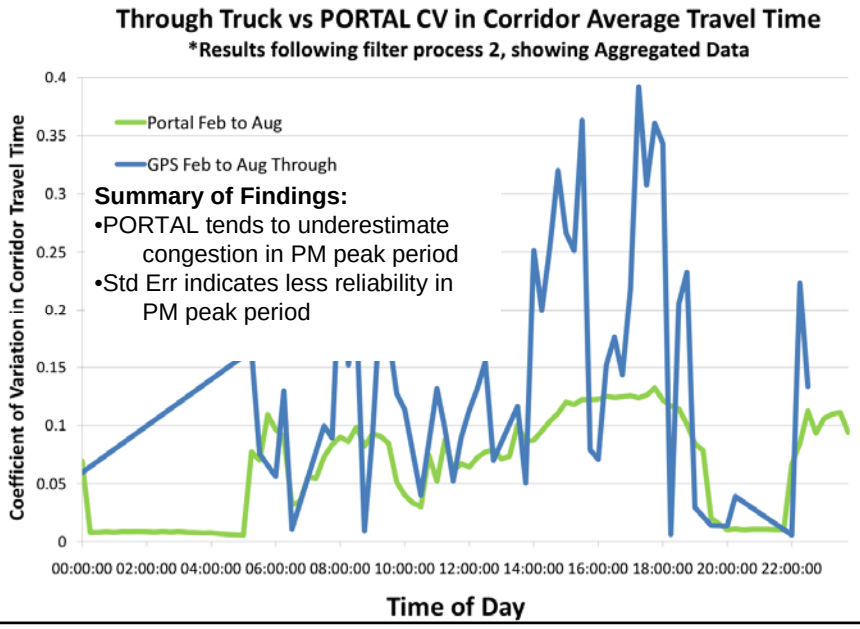
# Results: Recurring Congestion






# Results: Recurring Congestion

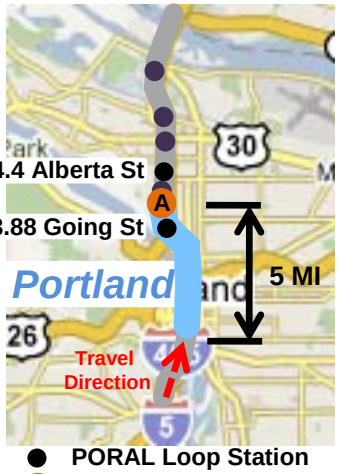


# Non-Recurring Congestion Analysis

## Case Study: Non-Recurring Congestion

**Non-Recurring Congestion**

- Similar Methodology,
- ***5 mile segment near incident "A"***
- Incidents Downstream of "A"

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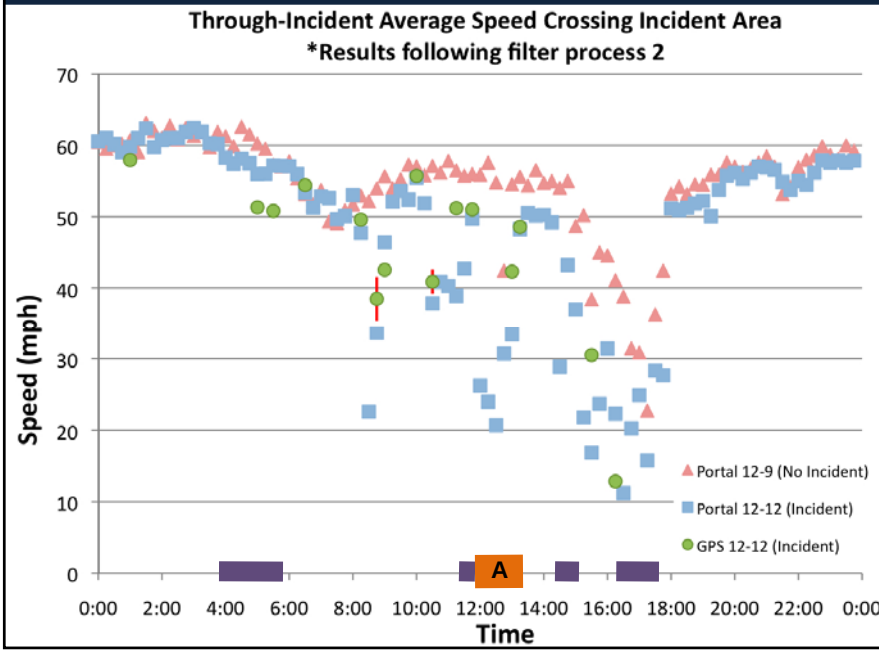
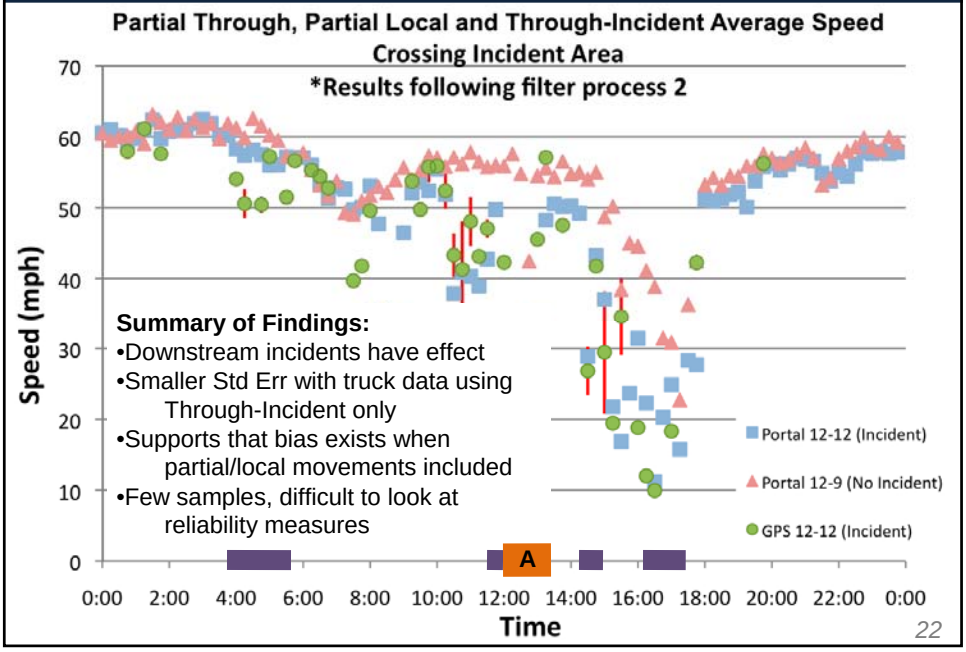
# Results: Non-Recurring Congestion






# Results: Non-Recurring Congestion

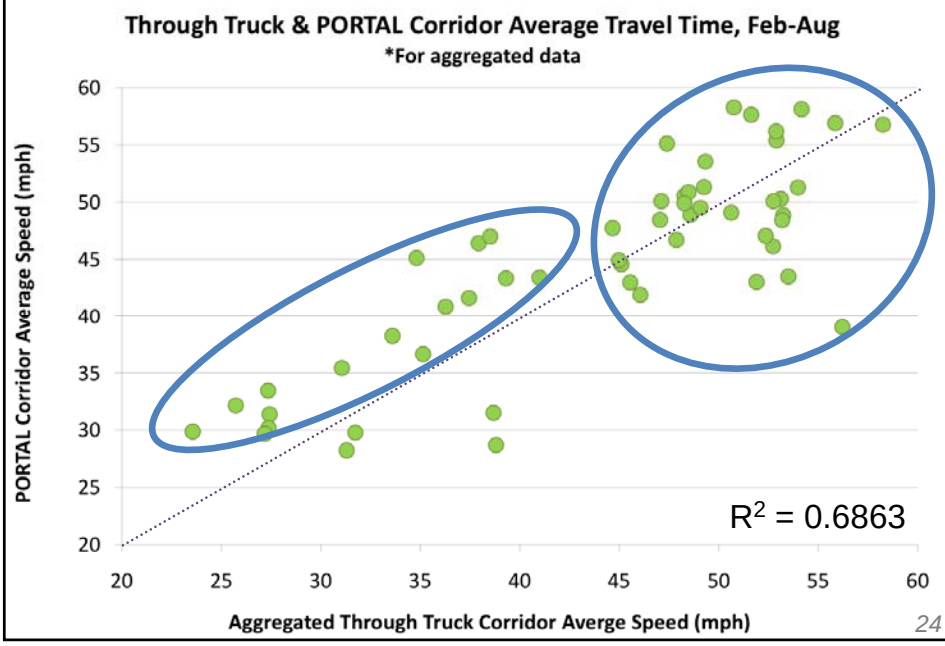



**Summary of Findings:**

- Downstream incidents have effect
- Smaller Std Err with truck data using Through-Incident only
- Supports that bias exists when partial/local movements included
- Few samples, difficult to look at reliability measures

# Summary of Findings

## Truck Data vs PORTAL Comparison



## Research Next Steps

# Work to-date is a good foundation…

- **Improving complexity of programming**
- **Using PORTAL data dynamically**
- **Statistical and Sensitivity Testing**
- **Quantifying Costs, Emissions and Health Impacts**




## Conclusions

- **Integrated GPS, loop sensor and incident data**
- **New methodology to identify local and through trucks**
  - Remove bias of trucks resting/refueling
  - Through trucks best indicator of congestion
  - Indications that loop sensor data may underestimate congestion in PM peak
- **Performance data useful to public agencies**
  - Expand to look at bottlenecks
  - Study greater time periods
  - Local/freeway transitions
- **Could be incorporated into Oregon Freight Data Mart or other web based platform**

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# Questions??

Nikki Wheeler nicole.m.wheeler@gmail.com
Dr. Miguel Figliozzi figliozzi@pdx.edu

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