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Visual Information. Visible Results.



Truck Traffic Analysis Using IKONOS Satellite Imagery

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Agenda



❑ IKONOS Satellite System (Brief Overview)

❑ Truck Traffic Analysis Pilot

- Vehicle Identification
- Quantifying Flow
- Classifying Vehicles



❑ Summary

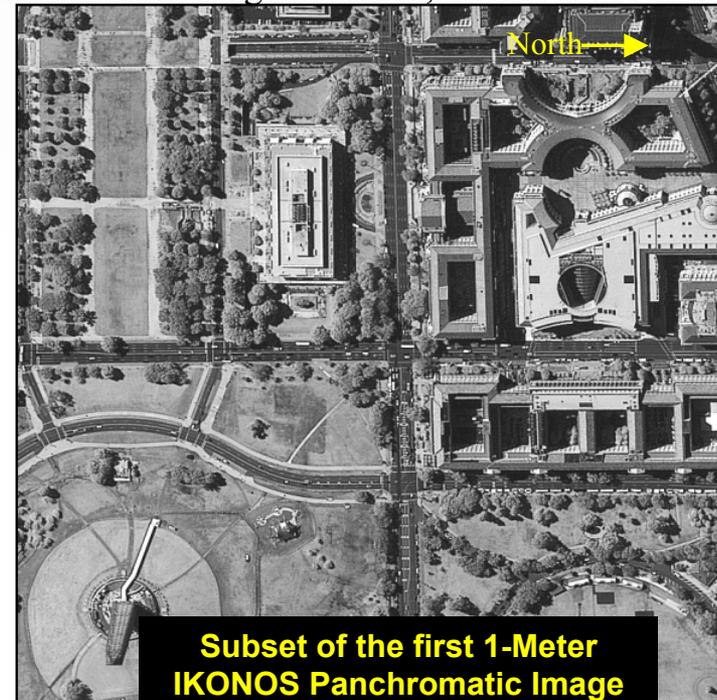
Space Imaging - A Brief History



- ❖ PDD-23 Signed, 1994
- ❖ Space Imaging Founded, 1994
(Lockheed/E-Systems/Mitsubishi)
- ❖ Space Imaging Moves to Denver, 1995
- ❖ Space Imaging Launches IKONOS I, April 1999
- ❖ Space Imaging Launches IKONOS II, September 1999



- ❖ IKONOS First Image Released, October 1999



**Subset of the first 1-Meter
IKONOS Panchromatic Image
Washington, D.C.**



Key IKONOS System Specifications

Spatial Resolution

- ❑ 1-Meter Pan, 4-meter MS ($\pm 26^\circ$ from Nadir)
- ❑ 1.5-Meter Pan, 6-Meter MS (Out to 45° from Nadir)
- ❑ 2-Meter Pan, 8-Meter MS (45° to 51° from Nadir)

Information Content

- ❑ Always Collects Pan & Multispectral Simultaneously
- ❑ 4 Multispectral Bands (Blue, Green, Red, Near-Infrared)
- ❑ 11-bit Dynamic Range

Metric Accuracy

- ❑ 1:24,000 without Ground Control
- ❑ 1:2,400 Map Scale with Ground Control

Timeliness & Dependability

- ❑ Direct Tasking
- ❑ Frequent Revisit (1-3 Days)
- ❑ Images Collected 10-11AM
- ❑ Global Archive



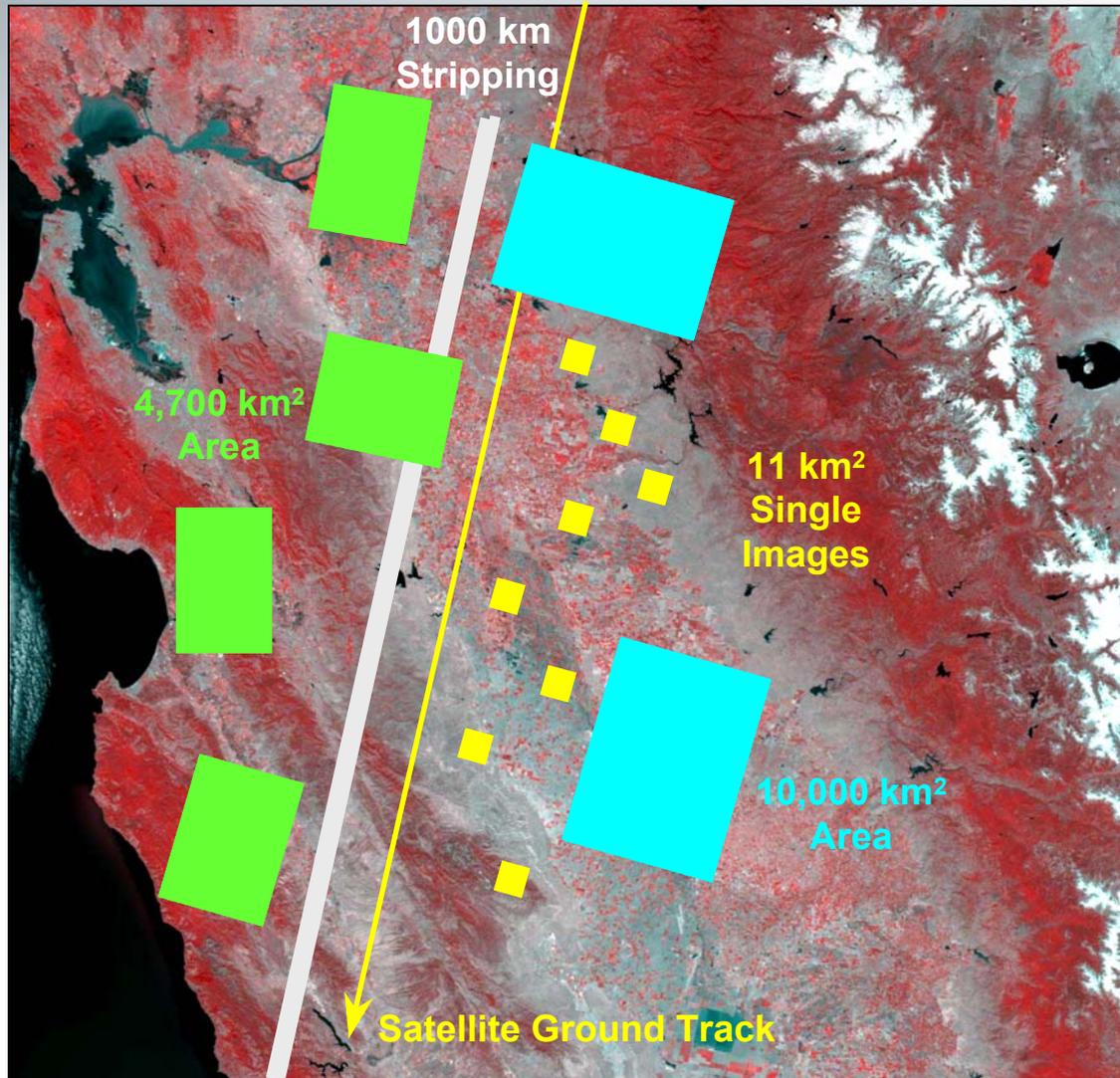
**Athena II
(IKONOS Launch Vehicle)**



IKONOS Satellite



IKONOS Collection Modes



IKONOS Imagery



1-Meter Panchromatic



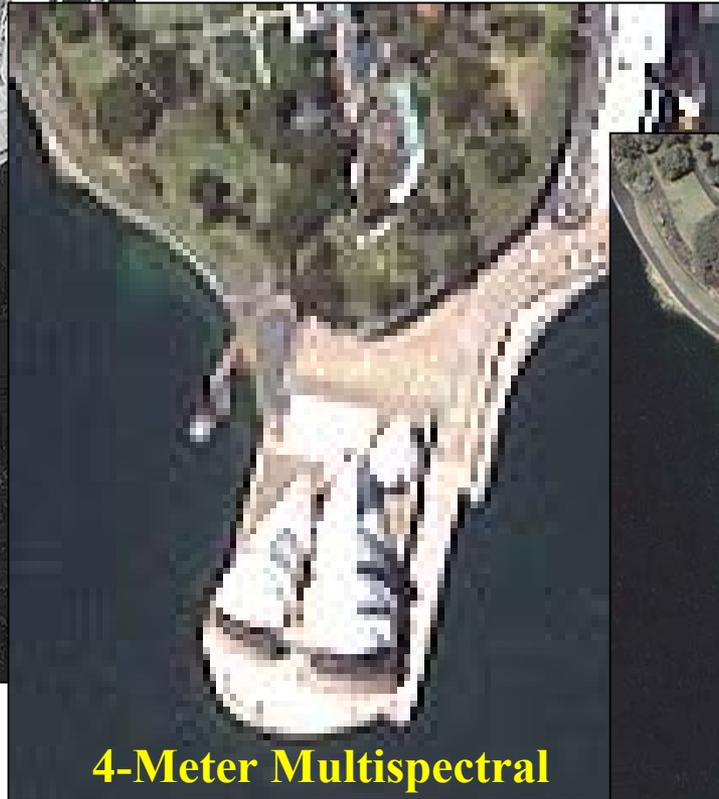
4-Meter Multispectral

Sydney, Australia

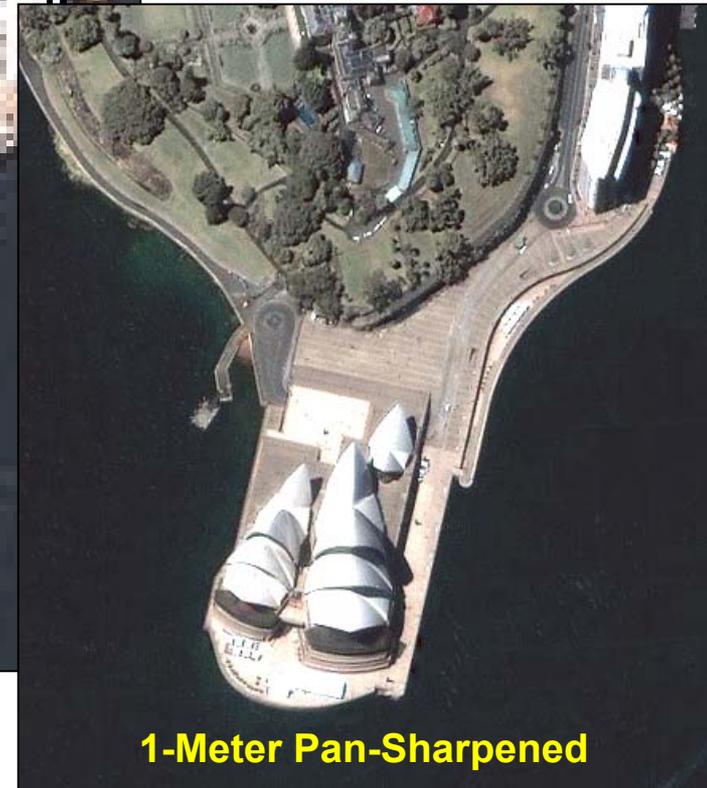
The Pan-Sharpener Process



1-Meter Panchromatic



4-Meter Multispectral



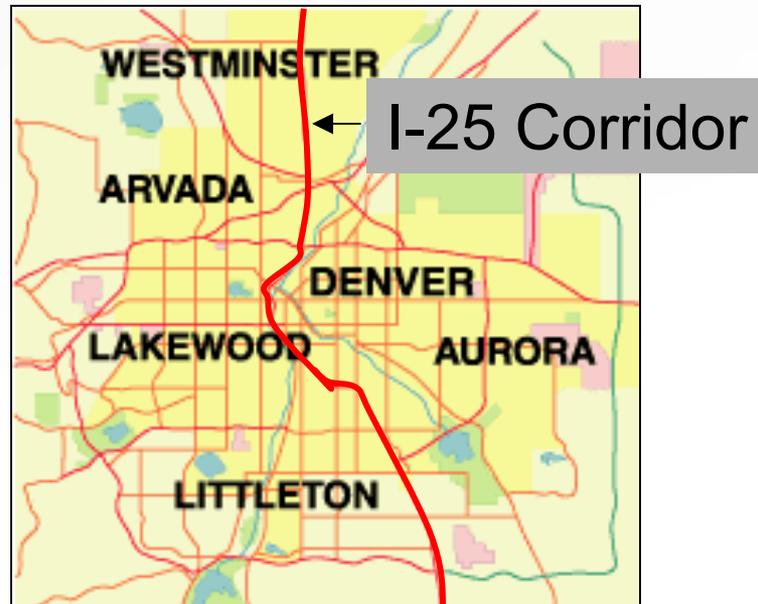
1-Meter Pan-Sharpener

Truck Traffic Analysis Pilot



□ Study Area

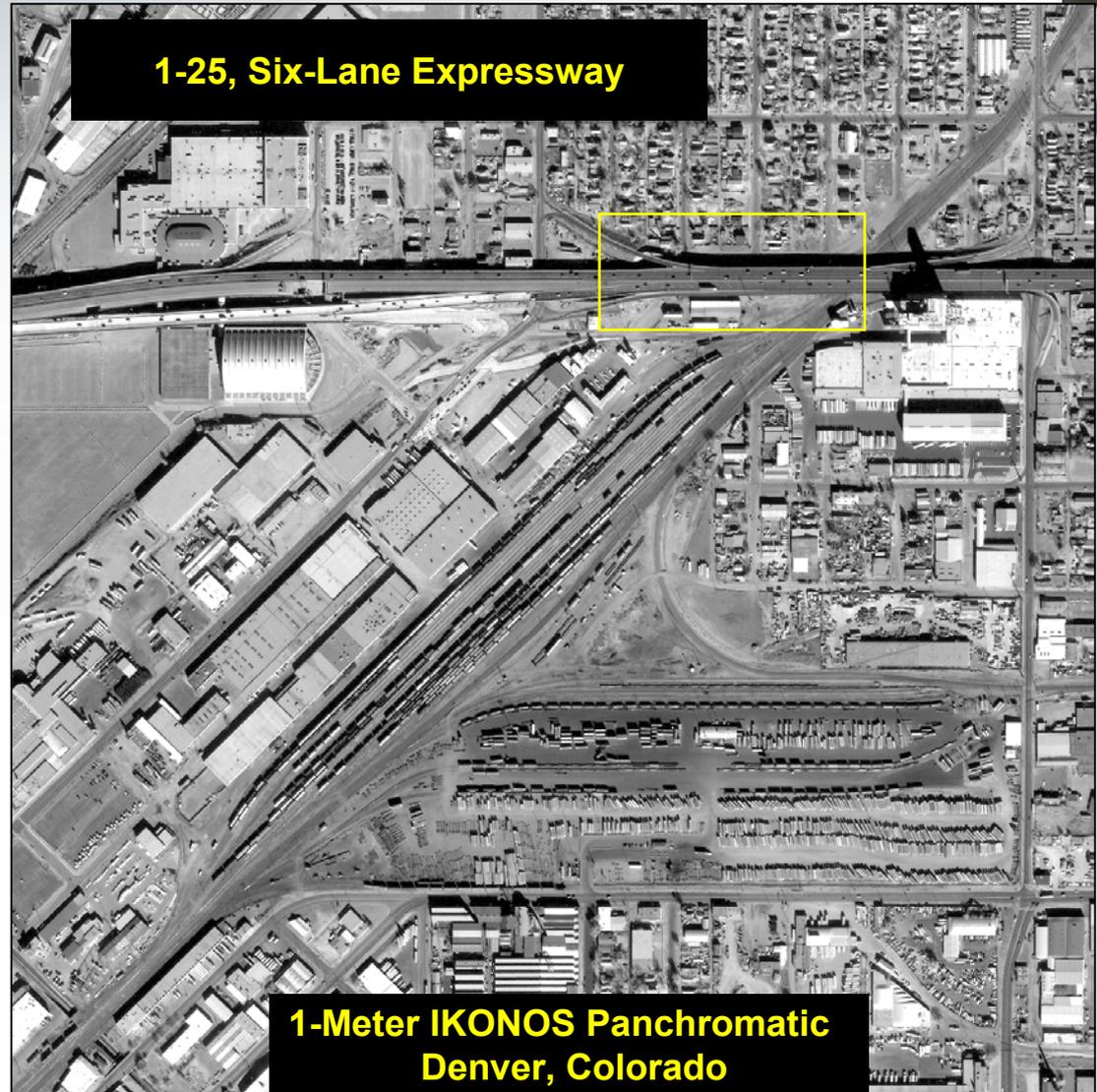
- I-25 corridor north of Denver
- Need for additional truck stops



Purpose of Pilot



- ❑ Identify Vehicles
 - Traffic counts (trucks > 60 feet in length)
- ❑ Quantify Flow Rate
 - Function of vehicle density and speed
- ❑ Classify Vehicles



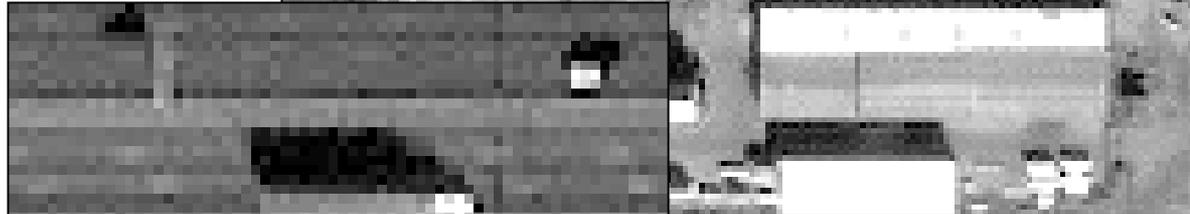
1-25, Six-Lane Expressway

1-Meter IKONOS Panchromatic
Denver, Colorado

Identify Vehicles



1-25, Six-Lane Expressway



Trailer

Tractor

1-Meter IKONOS Panchromatic
Denver, Colorado

Identify Vehicles (cont.)



**IKONOS 1-Meter Panchromatic
I-25 Denver**



Quantify Flow



❑ Function of Vehicle Density and Speed

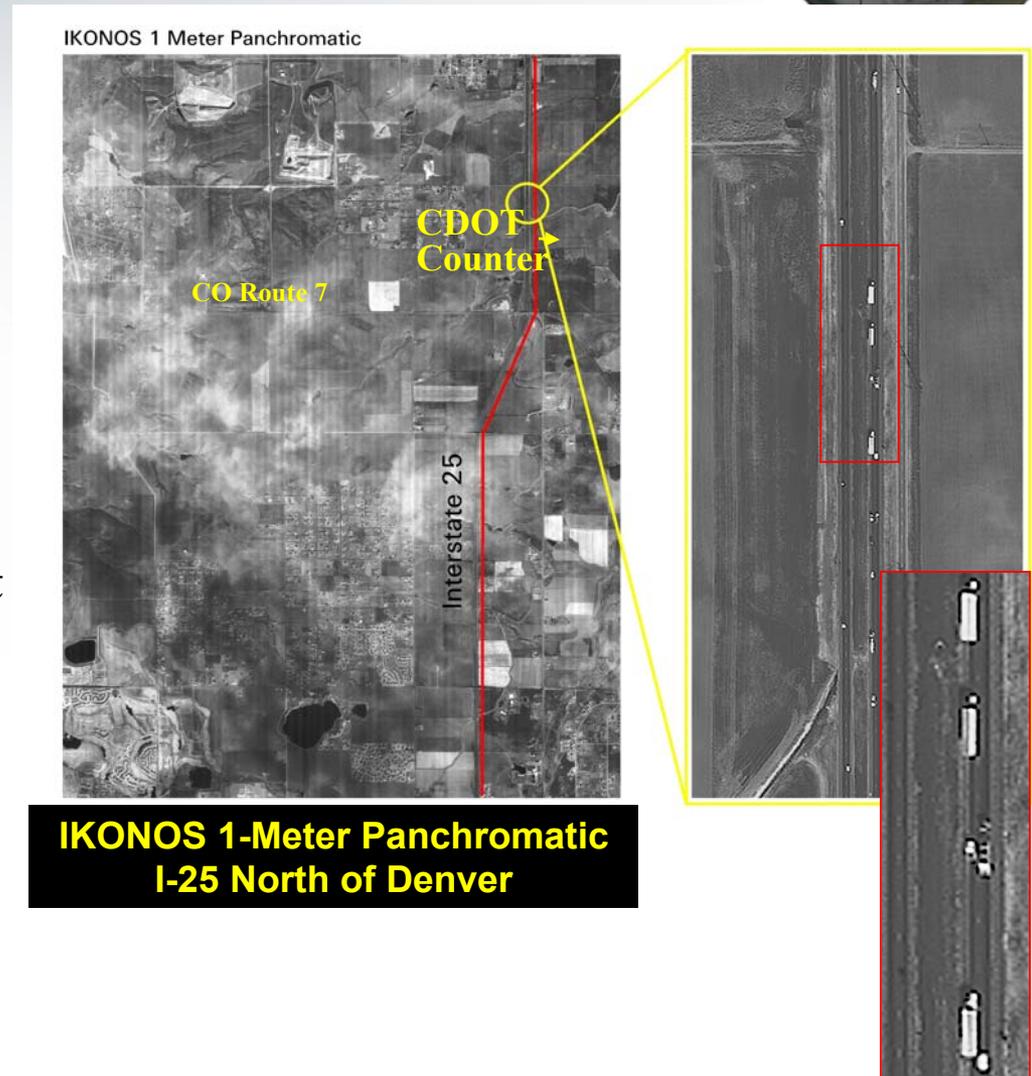
- Vehicle density from imagery
 - Truck counts
 - In 5.9 mile corridor
- Speed: Assumed speed limit, 75 mph

❑ Used IKONOS 1-Meter Panchromatic Imagery

- Taken 10:12 AM, 11 Nov 1999

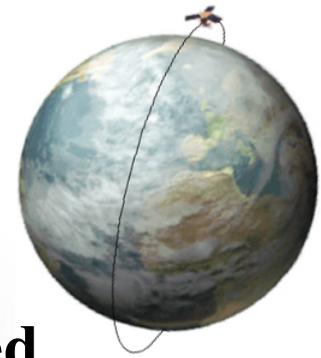
❑ Estimated Hourly Flow Rate (>60 ft in length between hours of 10 to 11 AM)

- 292 trucks from imagery
- 280 from ground-truth/CDOT counter
 - Approx. +5% error



**IKONOS 1-Meter Panchromatic
I-25 North of Denver**

Quantify Flow (cont.)



□ Sensitivity Analysis As a Function of Truck Speed

- | | |
|--|---|
| – Estimated Speed 65 MPH | Results in a -9.6% error
253 trucks compared to 280* |
| – Estimated Speed 70 MPH | Results in a -2.5% error
273 trucks compared to 280* |
| – Assumed Truck Speed the
Limit, 75 MPH | Results in a +2.8% error
292 trucks compared to 280* |

*Count from CDOT counter

Classify Vehicles



□ Three Classes*: All Vehicles in 5.9 Mile Segment

< 20 Feet: *Passenger*

(Motorcycles, cars, pick-ups)

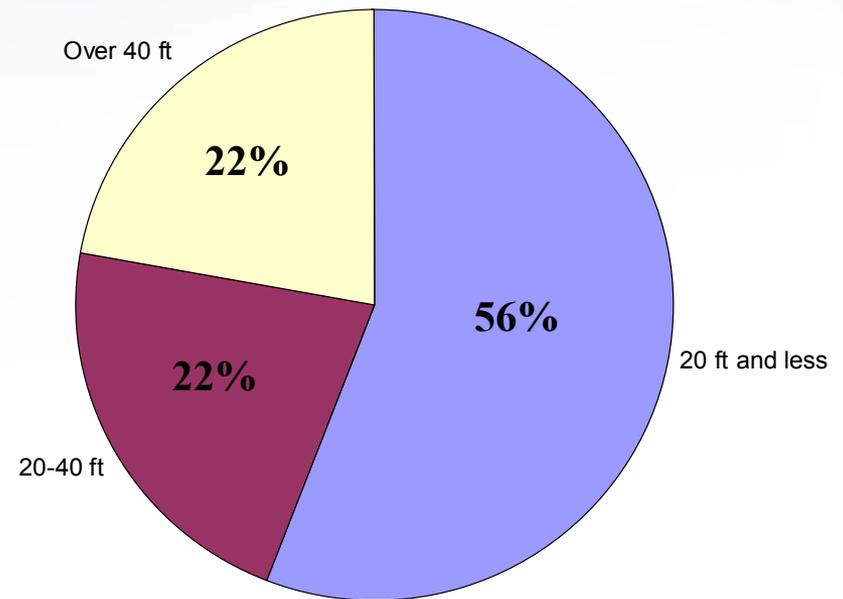
20-40 Feet: *Single Unit*

(RVs, buses, farm truck, etc.)

> 40 Feet: *Semi-Trucks*

(Combination tractor/trailer)

*Classes suggested by CDOT.



Couple Imagery Analysis With GIS Modeling

Use GIS to Drive a Strategic Plan

WHY? Imagery analysis is time consuming and needs to be applied with greatest benefit.

➤ **Potential “Area” vs. Potential “Site” ID Analysis**

- “Area” = A need for additional truck stops (rest and refuel)
- “Site” = Within an “area”, where are the best sites for truck stops?

➤ **“Area” A Macro Concept**

- Search the U.S. for potential “areas” where additional truck stops are needed.
 - Volume of truck traffic relative to existing truck stops
 - 4-lane interchanges/intersections of Interstate, US, and State highway network
- Proximity Analysis Using GIS Modeling Criteria
 - Distance or time between existing truck stops to identify “gaps”

➤ **“Site” A Micro Concept**

- High-volume truck traffic interchanges/intersections
- Large tracts of vacant land close to interchanges/intersections
- Easy ingress and egress

Summary: Role of Satellite Imagery



- **Help Select Potential “Areas” for Additional Truck Stops**
 - Monitor truck traffic through time
 - Potential to quantify flow for 10-11 AM time period as an traffic volume indicator

- **Help Select Best “Sites” Within “Areas”**
 - Identify and measure vacant tracts of land
 - Identify access routes into and out of potential “sites”
 - Identify sensitive environmental habitats/wetlands
 - Identify drainage patterns

In both situations, a “narrowing down” process and high-resolution satellite imagery can complement data collected on the ground.



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