The 2001-2004 Atlanta Instrumented Vehicle Intensive

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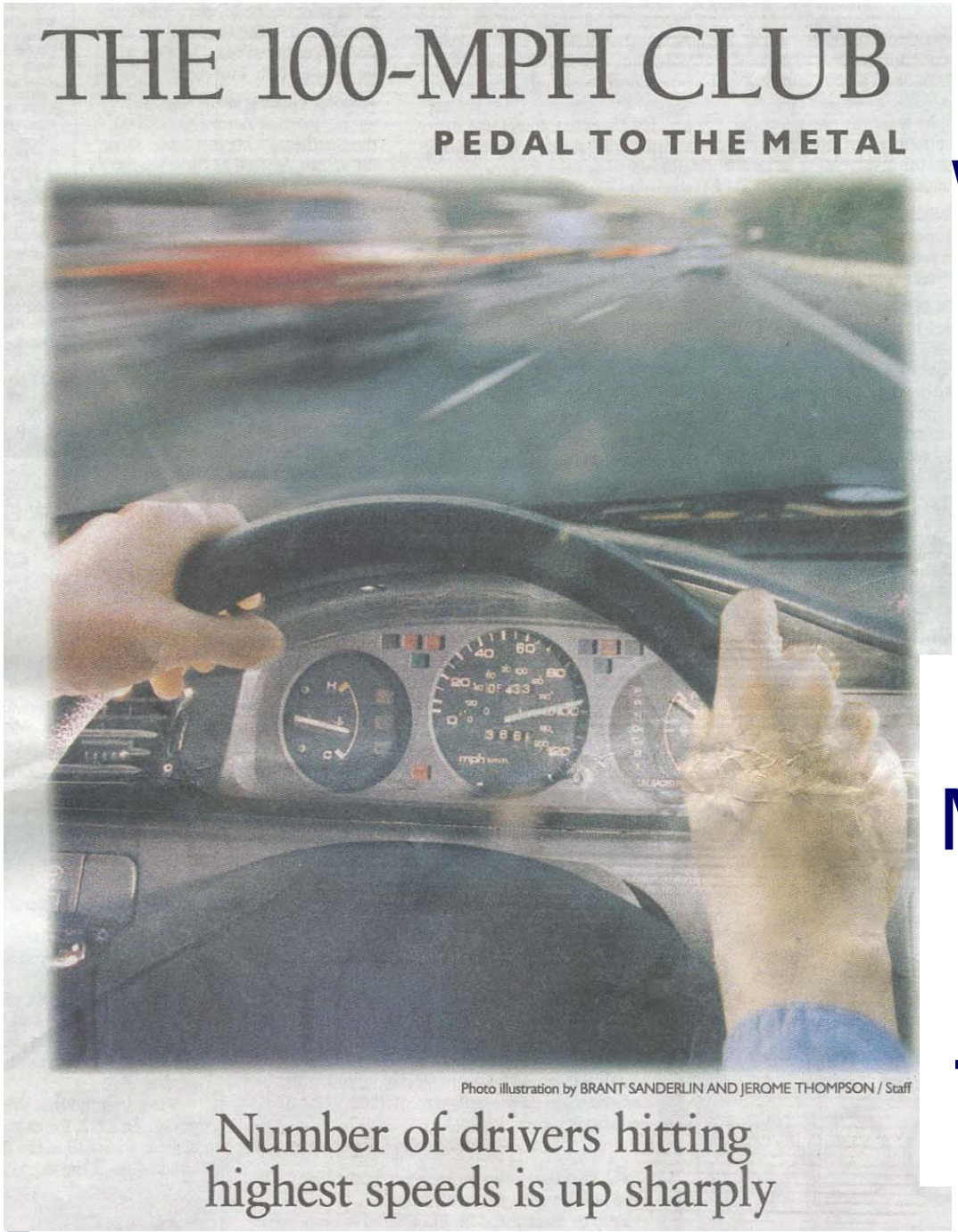

1000 Tickets are Written Each Year in Atlanta for Speeding over **100** MPH

17,000 Vehicles Monitored on I-285 in the Commute: **1%** Complied with the Speed Limit

Background: Three City Study

- **Instrumented vehicle studies**
  - **Atlanta, Baltimore, and Spokane (and Los Angeles)**
  - **Date, time, engine start, rpm, map, throttle position**
- **Observed driving patterns were significantly different**
  - **Can match any vehicle-day of driving to the appropriate city 95% of the time**
- **Could not explain the reasons for the differences**
  - **No data to compare across driver characteristics**
  - **No data to compare across vehicle characteristics**
  - **No route data to compare infrastructure effects**
  - **No interaction analyses possible**

Atlanta Instrumented Vehicle Studies

- **Two major multi-year research efforts are now underway in Atlanta**
  - **National Highway Transportation and Safety Administration Study (1100 Vehicles)**
  - **Federal Highway Administration Value Pricing Study (500 Vehicles)**
  - **FHWA Congestion Pricing Study (50 Vehicles)**
- **All projects employ instrumented vehicles to collect a wide variety of driving pattern, driver behavior, and engine operating parameters**

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NHTSA Study

- **Goal: Develop an understanding of the relationships between driver behavior, onroad driving patterns, and crash risk across various demographic, environmental, and physical conditions**
- **Examine factors affecting crash occurrence**
  - **Driver demographics/socio-economic factors, driver skill factors, vehicle factors, environmental factors, and transportation system operating characteristics**
- **Principle Investigators at Georgia Tech:**
  - **Jennifer Ogle and Simon Washington**

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NHTSA Project Scope

- **Instrument 1100 vehicles from 600 representative households in Atlanta and monitor activity for 2 years**
- **Activity monitoring and crash detection equipment:**
  - **Onboard computer, tri-axial accelerometer, GPS, digital cellular modem**
- **Collect and upload details on tripmaking and onroad operating characteristics to a central data warehouse**
- **Collect data for the 100+ crash events (>5% annual crash rate/vehicle) and correlate the crash occurrence to high-risk driving patterns (speed/acceleration, congestion, near misses, etc.)**

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NHTSA Timeline

- **Equipment acceptance testing by April 2001**
- **Infrastructure set-up and testing by May 2001**
- **Installation and data collection begins June 2001**
  - **Staggered deployment over 3 month period**
  - **Continuous data collection for 2 years (all vehicles)**

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NHTSA Participants

- **Subjects will be selected in conjunction with the Year 2000 SMARTRAQ Travel Survey recruitment**
  - **Strategies for Metropolitan Atlanta's Regional Transportation and Air Quality (SMARTRAQ)**
- **SMARTRAQ is based on 8,000 household travel survey to address land use, travel behavior, air quality, safety as well as other critical issues in the Atlanta region**
- **Random Sample of Households based on:**
  - **Income (4-5 strata)**
  - **Household Size (4-5 strata)**
  - **Land Use – Residential Density (4-5 strata)**

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Participant Data

- **Household demographics**
  - **Household and individual survey data**
    - **Demographics and routine destination data**
  - **Standard travel diary survey(s)**
  - **Attitudinal data from periodic surveys**
- **Vehicle data**
  - **Vehicle Identification Number (VIN)**
  - **Engine and performance data**
  - **Safety systems**
  - **Fuel delivery and emissions control systems**

NHTSA Onroad Data Collection

- **Driving characteristics (every trip)**
  - **High resolution activity data**
  - **Date, time, latitude, longitude, speed, acceleration, heading, DGPS status, # Satellites, PDOP, HDOP**
  - **GPS data at 0.2 Hz, speed/acceleration at 1 Hz**
  - **OBD-capable system**
- **Aggressive driving characteristics and near-miss data**
- **Crash detection and notification**
  - **Crash details via accelerometers**
  - **Field surveys of crash and prevailing conditions**

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NHTSA Trip Data

- **Trip origin**
  - **Date, time, location**
  - **Soak time (time since last trip end)**
- **Trip destination**
  - **Date, time, location**
  - **Trip duration (time)**
  - **Travel distance**
- **Driving characteristics**
  - **Speeds, accelerations, aggressive maneuvers**
- **Route choice**

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Value Pricing Project Scope

- **Instrument 500 vehicles from 273 representative households in Atlanta and monitor activity for 3 years**
  - **Onboard computer, GPS, OBD scanner, digital cellular modem**
- **Collect tripmaking and onroad operating data**
- **Implement pay-as-you-drive insurance strategies in second and third years and monitor consumer response**
  - **Per-mile charge for insurance in year 2**
  - **Per-mile rates adjusted for risk factors (time-of-day, congestion levels, routes, etc.) in year 3**

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Value Pricing Implementation

- **Coordinate initial deployment with NHTSA project**
- **Same sampling framework as NHTSA project**
- **Same basic demographic and monitored tripmaking data will be collected in both projects**
- **Annual travel diaries collected (summer as well)**
- **Employer interviews conducted each year to identify employer workplace incentives (ensure that changes in commute behavior result from insurance treatment)**
- **OBD data stream provides continuity between experiments (100 NHTSA vehicles similarly equipped)**

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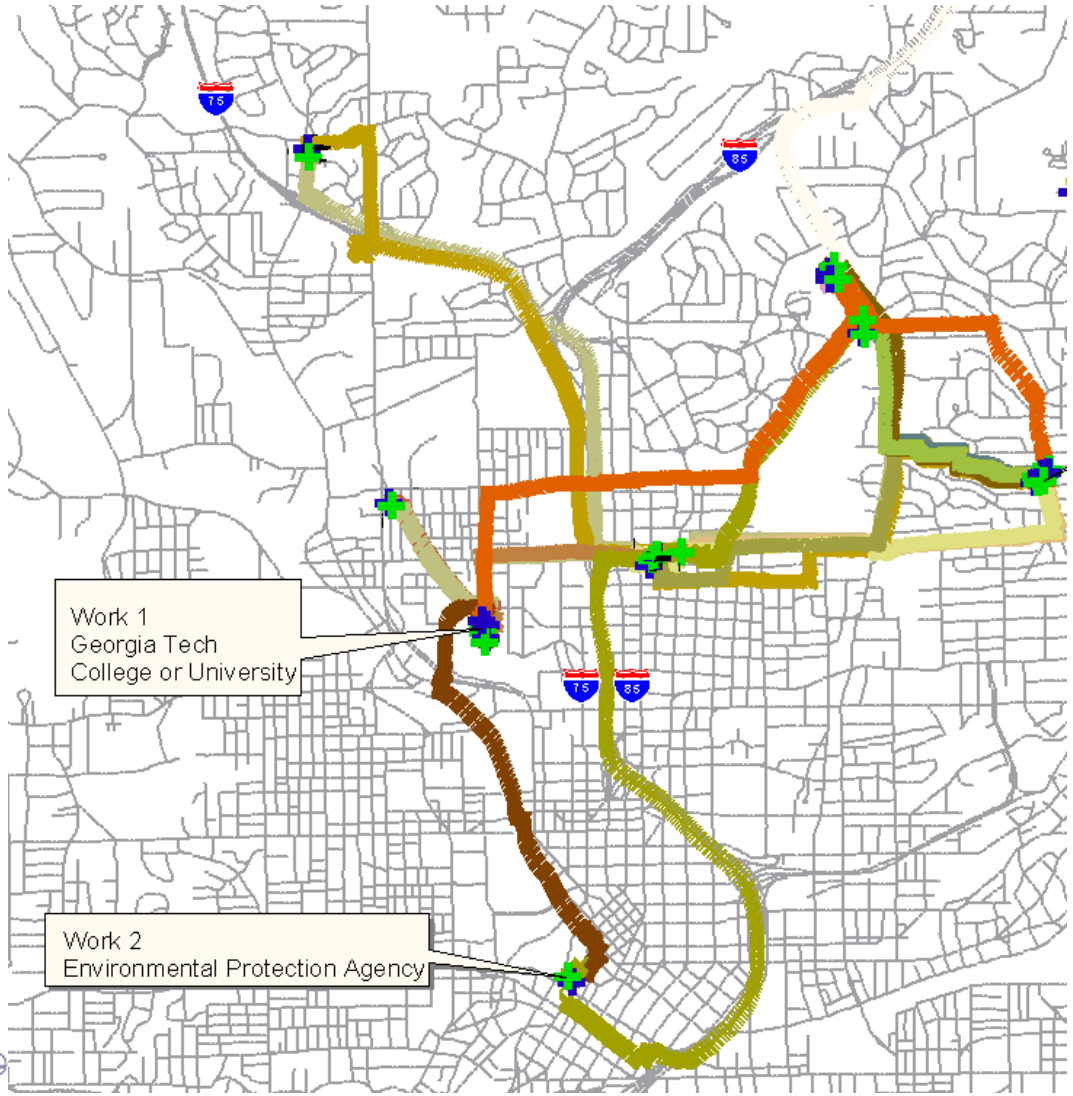
All Trips (GT Participant #28)



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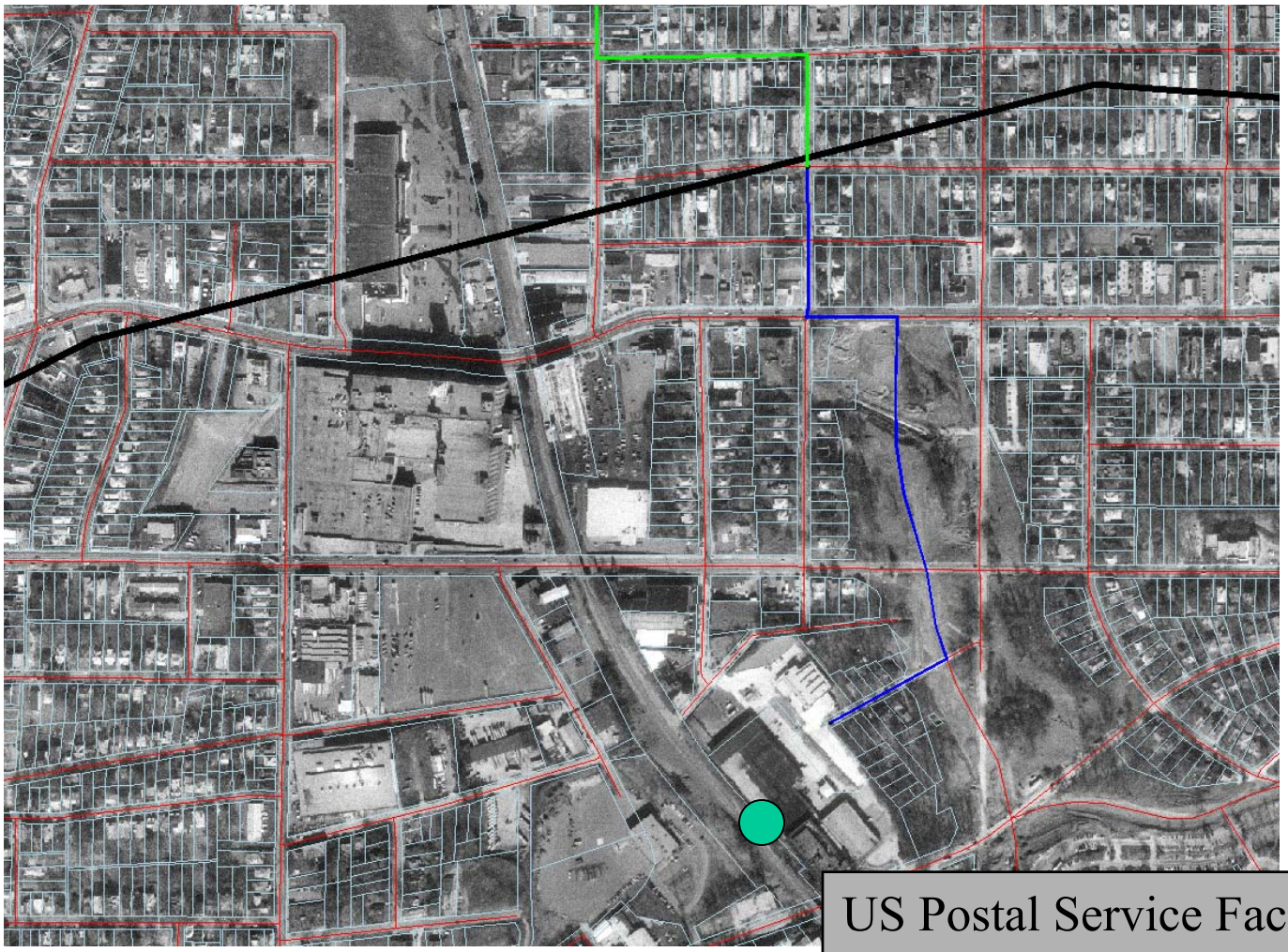
GIS Mapping Detail



US Postal Service Facility
Angier Springs Rd NE

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Data Transfer

- **Data transfer by cellular phone**
- **Data are transferred periodically (e.g., when storage reaches threshold or bi-weekly) during off-peak hours**
- **System can be remotely configured by cell phone**
  - **Each unit can be set 0.2 Hz to 1 Hz or at trip-level frequencies throughout the study period**
- **NHTSA Crash notification messages sent immediately upon detection, uploading the data preceding the crash**
- **Daily system integrity checks verify that units are communicating properly**

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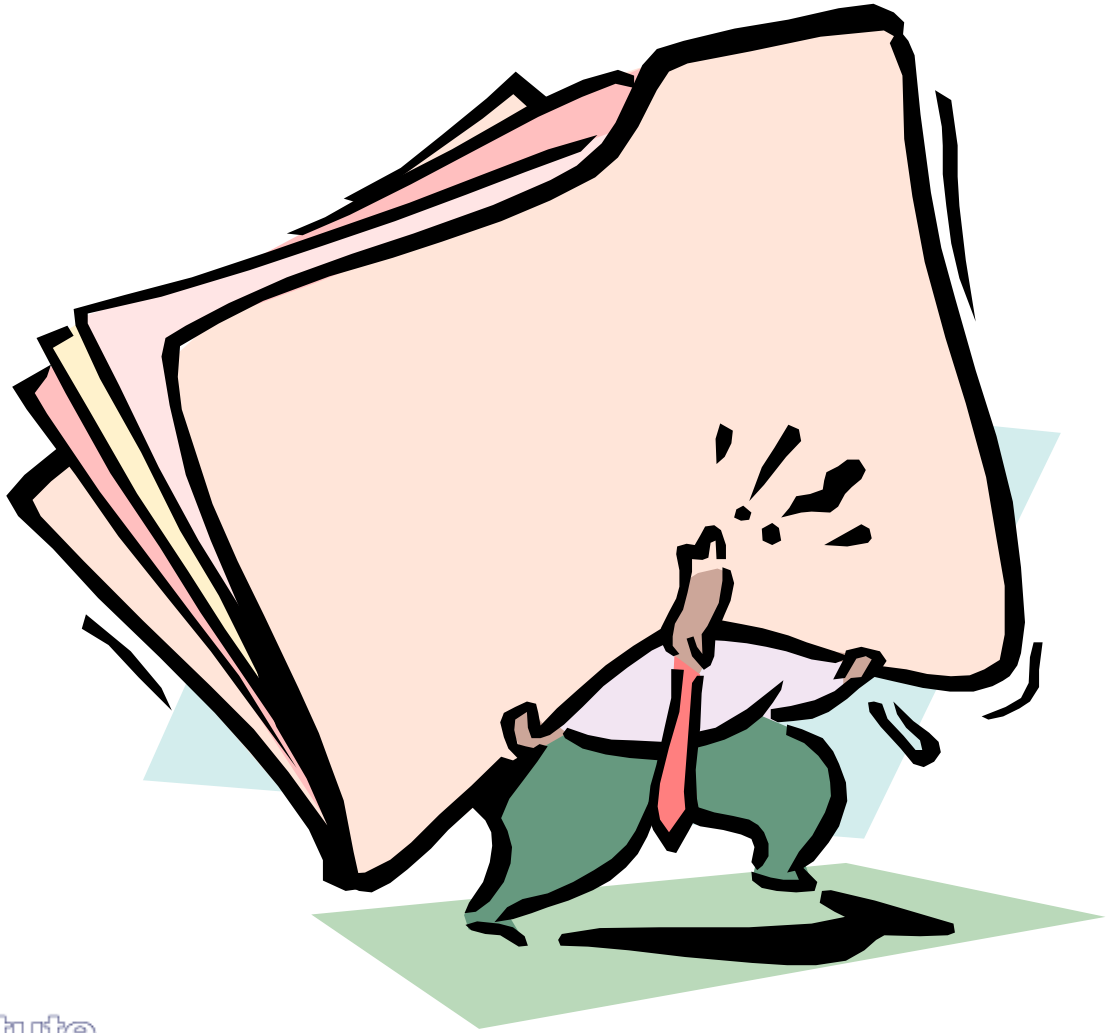
Urgh!



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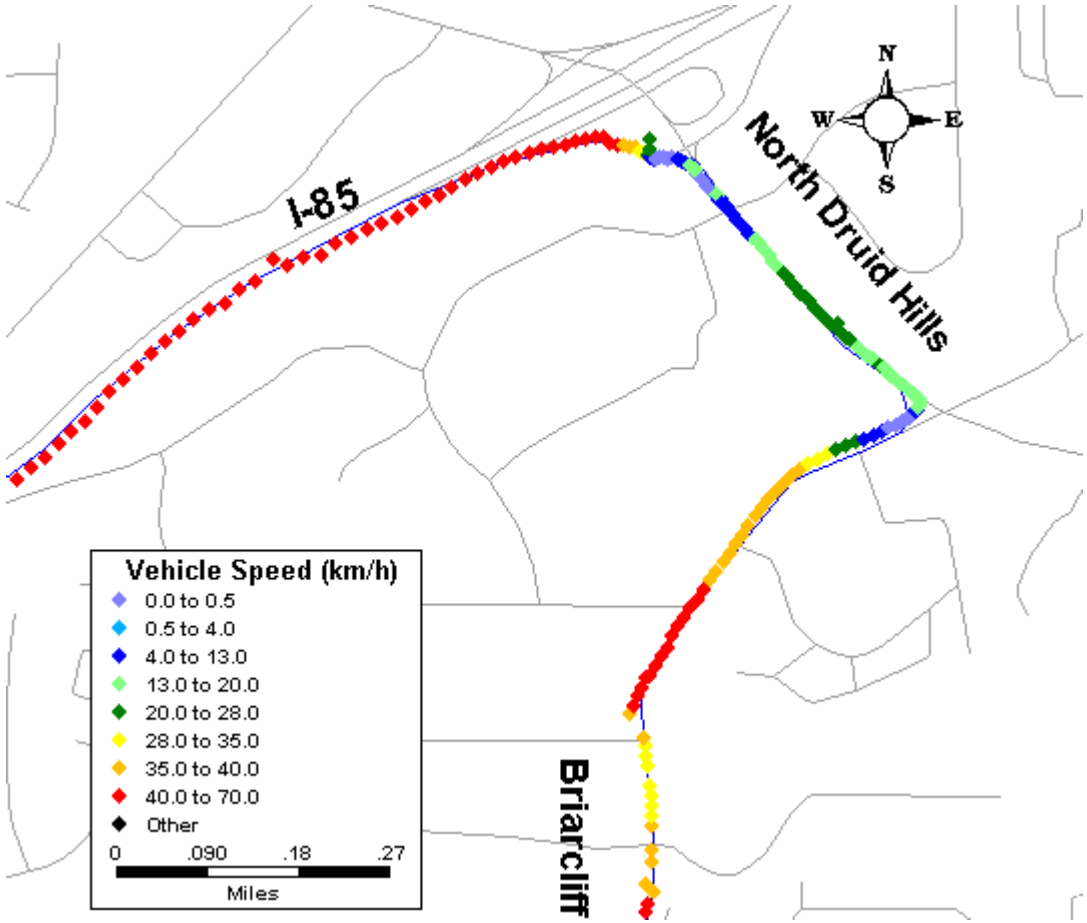
Vehicle Speed Thematic



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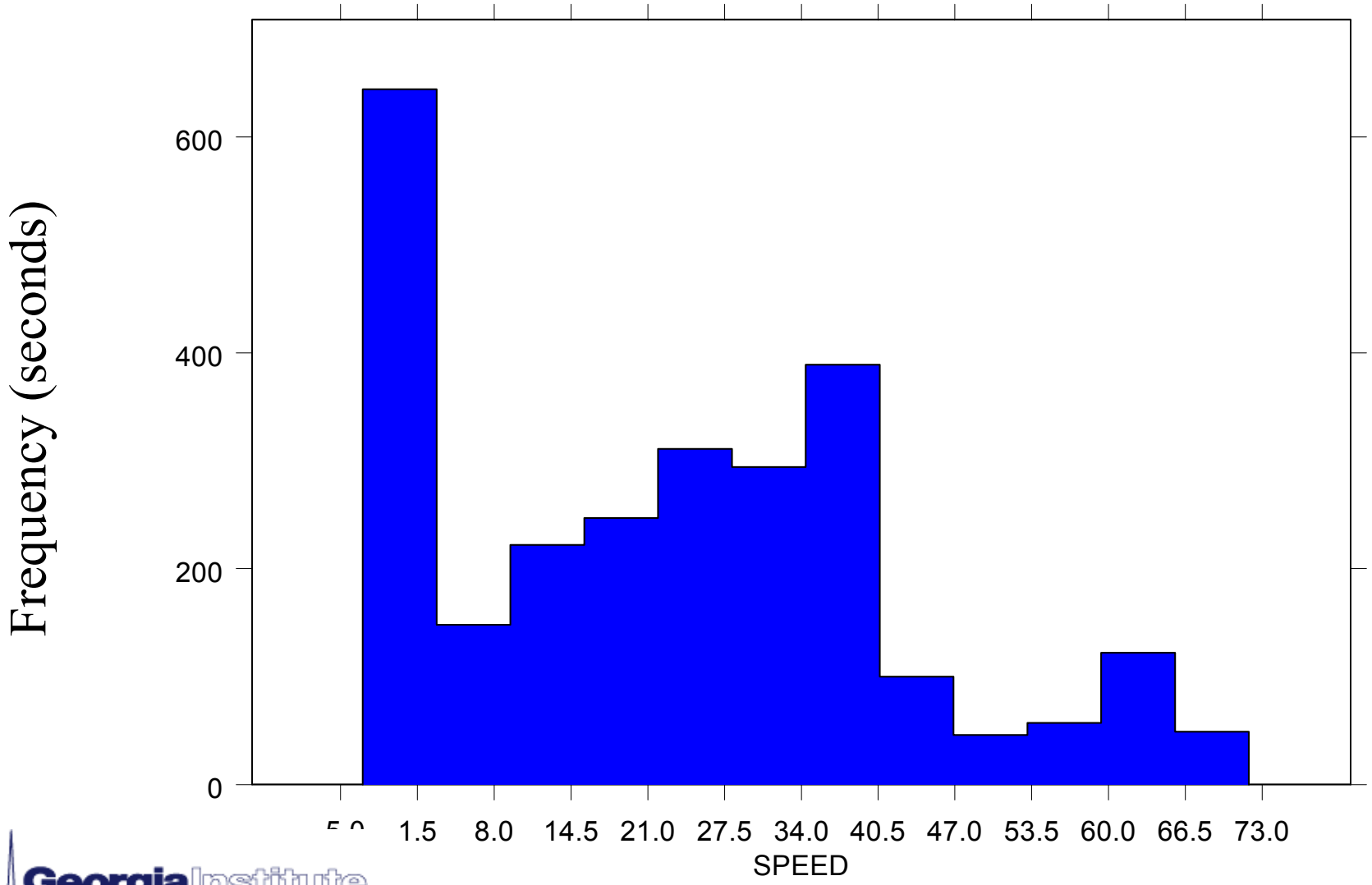
Histogram of Speed (mph)



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OBD II Capabilities

- **System will monitor the OBDII data stream**
  - **Separate black box unit**
  - **Low-power scanning (hardware) and code conversion (software) system**
- **All standard OBDII parameters will be collected and transferred to the data center:**
  - **vehicle speed, engine speed, manifold pressure, throttle position, coolant temperature, oxygen sensor, engine misfire, fuel injection, evaporative purge, exhaust gas recirculation, air injection, etc.**

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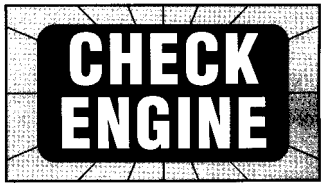
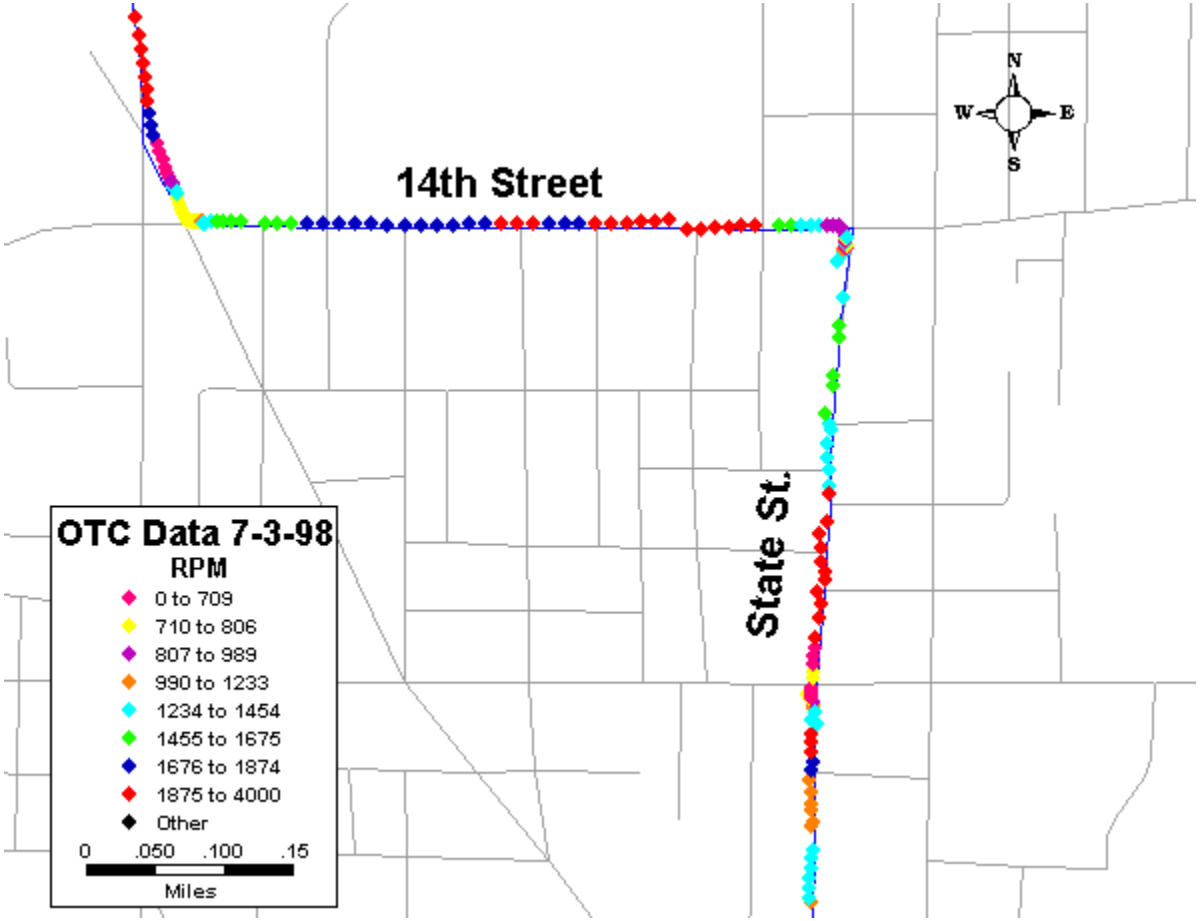


Vehicle RPM Thematic



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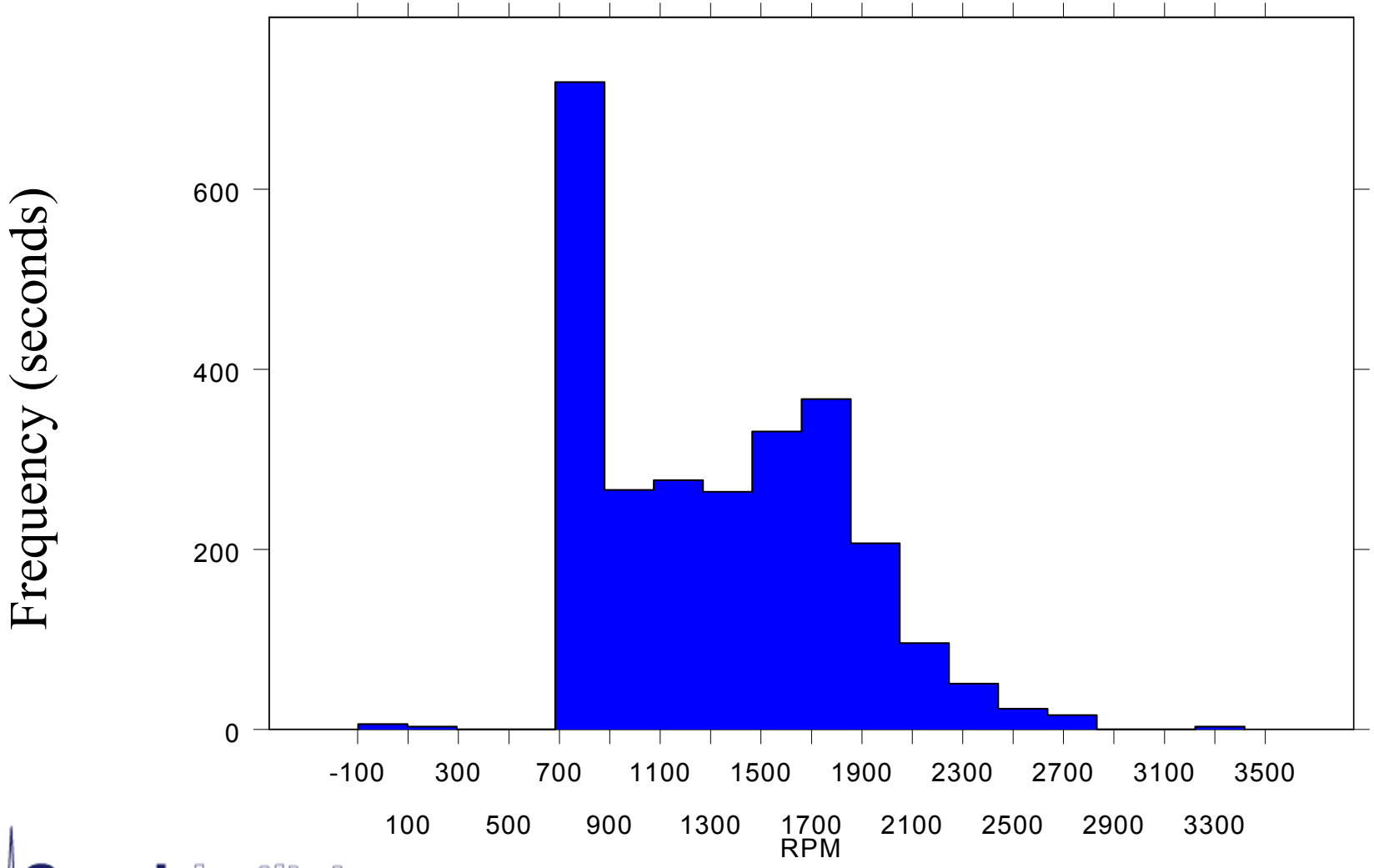
Histogram of Engine RPM



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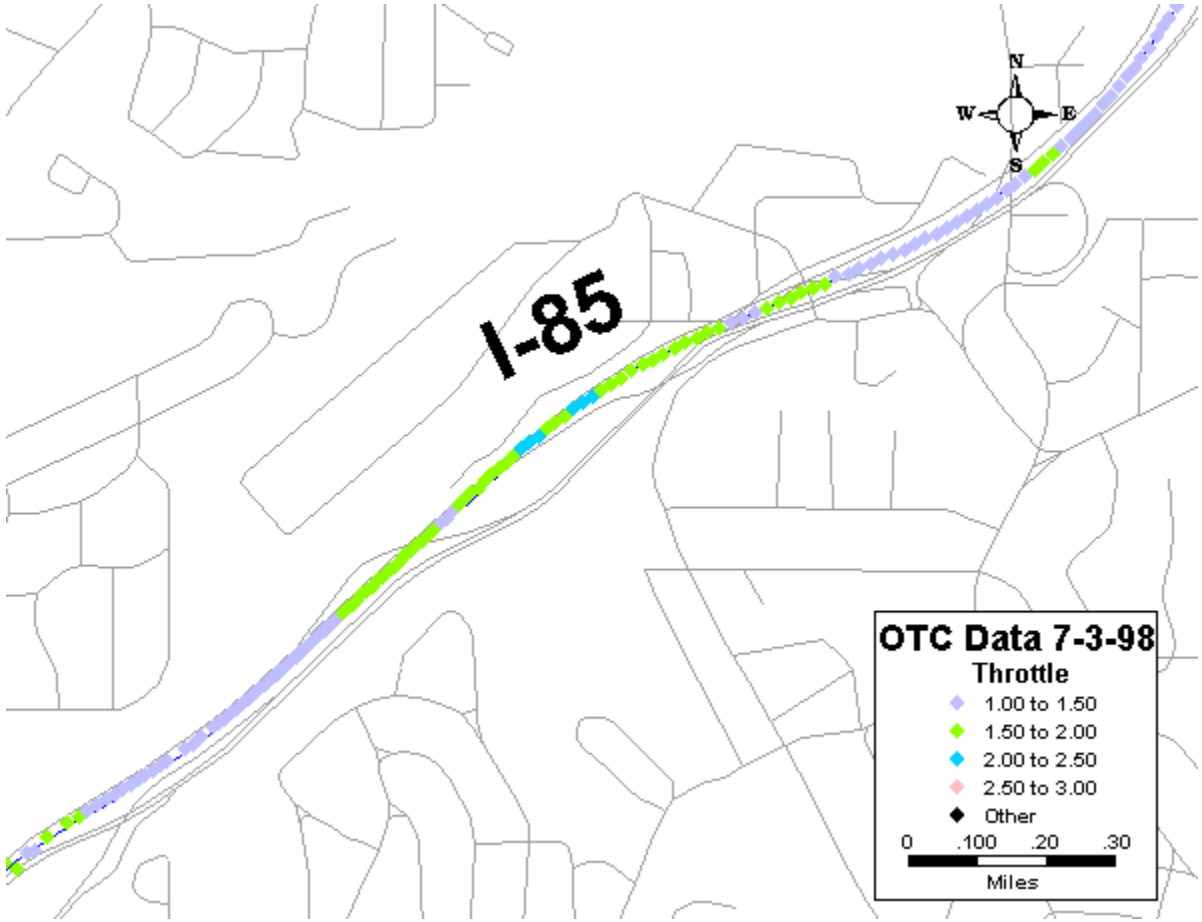
Throttle Position Thematic



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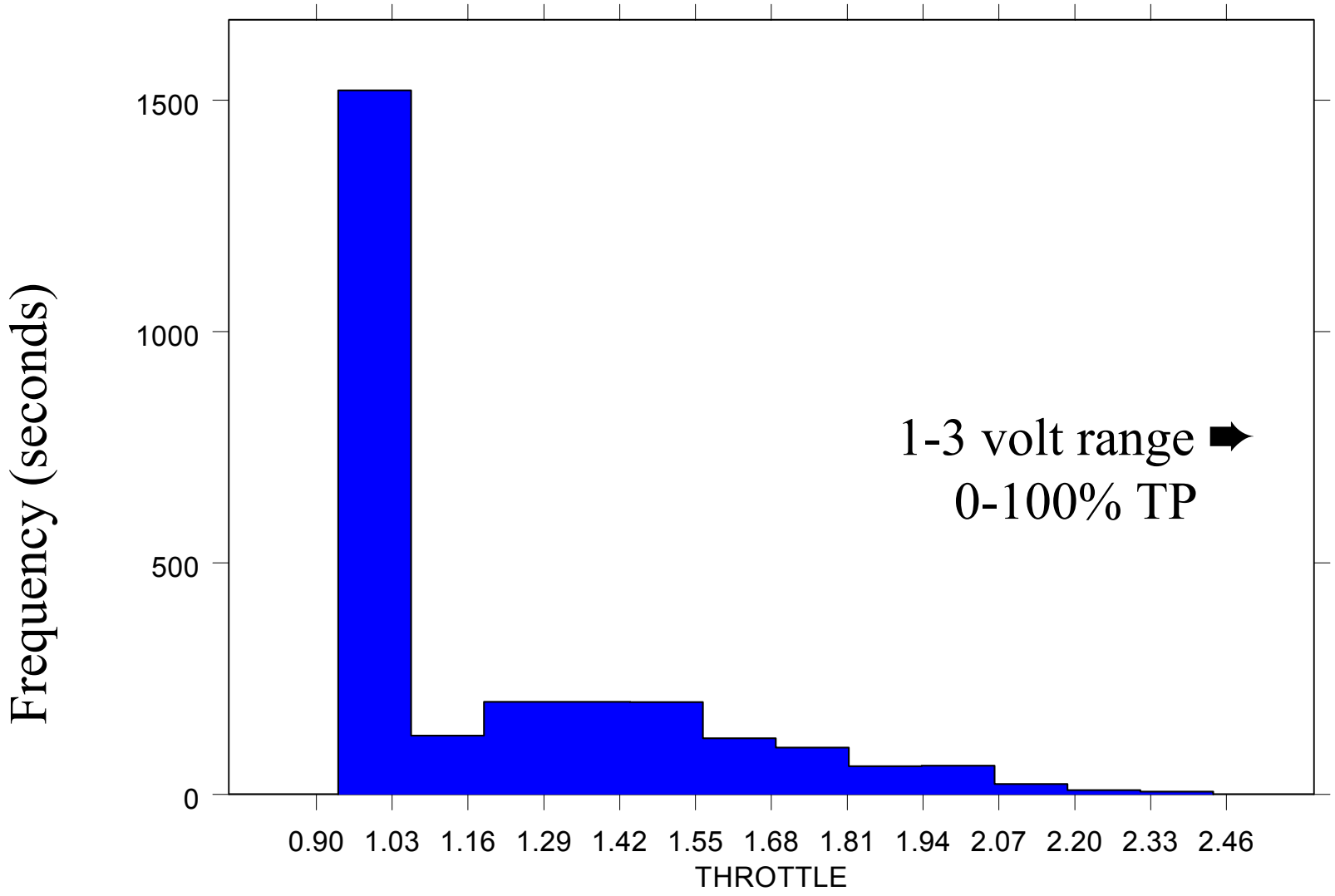
Histogram of Throttle Position (volts)



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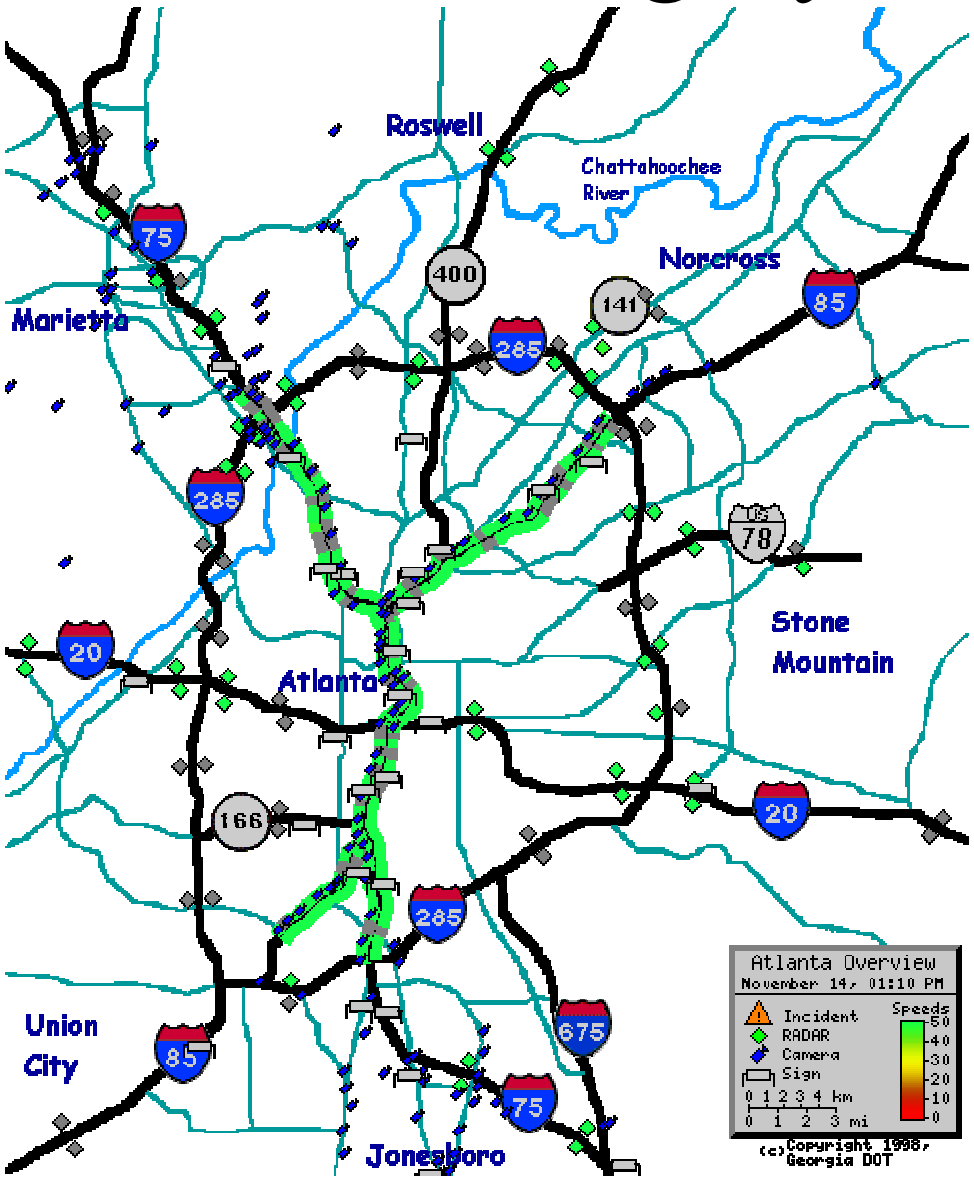
ATMS Monitoring System



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Travel Demand and Emissions Modeling Benefits

- **GPS provides trip origin, destination, and route choice**
  - **Improved spatial and temporal resolution**
  - **Calibration of traffic flow and simulation models**
- **Second-by-second operating speeds and acceleration**
- **Engine start and soak distributions (by purpose)**
  - **Operating profiles after engine start**
- **Identify probable enrichment/enleanment locations**
- **Grade effects on operating conditions (GIS-grade)**
- **Congestion effects on operating conditions (ATMS)**
- **Identification of driver behavior interaction effects**

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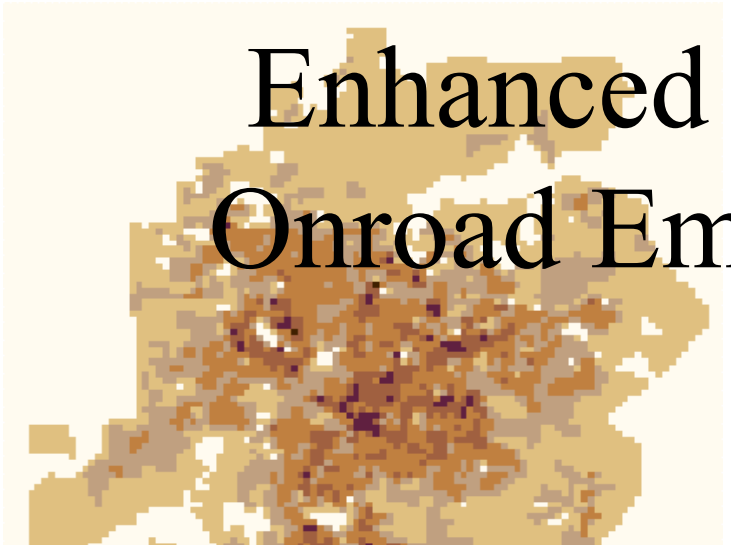
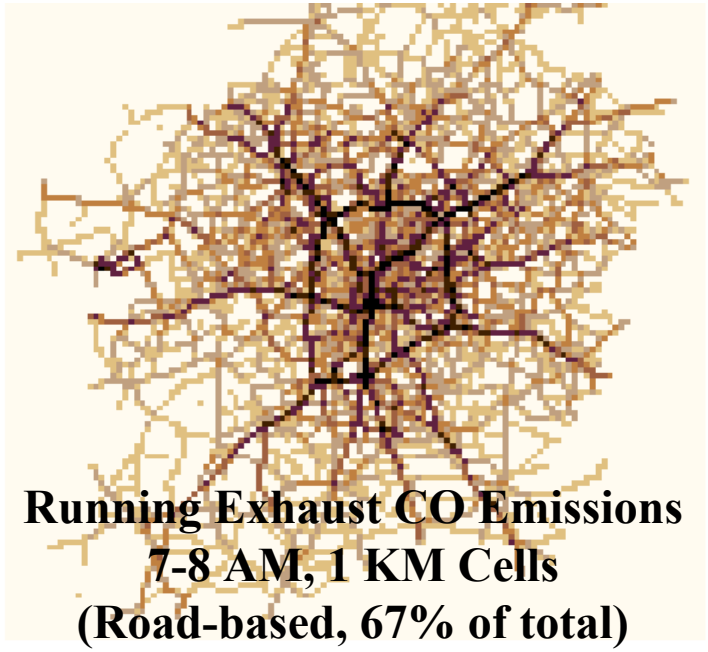
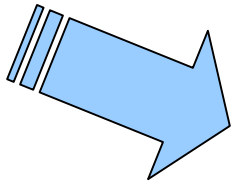
Enhanced Engine Start and Onroad Emissions Modeling

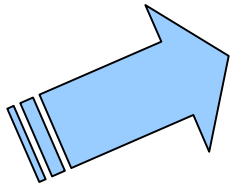


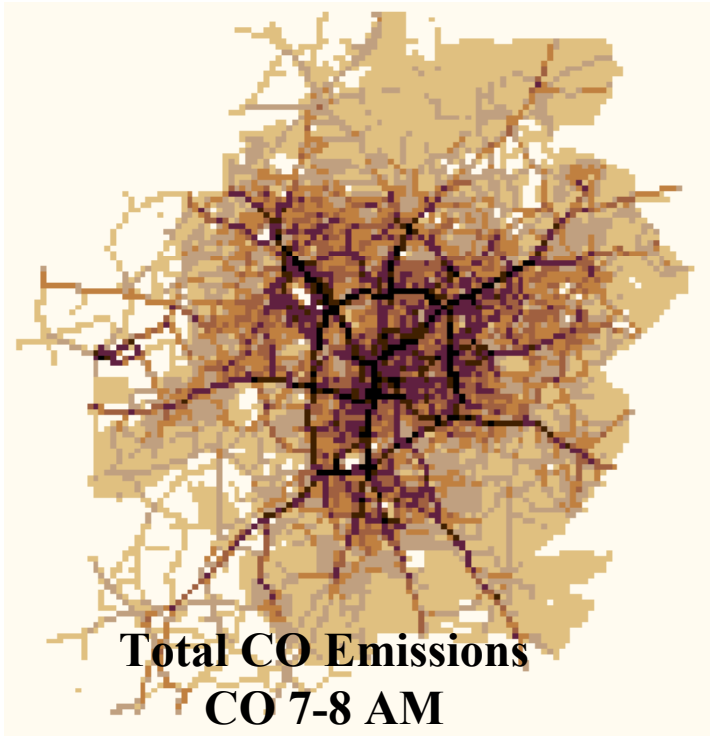
Engine Start CO Emissions
7-8 AM, 1 KM Cells
(Zone-based, 33% of total)



Running Exhaust CO Emissions
7-8 AM, 1 KM Cells
(Road-based, 67% of total)







Total CO Emissions
CO 7-8 AM