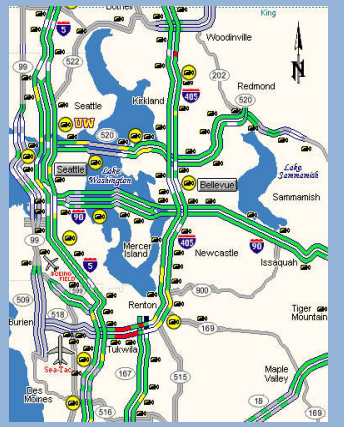
Road Weather Research



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NCAR – Research Applications Lab

Boulder, CO

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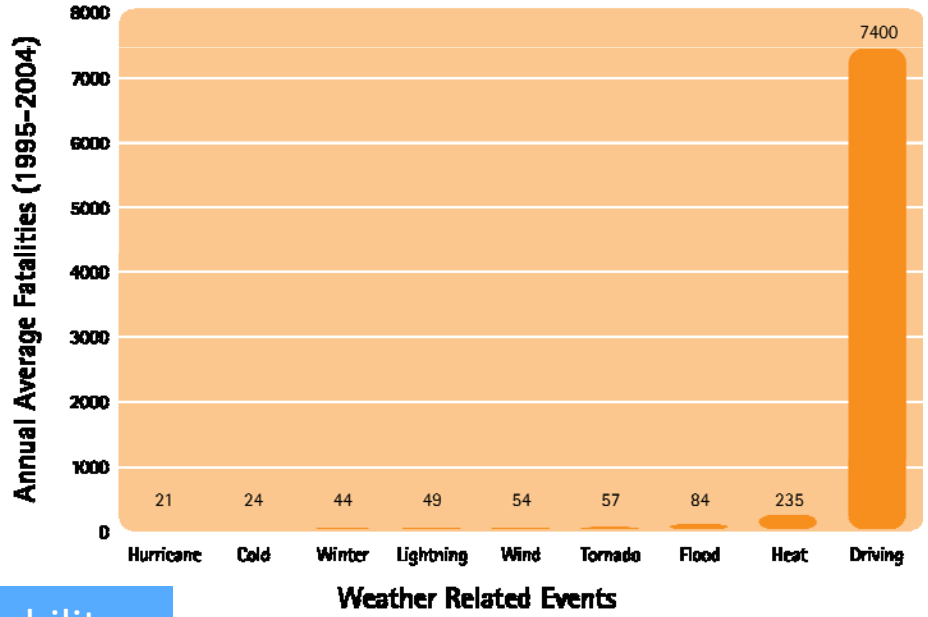
U.S. Department of Transportation
Federal Highway Administration

Why Invest in Road Weather Research

Safety

Over 1,500,000 crashes occur each year during poor weather conditions, which result in more than 690,000 people injured and nearly **7,400** fatalities.*

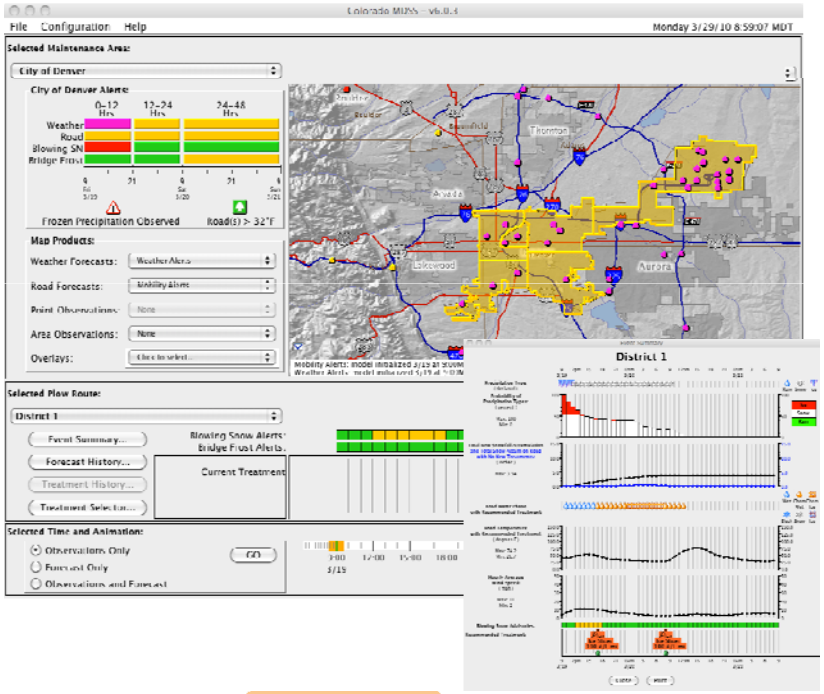


Efficiency and Mobility

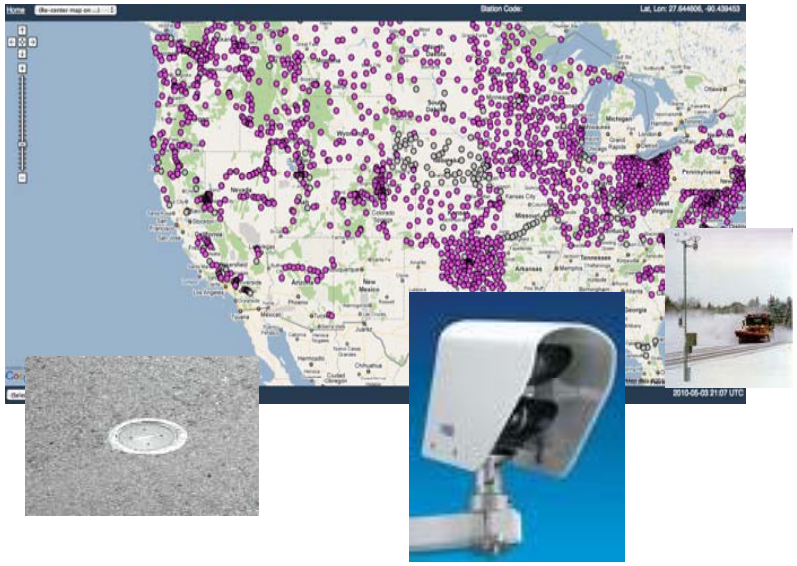
It is estimated that 554 million vehicle-hours of delay per year result from snow, ice, and fog at an approximate cost of $8 billion.

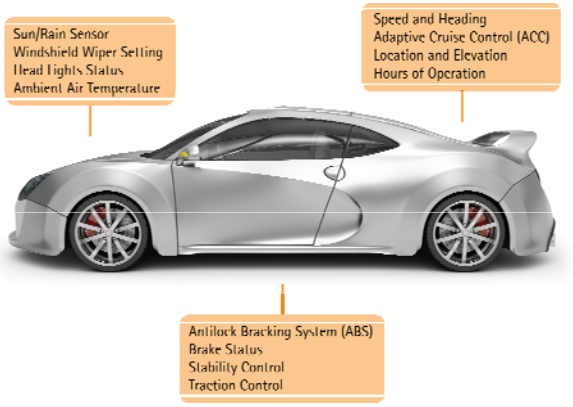
Current Solutions

Maintenance Decision Support System - MDSS

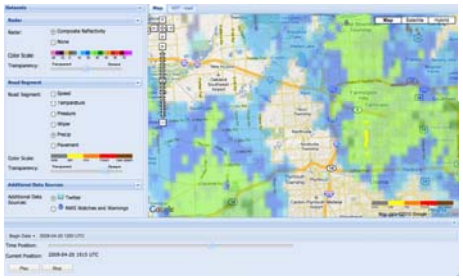


Clarus System

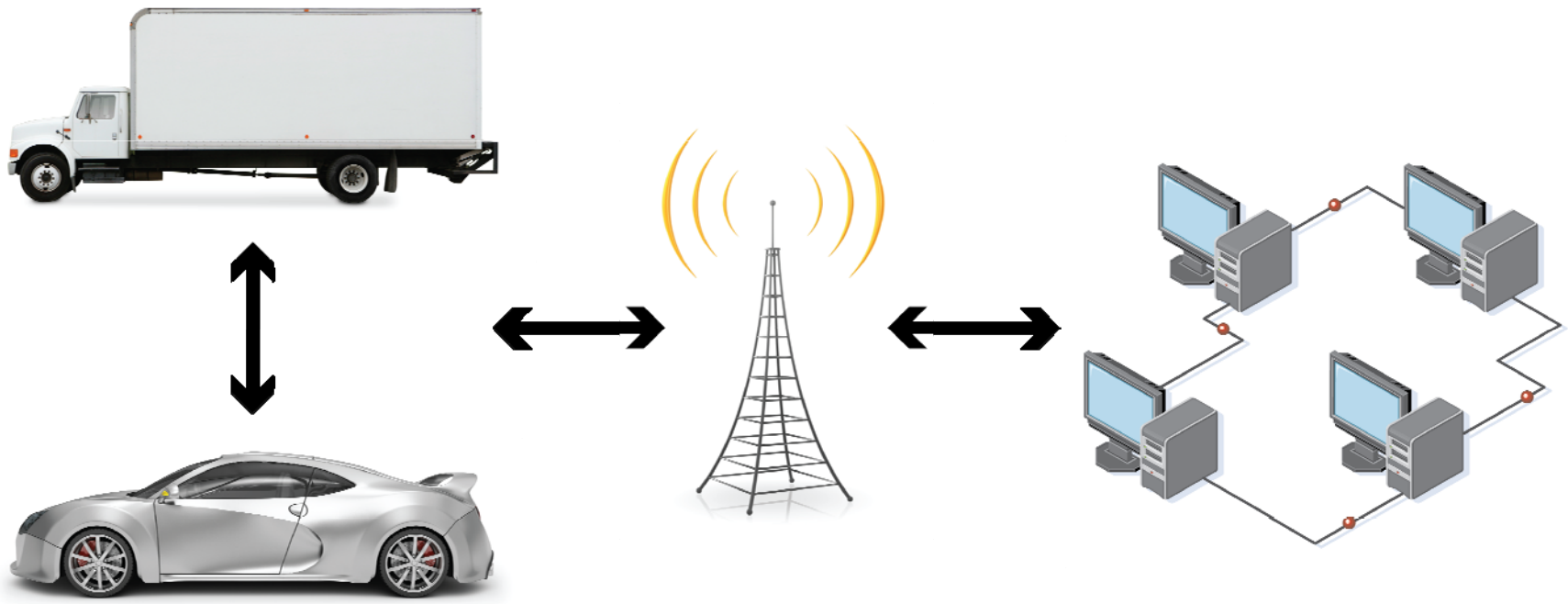




Intellidrive[SM]-enabled Weather



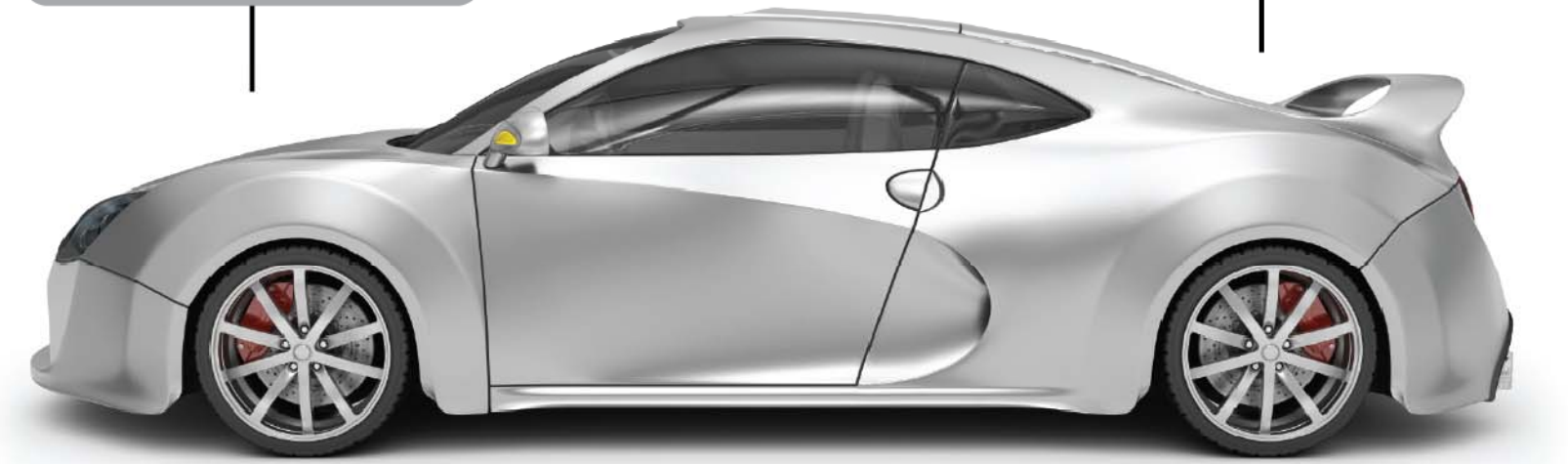
Weather Observations from Connected Vehicles



Weather Observations from Connected Vehicles

Barometric Pressure
Windshield Wiper Setting
Headlights Status
Ambient Air Temperature

Speed and Heading
Adaptive Cruise Control (ACC)
Location and Elevation
Hours of Operation



Anti-lock Braking System (ABS)
Brake Status
Stability Control
Traction Control

Yaw/Pitch/Roll
Accelerometer
Steering Angle
Differential Wheel Speed

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Vehicle Data Translator (VDT) – Version 3.0

Objectives

- Better Characterization of current weather and road-weather conditions
- Accurate Quality Checking and/or Quality Control of vehicle data
- Development of inferred road segment specific weather and road-weather information for end-user applications

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Vehicle Data Translator (VDT) – Version 3.0

Ancillary: Radar, Satellite, RWIS, Etc.

VDT 3.0

Stage I

Mobile data ingesters

Output data handler

Stage II

Ancillary data ingesters

QCh Module

Statistics module

Output data handler

Stage III

Inference Module

Output data handler

Parsed mobile data

Qched data, Basic road segment data

Advanced road segment data

Apps

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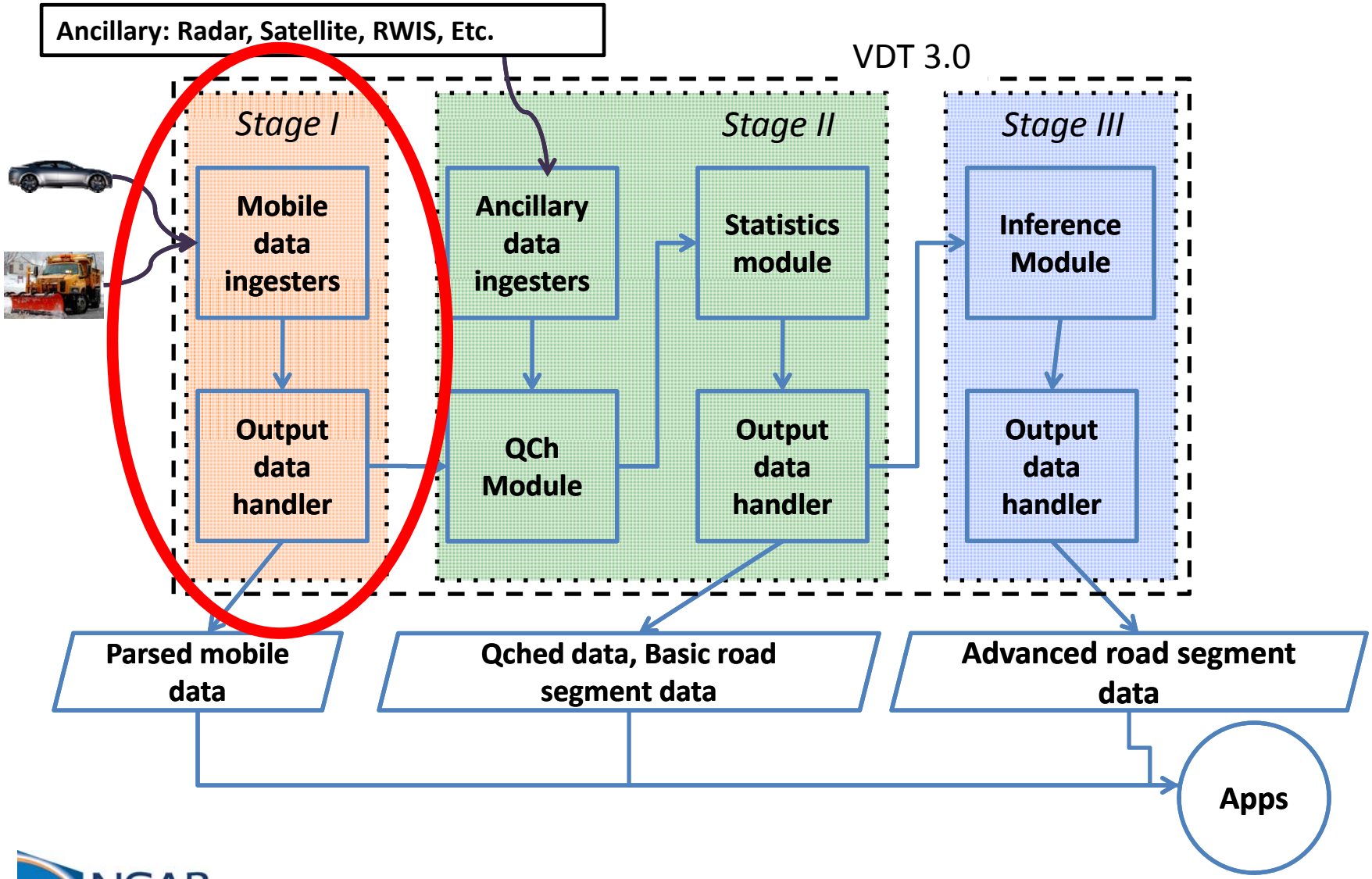
Vehicle Data Translator (VDT) – Version 3.0



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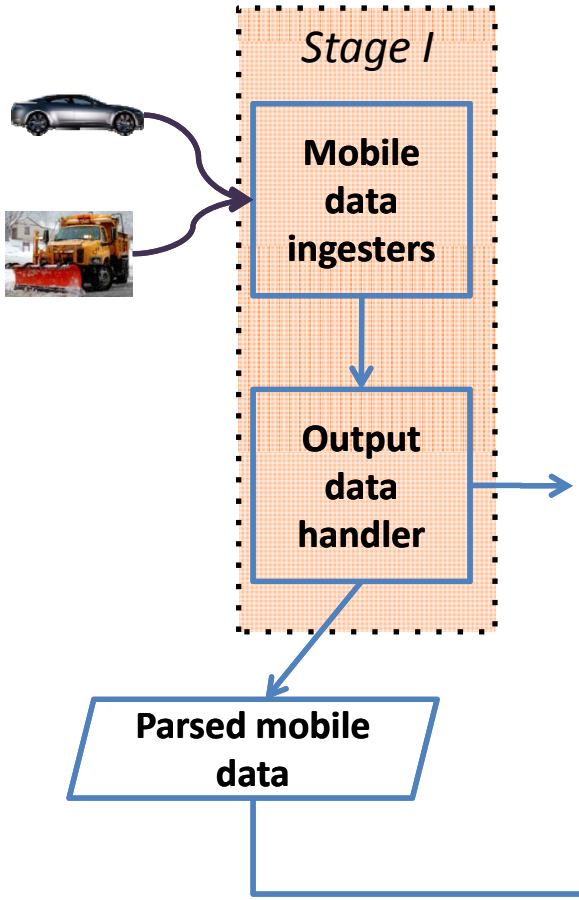

- Ingest vehicle data from CANBus & aftermarket sensors
- Data parsed, sorted/binned
- Light Quality Control
- Sorted by time, road segment and grid cell
  - Segments & grids user defined
- All processed data available for other applications

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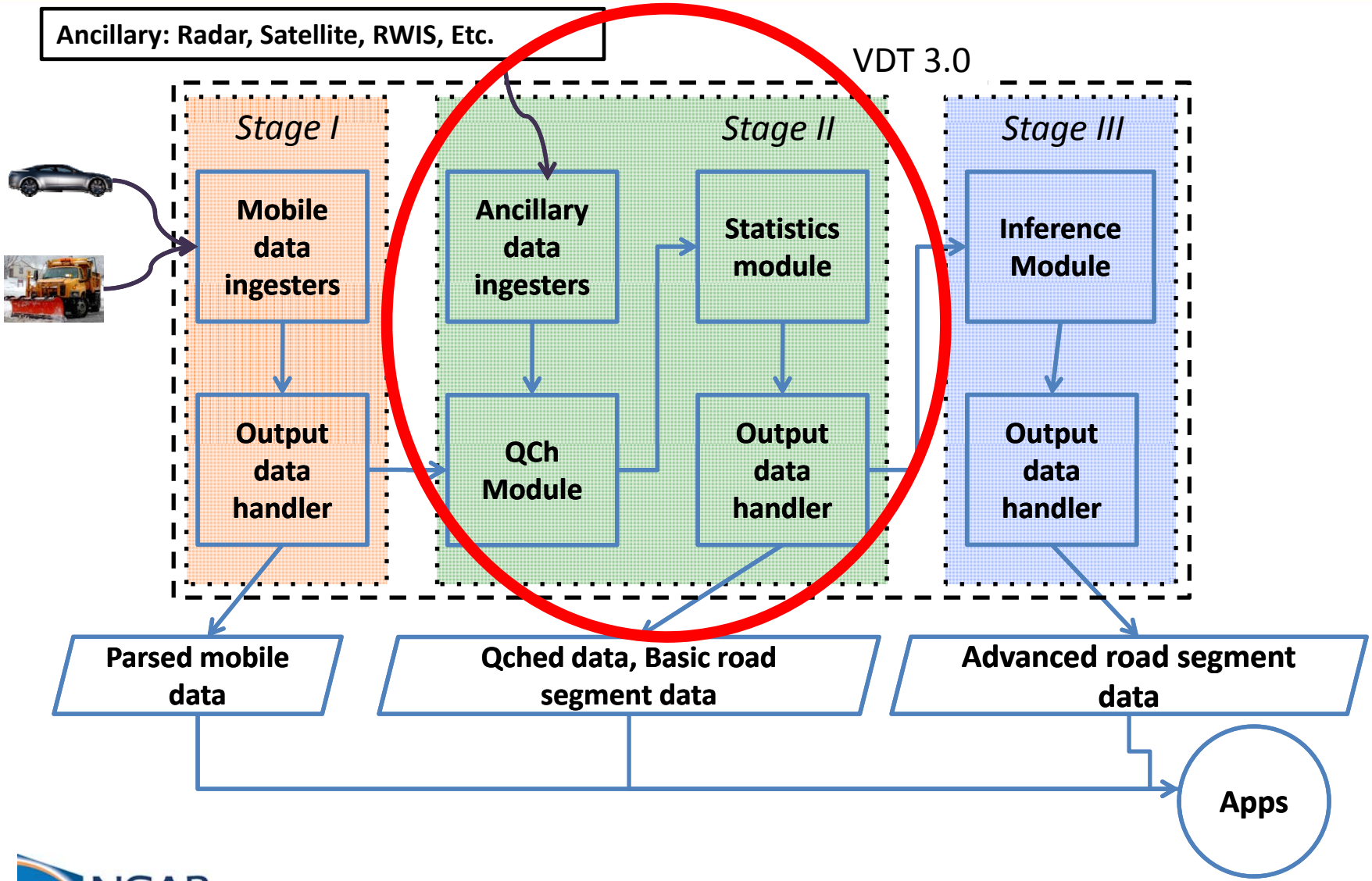
Vehicle Data Translator (VDT) – Version 3.0



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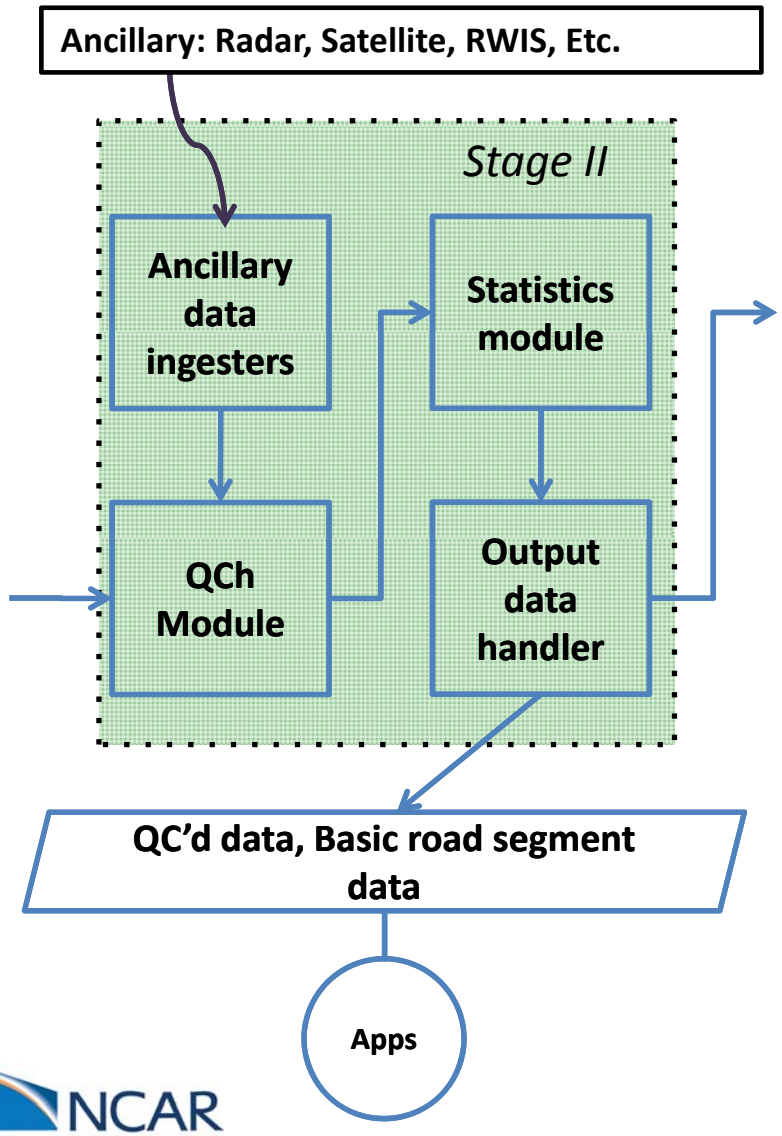

- Ingest ancillary data for QC and Stage III
- Quality Checks
  - From *Clarus*: Sensor Range, Spatial, Climate Range
  - New Mobile Data Tests: Data Filtering (tunnel, slow speeds), Model Analysis, Neighboring Vehicle, Combined Algorithm
- Combines point data into basic road segment products
  - Temp range, speed, etc

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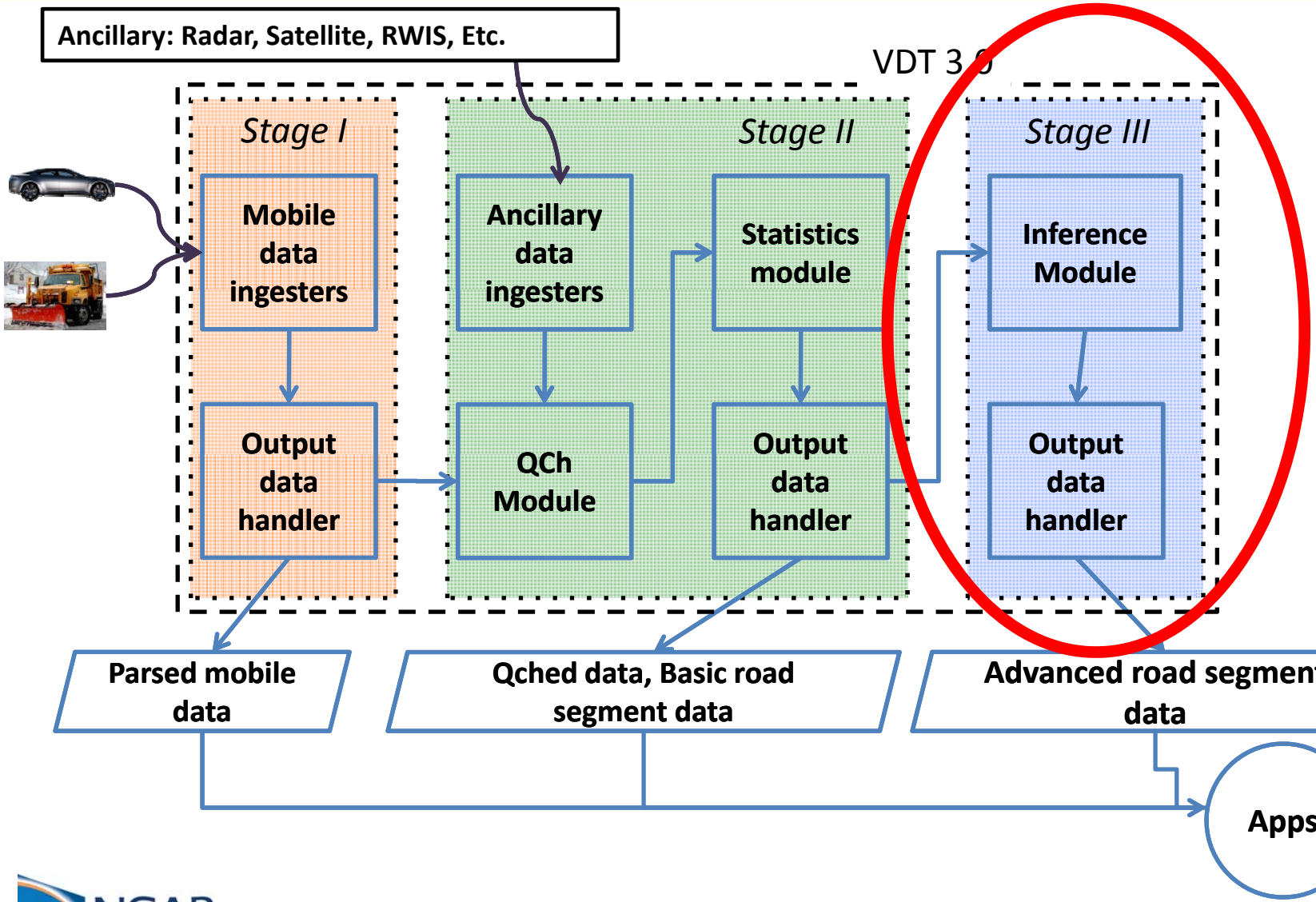
Vehicle Data Translator (VDT) – Version 3.0



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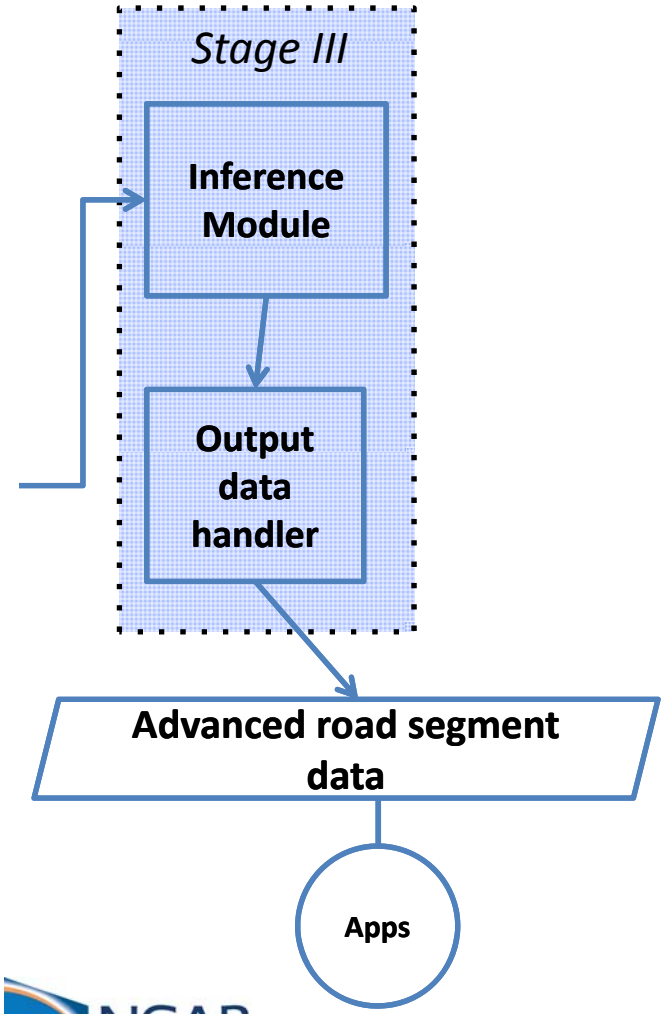
Vehicle Data Translator (VDT) – Version 3.0



- More sophisticated road impact information
- Precipitation Type and Intensity: combines basic vehicle (e.g. wiper, temp), weather radar and satellite data
- Visibility: combines basic vehicle (e.g. headlight, wiper, temp), satellite and fixed weather station data
- Pavement Condition: combines more vehicle (e.g. ABS, traction, etc) , weather radar and satellite

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Solicitation for Partnership with States

- NCAR issued the solicitation last fall (2010)
  - Scope of Work
  - Funding assistance / Grant
- Pool Funds and Consortia were targeted: Aurora, IntelliDrive, Clear Roads, MDSS
- Just a handful of states expressed interest:
  - Idaho
  - Minnesota
  - Nevada
  - South Dakota

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Integrated Mobile Observations (IMO) Project

- Selection based on
  - Fleet
  - Maturity of the maintenance ITS program
  - Integration of mobile obs into state's application
    - MMS, MDSS, MODSS, TIS….
  - Other factors/synergies (multi-state, corridor, etc.)
  - Willingness to make data and lessons learned widely available /open source

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Integrated Mobile Observations (IMO) Project

Selected States

- Minnesota
- Nevada

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Integrated Mobile Observations (IMO) Project

Selected States

- Minnesota

- Nevada and Utah

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Integrated Mobile Observations (IMO) Project

Nevada

- Why
  - Actively pursuing an AVL/MDSS program
  - Fleet adds variety to the study (different manufacturer)
  - Strong upper management support
  - Strong proposal
    - Potential corridor-wide participation (I-80 corridor)
    - Strong partnership with academia (Univ. Nevada-Reno)
    - Proposed integration with MDSS, MMS, TIS
    - Ability to collect desired data parameters (from CAN-Bus and add-on sensors)
- Level of Funding: $263K granted via an allocation memo

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Various Weather & MDSS Data Parameters

In-vehicle computer

Road and weather sensors

- Numerous sensors and devices are controlled or monitored by a vehicle-mounted computer.
- Data is logged in-vehicle as well as sent via radio to UNR in near-real-time using the NDOT EDACS radio network.
- All instrument and equipment installations are being done by UNR &NDOT teams who are familiar with the vehicles (NDOT) and instrumentation (UNR).

Data Being Gathered

NV IMO Project (UNR/NDOT)

- General Data
  - GPS Date, time, location, bearing, speed, altitude, accuracy
- Road Conditions
  - Road surface temperature
  - Vehicle accelerations (surface friction)
  - Road condition images (camera)
- Atmospheric Conditions
  - Pressure, temperature, relative humidity, dew point
  - Wind speed and direction
- Vehicle & Equipment Data
  - Speed, brake status, engine intake air temperature & pressure
  - Spreader and plow status
  - Steering, traction control, ABS, yaw, accelerations, emissions data, engine data, headlight and wiper status

Blue denotes parameter being implemented
Gray denotes parameter "under study"

Two Vehicle Types
Based in NV Districts 2 & 3 Along I-80 Corridor

- Vehicles with winter assignments along I-80 were selected.
- Makes & models are presently limited to vehicles with compatible CANBus or OBDII vehicle data formats.

Integrated Mobile Observations (IMO) Project

Research and Applications

- VDT 3.0 Algorithm development
- Possible Input to MDSS, MMS, TIS
- Assimilation into pavement model

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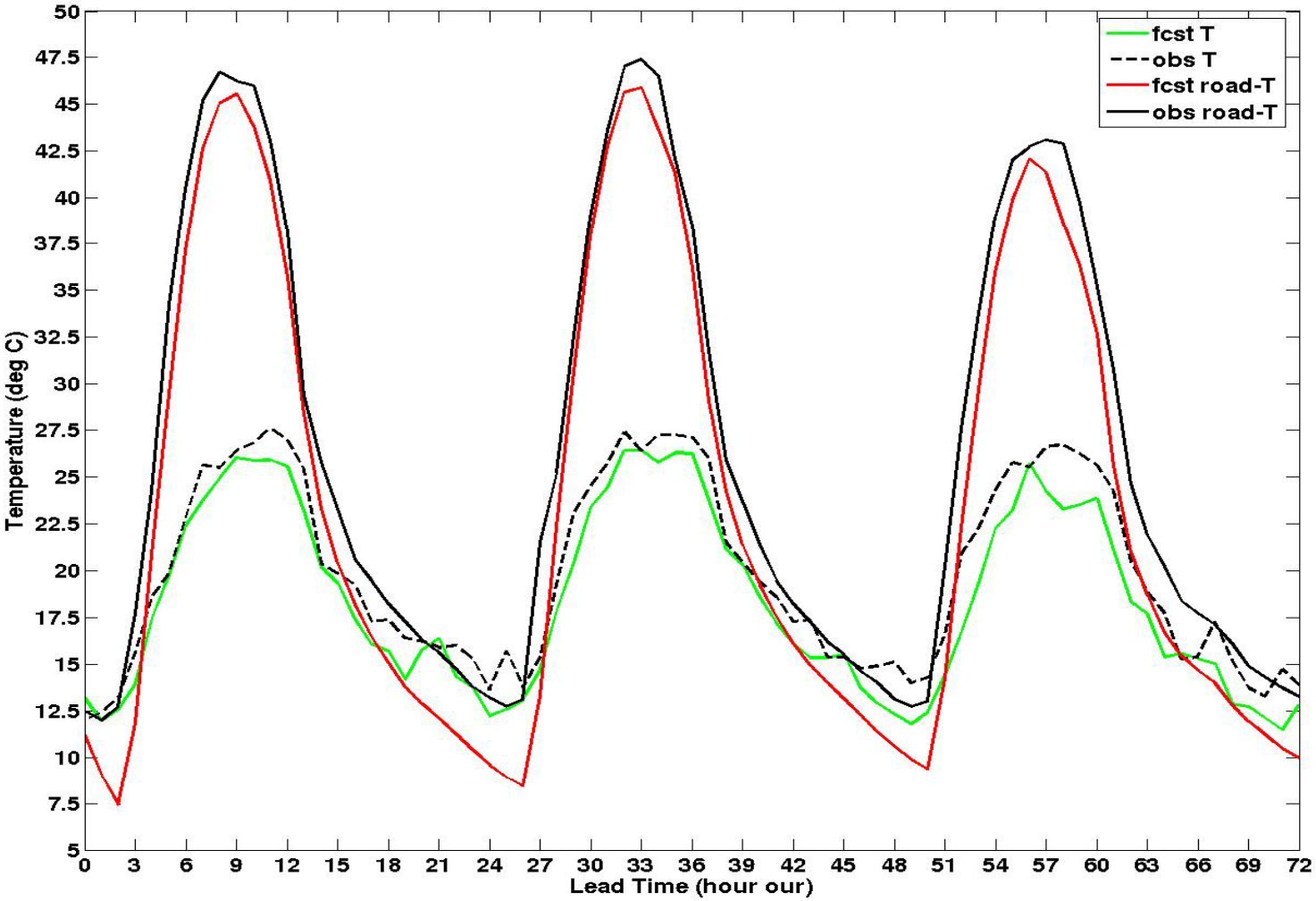
APPLICATIONS – IMO Project

Pancake Summit – 22 September 2011 1200UTC



FUTURE APPLICATIONS

VDT-based weather alerts

- ❖ Impending weather hazards
- ❖ Alerts from other vehicles
- ❖ Re-routing
- ❖ Decision support

Not just for the everyday driver!

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FUTURE APPLICATIONS

Road Maintenance – Where are we losing the road to ice?
When should we paint or repair?

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Route Specific Impact Warnings for…

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Route Specific Impact Warnings for…

School Buses

FUTURE APPLICATIONS

Road Maintenance – Where are we losing the road to ice?
When should we paint or repair?

Route Specific Impact Warnings for…

School Buses

Truckers

FUTURE APPLICATIONS

Road Maintenance – Where are we losing the road to ice?
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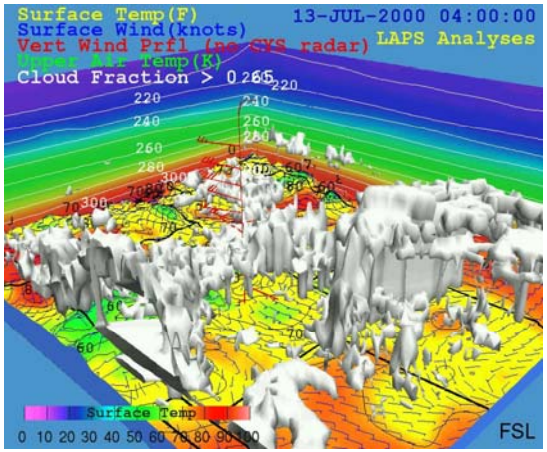
Route Specific Impact Warnings for…

School Buses

Truckers

EMS

More APPLICATIONS



Numerical Weather Modeling

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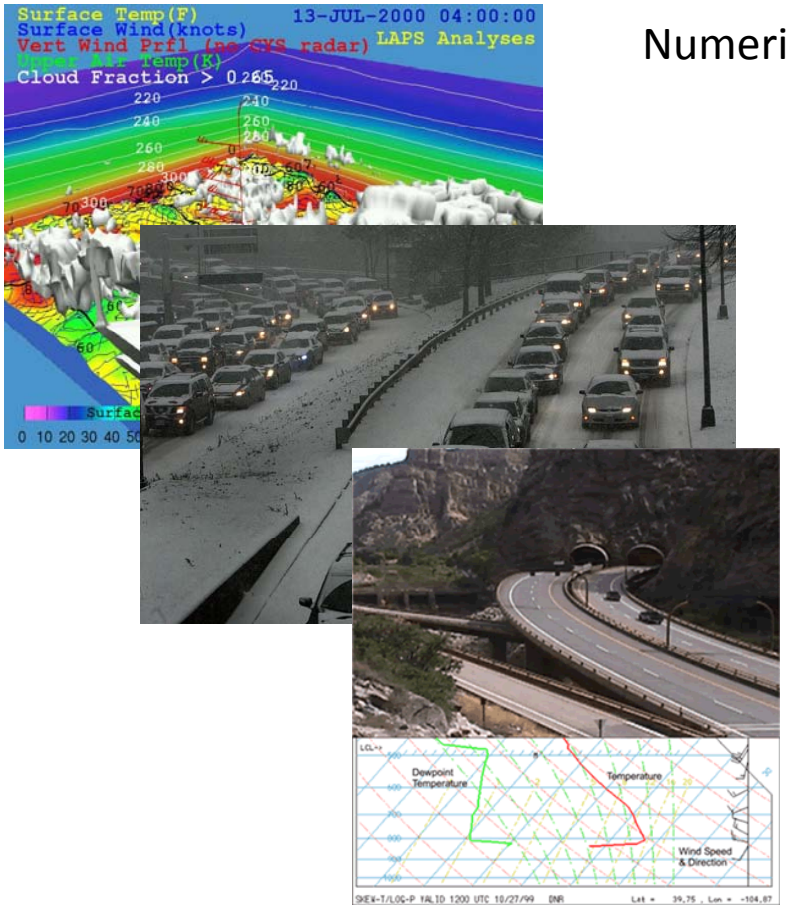
More APPLICATIONS

Numerical Weather Modeling

Traffic Modeling and Alerting

More APPLICATIONS



Numerical Weather Modeling

Traffic Modeling and Alerting

Weather Modeling – complex terrain

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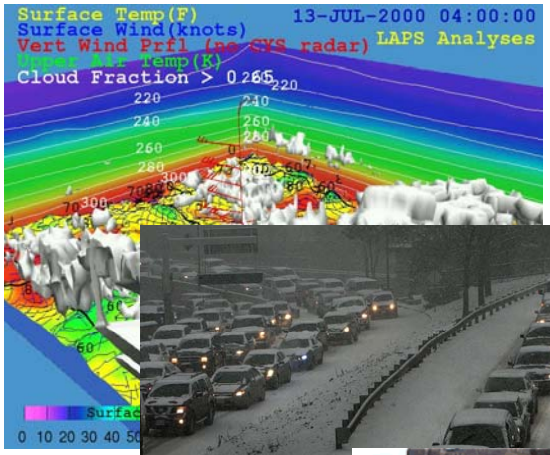
More APPLICATIONS



Numerical Weather Modeling

Traffic Modeling and Alerting

Weather Modeling – complex terrain

Other surface transportation users

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