ROADIDEA

Road Map to Radical Innovations in Transport Services

Pirkko Saarikivi

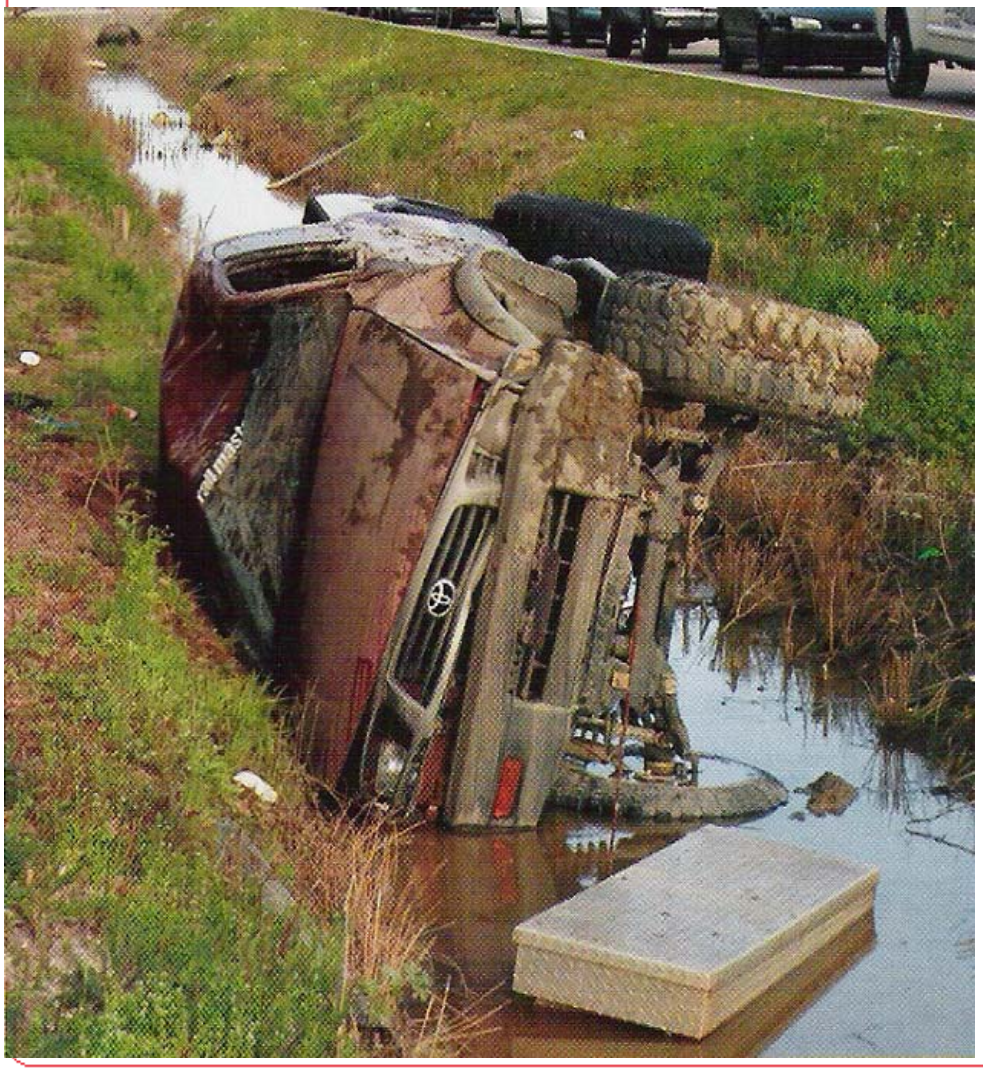
Foreca Consulting Oy

ROADIDEA-INCO Seminar 24 September 2010 , Environment Canada

Contents

- ROADIDEA objectives and introduction
- ROADIDEA-INCO: Comparing EU, USA and Canada
- The top ROADIDEA innovations
- Finnish road weather service and METRo

Problem 1: Traffic may kill you!



- More than 40.000 killed every year in the EU in traffic accidents
- More than 1.200.000 injured
- Weather plays a significant role in most accidents
- EU target of 50% reduction no success

Problem 2: It's getting hot!

- 20% of green house gas emissions are generated by transport
- But efficient and safe transport is vital for the society and economy

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Road Map for Radical Innovations in European Transport Services

- Budget: 4.9 M€ European Union funding: 3.3 M€
- Duration: 34 months 2007-2010
- Coordinator: Foreca Consulting Ltd / Dr. Pirkko Saarikivi
- 14 Partners from **Finland**: Foreca Consulting Ltd, VTT, Finnish Meteorological Institute, Destia, Logica Suomi, **Sweden**: Klimator AB, Semcon Caran AB, **The Netherlands**: Demis BV, **Germany**: DLR, Pöyry Infra Traffic GmbH, **Italy**: ARPAV, **Hungary**: Road Safety Engineering Bureau, **Croatia**: Meteo-Info d.o.o., **Slovenia**: Amanova d.o.o.

Overall objectives

- Thorough analysis of the **potential** of the European transport service sector for new **innovations**
- Opportunities and barriers?
- Can Europe produce **radical innovations**?
- We claim that...

Our hypothesis

- Effective **accessibility** to all kinds of useful **information**,
- combined with **advanced data fusion** methods,
- applied on technological **information platforms**,
- with high level of **standardisation**;
- These are the prerequisites for the creation of **innovative mobility services!**

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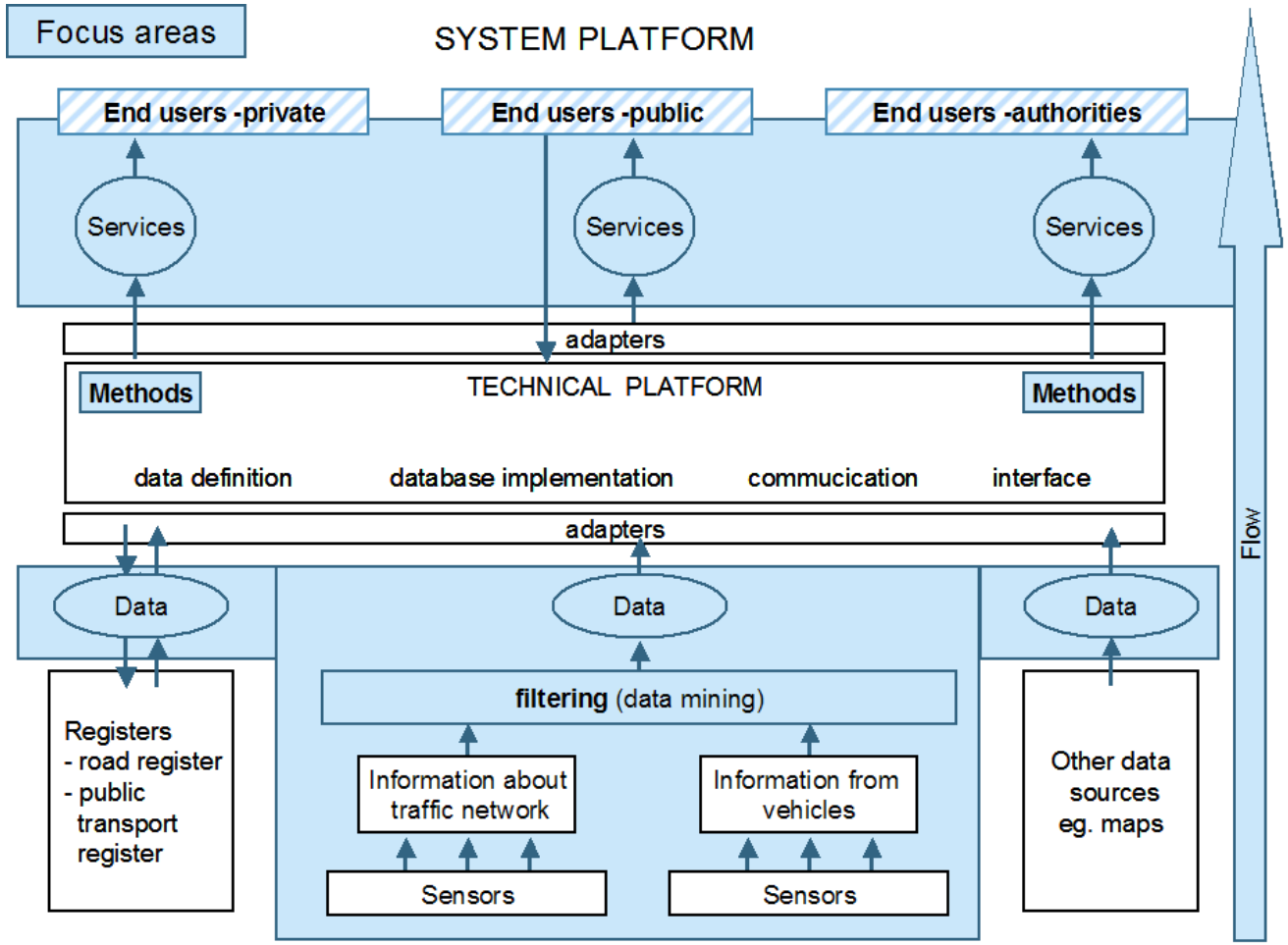
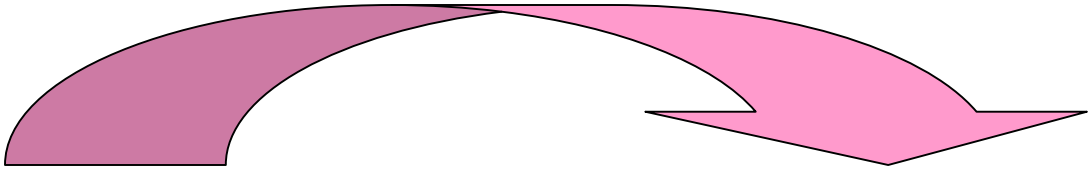
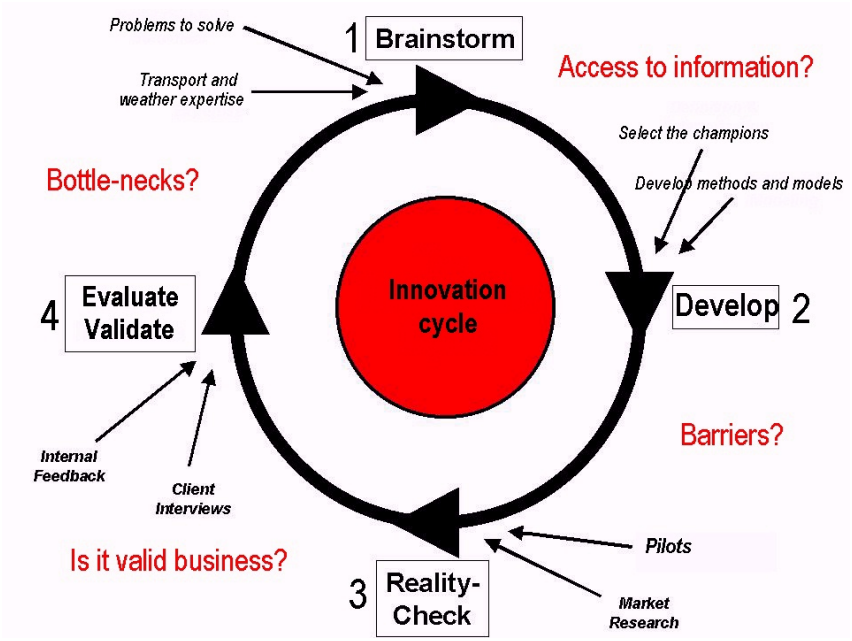
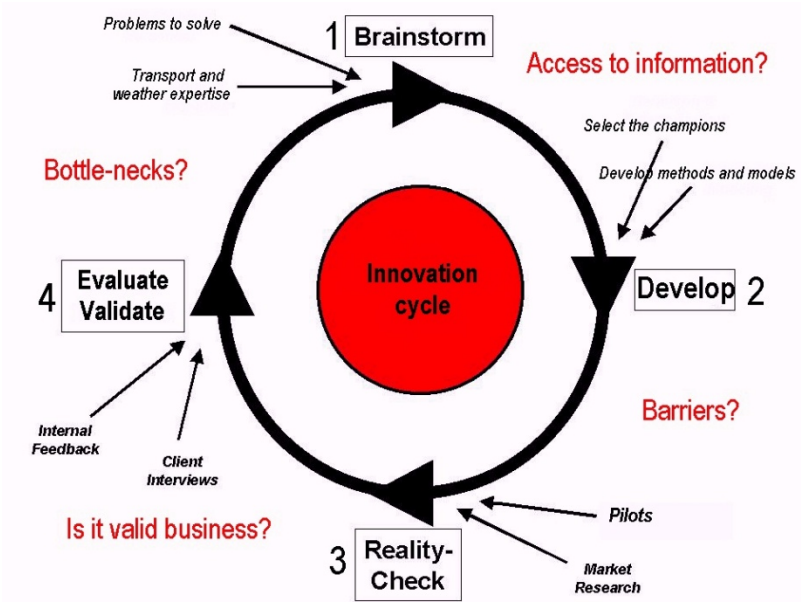
Technical platform and data flow



Two innovation cycles







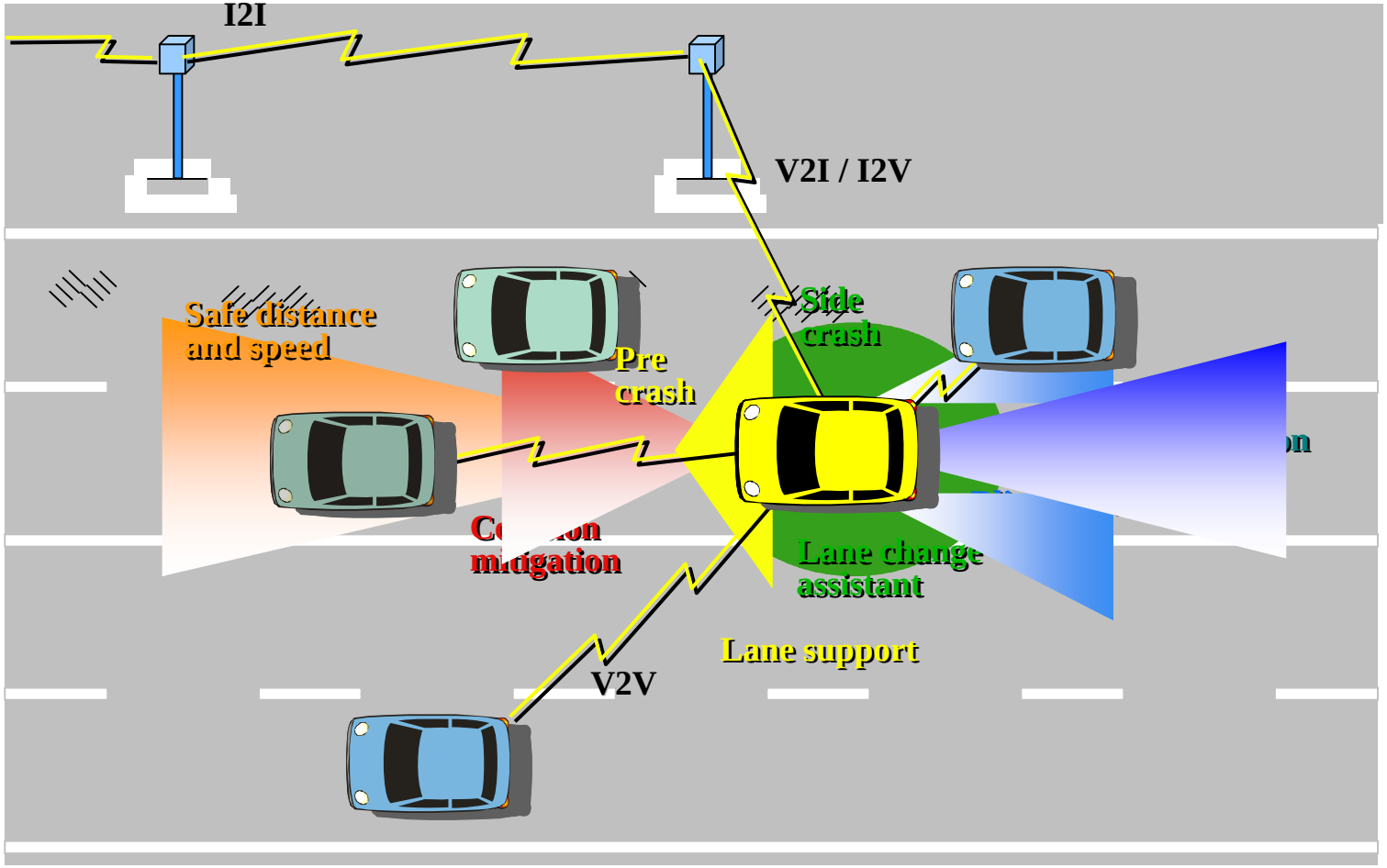
New ideas created and evaluated

- More than 100 road service ideas created in brainstorming sessions
- Few had potential, many were not feasible
- Filtering using democratic voting
- Best ideas shortlisted and developed further

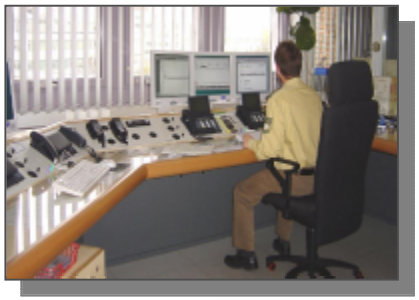
And how does the future of weather and traffic services look like?

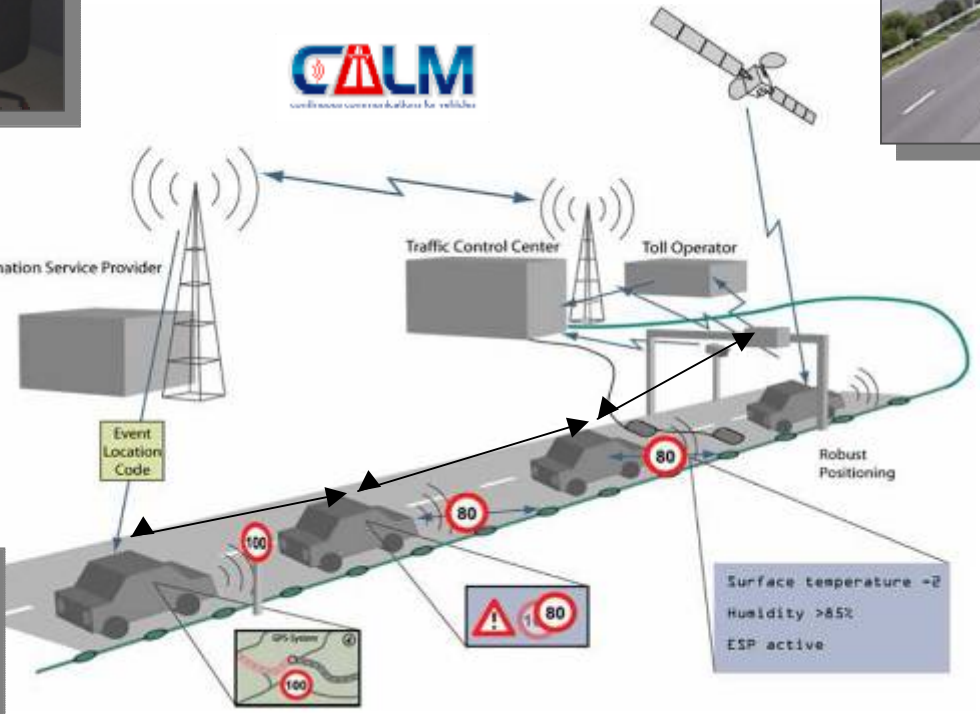
Transport information systems are getting more and more complicated

New V2I/I2V communication



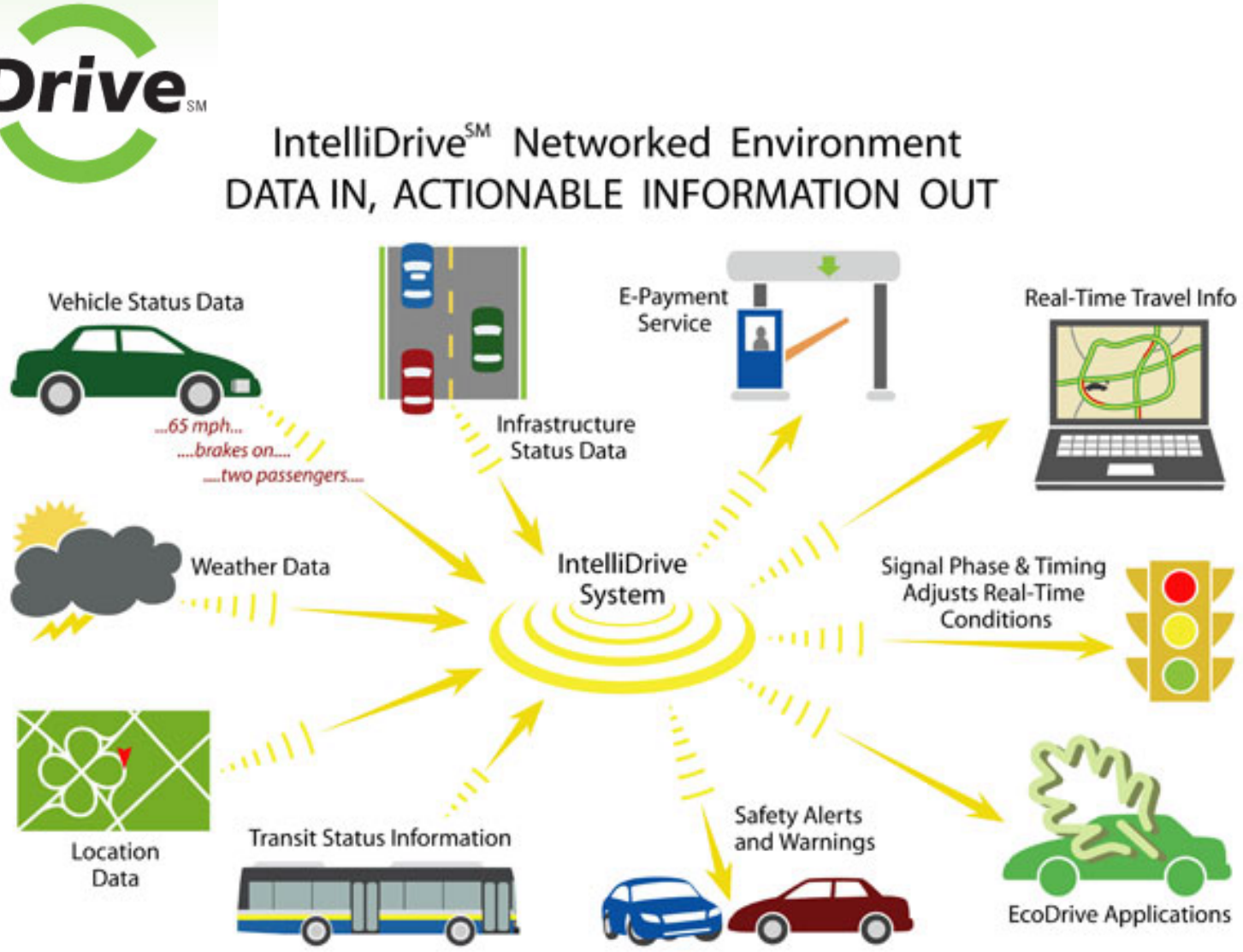
Increasingly complex systems





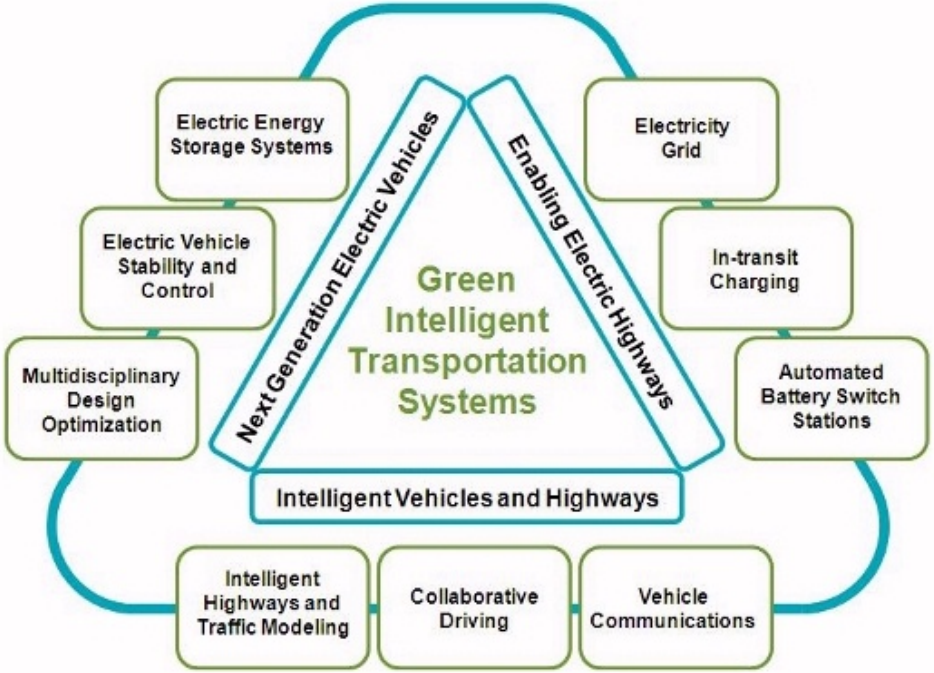
Source: COMeSafety and COOPERS projects

IntelliDrive℠
Safer. Smarter. Greener.



GREEN its GREEN INTELLIGENT TRANSPORTATION SYSTEMS

Through this highly collaborative effort, researchers from University of Waterloo, University of Toronto, and several automotive companies are developing innovative technologies that will collectively improve fuel efficiency and safety, while reducing emissions, manufacturing costs, and traffic congestion. The research team is also investigating efficient methods of power distribution and delivery that will limit the impact of widespread electric vehicle use on our electricity grid. The figure below illustrates the inter-relationships between the three main research themes covered by Green ITS.



University of Waterloo
200 University Avenue West
Mechanical & Mechatronics Engineering, E2 2354G
Waterloo, Ontario, Canada N2L 3G1

WatCAR
Waterloo Centre for Automotive Research

ROADIDEA-INCO

In the USA and Canada

- Comparing ROADIDEA concept and results in the EU, the USA and Canada
- Partner projects: ***Clarus initiative*** of the FHWA and ITS Canada, Transport Canada and Environment Canada
- Visits in three phases:

  1. Introductory and planning during TRB2010 in Washington and SIRWEC/PIARC in Quebec

  2. Fact finding missions, Innovation seminars in the USA 27-28.4. and Canada 24.6.

  3. Final seminars in Brussels 11.6. and September in USA and Canada
- Final Report (out in October 2010) analyses existing data policies, availability and content of road information, methods and models, and provision and innovation of mobility services

Partners: Foreca Consulting Ltd, DLR, Amanova. EC funding 99 k€. Start date 1. Jan 2010, duration 7 months.
Contacts: Pirkko.Saarikivi@foreca.com, Rene.Kelpin@dlr.de, Igor.Grabec@amanova.si

European Commission
Information Society and Media

Comparing the continents

47 countries, 23 languages

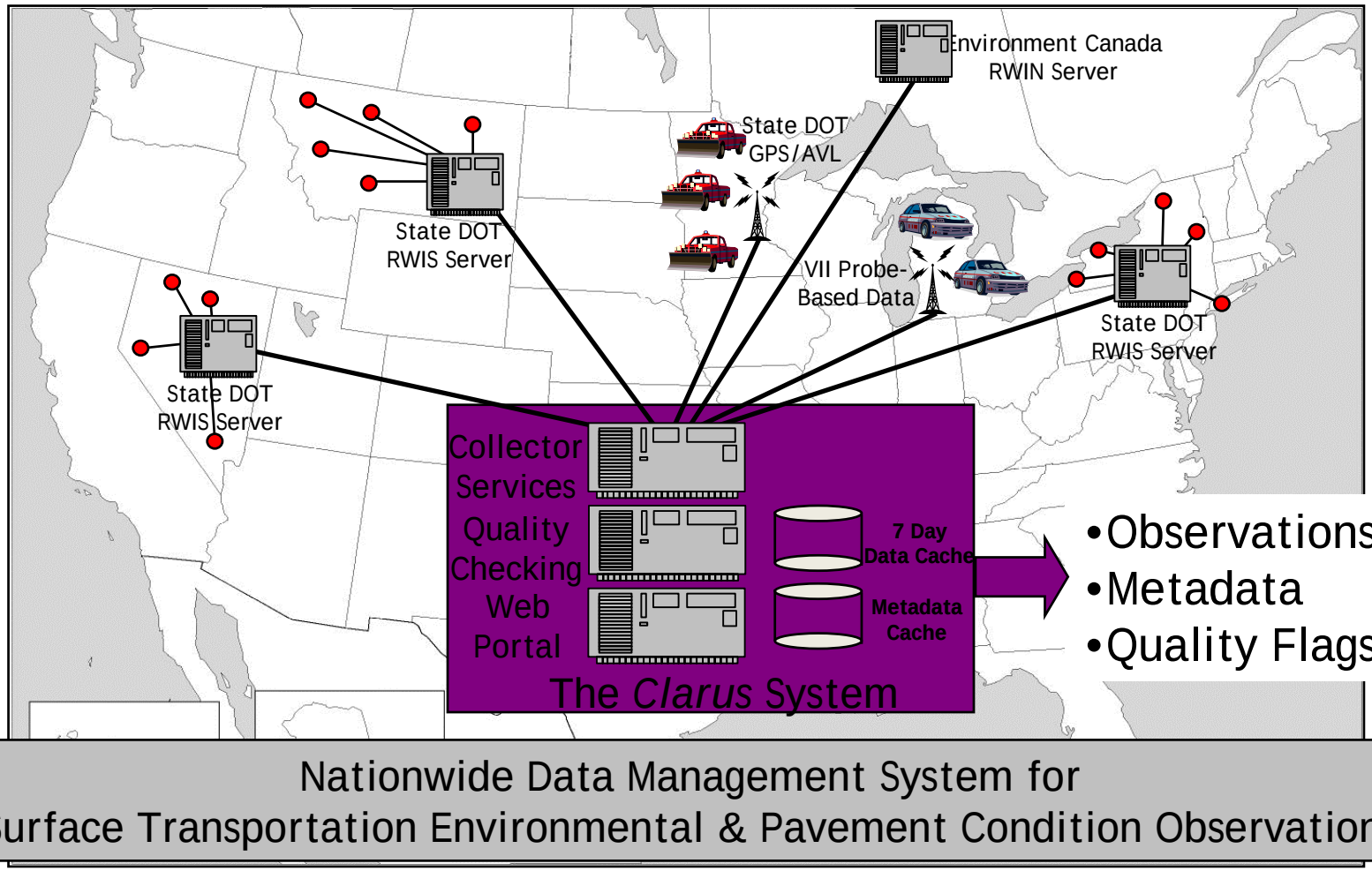
The *Clarus* Initiative

Clarus is an R&D initiative to demonstrate and evaluate the value of

"Anytime, Anywhere Road Weather Information"

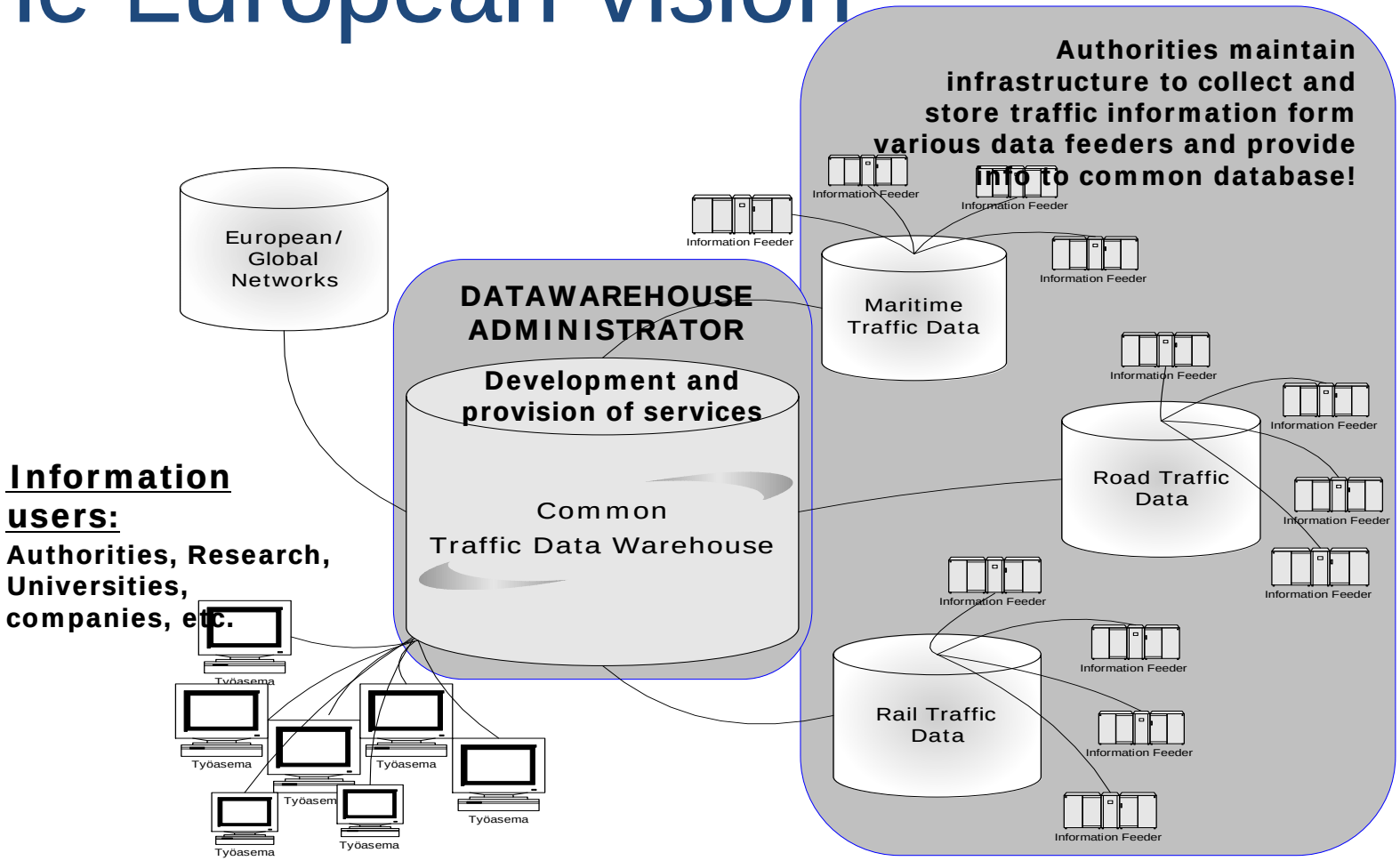
provided by both **public agencies and the private weather enterprise** to transportation users and operators.

US Federal Highway Administration vision: Clarus initiative



Nationwide Data Management System for
Surface Transportation Environmental & Pavement Condition Observations

One European vision



Source: Finnish Marine Administration

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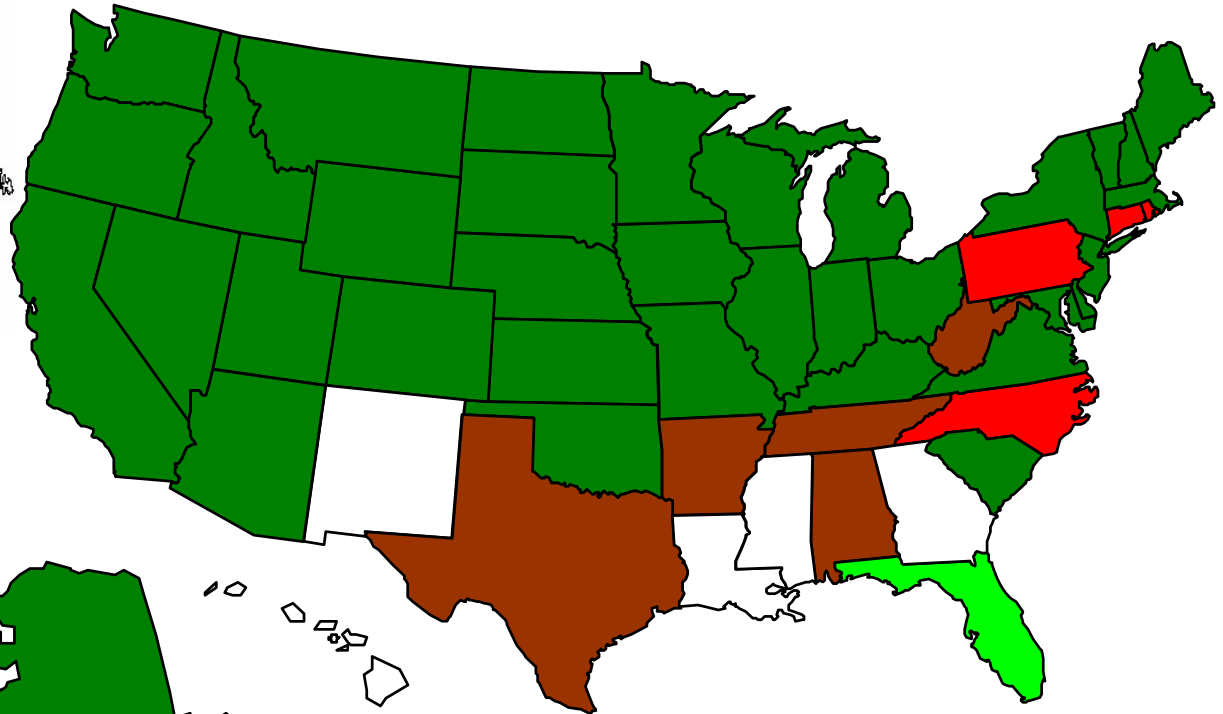
Participation Status for *Clarus* as of December 31, 2009

Canadian RWIN Participation



Local DOT Participation

- City of Indianapolis, IN
- McHenry County, IL
- City of Oklahoma City, OK
- NY State Thruway
- City of Denver, CO
- Washington, DC

Sensor & Station Count

2,019 Sensor Stations (ESS)
46,723 Individual Sensors

Clarus Connection Status

- Connected (35 States, 3 Locals, 3 Provinces)
- Partially (1 State)
- Pending (5 States, 2 Locals)
- Considering (4 States, 1 Local)

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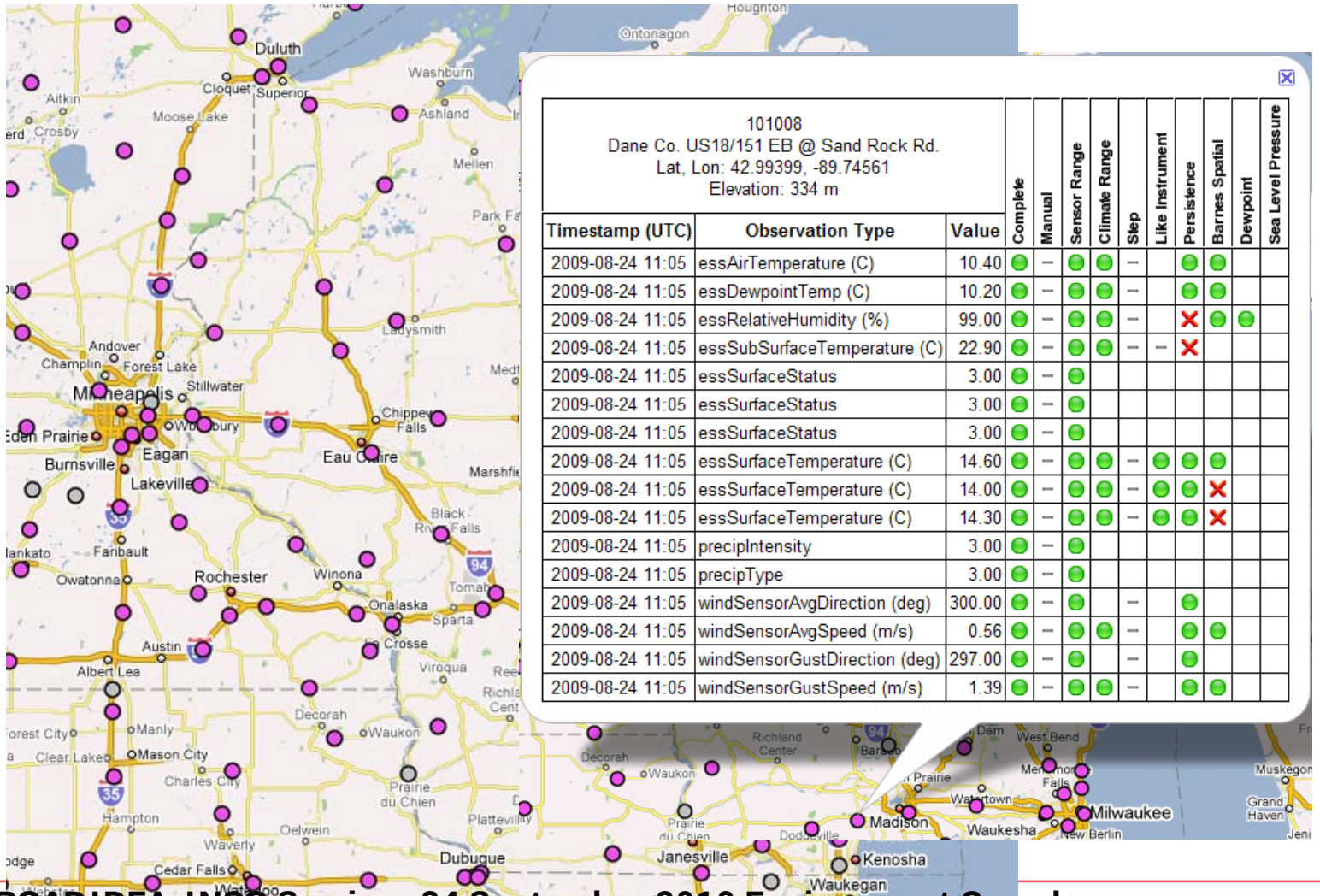
Clarus quality control



101008
Dane Co. US18/151 EB @ Sand Rock Rd.
Lat, Lon: 42.99399, -89.74561
Elevation: 334 m

Timestamp (UTC)	Observation Type	Value	Complete	Manual	Sensor Range	Climate Range	Step	Like Instrument	Persistence	Barnes Spatial	Dewpoint	Sea Level Pressure
2009-08-24 11:05	essAirTemperature (C)	10.40	●	–	●	●	–		●	●		
2009-08-24 11:05	essDewpointTemp (C)	10.20	●	–	●	●	–		●	●		
2009-08-24 11:05	essRelativeHumidity (%)	99.00	●	–	●	●	–		✗	●	●	
2009-08-24 11:05	essSubSurfaceTemperature (C)	22.90	●	–	●	●	–	–	✗			
2009-08-24 11:05	essSurfaceStatus	3.00	●	–	●							
2009-08-24 11:05	essSurfaceStatus	3.00	●	–	●							
2009-08-24 11:05	essSurfaceStatus	3.00	●	–	●							
2009-08-24 11:05	essSurfaceTemperature (C)	14.60	●	–	●	●	–	●	●	●		
2009-08-24 11:05	essSurfaceTemperature (C)	14.00	●	–	●	●	–	●	●	✗		
2009-08-24 11:05	essSurfaceTemperature (C)	14.30	●	–	●	●	–	●	●	✗		
2009-08-24 11:05	precipIntensity	3.00	●	–	●							
2009-08-24 11:05	precipType	3.00	●	–	●							
2009-08-24 11:05	windSensorAvgDirection (deg)	300.00	●	–	●		–		●			
2009-08-24 11:05	windSensorAvgSpeed (m/s)	0.56	●	–	●	●	–		●	●		
2009-08-24 11:05	windSensorGustDirection (deg)	297.00	●	–	●		–		●			
2009-08-24 11:05	windSensorGustSpeed (m/s)	1.39	●	–	●	●	–		●	●		

Next Steps for *Clarus*

- Enhanced QC Algorithms
- Mobile Sensing Research
- Transition *Clarus* to NOAA by 2011
- Provide an environment to innovate and create new and improved services

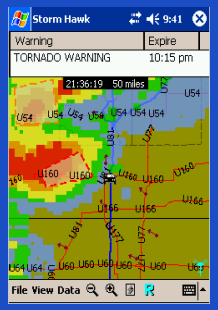
ROADIDEA

Source for unlimited service innovations!

511 Travel Info

Credible & Precise Travel Advice

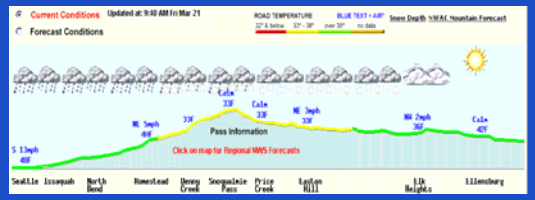
Add Detail to HAR & VMS



Spawn New Technologies (PDA, cell)

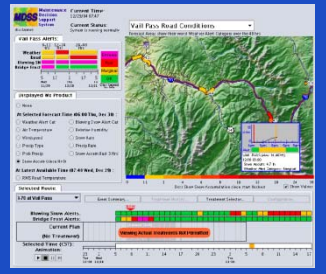
Route Specific Radio & TV Broadcasts of Travel Conditions

Clarus



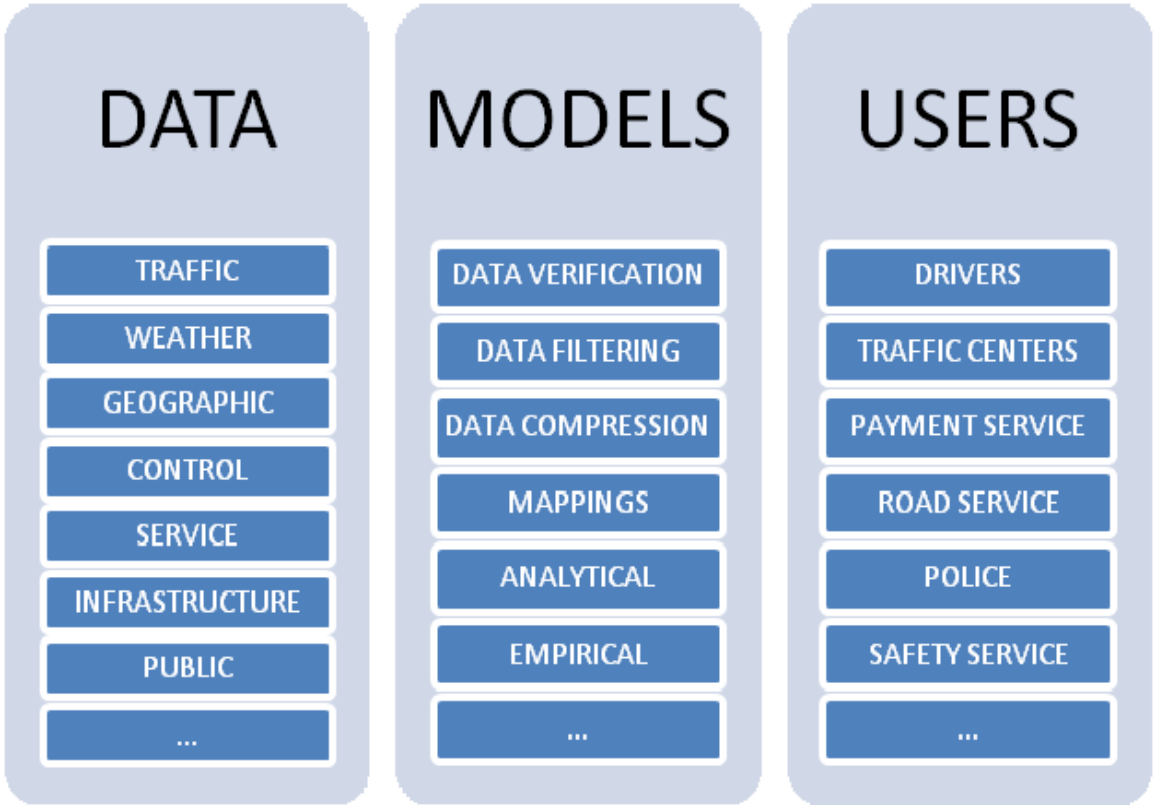
More Effective Websites

In-vehicle Information



Enhanced decision making tools

Data + Models = ITS services



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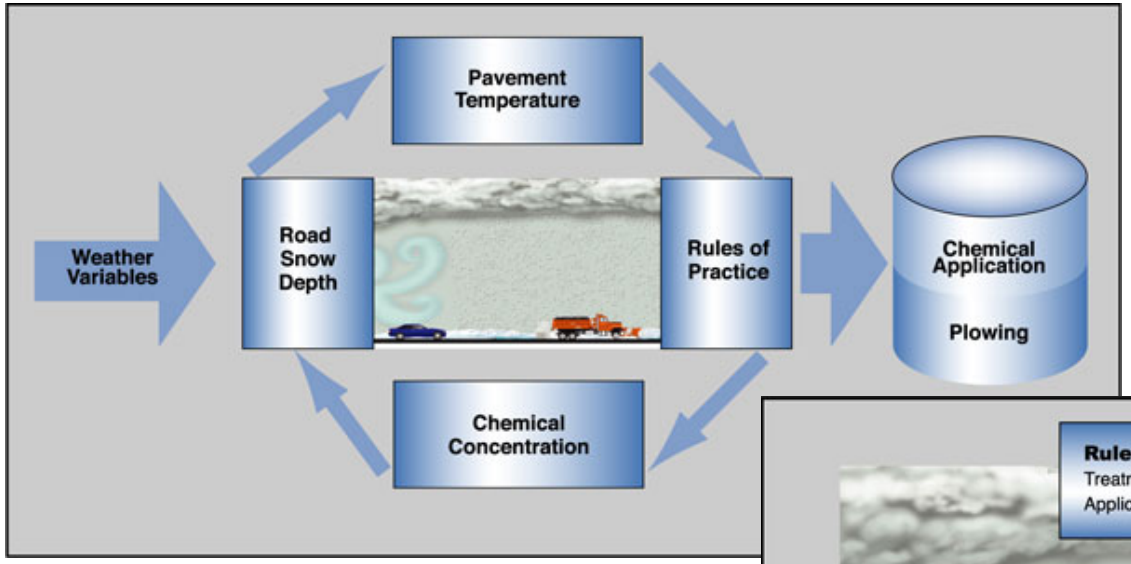
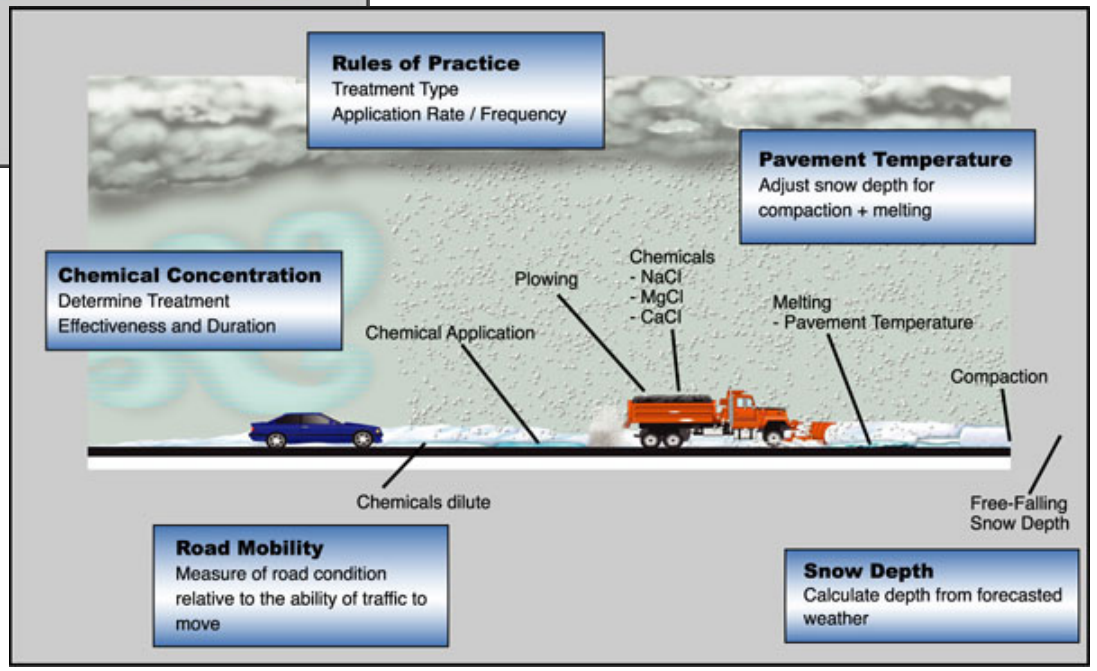
Models for road applications





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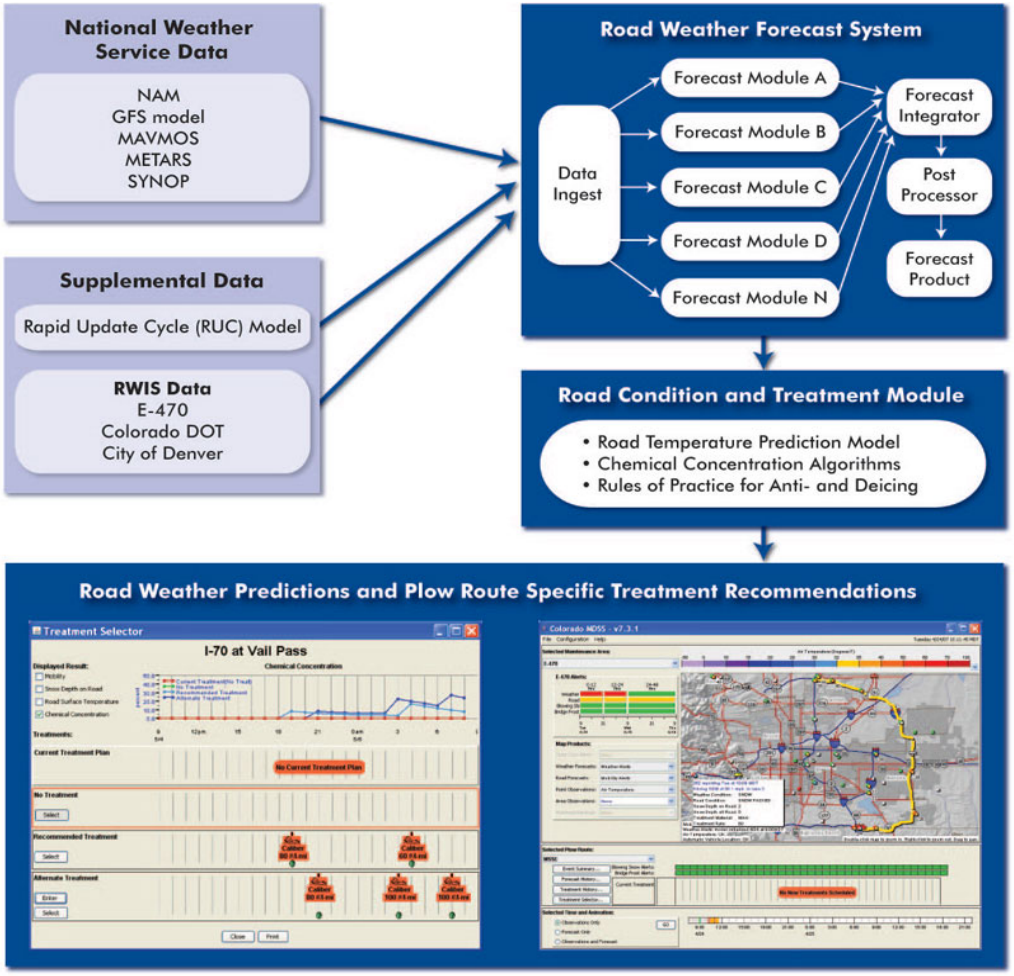
Decision Support – the MDSS



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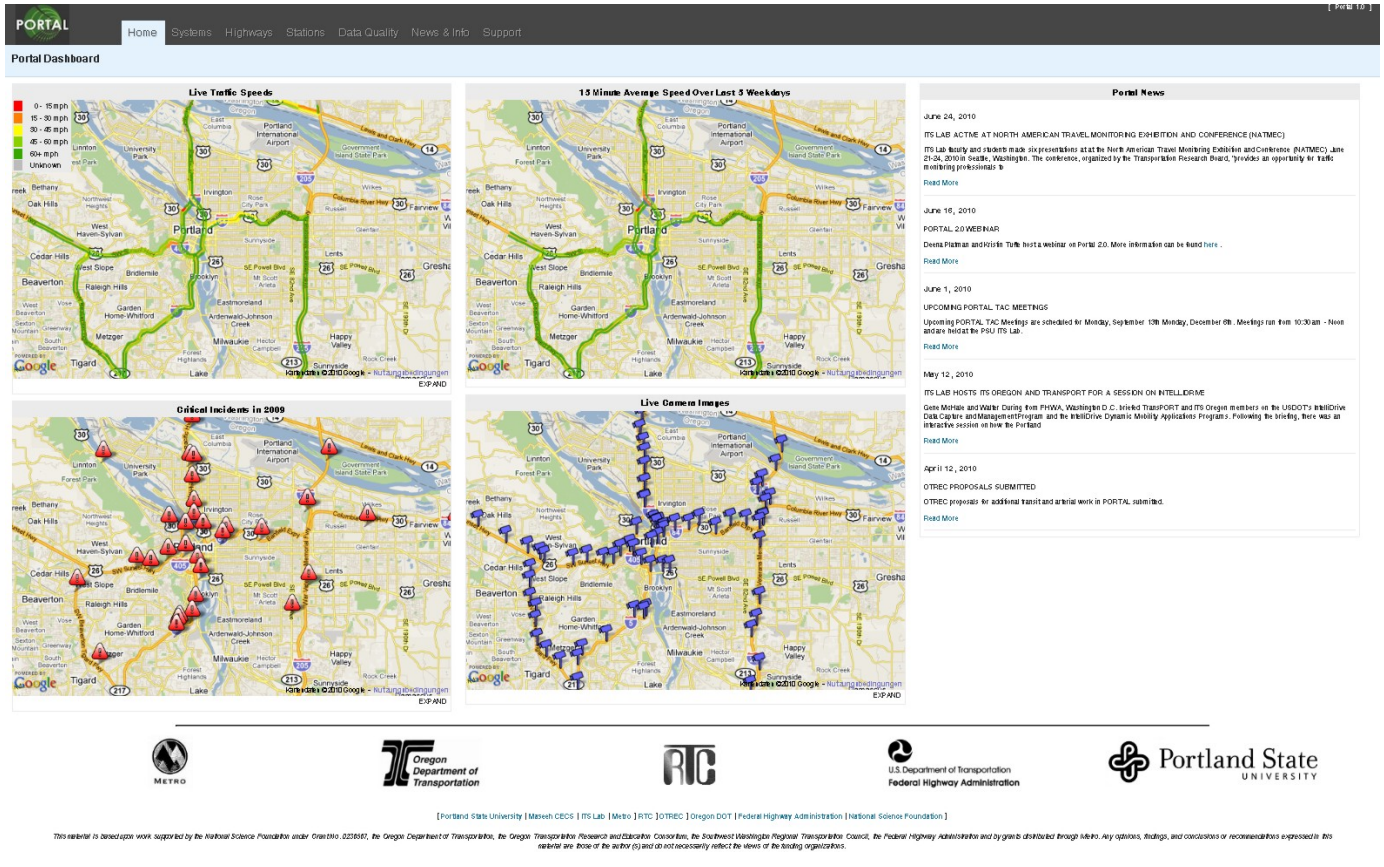
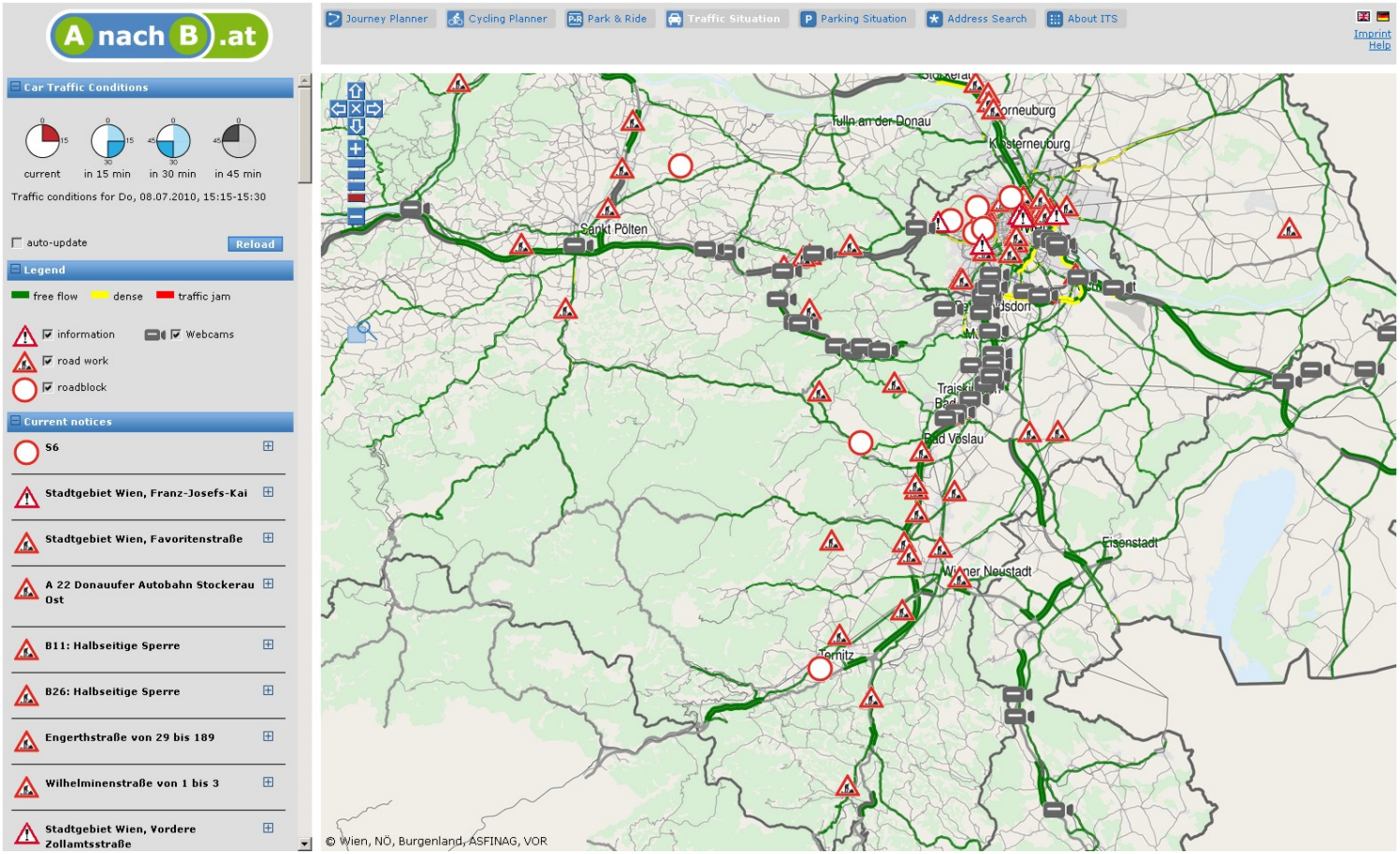
Some mobility service solutions



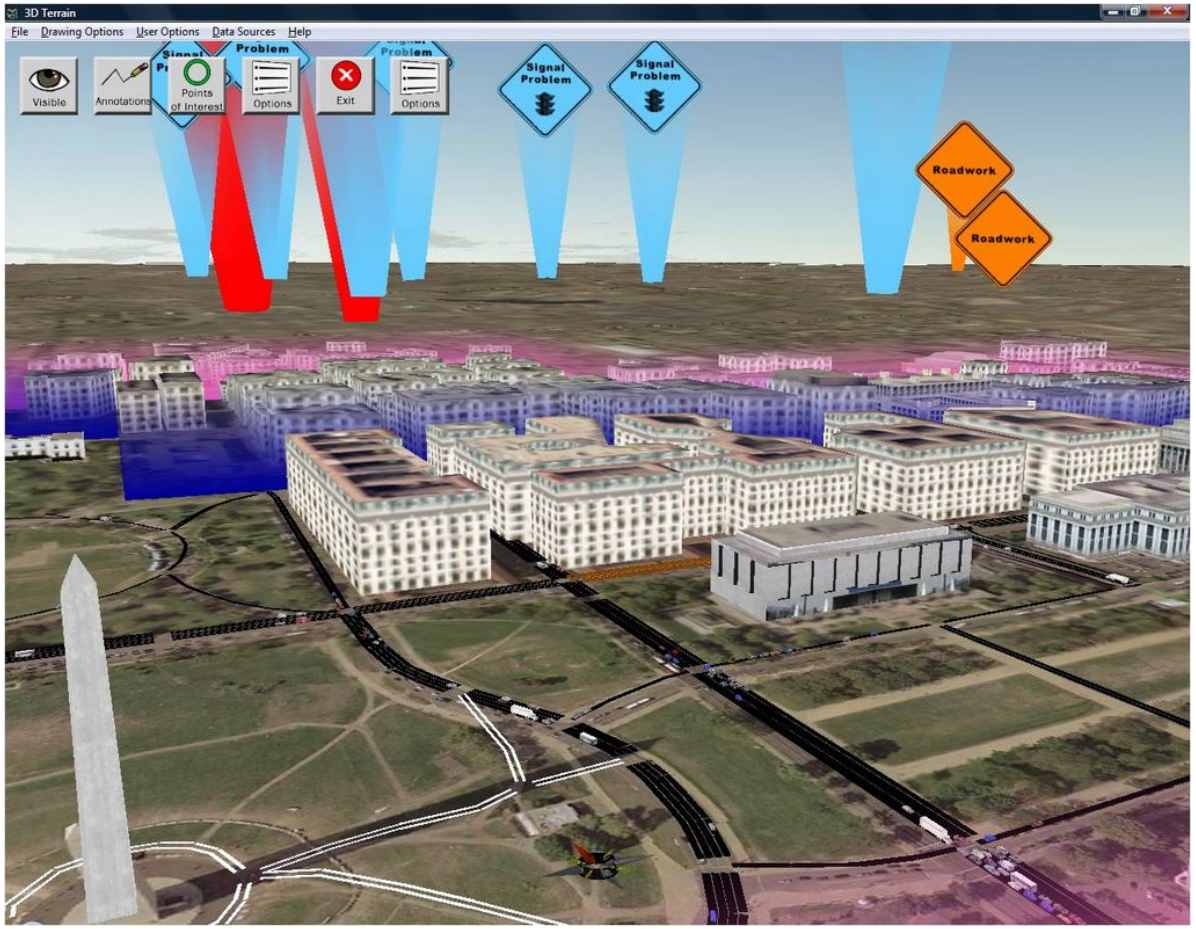
Portal home page

Some mobility service solutions



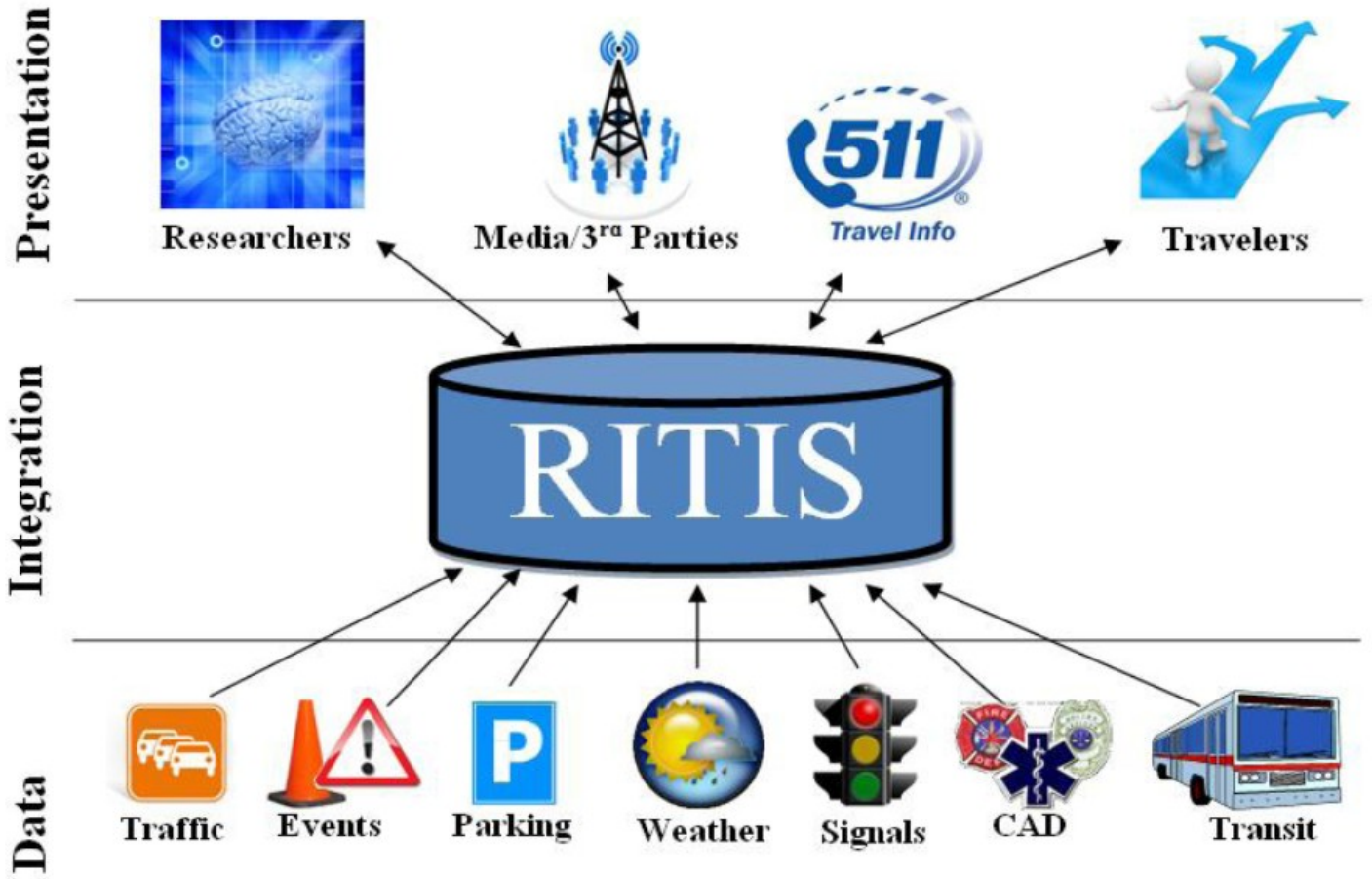
AnachB.at - Traffic Situation in the Vienna region

Some mobility service solutions



RITIS 4D data visualisation

Some mobility service solutions



RITIS Diagram – From Data to Application

Top ROADIDEA service ideas

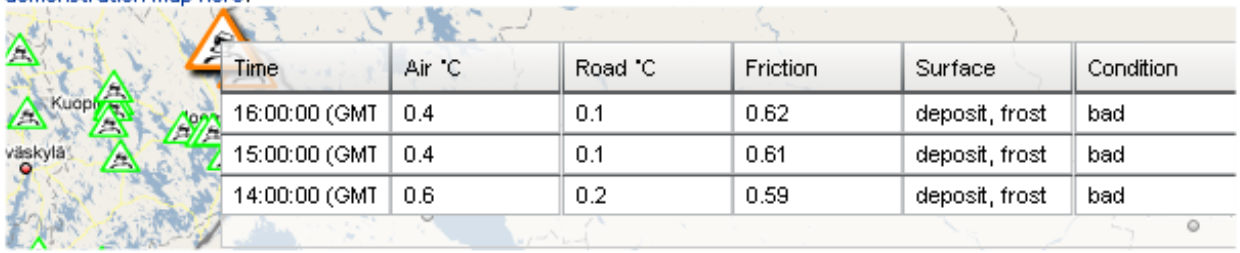
- ”Pulp Friction” slipperiness warning system
- Fog warning system in Italy
- Route weather planner for cyclists and motorcyclists
- Combining weather and traffic models in Gothenburg Sweden

Friction model for slipperiness warnings

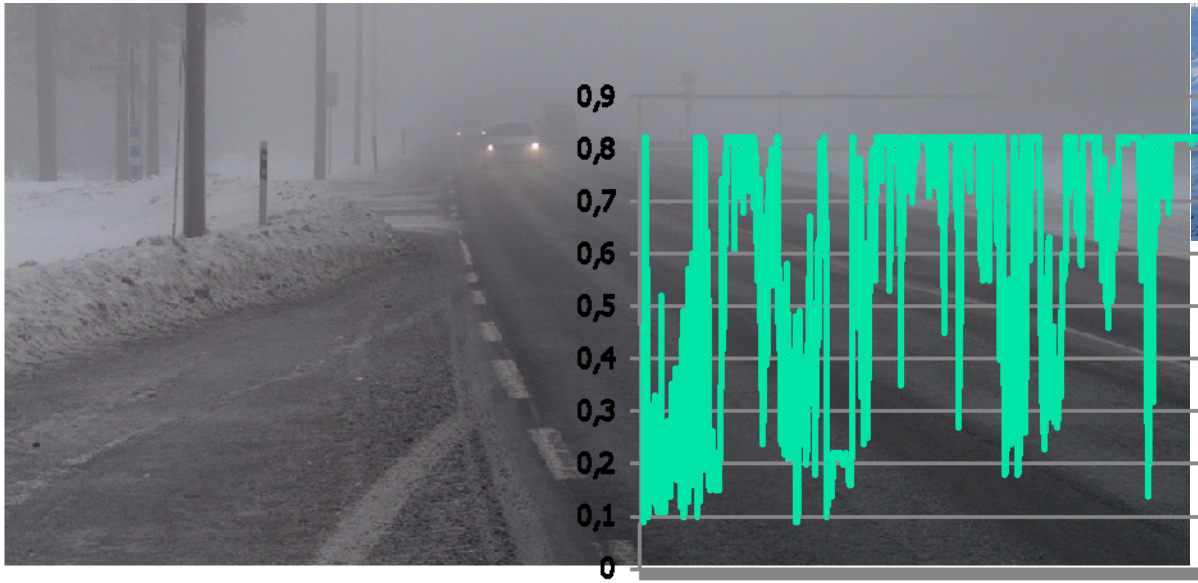
Pulp friction pilot produces road slipperiness prediction for Finland 11/19/2009 2:04 PM

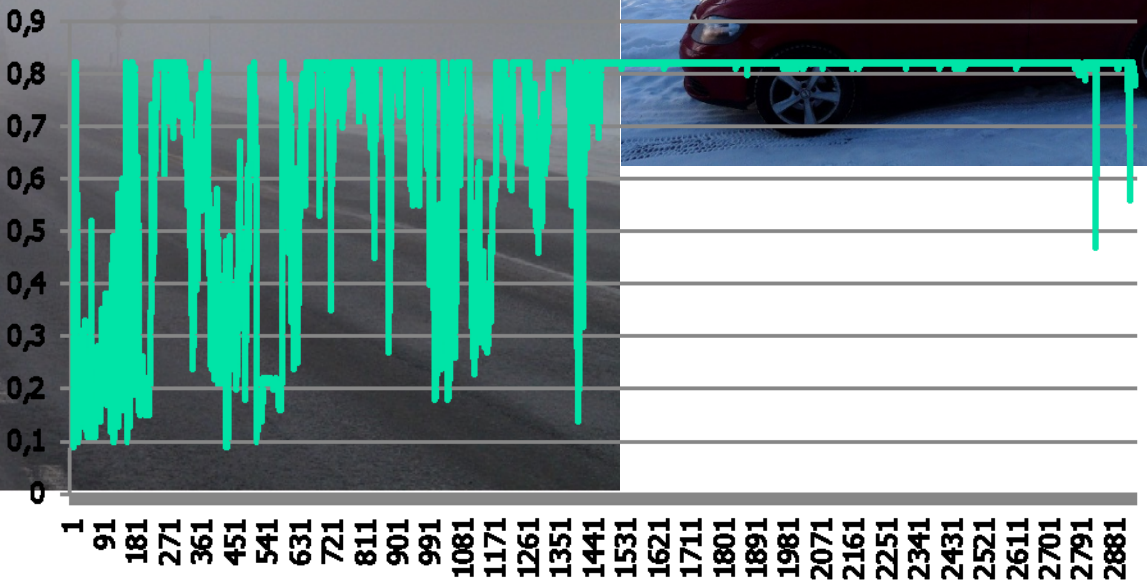
by Poul Grashoff (internet)

The pulp friction pilot produces predictions for road slipperiness for 91 weather stations in Finland. You can find a demonstration map here.



Time	Air °C	Road °C	Friction	Surface	Condition
16:00:00 (GMT	0.4	0.1	0.62	deposit, frost	bad
15:00:00 (GMT	0.4	0.1	0.61	deposit, frost	bad
14:00:00 (GMT	0.6	0.2	0.59	deposit, frost	bad



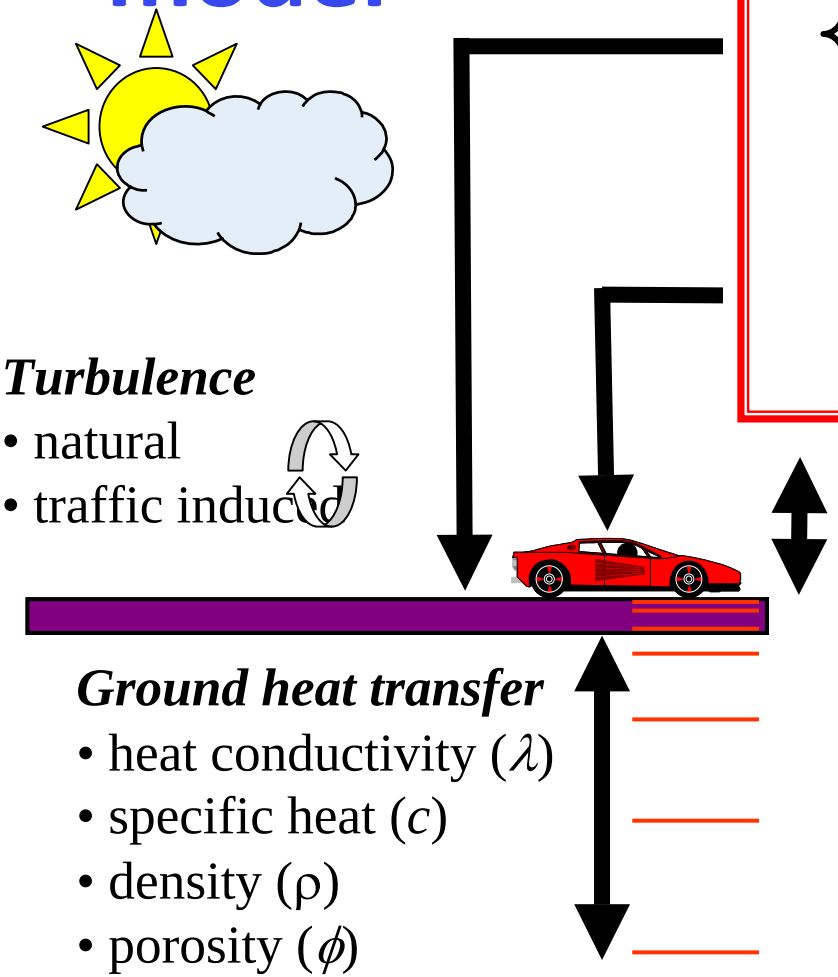


Idea

- Snow and ice may exist almost 6 months a year on Finnish road network
  - ➘ **Increased traffic incident risk**
- Develop a statistical forecast model for road surface friction based on friction measurements made by Vaisala DSC111 instrument
- Develop a forecast tool for meteorologists and road maintenance personnel
- Product(s) for drivers

Vaisala DSC111

FMI's road weather model



Upper boundary forcing

Atmosphere

- wind speed (V_z)
- air temperature and humidity (T_a , Rh)
- global (short wave) radiation ($R_{S\downarrow}$)
- incoming long wave radiation ($R_{L\downarrow}$)
- precipitation (P)

Traffic

- mechanical wear, heating

Turbulence

- natural
- traffic induced

Surface heat exchange

- sensible heat flux (H)
- latent heat flux (LE)
- long wave radiation (R_L)
- stability

Ground heat transfer

- heat conductivity (λ)
- specific heat (c)
- density (ρ)
- porosity (ϕ)

Road weather classification

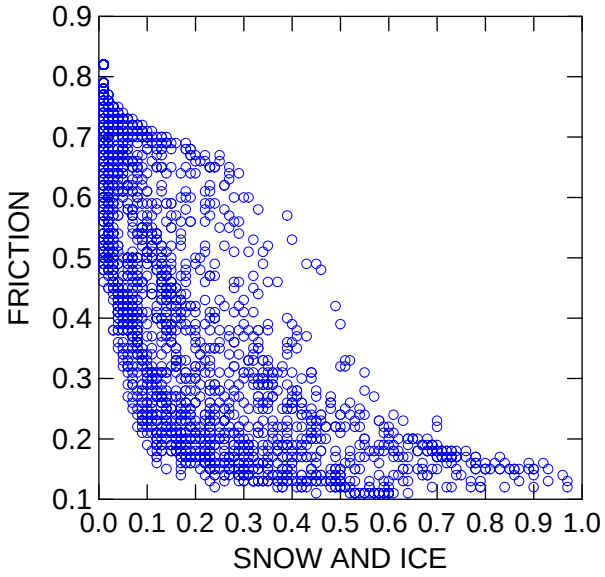
Friction	0,00 – 0,14	0,15 – 0,19	0,20 – 0,24	0,25 – 0,29	0,30 – 0,44	0,45 – 1,00
Description of the road surface	Wet ice	Icy	Packed snow	Rough ice/ packed snow	Clear and wet	Clear and dry
Slipperiness classification	Very slippery	Slippery	Fair winter condition	Good winter condition	Good road condition	Good road condition
Road weather index	Very bad road weather		Bad road weather		Normal road weather	

Classification by Finnish Transport Agency

Observed friction vs. snow+ice and water on the surface

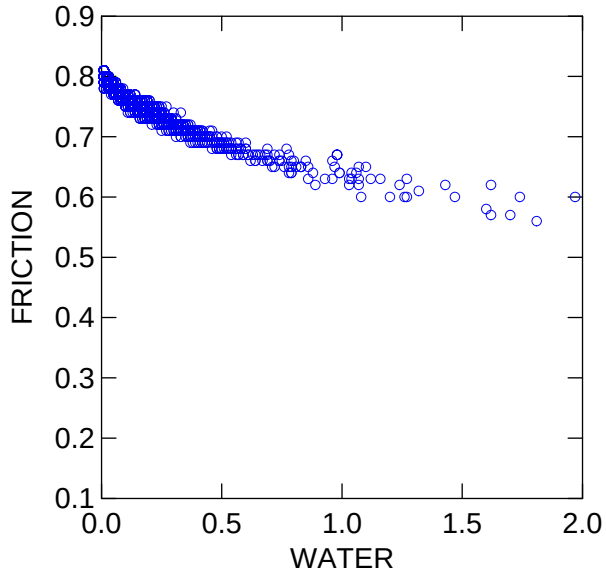
Anjala observations, winter 2007-2008

a)



Observed friction with ice and/or snow on the surface (water content in mm)

b)

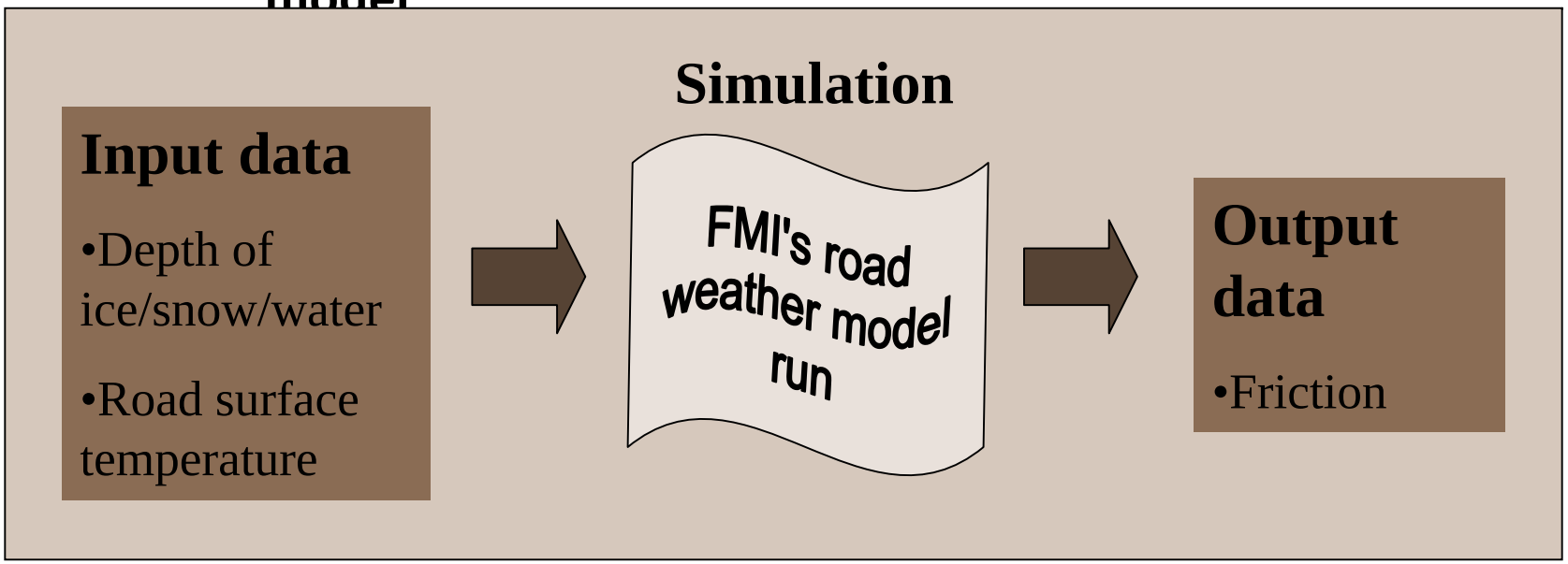


Observed friction with water on the surface.

How does the friction model work?

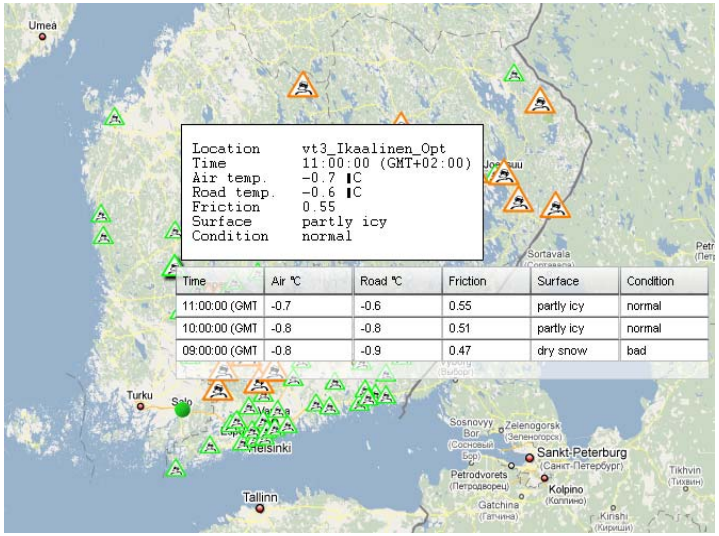
All input data is available from FMI road weather model

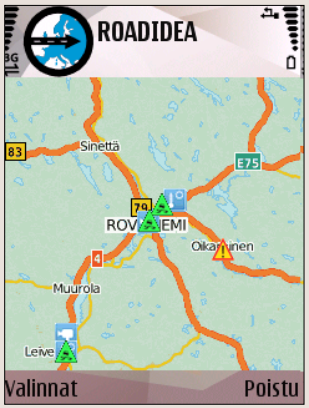
- **Friction formulas included into the road weather model**



Implementation

- Google.maps application presents 3-hour forecast of expected road weather
  - Temperature
  - Friction
  - Road condition
- Produced in collaboration between FMI, Destia and Demis
- http://pilot.roadidea.eu/friction/





- **Also, a mobile phone application available**
- **Information of road weather (including friction), roadside photographs, warnings given by other users**
- **Produced in collaboration between FMI, Destia and Logica**

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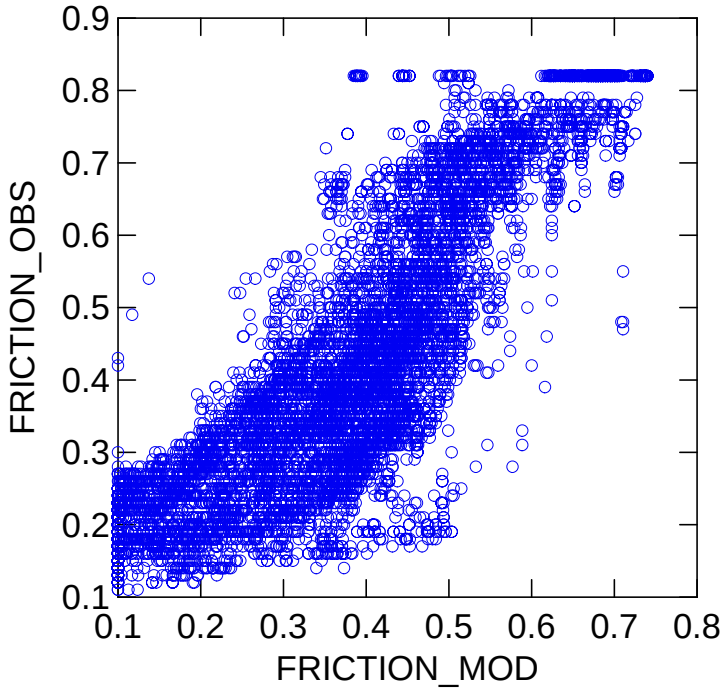
Validation results

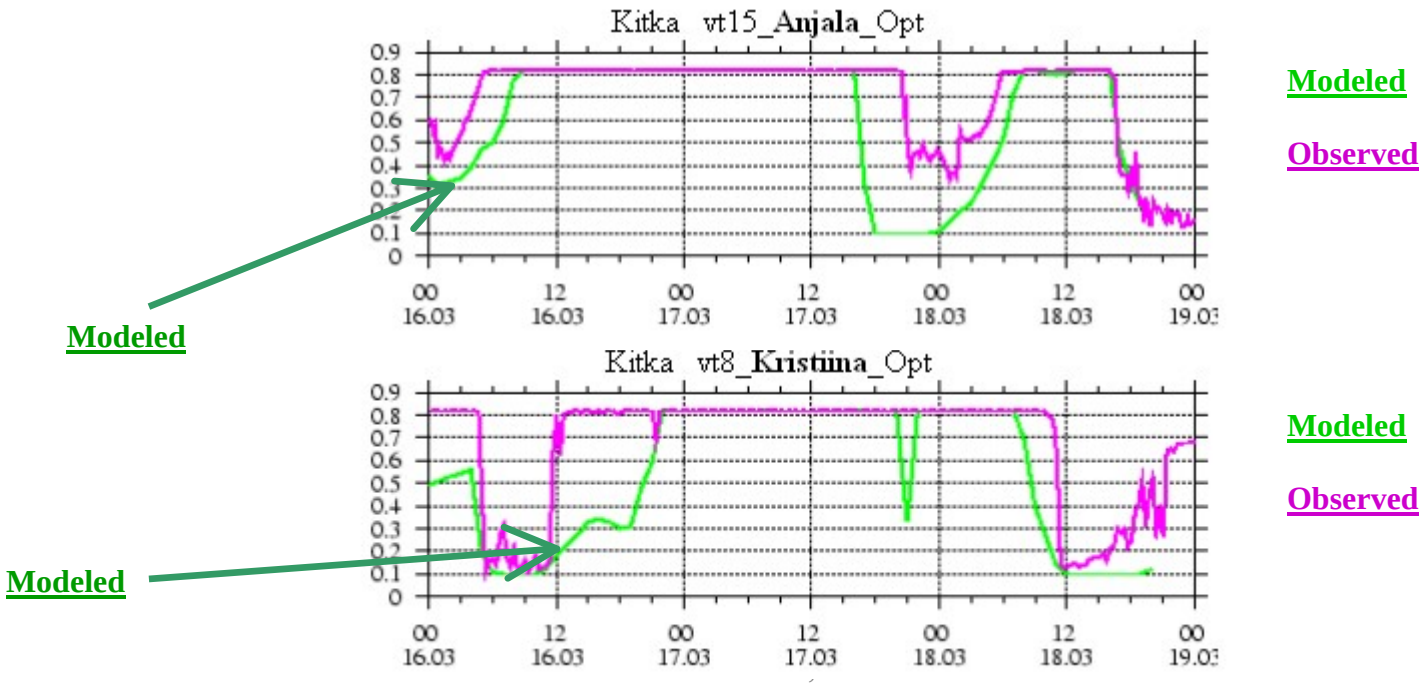
- Modeled vs. observed road surface friction when snow/ice on the surface
- Correlation 0.86



Utti 2009/2010

More results

- Model simulates cases of poor friction well, but…
- Model produces typically too low friction values for a too long time
  - The road weather model has too big storages for ice
  - The road weather model lacks information about road maintenance actions ⇔ Necessary input data for a well-functioning model !



Conclusions and future

- Friction model is a new, innovative product
- Results are not quite as good as expected, but the shortcomings are realized
- Further development, testing and evaluation is an ongoing process

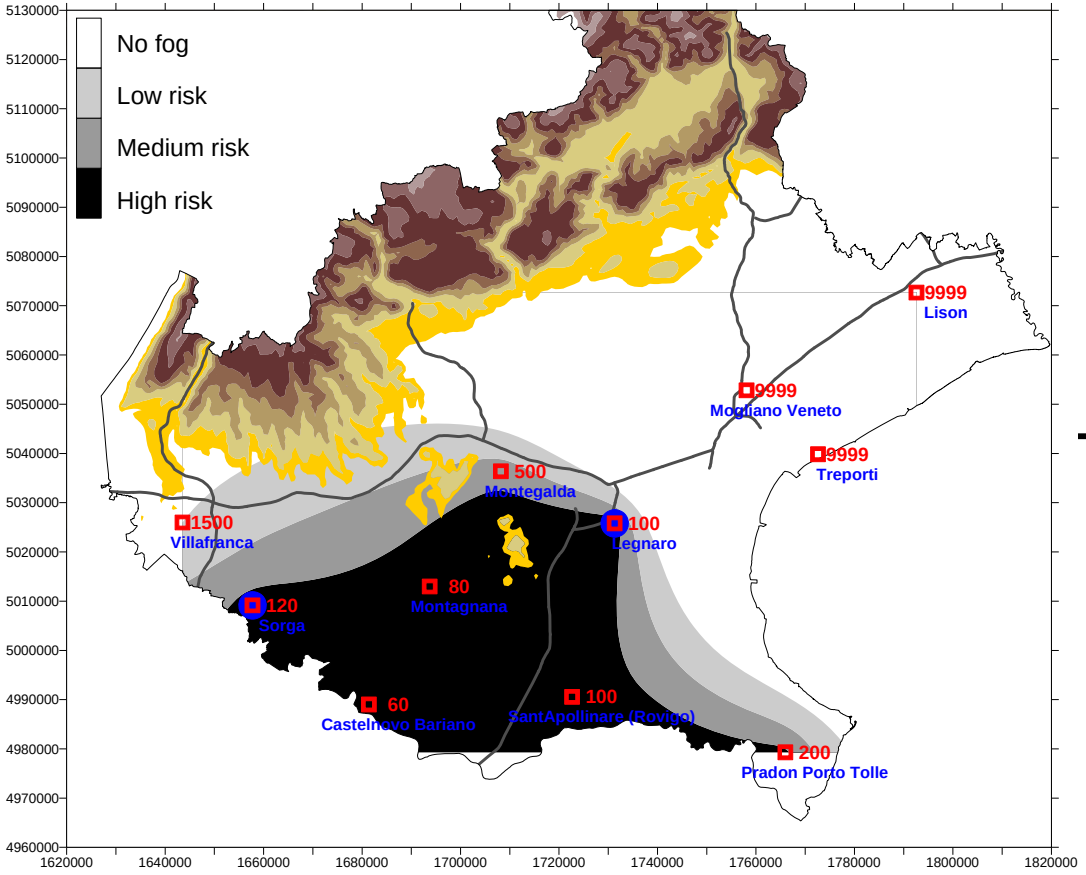
Guidelines

- Define station specific relationships at all computation points
- Investigate a probabilistic approach to friction/slipperiness forecasting

- Contact: Marjo.Hippi@fmi.fi

Fog pilot products

Real-time fog alert maps



DISSEMINATION

Private car drivers

Transport companies

Road management

Authorities

ROADIDEA

arpav

Roadidea FOG PILOT – Model flow

Input data

Pre processing probability maps

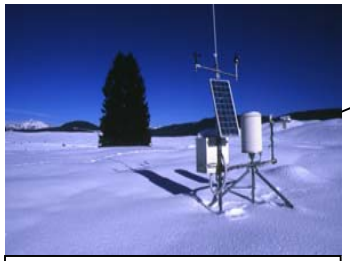
Weights

Merging

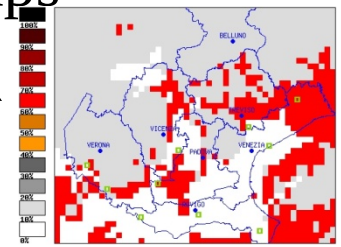
Final Product

satellite

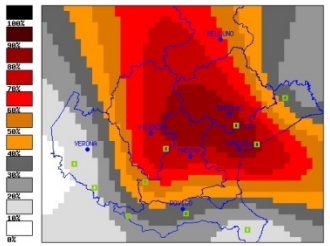
visibilimeters



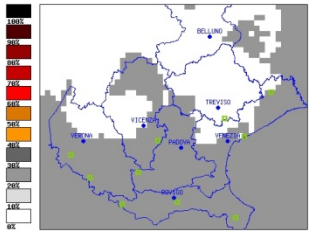
met. stations



W_{SAT}

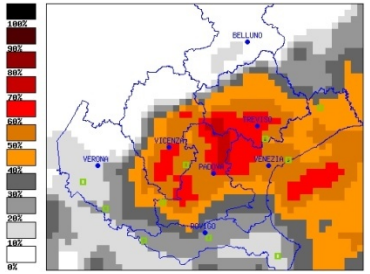


W_{VIS}



W_{MET}

Weighted Mean



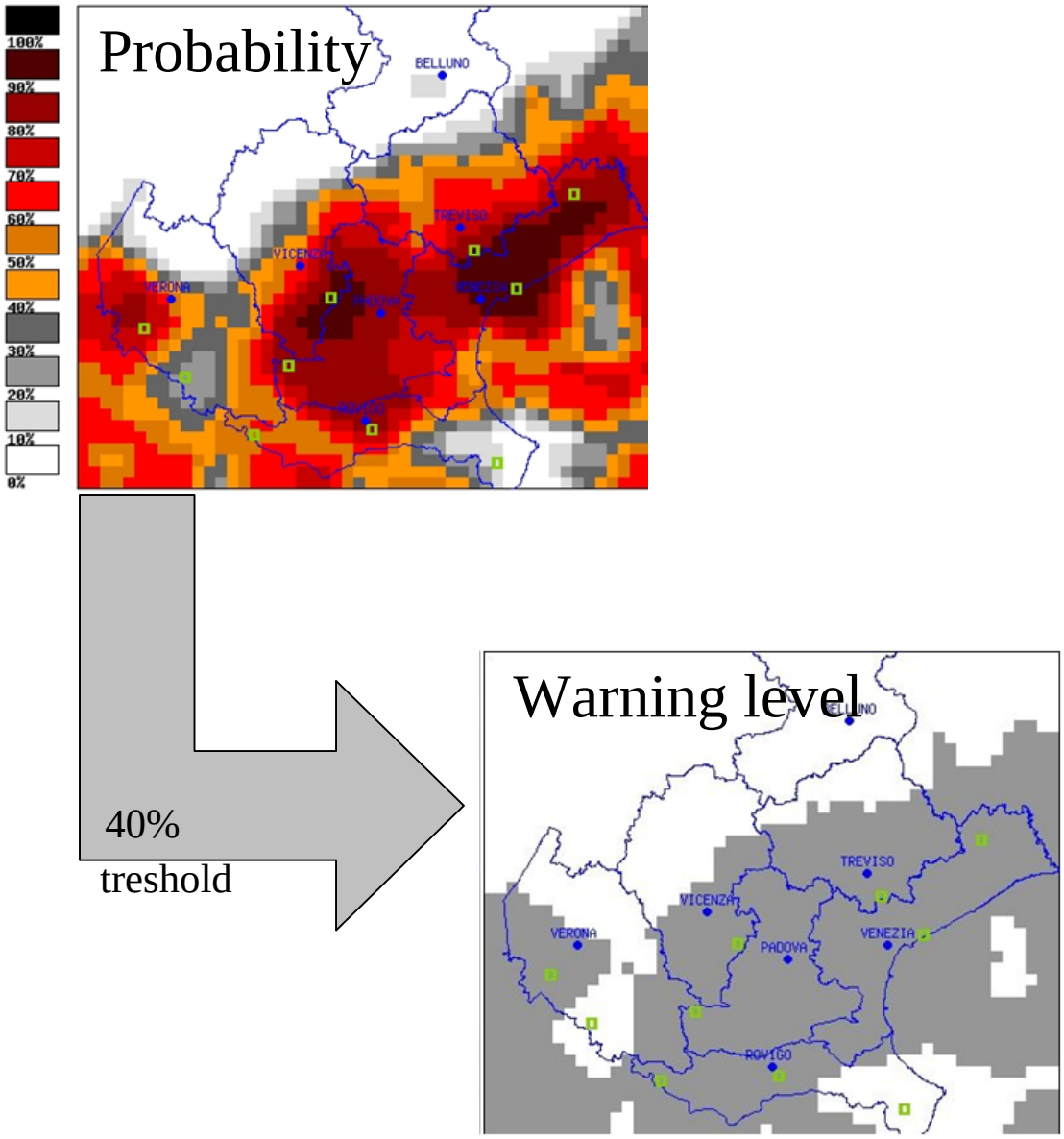
$$P(x,y) = \sum_{i=1}^{3} \sigma_i \cdot w_i(x,y) \cdot p_i(x,y)$$

PROBABILITY > WARNINGS

We can associate an alert level to a probability treshold

A good choice could be a 30-40% treshold to give a fog warning

(derived from probabilistic verification to maximize the economic value of the monitoring system and corresponding about to a 75% POD and 10% POFD)



A. Rossa, F. Domenichini, F.

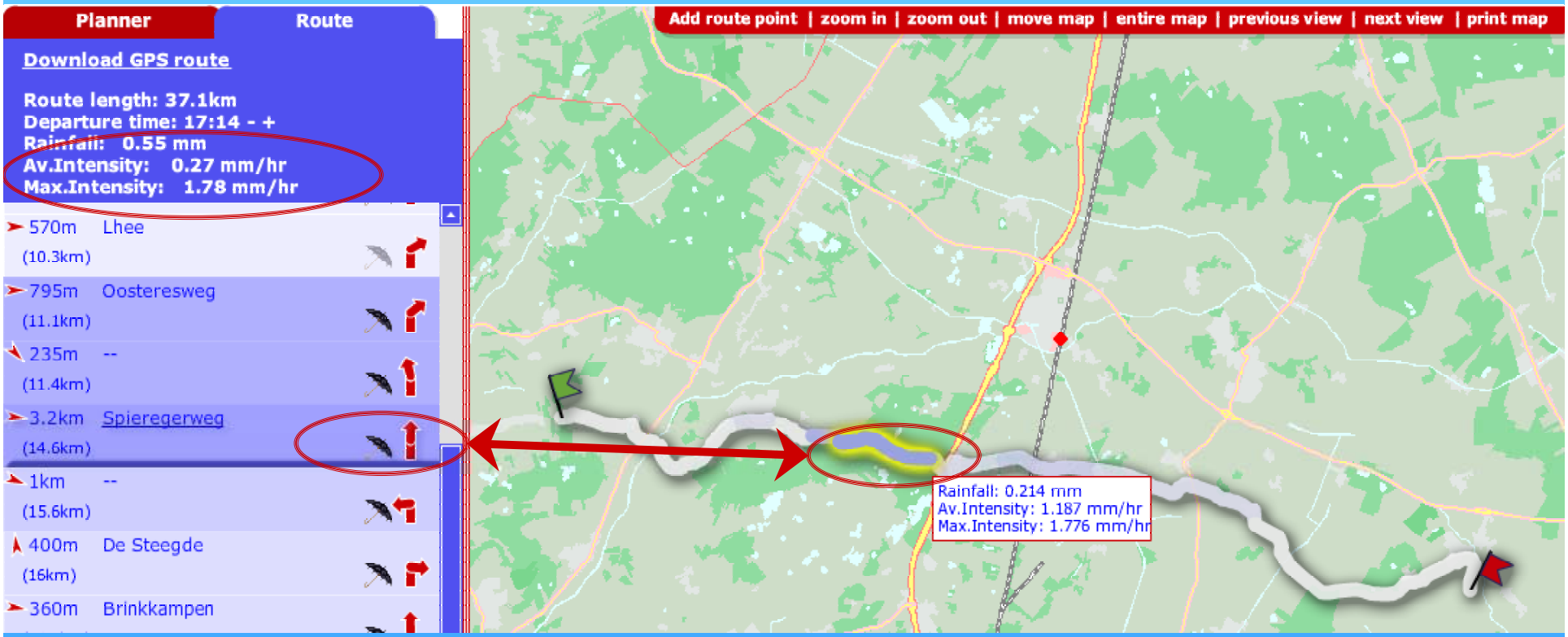
CONCLUSIONS

- a probabilistic areal fog monitoring system has been built, using limited number of visibility detectors, satellite data, meteorological station data
- probabilistic verification of the Fog Pilot shows pretty good performance with probability of detection of 70-80%, probability of false detection of about 5-15%
- most value to the final product is brought by direct visibility measurements, whereas satellite brings added value especially in the spatial interpolation
- fog Pilot has the potential to give support for accident prevention and traffic management

ARPAV Fog Pilot WEB SITE http://85.42.129.76/ROADIDEA

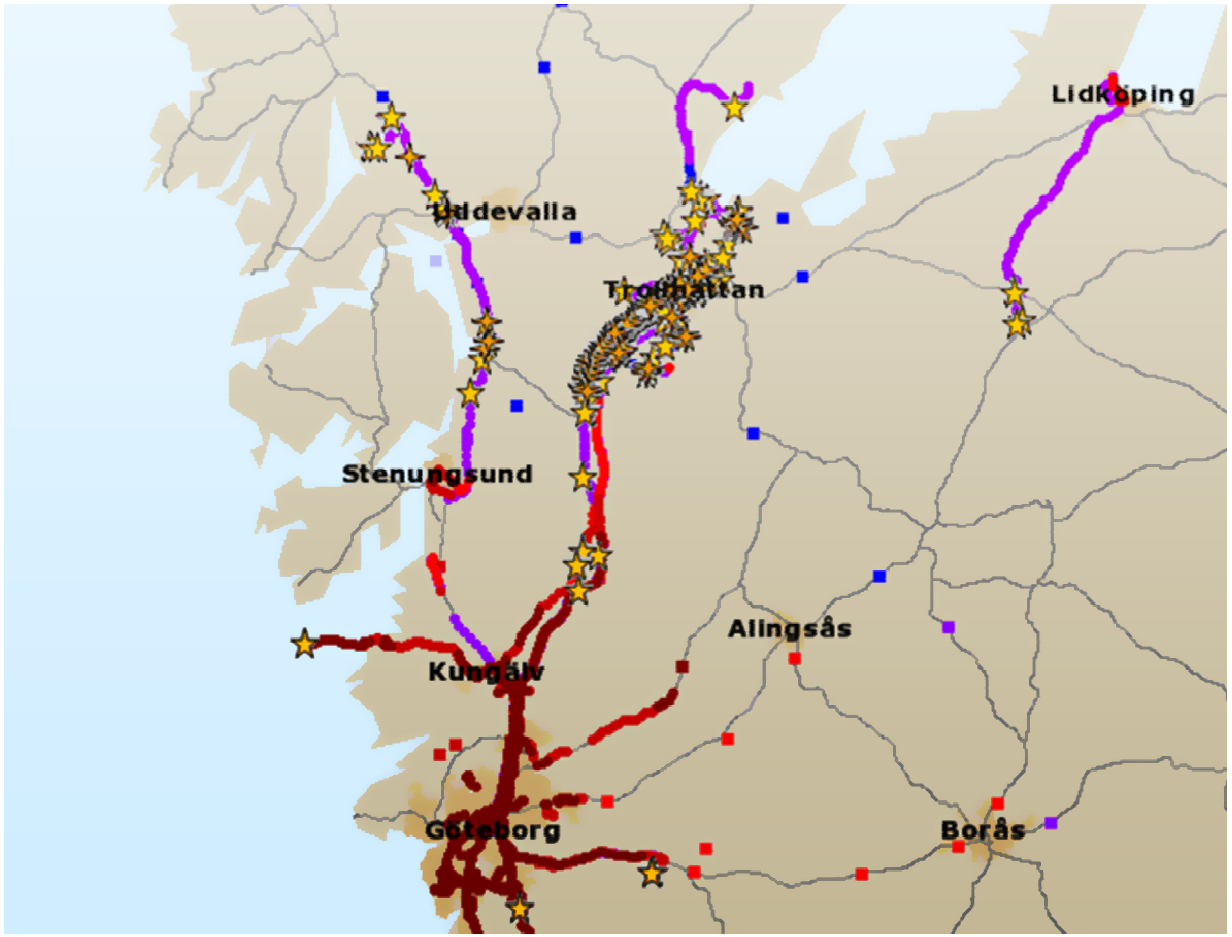
ROADIDEA

Example with rainfall, check out the umbrella's and colored trip segments….



1. **Based on proven bicycle trip planner**
2. **From – Via – To trip planning**
3. **Cyclists and Motorcyclists**
4. **After planning trip you see the total expected rainfall over the trip and which sections you will get wet**
5. **You can change departure time and average speed to optimize your trip**

Gothenburg pilot



- Info from ordinary cars combined with weather obs

Key ROADIDEA conclusions

- Technology or service delivery are not barriers any more
- More data and more complex data systems are emerging and need development
- Access to data is the key barrier for new innovative (European-wide) services
- Recommendation for a minimum data set that should be available in all EU countries with reasonable conditions

www.roadidea.eu

- Plenty of documents available covering the detailed analyses of transport systems
- You can still write down your own ideas
- ROADIDEA web site will be available for some years after the project


Questions?
KEEP YOUR EYES OPEN
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