

Development of mobile optical remote road condition monitoring in Finland

A red Volkswagen Golf is parked on a two-lane asphalt road in a snowy, wooded area. The car is viewed from the rear. Two large, white, cylindrical optical sensors are mounted on a rack on the back of the car, secured with black straps. The license plate is partially visible and reads 'FINLAND'. The car has 'GOLF' and '1.6 FSI' badges. The road is flanked by snow-covered ground and evergreen trees. The sky is overcast.

Dr. Pirkko Saarikivi, CEO

Foreca Consulting Ltd

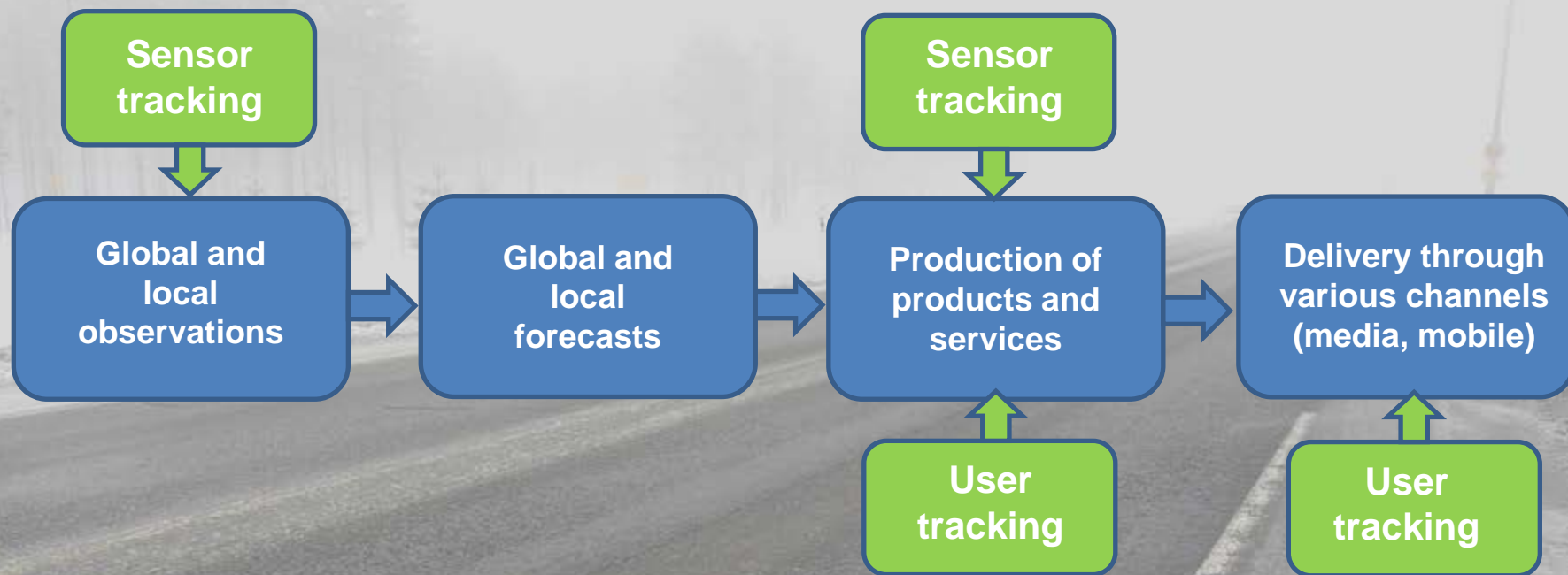
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We argue that...

- **Weather and road weather forecasters (and systems) are blind to the observational and forecast data being used**
- **The weather and road condition analysis is not revealing the true situation but some blurred image seen through the data resolution glasses**
- **The more resolution we get, the more we understand**
- **Now we DO have means to improve our vision**

Weather service chain



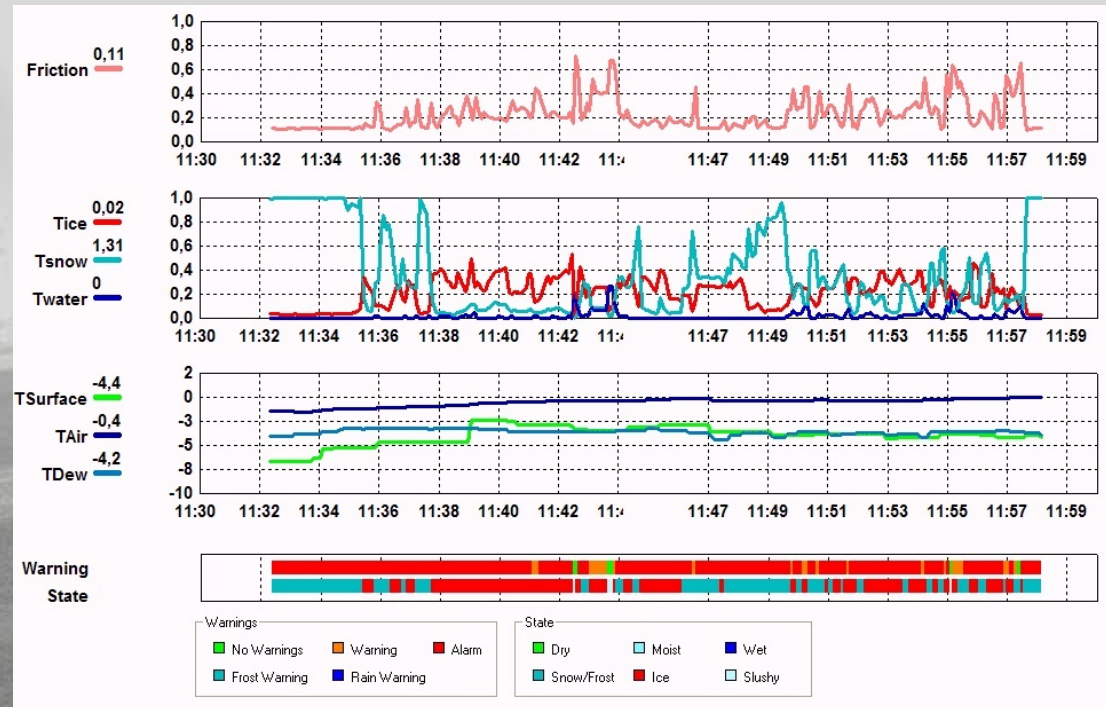
In the last decades Global Navigation Satellite Systems (GNSS) have improved our observing capabilities

**as well as the production phase,
and also the final delivery phase.**

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2005 start of mobile friction observing

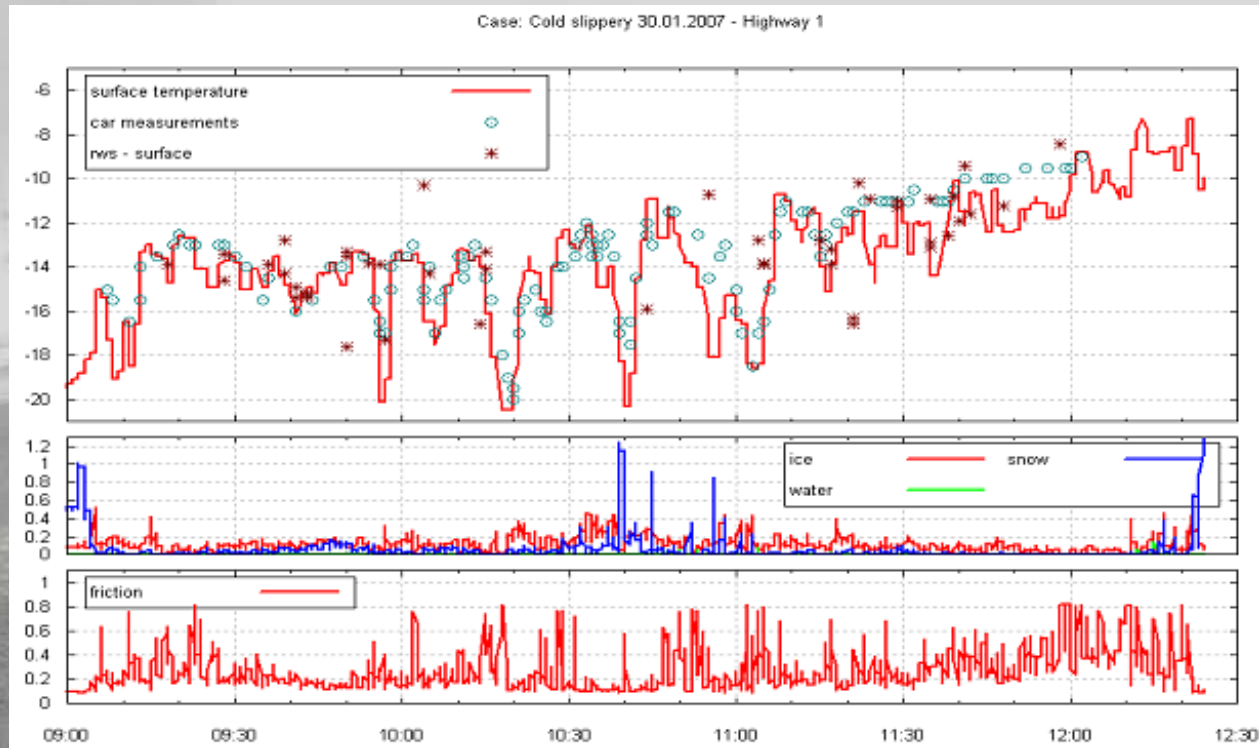


- In 2004, the most severe traffic accident in Finland. Bus and a truck collided, causing 23 dead and 14 injured
- Project ColdSpots 2005-2007 initiated with public, private and operator partners (FMI, Foreca, Destia)
- Improved data sets, models and observing with DSC111 and DST111

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First observations of large variations



- Our observing vision improved dramatically!
- Large local variations, cold air pools
- Ice on road, friction dangerously low

Beautiful day => drivers cannot see the risk!

Second phase 2007-2010: unit on top

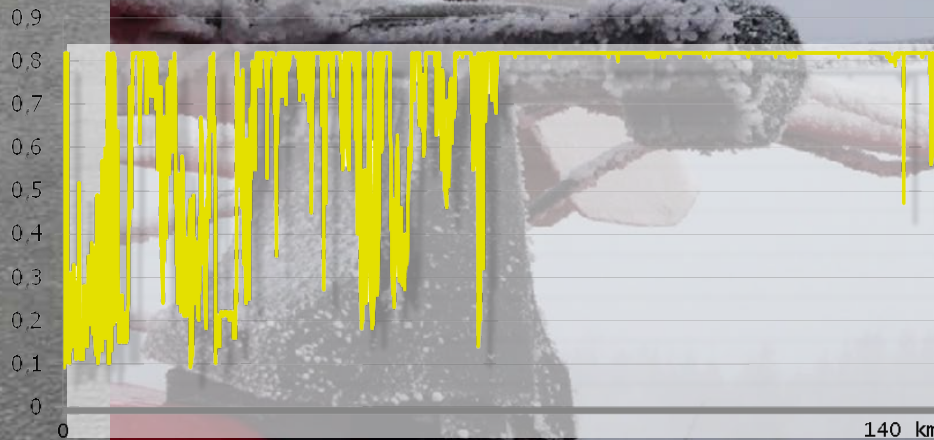
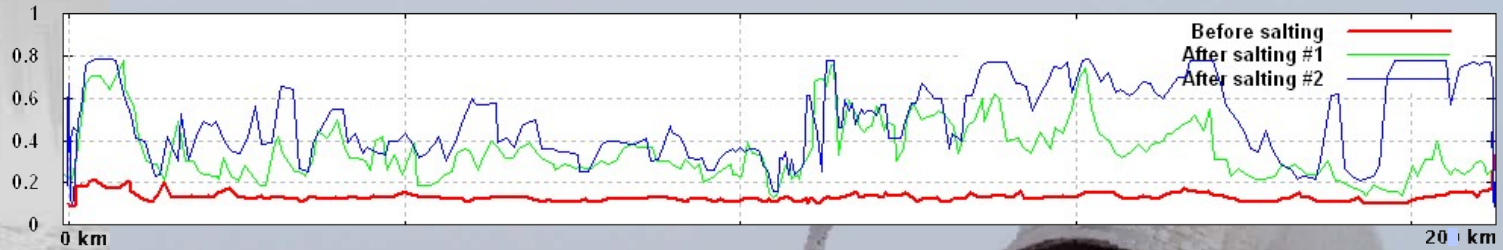


- Used in project ROADIDEA (2007-2010)
- DSC111 and DST111 mounted on poles on top of the car
- Datalogger, GPS, laptop and smart phone inside

Sensor tracking

Global and local observations

Effects of road management observed



ROADIDEA

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Mobi-Roma in 2011-2012

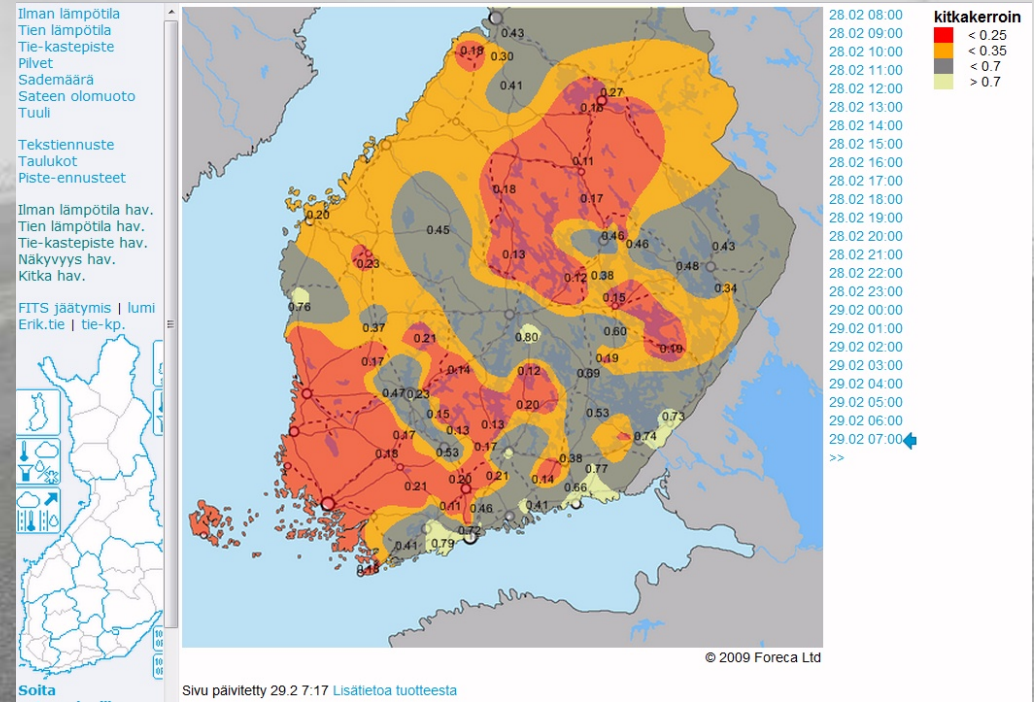
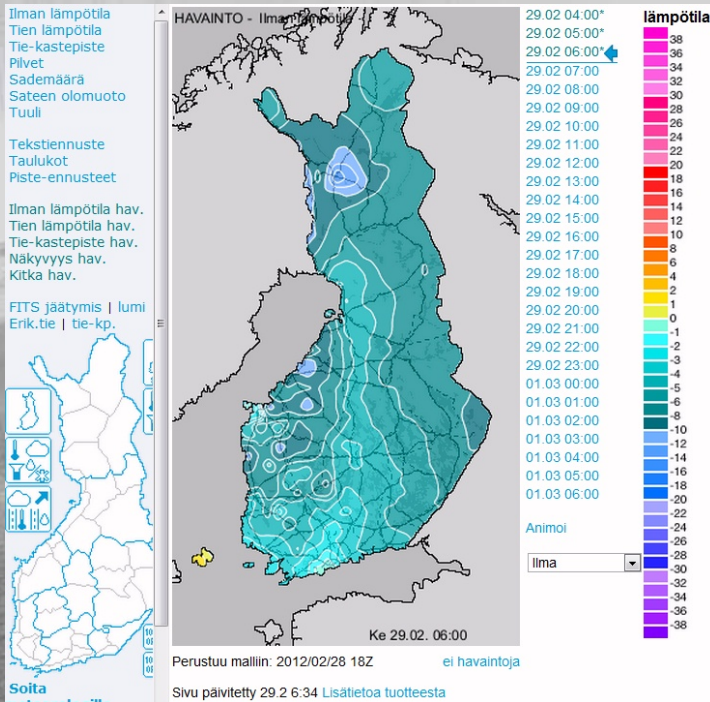


- Using TECONER RCM411 optical remote sensor
- Accurate, light and easy to mount
- Data collected to a smart phone and web service
- Notice how water film increase is verified in the wheel path when the car stops (figure on the right)

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Fixed networks improve as well



Variability of temperature as resolved with RWIS network

Variability of friction as resolved with fixed DSC111 sensors



Combine mobile observations to data from fixed stations to create **Hybrid Observing Systems** with increased resolution in time and space

Fixed station network has resolution of **50-100 km** whereas spacing of mobile obs is **50-100 m**

Thousand times better resolution!

Hybrid system combining the benefits

Observing system	Fixed	Mobile	Hybrid
Measurement units	Equipped masts	Equipped cars with GNSS	Both masts and cars
Total units	80	10	90
Spatial resolution	60 km	100 m	60 km & 100 m
Temporal resolution	30 min	3 sec	30 min & 3 sec
Observations / day	3840	172800	176640
DC synoptic 100 km	100 %	100 %	100%
DC meso-scale 10 km	40 %	15 %	55 %
DC micro-scale 1 km	1 %	5 %	6 %
DC topographic effects	No	Yes	Yes
DC lanes, GPS	No	No	No
DC lanes, Galileo	No	Yes	Yes

Project GalileoCast assessed Detection Capacity = DC

Road condition observing system should be optimised to maximise the benefits and minimise the costs

Hybrid system must reveal the safety critical phenomena that the fixed system is missing

Conclusions and next steps

- Intelligent and multi-functional road infra and service systems are developed intensively around the world
- The transport systems of the future will be very much relying on accurate and reliable positioning systems
- In Finland development of mobile and hybrid observations continues
- Road condition models will be improved with mobile data
- Immediate product generation and delivery to road users' cars
- I have a dream: 
- 24/7 mobile observing network in Finland with weather alert button in each car: no driving if the driver does not listen to the warnings first!

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Contact information

Foreca Consulting Ltd

Tammasaarenkatu 5, 00180 Helsinki, Finland

Dr. Pirkko Saarikivi, Managing Director

Tel. +358 40 5000262

Pirkko.Saarikivi@foreca.com

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