



FINNISH METEOROLOGICAL INSTITUTE

Intelligent Road Weather Application Development @ Finnish Meteorological Institute

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... with much too many supporters, collaborators and co-workers to list here ...



Reminiscing SIRWEC 2014



17TH INTERNATIONAL ROAD WEATHER CONFERENCE IN ANDORRA



FINNISH METEOROLOGICAL INSTITUTE

Sochi 2014 Winter Olympics Road Weather pilot (SIRWEC Andorra)

CoMoSe
Project
F



1

Sochi 2014 Winter Olympics Road Weather pilot



CoMo
SeF



1

Sochi 2014 Winter Olympics Road Weather pilot

End-user = Finnish skiing service team, Feedback :

- " HARMONIE was superior "
- " HARMONIE visibility forecasts were excellent "
- " HARMONIE precipitation and cloud height fcs were highly useful "
- " HARMONIE five-panel user interface was really good "

Sochi 2014 Road Weather Pilot: End-user Feedback

Scale : 1 = Fully disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Fully agree

Date	<u>Friction forecast</u> gave a good estimate of slipperiness	<u>FC storage terms</u> (water, snow, ice) are realistic	Road weather forecast was useful	Notes (free text)
16.2.2014		5	4	Precipitation, however road surface dried towards Adler
20.2.2014	5	5	2	Dry road surface, i.e. No real need for RW forecast
21.2.2014		5	3	Variable road surface humidity
23.2.2014	5	5	2	Dry road surface, i.e. No real need for RW forecast

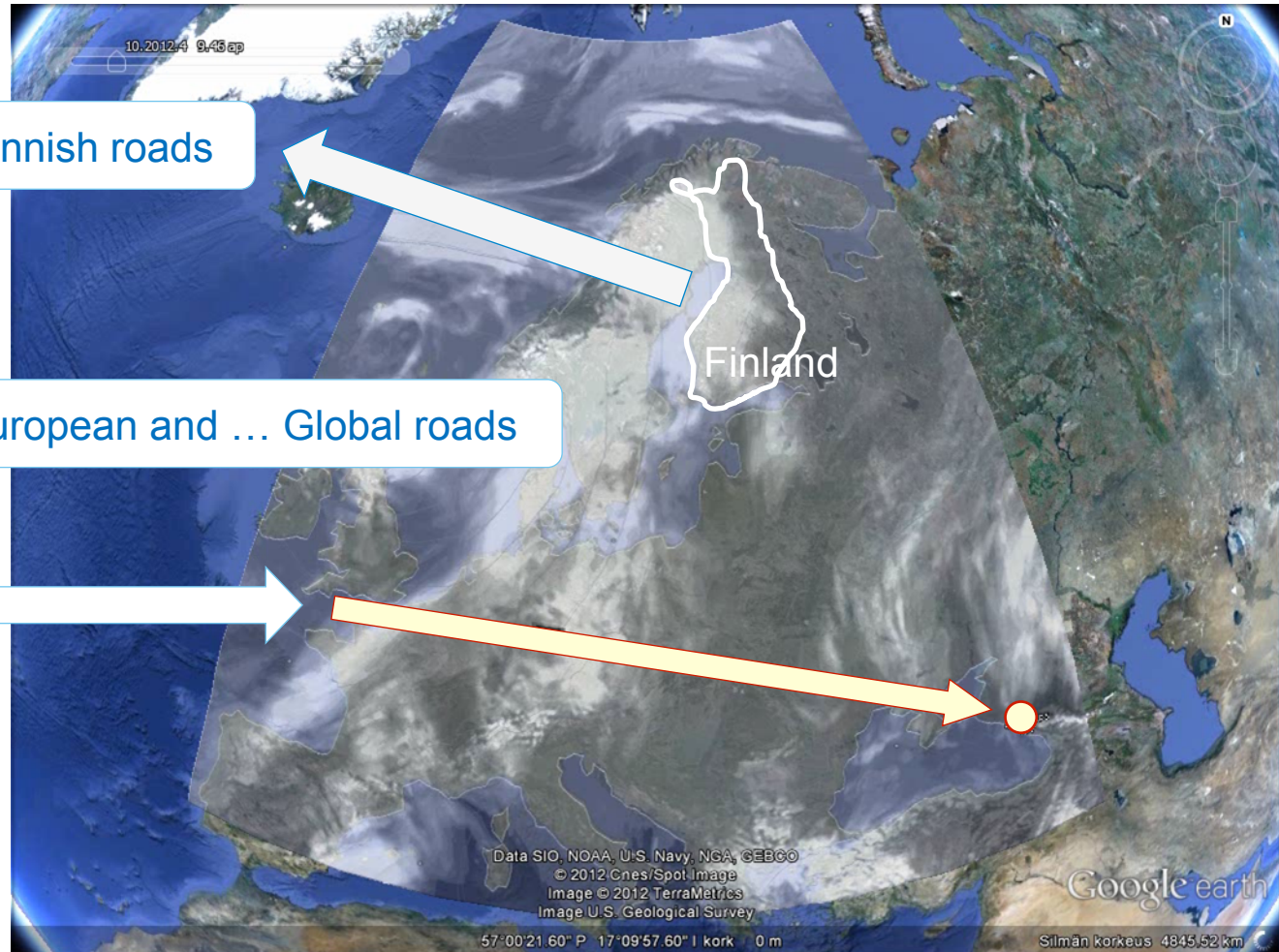


FMI ROAD WEATHER FORECAST SYSTEM

Initially, developed for Finnish roads



Recently, exported to European and ... Global roads





This Presentation Covers :

Project / Funding

1. **Sochi 2014 Winter Olympics** ↔ **CoMoSeF**
 2. **Road stretch impact forecasting** ↔ **FP7 FOTsis**
 3. **Road weather, Norway + Sweden** ↔ **ASSIST**
 4. **Road weather for Holland** ↔ Customized funding
 5. **Road weather for Estonia** ↔ Customized funding
 6. **Mobile vehicle observations** ↔ **D2I**
 7. **Breaking distance application** ↔ **D2I**
 8. **Pedestrian weather application** ↔ TSR funding
 9. **Intelligent Arctic truck platoon** ↔ EU regional funding
- ✓ **Road weather to New Zealand / ...pending**

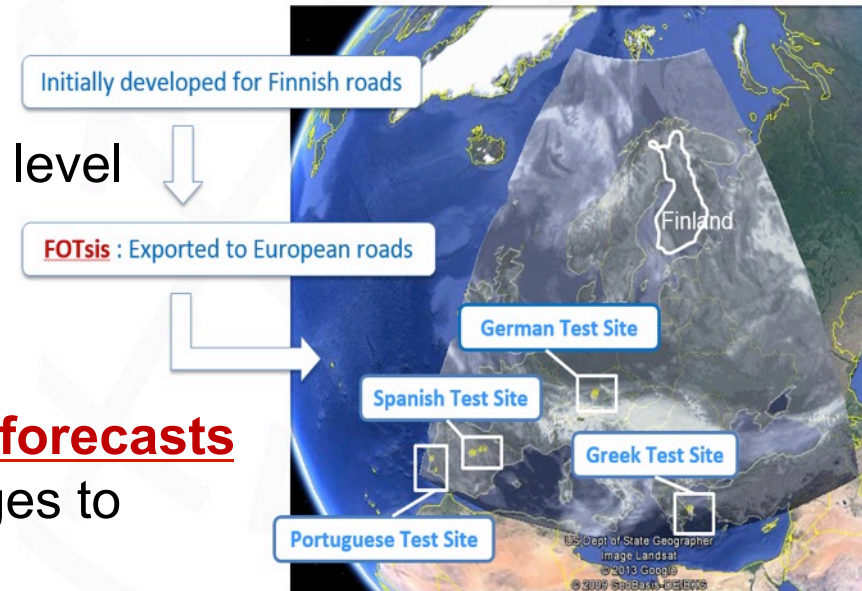


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FP7 FOTsis : Intelligent Road Weather Services for End-users



1. FOT : Field Operational Tests @ European level
2. Intelligent road weather forecasting system development for European highways
3. Forecast system output : **Weather impact forecasts** delivered as adverse weather alert messages to **road end-users**



- Map-matching of vehicles based on GIS application (by partner GeoVille)

❑ **Intelligent road weather ⇔ Highly relevant ITS application !**



2

Road Weather Forecasting System : Output

Road weather forecasts



Post-processed as Weather Alerts

based on pre-defined thresholds for individual weather variables

- Snow / Sleet
- Heavy snowfall/sleet
- Cold snowfall/sleet
- Rain
- Heavy Rain level 1
- Heavy Rain level 2
- Freezing rain
- Damp surface
- Wet surface
- Snow on the road
- Ice road
- Visibility \leq 400 meters
- Visibility \leq 250 meters
- Visibility \leq 80 meters
- Blizzard
- Strong Wind
- Very Strong Wind
- Extreme Wind
- Wind Gust
- Strong Wind Gust
- Extreme Wind Gust
- Slippery Road
- Very Slippery Road
- Extremely Slippery Road

Final output to End-users

Weather Alert Message

weather warning level description
Level -1 – NO warning
Level 1 - Control your speed
Level 2 - Minimize your speed
Level 3 – STOP DRIVING

Final output to End-users



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The Success of :



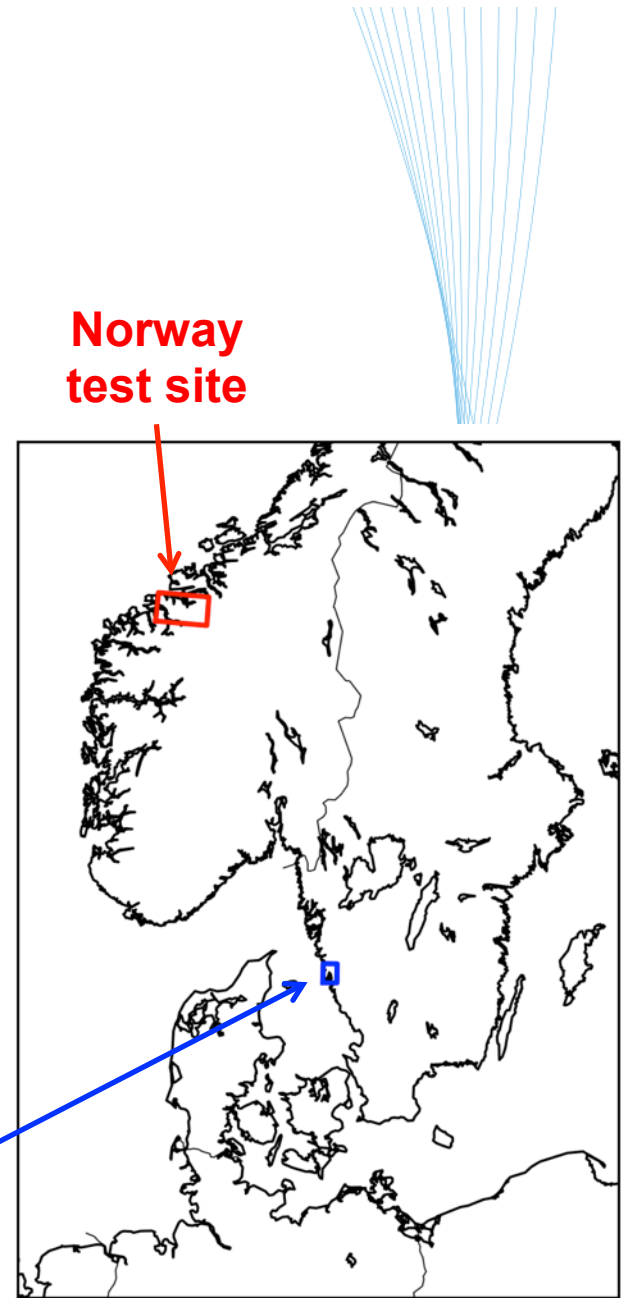
- ✓ New avenues to develop and test **FMI** research & service applications
 - ⇔ (Road) Weather modeling in new environments
- ✓ Huge amounts of meteorological data in the established FOTsis database, for future applicability
- ✓ New partnerships based on FOTsis collaboration paving the way to new project initiatives
- ✓ Strongly increased publicity & reputation to **FMI** road weather expertise leading to **spin-offs**:
 - **Estonia, Netherlands roads**
 - **New Projects : ASSIST, CyberWI, SafeCOP...**

"Cyber/Cloud" security projects



3 ASSIST Road Weather Demonstration Project

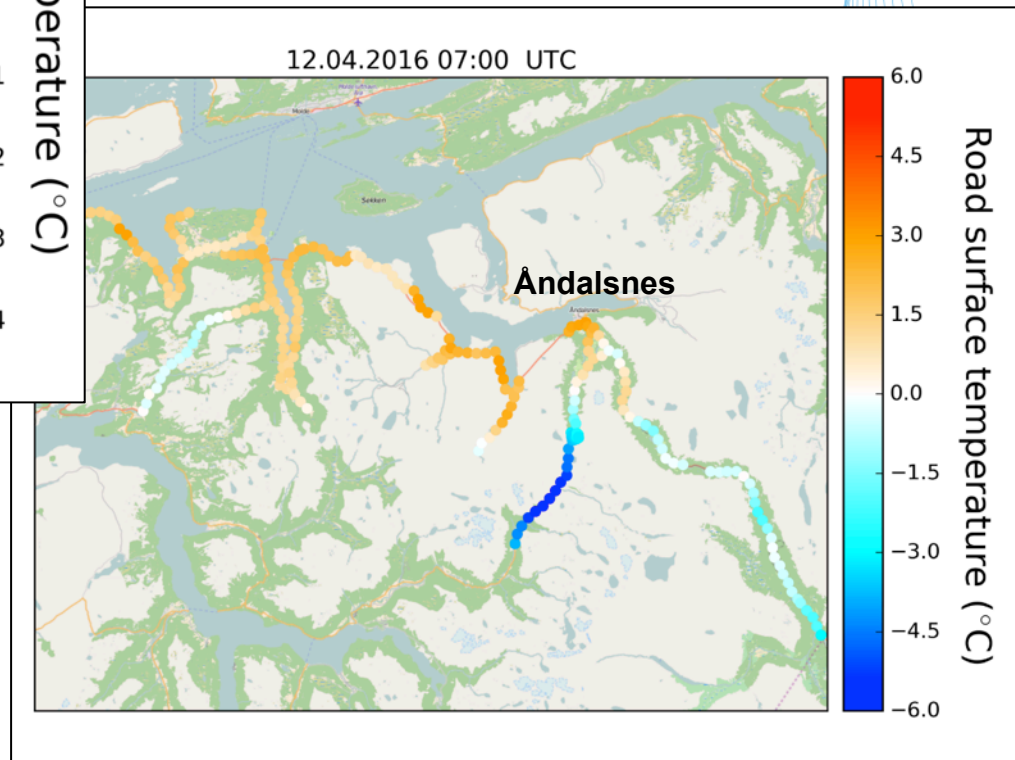
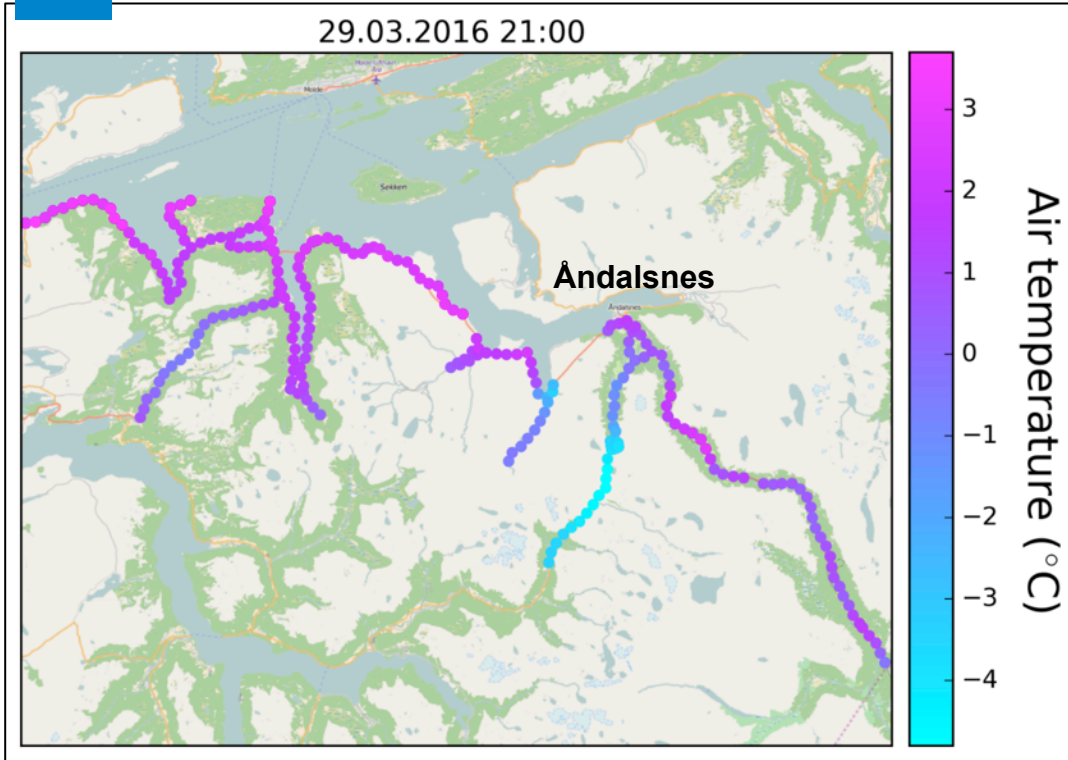
- ✓ Pilot demonstration for space-based winter maintenance services
- ✓ FMI provides road weather forecasts supporting winter road management for pre-defined test sites in Sweden and Norway
 - Especially Norway site is meteorologically very challenging due to fjords and mountainous environment
 - Sky-view factor and height correction applied
- ✓ Ongoing project





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Norway test site





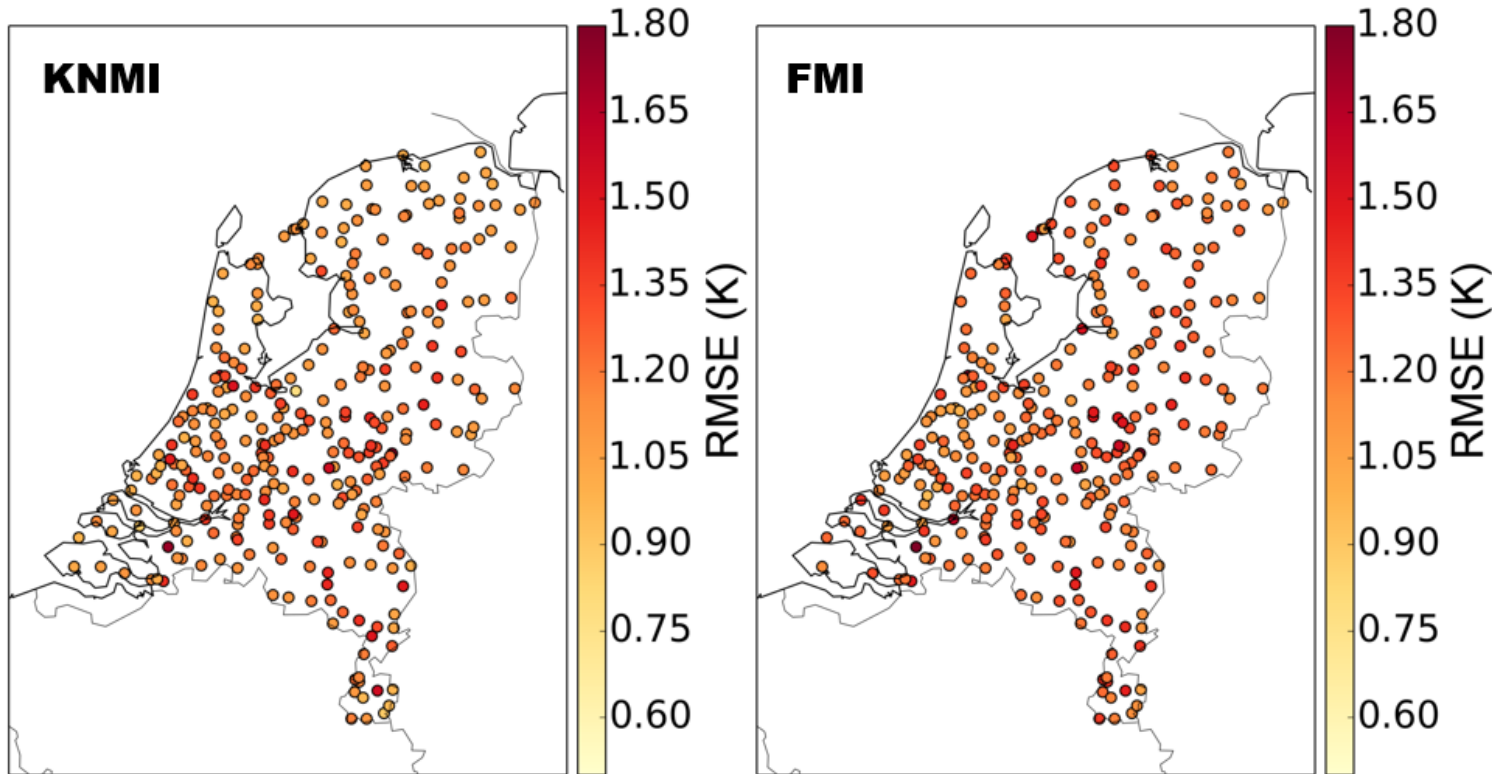
4 FMI Road Weather Model in Holland

FMI RWM model implemented on Dutch highways (2015)

- ✓ Assess performance of KNMI's recently developed RWM
- ✓ Comparison of FMI and KNMI models
- ✓ 322 road RWSs around Netherlands
- ✓ Utilize Harmonie NWP model to force KNMI RWM
- ✓ Test period: 15 Jan – 1 March 2015
- ✓ Scientific paper to be submitted spring 2016



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RMSE of +6 hr road surface temperature forecasts

- ✓ KNMI RWM is well suited to provide forecasts on Dutch roads
- ✓ Slightly lower performance of FMI RWM probably due to model optimizations for Finnish special winter conditions
- ✓ Collaborative study benefited both parties



5 FMI Road Weather Model to Estonia

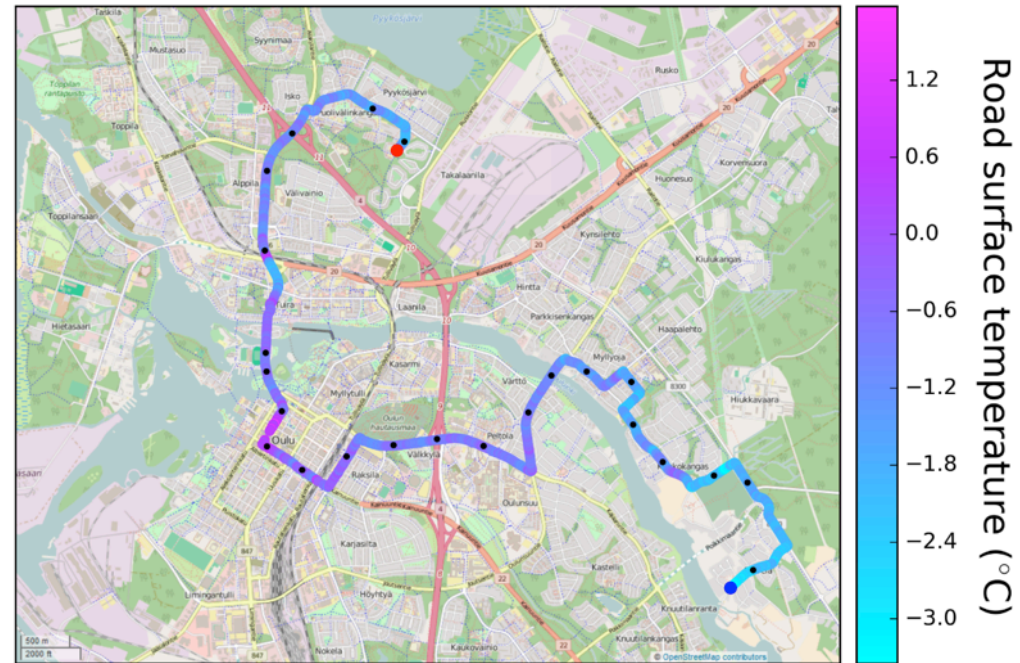
- ✓ Collaboration with Estonian Environment Agency (2015)
- ✓ FMI provided necessary collaborative R&D consultation to implement our RWM in Estonia
 - First time FMI RWM ran outside of the Institute
- ✓ RWM performance tested on Estonian roads (Tallinn-Tarto highway)





6 Use of Mobile Vehicle Observations in Road Weather Modeling

- ✓ Road weather stations too sparsely located
 - *Insufficient input for precise forecasts*
- ✓ Measurement campaign in the city of Oulu: Mobile observations used as input in FMI road weather model

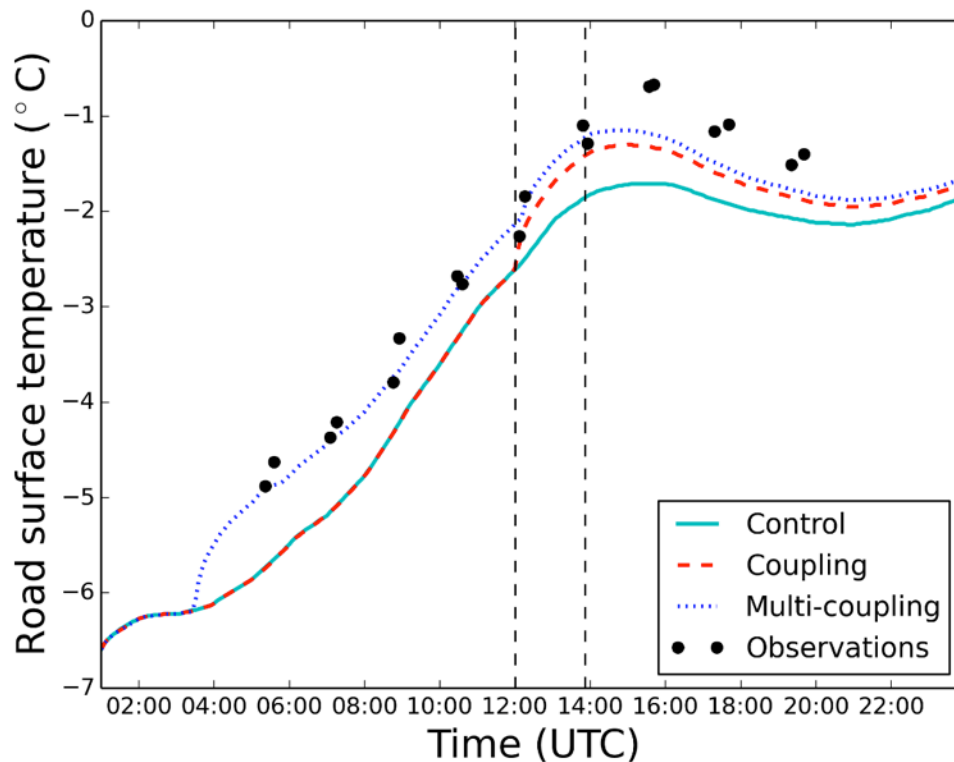


Measurements 8th December 2015, 16:16-16:57 o'clock



6 Mobile Vehicle Observations in Road Weather Modeling

**Welcome to
Poster # 17 !**



Virve Karsisto
PhD work

Forecasts improved
considerably !

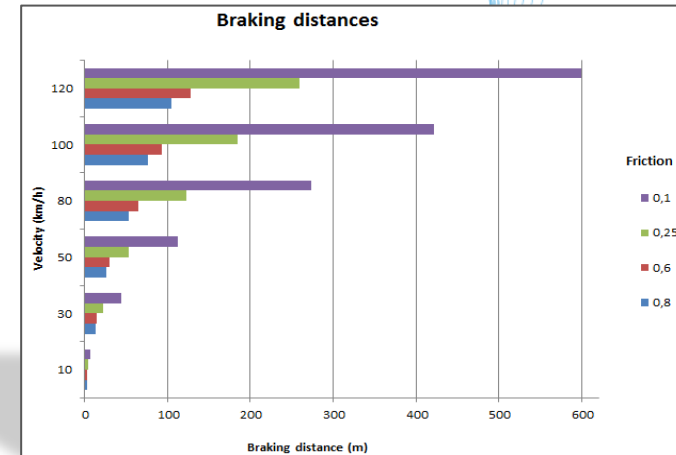
RMSE (°C) of Surf.T forecasts
of the different model versions

Model version	3-5 h	5-7 h	7-9 h
Control	1.10	1.18	1.22
Coupling	0.61	0.77	0.92
Multi-coupling	0.59	0.76	0.91

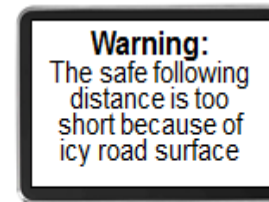
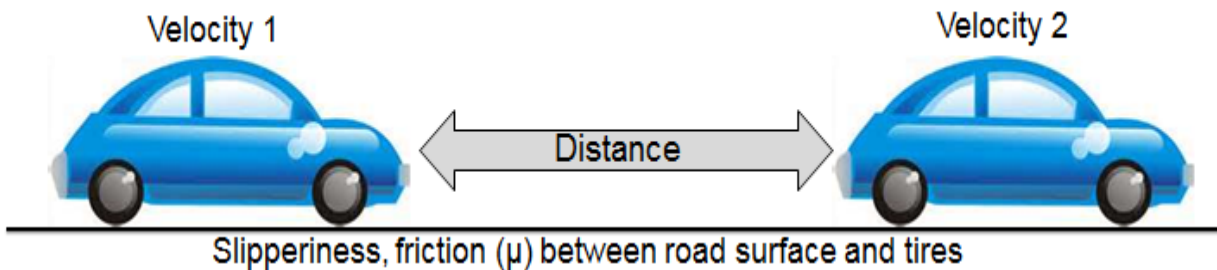


7 Braking Distance Application

- ✓ Application to inform drivers when too close to car driving ahead
- ✓ Application takes into account the prevailing friction - observed and forecast
- ✓ D2I (Data-to-Intelligence) project



Braking distances vary as function of speed and slipperiness (friction)

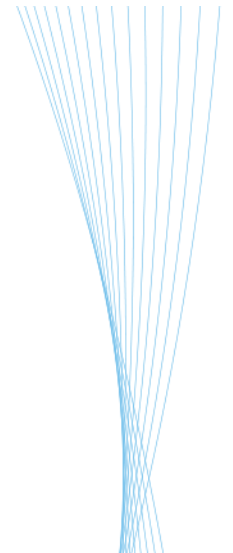




8 Pedestrian Sidewalk Application

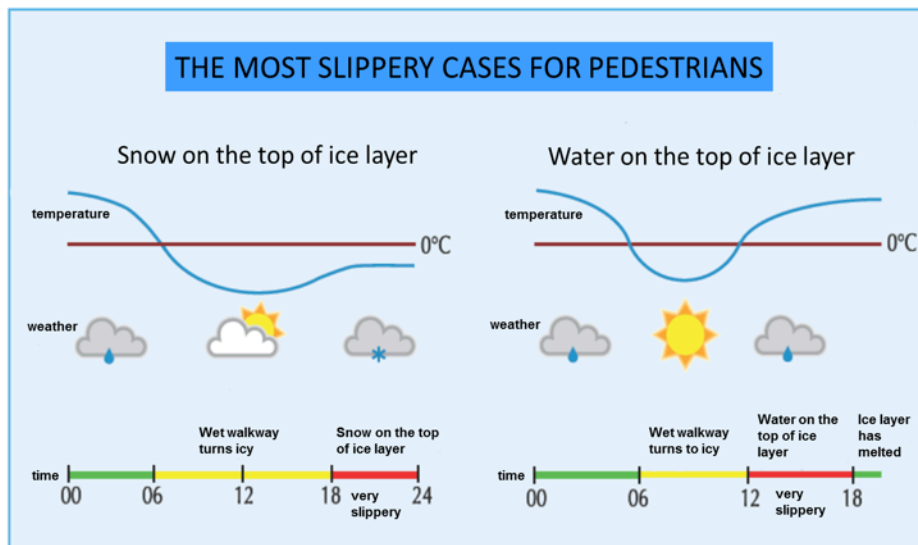
Goal : Reduction of slipping accidents

1. Winter maintenance of pavements
 2. Increase awareness of pedestrians
 3. Promote foot wear with good grip
- ✓ Pedestrian sidewalk condition model
 - ✓ Warnings given when expecting slippery walkway conditions

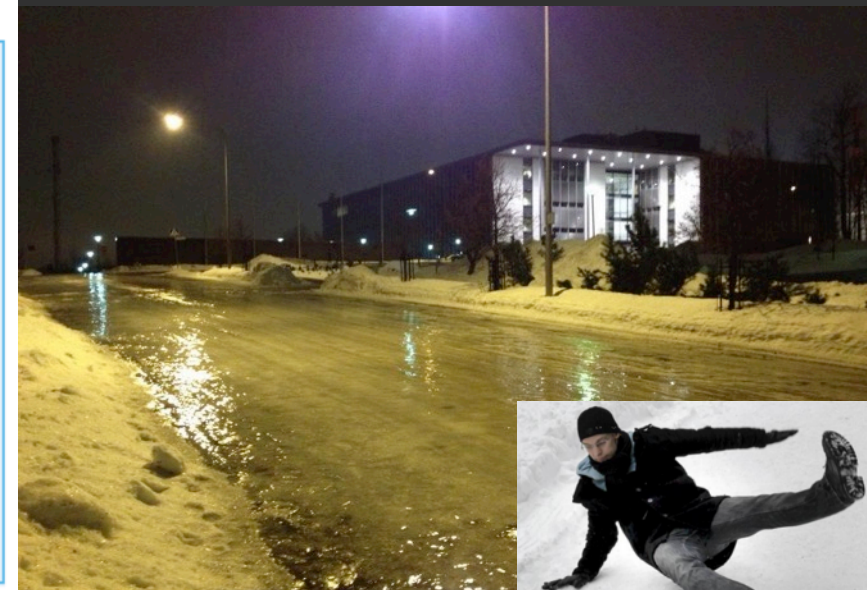


Slipperiness index

- Normal
- Slippery
- Very slippery ⇔ Warnings



5/16/16



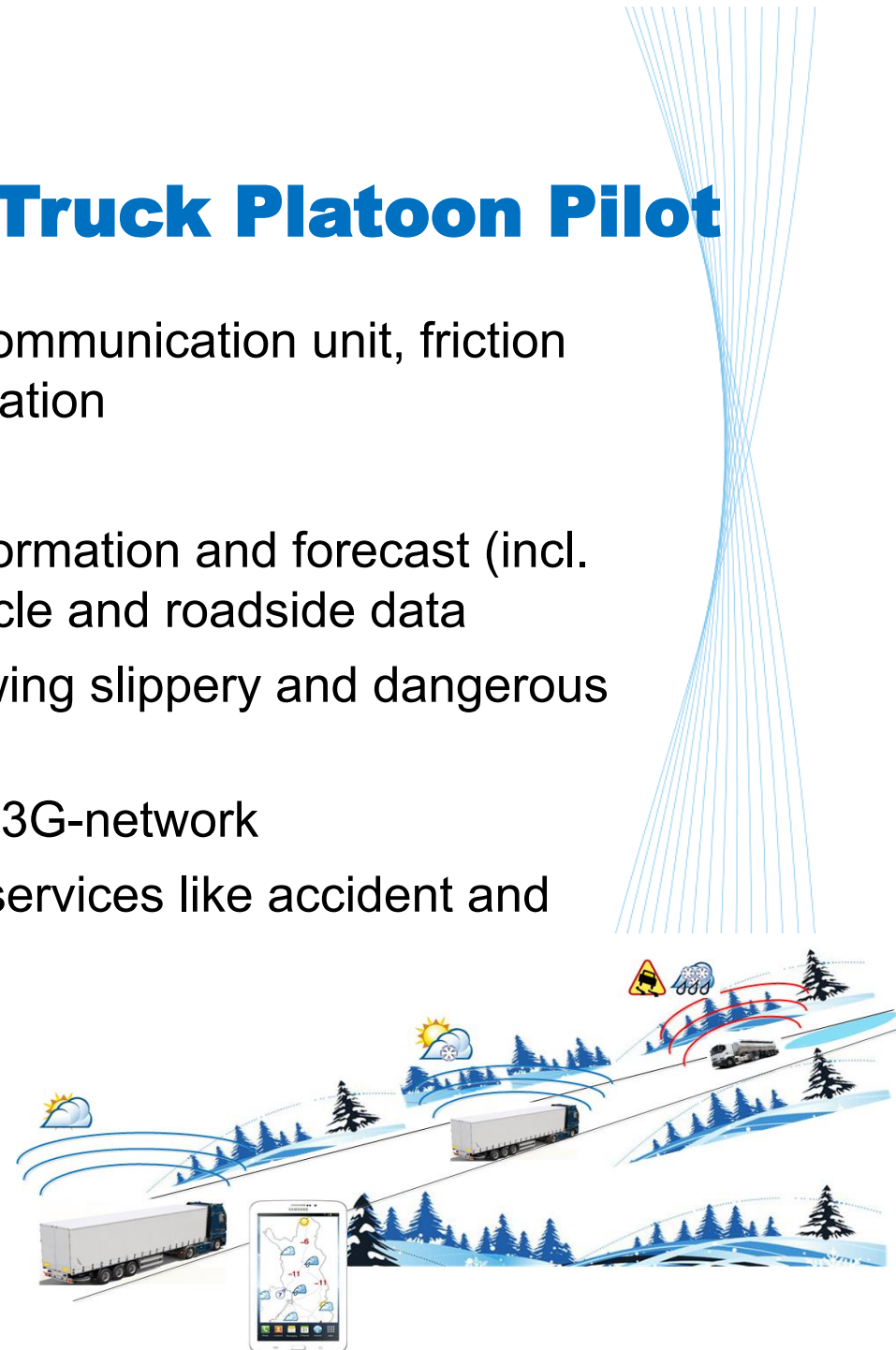


9

ITS: Intelligent Arctic Truck Platoon Pilot

- ✓ 6-8 test vehicles instrumented with communication unit, friction measuring and telematics instrumentation
- ✓ Roadside reference data from RWSs
- ✓ Real-time, accurate road weather information and forecast (incl. friction forecasts) provided with vehicle and roadside data
- ✓ Provision of map-based service showing slippery and dangerous spots along the route
- ✓ Information delivered in real-time via 3G-network
- ✓ Potentially deployment of additional services like accident and reindeer warnings
- ✓ Service delivered to project partners via 3G-based user device (tablet PC or smart phone)

New upcoming project @ FMI!





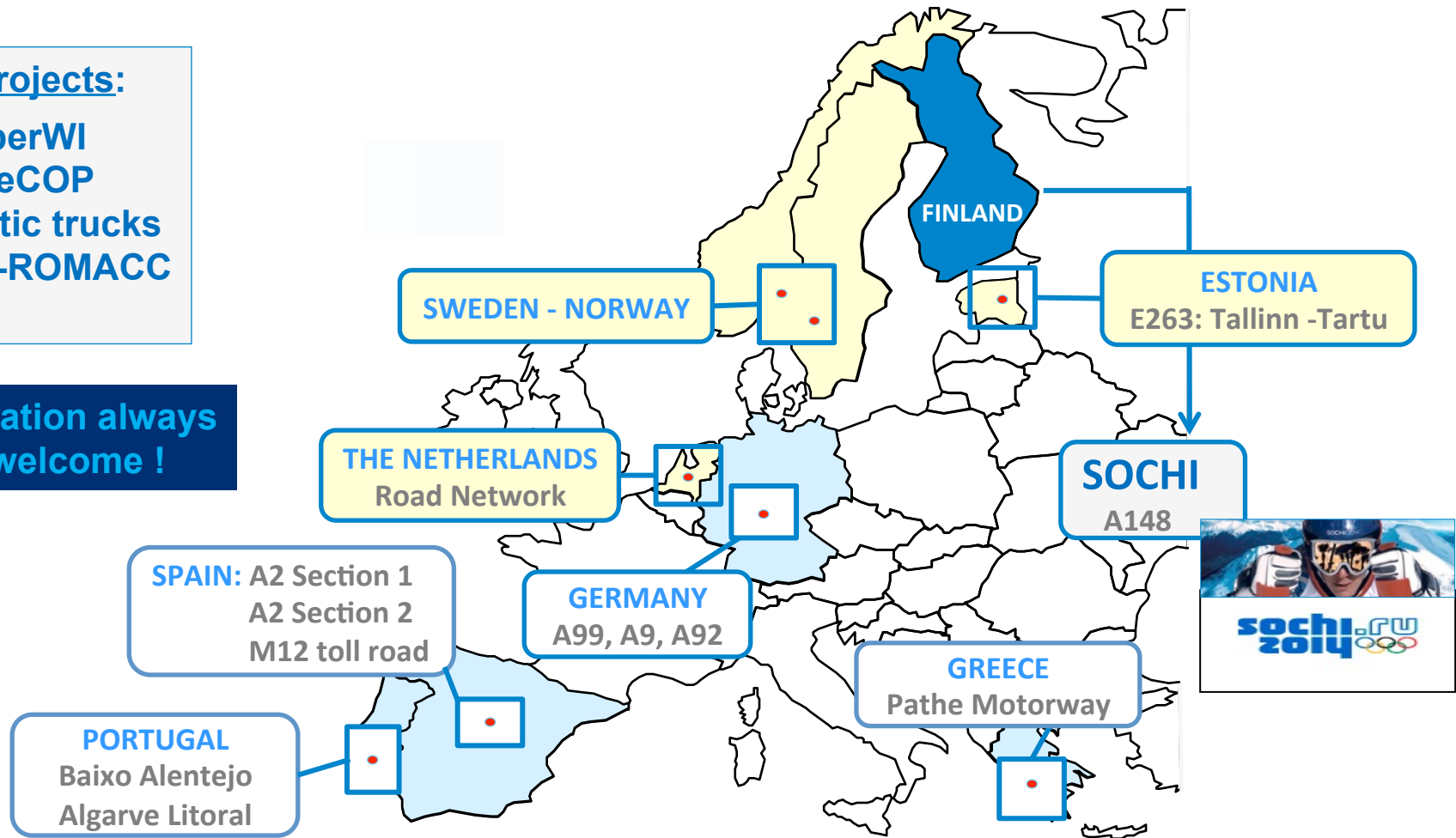
Summary

Exporting FMI Road Weather Expertise towards next HORIZON(s) **2020...**

New projects:

- ✓ CyberWI
- ✓ SafeCOP
- ✓ Arctic trucks
- ✓ ITS-ROMACC
- ✓ ...

Collaboration always
very welcome !



... **but what's going to be there
by the next SIRWEC, 2018**

(wherever it will be held):



Pertti will have retired

from



FINNISH METEOROLOGICAL INSTITUTE

... Studying & Listening to Blues @ Home

(enjoying his collection of > 10 000 Blues albums)