A Feasibility Study for Weather-Controlled Variable Speed Limits (VSL) in Norway

2016 International Conference on Winter Maintenance and Surface Transportation Weather

Torgeir Vaa, Norwegian Public Roads Administration
Trond Foss, SINTEF Transportation

Learning outcomes

- Variable speed limits (VSL) has become relevant in Norway because the speed limit is set up on highways
- The study show how an ITS application for VSL may function for a virtual pilot on E18 in Vestfold County (2 + 2 lanes highway)
- The study focuses on road surface conditions (friction)
- The pilot show the potential for a VSL system, but the system is not ready to be implemented
- Several research questions has to be addressed

Background

- The building of highways with high speeds and traffic volumes is increasing in Norway
- There is a new policy in Norway to increase the speed limit on highways from 90 and 100 km/h up to 110 km/h
- It has also been politically discussed the introduction of 130 km/h as an upper speed limit

Picture source: www.dinside.no

Background

Fartsgrenser på motorveiene

Statssekretær Bård Hoksrud (Frp) ønsker variable fartsgrenser

State Secretary Bård Hoksrud wants variable speed limits

Supported by Norwegian council for Traffic Safety

The proposal from the government is raising the speed limit on certain motorways to 110 km/h. At the same time State Secretary Bård Hoksrud introduce variable speed limits.

That means speed limits customized to weather, implying a significant reduction if the driving conditions are difficult.

Introduction

- Highways with high traffic volumes will usually have standard requirements implying that the road surface should be bare a short time after the weather incident/snowfall

- However, there will be certain weather conditions that prevents the contractor to maintain the required level of service all the time

- A reduction of the stopping abilities and traction control during winter time when the required level of maintenance cannot be achieved, will be critical on highways with high traffic volumes and high speed limits

Introduction

- Research has shown that drivers reduce the speed when the driving conditions are getting worse but not to the extent that is needed for keeping the risks on an acceptable level

- This implies an increased probability for severe traffic accidents to occur during the periods when the drivers do not adapt their speed to the actual driving conditions

Introduction

- During periods with snow and ice and low friction there is a need to inform the travelers and temporarily reduce the speed limits until the required maintenance level has been achieved

- Hence, one should expect periods where there is a need to activate ITS applications that informs the travelers on the driving conditions and reduce the speed limit

Objectives of the feasibility study

- Investigate state-of-the-art for:
  - ITS applications informing travellers about weather and road conditions that may cause an increased risk level concerning traffic safety
  - ITS applications that reduce the speed limit due to bad weather and road conditions

ITS applications studied

Inform travellers about weather and road conditions

This application includes:

- monitoring the road and weather conditions by data collection
- management of data collected
- distribution of road and weather condition information to the travellers

Picture source: ntl.bts.gov

Reduce the speed limit due to weather and road conditions

This application includes:

- monitoring the road and weather conditions by data collection
- management of data collected
- effectuate reduced speed limits

Picture source: thetimes.co.uk

Methodology

The methodology applied for the state-of-the-art for the two ITS applications has been to:

- Define a physical architecture for systems that:
  - Collects data about weather and road conditions
  - Determine the status for now and for the next coming hours (prognoses)
  - Informs the travellers about the weather and road conditions
  - Effectuates (manually or automatically) traffic management measures like reduced speed limits

State-of-the-art for weather and road condition information systems

A literature review

- describes the findings in US, Canada and 5 countries in Europe that have road and weather conditions comparable with the conditions in Norway in the winter period

- Both web based systems, smart phone apps and SMS services

State-of-the-art for Variable Speed Limits (VSL)

The literature search shows that:

- Most published scientific articles are mainly concerned with the use of microscopic traffic simulations to evaluate future implementations of VSL System
- Most of the public Traffic management documents available on the Internet deal with temporary variable signs implemented on roads in the case of road works
- There is no or very little information on the strategies and procedures behind the use of VSL
- An exception is the Finnish literature available in English that have some information on the principles for reducing the speed due to road surface conditions, heavy rain or poor visibility

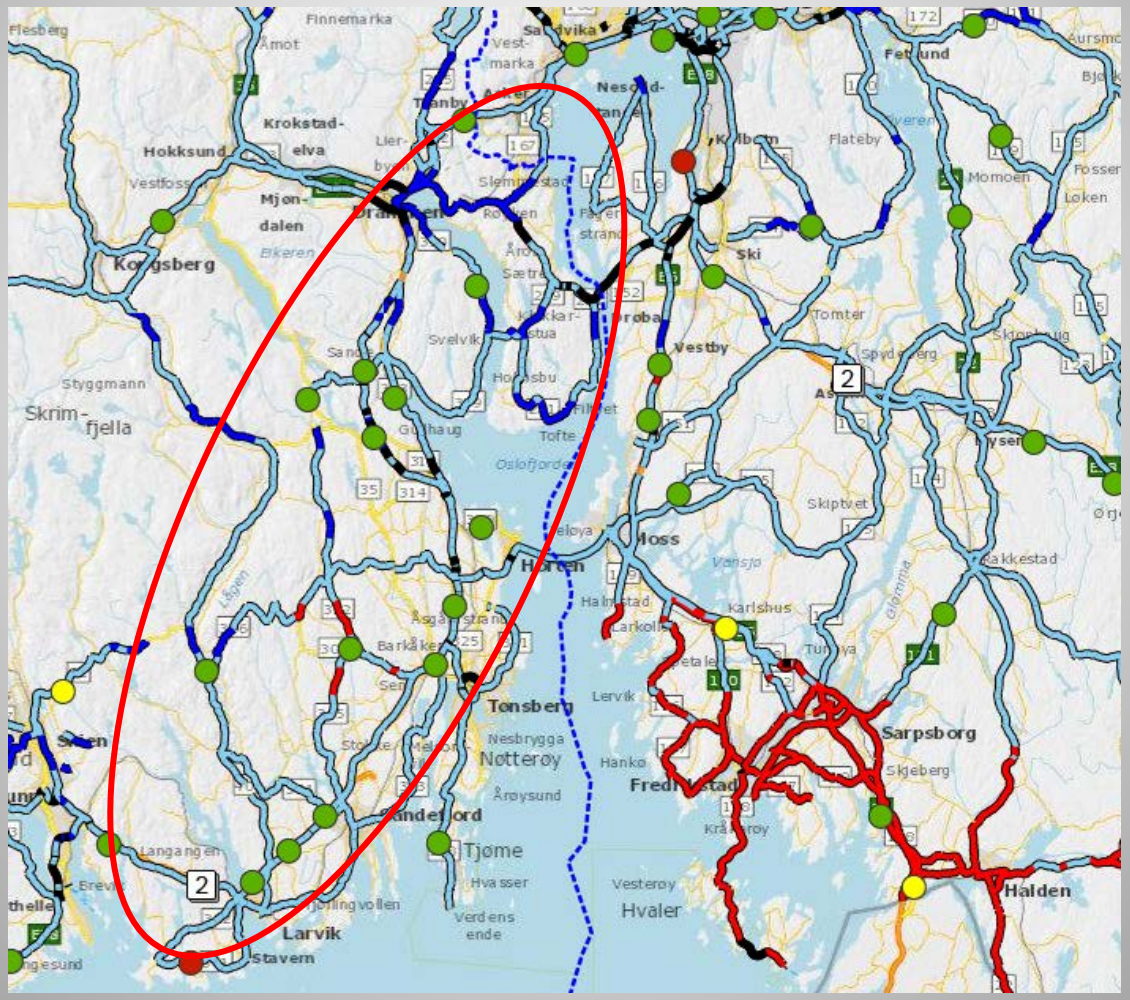
Example on conditions for reduced speed using VSL

PARAMETERS	VALUES	VMS-SIGN	INFO SIGN
(D) DANGEROUS ROAD CONDITIONS **Speed limit by automatic system 80 km/h** **Speed limit 60 km/h manually, if traffic control center officer decides that it is necessary.** **VMS/INFO-signs automatically according to following rules.** **AT LEAST ONE OF FOLLOWIN TERMS (D1...D3) FULLFILL**			
(D1) DANGEROUS CONDITIONS BECAUSE OF ROAD SURFACE CONDITIONS			
Right lane friction AND **Road surface temperature**	μ < 0,15 AND Road surface < +2°C	'Slippery road' (144)	"DANGEROUS ROAD SURFACE CONDITIONS"
(D2) DANGEROUS CONDITIONS BECAUSE OF RAIN			
Form of rain	18 = freezing rain	'Slippery road' (144)	"FREEZING RAIN"
(D3) DANGEROUS CONDITIONS BECAUSE OF VISIBILITY			
Visibility	< 100 m	'Danger'	"POOR VISIBILITY"

Objectives of the feasibility study

- Describe how an ITS application for VSL may function for a virtual pilot on E18 in Vestfold County (2 + 2 lanes highway), Norway
- By virtual pilot is meant that the found requirements for VSL are applied on the highway section without really changing the speed limits
- Recommend future work based on the findings in the study

Study area in Norway



Hanekleiva RWIS station, E18

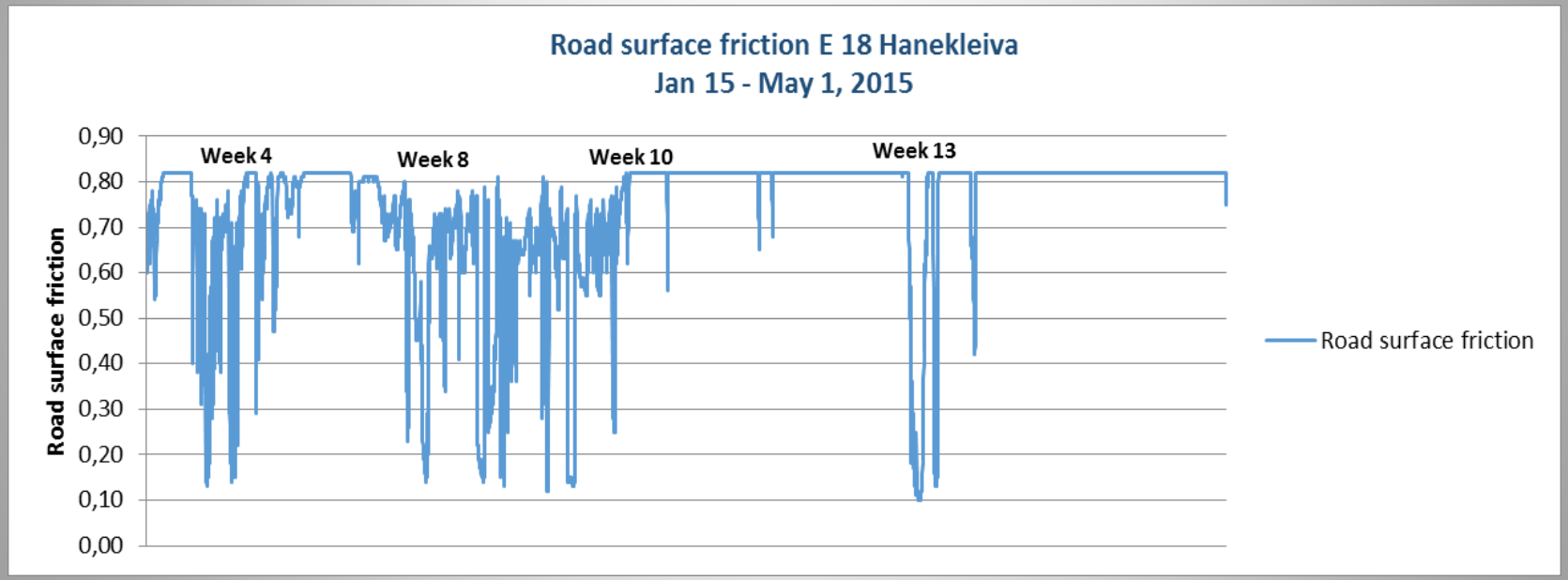
- With optical sensor

Hanekleiva RWIS station, E18

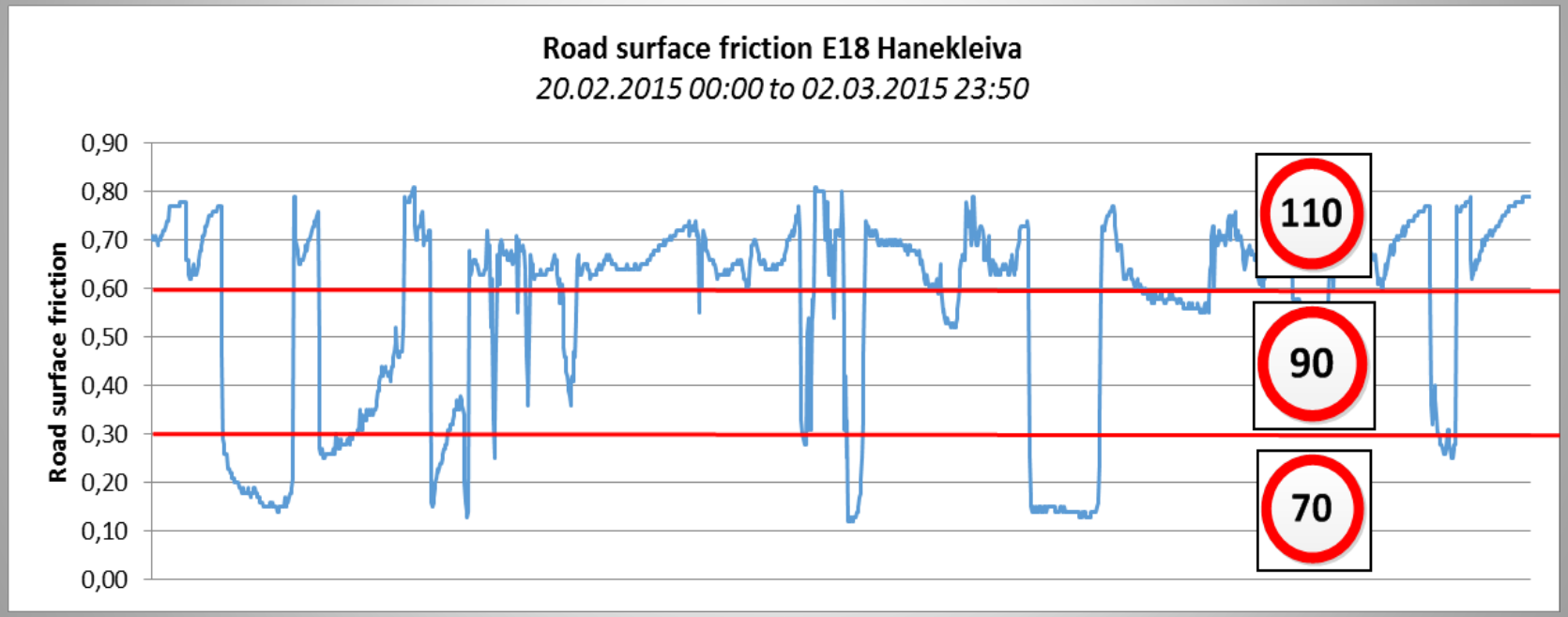
The E18 pilot

- The pilot road E18 have seven RWIS stations instrumented with optical sensors and LED variable speed limit signs are already in place.

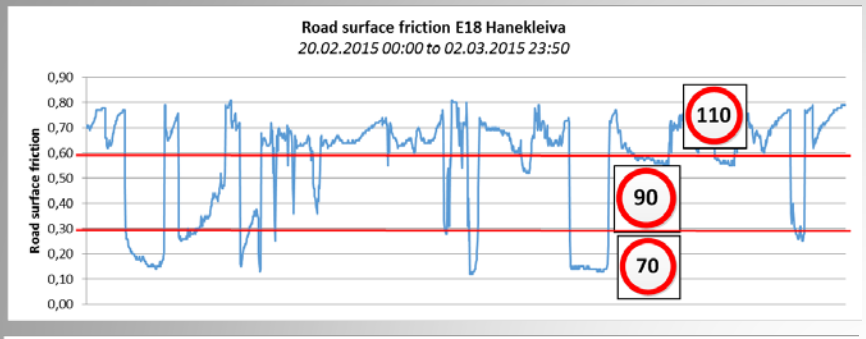
Results from the pilot

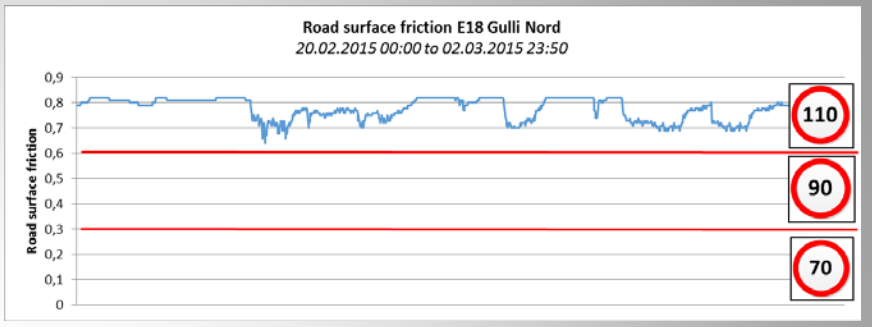


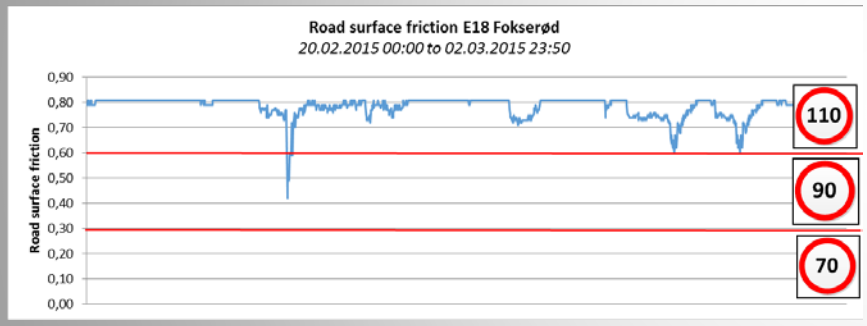
Results from the pilot

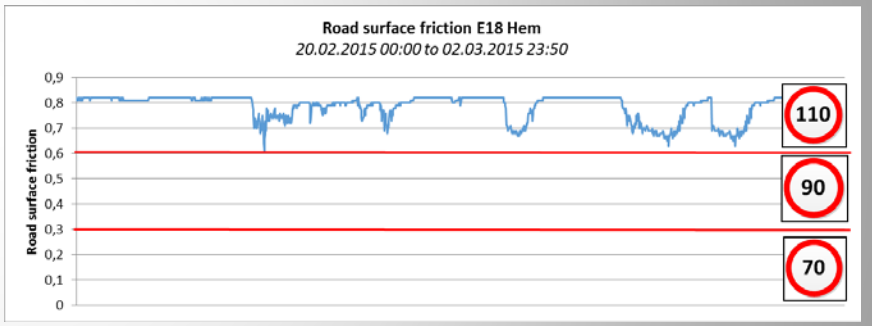


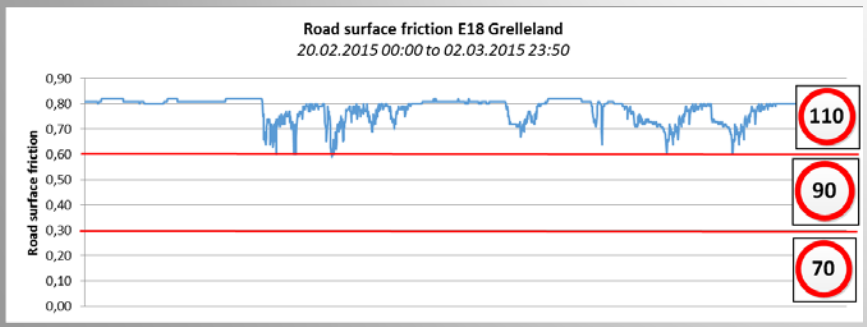
Period 20.02.2015 00:00 – 02.03.2015 23:50

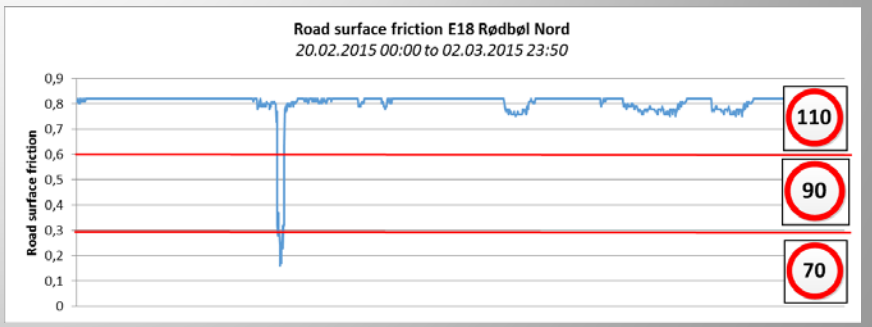












Possible causes for differences at measuring sites within the same area

- Differences in climate
- Differences in topography
- Sensors
  - Differences in sensors, e.g. caused by lack of calibration)
  - Differences in sensor maintenance, e.g. cleaning of lenses

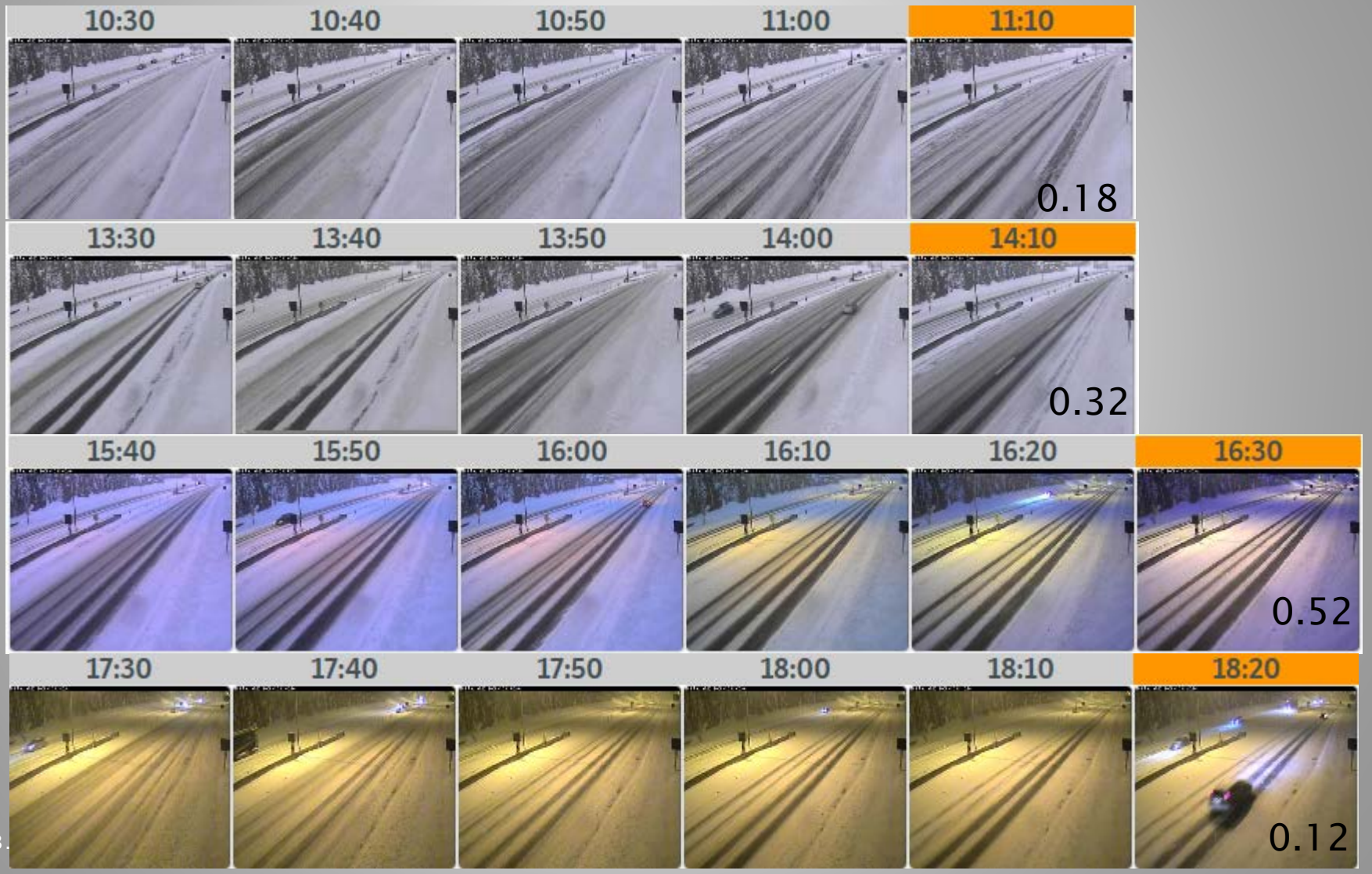
Grelland RWIS station, E18

Gulli North RWIS station, E18

Fokserød RWIS station, E18

Rødbøl North RWIS station, E18

Rødbøl North RWIS station, E18



Research questions

- What are the speed limits that should be used? 70, 90 and 110 km/h or other speed levels?
- What are the friction limits to be used for a dynamic speed limit balancing the risk caused by reduced friction?
- How many sensors are needed?
- Availability of additional data sources
- What is the accuracy and reliability of the sensors installed?
- How does uncertainty and reliability influence on the speed change algorithms?

Learning outcomes

- Variable speed limits (VSL) has become relevant in Norway because the speed limit is set up on highways
- The study show how an ITS application for VSL may function for a virtual pilot on E18 in Vestfold County (2 + 2 lanes highway)
- The study focuses on road surface conditions (friction)
- The pilot show the potential for a VSL system, but the system is not ready to be implemented
- Several research questions has to be addressed

- Contact information: torgeir.vaa@vegvesen.no