SRIS
Slippery Road Information System

IVSS Project Report

The idea is that data from existing sensors in vehicles about the road condition (ESP, ABS) and other useful information (temperature, windshield wipers) is transferred from vehicles and then combined with weather data, resulting in an improved and increased information about the road conditions.

SRIS covers a spatially larger area compared with the fixed positions of the road weather stations. The SRIS also gives a denser temporal resolution.

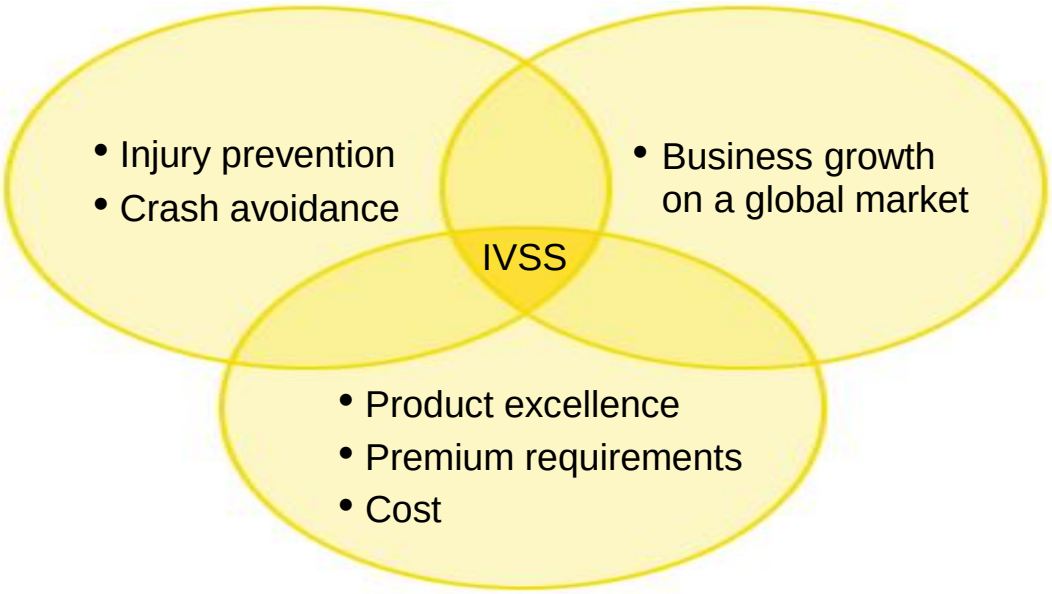
Field-tests have been performed during the winter 2007/2008 with 100 cars and 80 weather stations in west of Sweden.

The conclusion is that SRIS is technically possible to use. It also has a high national economic potential since SRIS is commercially interesting to develop and use. If a decision is taken today, it is technically possible to have a Swedish national system in two years. Within four years it would be possible to have exported SRIS to several European countries.

The IVSS Program

The IVSS programme was set up to stimulate research and development for the road safety of the future. The end result will probably be new, smart technologies and new IT systems that will help reduce the number of traffic-related fatalities and serious injuries.

IVSS projects shall meet the following three criteria: road safety, economic growth and commercially marketable technical systems.



Three interacting components - for better safety, growth and competitiveness:

The human being

Preventive solutions based on the vehicle's most important component.

The road

Intelligent systems designed to increase security for all road users.

The vehicle

Active safety through pro-active technology.

SRIS – Slippery Road Information System

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1. Introduction SRIS

SRIS – Slippery Road Information System is a result of research within traffic safety using existing in-vehicles technology together with infrastructure in a new and innovating way.

SRIS is collecting information from existing sensors in vehicles about the road condition (ESP, ABS) and other useful information (temperature, windshield wipers etc), and transmitting to a central database. The information is combined with weather information from Road Weather Stations and as result, improved and increased information about the road condition can be provided. One of the real benefits with SRIS is that it covers a spatially larger area compared with the fixed positions of the road weather stations. The SRIS also gives a denser temporal resolution.

The users of the SRIS information could be all from drivers getting information about slippery road condition to road maintenance personnel who get a better overview how to use their efforts. SRIS can also be used as a tool for the road administration to validate the result from the maintenance.

The SRIS focus to deliver information with a higher quality to alert the drivers and road maintenance about the actual conditions to make efforts for avoiding accidents.

Approximate 90% of all new cars in Sweden have ESP (Electronic Stability Program). By using only existing sensors in vehicles, a greater coverage can be established. All vehicles in the SRIS field-test had a special equipment to transmit the signals from the vehicles to a central database. More important is that many new cars has integrated telecommunication equipment, so the real big task in the future, is integrate SRIS in the electrical architecture of the vehicle so the vehicles can send information without the extra equipment that has been used now. Perhaps, SRIS could be a software solution.

SRIS experienced a field-test in the winter 2007/2008 with 100 cars and the result was successful. The result showed that in most cases, the information from the vehicles corresponds with the information from the road weather stations. But there were also situations when SRIS detected slipperiness without warnings from the road weather stations.

In a worldwide perspective, the idea and scenario is to increase SRIS to more countries and technically, many of the new vehicles have ESP and telephone, so it’s more a political challenge.

2. Swedish introduction

Projektet SRIS – Slippery Road Information System– är ett samarbetsprojekt mellan Vägverket, Semcon, Klimator, Logica, Bilia, Caran-Eis, Saab samt Combitech. Projektet delfinansieras av IVSS, Intelligent Vehicle Safety Systems. Ett program som syftar till att stimulera forskning och utveckling för morgondagens trafiksäkerhet.

SRIS vision är att hjälpa trafikanter bedöma det rådande väglaget samt att ge möjlighet till förbättrad och mer effektiv vinterväghållning. Projektmålet är att utvärdera om informationsöverföring från bil kombinerat med väderdata (VViS) kan utgöra ett underlag för att öka trafiksäkerhet och förbättra vinterväghållningen.

SRIS (Slippery Road Information System) är ett system för att utvärdera vinterväglag i realtid. Det är baserat på ABS- och ESP- information från bilar som kombineras med väderinformation från väderstationer (VViS). Moderna bilar med olika säkerhetssystem som registrerar hur bilen beter sig i olika körsituationer ger möjlighet att detektera signaler från bromsar, anti-spinnfunktioner och andra parametrar som tillexempel temperatur och vindrutetorkare. Datat från bilarna kan ge mycket information om väglag och väderförhållanden. En viktig del är att datat genereras genom vanlig körning det vill säga bilarna skall inte provoceras eller bromsas på något speciellt sätt. Det som genererar relevanta signaler är det rådande vädret eller väglaget som påverkar bilen.

I dagsläget kan inte VViS ge information om, är hur läget är på själva vägen, i fråga om halka och väglag. Med hjälp av VViS-data kan det troliga läget på vägen förutspås men då är inte hänsyn taget till genomförda vinterväghållningsåtgärder eller t.ex. om snön är så pass kall att den inte fastnar på vägytan. VViS ger mycket detaljerat punktinformation men kan inte visa hur det ser ut mellan stationerna, och det finns därför ett behov av att komplettera detta system med nya metoder för att öka och förbättra informationsinnehållet.

SRIS projektet möjliggör denna information eftersom den integrerar information från VViS stationerna med information så som temperaturer, slirighet och friktioner på vägbanorna från bilar i området. Med denna information kan väglaget mer exakt preciseras samtidigt som informationen kommer i realtid. Detta gör att underhållsåtgärder kan optimeras.

SRIS har genomförts i två fälttester. Den första säsongen 2006/2007 innefattade 80 väderstationer och 20 bilar. Den andra säsongen 2007/2008 innefattade 80 väderstationer och 100 bilar.

Föreliggande rapport redogör för resultaten från projektet och vilka slutsatser som kan dras samt även en analys av kommersiella möjligheter.

3. System overview

The SRIS test in Sweden was performed by use of 100 cars, 90 of them were located in the Gothenburg area and 10 cars in Stockholm. The car models used in the test were Volvo V70s and Saab 9-5s. The used cars were both company cars and taxis to get a high frequency of usage and driving distance of the cars.

The weather information is collected by 80 Road Weather Stations and transmitted to a central database, located in Borlänge, Sweden. At the same time, vehicles are reporting background data or events of slipperiness from the existing in-vehicle sensors to the same database.

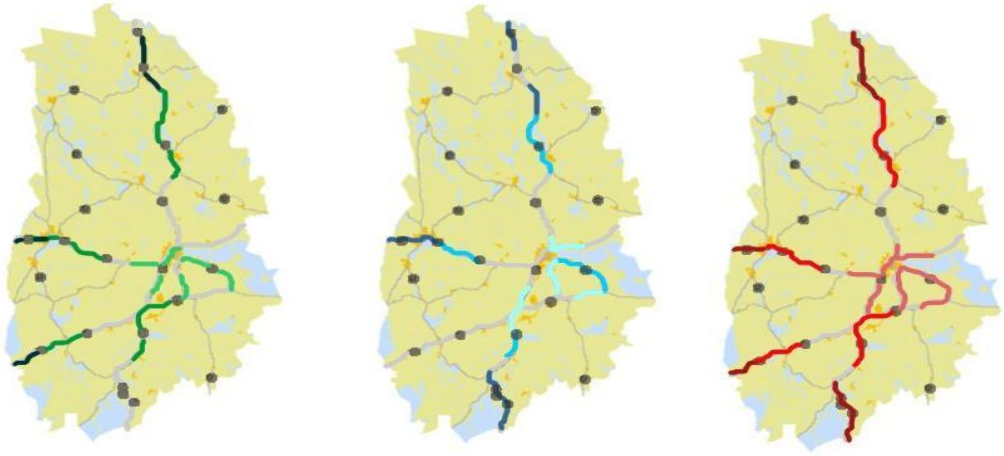
The SRIS system is based on three different models:

- The vehicle model
- The weather model
- The analyze model

The test area is divided into smaller segments, witch are connected to road weather stations. The road weather stations give meteorological input to the weather model and define three different levels of slipperiness:

- **No slipperiness**
- **Slippery**
- **Very slippery**

The next step is that the weather model is compared with the number of reported events from the vehicles. The result by combining these sources is presented in the analyze model, the right picture below.



Event of slipperiness from vehicles, estimations from the weather model and analyze model

4. Result

4.1. Data types from Vehicles

The data type from the vehicles is categorized into two types:

- Event data
- Background data

Event data is when the vehicle triggers a sensor connected to the car safety system, and a signal is sent to the database with a report of the event including other useful information such as e.g. position and temperature.

Background data is a continuous report, delivered from the vehicles with a specified timeframe. Background data include e.g. position to track the vehicles.

4.2. The relation between the signals from vehicles and actual road conditions

The actual road weather has been collected from road weather stations during the season 2007-2008 and has been sorted by an expert system[1] to classify the different types of slipperiness. The signals from the vehicles have been sorted due to the type of slipperiness that was registered in relation to the closest road weather stations.

The table shows the allocation of event data and background data, based on type of slipperiness. Event frequency is the quota between the number of events and background data. The probability of slipperiness is estimated by the event frequency.

	NO SLIPPERY	RAIN	RAIN ON COLD ROAD	SNOWSLIPPERY	FROST SLIPPERY
Events	10861	1512	1126	3256	789
Background	1291426	174314	13459	27764	30659
Event frequency	0.0084	0.0087	0.084	0.12	0.026
Probability of slipperiness	1	1,03	10	14	3

[1]. Norrman, J., Eriksson, M., and Lindqvist, S. (2000). Relationships between road slipperiness, traffic, accident risk and winter road maintenance activity.
Climate research, 15:185-193.

4.3. Determination of different types of slipperiness

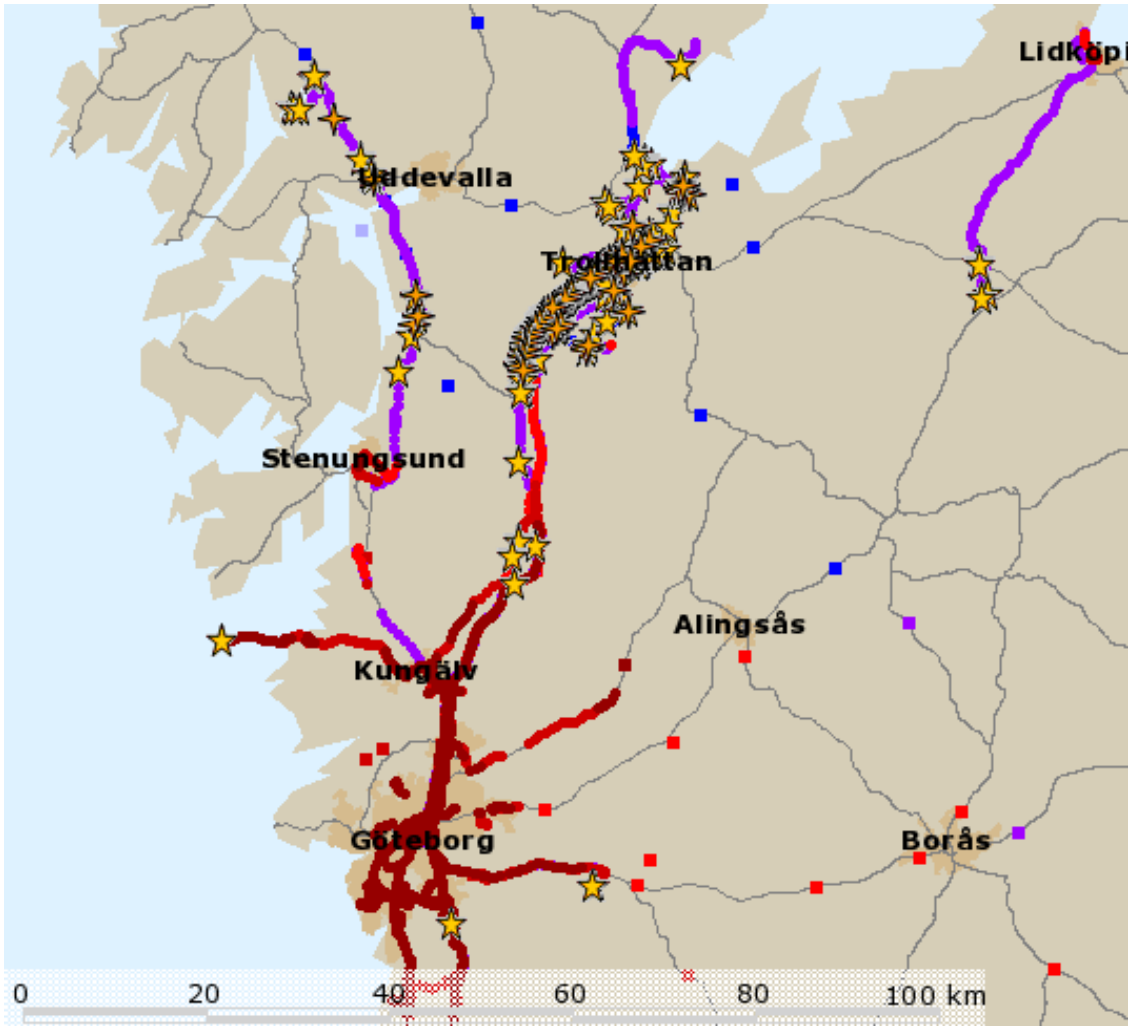
With the help of the analyze model, the different levels of slipperiness can be categorized. The road condition below is categorized from most to least slipperiness.

MOST SLIPPERY (EVENT DATA / BACKGROUND DATA))
Slippery on snow road
Rain on cold road
Frost slipperiness
Rain
No slipperiness

An important conclusion is that the weather has a major impact on how often the vehicles are reporting event of slipperiness. This means that it is possible to detect and determine the risk and level of slipperiness on the roads.

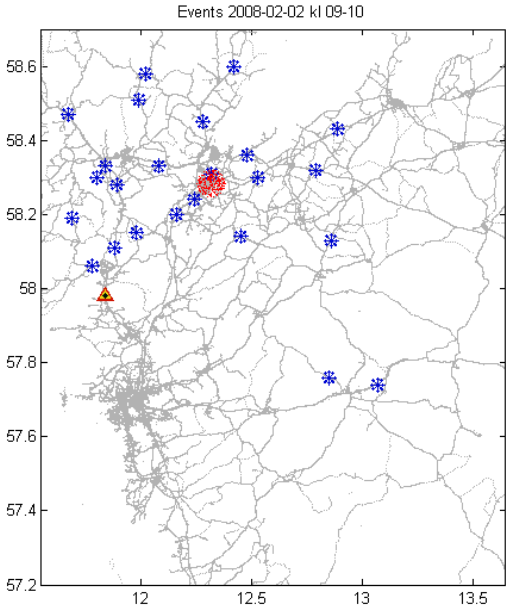
5. Graphic presentation of vehicle data and weather

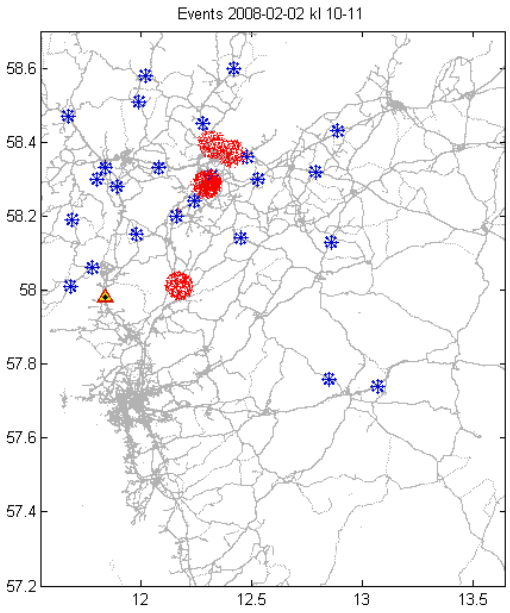
The picture below shows a period where a lot of vehicles report event of slipperiness and the actual temperature. The slipperiness event is shown by stars and the color indicates temperature. The picture made it possible to give a better visualization of the actual road condition.



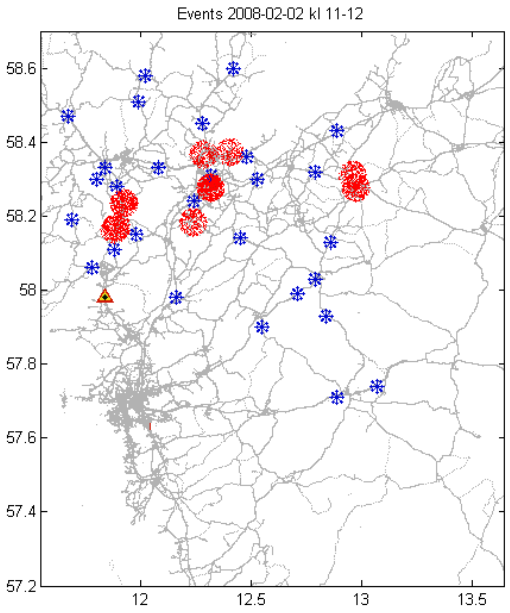
6. Case - example

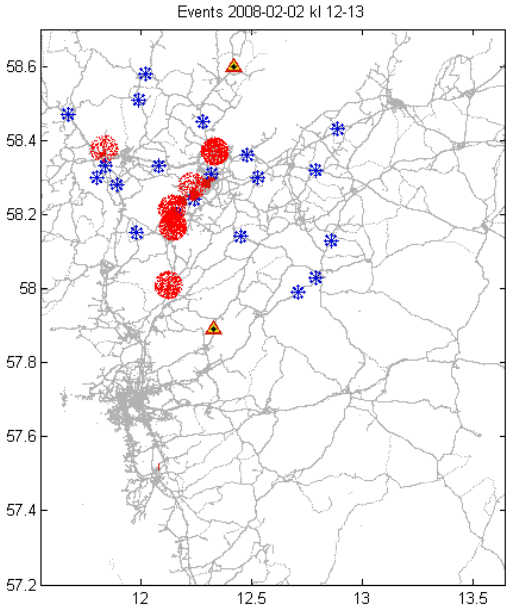
The following pictures show a sequence of information from road weather stations (blue) and reported events from vehicles regarding slipperiness (red). The first pictures show that the road weather stations indicate risk of slipperiness, but not so many events from the vehicles. Later the same day, the snowfall decreases and also the indications from the road weather stations. But more important is that the cars are still detecting slipperiness on the roads.

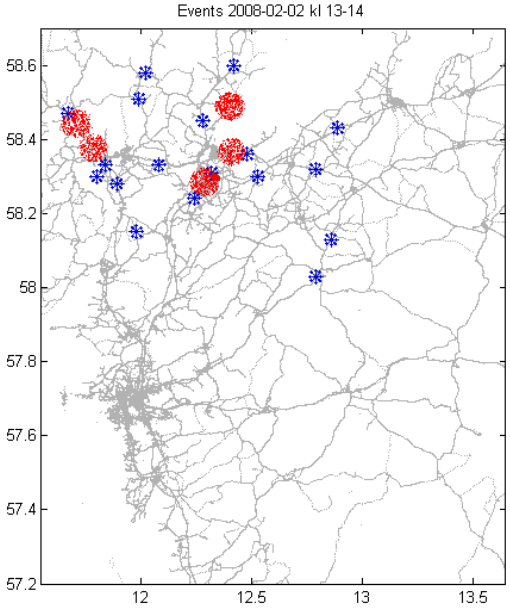


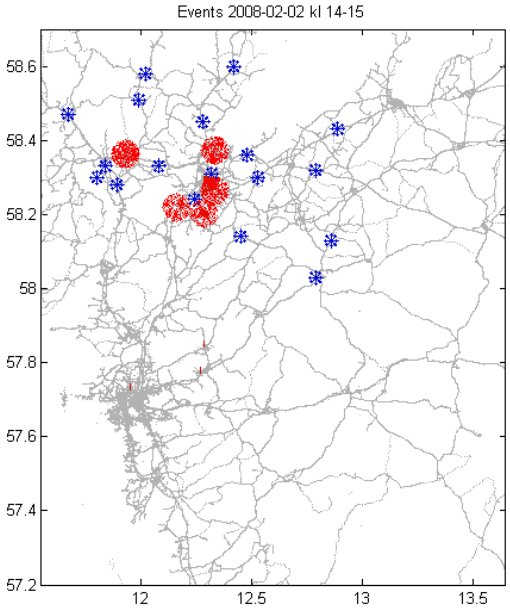


The rest of the figures show how the slippery reports increases from vehicles depending on the locations.

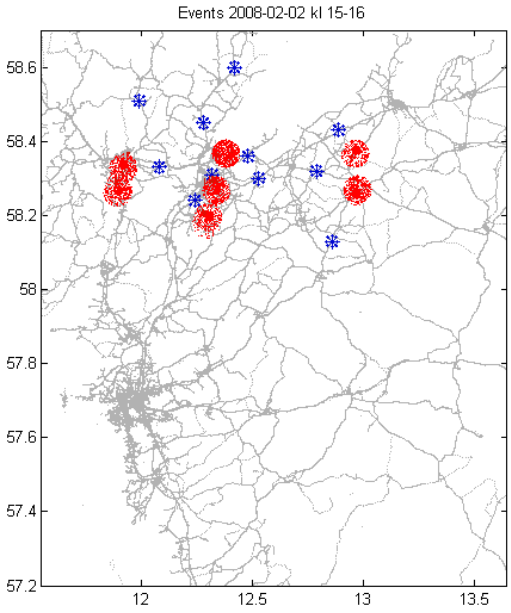




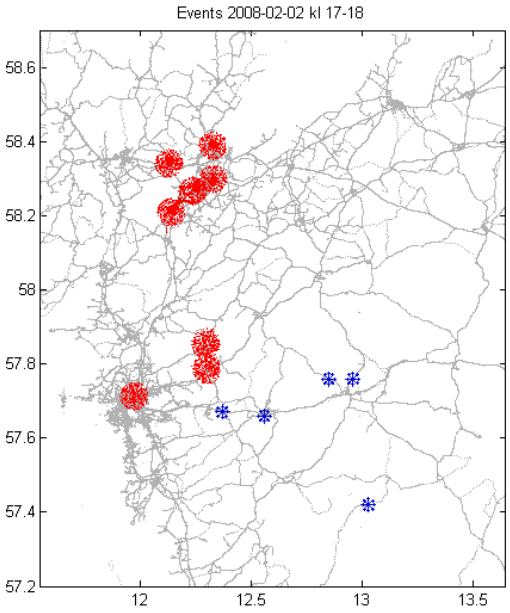




Later in the evening the same day, the road weather stations still detect snowfall, but less as previous.



In the evening, the snowfall and the indications from the weather stations have almost disappeared. But the vehicles are still reporting slippery condition in the area.



These figures show that with road weather stations as only source, it is difficult to have a high quality of the actual road conditions.

A conclusion is thus that SRIS can detect slippery conditions when the road weather stations do not catch the slipperiness.

7. Conclusion and recommendations

The performed field tests show that collected data was possible to combine in a useful way to get an increased usability of the provided information. SRIS increases the possibilities to identify severe road conditions. The field test with 100 cars has shown a good result and that SRIS is possible to apply to more vehicles and gain a growing profit for the society, both for drivers and road maintenance.

The result from the SRIS field-test showed a good result is the test area. An external social economic report has been made in a Movea report where the conclusion is that the system gives a very high social economic outcome when compared with the cost for SRIS.

The economic benefits would be for the road administration who pays for the road maintenance and insurance companies who can lower their costs.

But most important of all is that SRIS has a potential to increase the traffic safety which can save lives. SRIS also has a potential to give benefits for the environment avoiding unnecessary road salting.

If a decision is taken today, SRIS could be a reality within two years and in four years it would be possible to export SRIS to several European countries.

8. Publications and attachments

- SRIS Final report (Swedish)
    - Attachments to the report (Swedish)

IVSS partners: