



XIII  
INTERNATIONAL  
WINTER ROAD  
CONGRESS

QUÉBEC, FEBRUARY 8 TO 11, 2010



Québec 

# SUSTAINABLE WINTER SERVICE FOR ROAD USERS

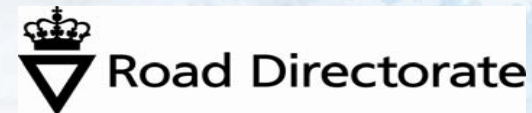
*GPS Controlled Salt Spreading and Section Based  
Forecasts*

Bo Sommer

Danish Road Directorate

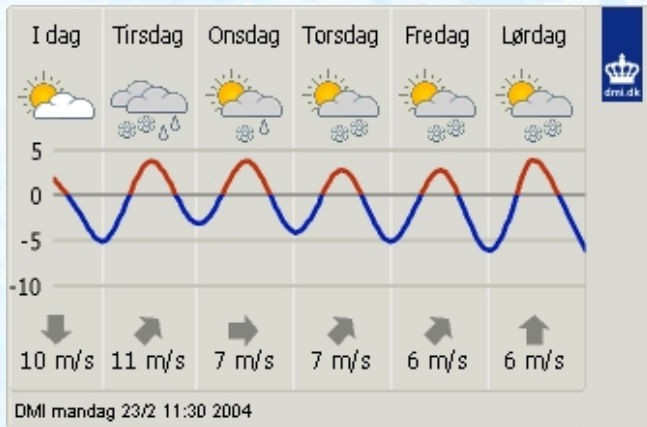
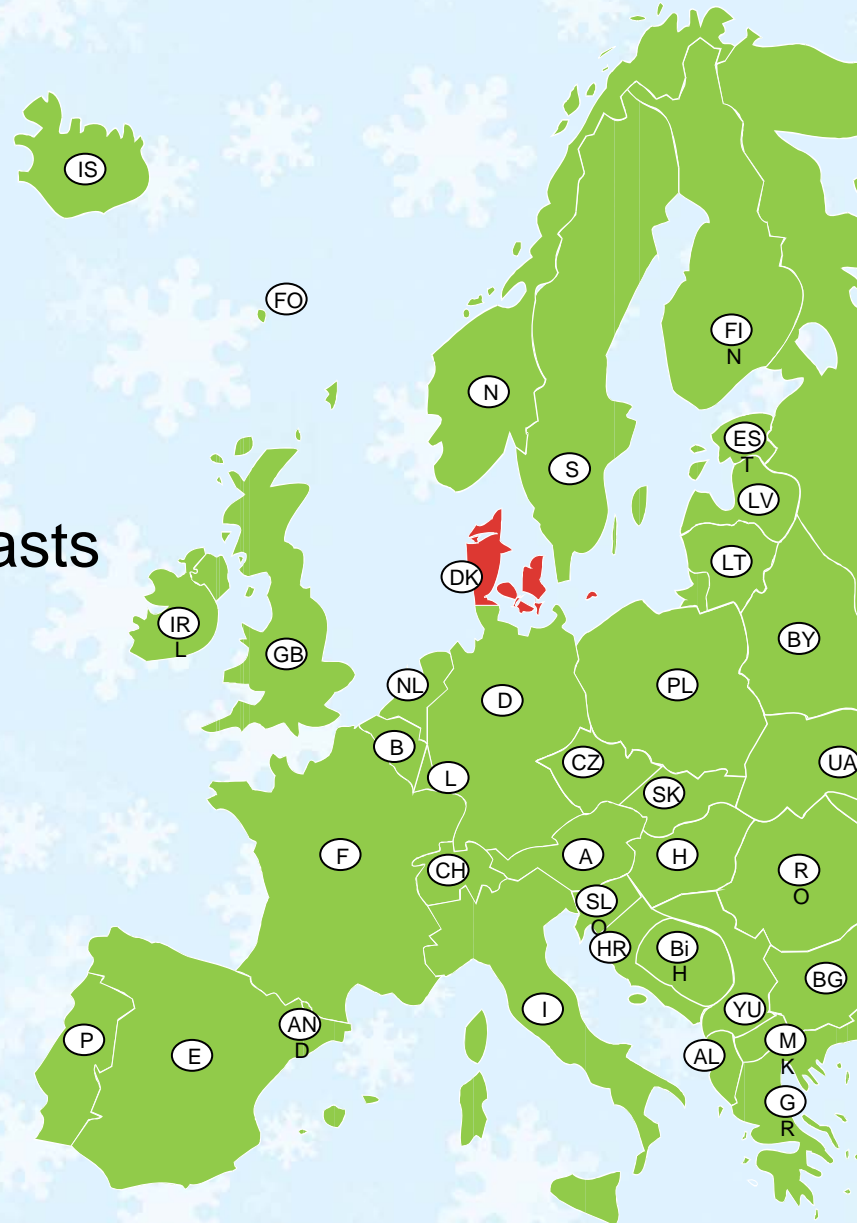
M.Sc. – System Specialist

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# OUTLINE

- Winter in Denmark
- GPS Controlled Spreading
- Dynamic Salting
  - Salting Based on Section Forecasts



# WINTER IN DENMARK

- Winter season is 1/10 – 30/4
- Snowfall 5-10 days yearly, 30-50 cm in total
- App. 100 salting actions, 70-80 % against rime and freezing wet roads
- Six winter centrals operates the state road network (3.800 km)
- Private contractors come with a truck and a driver
- We own spreaders and ploughs





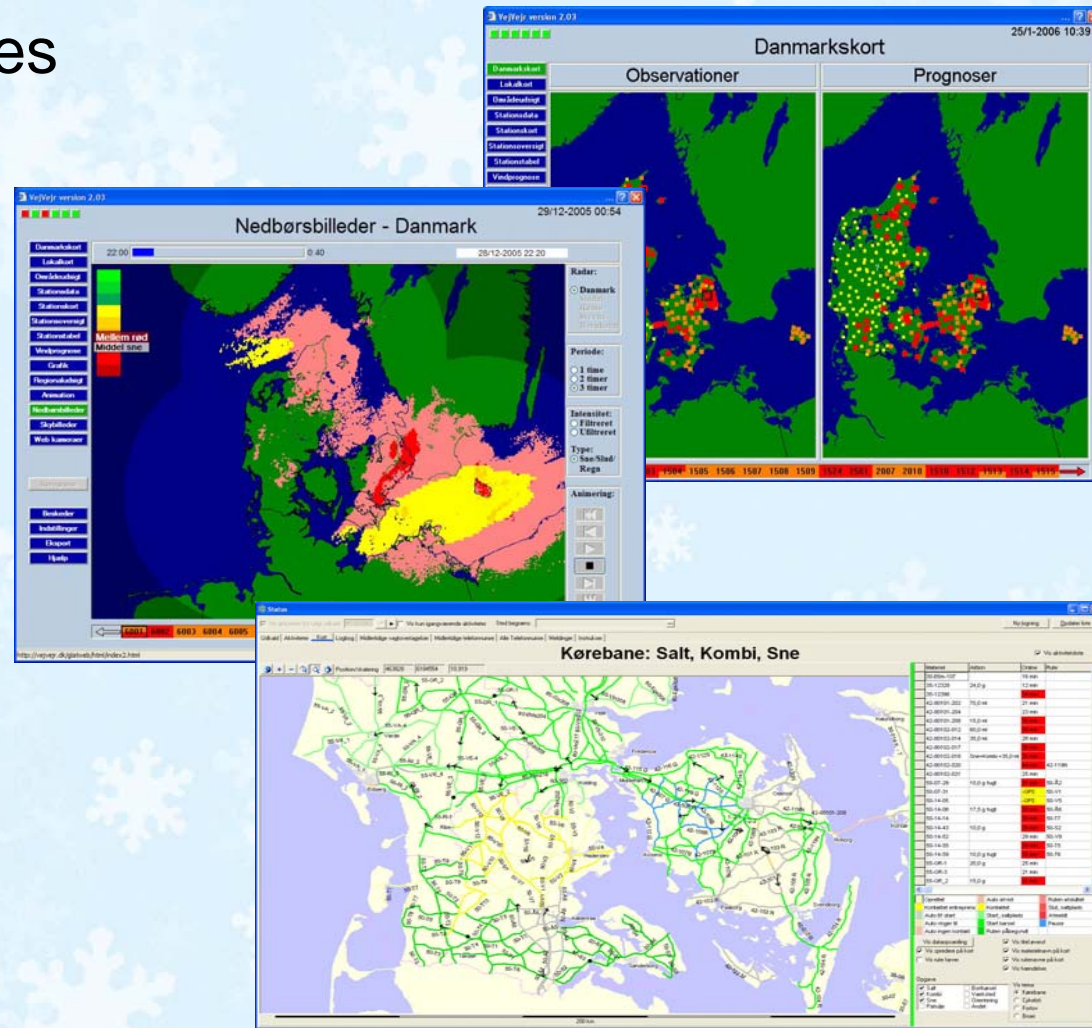
# WINTER IN DENMARK - TOOLS

VejVejr, our RWIS:

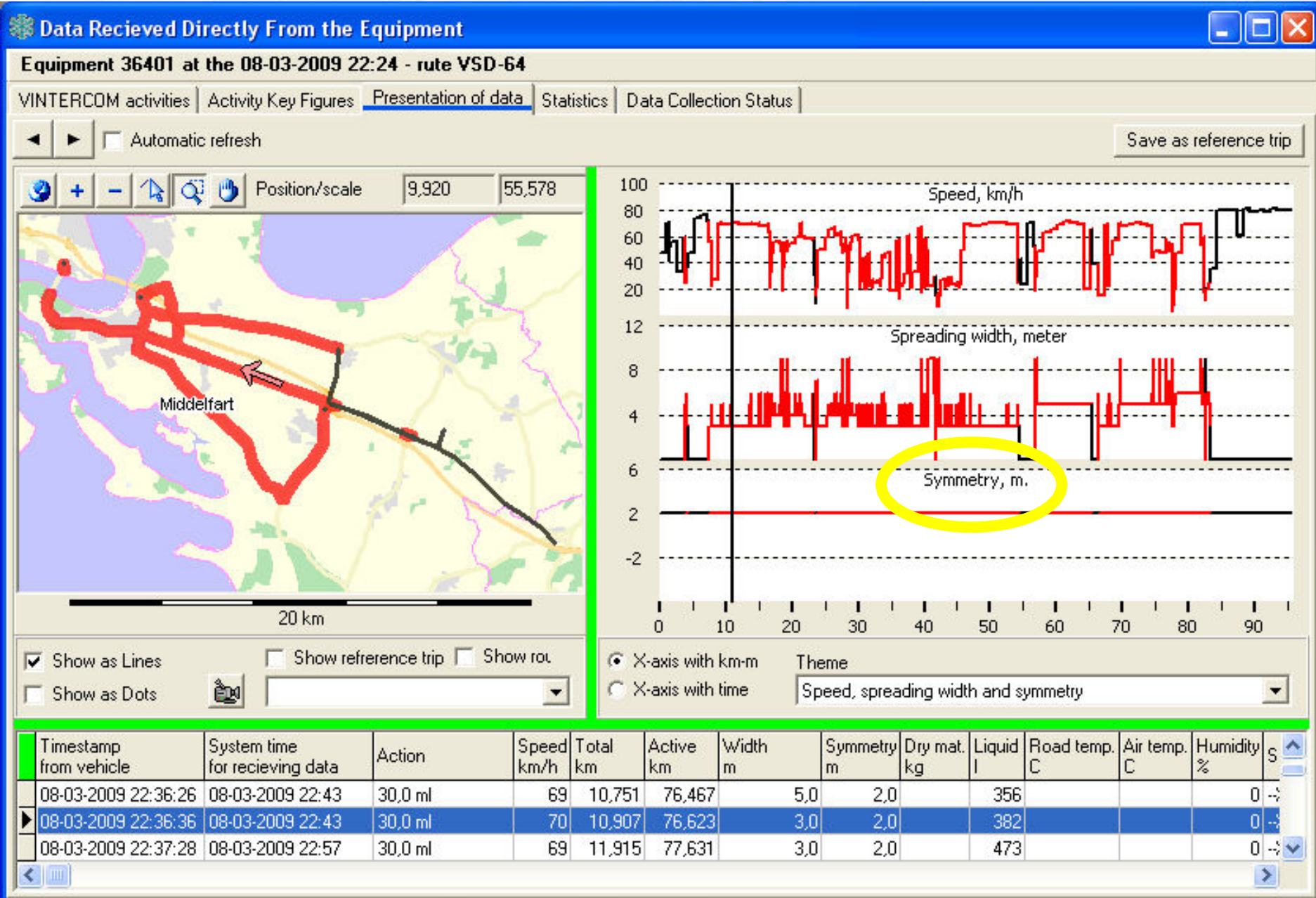
- Measurements and forecasts for >350 stations
- Radar and satellite images
- Regional forecasts
- Web cameras

Winterman:

- Callout
- Documentation
- Road weather reporting



# ONE SALTING ACTION SHOWN IN WINTERMAN





# GPS CONTROLLED SALT SPREADING

Dosage settings, spreading width, spreading symmetry and beacon light must be handled automatically

The driver must always be able to override the automatic system



**OFF**



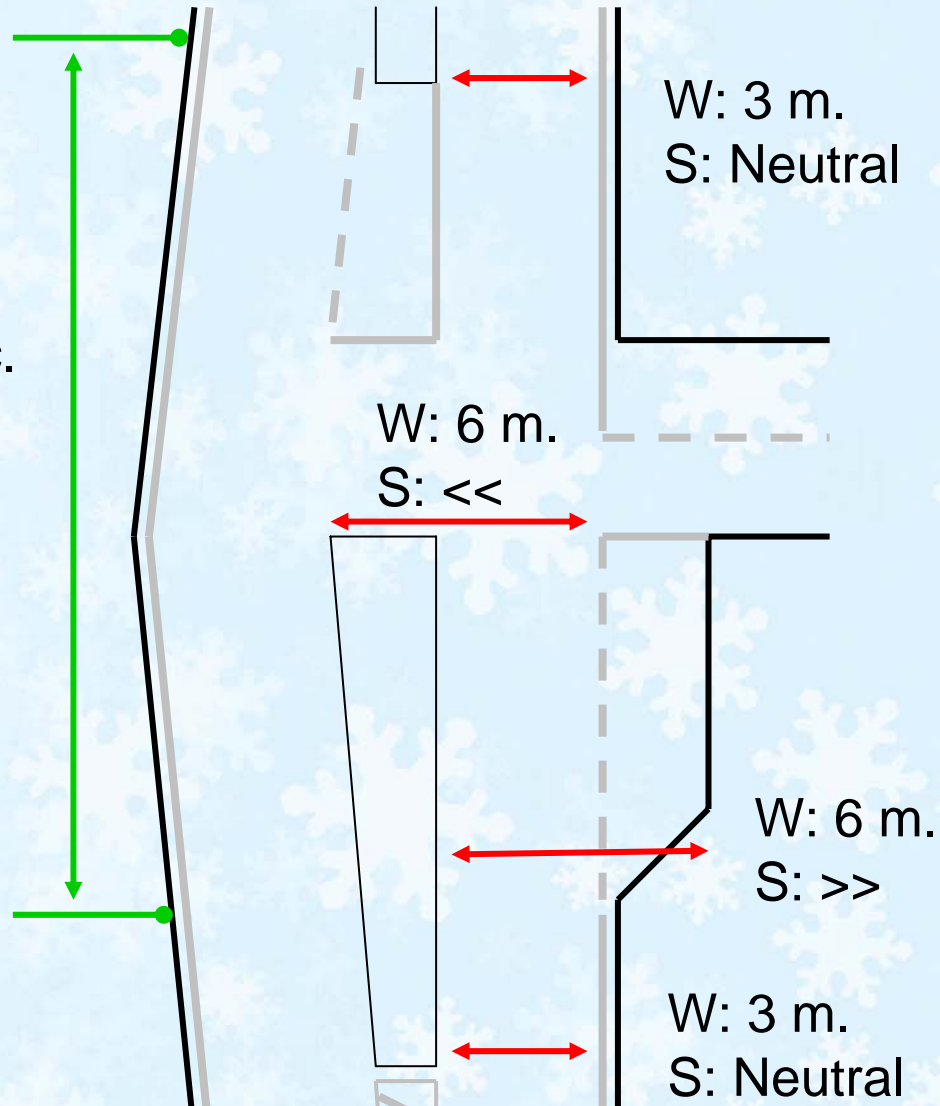
**ON – 10g/m<sup>2</sup>  
6 m width**



**ON - 20 g/m<sup>2</sup>  
9 m width**



# A TYPICALLY T-JUNCTION



**A typical 2½ hour salting route  
has 200-700 adjustments**

# HOW DOES IT WORK

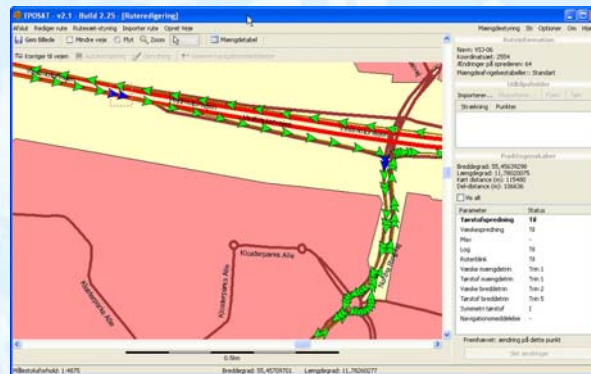
## 1: Recording

Record the route and settings with a simulator



## 2: Adjustments made in specific software

Fine tune the recorded route  
Add different dosage setups



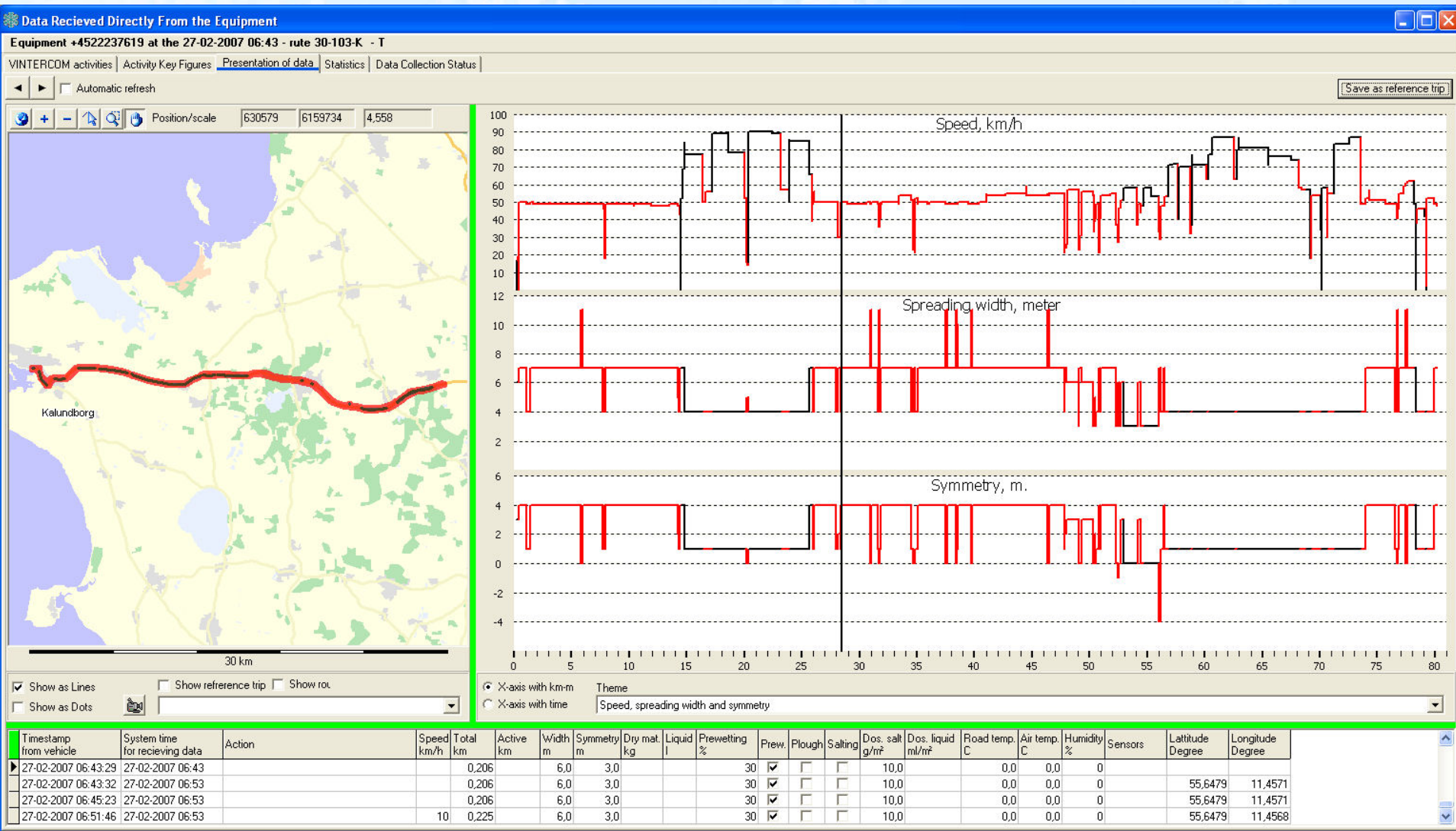
## 3: Daily operation

Replay the route again and again





# GPS CONTROLLED SPREADING: BEFORE vs. AFTER



# GPS CONTROLLED SPREADING: BEFORE vs. AFTER

Data Received Directly From the Equipment

Equipment 2020 at the 4-03-2008 22:33 - VINTERMAN materiel VSJ-02-NY

VINTERCOM activities | Activity Key Figures | Presentation of data | Statistics | Data Collection

Automatic refresh

Position/scale 671591 6153101 6,620



Show as Lines Show reference trip Show route

Show as Dots

X-axis with km-m Theme

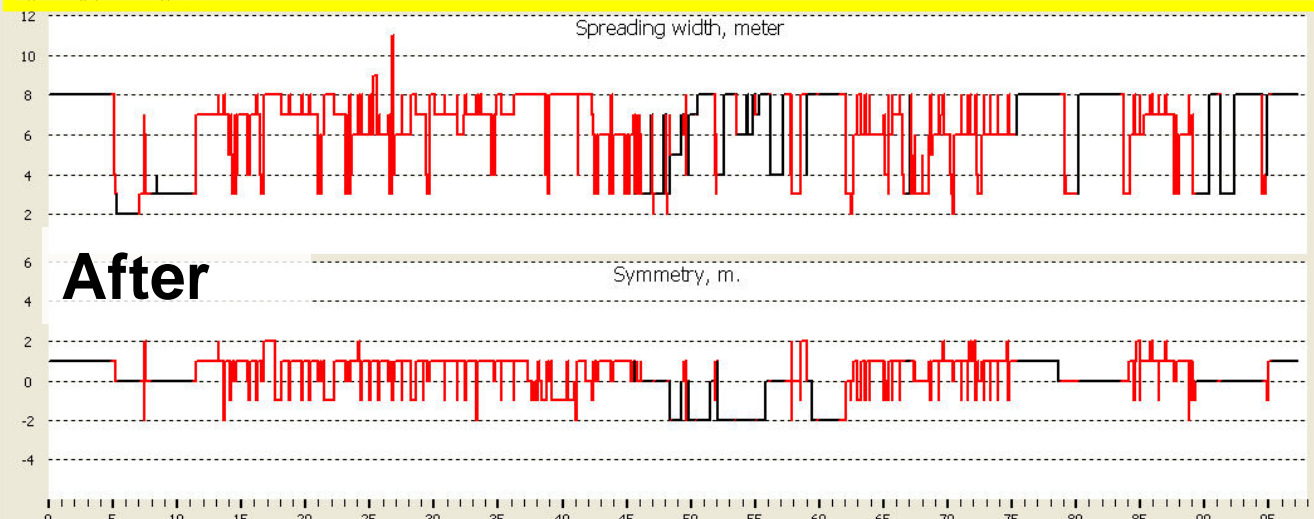
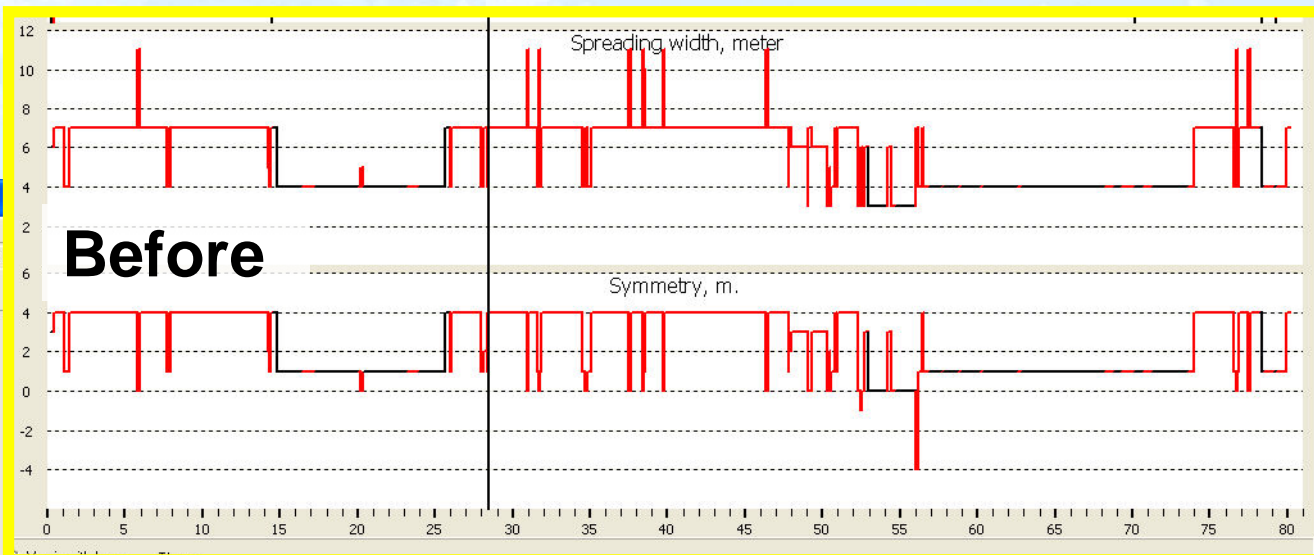
X-axis with time Speed, spreading width and symmetry

Timestamp from vehicle System time for receiving data Action

Speed/km/h Total km Active km

Width m Symmetry m Dry mat. kg Liquid l Prewetting % Prew.

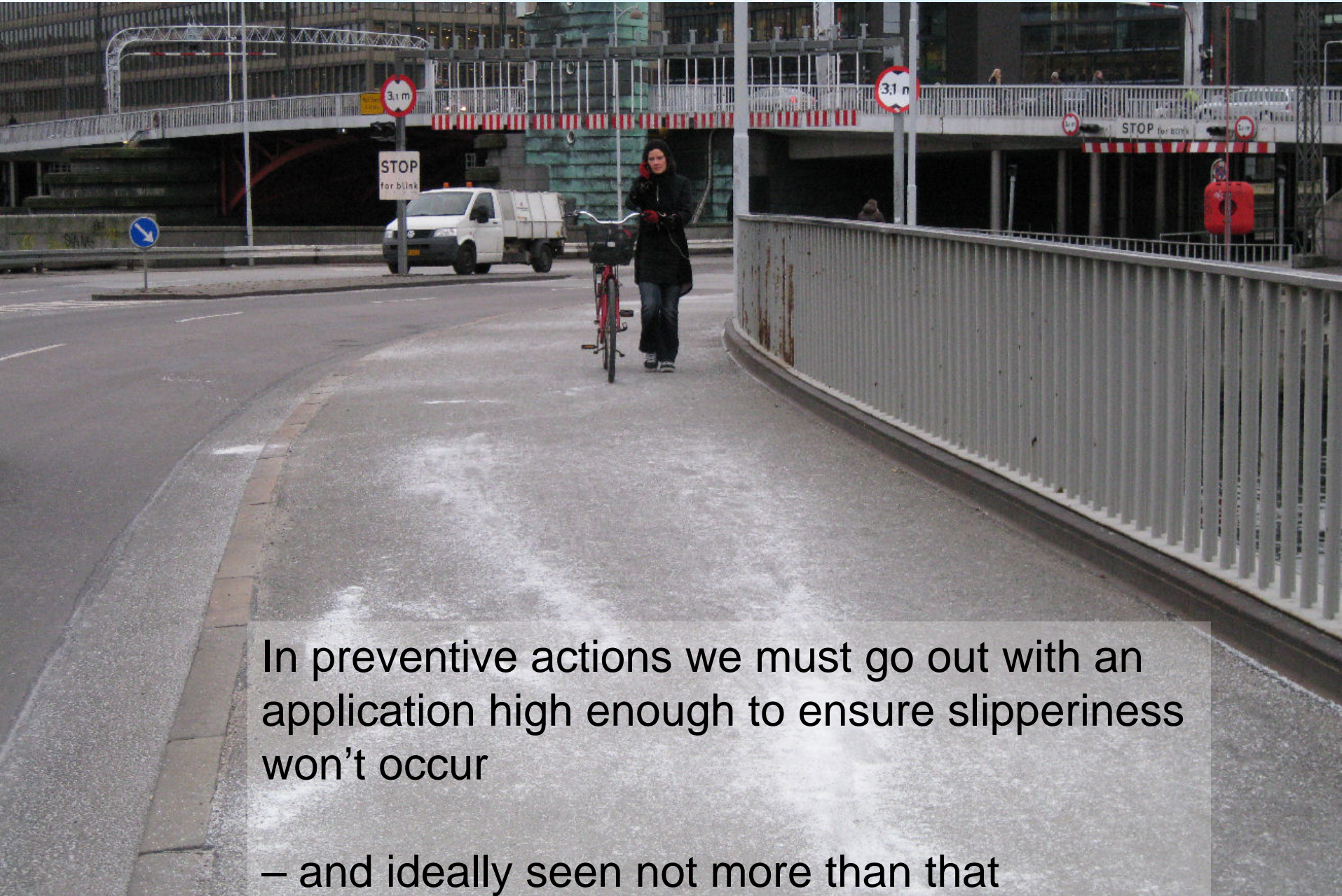
Dos. salt g/m² Dos. liquid ml/m² Road temp. C Air temp. C Humidity % Sensors Latitude Degree Longitude Degree



Timestamp from vehicle	System time for receiving data	Action	Speed/km/h	Total km	Active km	Width m	Symmetry m	Dry mat. kg	Liquid l	Prewetting %	Prew.	Dos. salt g/m <sup>2</sup>	Dos. liquid ml/m <sup>2</sup>	Road temp. C	Air temp. C	Humidity %	Sensors	Latitude Degree	Longitude Degree
4-03-2008 22:33:00	4-03-2008 22:36		1			8,0	1,0			0	<input type="checkbox"/>	7,5	15,0	-3,0	-0,5	0	---		
4-03-2008 22:34:12	4-03-2008 22:36		72	1,036		8,0	1,0			0	<input type="checkbox"/>	7,5	15,0	-2,0	-2,0	0	---	55,6905	11,6917
4-03-2008 22:35:58	4-03-2008 22:48		66	2,076		8,0	1,0			0	<input type="checkbox"/>	7,5	15,0	-3,0	-2,0	0	---	55,6833	11,6929
4-03-2008 22:36:50	4-03-2008 22:48		73	3,094		8,0	1,0			0	<input type="checkbox"/>	7,5	15,0	-3,0	-2,5	0	---	55,6742	11,6906



# DYNAMIC SALTING – SELECTIVE SALTING



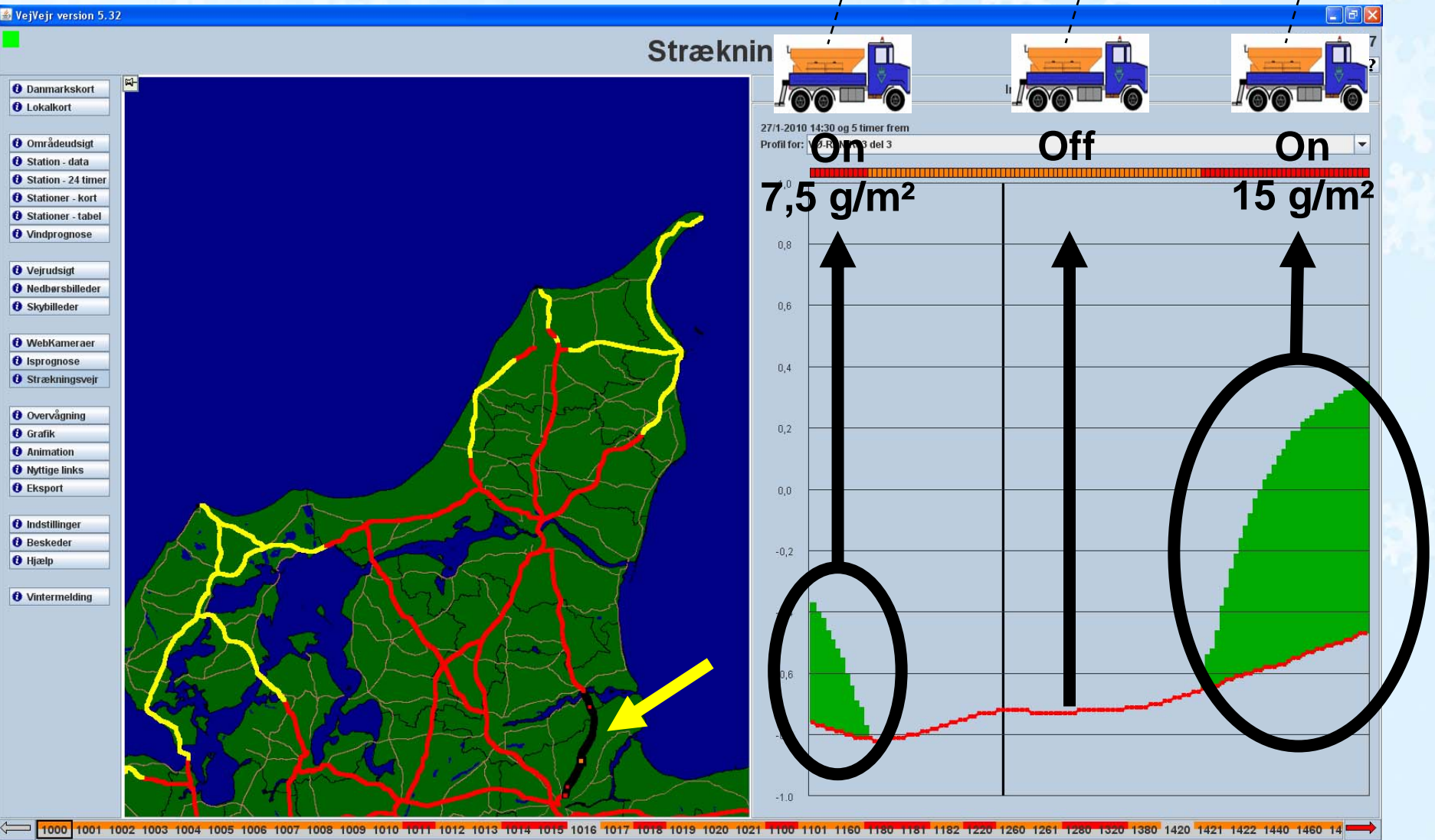
In preventive actions we must go out with an application high enough to ensure slipperiness won't occur

– and ideally seen not more than that



# DYNAMIC SALTING – SELECTIVE SALTING

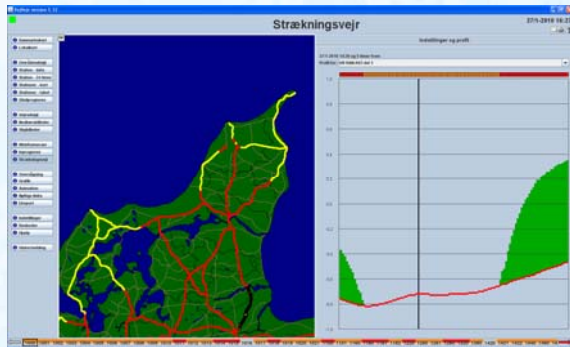
Salting based on a forecasted road temperature and dewpoint



# HOW DOES IT WORK

## 1: RWIS create a forecast

Sent automatically to Winterman every hour



## 2: Winterman prepare spreader data

Winterman transfer the forecast to an application rate

The screenshot shows a window titled 'State of Affairs' with a table of data. The table has columns for 'Station', 'Type', 'Status', 'Temperature', 'Humidity', 'Wind', 'Precipitation', 'Road Condition', 'Time to next event', and 'Deadline'. The data rows show various road segments with their respective status and forecast information.

Station	Type	Status	Temperature	Humidity	Wind	Precipitation	Road Condition	Time to next event	Deadline
LV_01	Other	File	21	LV_01	10.00		Not salted	24-02-2004 15:36	
PL_01	Lab	File	22 30.1	VLT	4.00		Being salted	24-02-2004 15:35	25-02-2004 20:35
PL_02	Lab	File	26 30.2	HMS	4.00	20	Being salted	24-02-2004 15:36	25-02-2004 20:35
PL_03	Lab	File	29 30.3	JL	10.00		Contracted	24-02-2004 15:54	
PL_04	Lab	File	32 30.4	STU	10.00		Contracted	24-02-2004 15:54	
PL_05	Lab	Variable	52 30.1	BY	4.00	10	Contracted	24-02-2004 15:49	
PL_06	Lab	Variable	57 30.2	BY	4.00	20	Being salted	24-02-2004 15:34	25-02-2004 20:34
LV_01	Other	Vægen	81	VLT	4.00	20	Contracted	24-02-2004 15:52	
LV_02	Lab	Vægen	83 30.1	BBT	4.00	20	Being salted	24-02-2004 15:14	25-02-2004 20:14
LV_03	Lab	Vægen	86 30.2	AB	4.00	20	Being salted	24-02-2004 15:14	25-02-2004 20:14
LV_04	Lab	Vægen	90 30.3	ADU	10.00		Contracted	24-02-2004 15:08	
LV_05	Lab	Vægen	93 30.4	ADU	10.00		Being salted	24-02-2004 15:21	25-02-2004 20:21
LV_06	Lab	Vægen	96 30.5	BBT	10.00		Contracted	24-02-2004 15:45	
PL_01	Information	Vægen	100				Contracted	24-02-2004 15:59	
PL_02	Information	File	136				Contracted	24-02-2004 15:57	
PL_03	Information	File	137				Contracted	24-02-2004 15:57	
PL_04	Information	File	140				Contracted	24-02-2004 15:57	

## 3: Salting

On power-up the spreader get all settings automatically



Q: When can it be used ?





No !!!



Februray 2007

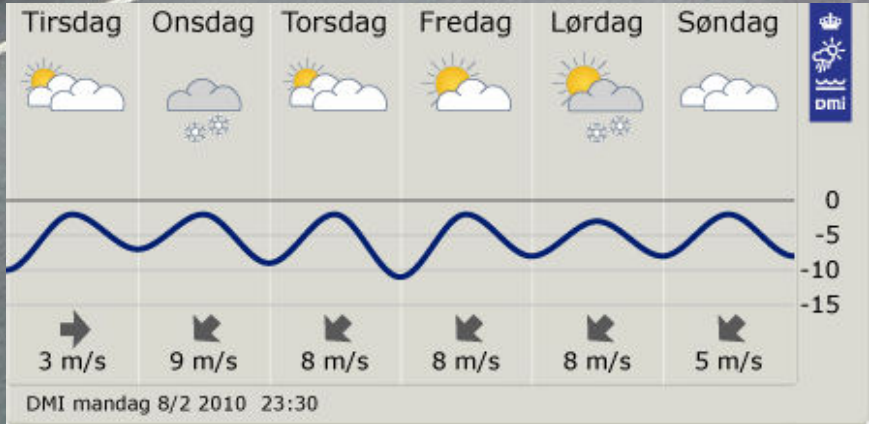


NEITHER HERE...



March 2008

# IN PREVENTIVE ACTIONS: YES !





# CONCLUSION

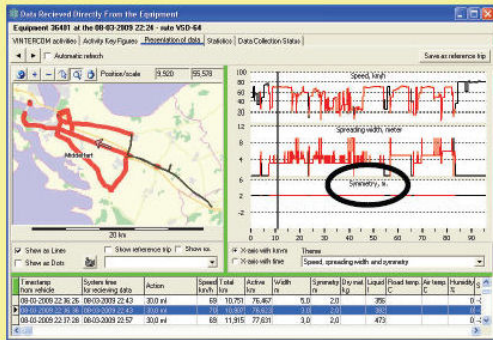
- GPS Controlled Spreading is in routine operation
- Dynamic Salting is in a testing phase
- Dynamic Salting demands high quality forecasts





# POSTER

## GPS CONTROLLED SALT SPREADING



A typical example from the data collection. The driver has changed the spreading width frequently, but never changed the spreading symmetry.

### Goal

The salt spreader must be able to handle spreading width, symmetry and dosage automatically while the driver just follows the route

### Why?

Data collection has shown that the driver have no chance of handling all the needed settings while driving the truck at the same time

## How does it work

### 1: Recording

Record the route and settings with a simulator

### 2: Adjustments made in specific software

Fine tune the recorded route  
Add different dosage set-ups



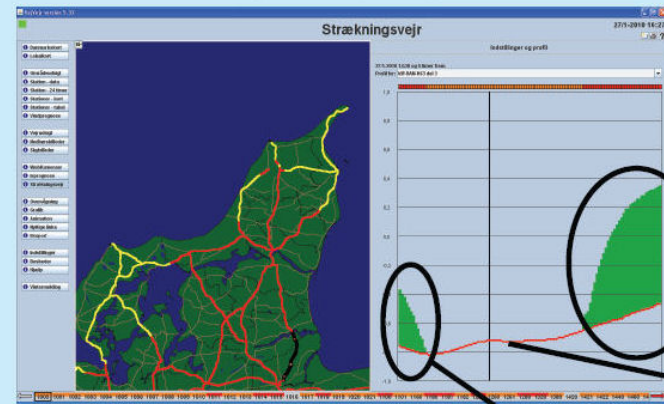
### 3: Daily operation

Replay the route again and again



## DYNAMIC SALTING

Dynamic Salting is salting based on a section level forecast of the temperature, due point etc.




A map with section forecasts. The black line is a 30 km route with temperature forecast shown at the graph in the right side.

The red line is the worst road temperature along the route. The green area shows the worst due point and the expected amount of rime.

The forecast is converted to a dosage setting. This is applied to the road automatically by the spreader using GPS Controlled Salt Spreading

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Ministry of Transport  
Denmark



Thank you for your attention

F. Knudsen, B. Sommer