The Swedish winter model
It’s common practice to carry out anti-icing measures and snowploughing whenever the roads are slippery or snowy, sometimes preferably even beforehand.

But how to optimize and evaluate different winter road standards?
Winter Model

Designed by VTI
- Swedish National Road and Transport Research Institute

To be used by the
- Swedish Transport Administration

- as a calculation tool to estimate costs when changing winter road maintenance standards
Aim of the Winter Model

• is to estimate and put a value on the most important strategies and measures in winter road management for
• road users
• road management authorities
• society at large
Road Condition Model

The hub of the Model is the Road Condition Model which, on the basis of weather data, undertaken road measuser and traffic, calculates road conditions hour by hour during the winter season

Controls calculation in the Effect models.
A lot of Data! Road Condition model.

Väglagsmodellen

Körfältet uppdela i fem ytor:
1. Körfältskant
2. Höger hjulspår
3. Mellan hjulspår
4. Vänster hjulspår
5. Vägmitt
A lot of Data – different zones of Sweden.

### Indata

**Klimatzon Mellersta Sverige**  
**Vintern 2006 - 2007**  
**VViS 1921 Urvalla**

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Calculates every half hour according to Data on Weather, Traffic and Measures taken!!
Effect Models and Costs

ACCIDENT MODEL: accident rates, accident types, consequences according to different road conditions and their duration.

ACCESIBILITY MODEL: effect of different road conditions on mean speed and trip times.

VEHICLE COST MODEL: i/ cost of fuel consumption on different road conditions and ii/ corrosion due to road salt.

ENVIRONMENT MODEL: impacts on roadside vegetation due to road salt

ROAD MANAGEMENT COSTS: i/ direct cost of the measure ii/ costs of damage and wear of road surfacing, road marking etc
So Effects and Costs are calculated: CBA

- Effects on Accidents
- Accessibility (speed and flows)
- Fuel consumption
- Corrision
- Environmental effects
- Costs incurred by the Road Administration for the measure
- Costs of the Road Administration for wear

Change to the effects in the above areas cause change in the costs and benefits for road users and society at large.
General conclusion

If you lower the winter road standard (from today that is)
Costs for the Society will rise!
One of the Effect Models
The environmental sub-model:

1) Calculates the salt exposure in the surrounding road sides.

2) Calculates the damage depending on the vulnerability to received salt dose.

3) The calculates the area of the roadside with a damage above a certain set limit value.

More information: goran.blomqvist@vti.se
4) For now, the model only uses the environmental 'component' spruce plant (1.5 y.o.), but other components can be added, once their vulnerability to salt is known.

5) The damage appraisal is based on assumptions about the loss of forest yield and an "aesthetic" cost caused by the brown tree curtains.
Current assumptions:

Dose-response, (vulnerability): *Picea abies*, 1.5 y.o.

Tolerance level: 50% dead plants

Right-of-way width: 5 meter

Loss of forest yield (class G30): 17 750 kr/ha

Annual cost (calculation period 40 years): 440 kr/ha

Share of spruce plantation: 25%

Aestetical cost: Willingness to pay
The environmental model uses information from the road surface condition model and the residual salt model:

- **Weather**
- **Winter road condition model**
- **Maintenance measures**
- **Output**
- **Residual salt model**
- **Road surface condition**
- **Residual salt amount**
- **Roadside exposure**
- **Impact**

Wind speed & direction

Traffic

Traffic
Example of other use of the Winter model

Journal of Transport Geography
”Are winter road maintenance practices energy efficient? A geographical analysis in terms of traffic energy use”
Lina Nordin and Anna K. Arvidsson

Paper aims to focus on the energy perspective of the winter maintenance operations.

Finding: It is possible to reduce 10.7% of traffic energy use if the starting criterion for snow removal is changed from 1 cm to 2 cm before action needs to be taken. If the speed limit also reduces from 90 km/h, the saving could be up to 17.2%.
Link to trv.se of efficiency analysis and traffic forecasts in the transport sector: http://www.trafikverket.se/samhallsekonominochprognoser

...Thank you!