Defining climatic parameters for selecting winter maintenance strategies for roads

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Aims of the study at VTI

– To analyse the relationships between winterrelated accidents, climatic conditions and the selected strategies for the winter maintenance.

– To establish climatic parameters that define whether use of salt or sand are favourable or not.

– To propose criterias, based on the climatic parameters, that may be useful in selecting the strategy for the winter maintenance.
Scandinavian guidelines for selecting the standard for the winter maintenance

![Diagram showing the selection of winter maintenance standards based on climate and road type. The diagram includes categories for Trunk roads, National roads, Regional roads, and three salting standards (A, B, C), as well as a sanding option.](image-url)
Existing strategies for friction control

Salting

Warm wetted sand method
Effectiveness of salt/warm wetted sand related to temperatures and precipitation

Climates favourable/not favourable for salt

Salt should be avoided
Salt should be used with caution
Salt is efficient

Climates favourable/not favourable for warm wetted sand

No need for gritting
Warm wetted sand is favourable
All gritting methods have limited effects and duration

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Definition of the climatic parameters describing whether salt or warm wetted sand are favourable/not favourable

- **Winter severity Index**
  - Hours with road surface temperatures $<-8^\circ C$/total number of hours

- **Winter Stability Index**
  - Number of 24 hour periods with temperatures below $-1^\circ C$ and less than 3mm precipitation in 6hrs/total number of days

- **Winter Instability Index**
  - Number of fluctuations around $0^\circ C$/total number of days
Characteristic climates described by the parameters

Winter Instability Index, \( W_{\text{inst}} \)

- Nearly daily variations around 0°C
- Longer periods with temperatures above 0°C
- Very few winter situations
- Stable winter temperatures, but with precipitation several days
- Great variations in the winter climate

Winter Stability Index, \( w_{\text{stab}} \)

- Stable winters with road surface temp < -1°C and moderate precipitation

No realistic combination of the two parameters
Dividing Sweden into 4 climatic zones
Monthly values for the winter indexes

Severity Index

Instability Index

Stability Index

Southern Sweden
Central Sweden
Lower Northern Sweden
Upper Northern Sweden
Recorded accident data

- The analyses are based on recorded fatalities and severely injuries, 1993/1997
- The accidents are divided into five road surface conditions, and four climatic regions
- VTI have calculated the vehicle mileage for each road condition and for the four climatic regions
- Based on the data material, road accident frequencies related to climatic zones and road conditions are calculated
Calculated accidents per mill. veh. km for driving on snow and ice covered roads
Recommendations for salt/warm wetted sand

- Nearly daily variations around 0°C
  - Salting for AADT > 2000 if Wsev < 0.2
  - Gritting for AADT < 2000 or Wsev > 0.2
  - Warm wetted sand has only minor effects

- Longer periods with temperatures above 0°C
  - Salting for AADT > 2000 if Wsev < 0.2
  - Warm wetted sand for AADT < 2000 or Wsev > 0.2

- Great variations in the winter climate
  - Stable winter temperatures, but with precipitation several days
  - Stable winters with road surface temp < -1°C and moderate precipitation

Winter Instability Index, W_{inst}

Winter Stability Index, w_{stab}
Conclusions

- The established climatic parameters are appropriate to describe whether salting or warm wetted sand are favourable or not in a given time period.

- Salt should be used with great caution if the frequency of road surface temperatures exceeds 20% in the selected period.

- Warm wetted sand is a realistic alternative to salt in stable, cold climates, where the probability to have the effect of the sanding action to last for more than 24 hours exceeds 20-30%.

- Salt is probably the only alternative on high speed roads in periods with high frequencies of fluctuations around 0°C.
Thank you for your attention
Monthly values for the indexes

Winter Stability Index, $W_{stab}$

Winter Instability Index, $W_{inst}$

UNS-Jan (0.53)
UNS-Nov (0.23)
UNS-Mar (0.25)
CS-Jan (0.16)
CS-Nov (0.03)
CS-Mar (0.07)
UNS-Jan (0.53)