IRWIN
Improved winter index for maintenance and climate scenarios

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IRWIN in brief

- ERA-NET Road project IRWIN from November 2008 to December 2009 with three partners:
  - Foreca Consulting Ltd, Finland
  - Klimator AB, Sweden
  - University of Gothenburg Regional Climate Group

- Aim: Downscaling climate scenarios on road network to develop locally accurate winter index, ideal for road maintenance assessments
Global air temperature
2008 anomaly +0.33°C
(10th warmest on record)
Road Weather Information Stations

- RWIS station
- Synoptic station
Advantages of RWIS data

- Measurements close to the road
- Data used by maintenance for decisions
- Frequent measurements (30 minutes)
- High frequency of field stations
RWIS-data

Comparison between four stations in western Sweden
Three areas in Sweden

- Gothenburg
- Stockholm
- Sundsvall
Three areas in Finland

FinnRA stations

IRWIN stations and areas
The climate scenarios generated in *IRWIN* are based on outputs from two GCMs:

- **CCSM3** - *Community Climate System Model, version 3.0, from the National Center for Atmospheric Research (NCAR) in US*

- **ECHAM5** - *ECHAM5/MPI-OM model from Max Planck Institute for Meteorology*

**Climate scenario to 2025-2055**
Method

RWIS – database 1998 - 2008

Index calculations

Adaptation cost analyse

RWIS – database 2025 - 2055
Winter Index

\[ WI = \sum (A_{\text{ice}} + B_{\text{frost}} + C_{\text{Prec}} + D_{\text{drift}}) \]

- \( A_{\text{ice}} \) – situation with risk of road icing
- \( B_{\text{frost}} \) – situation with risk of hoar frost
- \( C_{\text{Prec}} \) – situation with precipitation
- \( D_{\text{drift}} \) – situations with drifting snow

- Index measures need for Salting and Plowing
- Takes into account also strong winds and extreme precipitation for design and planning
Use of index calculation to determine need of maintenance activities
Average November-to-March rain- and snowfalls for all stations in the Sundsvall region for the ECHAM-5 based scenario. Thin lines are annual means, thick lines are 10-year averages. Under this scenario, the amount of snow declines by nearly 50% by year 2100, whereas the rainfall increases by over 100%. This demonstrates the value of the IRWIN statistical downscaling methodology – the publicly available GCM outputs do not differentiate between rain and snow, only total precipitation is provided.
Number of days in the winter season (November-to-March) in the Stockholm region where the air temperature falls below 0ºC.

Under this ECHAM-5 based scenario the number of days where temperature falls below freezing will decrease by ~30% by 2100.
Number of 30-minute periods where the maximum wind gust exceeds 100km/h on the Tjörn Bridge, for the ECHAM-5 based scenario.
The number of wind gusts over 100km/h increase significantly in this scenario.
# Change in snow events

<table>
<thead>
<tr>
<th>Area</th>
<th>Snow 1 – 3 mm</th>
<th>Snow 3 – 5 mm</th>
<th>Snow &gt; 5 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>-8,9%</td>
<td>-8,3%</td>
<td>-7,5%</td>
</tr>
<tr>
<td>S2</td>
<td>-15,4%</td>
<td>-17,4%</td>
<td>-15,0%</td>
</tr>
<tr>
<td>S3</td>
<td>-3,0%</td>
<td>-4,2%</td>
<td>-8,5%</td>
</tr>
<tr>
<td>F1</td>
<td>-4,8%</td>
<td>-2,8%</td>
<td>-0,6</td>
</tr>
<tr>
<td>F2</td>
<td>-4,3%</td>
<td>-1,7%</td>
<td>2,5%</td>
</tr>
<tr>
<td>F3</td>
<td>-0,6%</td>
<td>0,5%</td>
<td>1,9%</td>
</tr>
</tbody>
</table>
## Change in salting indexes

<table>
<thead>
<tr>
<th>Area</th>
<th>% change Index 7</th>
<th>% change Index 8</th>
<th>% change Index 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>-2 %</td>
<td>-2 %</td>
<td>-2 %</td>
</tr>
<tr>
<td>S2</td>
<td>-7 %</td>
<td>2 %</td>
<td>5 %</td>
</tr>
<tr>
<td>S3</td>
<td>15 %</td>
<td>16 %</td>
<td>23 %</td>
</tr>
<tr>
<td>F1</td>
<td>-5 %</td>
<td>3 %</td>
<td>6 %</td>
</tr>
<tr>
<td>F2</td>
<td>12 %</td>
<td>10 %</td>
<td>16 %</td>
</tr>
<tr>
<td>F3</td>
<td>13 %</td>
<td>11 %</td>
<td>18 %</td>
</tr>
</tbody>
</table>

- **Index 7**: road icing
- **Index 8**: hour frost
- **Index 9**: surface temp around 0°C
Local changes in ploughing need

Index calculation in relation to:
road length, road type, topography, land use & Climate

<table>
<thead>
<tr>
<th>Index</th>
<th>km 1980-2010</th>
<th>km 1980-2011</th>
<th>km change</th>
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</thead>
<tbody>
<tr>
<td>Index1</td>
<td>51970</td>
<td>50209</td>
<td>-1761</td>
</tr>
<tr>
<td>Index2</td>
<td>4775</td>
<td>4569</td>
<td>-207</td>
</tr>
<tr>
<td>Index3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Index4</td>
<td>20603</td>
<td>14875</td>
<td>-5728</td>
</tr>
<tr>
<td>Index5</td>
<td>2062</td>
<td>1814</td>
<td>-248</td>
</tr>
<tr>
<td>Index6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Index7</td>
<td>14002</td>
<td>13693</td>
<td>-309</td>
</tr>
<tr>
<td>Index8</td>
<td>144543</td>
<td>141814</td>
<td>-2730</td>
</tr>
<tr>
<td>Index9</td>
<td>96934</td>
<td>94765</td>
<td>-2169</td>
</tr>
</tbody>
</table>
Benefits of IRWIN project

• better linkage between weather and maintenance needs
• better understanding of variations to be expected
• better knowledge of impact from climate change on maintenance needs
• better coverage of extreme events
• Final report IRWIN 2009: Improved local winter index to assess maintenance needs and adaptation costs in climate change scenarios. ENR SRO3 report, http://www.eranetroad.org
Advice to Road Owners

• Archive all your RWIS data with good metadata on stations, sensors and formats
• Do not change station numbering or sites
• For climate studies, long and un-interrupted time series required (minimum 10 years)
• Raw data must be interpolated for analysis to regular 30 min intervals
• Similar index calculations can be made in other areas if good enough data available
Contact information

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