

DIGITALIZATION AND ROAD WEATHER FORECASTS TO HELP DECISION MAKING FOR ROAD MAINTENANCE

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Introduction

Road maintenance and its timing is critical on countries like Finland where wintery roads are present for notable part of the year. With well scheduled and controlled maintenance operations companies can cut down their costs on operations and also gain more safety on roads.

Finnish Meteorological Institute's (FMI), Road Weather Model (RWM) is been used to forecast the upcoming road conditions. One of the biggest road maintenance companies in Finland Destia has directed their maintenance operations side by side with FMI's on duty meteorologists for over 15 winters. During the ongoing 5G-SAFE project, funded by Finnish Funding Agency for Technology and Innovation (Business Finland), FMI and Destia has been improved the snowplough scheduling forecast system.

Destia among other Finnish maintenance companies is collecting their maintenance operations information in digital format. This information has been imported to FMI's RWM to make the road maintenance operation scheduling even more precise.

FMI Road Weather Model

At Finnish Meteorological Institute (FMI), Road Weather Modelling (RWM) development has been going on since the 1970's to improve the knowledge of the forthcoming road surface conditions. The present-day RWM is a one-dimensional energy balance model that can predict surface temperature and storage amounts for water, snow, ice and frost on roads. The model produces gridded (for map visualization with 10 km spatial resolution (Figure 1)) and point forecasts for any desired location with a one hour time resolution. The model can be simulated wherever Numerical Weather Prediction (NWP) data is available. The model has been operationally running since 2000 (1).

Already since the early years the RWM has been used to predict the road surface conditions for road maintenance scheduling to take action beforehand and also to bring more cost-efficiency to the operations. The output products have been in everyday use for winter time for road maintenance scheduling for over 15 years in Finland. As one of the spin-offs in R&D for RWM has been the snowplough operation scheduling forecast. It tells the user predicted time for next snow plough based on NWP model data. Lot of presumptions have been made in RWM calculation since lot of important information has been lacking e.g. time of the last snowplough.

During the latest years' one of the major development for RWM is the use of observed road surface temperature, so called coupling method (2). It is shown that using road surface temperature instead of using observed 2 m temperatures as input data for starting the model, it will make the model perform even better for the first hours. Model can still be simulated without any road weather station observations. The model has been already in the past designed that way that if real time snowplough information would be available it could be imported in to the model.

Finnish Transport Agency (FTA) nowadays demand the maintenance companies to provide their maintenance information digitally and in real-time. With use of this information we have more precise knowledge of the snow amounts that are on the road which will make scheduling forecast more precise.

Winter Road Maintenance

In Finland the FTA tenders out the road maintenance work. It also determines the limit values of snow allowed on different roads and the operation time when the snow has to be removed from the roads. The snow amount allowed on the roads depends heavily on the traffic rate.

In Finland the total cost of national winter road maintenance is around 100 M€. This update for snow plough scheduling will hopefully bring more cost efficiency to the maintenance and improve safety on winter roads.

Snowplough scheduling product development made in 5G-SAFE project

Firstly it was made possible to read the real time road maintenance operations into the RWM. Assumption was made that when snow was ploughed from a road weather station location the snow storage on that location would be decreased close to 0. To be more precise of the snow amounts on the road after last snowplough also more accurate radar observation data was implemented into the model. While knowing the maximum snow thicknesses and operation times allowed for different maintenance levels it was possible to determine the scheduling times for snowploughing.

Future development

As the project goes on we plan on implementing other observation data eg. mobile observations into the RWM as well. We have half a dozen trucks implemented with telemetry devices, friction and road temperature measuring devices made by Teconer Ltd. and also on board dash cameras. The trucks are running in harsh conditions in wintertime, almost non-stop between Kevitsa Mine and Kemi harbour in Finnish Lapland. With all this information we hope to get more precise situation awareness of the road state during the winter season and this will keep on improving our RWM based services.

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