Computer Generated Maintenance Recommendations with and without Automatic Nowcasting

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INTRODUCTION

Foreca currently forecasts road weather conditions for approximately 200 000 km of roads with around 1500 road weather stations, mostly in Northern Europe.

Some of our customers have raised the issue of **"too much data"**. Especially inexperienced supervisors are at times overwhelmed by the amount of information available in the decision support systems.

The maintenance recommendations described in this presentation are Foreca's response to the too much data issue. We have created a recommendations engine that can summarize the maintenance situation in a couple of clear sentences. The recommendations have been formatted with personnel training in mind and provide an overview of the expected maintenance tasks with some specific advice. Instead of being just "do that" commands, the texts include the rationale behind the action, i.e. "because of this, do that". This also makes it easier for users to evaluate the relevance of the recommendations to the operational situation.

During the winter 2015-2016, selected pilot customers have evaluated Foreca's maintenance recommendations in two very different settings:

1. a meteorologist-supervised area
2. an area with completely automated forecast production with no meteorologist intervention

METHODS

The METRo road weather model is used to predict the sequence of road weather events for the next 24 hours. Events for the past 12 hours are obtained from earlier predictions. This 36-hour sequence of road weather events is used as input for the recommendations engine, which identifies an optimal sequence of maintenance actions. As of now, the system includes 46 different actions, such as checking meltwater, plowing, personnel break, etc.

There are two separate recommendations engines: one for roads where chemicals can be used and another for roads where salt use is not allowed, e.g. due to ground water protection.

To test the impact of nowcasting on the recommendations, two parallel experiments were made, both using atmospheric forecasts from the SMHI HIRLAM (6-hourly, 3 h latency), and the other additionally using automatic nowcasting based on radar and Meteosat-PRIME cloud analyses.

RESULTS

Customer feedback of recommendations was positive for the area with meteorologist supervision. For the area with completely automated forecasts we received some negative feedback, which was at least partly traced to failed snow forecasts, see case 4 for an example.

Numerical verifications show that the road surface temperatures were improved significantly by the cloudiness nowcasting.

CONCLUSIONS

The recommendations engine is a great help in meteorologist-supervised markets, but further refinements are needed for radar processing before completely automated use is feasible. Cloudiness nowcasts can be endorsed without hesitation.

FUTURE WORK

With the increasing availability of real-time maintenance action data from the fleet, it will become feasible to base the recommendations on the real sequence of maintenance actions that have already been performed.

REFERENCES

Crevier, L.-P., and Y. Delage. METRo: A New Model for Road-Condition Forecasting in Canada.

Recommendations Case Examples

Case 1: warm spring day followed by below-zero night

Location Lahti vt12
16/3 03:00 Monitor cloudiness closely until 05, a break will lead to need for salting.
16/3 14:00 Check meltwater during the day.
16/3 22:00 Icing, use pre-wetted salt or liquid brine.

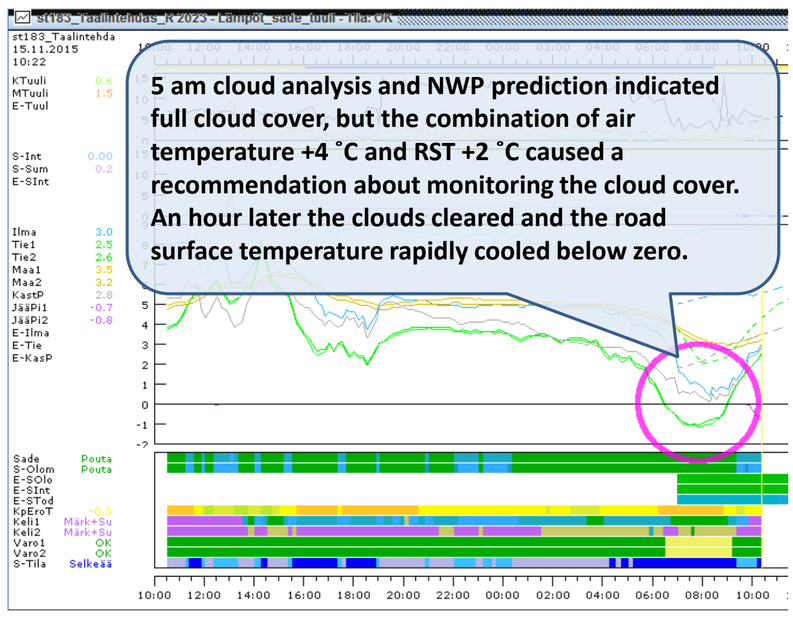
Foreca recommendation was to check the meltwater situation during the day, since the algorithm estimated that roadsides would still have snow banks which could in some locations leave the road wet due to meltwater.

March 17th in Lahti a truck carrying 40 tons of sulfuric acid crashed into trees after the driver lost control due to slippery road.

Police say accident was due to frozen meltwater from roadside snow.

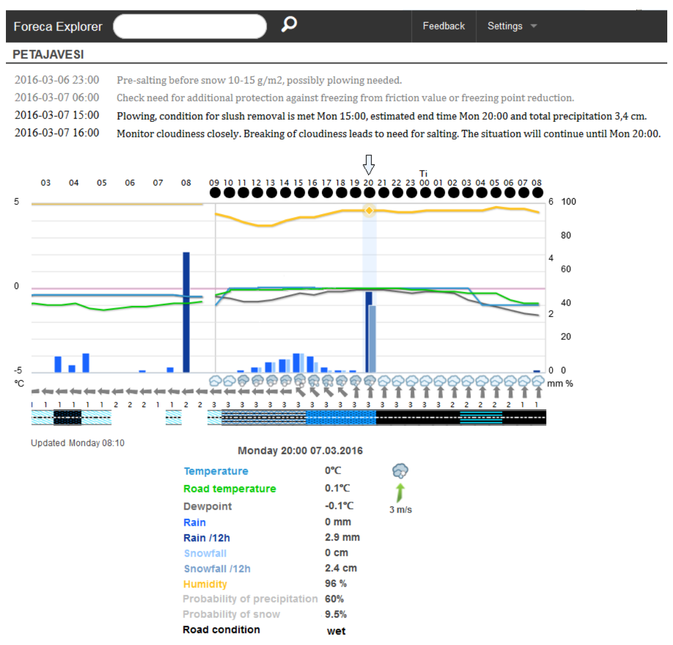
Case 2: full cloud cover predicted, temperatures barely above zero

Location Taalintehdas st183
15/11 05:00 Monitor cloudiness closely until 08, a break will lead to need for salting.



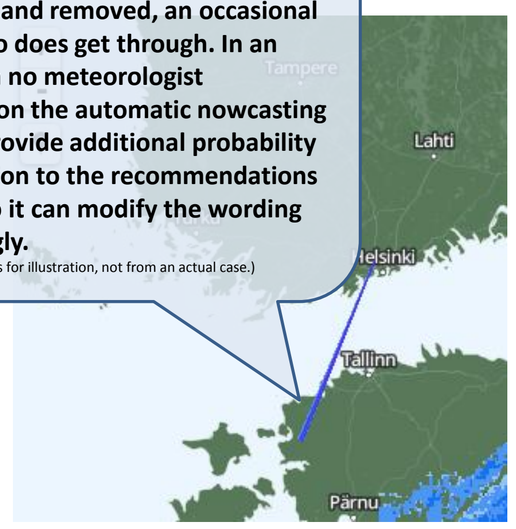
5 am cloud analysis and NWP prediction indicated full cloud cover, but the combination of air temperature +4 ˚C and RST +2 ˚C caused a recommendation about monitoring the cloud cover. An hour later the clouds cleared and the road surface temperature rapidly cooled below zero.

Case 3: modest amount of mixed snow and rain



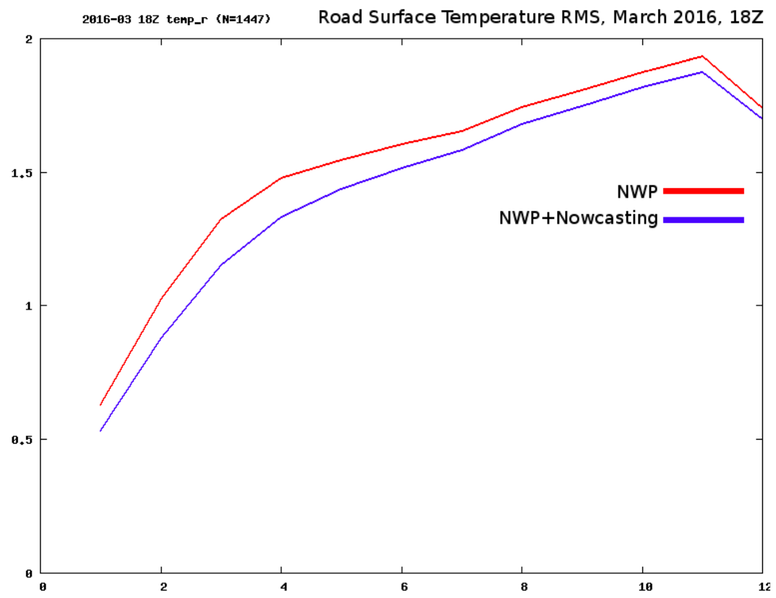
Case 4: a false radar echo can cause a recommendation related to snowfall

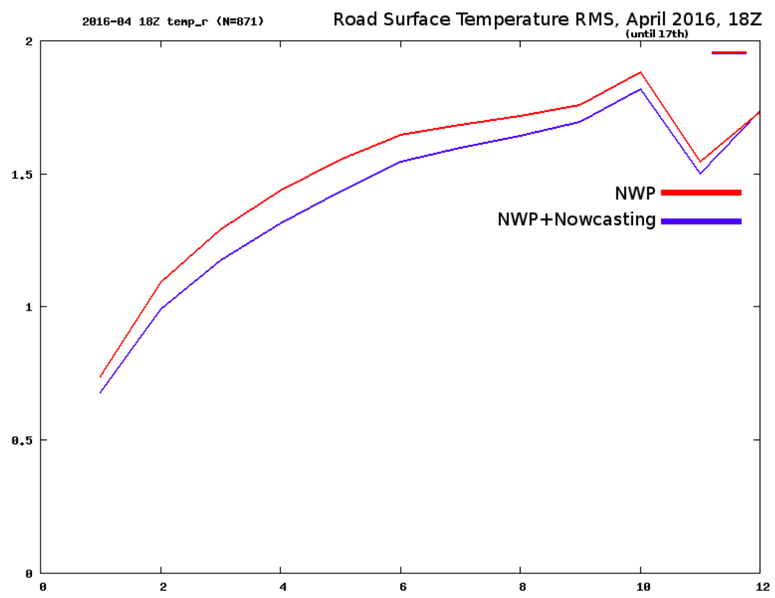
Though most false echoes are detected and removed, an occasional false echo does get through. In an area with no meteorologist supervision the automatic nowcasting should provide additional probability information to the recommendations engine so it can modify the wording accordingly.
(The image is for illustration, not from an actual case.)



Verifying the Effect of Meteosat-PRIME Cloudiness Nowcasts on Road Surface Temperature Forecasts

The road surface temperature (RST) forecasts made at 18 UTC were collected for a period of one and a half months and verified against RST observations. The pilot area was Estonia where 18 UTC was close to sunset at the time of the study so the forecasts are evening forecasts made for the entire night. The NWP model in use was the SMHI HIRLAM C11. The root-mean-square (RMS) error plots below show that the cloudiness nowcasts improve the relative quality of RST forecasts up-to +4 hours, after which the benefits start diminishing, finally disappearing an hour after sunrise. The improved RST forecasts should directly translate to recommendations that are more accurate since RST is a critical component in many recommendations.





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