NOWCASTING FOR THE ROAD MAINTENANCE DURING WINTER IN THE CZECH HYDROMETEOROLOGICAL INSTITUTE

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Introduction

In the Central Europe (CE), especially winter weather creates many challenges for the road maintenance authorities, who ensure fluent and safe traffic. Potentially dangerous weather phenomena during this season include decreased visibility (due to fog or heavy snowfall), icy road conditions (black ice, glaze, frost deposit) or snow drifts. Regarding the high impact of these phenomena on traffic, Forecasting Offices of the Czech Hydrometeorological Institute (CHMI) issue new road weather forecasts every 4-7 hours during the winter period (1st November to 31st March). Crucial information is provided by regional NWP models (ALADIN, ICON, UM) with a six-hour update cycle, and atmospheric sounding. However, to increase the accuracy of forecasts, several nowcasting techniques are employed as well. We present the most frequently used techniques and real-time data sources. Furthermore, we introduce a case study of one of the most dangerous road weather episodes during winter 2018/2019 in Czech Republic (CR). Lastly, we conclude strengths and shortcomings of nowcasting for the road maintenance during winter and suggest possible improvements.

Real-time data sources

To get an overview of the meteorological situation over CE and CR (especially the amount and type of cloud cover, snow cover and presence of precipitation), we utilize products of satellite (Meteosat Second Generation, IR and VIS channels) and radar data (CZRAD, CERAD). Furthermore, the Vaisala software HydroClass (HCLASS) is available to classify targets from CZRAD data into categories of precipitation using dual polarization measurements.

An important source of real-time data, particularly on a regional level of forecasting, are networks of point measurements: (a) Automatic weather stations (AWS) and stations with professional observation, (b) Precipitation gauges, (c) Road weather stations (state of the road, temperature of the road).

In addition, we obtain information from the Database of Incidents reported by Fire and Rescue Service, that help to verify dangerous weather, and web cameras, that help to verify visually detectable phenomena e.g. the presence of fog, snow drifts or frost deposits.

Methods of nowcasting

For an operational nowcasting of winter weather phenomena, we use two main methods in CHMI: (a) Extrapolation and (b) Blending of NWP model outputs with observation.

An areal extrapolation of radar echoes is executed by system COTREC, which yields forecast up to +60 min from current time. This method is mainly applied during high-impact winter events as heavy snowfall or glaze ice occurence.

Blending of NWP model outputs with observation of meteorological elements is the most frequently used nowcasting technique for creating road weather forecasts in winter, when we issue a very-short-range forecasts covering up to 7 hours from the real time. An example of the blending is shown by Fig. 10.

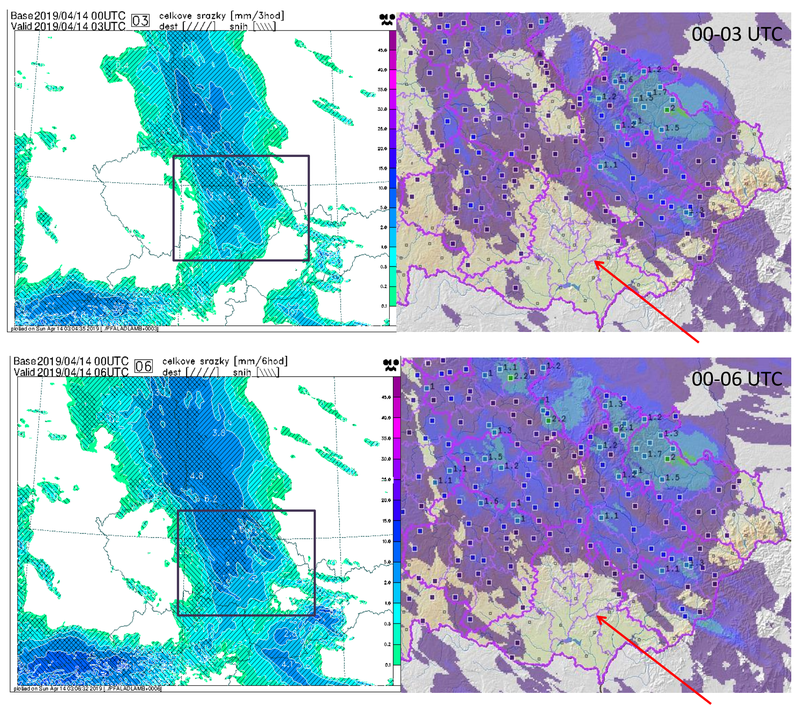

Fig. 10: Blending of ALADIN-modelled 3h (top left) and 6h (bottom left) total precipitation with observation (top and bottom right, CZRAD-precipitation gauge merged data). Based on a difference in the first 3h period (no precipitation in South Moravia - marked by red arrow), we assumed also the second 3h period will bring little to none of the predicted precipitation (and correctly - see bottom right).

Conclusions

Utilization of NWP models has proven very helpful in terms of predicting dangerous road conditions hours or even days in advance. Several real-time data sources provide information about the precise timing of the anticipated dangerous episode and CHMI forecasters often use direct phone connection to consult the road maintenance authorities, which has proven effective as well.

The determination of precipitation type reaching the ground, especially at night, is one of the biggest challenges facing forecasters. The density of meteorological stations with professional observation operating during the night is low and use of web cameras is limited. Forecasters are able to obtain information about the change of the precipitation type in the atmosphere from HCLASS, however, further verification in operation is necessary.

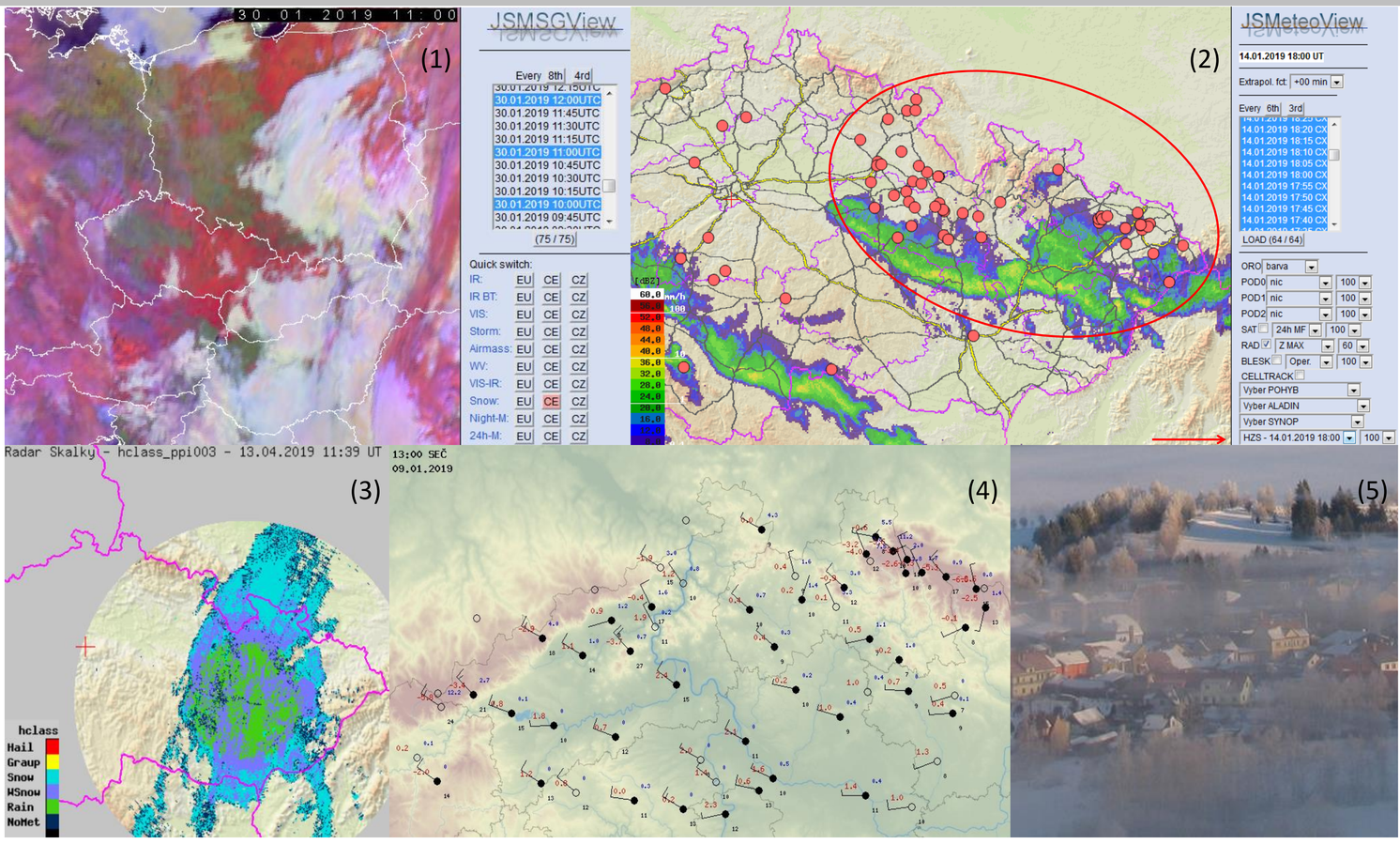

Fig. 1 (top left): MSG product Snow, Central Europe (combination of VIS 0.8, IR 1.6 and difference (IR 10.8 - IR 3.9)), red = snow covered ground, green = snow-free ground, white/yellow = low clouds, pink/blue = medium/high clouds ; **Fig. 2** (top right): Radar product Z_MAX (maximum reflectivity), heavy snowfall on the front accompanied by strong wind - red dots refer to incidents reported by Fire and Rescue Service (czech abb. HZS), 63 % of incidents within the red circle = fallen trees ; **Fig. 3** (bottom left): HCLASS, last snowfall of winter 2018/2019 in South Moravian region ; **Fig. 4** (bottom middle): Network of AWS in the region of Ústí nad Labem, episode of heavy snowfall and resulting road calamity, especially in mountain passes, blue = 6 h precipitation, red = 2 m temperature, black = strongest wind gust since 00 SEČ (UTC+1) ; **Fig. 5** (bottom right): CHMI web camera image 15.02.2019 (Volary town, SW of CR) - visible presence of fog and frost deposit.

The glaze ice episode in the west of Bohemia, November 2018

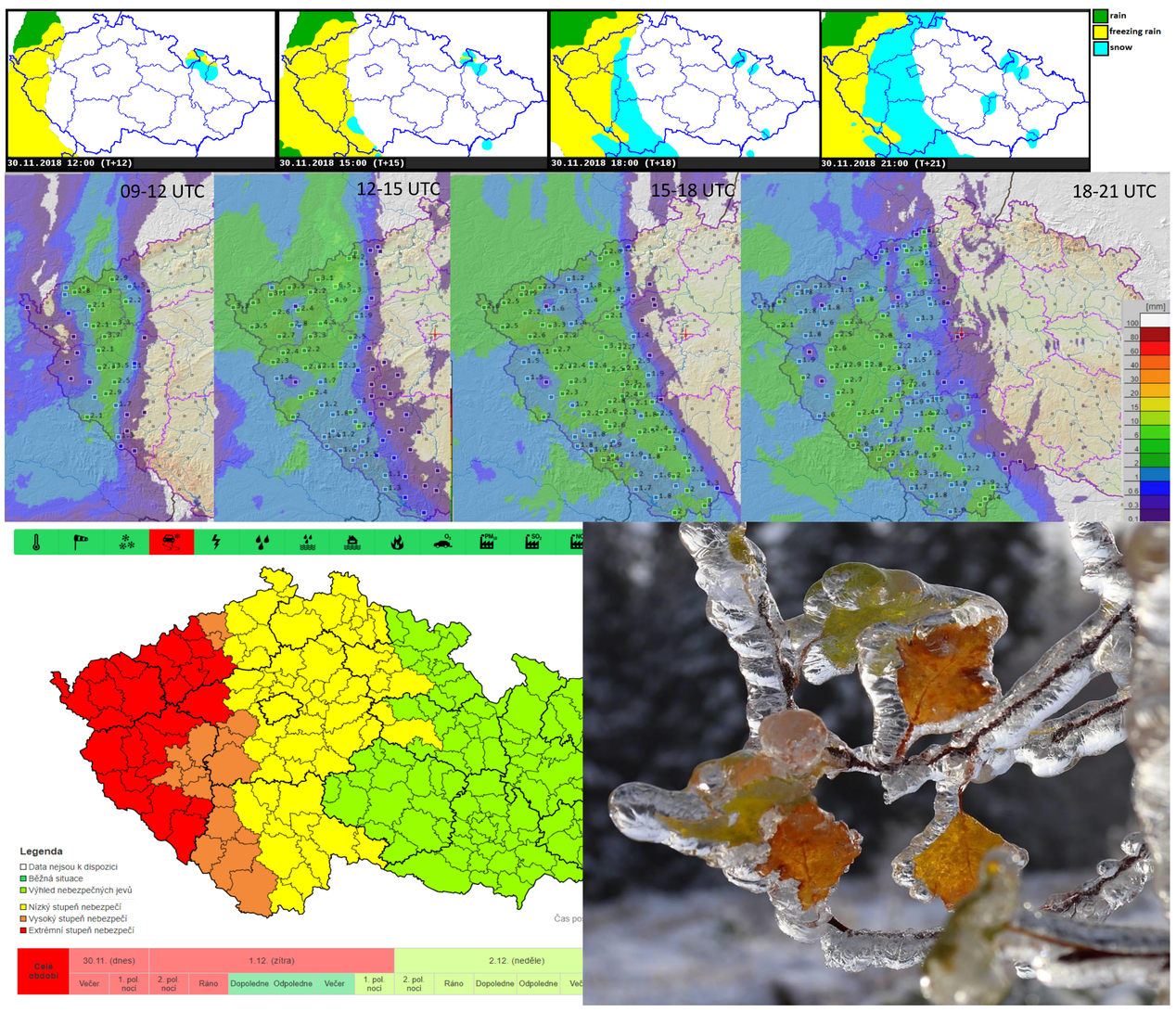

Fig. 6 (top): ALADIN model output – the type of precipitation. The glaze ice warning was issued based on the model results. **Fig. 7** (2nd top): CZRAD-precipitation gauge merged data – monitoring of the situation. In the west of Bohemia, 6 mm of freezing rain already fell in the previous 8h. **Fig. 8** (bottom left): The glaze ice warning was changed (30.11.2018 15 UTC) by degree of danger increased (red = extreme degree of danger, orange = high degree od danger, yellow = low degree of danger). Freezing rain and the formation of glaze ice was assumed to continue until Saturday morning. **Fig. 9** (bottom right): The glaze photographed by the observer Roman Szpuk in Churáňov, SW of CR.

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