Road meteorology evaluation in the Czech Republic

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ABSTRACT

The paper presents state-of-the-art of road meteorology from the point of view of national meteorological service co-operating closely with the Road and Motorway Directorate of the Czech Republic. Development in this area was very positively influenced by participation in the community of SIRWEC. Experiences with dealing different problems could be helpful for other countries and meteorological institutes introducing road meteorology into operation.

Keywords: national meteorological service - weather forecasts - RWIS - overview.

1. INTRODUCTION

Orography of the Czech Republic is complicated to such degree that the Czech Hydrometeorological Institute (CHMI) as national authority for integrated warning system operates besides of central forecasting office in Prague six other regional branches with forecasting units. As regards road transport the mountain ridges around the borders are cut by important roads at altitudes up to 1000 m above sea level with local roads even higher. Also much frequented Motorway D1 connecting Prague and Brno breaks through highland at about 700 m ASL what can lead to critical situations (total collapse and closure of D1 in February 2001or March 2008). And there are other highlands across territory of the Czech Republic. It is very rarely that country is hit by adverse weather as the whole so forecasting for such area is quite sensitive.

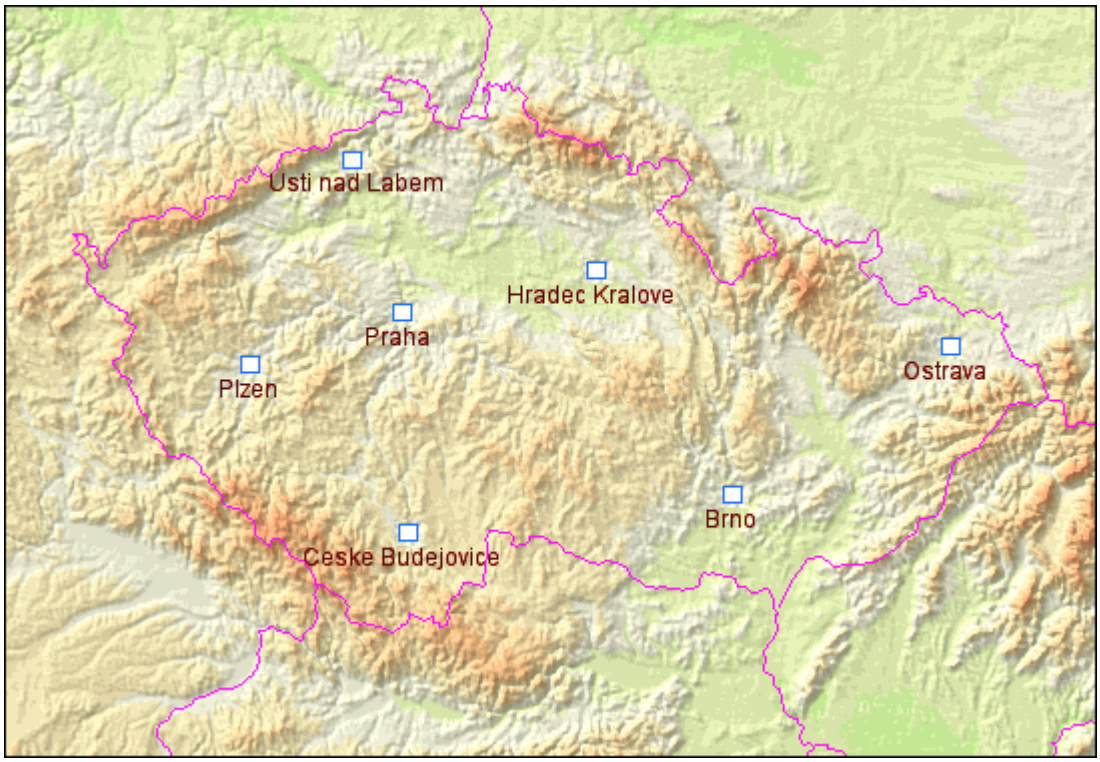

Fig. 1 Orographic conditions and disposition of CHMI forecasting offices

2. ROAD WEATHER FORECASTS

We could track genesis of co-operation between meteorologists and road managers maybe 20-30 years ago. In the beginning as in other countries it was more or less regular mutual exchange of information in form of phone consultancies often on local level. More systematic service was developing during the construction of D1 (Prague – Brno) in 70-ties as sections of new motorway have been opening step by step. Modern conception of meteorological support started in the middle of 90-ties in context with economic stimulation of winter maintenance and installation of the first road weather stations.

2.1 Regular special forecasts

Format of new text bulletins with specific information for road managers developed by regional forecasting office Usti nad Labem was introduced in winter 1995/96. The text message was optimized for presentation on TV screen as Teletext (hidden page) – that means max 69 characters per line. Forecast was issued every 6 hours with lead time 9 hours (3 hours overlap period) accessible on TV 1,5 -2 hours after deadline. During some years the messages were distributed also by e-mails or as input into different versions of RWIS almost immediately after editing by forecaster.

```
FPCZ71 OKPL 180800
dne: 18.3.2008 v 9:00 SEC
Specialni predpoved pocasi pro zimni udrzbu komunikaci
na obdobi od 9 do 18 hod. dne 18.3.2008
═══════════════════════════════════════════════════════════════════
Plzensky kraj - okresy Tachov (TC), Domazlice (DO), Klatovy (KT),
                Plzen-sever (PS), Plzen-mesto (PM), Plzen-jih (PJ),
                Rokycany (RO)
-------------------------------------------------------------------
Pocasi: Promenliva, vetsinou velka oblacnost, snehove prehanky. V
polohach pod 500 m prechodne srazky smisene deste se snehem.

Teploty:
        v nizsich polohach: Tmax 1/4, k veceru 2/-1
        v pasmu 600-800 m n.m.: Tmax -2/1, k veceru 0/-3

Nulova izoterma: 500-600 m

Vitr: Z-SZ 4-8 m/s, narazy kolem 15 m/s

Pravdepodobnost vyskytu srazek: 90 %

Predpokladana intenzita srazek: slaba, prechodne i mirna, novy snih 1
-4 cm

Charakter srazek: snehove prehanky, pod 500 m i smisene

Vyskyt nebezpecnych jevu: novy snih 1-4 cm, od 600 m snehove jazyky

CHMU Plzen, meteorolog ve sluzbe: boh     tel: 377 256 672
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Fig. 2 Short range forecast (09-18 CET) FPCZ71 for Plzen region with 7 districts

The forecaster has possibility to express for example probability, intensity and form of precipitation up to district level, to emphasize danger phenomena including expected timing and other details. The road surface temperature and the state of road cover are not incorporated because we still do not use energy balance model (see chapter 5).

At the same frequency bulletin FXCZ72 (Fig. 3) is issued with line forecast for each motorway. The responsibility for some sections of motorways lies on regional forecasting offices which prepare proposal of forecast finally edited by forecasters in Prague. Besides of weather guidance the road manager will receive expected air temperature extremes, amount of new snow, possible danger phenomena etc. for all motorway sections.

The format of text messages is already outdated and we have prepared some alternatives in sense of table driven text. During the summer we are going to test new editor supported by Visual Weather system (www.iblsoft.com) introduced in CHMI operation during spring 2007. After development of energy balance model also other parameters will be included.

Described forecasts are not the only outputs of our meteorologists. We also provide regional outlooks for next 3 days and week or month general outlook for planning purposes. There is also special forecast for public and media focused on danger winter phenomena issued at early morning and late afternoon.

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FXCZ72 OKPL 280200
Dalnice D5

 Pocasi: zatazeno az oblacno, obcas snezeni, v nejnizsich polohach i
dest se snehem

 Vitr: Z az SZ 4-8 m/s, narazy 15-20 m/s

 km  teploty  srazky(charakter)     intenzita      %
 0   min
 -   max
 29  ext
 Nebezpecne jevy: -
 km  teploty  srazky(charakter)     intenzita      %
 29  min -5   snezeni, smisene      1-5 cm         90
 -   max +1
 80  ext
 Nebezpecne jevy: tvorba zmrazku, naledi,misty jazyky
 km  teploty  srazky(charakter)     intenzita      %
 80  min -5   snezeni, smisene      1-5 cm         90
 -   max +1
 131 ext
 Nebezpecne jevy: tvorba zmrazku, naledi,misty jazyky
 km  teploty  srazky(charakter)     intenzita      %
 131 min -6   snezeni, smisene      1-5 cm         90
 -   max  0
 151 ext
 Nebezpecne jevy: tvorba zmrazku, naledi,misty jazyky

RPP Plzen, tel 377 256 672, meteorolog ve sluzbe: kop
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Fig. 3 Example of the "line" forecast FXCZ72 for 3 sections of Motorway D5 (29-80, 80-131 and 131-151 km)

2.2 Verification of regular forecasts

It is necessary to have good feedback about actual road weather to verify such type of forecast. Next to data from RWIS and climatologic stations it is important to communicate with road managers, be familiar with reports about accidents, news from local media etc. Preconditions for such work are relatively good for example in the region of Plzen forecasting office with sufficient network of road weather stations [6] and long partnership with road managers.

Weather conditions from period 07-07 CET are regularly evaluated from the point of view of new snow cover (>1 cm), glaze or black ice occurrence distinguishing area under 800 m above sea level (worse information coverage from higher locations). If such danger phenomena had been observed it was called like „event" and compared with all archived bulletins FPCZ71 and FXCZ72. The forecast was successful if the event had been foreseen at „real time"(with enough lead time for managers to react). Such attitude is a little subjective. But if it is evaluated by one person we can suppose to have relatively stable point of view.

A standard way of verification is usage of contingency table with exploration of hit, false alarm, miss, null event and different quantities like false alarm ratio or probability of detection. However forecast of „event"is not dichotomous (yes-or-no) and we can find many cases which would be difficult to strictly qualify as successful or not. For example you expect new snow more than 1 cm, the guess is about 5 cm (ploughing necessary) but reality is 2 cm. Was the forecast right? It was inaccurate. So our attitude was to find percentage of good forecasts, inaccurate and incorrect information. The results from five winter seasons are in the table:

season	events	successful	inacurate	incorrect
1999/2000	56	80%	16%	4%
2000/2001	38	79%	21%	0%
2001/2002	33	85%	15%	0%
2002/2003	42	93%	5%	2%
2003/2004	37	84%	14%	2%

Tab. 1 Verification of forecasts of the „events"

As „inaccurate"were signed forecasts with radically erroneous estimation of new snow, probability and form of precipitation. Mostly it was caused by failure of numerical models.

2.3 Flash warnings

Of course there are many situations which are not/can not be described by regular forecasts in sufficient manner. In these cases we usually use phone consultancy. However practise is not the same in each region – it depends on relationships and historical development on local level.

Standard solution could be short message distributed by SMS and e-mails with lead time 0-2 hours. Format for such warning was developed under leadership of regional forecasting office Usti nad Labem in 2004 and tested for some time in northern and western Bohemia. This solution is compatible with general integrated warning system of CHMI and still waits for application.

2.4 Graphical information

It is very desirable and useful to work with alternative outputs in form of meteograms and other diagrams. In last winter season suite of prognostic graphs (see Fig. 4) produced by local area model ALADIN was tested. These prognostic curves and diagrams were calculated as representative for climatologically compatible areas. Disadvantage of this information is its origin as direct model output without intervention of forecaster. Nevertheless it was used by some road managers and welcome. It will be object of further research and in future good started point for outputs from energy balance model. For the present time forecaster can influence only prognostic curves coming from Vaisala Ice Break module used for motorway network.

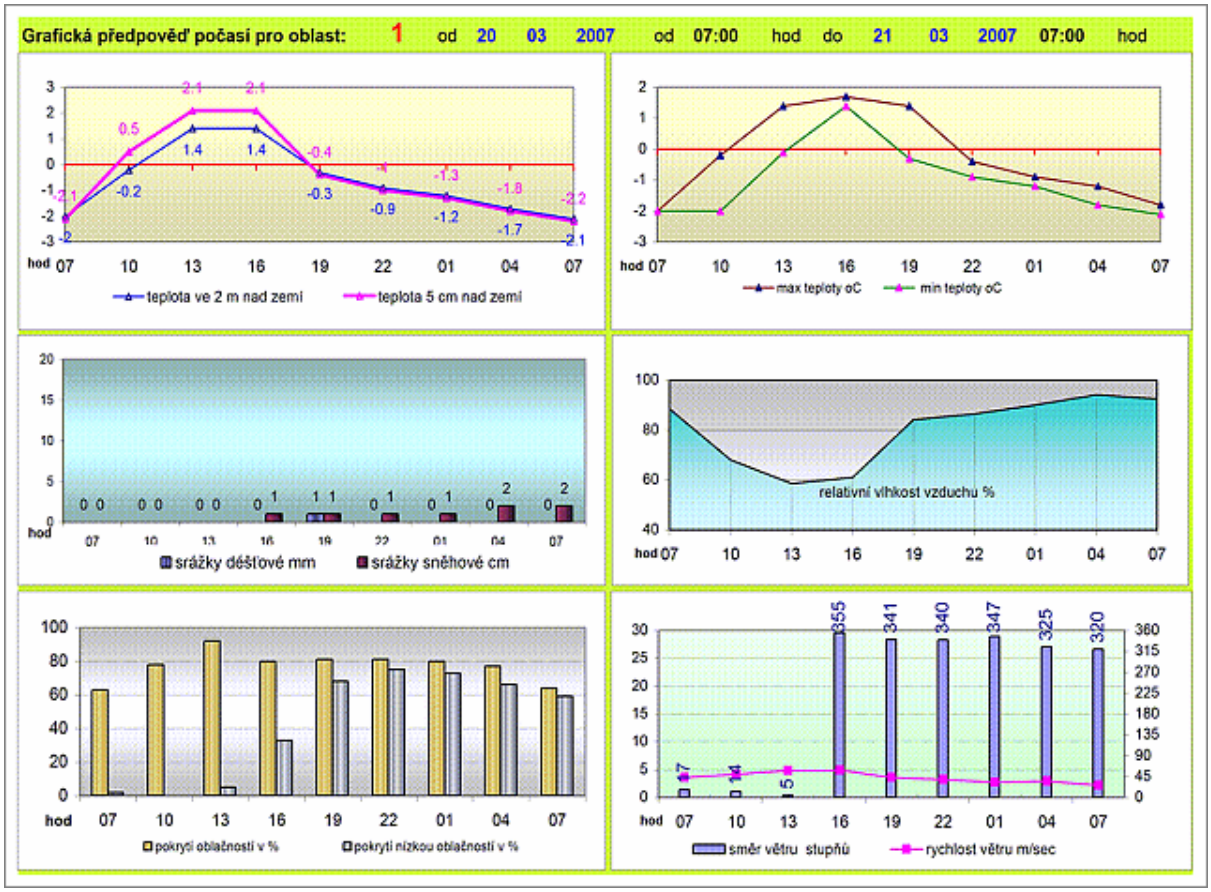

Fig. 4 Graphical forecast from ALADIN model: 2m temperature, 5 cm temperature, extreme temperatures, precipitation (snow/rain), relative humidity, cloudiness (total/low) and wind.

3. RWIS

Special forecasts are prepared with knowledge of data from road weather sensors and their behaviour during last night. But only a few years ago it was not possible to control road weather data in one presentation system (competition of more than five technologies, see [1]). Problem with fragmented network was overcome by establishing duty to deliver data in unified code [3],[5]. The project of national RWIS (in Czech language called SMIS) was successful and password protected access to data server was opened before winter 2006/2007. For some of regional forecasting offices it was the first experience with road sensors measurement.

In general from the point of view of meteorologist the density of road sensors in many parts of country is sufficient. The problem is in border regions where in contrast with meteorological data (SYNOP) the road sensors are limited by border line. Unfortunately our radar network which covers territory of the country quite well in summer time is insufficient during winter without possibility to control precipitations from low cloudiness, in particular freezing drizzle and snow shower from cumuliform clouds lower than 3 km (it is also problem of neighbouring radars). For this purpose it would be very desirable to exchange data across border and that is one of the reasons why CHMI supports project of CERWIS [1],[2],[5].

4. TRAINING

Behaviour of road surface temperature is often quite different than changes in 5 cm over the grass which each forecaster should know very well. If someone is beginner at this area he should learn a lot of things about temperature and moisture changes during marginal nights, about hoar-frost formation and other fascinating phenomena. Twice important it is to train road managers, not only about road surface behaviour but also how to understand weather forecast and radar or satellite information. In case of managers there is also higher risk of personal fluctuations, so regular training workshops with illustrative case studies are very important. Good contribution for this purpose is the handbook about meteorological terminology and forecasting prepared by colleagues from Ostrava forecasting office. Another and very valuable source of information is the „RWIS web guide“accessible on SIRWEC webpage. Besides of other it is very good material for training forecasters about freezing temperature, road salting and factors influencing road conditions. Surely case studies dealing with accidents caused by adverse weather or with failed forecasts are very impressive. Unfortunately there is much to do to train people by regular and systematic way.

5. DEVELOPMENT

Missing tool for forecasting of the road surface state and temperature in domain of the whole country is the main drive for research. Possible solutions have been investigated by the Institute of Atmospheric Physics AS CR and CHMI during 2007 and contract for energy balance model development sponsored by the Road and Motorway Directorate of the Czech Republic was prepared in spring 2008. Simultaneously CHMI accepted offer of the University of Birmingham to organize trial with application of XRWIS in conditions of the Czech Republic during next winter season.

6. CONCLUSIONS

The national meteorological service CHMI utilizes potential of unified RWIS (SMIS) which was developed after overcoming of problems with diversity of road weather measurements. Lack of data near the border was found especially in context of limited radar information in winter conditions. CHMI will optimize format of forecasts and participate in development of energy balance model.

7. REFERENCES

[1] Glanc, D., Skuthan, M. and Svarc, J. 2002. *Integrated RWIS in the Central European Territory.* Proceedings for 11th SIRWEC conference, Sapporo, Japan.

[2] Glanc, D., Skuthan, M. 2008. *Road meteorology and international cooperation.* Proceedings for 14th SIRWEC conference, Prague, the Czech Republic.

[3] Endrulat, T. and Sulan, J. 2006. *BUFR template for road weather data.* Proceedings for 13th SIRWEC conference, Torino, Italy.

[4] Skuthan, M. 2004. *The significance of the severe events warning service in relation to the classic methods of road meteorology*. Proceedings for 12th SIRWEC conference, Bingen, Germany.

[5] Skuthan, M. 2006. *Central European Transnational Road Weather Information System.* Proceedings for 13th SIRWEC conference, Torino, Italy.

[6] Sulan, J. 2004. *Experiences with hoar-frost and its monitoring in Western Bohemia*. Proceedings for 12th SIRWEC conference, Bingen, Germany.