H14-205

ASSET OF THE USE OF NWP MODEL ALADIN FOR THE CONSTRUCTION OF WIND ROSES

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Abstract: The software system CALMET Integrator is a user interface for the calculation of wind roses divided into classes of wind speed and atmospheric stability. The system was developed in a cooperation of the Czech Hydrometeorological Institute and a private company IDEA-ENVI. Examples of the wind roses constructed by CALMET Integrator were presented at the HARMO13 conference (abstract H13-230).

CALMET Integrator evaluation revealed discrepancies between wind roses constructed form local measurements and those calculated by CALMET when only neighboring stations and balloon soundings were included. In this paper we present improvement achieved when upper air data from the NWP model ALADIN were included in the calculation.

Key words: *wind rose, wind field model, CALMET integrator, NWP model ALADIN*

INTRODUCTION

This text follows up a HARMO 13 conference abstract „Use of the Calmet model for preparation of wind roses for the regulatory modelling purposses" (Zemánková and Škáchová 2010), which introduced software system CALMET Integrator – a user interface for the calculation of wind roses divided into classes of wind speed and atmospheric stability. The system development is a result of cooperation between Czech Hydrometeorological Institute and a private company IDEA-ENVI.

Calculation of the wind roses in the CALMET Integrator is done by the diagnostic 3-dimensional meteorological model CALMET, which is a part of the dispersion modeling system CALPUFF (Scire et al., 1990a, 1990b). Model CALMET contains diagnostic module which provides hourly wind speed and wind direction data on a predefined 3-dimensional gridded domain. The wind field module contains objective analysis and parametrized treatments of complex terrain effects. Further, the CALMET model is able to calculate micrometeorological characteristics of the boundary layer over land as well as over water bodies. Three types of basic input data are necessary to run the CALMET model: geography of a model domain giving the information on terrain elevation and land cover, hourly meteorological data from the surface stations in the vicinity of the site where the wind rose is desired, and an upper air (sounding) data file with frequency of measurements of at least 12 hours. Optionally, the CALMET model accepts prognostic data from a meteorological model (MM5 by default).

So far only station measurements and balloon sounding were used on the input for the CALMET in the routine practice at the CHMI. Nevertheless when there is no meteorological station available in the vicinity of the spot of interest, results of such calculation may be unreliable. In this paper we show the improvement that can be achieved when also outputs from NWP model are used.

For the evaluation of CALMET Integrator 5 stations were selected: Praha-Libuš, Praha-Ruzyně, Přerov, Kocelovice, and Pec pod Sněžkou. Balloon sounding measurement were available at Praha-Libuš and Prostějov stations (Fig. 1). Crossvalidation was used for the model evaluation – it means that for each station wind rose constructed from the site measurements was compared to the one computed by CALMET when only neighboring stations and sounding data were included. This revealed discrepancies, especially when the site was distant from the place of sounding and the terrain was more complex. Possible improvement was seen in inclusion of the vertical profile from the nearest gridpoint of the NWP model ALADIN.

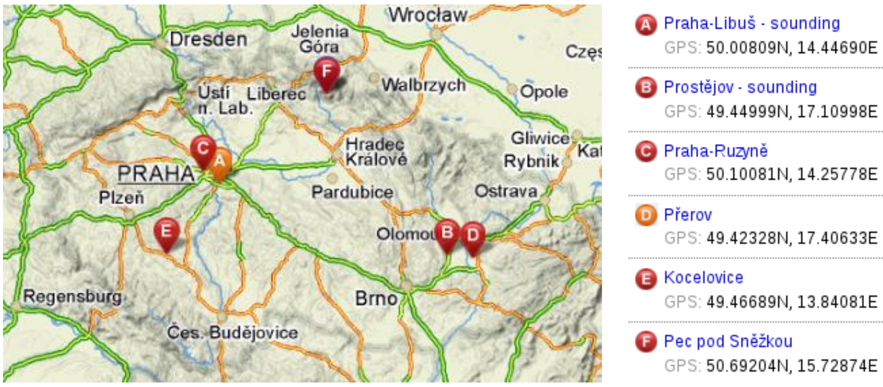

Fig. 1 Location of selected stations and sites of balloon sounding.

MODEL SETUP

CALMET was run with 1 km horizontal resolution. Modeling grid of 40x40 horizontal cells and 10 vertical levels was centred at the station location. First level was at 10 m AGL and last at 700 m AGL. Sounding at Praha-Libuš were available at 0, 6, 12, and 18 UTC, sounding at Prostějov at 0 and 12 UTC. Neighboring stations were the closest ones but were not limited to the CALMET computational domain. Vertical profile was also taken from the ALADIN gridpoint nearest to the station. Both ALADIN profile and sounding data were limited by 500hPa level. For ALADIN model we tested use of both 1h and 6h data (0, 6, 12, 18 UTC) but the results were similar. Therefore in the following only 6h ALADIN data are used. In addition we also constructed wind rose from the ALADIN 1st level data at the ALADIN gridpoint nearest to the station. Reference wind rose from the site measurement was constructed from 1h data.

ALADIN model
ALADIN/CE, version CY35T1star was used. In the integration analysis followed by 6-hour forecasts was carried out regularly at 0, 6, 12 and 18 h UTC. For upper air parameters, the analysis presented a sophisticated combination of the global analysis of the driving model ARPEGE with the mesoscale structures simulated by ALADIN and for the surface parameters, ground temperature and relative humidity was assimilated by the optimal interpolation method. Resolution of the model was 8.997 km.

RESULTS
Praha – Libuš (Fig. 2) is dominated by W and SW winds. Model Calmet reproduces this pattern, but overestimates largely SW frequenies. Inclusion of Aladin profile has no effect on the resulting rose compared to the case when just sounding and nearby stations were used. Wind rose obtained from Aladin 1st layer data reproduces well SW but underestimates W frequencies, but still it gives the most acceptable results.

Praha-Ruzyně (Fig. 3) is located in a flat terrein on the east edge of Prague. All wind roses obtained with inclusion or sole use of Aladin data are similar and reproduce well observed data. Wind rose obtained with sounding and stattion data only is very similar to the one at the Praha – Libuš station.

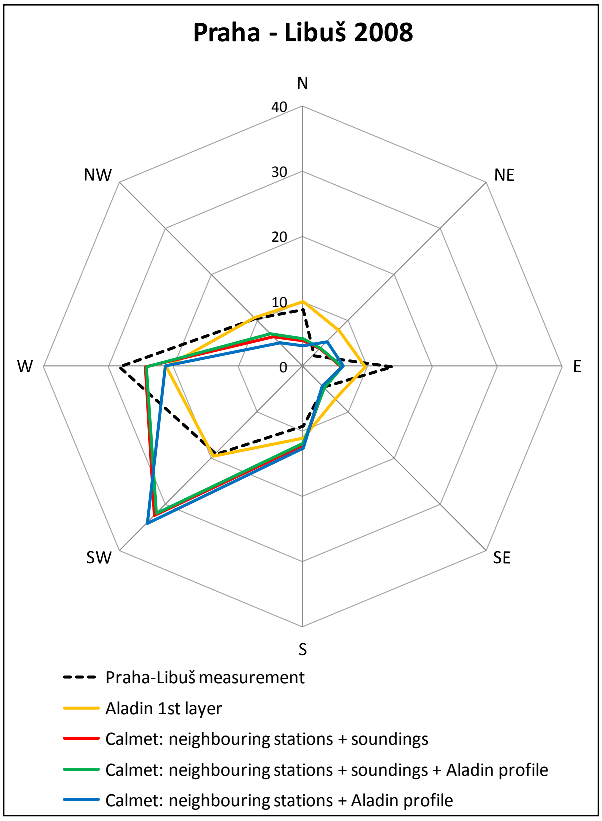

Fig. 2 Praha – Libuš

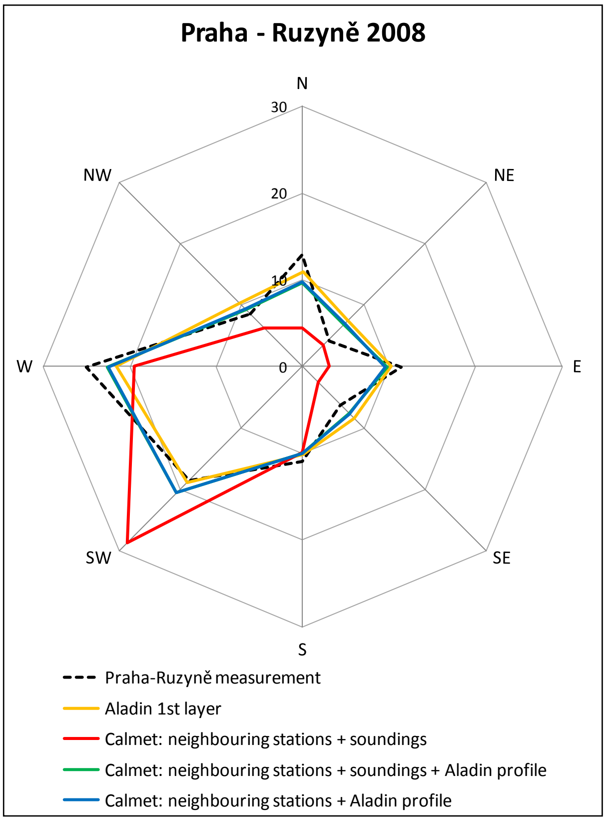

Fig.3 Praha – Ruzyně

Přerov (Fig. 4) is located in the top of a v-shaped valey which limbs point in NW and NE direction. Station is dominated by S winds. When soundings and station data are used we receive large overestimation of SE winds. Aladin reduces this overestimation and even better reproduction of SE winds is obtained with Aladin 1st layer data only

Kocelovice (Fig. 5) is situated in a slightly hilly terrein in south Bohemia and dominated by west winds. When only measurements and soundings are included in calculation, NW and SW winds frequency is overestimated. Inclusion of Aladin profile reduces N and SW frequencies as is desirable. The best results are obtained with 1st layer Aladin data.

Pec pod Sněžkou (Fig. 6) station is located in a very complex mountain terrain, in a valey with NE axis. CALMET Integrator is not able to reproduce measured windrose with only sounding and station data on the input. Additional use of ALADIN profile improves it's performance – especially limits west winds. But the best results are obtained with sole ALADIN 1st layer data from the nearest grid.

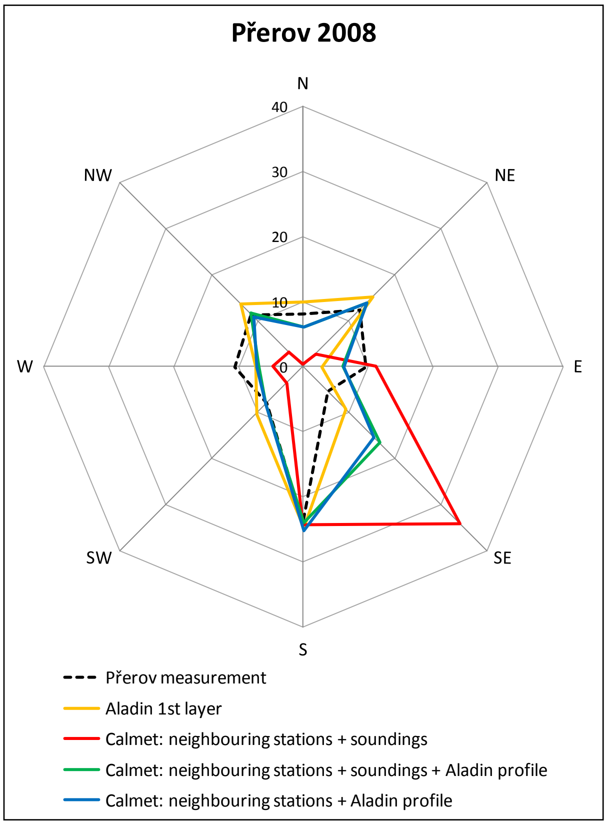

Fig. 4 Přerov

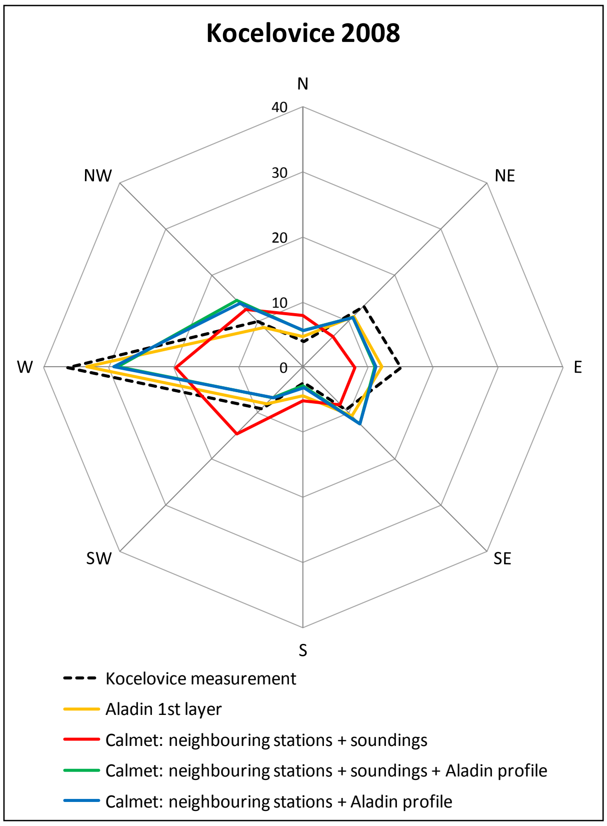

Fig. 5 Kocelovice

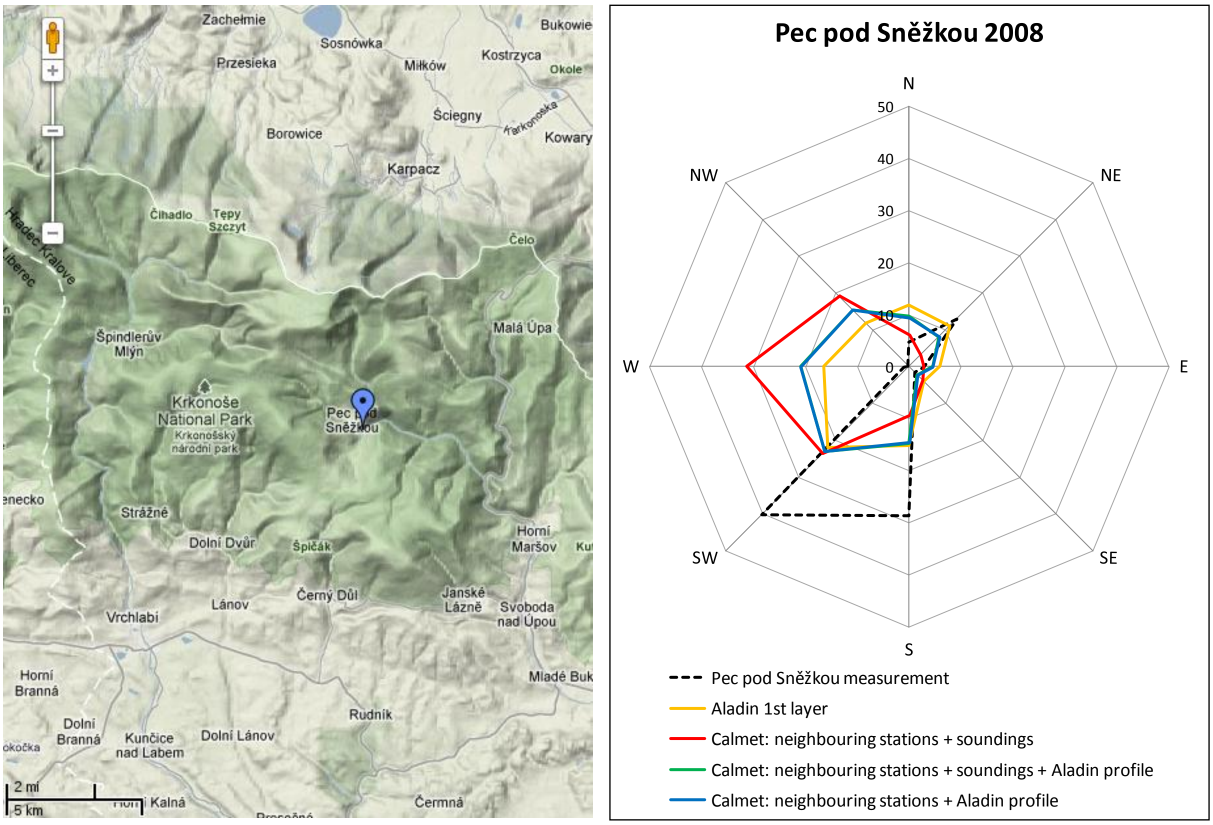

Fig. 6 Pec pod Sněžkou

CONCLUSION

It was shown that interpolation of the two remote sounding measurements, especialy in complex terrain is insufficient. Inclusion of ALADIN data led in all cases to the improvement of resulting wind roses and often wind roses constructed from the sole ALADIN data from the first layer at the nearest gridpoint gave the best results.

Special care should be given to the selection of neighboring stations used in calculation (e.g. case of Praha-Libuš station). Also finer resolution of CALMET grid should be tested. Current operational resolution of ALADIN model is 4.7km. It is desirable to test the results also with this higher resolution ALADIN data and posibly try to introduce virtual stations in the nearest Aladin grid points. Another issue is the selection of ALADIN gridpoint(s) when, especialy in a a complex terrain, the nearest one might not be the best suitable.

ACKNOWLEDGEMENT

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