An application of the French MOS to the territory of the Czech republic

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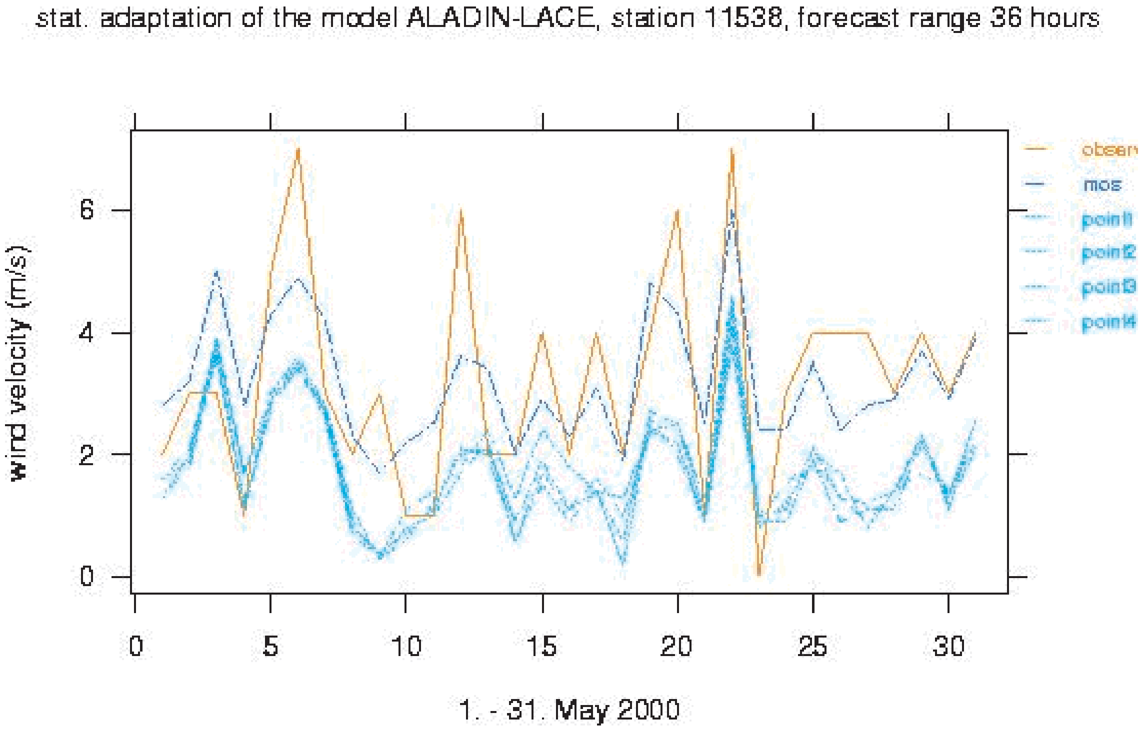
Introduction:

The need for point deterministic weather predictions has been increasing gradually among users of the predictions from the ALADIN numerical model. For construction of point predictions from a numerical model, methods of statistical adaptation are used. Two years ago the work has begun at the Czech Hydrometeorological Institute on statistical adaptations of outputs from the ALADIN numerical model (with high resolution) for point predictions at the sites where synoptic stations are located. Based on the experience of experts from Météo France, the linear regression Model Output Statistics (MOS) method was chosen to adapt the point predictions of two meter temperature, maximum and minimum temperature, wind speed and cloudiness. The application of the French statistical model was developed for the ALADIN-LACE forecasts for 6 hour temperature, cloudiness and wind speed for the Czech synoptic stations. The study is based on a one year period from February 1, 1999 to January 31, 2000. The improved products of the model prediction are compared with the direct model outputs and observations at an independent sample for the period February 1, 2000 to September 30, 2001.

Method:

The aim of the use of statistical adaptation in the Czech Republic is to improve the forecast of the numerical weather model for our stations. Results were obtained for all Czech synoptic stations for temperature, cloudiness and wind speed for the forecast ranges of 24,30,36,42,48 hours, for minimum temperature with forecast range of 30 hours, for maximum temperature with forecast range of 42 hours. The method of multiple linear regression with canonical regression was applied to the output fields of the model ALADIN-LACE. Regression equations were calculated for each station, for each parameter and for each time range separately. The canonical predictors are made up from the 4 grid points surrounding the site considered. The forward stepwise selection is used to determine the optimum number of predictors, and after that the best predictors are selected. The best number of predictors appears in most cases to be equal 3. For each predictand, the best predictors were found. The coefficients in the equations were computed for all predictands and all forecast ranges. To check the performance of the equations (before the start of their operational use), some examples on the independent sample were calculated for May 2000. An example is shown for the prediction of wind speed at the station of Temelin for the forecast range of 36 hours. The lines in the figure indicate: point 1 to point 4 is the direct model prediction from the nearest four gridpoints surrounding the station, "MOS" is prediction improved by statistical adaptation and "observ." is the observation at the station :



The application of the MOS method to the wind speed prediction for 36 hours at the Temelín station (11538) for May 2000 reduces the root mean square error from 2.0 to 1.2 m/s.

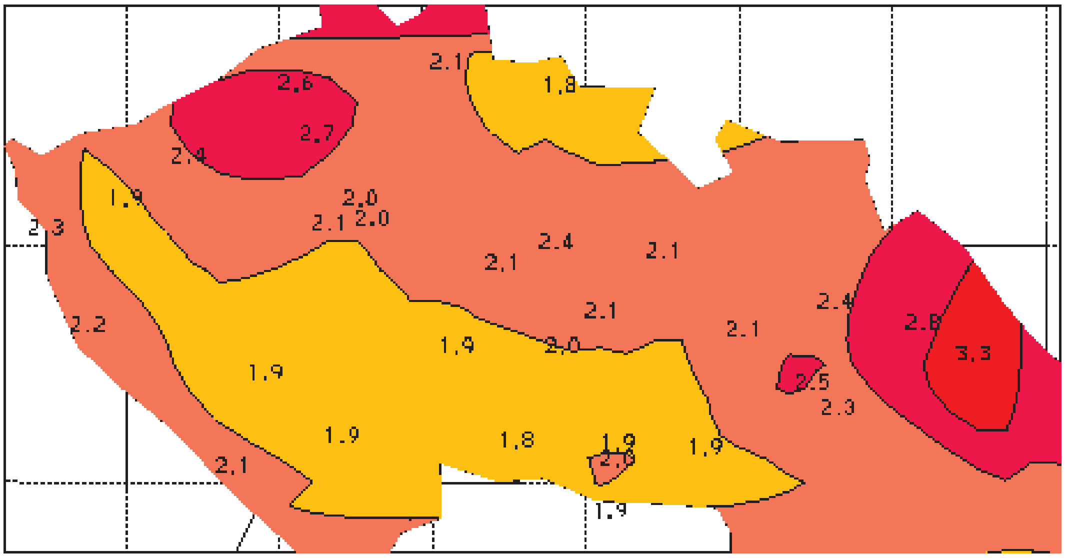
Operational use and results:

The results are satisfactory for the majority of stations, and models are stable enough. The models are used operationally in the Czech Republic since June 2000. The improved products of the model prediction are compared with direct model outputs and observations for independent sample for the period 1.4.2000-30.9.2001. On some examples of averaged Root mean square error it is possible to see how much the MOS equation improves the model outputs: MOS gives smaller root mean square error than direct model outputs for all predictands everywhere. One example is shown for minimum temperature with forecast range of 30 hours. The RMSE of prediction by MOS is much more homogeneous over Czech Republic than the direct model output. The RMSE of direct model outputs ranges from 1.8 to 3.3 at the stations, which is improved by MOS to the range from 1.6 to 2.4.

Multiple Linear Regression model used canonical regression

MINIMAL TEMPERATURE RMS DIRECT MODEL OUTPUTS

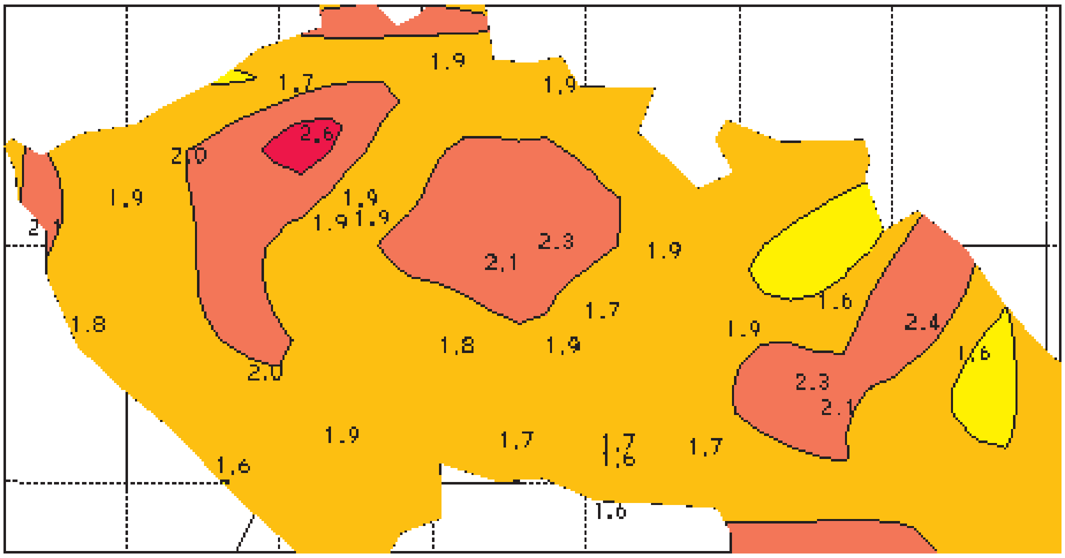
period 1.4.2000 – 30.09.2001 forecast range 030 hours



Multiple Linear Regression model used canonical regression

MINIMAL TEMPERATURE RMS IMPROVED MODEL OUTPUTS

period 1.4.2000 – 30.09.2001 forecast range 030 hours

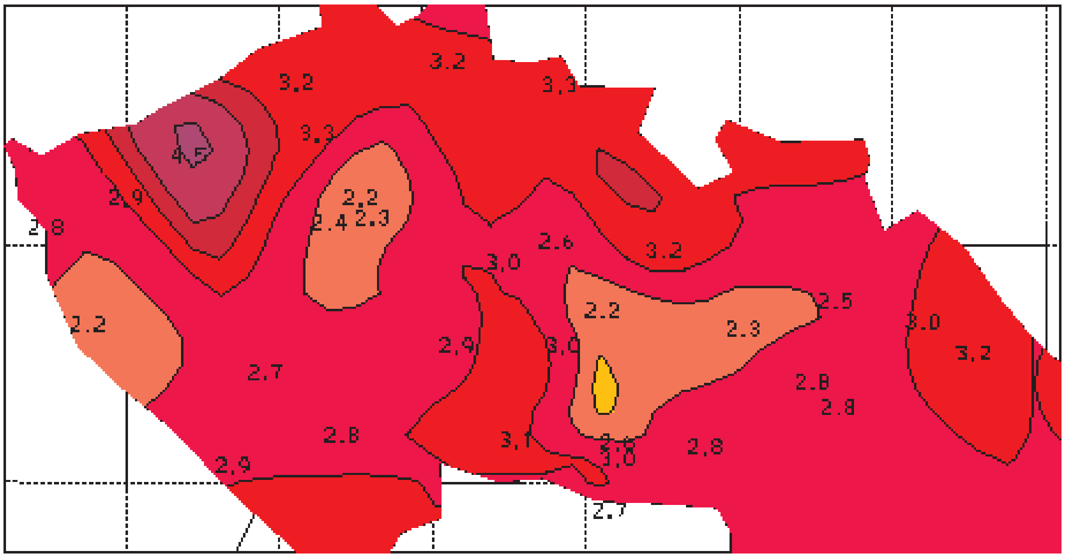


The second example is shown for maximum temperature with forecast range around 42 hours. It has features similar to minimum temperature, however, both direct model output and MOS have large errors. Maximum temperature remains a problematic element even if MOS applied. The best improvement of RMSE appears at mountain stations and the stations close to mountains.

Multiple Linear Regression model used canonical regression

MAXIMAL TEMPERATURE RMS DIRECT MODEL OUTPUTS

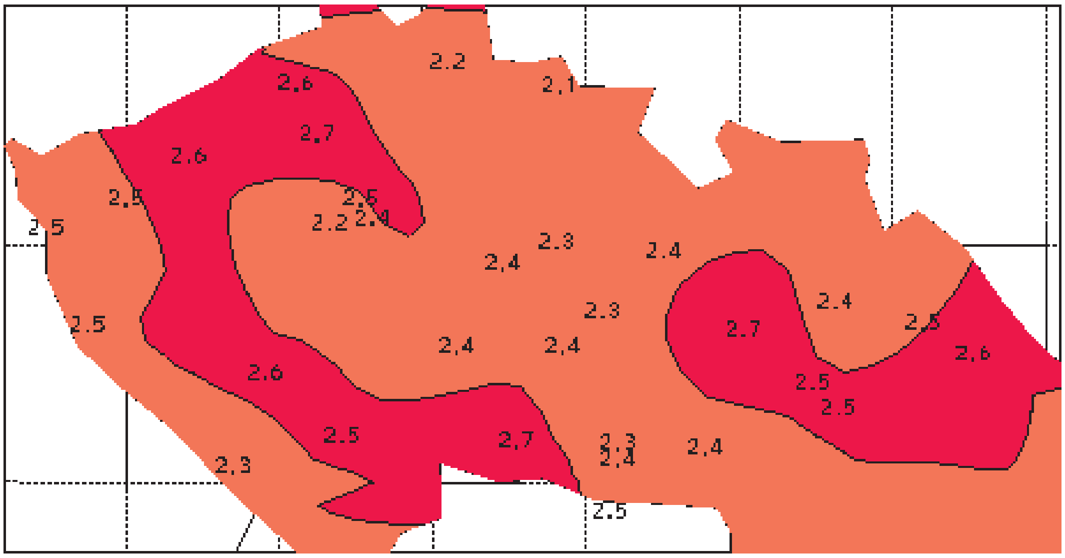
period 1.4.2000 – 30.09.2001 forecast range 042 hours



Multiple Linear Regression model used canonical regression

MAXIMAL TEMPERATURE RMS IMPROVED MODEL OUTPUTS

period 1.4.2000 – 30.09.2001 forecast range 042 hours



Conclusion and prospects:

The results are satisfactory for the majority of stations, and models are stable enough. The models are used operationally in the Czech Republic. The best number of predictors appears in most cases to be equal 3, for which the equation is acceptably stable and the improvement is sufficient. To obtain larger numbers of useful predictors, better stability and more improvement, probably the sample longer than one year is needed. In October 2001, a two-year sample of model outputs starting at October 1999 was completed. Fields of derived predictors were also calculated. We installed French software *Statw* for the selection of predictors. The first tests on the two-year sample give promising results. We hope that the new MOS, built on the complete two year sample with the independent sample half a year long, will start operating at the Czech Hydrometeorological Institute soon. The outputs of the new MOS will include the same elements as that of the present system in operation, that is, two meter temperature, maximum and minimum temperature, wind speed and cloudiness. The adapted forecast will be issued for the whole forecast range of ALADIN, that is up to 48 hours with a 3 hour step. The output will be issued also in a graphical form (at present, the MOS outputs are operationally available only in the form of tables).