Overestimation of minimum temperature during summer 2009

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Introduction

During summer 2009 we were given notice about very bad minimum temperature forecast provided by operational version of ALADIN/CE. The problem can be demonstrated on Fig. 1., where minimum and 2m temperature forecast and observation are displayed at the station Prague-Libus. There is apparent an overestimation of minimum temperature for most of the days this month, which sometimes reached about 5 deg.

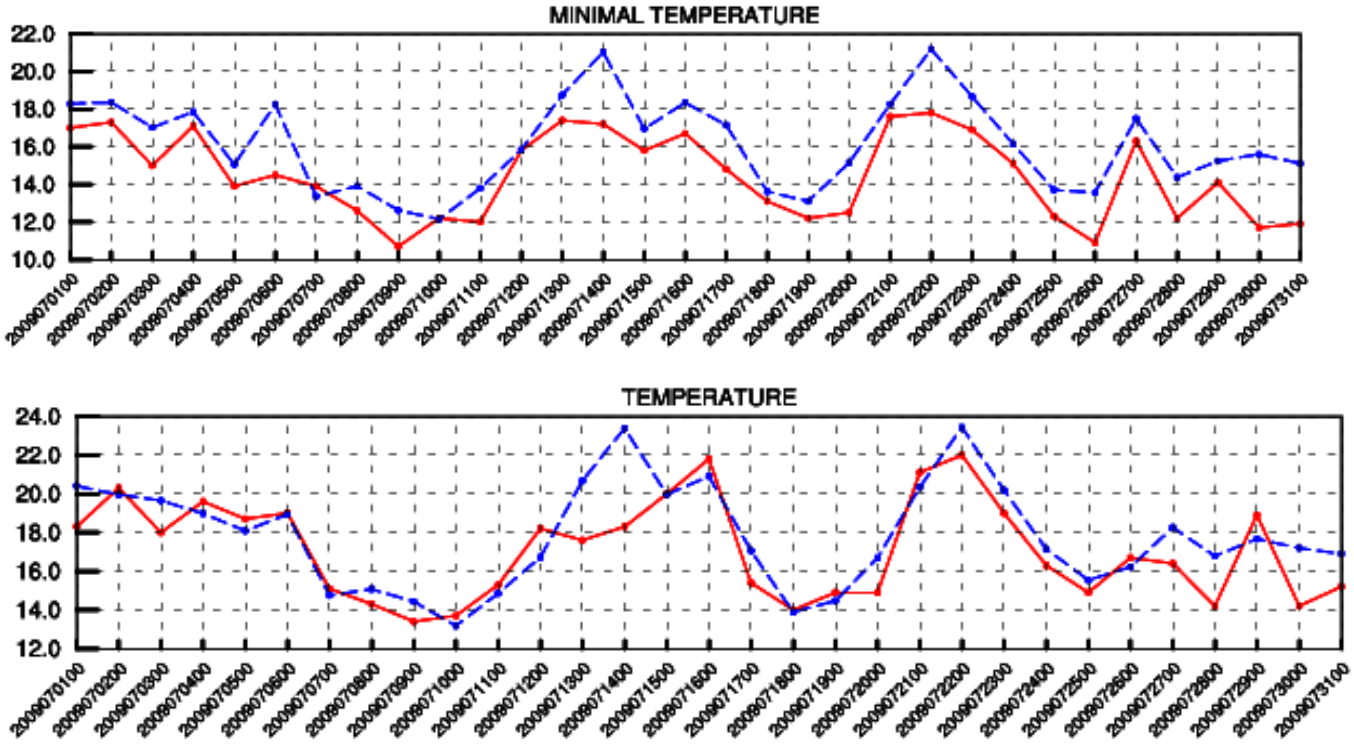

Fig. 1: Time series of +30H range of 00UTC forecasts for July 2009 at station Prague-Libus in blue and corresponding observation in red, minimum temperature on the top and 2m temperature bottom.

In order to investigate this problem a few tests were performed for one particular day in July and a summary will be described in next section. Longer time evolution of minimum temperature can be found in appendix, but will not be studied in this report.

Case study

First of all we tried to check whether the problem could be related to the diagnostics of 2m temperature (T2m in further text) and for one day 20090714. An evolution of temperature in the last model level, on the surface and at 2m were compared, see Fig 2. The 2m temperature lies between the last model level and surface temperature, thus the problem is most probably not connected to the T2m diagnostics. There is apparent large increase of surface temperature (Ts) with forecast range and maybe insufficient cooling during night. The surface temperature in coupling files provided by global model ARPEGE is smaller and although errors at the beginning of the forecast are not so large, we decided to investigate relation of Ts with surface and soil water reservoirs.
Following experiments were run:

- **ZALI** - only surface and deep soil reservoirs were taken from coupling file (ELSCF*000)
- **SURF** - all surface fields were taken from the first coupling file (ELSCF*000)
- **DYNA** - all surface and upper-air fields were taken from the first coupling file (ELSCF*000) - dynamical adaptation mode

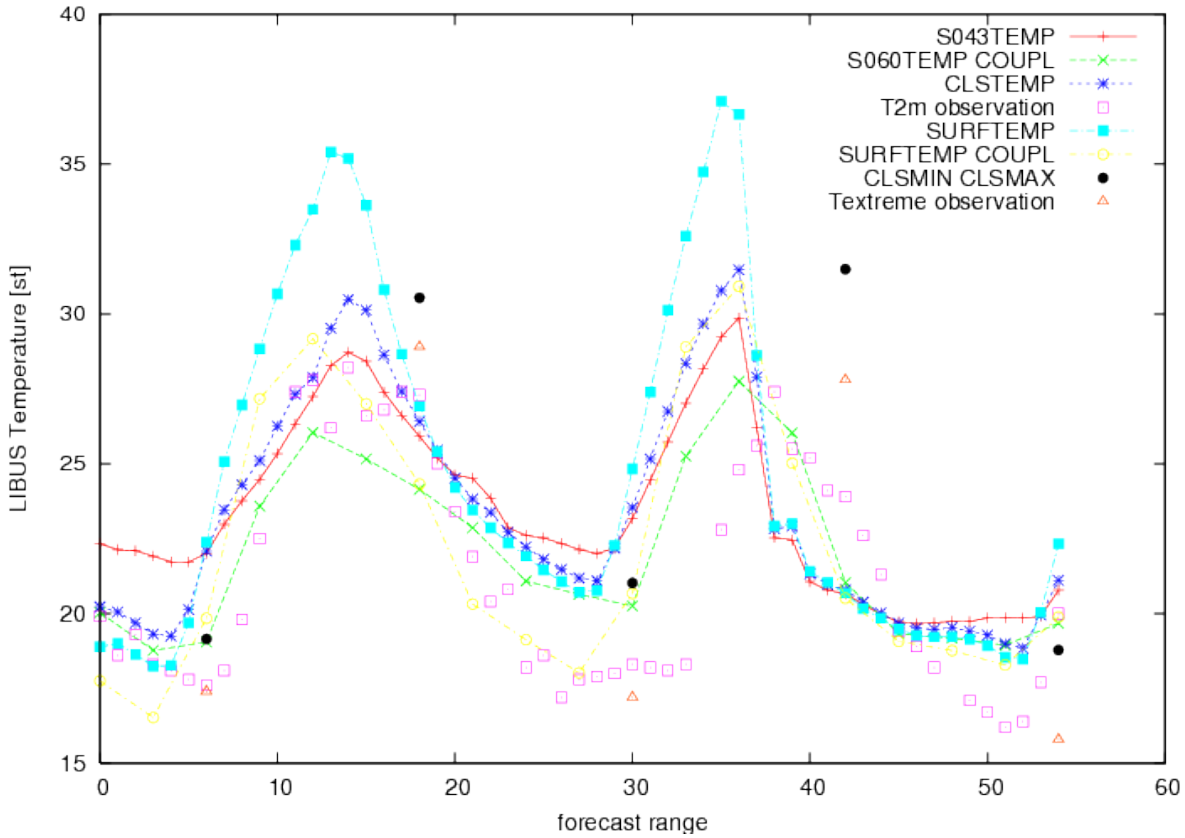

Fig. 2: Evolution with forecast range for the last model level temperature on ALADIN resolution in red and on ARPEGE resolution in green, forecasted 2m temperature in blue and 2m observation in violet, surface temperature on ALADIN resolution in light blue and on ARPEGE resolution in yellow. Extreme (minimum and maximum) observation in red triangles and model forecast as black dots.

The evolution of T2m is on Fig. 3. and although there is some improvement in excessive T2m increase

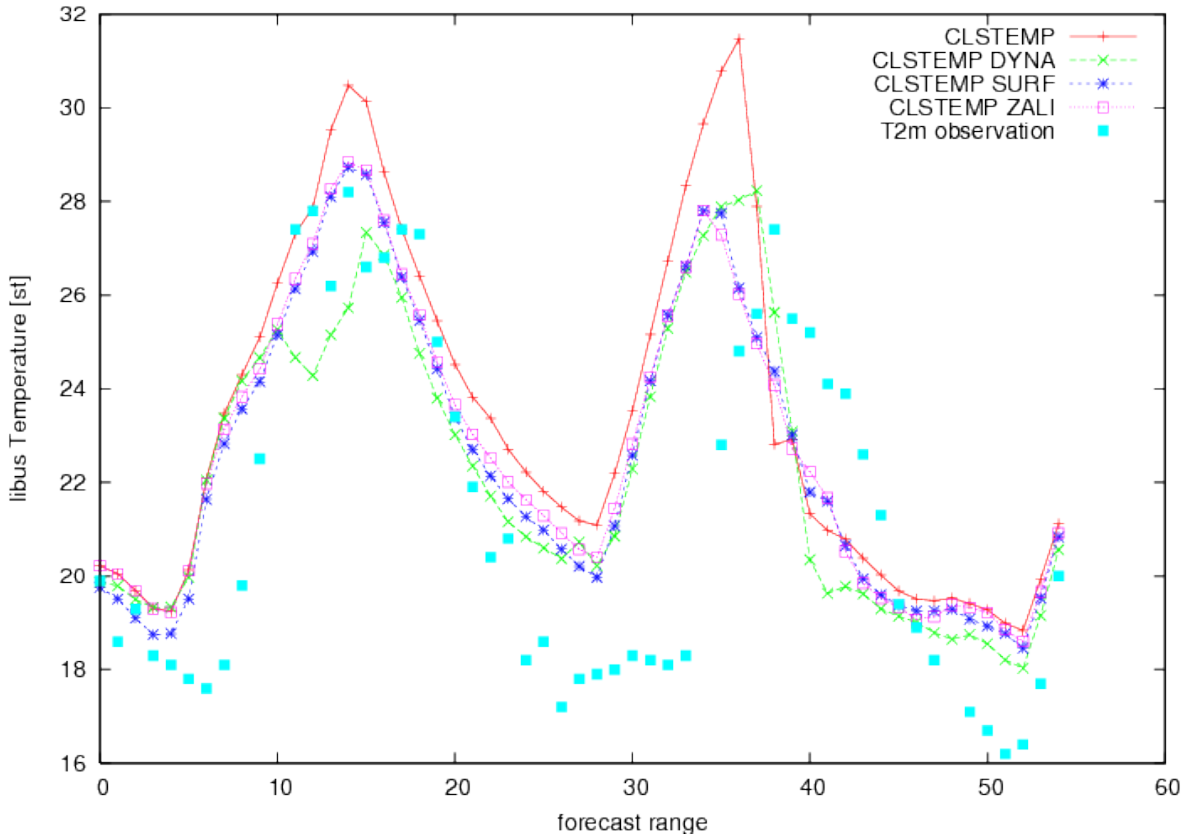

Fig. 3: Evolution with forecast range for T2m for operational forecast in red and experiments DYNA,SYRF and ZALI in green, blue and violet and T2m observation in light blue.

during the day when surface and deep soil reservoirs (or all surface fields) were taken from the first coupling file, but there is still insufficient cooling during the nights.

Assimilation experiment

In order to investigate relevance of operationally used surface scheme to the drying of surface and soil reservoirs we performed a 6 weeks assimilation experiments **S02** with modified OI coefficients. The OI coefficients has a role on analysis increments in any conditions, it determines the intensity of soil moisture analysis increments. Soil moisture evolution should respond more quickly or slowly to 2m errors evolution. We used coefficients currently used in ARPEGE surface analysis and loosely speaking the analysis should be more moist and colder. In the last experiment **S03** OI surface analysis was replaced by surface blending to compare the behavior of surface analysis with completely different algorithm.

- **S02** - with OI coefficients analyse.isba.03 file currently used in ARPEGE surface analysis
- **S03** - OI surface analysis replaced by surface blending

To save CPU only assimilation cycling was run and +6H forecast (guesses) were verified against SYNOP observation. After 6 weeks there was found very little moistening and cooling in experiment **S02** and only very little impact was found (see Fig. 6.). And although that the experiment **S03** is little bit warmer and drier than operational (or **S02**), after 6 weeks there are very small differences in the scores, which could be interpreted as confirmation of "reasonable" operational surface analysis behavior.

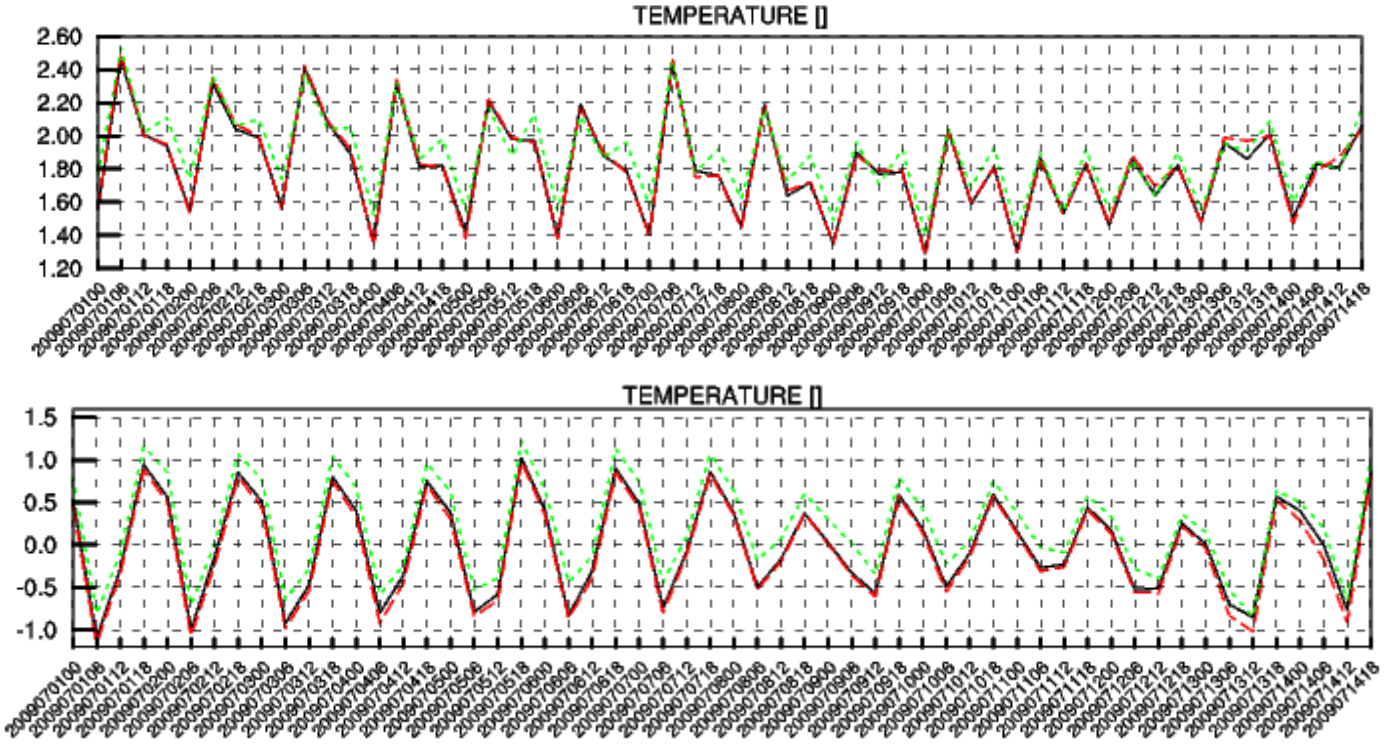

Fig. 4: Time series of T2m +6H forecast from the assimilation for period 1-14 July 2009, operational run in black, S02 in red and S03 in green. RMSE on the top and BIAS bottom.

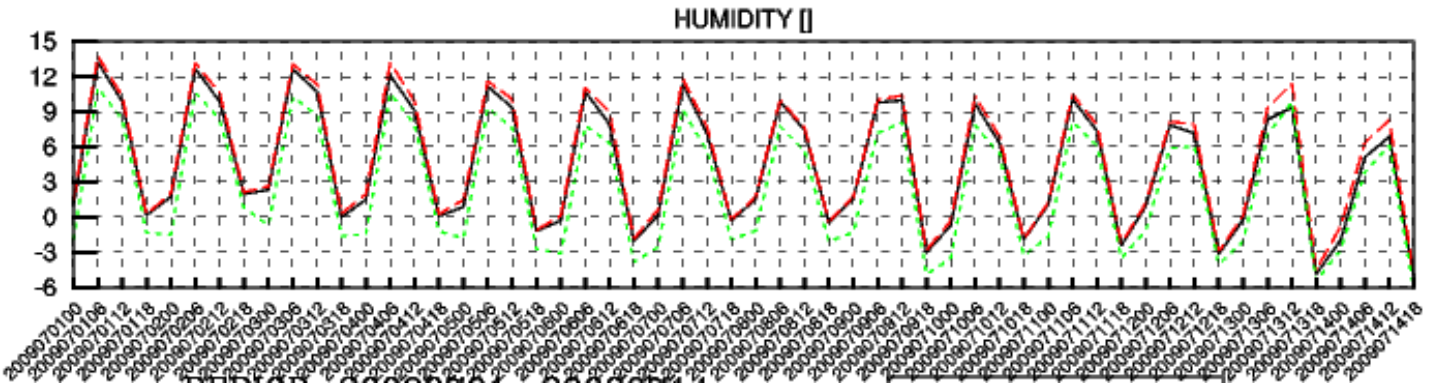

Fig. 5: Time series of RH2m +6H forecast BIAS from the assimilation for period 1-14 July 2009, operational run in black, S02 in red and S03 in green.

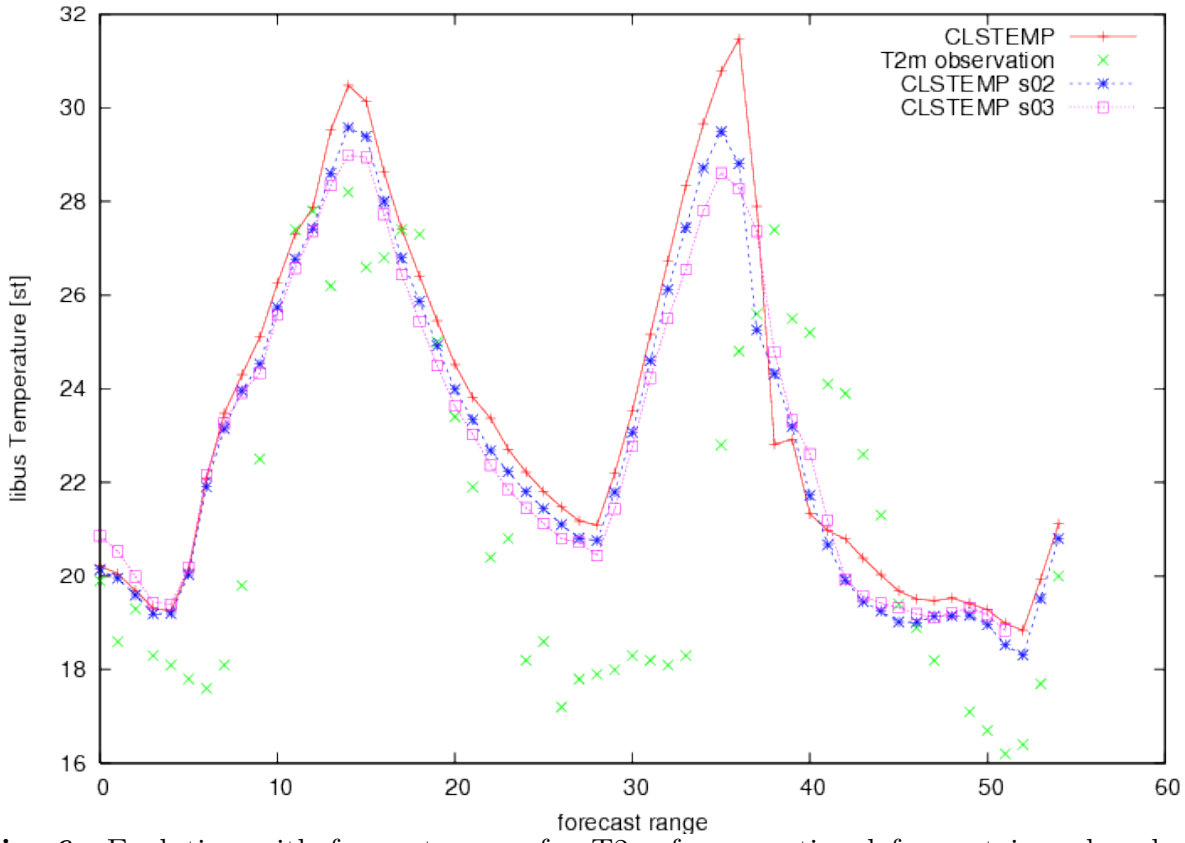

Fig. 6: Evolution with forecast range for T2m for operational forecast in red and experiments S02 and S03 in blue and violet and T2m observation in green of the forecast starting 20090714 00UTC.

Summary

To conclude although some studies were performed to identify cause of above mentioned problem no satisfactory explanation was found. Any suggestion to clearly identify whether problem comes from surface analysis, surface model scheme (ISBA) or interaction of the surface with upper-air physics is more than welcome.

Appendix

Long time verification of minimum temperature

An overestimation of minimum temperature seems to be feature of almost all warm period of year 2009.

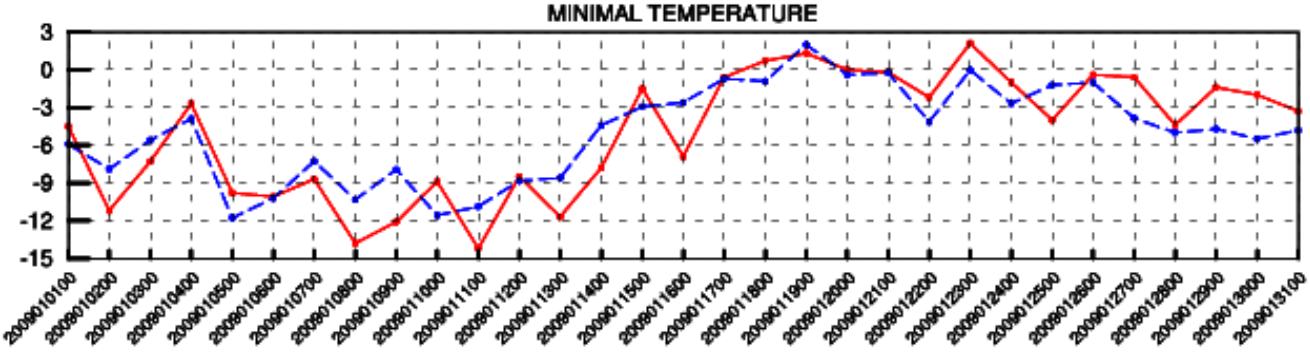

Fig. A1: Time series of +30H range of 00UTC forecasts for January 2009 at station Prague-Libus in blue and corresponding observation in red.

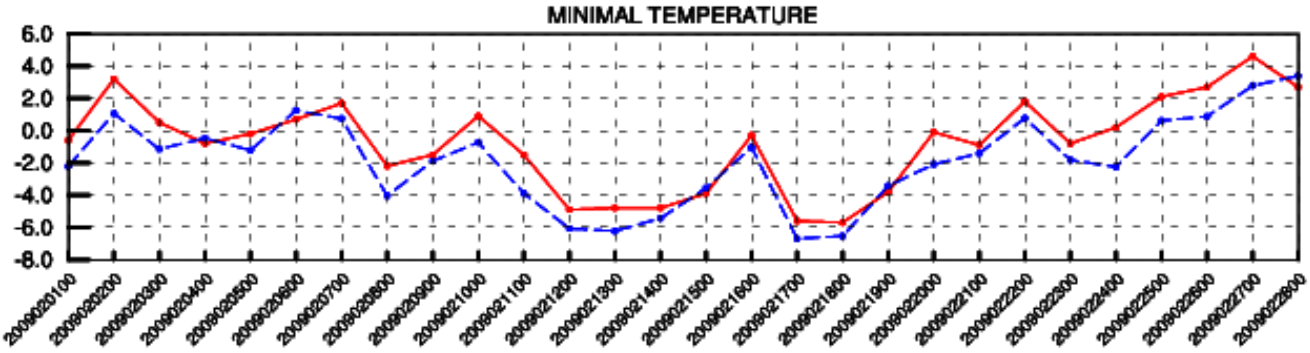

Fig. A2: same as above, but for February 2009

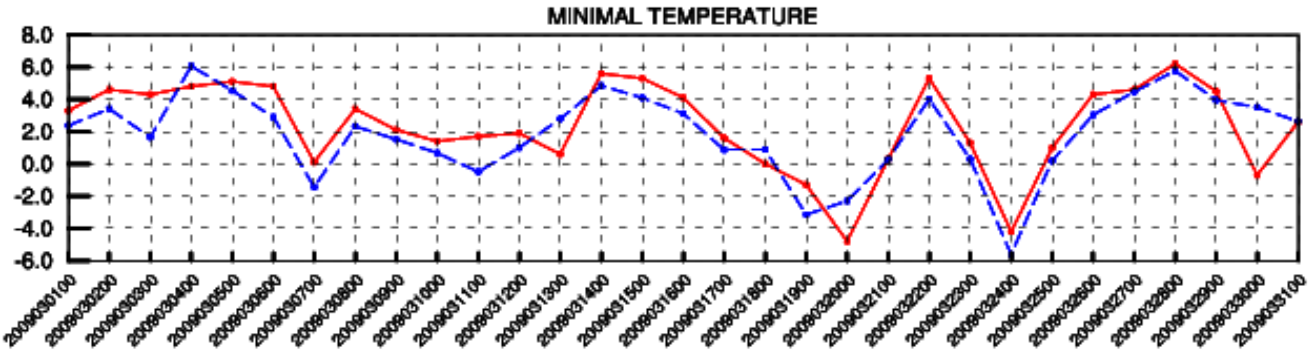

Fig. A2: same as above, but for March 2009

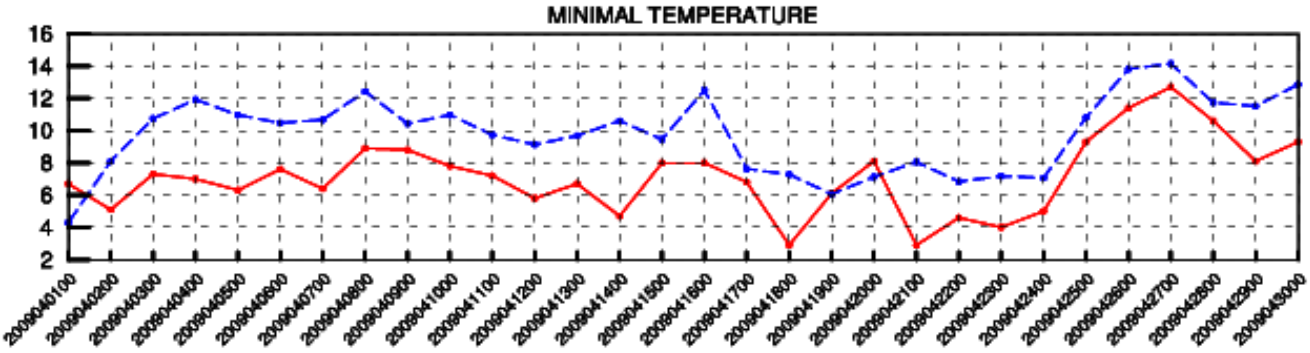

Fig. A2: same as above, but for April 2009

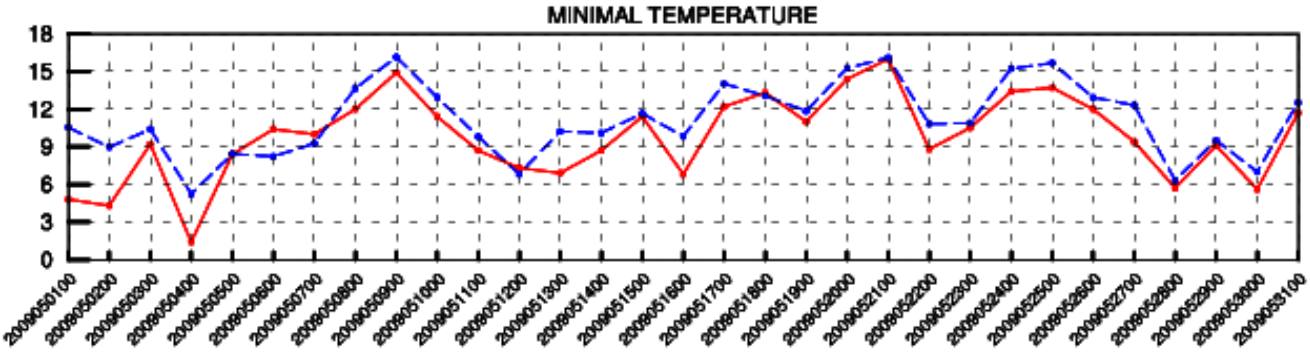

Fig. A1: Time series of +30H range of 00UTC forecasts for May 2009 at station Prague-Libus in blue and corresponding observation in red.

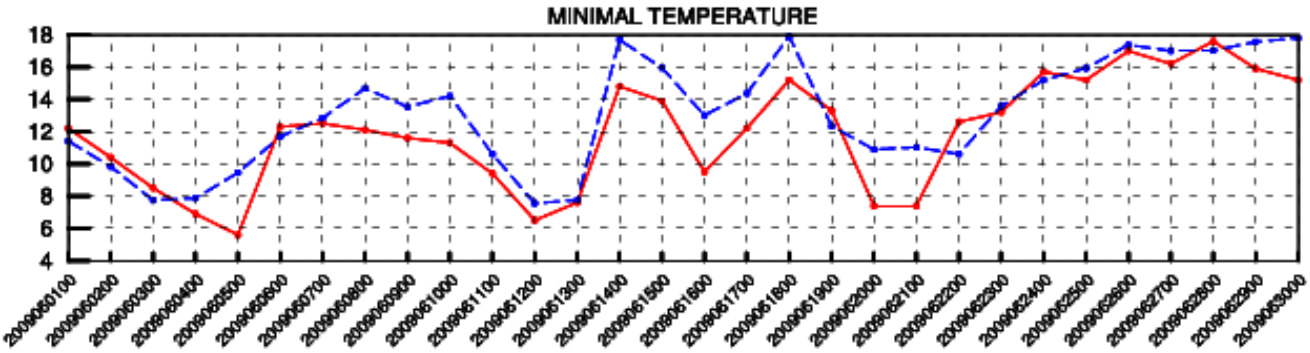

Fig. A2: same as above, but for June 2009

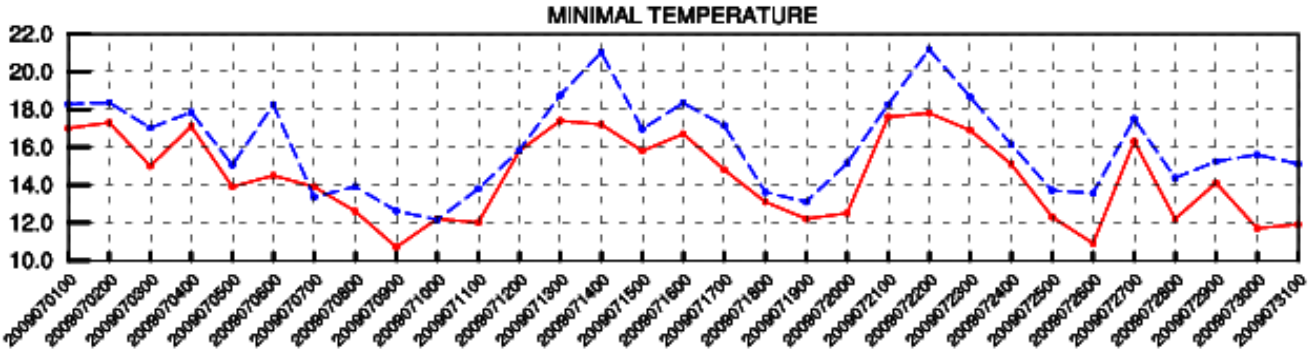

Fig. A2: same as above, but for July 2009

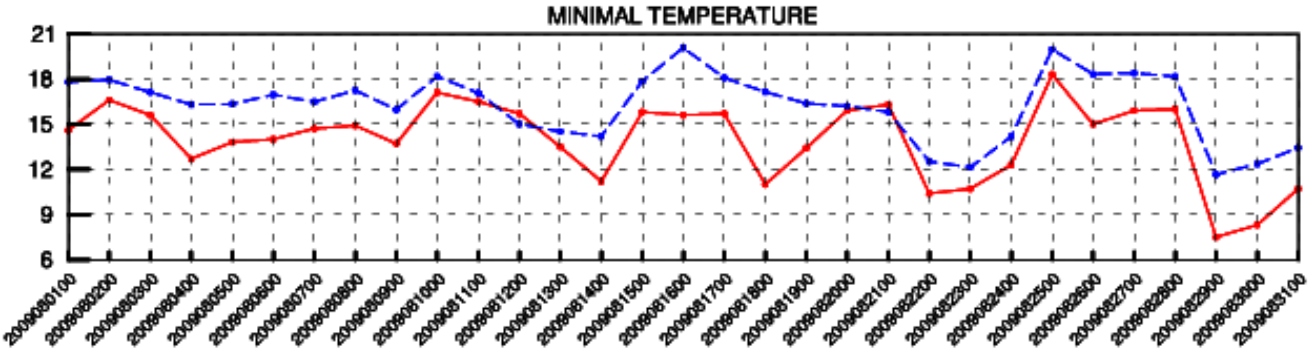

Fig. A2: same as above, but for August 2009

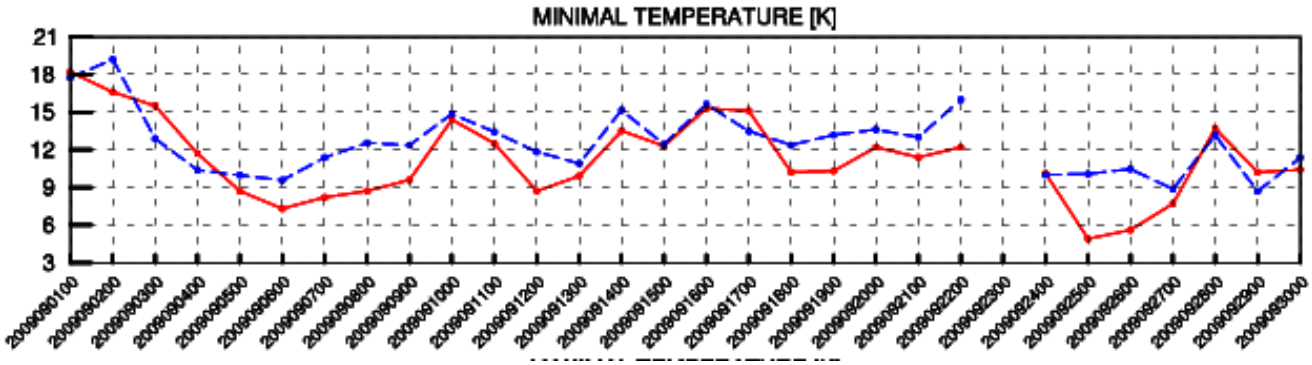

Fig. A1: Time series of +30H range of 00UTC forecasts for September 2009 at station Prague-Libus in blue and corresponding observation in red.

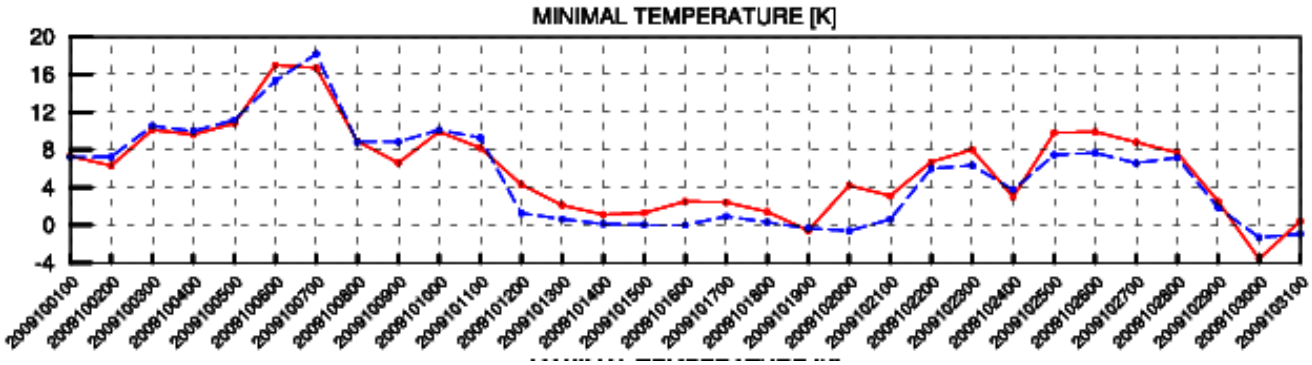

Fig. A2: same as above, but for October 2009

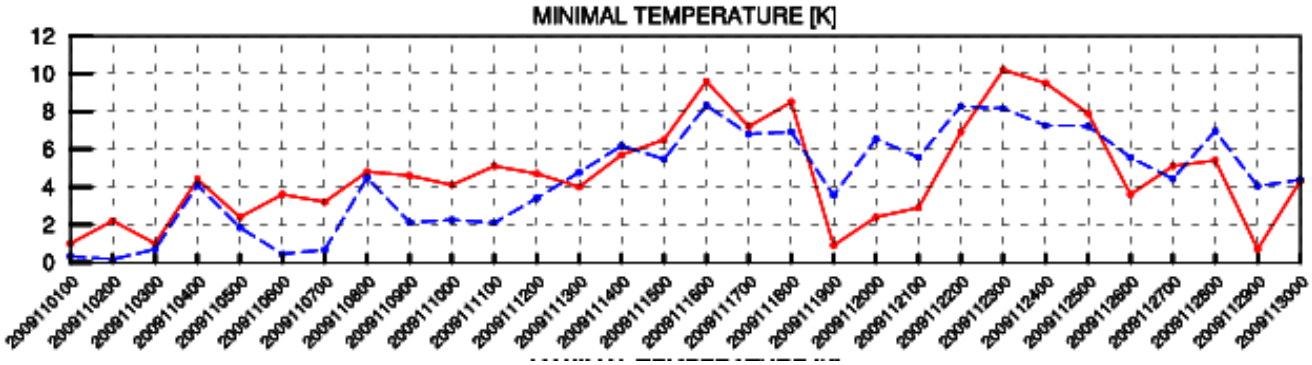

Fig. A2: same as above, but for November 2009

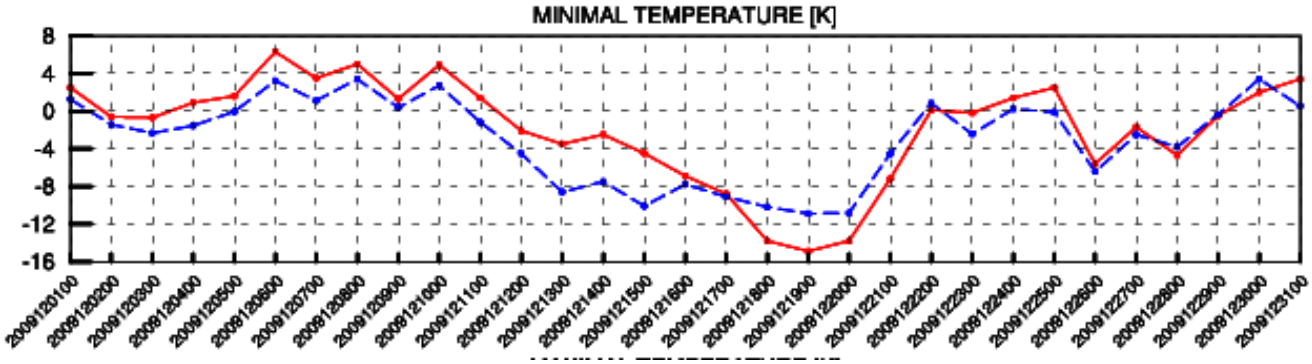

Fig. A2: same as above, but for December 2009