Two case studies with ALADIN/LAMEPS based on ARPEGE/PEACE ensemble system

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Introduction

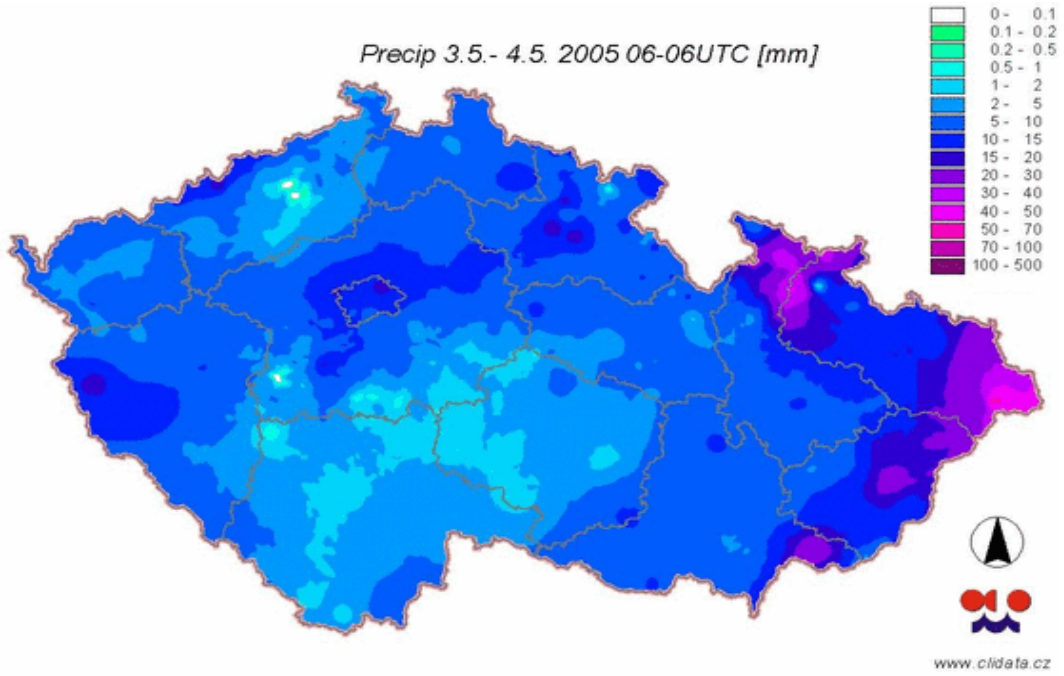
Recent idea to use the ensemble forecasting technique initially mainly for the hydrological purposes at Czech Hydrological Institute (CHMI) is behind this relatively short stay regarding time and computer power intensiveness of the most of work based on ensemble prediction systems (EPS). Hungarian know-how, verification tools and IBM supercomputer were used to get quickly into the EPS problematic. Simple evaluation of two case studies were done as a basic exercise with French EPS system (PEACE). The first case study is from 3rd May 2005 with observed underestimation of mainly convective event in the south-eastern part of Czech republic. Second includes the main flood period from August 2002 in Czech. The work will continue at CHMI. The comprehensive evaluation of the whole flood period from EPS point of view (meteorological and hydrological) is expected.

EPS settings

For the second case study global ARPEGE/PEACE (Nicolau, 2004) ensemble system had to be run starting from the analysis to get boundary and initial conditions for ALADIN/LAMEPS. The PEACE forecast length was up to +60 (start at 18 UTC) to have daily precipitation sums for two consecutive days. All relevant starting dates were considered (9.-12. August, 2002, only 36 hour forecast for the last day was produced). For the first case study there was no need to rerun PEACE system because the global forecasts were still to disposal from operational run at Meteo-France. Until now the best ALADIN/LAMEPS settings for computation of singular vectors (Hagel, 2004) were used: target domain covering Europe and some of the Atlantic (70N/330W/30S/35E) and target time 24h. These settings are likely not the best, the work on their improvement is still in progress. ARPEGE analysis resolution from August 2002 is T298/41L, used ALADIN resolution was 12 km and 37 vertical levels. Eleven ensemble members (10 perturbated + 1 control) were produced each time. Only postprocessed main forecast fields on standard atmospheric levels have been stored (in original Lambert projection for the whole domain and in latlon projection for Czech domain).

Results of the first case study

Only a simple subjective verification of daily precipitation sum from 3rd May, 2005 is presented. The observed precipitation can be seen in Fig. 1. Comparing with the control run (see Fig. 2 top left) one can see very good forecast for Jeseniky mountains (localised in the north-west of Moravia) with heavy rains over 20 mm/day. There was a good forecast also for the northern part of Beskydy (mountains in the eastern part of Czech republic) but with only half of observed maxima (above 50 mm/day). Almost completely missing heavy rains were in the middle part of Beskydy and south-eastern Moravia.



Further the precipitation in the western part of Czech was often missing in the control forecast.

Fig.1 Observed daily precipitation for 3rd May, 2005.
Data source: Czech climatological database CLIDATA (more then 800 available measurments for the computations of daily precipitation sum)

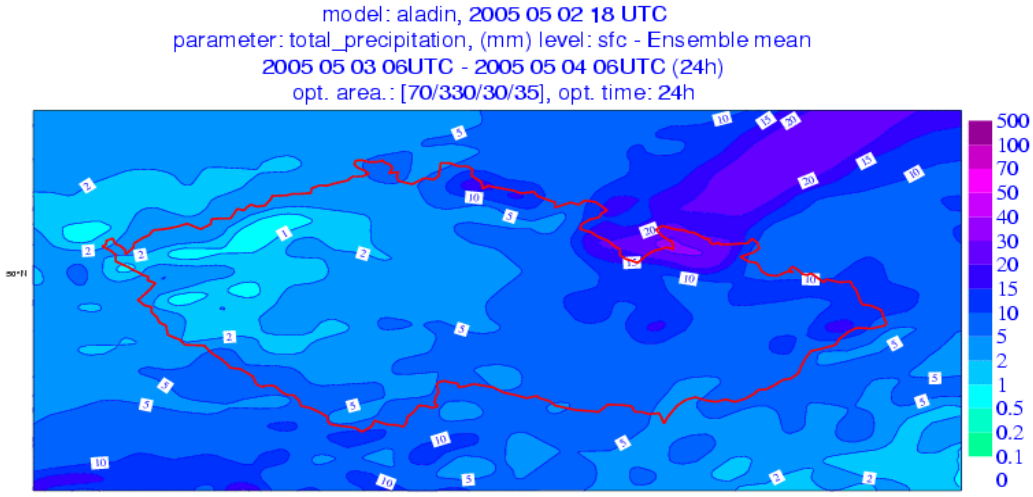


Fig. 2 Ensemble mean daily precipitation for 3rd May, 2005. The scale is the same as in Fig.1.

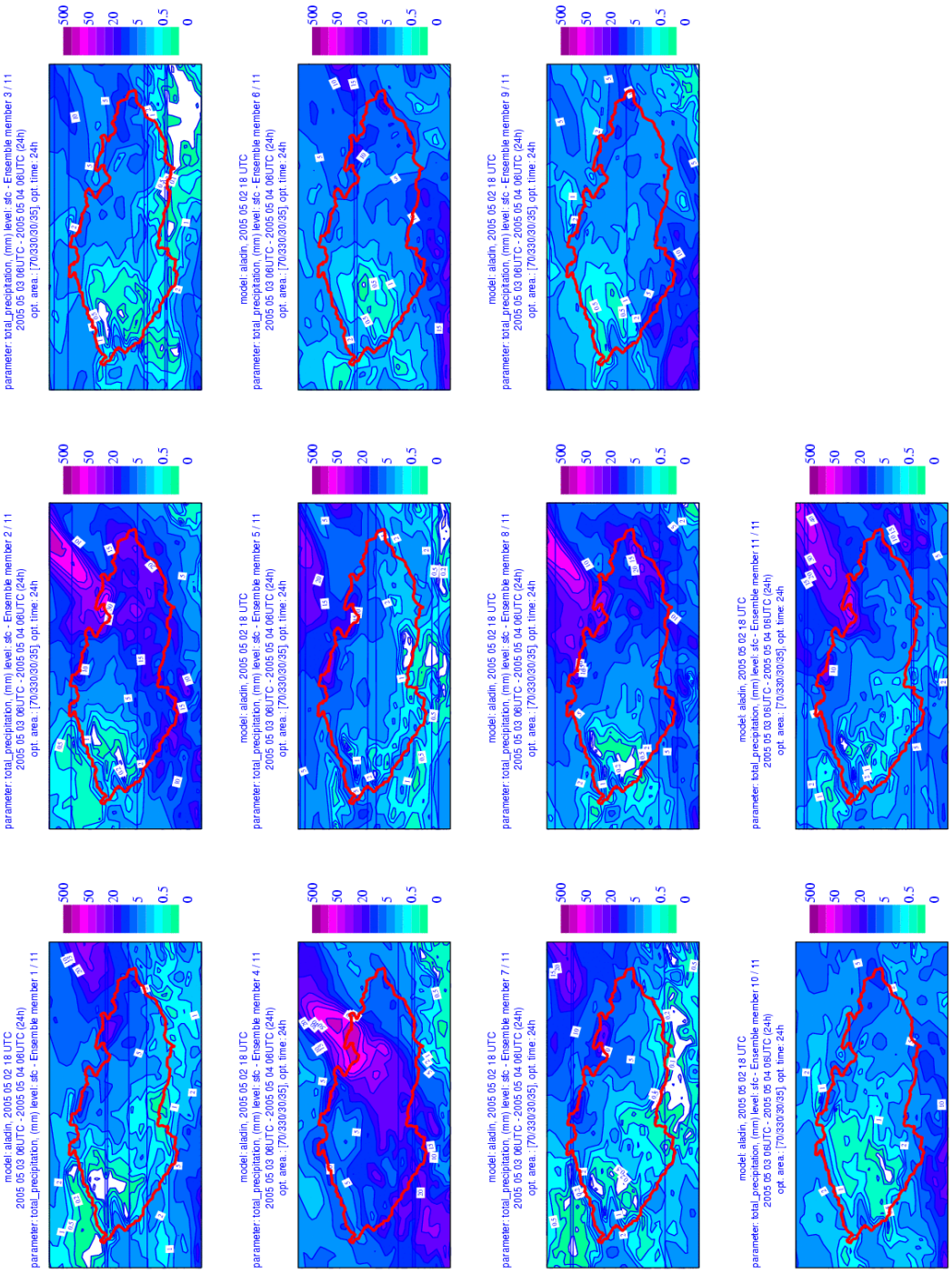


Fig.3 Daily precipitation forecast for 3rd May, 2005 for 10 ensemble members + 1 control run (top left looking from landscape view)

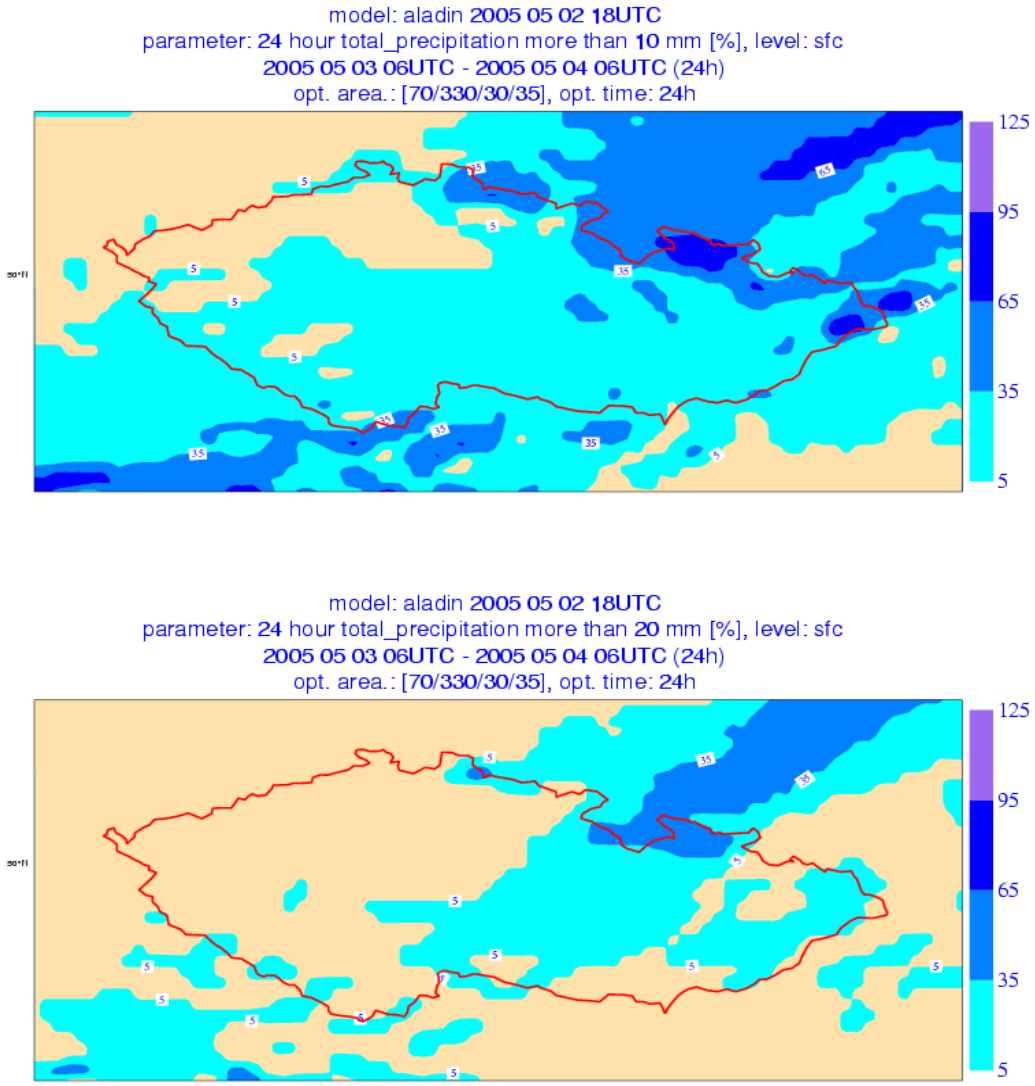


Fig. 4 Probability forecast of daily precipitation above 10 resp. 20 mm, top resp. bottom figure for 3rd May, 2005.

ALADIN eps mean daily rainfall is generaly slightly better (more wet) but the main problems remain (Fig. 3). From the probabilistic charts two areas with heavy rains can be identified but the strong convection event in the middle part of Beskydy and south-eastern Moravia is still not recognised. It might be related to the generaly worse predictability of convective events in LAM even in their non-hydrostatic version with resolution around 3 km (Walser, Schaer, 2002).

Results of the second case study

The flood from August 2002 was one of the worst in Bohemia during last hundred years. Deterministic ALADIN prediction was very good with the main deficiency over Krusne hory (mountains in the north-western Bohemia) where an area with the second highest rain maxima was too weakly expressed. Further apart from generally good overall precipitation pattern there was too much precipitation forecast in the middle of Czech republic and only few around Sumava mountains (southern part of Bohemia). Also the highest maxima in Jizerske hory (mountains in the Northern Bohemia) were underestimated (see Fig. 5 - observations and 7 top, left – control run).

Because of only available observed two days precipitation sum (12.-13.8. 2002) the results of one ALADIN/LAMEPS 60h long integration starting from 18 UTC, 11th May are shortly disscused. ALADIN EPS mean looks to perform better then control run (Fig.6). Too low maxima over Jizerske hory are increased and too high ones in the middle of Czech republic decreased. There is also more precipitation over Krusne hory and Sumava. Nevertheless only one EPS member gives clearly more but still not sufficient amount of precip over Krusne hory. It is known that other models both local and global ones had also problems in that area. It is very well seen that the predictability of the flood event was very good because the heavy rains in the most affected area in Northern Bohemia are present in all eps members. There is a high probability of the occurrence of heavy rains even for the treshold 150 mm in 48 hours (Fig. 8, bottom).

Summary and future plans

The method of runnig and verification of ARPEGE/PEACE and ALADIN/LAMEPS was learnt. A simple subjective verification of two case studies was done. The 60h forecasts of ALADIN/LAMEPS starting at 18 UTC from all relevant dates to cover flood period between 11th and 13th August, 2002 were produced. The work on more exact evaluation of the whole flood period from August 2002 at CHMI is planned (objective scores computations for different catchments or predefined areas, preparation of inputs for hydrological models and evaluation of their outputs (see Balint, 2004)). The main points leading hopefully to skillful operational ALADIN/LAMEPS for meteorological and hydrological purposes in 1-2 years at CHMI can be summarised as follows:

- continue in evaluation and verification of flood events from August 2002 with the same setting of EPS system as described above (+ preparation of related graphical tools for evaluating and verification of both outputs meteorological and hydrological)

- redo the same procedures but with the ECMWF/EPS (IFS as forcing global model for ALADIN model)

- exercises on more case studies with the tools/settings as described in first point

- scientific work on the improvement of performance of the whole EPS system in the frame of LACE cooperation (prefered topics for the time being should be related to French ARPEGE/PEACE system as forcing for ALADIN/LAMEPS)

Acknowledgement

A big thanks to the whole hungarian E.O.N. team for a possibility of rapid start with EPS at CHMI. The gained knowledges and tools will by hopefully used and furher developed for the sake of entire ALADIN/LACE community in near future. The biggest thanks go to Edit Hagel for her essential help with the solution of both technical and scientific problems during the stay.

References

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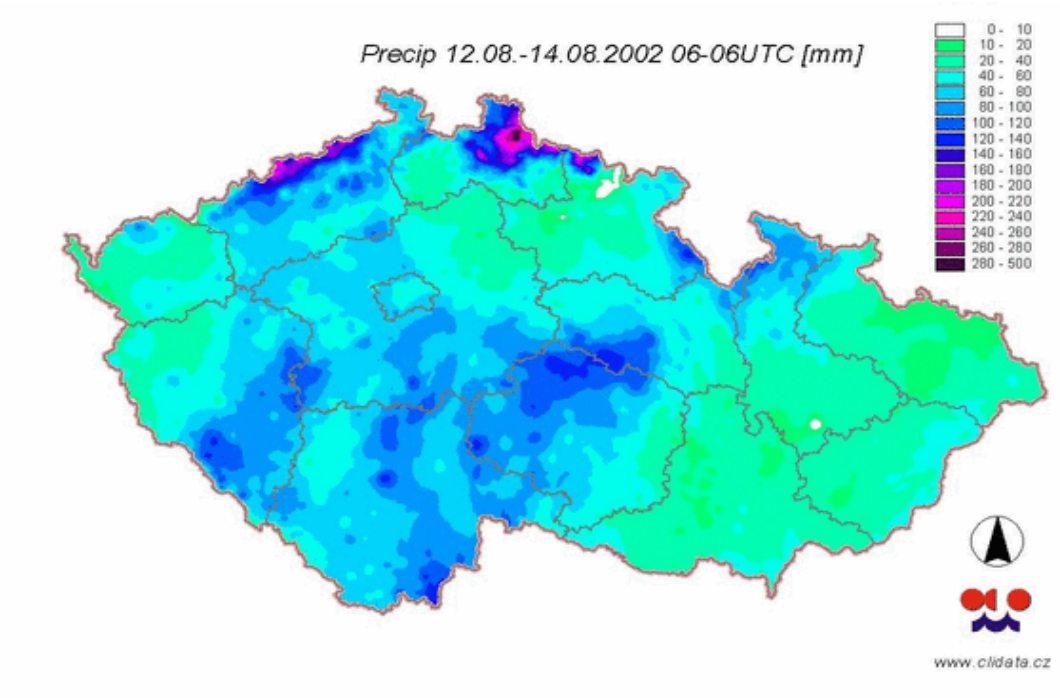

Fig.5 Observed two days precipitation sum for August 12.-13., 2002.
Data source: Czech climatological database CLIDATA (more then 800 available measurments for the computations of daily precipitation sum)

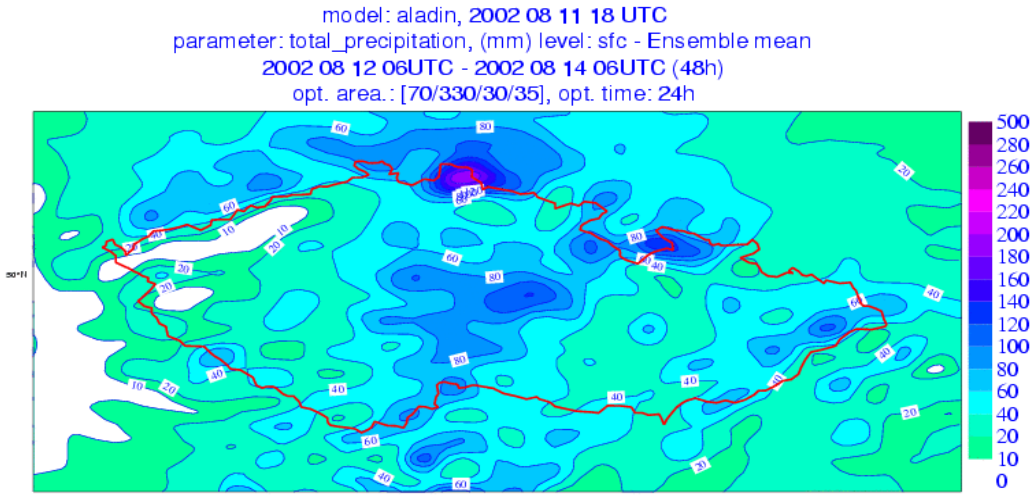

Fig. 6 Ensemble tvo days mean precipitation for August 12.-13., 2002. The scale is the same as in Fig.5.

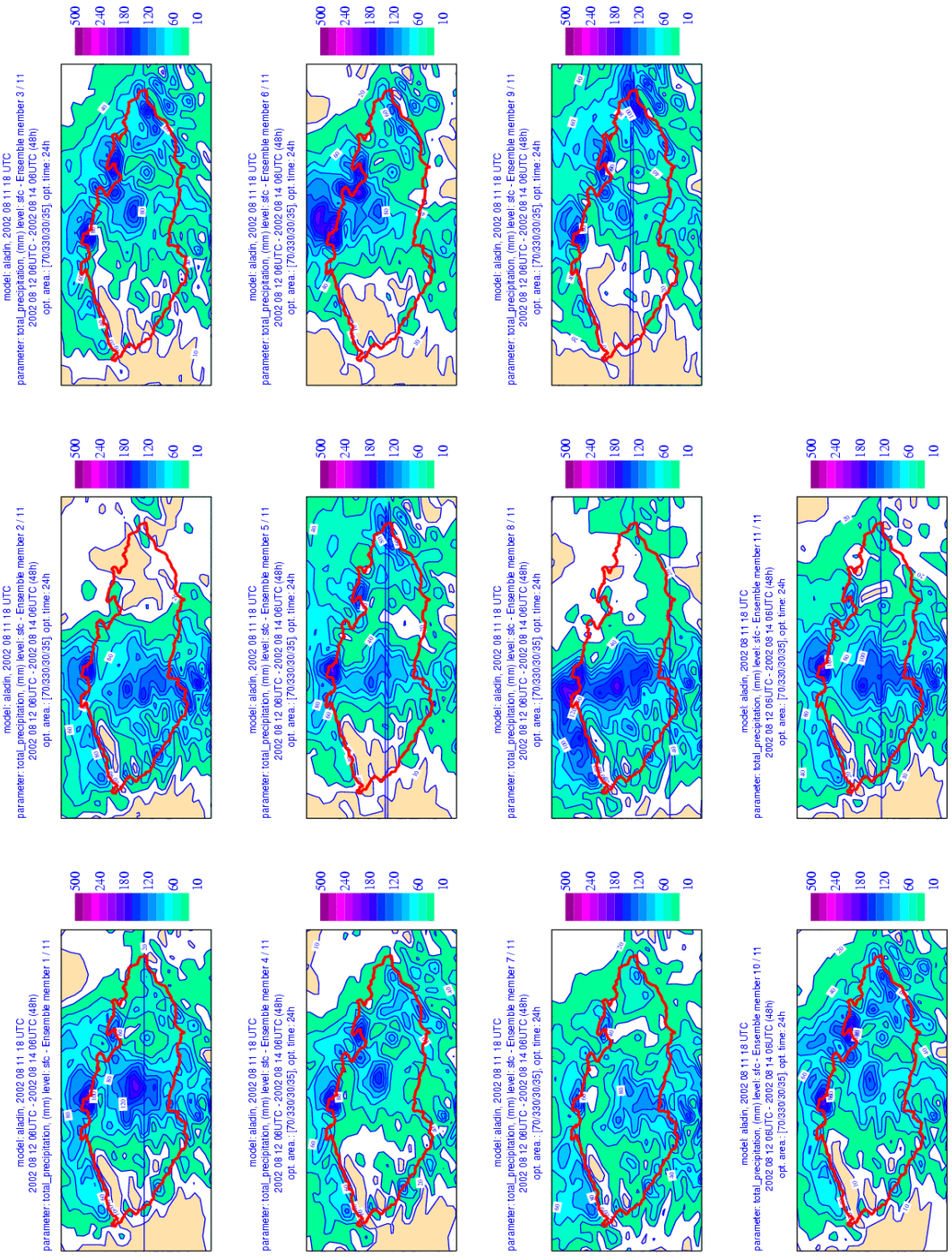

Fig.7 Two days precipitation sum forecast for August 12.-13., 2002. for 10 ensemble members + 1 control run (top left looking from landscape view)

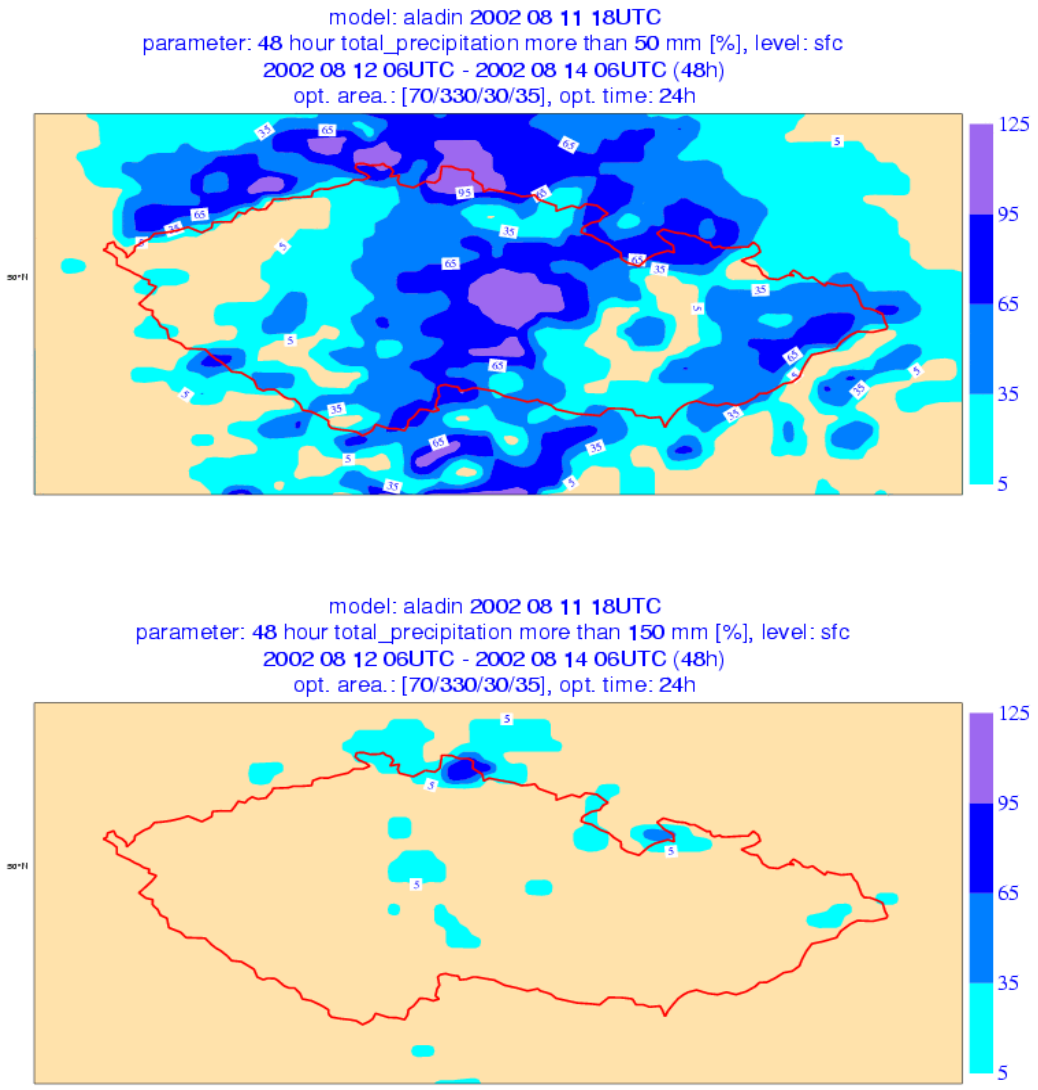

Fig. 8 Probability forecast of two days sum of precipitation above 50 resp. 150 mm, top resp. bottom figure for August 12.-13., 2002 .