I. INTRODUCTION

The contribution is focused on verification of few convective events occurred between 23 June and 5 July 2009 on the territory of the Czech Republic (CR) and produced heavy rainfalls. Radar reflectivities measured by Czech radar network CZRAD (rady Bodná a Sliková, Fig. 1) every 5 minutes were converted into rainfall intensities using standard Z-R relationship and integrated in time every 15 minutes. The adjustment coefficient that was applied during every time step was obtained by comparing integrated 15min rainfall estimates within 1 hour with hourly adjusted radar-derived rainfall estimates (see 3).

The 15min precipitation totals were predicted by non-hydrostatic NWP model COSMO, which is integrated with a horizontal resolution of 2.8 km. The radar reflectivity was assimilated into the model run. The extrapolated radar reflectivity was assimilated into the model as well and the extrapolation method is based on the COTREC algorithm. The verification was performed for the first three hours of forecasting and the ends of the assimilation window were in 12-16 UTC.

II. ADJUSTMENT PROCEDURE

On the whole, 40 forecasts from 8 days of convective precipitation were evaluated for each hour. The evaluation included subjective verification and the objective verification scores Fractions Skill Scores and SAL. The aim of our study is to i) prepare the gauge-adjusted 15min precipitation radar totals, ii) assess how accurately the model is able to simulate the 15min totals.

III. COSMO NWP MODEL VER. 4.11

• The model was over the area shown in Fig. 1, which is composed of 281 by 211 grid points with a horizontal resolution of 2.8 km, 50 vertical levels and time step of 30 s.
• The initial and lateral boundary conditions are interpolated from the prognostic fields of the COSMO-EG model, which is operated by German Weather Service and its horizontal resolution is approximately 7 km.
• The verification area covers the CR and consists of 188 by 116 grid points (Fig. 2).
• The parameterisation of deep convection was not used and the parameterisation of shallow convection was included.
• The model uses 2-moment microphysics parameterization (type_gscf = 2483 – low CCN, continental).
• The assimilation utilizes a water vapour correction (WVC) method.
• A graphical view of the organisation of the assimilation and forecasting is shown in Fig. 3.

IV. METHODS OF VERIFICATION

1) Fraction Skill Score (FSS) – neighbourhood method

- FSS compares the fractional coverage of observed events (e) to the fractional coverage of forecasted events (f) in windows (horizontal areas EA) surrounding the grids in the verification domain.
- Event is defined as a grid precipitation larger than a certain threshold (P > Pth).
- For the FSS definition see the formula rights – N is the number of elementary areas over the domain.
- The FSS has a range [0,1] with 0 = a complete forecast mismatch.
- FSS=1 for a perfect forecast
- The FSS increases with the scale (the size of the elementary area)

2) SAL – feature-based method

- The assimilation utilises a water vapour correction (WVC) method.
- A graphical view of the organisation of the assimilation and forecasting is shown in Fig. 3.
- The assimilation was prepared using 5 min radar data and 1h gauge adjusted data
- A comparison of 15 min and 1 hour model forecasts showed relatively similar features in terms of neighbourhood (FSS) and feature-based (SAL) verifications.
- Greater differences were observed (FSS only) when longer period of forecast and higher thresholds were considered, in this cases 15 min model outputs were generally more accurate.
- Such finding allow to reliably perform verifications of 15 min model forecasts in the future.
- These findings are valuable for very short-range forecast with radar data assimilation because the assimilation significantly improves the precipitation forecast accuracy.

Acknowledgement
This work was supported by the grant GACR 205/07/0905 and by the grant SVV 2011-283-201 in cooperation with Department of Physical Geography and Geocology, Faculty of Science, Charles University in Prague. Authors thank to Dr. Samek for data preparation.