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Quantitative precipitation estimates from CERAD, BALTRAD and gauges

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Abstract. Within the framework of ELDAS, the Development of a European Land Data Assimilation Systems to predict floods and droughts, continental-scale 3-hourly precipitation fields have been analysed from operational data of CERAD (Central European radar network), BALTRAD (Baltic radar network) and about 21 600 precipitation gauges. Here we focus on the application of CERAD and BALTRAD for quantitative precipitation estimation (QPE) that is the choice of quality control methods, the impact of input radar data quality on the analysis results and the analysis algorithm. The quality of the radar derived precipitation fields has been estimated by comparison with ground truth fields at the spatio-temporal scale of the ELDAS grid (0.2 degree/daily). Additionally, statistics on the availability of CERAD and BALTRAD data for the entire ELDAS period Oct. 1999 to Dec. 2000 have been compiled. The final ELDAS precipitation product comprises disaggregated daily rain gauge analyses based on 3-hourly accumulated CERAD and BALTRAD fields.

1 Introduction

To improve Numeric Weather Prediction (NWP) models the EU-funded project ELDAS, the Development of a European Land Data Assimilation Systems to predict floods and droughts, vd Hurk (2002), was launched. Aim is to demonstrate the impact on NWP caused by soil moisture assimilation, which is forced by observed precipitation. For this demonstration project continental-scale 3-hourly precipitation fields have been analysed from operational data of CERAD (Central European radar network), BALTRAD (Baltic radar network) and national precipitation gauge networks. In data sparse regions predicted precipitation fields from ECMWF t511 experimental runs have been blended. These fields serve as forcing data for the ELDAS soil moisture data assimilation.

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2 Data and methods

Operational CERAD and BALTRAD (Michelson et al., 2000) data have been collected for the ELDAS reference period Oct. 1999 to Dec. 2000. CERAD consists of about 40 radar sites located in 11 countries in Central and Eastern Europe. The temporal resolution of CERAD is 30 min, the spatial resolution 4km. BALTRAD provides about 30 radar sites from 6 Nordic countries with a resolution of 15 min/2 km. Nearly all radars operating in CERAD and BALTRAD are C-band radars. While the BALTRAD data are quality controlled (Michelson, 2003) and therefore used as provided by the Baltic Radar Data Centre (BRDC), it was necessary to implement a clutter removal algorithm to the CERAD data. Brugger (2004) implemented a semi-automatic algorithm to remove radar specific uncertainties and artefacts.
This algorithm is based on a multi-temporal objective image processing method. Additionally, the operational CERAD data have been checked by a visual control. After quality control both CERAD and BALTRAD have been accumulated to 3-hourly precipitation sums by applying the proposed Z-R relationships for operational applications. Finally, these radar derived precipitation fields have been interpolated to the ELDAS grid (0.2 degree regular lat/lon grid).

The precipitation gauge data set consists of about 21 600 rain gauges over Europe. These data have been corrected for systematic measurement errors and interpolated to the ELDAS grid using the PCA model (Rubel and Hantel, 2001) and serve as ground truth for the calibration of the merged radar data as well as for NWP model verification (Rubel, 2004).

3 Results

Figure 1 and 2 depict the processing line for analysing CERAD and BALTRAD data, respectively. The processing lines begins with the original data and ends with the final radar analysis on the regular lat/lon grid. In the CERAD most of the artefacts have been removed successfully and the unrealistic precipitation amounts due to sea clutters over

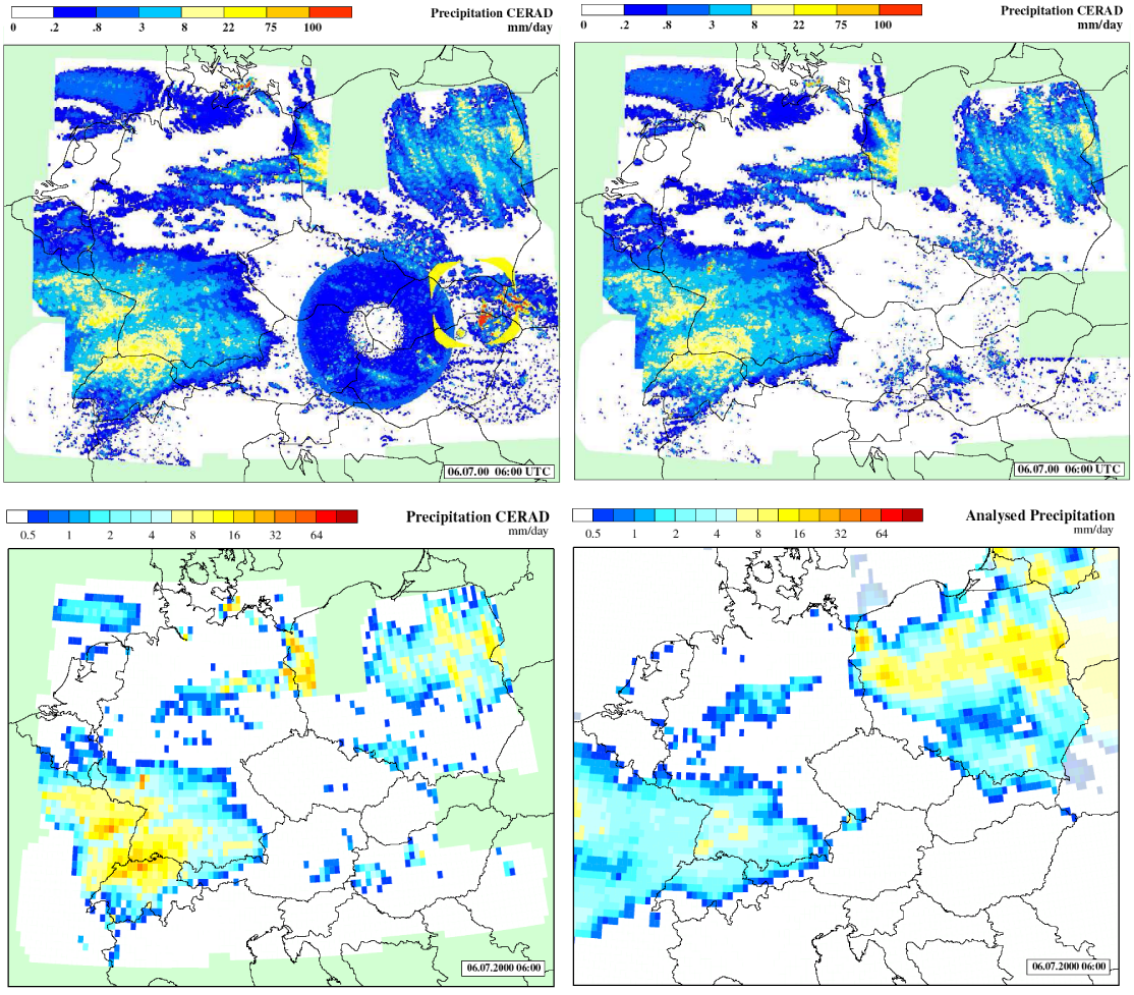

Fig. 1. Processing line for CERAD precipitation: Daily precipitation estimated from raw CERAD data (upper left panel), CERAD data after correction (upper right), corrected CERAD interpolated to the 0.2° ELDAS grid (lower left) and for comparison analysed rain gauge data on the ELDAS grid (lower right). Date July 6, 2000, 06 UTC. Note that the scaling for precipitation on the original CERAD projection (upper panels) is different from those on the ELDAS grid (lower panels).

Table 1. Verification results for CERAD (left) and BALTRAD (right) for the entire year 2000.

Observed Precipitation	2.48	2.40
	CERAD	**BALTRAD**
Estimated	2.19	0.76
Mean error	−0.29	−1.64
Mean absolute error	2.38	1.95
RMS error	6.10	4.17
Rank-order correlation	0.63	0.57
Hit rate, HR	0.74	0.66
Critical success index, CSI	0.61	0.52
Prob. of detection, POD	0.69	0.55
False alarm ratio, FAR	0.16	0.11
Bias score, BIAS	0.83	0.62
True skill statistics, TSS	0.50	0.42

the Baltic Sea were decreased. For BALTRAD only values above a threshold of 0.2 mm/h have been considered. These radar derived precipitation fields correspond quite well to the field of the surface analysis. Additionally, the quality of radar data processing has been evaluated by objective verification measures. Table 1 depicts the verification results. While BALTRAD significantly underestimates precipitation amounts (gauges 2.40 mm/day, BALTRAD 0.76 mm/day), the quantitative precipitation estimates from quality controlled CERAD data are of same order as observed (gauges 2.48 mm/day, CERAD 2.19 mm/day). On the other hand, BALTRAD performs better in scores of mean absolute error, RMS error and false alarm ratio (FAR).

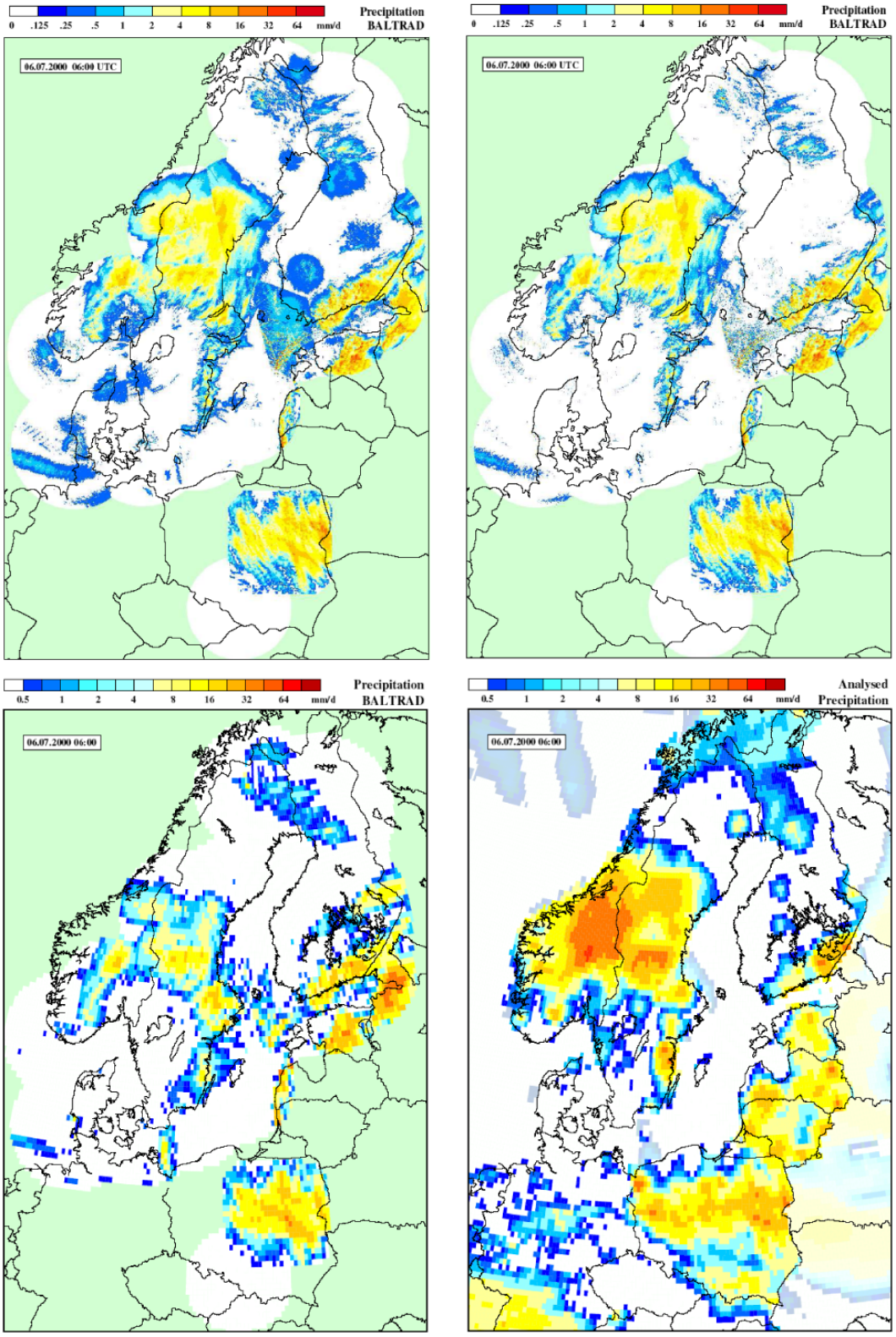

Fig. 2. Processing line for BALTRAD precipitation: Daily precipitation estimated from raw BALTRAD data (upper left panel), BALTRAD precipitation with applied threshold of 0.2 mm/h (upper right), BALTRAD precipitation interpolated to the 0.2° ELDAS grid (lower left) and for comparison analysed rain gauge data on the ELDAS grid (lower right). Date July 6, 2000, 06 UTC. Note that the scaling for precipitation on the original BALTRAD projection (upper panels) is different from those on the ELDAS grid (lower panels).

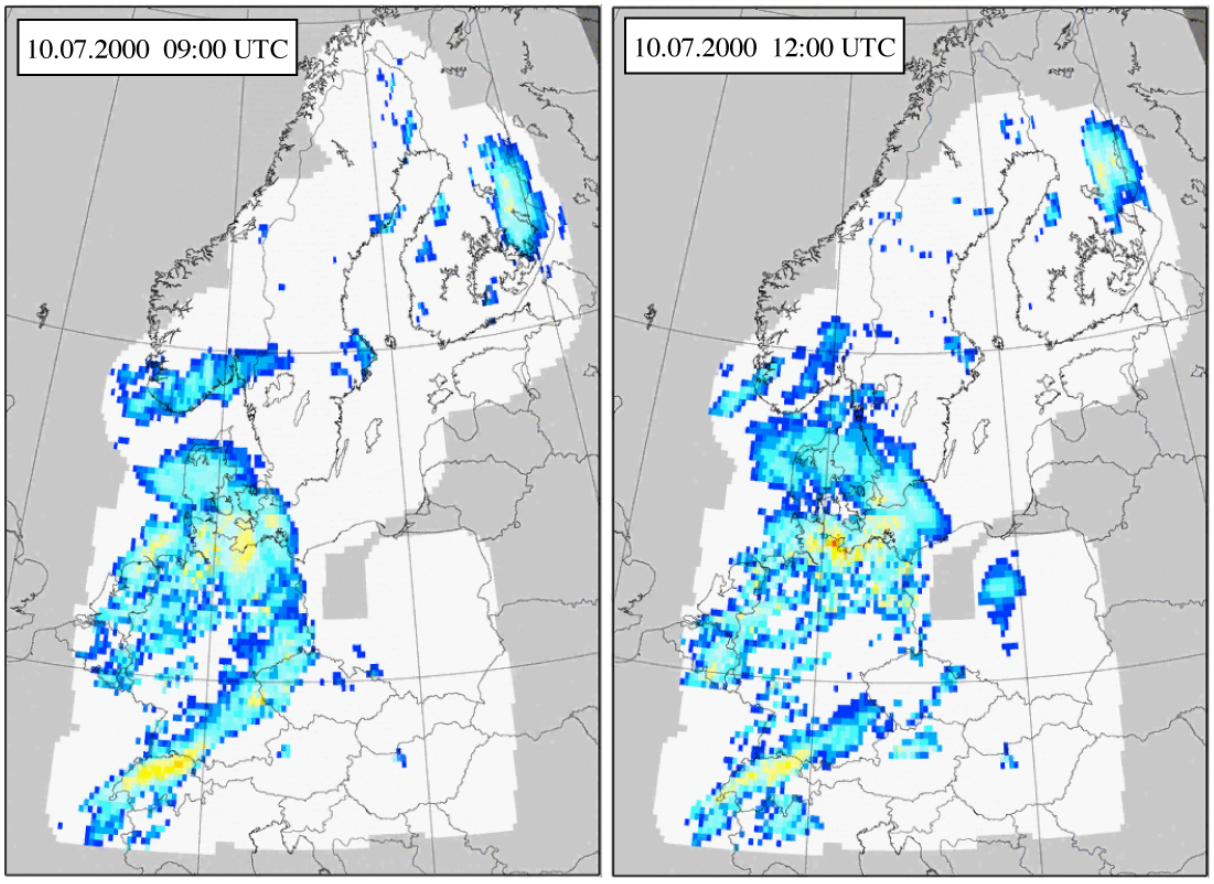

Fig. 3. Example of merged BALTRAD-CERAD precipitation fields, calibrated with the daily precipitation gauge analysis for 10 July 2000, 9:00 UTC (left) and 12:00 UTC (right). Scaling see Fig. 2 (lower right), units mm/3 h.

4 Conclusions

The 3-hourly precipitation fields are available for the ELDAS reference period Oct. 1999 to Dec. 2000 and are in accordance with NWP community specifications; that is maximal spatial coverage and high temporal resolution. It is planned to store the files as GRIB and make the data sets available via the ECMWF MARS archive. Additionally, the data sets will be archived at the Global Precipitation Climatology Centre (GPCC).

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